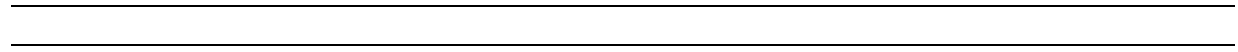


**U.S.-Specific Schedules of Requirements
for Transport of Specified Types of
Radioactive Material Consignments**

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ABSTRACT

This document provides technical guidance to shippers on compliance with U.S. Nuclear Regulatory Commission (NRC) and U.S. Department of Transportation (DOT) regulations for packaging and transporting radioactive materials in the United States. The guidance is in the form of Schedules (guides). These Schedules reflect the U.S. regulations in effect on April 1, 1997, and are intended to be the domestic counterpart to the schedules issued by the International Atomic Energy Agency (IAEA) for international transportation safety regulations.

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INTRODUCTION

These Schedules are a consolidation of the requirements of the Regulations for each of 12 categories of radioactive material. Once the shipper has properly categorized the radioactive material shipment, these Schedules can be used to define the specific requirements for shipment of that category of radioactive material. They were developed by collecting the requirements applicable to each type of shipment from the regulations, then paraphrasing the regulation for simplicity and conciseness. A regulatory reference is provided so that the regulation can be readily consulted when desired.

These Schedules do not specifically address all possible shipments involving radioactive materials; in particular, they do not fully address shipments of mixed wastes or other radioactive materials that also satisfy the DOT definition for another hazard class.

The Nuclear Regulatory Commission's (NRC's) regulations are located in Title 10 of the Code of Federal Regulations, the Postal Service's are in Title 39, and the Department of Transportation's (DOT's) regulations are found in Title 49. The full references for the abbreviations in the Schedules are as follows:

1.xx	39 CFR 1.xx
20.xx	10 CFR 20.xx
30.xx	10 CFR 30.xx
71.xx	10 CFR 71.xx
73.xx	10 CFR 73.xx
100.xx	10 CFR 100.xx
107.xx	49 CFR 107.xx
171.xx	49 CFR 171.xx
178.xx	49 CFR 178.xx

These Schedules are intended to be used as a guide to the Regulations NOT as a substitute for them. Nothing contained in the Schedules may be construed as having the force and effect of NRC or DOT regulations, or as relieving any shipper or licensee from compliance with the requirements of 10 CFR Part 71, 49 CFR Part 173, or any other applicable regulation. They are designed for use by the shipper and for use by those enforcement personnel inspecting shipments or shipment records.

BACKGROUND

NRC and DOT issue domestic regulations for the safe transportation of radioactive materials. These regulations are adopted from those issued by the International Atomic Energy Agency (IAEA).

In recognition of the need to provide a summary of regulatory requirements for shippers and carriers, IAEA published a set of Schedules [Reference 1] as a guide to its *Regulations for the Safe Transport of Radioactive Material*, 1985 Edition [Reference 2]. Effective April 1, 1996, NRC and DOT revised their regulations for compatibility with the 1985 Edition of the IAEA regulations [References 3 and 4]. IAEA has recently issued the 1996 edition of the *Regulations for the Safe*

Transport of Radioactive Material [Reference 5], which incorporates the Schedules at the end of that document.

Shippers and carriers in the U.S. face a somewhat more complicated regulatory picture than some of their foreign counterparts, because they must understand the delineations between, and satisfy the requirements of, two regulatory agencies, NRC and DOT. NRC and DOT deemed it desirable to develop Schedules for the domestic requirements to help guide, from an operational perspective, the users of these regulations. These Schedules reflect domestic requirements in effect on April 1, 1997.

USING THE SCHEDULES

Several pieces of information need to be known in order to determine which Schedule to use. Consideration of the questions below will provide some general guidance. However, the consignment will need to meet all of the requirements of a particular Schedule for it to be valid. The Schedule Summary table at the end of this section may also be helpful in providing an overview of Schedule applicability and general requirements.

Form?

What is the form of the material being transported? Special form Class 7 radioactive material is a single solid piece, or is contained in a sealed capsule which meets certain size and test requirements designed to ensure a very high level of integrity. If the material is special form, then the special form maximum activity value, A_1 , will need to be determined; otherwise, the material is normal form, and the normal form maximum activity, A_2 , value will be required.

Radionuclide?

Which radionuclide is being transported? Knowledge of the radionuclide and form enables the A_1 or A_2 value to be determined from the table in 173.435 or 71 App. A. These values are the bases for many limits in the regulations. Methods for determining an A_1 or A_2 value for mixtures of radionuclides or when some or all radionuclides are unknown are also provided in the regulations.

Quantity?

What quantity of the radionuclide is being transported? The activity being shipped must be compared with the A_1 or A_2 value determined above in order to evaluate which Schedule may be appropriate.

If the radioactive quantity is very small compared to the A_1 or A_2 value then one of Schedules 0-4 may be applicable. For example, if the material is solid and the activity is not more than $10^{-3} A_1$ or $10^{-3} A_2$ then Schedule 1 should be considered. Other criteria will also need to be met. If the volume or mass is also very small, then it may be possible to use Schedule 0, especially if the material has other hazardous properties.

If the quantity is greater than that allowed in Schedules 0-4, but is not more than A_1 or A_2 then Schedule 9 may be applicable.

Quantities greater than A_1 or A_2 will normally require Schedule 10.

Material Type?

What is the nature of the radioactive material being shipped? This is a more general question than that of form but involves similar considerations.

If the material can be considered as being incorporated in instruments or articles and the quantities are very small, then Schedule 2 may be applicable. As its name implies, Schedule 3 may be used for articles manufactured from natural or depleted uranium or natural thorium.

Whenever the quantity of activity present is small relative to the volume of material present then the Schedules applicable to low specific activity (LSA) material (Schedules 5, 6, and 7) should be considered. For example, ores containing naturally occurring radionuclides and uniformly contaminated earth, concrete and rubble may be shipped using Schedule 5. Calculation of the A_2 /gram value will help decide if Schedules 6 and 7 may be appropriate.

Much decommissioning waste consists of objects which are not themselves radioactive, but which are contaminated on some, or all, of their surfaces. In this case Schedule 8 may cover the transport of this Class 7 radioactive material.

Fissile?

Schedules 0-10 are only applicable to non-fissile or fissile excepted materials. Any one of several criteria may be evaluated to see if a material is fissile excepted. These include small quantities of fissile radionuclides, and very dilute solutions. If the material is fissile then Schedule 11 must be used.

Schedule Format

The Schedules are presented in a two column format, the right column is the paraphrased requirement and the left column is the citation of the regulation in which the requirement is found. The requirements in these Schedules are paraphrased from the actual regulations for simplicity and conciseness.

In order to avoid unnecessary duplication, and to be consistent with the format of Reference 5, requirements, which are common to several categories, were consolidated in two sets of Common Provisions, one useful for the excepted package categories, the other for the remaining seven categories. Schedules 0-4 are the specific requirements for small quantities and the four categories of excepted packages, and have been grouped in Appendix A. Schedules 5-11 are the specific requirements for the remaining categories, and have been grouped in Appendix B. These Appendices are used by first identifying the Schedule that applies to the material of interest. The common provisions located at the beginning of the Appendix that contains the applicable Schedule, and the specific requirements contained in the Schedule, apply to the shipment of that material.

FURTHER HELP

For a hypertext version of these Schedules, access the following NRC or DOT internet addresses (URL's): <<http://www.nrc.gov/NRC/nucmat.html>> or <<http://www.hazmat.dot.gov>>.

Further help with the correct implementation of the regulations can be obtained from a variety of sources.

First, it is important that the terms used in the Schedules are correctly understood. Many apparently general terms have very specific meanings in the regulations. Examples of this are the terms hazardous material, hazardous waste, and hazardous substance, which are all very explicitly defined. Therefore, it is recommended that some time be spent reading the definitions found in 10 CFR 71.4, 49 CFR 107.3, 49 CFR 171.8, and 49 CFR 173.403. If the shipment involves fissile material for which physical protection is required, then the definitions in 10 CFR 73.2 should also be checked.

The Department of Transportation's Research and Special Programs Administration (RSPA) runs an Hazardous Materials Information Center which may provide the assistance needed and answer questions relating to the regulations. It can be accessed via email at <infocntr@rspa.dot.gov> or telephone on 1-800-467-4922 (202-366-4488 for callers in the Washington DC area). The telephone number is menu driven when calling from a touch tone phone. Non-touch tone phone callers must use 202-366-8553.

Internet access to reasonably current versions of the regulations can be found on a number of sites. These are useful for checking the original wording of the references in the Schedules if an updated hard copy is not readily available.

<http://www.access.gpo.gov/ch/index.html> This is a good site for looking up a section of the regulations or for searches.

<http://www.text-trieve.com/dotrspa> This site contains 49 CFR, DOT Exemptions and DOT Clarifications

<http://www.hazmat.dot.gov> This site, maintained by DOT's Office of Hazardous Materials Safety (OHMS), provides useful information about OHMS functions, procedures, activities, and requirements, including those for all hazard classes, and is linked to the above Text-Trieve site.

Finally, several of the carriers of hazardous material operate help lines for their customers and are only too willing to help ensure that radioactive materials are packaged and shipped correctly.

REFERENCES

1. *Schedules of Requirements for the Transport of Specified Types of Radioactive Material Consignments (As Amended 1990)*, Safety Series No. 80, International Atomic Energy Agency, Vienna, Austria, 1990.
2. *Regulations for the Safe Transport of Radioactive Materials, 1985 Edition (As Amended 1990)*, Safety Series No. 6, International Atomic Energy Agency, Vienna, Austria, 1990.
3. Code of Federal Regulations, Title 10, Part 71, *Packaging and Transportation of Radioactive Materials*.
4. Code of Federal Regulations, Title 49, Parts 171-178, *Subchapter C, Hazardous Material Regulations*.
5. *Regulations for the Safe Transport of Radioactive Material, 1996 Edition*, Safety Standards Series/Requirements, ST-1, International Atomic Energy Agency, Vienna, Austria, 1996.

SCHEDULE SUMMARY (Principal requirements only - consult regulations for detailed provisions)

Schedule No.	Schedule 0	Schedule 1	Schedule 2	Schedule 3	Schedule 4	Schedule 5	Schedule 6	Schedule 7	Schedule 8	Schedule 9	Schedule 10	Schedule 11	
Description	Small Quantities	Limited Quantities	Instruments and Articles	Articles from nat'l/ depleted Uranium/ Thorium	Empty Packages	LSA-I: Low specific activity	LSA-II: Low specific activity	LSA-III: Low specific activity	SCO-I/-II: Surface contaminated objects	Material in TYPE A packages	Material in TYPE B[x] packages	Fissile material	
UN Number(s)	N/A	2910				2912			2913	2975, 2976, 2978, 2979, 2980, 2981, 2982, 2974	2982, 2974	2918, 2977	
Specification of allowable contents (1)	Activities in fractions of A ₁ or A ₂ 30 ml liquid 30 g solid or 1 g Div. 6.1			Natural U/ depleted U/ natural thorium	Non-fixed internal contamination: ≤ 400 Bq/cm ² βγ ≤ 40 Bq/cm ² α	*Ores *U/Th concentrates *Solid unirr U/Th or their solid/liq mix/compound, *Non-fissile mat'l w/ unlimited A ₂ , *Uniformly dist. mat'l ≤ 10 ⁻⁴ A ₂ /g	*Tritiated water w/ ≤ 0.8 Tbq/l, *Solids/gases w/ specific activity ≤ 10 ⁻¹ A ₂ /g *Liquids w/ specific activity ≤ 10 ⁻³ A ₂ /g	*Uniformly dist. insoluble mat'l w/ specific act. ≤ 2 x 10 ⁻⁷ A ₂ /g	Contaminated objects w/ limits for fixed and non-fixed contamination on accessible and inaccessible surfaces between 0.4 Bq/cm ² and 8 x 10 ⁻³ Bq/cm ²	Activities: ≤ A ₁ or ≤ A ₂	As specified in CA certificate of package specification	As specified in package specification	
Requirements on the contents	RL ≤ 0.1 mSv/h @ 10 cm from ext. surface of unpkg'd instrument/article		RL ≤ 0.1 mSv/h @ 10 cm from ext. surface of unpkg'd instrument/article	Accessible surface must be sheathed in inactive material			RL of unshielded contents ≤ 10 mSv/h at 3 m. Activity uniformly distributed				As specified in CA certificate/package specification	As specified in package specs/ ship. mode.	
Packaging (2)	Small quantity	Excepted Package				TYPE A Packaging IP-1 (5) IP-2 when liquid & not EU	TYPE A Packaging IP-2 IP-3 when liquid & not EU	TYPE A Packaging IP-3 IP-2 under EU	TYPE A Packaging SCO-I, IP-1 (5) SCO-II: IP-2	TYPE A Packaging	TYPE B Packaging	6L, 6M (others) TYPE A, B[x] as appropriate	
Max.RL per package	≤ 0.005 mSv/h at surface					≤ 2 mSv/h at surface and ≤ 0.1 mSv/h at 1 m. Under EU: ≤ 10 mSv/h at surface + Vehicle RL limits							
Contamination	≤ 0.4 Bq/cm ² βγ ≤ 0.04 Bq/cm ² α					≤ 0.4 Bq/cm ² βγ ≤ 0.04 Bq/cm ² α							
Mixed Loading	Classified Class 7 except: explosive mat'l-Class 1; organic peroxide-Division 5.2; and a material that meets the definition of wetted explosive-Division 4.1.												
Labeling	No labels required				"EMPTY," Old labels removed	White- I, Yellow-II, Yellow-III according to category + additional Dangerous Goods labels as required. "RQ" for hazardous material							
Marking of packages	"Radioactive" on inner packaging,	"Radioactive" on inner packaging	"Radioactive" on article/instrument			Gross weight if > 50 kg (110 pounds)							
						"Radioactive - LSA" if EU			"Radioactive - SCO" if EU	"TYPE A"	CA Ident. mark as appropriate	"TYPE B[x]" Radiation Trefoil	Marked according to package type
Conveyance (3)	Placarding for Yellow III, exclusive use LSA/SCO, Hwy Rt. Controlled Qnty. "Corrosive" for some fissile, all UF6												
Transport documents (4)	Shipper's Certification per 173.4	Shipper's Certification per 173.421	Shipper's Certification per 173.424	Shipper's Certification per 173.426	Shipper's Certification per 173.428	Shipper's Certification, Shipping Papers, Emergency Procedures						CA ID as applicable	Controlled ship/CA cert. as applicable
Storage and dispatch	Segregation from persons, photographic material, live animals and other DG											Mult Class 7 restricted if any TL>10 or total >50	
Shipment	Segregation from persons, photographic material, live animals and other DG												
							Max activity/conveyance: 100A ₂ for combustible solids/all liquids+gases					Controlled Shipmt. if TL>10	

NOTES:

- If A1 values are used, the requirements regarding radioactive material in SF must be applied
- For radioactive Material with additional risk, (e.g. UF6), additional packaging requirements may apply
- Also valid for freight containers and tanks
- Additional requirements for international shipments.
- LSA-I and SCO-I may be transported unpacked under certain specific conditions combined with EU

KEY:
 RL - Radiation Level
 EU - Exclusive Use
 SF - Special Form
 TI - Transport Index

CA - Competent Authority
 DG - Dangerous Goods
 B[x] - B, B(m) or B(u)

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COMMON PROVISIONS FOR SCHEDULES 0-4

UN No.
Refer to appropriate Schedule 0-4

A.1. MATERIALS

173.435
71 App(A)
(Table A-1)
173.433(b)
71 App(A)(II)

- (a) A_1 and A_2 values for radionuclides are listed in 173.435 and 71 App A, Table A-1. The values below may be used for unlisted radionuclides (173.433, Table 10).

Contents	A ₁		A ₂	
	(TBq)	(Ci)	(TBq)	(Ci)
Only beta or gamma emitting nuclides are known to be present	0.2	5	0.02	0.5
Alpha emitting nuclides are known to be present or relevant data are available	0.10	2.70	2x10 ⁻⁵	5.41x10 ⁻⁴

Alternatively, other values may be approved by the U.S. Department of Transportation, Associate Administrator for Hazardous Materials Safety or U.S. Nuclear Regulatory Commission (NRC)

173.453

- (b) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (≤ 15 g), and to situations where criticality is impossible under any circumstances such as very dilute solutions and mixtures.

173.403
Special Form

- (c) Special form material must:
- (1) Be a single solid piece or capsule or is contained in a sealed capsule that can be opened only by destroying the capsule;
 - (2) Have one dimension not less than 5 mm (0.2 inch); and,

173.469

- (3) Satisfy a series of test requirements designed to provide assurance that even in severe accidents, the potential for radioactive material contamination is negligible.

173.476(a)

- (d) Each offeror of special form material must retain the safety analysis, including test documentation for at least one year after the latest shipment. An IAEA Competent Authority Certificate of Approval may be used to meet this requirement.

173.476(b) (e) Prior to the first export shipment of a special form material a DOT Approval
 173.476(c) Certificate must be obtained. For special form material manufactured outside the US
 an IAEA Competent Authority Certificate of Approval may be used to meet this
 requirement.

173.421-424 (f) Radioactive materials that satisfy the activity limits of Schedules 1-3 and also satisfy
 173.4 the definition of another hazard class must be packaged and offered in compliance
 with the requirements for the other hazard class, unless the material qualifies as a
 small quantity of hazardous material (see Schedule 0).

A.2. PACKAGING/PACKAGE

173.421(a) Excepted packages do not require DOT approval. However, the shipper must be prepared to
 173.424(a) demonstrate the compliance of the package with the general design requirements (see
 173.426(a) Appendix I).

A.3. MAXIMUM RADIATION LEVELS

173.421(a)(2) 0.005 mSv/h (0.5 mrem/h) at the surface of a package.
 173.424(e)
 173.426(c)
 173.428(a)

A.4. CONTAMINATION

173.421(a)(3) Non-fixed contamination on the external surfaces of excepted packages must be kept as low
 173.424(f) as reasonably achievable and the wipe limits given below must not be exceeded
 173.426(a) [173.443(a)(Table 11)]. Specific methods of performing the wipe are prescribed.
 173.428(a)

173.403
*Low toxicity
 alpha emitters*

Contaminant	Maximum permissible wipe limits		
	Bq/cm ²	μCi/cm ²	dpm/cm ²
Beta and gamma emitters and low toxicity alpha emitters	0.4	10 ⁻⁵	22
All other alpha emitting radionuclides	0.04	10 ⁻⁴	2.2

A.5. DECONTAMINATION

No specific provisions.

A.6. MIXED CONTENTS

No specific provisions.

A.7. LOADING AND SEGREGATION

No specific provisions.

A.8. LABELING AND MARKING

173.421(a) Excepted from labeling and specification marking requirements, unless a hazardous substance
173.424 or hazardous waste.
173.426
173.428

A.9. PLACARDING

173.422(b) None required.

A.10. TRANSPORT DOCUMENTS

173.422(a) A notice must be enclosed in or on the package, included with the packing list, or otherwise
forwarded with the package. This notice must certify that the package is acceptable for
transportation and must include the name of the consignor or consignee and the statement
specified in item 10(b) of the appropriate Schedule 1-4.

173.422(b)(3) A shipping paper is required if the radioactive material is a hazardous substance or a hazardous
waste (except for small quantities of certain hazardous materials - see Schedule 0).

A.11. STORAGE AND DISPATCH

No specific provisions.

A.12. CARRIAGE

175.704 There are specific prohibitions against transporting more than an A_2 quantity of plutonium by
71.88 air. Exceptions are provided for certain medical devices and very low specific activity
materials (≤ 70 Bq/g (≤ 0.002 μ Ci/g)).

A.13. OTHER PROVISIONS

Training

- 172.700(b)
173.422(b)(3)
171.8 *Hazmat
employee/
employer*
173.1(b)
- (a) Almost anyone involved in the handling and transport of radioactive material must undergo hazmat employee training prior to performing such duties. The training must be a systematic program that ensures that the person has general awareness and familiarity training, is able to recognize and identify hazardous materials, has knowledge of specific functional requirements applicable to the job and has knowledge of emergency response information and self-protection measures and accident prevention methods and procedures.
- 172.704(a) (b) Hazmat employee training must include: general awareness/familiarization training, function specific training, safety training, and OSHA or EPA training.
- 172.704(c) (c) Initial training, and recurrent training at least once every three years is required. Relevant training from a previous employer may be used to satisfy the requirements provided a current record is obtained from the previous employer.
- 172.704(d) (d) Records of current training, inclusive of the preceding three years must be created and retained for as long as that employee is employed by that employer as a hazmat employee and for 90 days thereafter

Licensing

- 30.41(a) (a) Generally, radioactive material may only be transferred to those authorized to possess it and such authorization (or exemption) must be confirmed before transfer. Specifically, byproduct material may only be transferred by NRC (or Agreement State) licensees to:
- 30.41(b) (1) The Department of Energy;
- (2) The agency in an Agreement State which regulates radioactive material;
- (3) Anyone exempt for the licensing requirements of the Atomic Energy Act or the Agreement State;
- (4) Any person authorized to receive such byproduct material under the terms of a specific or general license issued by the NRC or Agreement State.
- 100.20-30 (5) A person abroad in accordance with an NRC general export license;
- (6) Anyone else specifically authorized by the NRC in writing.
- 30.41(d) (b) The licensee transferring the radioactive material must verify that the transferee's license authorizes the receipt of the type, form, and quantity of the byproduct material transferred. Several methods are allowed, the simplest is to have and read a current copy of the transferee's license.

Other

173.422(b)
171.15
171.16

(a) A carrier must give immediate notification of significant incidents to the DOT. The types of incidents include fatalities, damage exceeding \$50,000, general public evacuation or spills. If needed, the reporting requirements are listed in 171.16.

174.750-Rail
175.45-Air
175.700(b)
176.710-Sea
177.861-Road

(b) When contamination is involved, the carrier also has to notify the offeror (and the FAA if an air shipment), isolate the spill, and not place the unit back in service until decontaminated.

Schedule 0

SMALL QUANTITIES OF HAZARDOUS MATERIALS

UN No.
N/A

Small quantities of certain hazardous materials such as: Class 3: Flammable; Division 4.1: Flammable solid; Division 4.2 (PG II and III): Spontaneously combustible; Division 4.3 (PG II and III): Dangerous when wet; Division 5.1: Oxidizer; Division 6.1: Poison; Class 7: Radioactive; Class 8: Corrosive; or Class 9 materials that also meet the definition of one or more of these hazards classes are exempt from any other 49 CFR requirements if this schedule is followed. *Note: This Schedule differs from Schedules 1-3 in that: a) prototype testing of the package is required; b) hazmat employee training is not required; and c) incident notification is not required.*

1. MATERIALS

- 173.4(a) (a) The maximum quantity of material per inner receptacle is limited to:
- (1) Thirty (30) ml (1 ounce) for authorized liquids, other than Division 6.1, Packing group I, materials;
 - (2) Thirty (30) g (1 ounce) for authorized solids, other than Division 6.1, Packing group I, materials;
 - (3) One (1) g (0.04 ounce) for authorized materials classified as Division 6.1, Packing group I; and
 - (4) The activity level does not exceed the appropriate values given in Schedules 1-3.
- 173.4(b)
173.421(a)(5)
173.424(g)
173.426 (b) The package must not contain more than 15 g of ²³⁵U unless in a manufactured article in which the sole Class 7 (radioactive) material content is natural or unirradiated depleted uranium and the outer surface of the uranium is enclosed in an inactive metal sheath made of metal or other durable protective material.
- (c) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (≤ 15 g), and to situations where criticality is impossible under any circumstances such as very dilute solutions and mixtures.
- 173.4(b)
173.424(d) (d) The radiation level at 10 cm from the external surface of any unpackaged instrument or article must not exceed 0.1 mSv/h (10 mrem/h).

2. PACKAGING/PACKAGE

173.4(a)(2-8)
173.4(b)
173.421(a)
173.424(a)

(a) Small quantity exception packages do not require DOT approval. However, the shipper must be prepared to demonstrate the compliance of the package with the general design requirements for Class 7 packages and the small quantity exception requirements (see Appendix A).

173.4(a)(7)
173.21

(b) Placement of the material in the package, or packing different materials in the package must not result in a violation of forbidden materials and packages.

3. MAXIMUM RADIATION LEVELS

173.4(b)
173.421(a)(2)
173.424(e)

(a) 0.005 mSv/h (0.5 mrem/h) at the surface of the package.

173.4(b)
173.424(e)

(b) For exclusive use, domestic shipments, the radiation level at any point on the external surface of a package bearing an instrument or article must not exceed 0.02 mSv/h (2 mrem/h).

4. CONTAMINATION

173.4(b)
173.421(a)(3)
173.424(f)

Non-fixed contamination on the external surfaces of packages must be kept as low as reasonably achievable and the wipe limits given in Common Provision A.4 must not be exceeded.

5. DECONTAMINATION

No specific provisions.

6. MIXED CONTENTS

No specific provisions.

7. LOADING AND SEGREGATION

No specific provisions.

8. MARKING AND LABELING

173.4(b)
173.421(a)(4)

(a) If the package contains limited quantities of Class 7 materials, the packaging is excepted from labeling and specification marking if the outside of the inner packaging or, if there is no inner packaging, the outside packaging itself bears the marking RADIOACTIVE.

- 173.421(a)4 (b) The shipper certifies conformance by marking the outside of the package with the statement "This package conforms to 49 CFR 173.4" or, alternatively, until October 1, 2001, with the statement "This package conforms to the conditions and limitations specified in 49 CFR 173.4".

9. PLACARDING

None required.

10. TRANSPORT DOCUMENTS

None required.

11. STORAGE AND DISPATCH

- 173.4(a)(9) The package may not be opened or otherwise altered until it is no longer in commerce.

12. CARRIAGE

No specific provisions.

13. OTHER PROVISIONS

- 30.41(a) (a) See Common Provisions A.13 under "Licensing".
30.41(b)
30.41(d)
- 173.4(c) (c) Packages which contain a Class 2, Division 4.2 (PG I), or Division 4.3 (PG I) material conforming to this Schedule may be offered for transportation if specifically approved by the Associate Administrator for Hazardous Material Safety.

Schedule 1

LIMITED QUANTITIES OF RADIOACTIVE MATERIAL IN EXCEPTED PACKAGES

UN No.
2910

Limited quantities of radioactive material, in forms other than manufactured instruments and articles, which represent a very limited radiological risk, may be transported in excepted packages.

1. MATERIALS

- (a) See Common Provisions A.1.
- (b) The quantity of radioactive material in a single package may not exceed the appropriate limits specified in the table below.

173.421(a)
173.425
173.433(d)
1 Subchapter C

Nature of Contents	Material package limits ¹	
	Modes other than mail	US Postal Service
Solids:		
Special Form.....	$10^{-3} A_1$	$10^{-4} A_1$
Normal Form.....	$10^{-3} A_2$	$10^{-4} A_2$
Liquids:		
Tritiated water:		
<0.0037 TBq/liter (0.1 Ci/L).....	37 TBq (1,000 Ci)	(100 Ci)
0.0037 TBq to 0.037 TBq/L (0.1 Ci to 1.0 Ci/L).....	3.7 TBq (100 Ci)	(10 Ci)
>0.037 TBq/L (1.0 Ci/L).....	0.37 TBq (1.0 Ci)	(0.1 Ci)
Other liquids.....	$10^{-4} A_2$	$10^{-5} A_2$
Gases:		
Tritium ²	$2 \times 10^{-2} A_2$	(2 Ci)
Special Form.....	$10^{-3} A_1$	$10^{-4} A_1$
Other Form.....	$10^{-3} A_2$	$10^{-4} A_2$

1. For mixtures of radionuclides whose identities and respective quantities are known, the A_1 or A_2 for the mixture may be calculated by A for the mixture = $1/\sum_i f(i)/A(i)$; where $f(i)$ is the fraction of activity of nuclide i in the mixture and $A(i)$ is either the A_1 or A_2 value for nuclide i as appropriate.
2. These values apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

- 173.421(a)(5)
1 Subchapter C
173.423
- (c) The package may not contain more than 15 grams of U-235.
- (d) Requirements for multiple hazard limited quantity Class 7 (radioactive) materials:
- 173.4
- (1) Except as provided in Schedule 0, when a limited quantity radioactive material meets the definition of another hazard class or division, it must be —
- (i) Classed for the additional hazard;
- (ii) Packaged to conform with the requirements of this Schedule; and
- (iii) Offered for transportation in accordance with the requirements applicable to the hazard for which it is classed.
- (2) A limited quantity Class 7 (radioactive) material which is classed other than Class 7 is excepted from the requirements for excepted package certification, description entries for radioactive material, radionuclide name, and passenger aircraft certification if the entry "Limited quantity of radioactive material" appears on the shipping paper in association with the basic description.
- USPS Pub. 52
624.11
- (e) For shipments via the US Postal Service the materials are restricted to those intended for use in, or incidental to, research, medical diagnosis, or treatment.
- 2. PACKAGING/PACKAGE**
- 173.421(a)
173.421(a)(1)
- (a) Excepted packages do not require DOT approval. However, the shipper must be prepared to demonstrate the compliance of the package with the general design requirements (see Appendix A).
- 1 Subchapter C
- (b) Liquids shipped by US Postal Service must be packed within a leak and corrosion resistant inner container surrounded by enough absorbent material to absorb twice the volume of the liquid.
- (c) Packages shipped by the US Postal Service can have no single dimension less than 2 ½ cm (1 inch), and the length and girth no less than 30 cm (12 inches).
- 3. MAXIMUM RADIATION LEVELS**
- 173.421(a)(2)
1 Subchapter C
- 0.005 mSv/h (0.5 mrem/h) at the surface of the package.
- 4. CONTAMINATION**
- 173.421(a)(3)
1 Subchapter C
- Non-fixed contamination on the external surfaces of packages must be kept as low as reasonably achievable and the wipe limits given in Common Provision A.4 must not be exceeded.

5. DECONTAMINATION

No specific provisions.

6. MIXED CONTENTS

No specific provisions.

7. LOADING AND SEGREGATION

No specific provisions.

8. MARKING AND LABELING

- 173.421(a) (a) Excepted from labeling and specification marking requirements.
- 173.421(a)(4)
1 Subchapter C (b) The outside of the inner packaging or if there is no inner packaging, the outside of the packaging itself bears the marking "RADIOACTIVE."
- USPS Pub. 52
624.11 (c) For shipments via the US Postal Service, the outside of the shipping container must be marked with the proper shipping name and the UN number.

9. PLACARDING

- 173.422(b) None required.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision A.10.
- 173.422(a)(1) (b) "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."

11. STORAGE AND DISPATCH

No specific provisions.

12. CARRIAGE

No specific provisions.

13. OTHER PROVISIONS

See Common Provisions A.13.

Schedule 2

RADIOACTIVE MATERIALS CONTAINED IN INSTRUMENTS AND ARTICLES IN EXCEPTED PACKAGES

UN No.
2910

Limited quantities of radioactive material in forms of components of manufactured instruments and articles, which represent a very limited radiological risk, may be transported in excepted packages.

1. MATERIALS

(a) See Common Provisions A.1.

173.424(b)
173.425
1 Subchapter C

(b) Instruments and manufactured articles, such as clocks, electronic tubes or apparatus, having as a component part radioactive material in amounts not exceeding the appropriate limits specified in columns two or three of the table below.

Nature of Contents	Limits for Each Instrument or Article ¹		Package Limits ¹	
	Modes other than mail	US Postal Service	Modes other than mail	US Postal Service
Solids:				
Special Form...	$10^{-2} A_1$	$10^{-3} A_1$	A_1	$0.1 A_1$
Normal Form...	$10^{-2} A_2$	$10^{-3} A_2$	A_2	$0.1 A_2$
Liquids.....	$10^{-3} A_2$	$10^{-4} A_2$	$10^{-1} A_2$	$10^{-2} A_2$
Gases:				
Tritium ²	$2 \times 10^{-2} A_2$	(2 Ci)	$2 \times 10^{-1} A_2$	(20 Ci)
Special Form....	$10^{-3} A_1$	$10^{-4} A_1$	$10^{-2} A_1$	$10^{-3} A_1$
Other Form.....	$10^{-3} A_2$	$10^{-4} A_2$	$10^{-2} A_2$	$10^{-3} A_2$

1. For mixtures of radionuclides whose identities and respective quantities are known, the A_1 or A_2 for the mixture may be calculated by A for the mixture = $1/\sum_i f(i)/A(i)$; where $f(i)$ is the fraction of activity of nuclide i in the mixture and $A(i)$ is either the A_1 or A_2 value for nuclide i as appropriate.

2. These values apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

173.424(c)
173.425
1 Subchapter C

(c) The total activity per package must not exceed the appropriate limits specified in columns four or five of the table above.

- 173.424(d)
1 Subchapter C
- (d) The radiation level at 10 cm from the external surface of any unpackaged instrument or article must not exceed 0.1 mSv/h (10 mrem/h).
- 173.424(g)
173.426
1 Subchapter C
- (e) The package may not contain more than 15 grams of ²³⁵U. If the sole radioactive material present is natural or unirradiated depleted uranium or natural thorium, Schedule 3 may apply.
- USPS Pub. 52
624.11
- (f) For shipments via the US Postal Service the materials are restricted to those intended for use in, or incidental to, research, medical diagnosis, or treatment.

2. PACKAGING/PACKAGE

- 173.424(a)
- (a) Excepted packages do not require DOT approval. However, the shipper must be prepared to demonstrate the compliance of the package with the general design requirements (see Appendix A).
- 1 Subchapter C
- (b) For shipments by the US Postal Service at least one dimension of the package must not be less than 10 cm (4 inches)

3. MAXIMUM RADIATION LEVELS

- 173.424(e)
1 Subchapter C
- (a) 0.005 mSv/h (0.5 mrem/h) at the surface of the package.
- 173.424(e)
- (b) For exclusive use, domestic shipments, the radiation level at any point on the package may not exceed 0.02 mSv/h (2 mrem/h).

4. CONTAMINATION

- 173.424(f)
1 Subchapter C
- Non-fixed contamination on the external surfaces of packages must be kept as low as reasonably achievable and the wipe limits given in Common Provision A.4 must not be exceeded.

5. DECONTAMINATION

No specific provisions.

6. MIXED CONTENTS

No specific provisions.

7. LOADING AND SEGREGATION

No specific provisions.

8. MARKING AND LABELING

- 173.424 (a) Excepted from labeling and specification marking requirements.
- 1 Subchapter C (b) For shipments via the US Postal Service, the outside of the inner packaging or if there is no inner packaging, the outside of the packaging itself bears the marking "RADIOACTIVE."
- USPS Pub. 52 624.11 (c) For shipments via the US Postal Service, the outside of the shipping container must be marked with the proper shipping name and the UN number.

9. PLACARDING

173.422(b) None required.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision A.10.
- 173.422(a)(2) (b) "This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910."

11. STORAGE AND DISPATCH

No specific provisions.

12. CARRIAGE

No specific provisions.

13. OTHER PROVISIONS

See Common Provision A.13.

Schedule 3

ARTICLES MANUFACTURED FROM NATURAL URANIUM, DEPLETED URANIUM, OR NATURAL THORIUM AS EXCEPTED PACKAGES

UN No.
2910

Articles manufactured of natural uranium, unirradiated depleted uranium or natural thorium, which represent a very limited radiological risk, may be transported in or as excepted packages.

1. MATERIALS

- 173.426 (a) No radioactive material other than natural uranium, unirradiated depleted uranium or natural thorium may be contained in the article.
- 173.426(b) (b) The outer surface of the uranium or thorium must be enclosed in an inactive sheath made of metal or other durable protective material.
- 1 Subchapter C (c) For shipments via the US Postal Service the materials are restricted to those intended for use in, or incidental to, research, medical diagnosis, or treatment.

2. PACKAGING/PACKAGE

- 173.426(a) (a) Excepted packages do not require DOT approval. However, the shipper must be prepared to demonstrate the compliance of the package with the general design requirements for Class 7 packages, and the small quantity exception requirements if applicable (see Appendix A).
- 173.426(b) (b) Transport of unpackaged articles manufactured of natural uranium, depleted uranium or natural thorium is allowed if the article itself qualifies as an excepted package and the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other durable material.

3. MAXIMUM RADIATION LEVELS

- 173.426(c) (a) 0.005 mSv/h (0.5 mrem/h) at the surface of the package.

4. CONTAMINATION

- 173.426(c) Non-fixed contamination on the external surfaces of packages must be kept as low as reasonably achievable and the wipe limits given in Common Provision A.4 must not be exceeded.

5. DECONTAMINATION

No specific provisions.

6. MIXED CONTENTS

No specific provisions.

7. LOADING AND SEGREGATION

No specific provisions.

8. MARKING AND LABELING

- 173.426 (a) Excepted from labeling and specification marking requirements.
- 173.426(c) (b) The outside of the inner packaging or if there is no inner packaging, the outside of the packaging itself bears the marking "RADIOACTIVE."
- USPS Pub. 52 624.11 (c) For shipments via the US Postal Service, the outside of the shipping container must be marked with the proper shipping name and the UN number.

9. PLACARDING

173.426 None required.

10. TRANSPORT DOCUMENTS

- 173.426(d) (a) See Common Provision A.10
- 173.426(d) (b) "This package conforms to the conditions and limitations specified in 49 CFR 173.426 for radioactive material, excepted package-articles manufactured from natural or depleted uranium, or natural thorium, UN2910."

11. STORAGE AND DISPATCH

No specific provisions.

12. CARRIAGE

No specific provisions.

13. OTHER PROVISIONS

173.426(d) See Common Provision A.13.

Schedule 4

EMPTY PACKAGINGS AS EXCEPTED PACKAGES

UN No.
2910

Empty packagings which have contained radioactive material and which represent a very limited radiological risk, may be transported as excepted packages.

1. MATERIALS

- 173.428 (a) Empty packagings which have previously contained radioactive material and have been emptied of contents as far as practical.
- 173.428(c) (b) The internal non-fixed contamination levels must not exceed one hundred times the levels specified in Common Provision A.4.
- 173.428(a) (c) Total content of ^{235}U cannot exceed 15 g.
- 173.421(a)(5)
173.421 (d) If (a) or (b) cannot be met, it may be possible to ship a used package as a limited quantity under Schedule 1.

2. PACKAGING/PACKAGE

- 173.428(a) (a) Empty packagings do not require DOT approval.
- 173.428(b) (b) The packaging must be in unimpaired condition and be securely closed so that there will be no leakage of Class 7 material under conditions normally incident to transportation.

3. MAXIMUM RADIATION LEVELS

- 173.428(a) 0.005 mSv/h (0.5 mrem/h) at the surface of the package.
- 173.421(a)(2)

4. CONTAMINATION

- 173.428(a) Non-fixed contamination on the external surfaces of packages must be kept as low as
- 173.443(a) reasonably achievable and the wipe limits given in Common Provision A.4 must not be exceeded.

5. DECONTAMINATION

No specific provisions.

6. MIXED CONTENTS

No specific provisions.

7. LOADING AND SEGREGATION

No specific provisions.

8. MARKING AND LABELING

173.428(d)
172.450

Any labels applied in conformance with previous 49 CFR hazardous material shipments must be removed, obliterated, or covered, and an "EMPTY" label affixed to the packaging. The label must be white with black printing. Each side of the label must be at least 152 mm (6 in), with "EMPTY" printed in letters at least 25.4 mm (1 in) high.

9. PLACARDING

173.422(b)

None required.

10. TRANSPORT DOCUMENTS

(a) See Common Provision A.10

173.422(a)(4)

(b) "This package conforms to the conditions and limitations specified in 49 CFR 173.428 for radioactive material, excepted package-empty package, UN2910."

11. STORAGE AND DISPATCH

No specific provisions.

12. CARRIAGE

No specific provisions.

13. OTHER PROVISIONS

See Common Provision A.13.

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UN No.
Refer to appropriate Schedule 5-11

B.1. MATERIALS

173.435
71 App(A)
(Table A-1)
173.433(b)
71App(A)(II)

- (a) A_1 and A_2 values for radionuclides are listed in 173.435 and 71 App A, Table A-1. The values below may be used for unlisted radionuclides (173.433, Table 10).

Contents	A ₁		A ₂	
	(TBq)	(Ci)	(TBq)	(Ci)
Only beta or gamma emitting nuclides are known to be present	0.2	5	0.02	0.5
Alpha emitting nuclides are known to be present or relevant data are available	0.10	2.70	2x10 ⁻⁵	5.41x10 ⁻⁴

Alternatively, other values may be approved by the U.S. Department of Transportation, Associate Administrator for Hazardous Materials Safety, or U.S. Nuclear Regulatory Commission (NRC)

173.403
71.4
Special Form

- (b) Special form material must:
- (1) Be a single solid piece or capsule or is contained in a sealed capsule that can be opened only by destroying the capsule;
 - (2) Have one dimension not less than 5 mm (0.2 inch); and,

173.469
71.75

- (3) Satisfy a series of test requirements designed to provide assurance that even in severe accidents, the potential for radioactive material contamination is negligible.

173.476(a)

- (c) Each offeror of special form material must retain the safety analysis, including test documentation for at least one year after the latest shipment. An IAEA Competent Authority Certificate of Approval may be used to meet this requirement.

- 173.476(b)
173.476(c)
- (d) Prior to the first export shipment of a special form material a DOT Approval Certificate must be obtained. For special form material manufactured outside the US an IAEA Competent Authority Certificate of Approval may be used to meet this requirement.
- 173.461
- (e) Required material characteristics (e.g., special form, LSA III leachability) may be demonstrated using the methods prescribed in 173.461.

B.2. PACKAGING/PACKAGE

- 173.461 (a) Each Schedule has its own listing of authorized packagings. The packaging requirements for each specific package type are summarized in Appendix I. The documented evaluation of packaging performance requirements may use any of the methods authorized in 173.461.
- 175.700(d) (b) Type B(M) packages may not be used on passenger carrying aircraft.

B.3. MAXIMUM RADIATION LEVELS

- 173.441 (a) The maximum allowed radiation levels are shown in the table below.
71.47
177.842(g)
- 175.703(e) (b) Packages exceeding a surface radiation level of 2 mSv/h or a Transport Index of 10 may not be transported by aircraft except under special arrangements approved by the DOT.

Type of Shipment	Radiation Level Limit				
	Transport Index (Dose rate in mSv/h times 100)	Package Surface	Vehicle Outer Surface (including top & bottom) (1)	2 m (6.6') from Vehicle Outer Surface (excluding top & bottom) (2)	Normally occupied space
Non-exclusive use	10	2 mSv/h (200 mrem/h)	---	---	---
Exclusive use	---	2 mSv/h (200 mrem/h) (3)	2 mSv/h (200 mrem/h)	0.1 mSv/h (10 mrem/h)	0.02 mSv/h (2 mrem/h) (4)

- Notes: (1) On flat-bed type of vehicles, 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 vehicle underside.
- (2) On a flat-bed type of vehicle, a point 2 m (6.6') from the vertical planes projected by the outer edges of the vehicle.
- (3) 10 mSv/h (1000 mrem/h) if the following conditions are met: the shipment is made in a closed transport type of vehicle; the package is secured within the vehicle so that its position remains fixed during transportation; and there are no loading or unloading operations between the beginning and end of operation.
- (4) This provision does not apply to private carriers if exposed personnel under their control wear radiation dosimetry devices as part of a radiation protection program.

B.4. CONTAMINATION

173.443(a) (a) Non-fixed contamination on the external surfaces of packages must be kept as low as reasonably achievable and the wipe limits given below must not be exceeded (173.443(a)(Table 11)). Specific methods of performing the wipe are prescribed.

Contaminant	Maximum permissible wipe limits		
	Bq/cm ²	μCi/cm ²	dpm/cm ²
Beta and gamma emitters and low toxicity alpha emitters	0.4	10 ⁻⁵	22
All other alpha emitting radionuclides	0.04	10 ⁻⁴	2.2

173.403
Low toxicity alpha emitters

173.433(b) (b) For packages transported as exclusive use shipments by rail or public highway only, the non-fixed (removable) radioactive contamination on any package at any time during transport may not exceed ten times the levels prescribed above. The levels at the beginning of transport may not exceed the values given in the table above.

B.5. DECONTAMINATION

Decontamination: General

173.443(c) (a) Each transport vehicle which exceeds the contamination limits in B.4(a) must be surveyed with appropriate radiation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at each accessible surface is 0.005 mSv/h (0.5 mrem/h) or less, and there is no significant non-fixed (removable) radioactive surface contamination.

174.715
177.843 (b) A closed transport vehicle used solely for exclusive use transportation by highway or rail of Class 7 material packages may be returned to service if:

- (1) A survey of the interior surfaces of the empty vehicle shows that the radiation dose rate at any point does not exceed 0.1 mSv/h (10 mrem/h) at the surface or 0.02 mSv/h (2 mrem/h) at 1 meter (3.3 feet) from the surface;
- (2) Each vehicle is stenciled with the words "For Radioactive Materials Use Only" in letters at least 76 millimeters (3 in) high in a conspicuous place on both sides of the exterior of the vehicle; and
- (3) Each vehicle is kept closed except for loading or unloading.

Decontamination: Aircraft

- 175.705
175.700(b)
- (a) Aircraft used routinely for the carriage of Class 7 materials must be periodically checked for radioactive contamination. The frequency of checks must be related to the likelihood of contamination and the extent to which Class 7 materials are carried. An aircraft must be taken out of service if the level of contamination exceeds that provided in B.4(a).
- 175.45
- (b) In addition to the requirements for reporting hazardous material incidents, a carrier must also notify the shipper at the earliest practicable moment following any incident in which there has been breakage, spillage, or suspected radioactive contamination involving Class 7 materials shipments. In no instance may the notification be later than the close of business of the following workday.
- 175.700(b)
- (c) Aircraft in which Class 7 materials have been spilled may not again be placed in service or routinely occupied until the radiation dose rate at any accessible surface is less than 0.5 mrem/h and there is no significant non-fixed (removable) radioactive surface contamination as determined in accordance with section B.4(a).
- (1) When contamination is present or suspected, the package and/or materials it has touched must be segregated as far as practicable from personnel contact until needed radiological advice or assistance is obtained.
- (2) The Regional Office of the U.S. Department of Energy or appropriate State or local radiological authorities can provide advice or assistance, and should be notified in cases of obvious leakage, or if it appears likely that the inside container may have been damaged.
- (3) For personnel safety, the carrier must take care to avoid possible inhalation, ingestion, or contact with Class 7 materials that may have leaked or spilled from its package. Any loose Class 7 materials and associated packaging materials must be left in a segregated area pending disposal instructions from responsible radiological authorities.

B.6. MIXED CONTENTS

- 173.2
173.2a
- (a) Radioactive materials that exceed the activity limits in 173.421 or 173.424, and that satisfy more than one hazard classification or division must be classified as Class 7 (radioactive materials) with the following exceptions:
- 173.2a(c)(1)
- (1) A Class 1 (explosive) material combination must be assigned a division in Class 1.
- 173.2a(c)(2)
- (2) A Division 5.2 (organic peroxide) material combination must be classified as Division 5.2.
- 173.2a(c)(4)
- (3) A material that meets the definition of a wetted explosive must be classified as Division 4.1.

B.7. LOADING AND SEGREGATION

Loading and Segregation: General

- 173.448(a) (a) Each shipment of Class 7 materials must be secured to prevent shifting during normal transportation conditions.
- 174.81(d)
177.848(d)
176.83(b) (b) Class 7 materials may not be loaded, transported, or stored together in the same transport vehicle or storage facility with Division 1.1, 1.2, or 1.5 materials during the course of transportation. The same is true for Division 2.1 materials unless they are separated in a manner that, in the event of leakage from packages under conditions normally incident to transportation, commingling of hazardous materials would not occur.
- 173.448(b)
174.81
176.83
177.848 (c) Except for the specific segregation requirements for rail, vessel, and highway (described later), or as otherwise required by the competent authority in the applicable certificate, a package of Class 7 materials may be carried among packaged general cargo without special stowage provisions, if:
- (1) The heat output in watts does not exceed 0.1 times the minimum package dimension in centimeters; or
- (2) The average surface heat flux of the package does not exceed 15 W/m² and the immediately surrounding cargo is not in sacks or bags or otherwise in a form that would seriously impede air circulation for heat removal.
- 173.448(c) (d) Packages bearing a RADIOACTIVE WHITE-I, RADIOACTIVE YELLOW-II, or RADIOACTIVE YELLOW-III labels may not be carried in compartments occupied by passengers, except in those compartments exclusively reserved for couriers accompanying those packages.
- (e) Packages must be loaded so that:
- 173.442(a) (1) The heat generated within the package by the radioactive contents will not, during conditions normally incident to transport, affect the integrity of the package; and
- 173.442(b) (2) The temperature of the accessible external surfaces of the loaded package will not, assuming still air in the shade at an ambient temperature of 38 °C (100 °F), exceed either:
- (i) 50 °C (122 °F) in other than an exclusive use shipment; or
- (ii) 85 °C (185 °F) in an exclusive use shipment.

Loading and Segregation: Aircraft

- 173.448(e) (a) Any single package with a transport index greater than 3.0 may not be transported aboard a passenger-carrying aircraft.
- 173.448(f) (b) Class 7 material may not be transported aboard a passenger-carrying aircraft unless that material is intended for use in, or incident to, research, medical diagnosis or treatment.
- 173.448(e)
173.448(g) (c) The transport index of an overpack may not exceed 3.0 for passenger-carrying aircraft shipments, or 10.0 for cargo-aircraft only shipments.
- 175.701(a) (d) No person may carry in a passenger-carrying aircraft any package required to be labeled RADIOACTIVE YELLOW-II, or RADIOACTIVE YELLOW-III unless the package is placed in the aircraft in accordance with the minimum separation distances prescribed in Appendix B.

Loading and Segregation: Plutonium by aircraft

- 71.88(a)(4)
175.704 (a) For significant quantities of plutonium there are a number of special requirements relating to stowage location, the strength of the tie down system and the limits on other hazardous materials with which it may be transported.

Loading and Segregation: Railroad

- 174.700(b) (a) The number of packages of Class 7 materials that may be transported by rail or stored at any single location is limited to a total transport index number of not more than 50. This provision does not apply to exclusive use shipments.
- 174.700(c) (b) Each package of Class 7 material bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels may not be placed closer than 0.9 meter (3 feet) to an area (or dividing partition between areas) which may be continuously occupied by any passenger, rail employee, or shipment of one or more animals, nor closer than 4.5 meters (15 feet) to any package containing undeveloped film (if so marked). If more than one package of Class 7 materials is present, the distance must be computed from the table given in Appendix B.
- 173.700(e) (c) A person shall not remain unnecessarily in, on, or near a transport vehicle containing Class 7 materials.

Loading and Segregation: Water vessel

- 176.704(a) (a) The sum of the transport indexes for all packages of radioactive materials on board a vessel may not exceed the limits in the table below.

Type of freight container or conveyance	Limit on total sum of transport indexes in a single freight container or aboard a conveyance			
	Not under exclusive use		Under exclusive use	
	Non-fissile material	Fissile material	Non-fissile material	Fissile material ^a
Freight container - small	50	50	N/A	N/A
Freight container - large	50	50	No limit	100 ^b
Vessels: 1. Hold, compartment or defined deck area:				
Packages, overpacks, small freight containers	50	50	No limit	100 ^b
Large freight containers	200 ^d	50	No limit	100 ^b
Vessels: 2. Total vessel:				
Packages, overpacks, small freight containers	200 ^d	200 ^d	No limit ^c	200 ^e
Large freight containers	No limit ^d	No limit ^d	No limit	No limit ^d

a Provided that transport is direct from the consignor to the consignee without any intermediate in-transit storage, where the total TI exceed 50.

b In cases in which the total TI is greater than 50, the consignment must be so handled and stowed so that it is always separated from any package, overpack, portable tank or freight container carrying Class 7 (radioactive) materials by at least 6 meters (20 feet).

c For vessels the requirements given in 1 and 2 must be fulfilled.

d Provided that the packages, overpacks, portable tanks or freight containers, as applicable, are stowed so that the total sum of the TI's in any group does not exceed 50, and that each group is handled and stowed so that the groups are separate from each other by at least 6 meters (20 feet).

e Packages or overpacks carried in or on a transport vehicle which are offered for transport under exclusive use provisions may be transported by vessel provided that they are not removed from the vehicle at anytime while on board the vessel.

- 176.704(c) (b) The limitations specified in the table above do not apply to consignments of LSA-I materials if the packages are marked RADIOACTIVE LSA and no fissile materials are included in the shipment. They also do not apply when the entire vessel is reserved or chartered under exclusive use conditions if the number of fissile packages allowed is not exceeded and if the entire shipment is approved by the Associate Administrator for Hazardous Safety in advance.

- 176.708(a) (c) The segregation distances which apply to the stowage of packages of Class 7 materials on board a vessel are given in Appendix B.

Loading and Segregation: Highway

- 177.842(a) (a) The number of packages of Class 7 materials in any transport vehicle or storage location must be limited so that the total transport index number does not exceed 50. The total transport index of a group of packages and overpacks is determined by adding together the transport index number on the labels on the individual packages and overpacks in the group. This provision does not apply to exclusive use shipments.
- 177.842(b) (b) Packages of Class 7 material bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels may not be placed in a transport vehicle, storage location or in any other place closer than the distances shown in the following table to any area which may be continuously occupied by any passenger, employee, or animal, nor closer than the distances shown in the table to any package containing undeveloped film (if so marked), and must conform to the following conditions:
- (1) If more than one of these packages is present, the distance must be computed from the following table on the basis of the total transport index number determined by adding together the transport index number on the labels on the individual packages and overpacks in the vehicle or store room.
 - (2) Where more than one group of packages is present in any single storage location, a single group may not have a total transport index greater than 50. Each group of packages must be handled and stowed not closer than 6 meters (20 feet) (measured edge to edge) to any other group.

Total transport index	Minimum separation distance in meters (feet) to nearest undeveloped film in various times of transit					Minimum distance in meters (feet) to area of persons, or minimum distance in meters (feet) from dividing partition of cargo compartments
	Up to 2 hours	2-4 hours	4-8 hours	8-12 hours	Over 12 hours	
None	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
0.1 to 1.0	0.3 (1)	0.6 (2)	0.9 (3)	1.2 (4)	1.5 (5)	0.3 (1)
1.1 to 5.0	0.9 (3)	1.2 (4)	1.8 (6)	2.4 (8)	3.4 (11)	0.6 (2)
5.1 to 10.0	1.2 (4)	1.8 (6)	2.7 (9)	3.4 (11)	4.6 (15)	0.9 (3)
10.1 to 20.0	1.5 (5)	2.4 (8)	3.7 (12)	4.9 (16)	6.7 (22)	1.2 (4)
20.1 to 30.0	2.1 (7)	3.0 (10)	4.6 (15)	6.1 (20)	8.8 (29)	1.5 (5)
30.1 to 40.0	2.4 (8)	3.4 (11)	5.2 (17)	6.7 (22)	10.1 (33)	1.8 (6)
40.1 to 50.0	2.7 (9)	3.7 (23)	5.8 (19)	7.3 (24)	11.0 (36)	2.1 (7)

Note: The distance in this table must be measured from the nearest point on the nearest packages of Class 7 material.

177.842(d) (c) Packages must be so blocked and braced that they cannot change position during conditions normally incident to transportation.

177.842(e) (d) Persons should not remain unnecessarily in a vehicle containing Class 7 materials.

B.8. MARKING AND LABELING

Marking and Labeling: General

- (a) Each package containing Class 7 (radioactive) materials:
- 172.310(a) (1) with a gross mass greater than 50 kilograms (110 pounds) must have its gross mass marked on the outside of the package.
- 173.310(d) (2) destined for export must be marked with "USA" in conjunction with the
173.471 specification marking, or other package certificate identification.
173.472
173.473
- (b) No package bearing a hazard label may be transported unless:
- 172.401(a) (1) The package contains a material that is a hazardous material, and
(2) The label represents a hazard of the hazardous material in the package.
- 172.402(b) (c) The appropriate hazard class or division number must be displayed in the lower corner of a primary hazard label and may not be displayed on a subsidiary label.
- 172.402(c) (d) A package containing a hazardous material which is authorized on cargo aircraft only must be labeled with a CARGO AIRCRAFT ONLY label.
- 172.402(d) (e) Each package containing radioactive material that also meets the definition of one or more other hazard classes, must be labeled as radioactive material and for each additional hazard, except Class 9.
- 172.312(a)(2) (f) Each package having an inside packaging containing liquid hazardous materials must be legibly marked with with package orientation markings on two opposite sides of the
172.312(c) package with arrows pointing in the correct upright direction. Arrows for other purposes are not allowed.

Marking and Labeling: Radioactive Labels

- 172.403(b) (a) The proper label to affix to a package of Class 7 material is based on the radiation
172.403(c) level at the surface of the package and the transport index. The label to be applied must be the highest category required for any of the two determining conditions for the package as shown in the table below. RADIOACTIVE WHITE-I is the lowest category and RADIOACTIVE YELLOW-III is the highest. For example, a package with a transport index of 0.8 and a maximum surface radiation level of 0.6 mSv/h (60 mrem/h) must bear a RADIOACTIVE YELLOW-III label.

LIMITING CONDITION		Label category ¹
Transport index TI	Maximum radiation level at any point on the external surface	
0 ²	Less than or equal to 0.005 mSv/h (0.5 mrem/h).	WHITE-1
More than 0 but not more than 1.	Greater than 0.005 mSv/h (0.5 mrem/h) but less than or equal to 0.5 mSv/h (50 mrem/h).	YELLOW-II
More than 1 but not more than 10.	Greater than 0.05 mSv/h (50 mrem/h) but less than or equal to 2 mSv/h (200 mrem/h).	YELLOW-III
More than 10	Greater than 2 mSv/h (200 mrem/h) but less than or equal to 10 mSv/h (1,000 mrem/h).	YELLOW-III ³

173.403
Highway route
controlled
quantity

¹ Any package containing a "highway route controlled quantity" must be labeled as RADIOACTIVE YELLOW-III.

² If the measured TI is not greater than 0.05, the value may be considered to be zero.

172.441(b)

³Must be shipped under exclusive use provisions.

172.403(f)
172.406(a)

(b) Each package labeled with a RADIOACTIVE label must have two of these labels, affixed to opposite sides (not the bottom) of the package, and near the proper shipping name marking if package dimensions are adequate. For freight containers, one of each required label must be displayed on or near the closure.

172.406(e)(5)

172.403(g) (c) The following must be entered in the blank spaces on the RADIOACTIVE label:

172.403(g)(1) (1) *Contents:* The name of the radionuclides as taken from the listing of radionuclides in 173.435. Symbols which conform to established radiation protection terminology are authorized, i.e., ⁹⁹Mo, ⁶⁰Co, etc. For mixtures of radionuclides, with consideration of space available on the label, the radionuclides that must be shown are those which in essence comprise 95% of the hazard. Specifically, for mixtures, the radionuclides (n) that must be shown on shipping papers, may be determined on the basis of the following formula:

173.433(f)

$$\sum_{i=1}^n a_i / A_i \geq 0.95 \quad \sum_{i=1}^{n+m} a_i / A_i$$

where:

n + m = all the radionuclides in the mixture,

m = the radionuclides that do not need to be considered,

a_i = the activity of radionuclide i in the mixture, and

A_i = the A₁ or A₂ value, as appropriate for radionuclide i.

172.403(g)(2) (2) *Activity:* Activity units must be expressed in appropriate SI units [e.g., Becquerels (Bq), Terabecquerels (TBq), etc.] or in both appropriate SI units and appropriate customary units [Curies (Ci), milliCuries (mCi), microcuries (uCi), etc.]. Abbreviations are authorized.

172.403(g)(3)
173.403
*Transport
Index*

(3) *Transport index:* If the measured TI is not greater than 0.05, the value may be considered to be zero.

Marking and Labeling: Overpacks

- 173.448(g) (a) If an overpack is used to consolidate individual packages of Class 7 materials, the packages must comply with the packaging, marking, and labeling requirements, and:
- (1) The overpack must be labeled RADIOACTIVE WHITE-I, RADIOACTIVE YELLOW-II, or RADIOACTIVE YELLOW-III, except as follows:
 - (i) The "contents" entry on the label may state "mixed" unless each inside package contains the same radionuclide(s);
 - (ii) The "activity" entry on the label must be determined by adding together the number of Becquerels (curies) of the Class 7 materials packages contained therein;
 - (iii) For a non-rigid overpack, the required label together with required package markings must be affixed to the overpack by means of a securely attached, durable tag. The transport index must be determined by adding together the transport indexes of the Class 7 materials packages contained therein; and
 - (iv) For a rigid overpack, the transport index must be determined by:
 - (A) Adding together the transport indexes of the Class 7 materials packages contained in the overpack; or
 - (B) Except for fissile Class 7 materials, the number determined by multiplying the maximum radiation level, taken by the person initially offering the packages contained within the overpack for shipment, in milliSievert(s) per hour at one meter (3.3 feet) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 feet)).
- 173.25(a)(2)
172.404(b) (2) The overpack must be marked with the proper shipping name and identification number, and labeled as required for each hazardous material contained therein unless markings and labels representative of each hazardous material in the overpack are visible.
- 173.25(a)(3)
172.312 (3) Each package subject to the orientation marking requirements must be marked with package orientation marking arrows on two opposite vertical sides of the overpack with the arrows pointing in the correct direction.

173.25(a)(4) (4) The overpack is marked with a statement indicating that the inside (inner) packages comply with the prescribed specifications when specification packagings are required, unless specification markings on the inside packages are visible.

172.404(a)
173.21
173.25 (b) When authorized hazardous materials having different hazard classes are packed within the same packaging, or within the same outside container or overpack, the packaging, outside container or overpack must be labeled for each class of hazard contained therein.

Marking and Labeling: Non-bulk packagings

(a) General marking requirements for non-bulk packagings are:

172.301(a) (1) Each non-bulk package must be marked with the proper shipping name and identification number (preceded by "UN" or "NA", as appropriate) for the material as shown in the hazardous material table (172.101).

172.301(c)
172.203(k) (2) Each non-bulk packaging containing hazardous materials with a generic name or one which includes n.o.s. must be marked with its technical name in parentheses in association with the proper shipping name.

(3) Consignee's or consignor's name and address. Each non-bulk package must be marked with the name and address of the consignor or consignee.

172.324(b) (b) For each non-bulk package that contains a hazardous substance, the letters "RQ" must be marked on the package in association with the proper shipping name.

172.302 **Marking and Labeling: Bulk packagings**

(a) General marking requirements for bulk packagings are:

(1) *Identification numbers.* Each bulk packaging must be marked with the identification number specified for the material in the hazardous materials table (172.101).

(i) On each side and each end, if the packaging has a capacity of 3,785 L (1,000 gallons) or more;

(ii) On two opposing sides, if the packaging has a capacity of less than 3,785 L (1,000 gallons); or

(iii) For cylinders permanently installed on a tube trailer motor vehicle, on each side and each end of the motor vehicle.

- 172.302 (2) *Size of markings.* Markings on bulk packagings must have a width of at least 6.0 mm (0.24 in) and a height of at least—
- (i) 100 mm (3.9 in) for rail cars;
 - (ii) 25 mm (one in) for portable tanks with capacities of less than 3,785 L (1,000 gallons); and
 - (iii) 50 mm (2.0 in) for cargo tanks and other bulk packages.
- (3) *Exemption packagings.* The outside of each bulk package used under the terms of an exemption shall be marked "DOT-E" followed by the exemption number assigned.

B.9. PLACARDING

- 172.504(a)
172.556 (a) With few exceptions, each bulk packaging, freight container, unit load device, transport vehicle or rail car containing any RADIOACTIVE YELLOW-III labeled packages must be placarded on each side and each end with RADIOACTIVE placards.
- 172.504(a)
173.427(a)(6)(v) (b) Except for unconcentrated uranium or thorium ores, each shipment of low specific activity material and surface contaminated objects shipped under exclusive use must be placarded on each side and each end with RADIOACTIVE placards.
- 172.507(a)
172.527
173.403 (c) Each motor vehicle used to transport a package of highway route controlled quantity of radioactive material, must have the required RADIOACTIVE warning placard on a white square background surrounded by a black border.
- 172.505(b) (d) In addition to any radioactive material placard required, each transport vehicle, portable tank or freight container that contains 454 kg (1001 pounds) or more gross weight of fissile or low specific activity uranium hexafluoride must be placarded with a CORROSIVE placard on each side and each end.
- 172.505(d) (e) Radioactive materials possessing secondary hazards may exhibit subsidiary placards. This may be done even when not required elsewhere in the regulations.
- 172.506(a) (f) Each person offering radioactive material for transportation by highway must provide the motor carrier with the required placards for that shipment, prior to or at the time the material is offered for transport. However, if the carrier's motor vehicle is already appropriately placarded, no action is needed.
- 172.508(a) (g) Each person offering radioactive material for transportation by rail must affix the required placards to the rail car containing the material. Placards which are on motor vehicles, transport containers or portable tanks may be used in satisfying this requirement.
- 172.516(a) (h) Each placard on a motor vehicle or rail car must be readily visible from the direction it faces. However, placards are not required to be visible from the direction of another motor vehicle or rail car to which it is coupled.

172.516(b) (i) The required placarding of the front of a motor vehicle may be on the front of a truck-tractor instead of, or in addition to, the placarding on the front of the cargo body to which the truck-tractor is attached.

172.516(c) (j) Placards must be securely attached and be maintained readily readable and visible.

B.10. TRANSPORT DOCUMENTS

172.201 Transport Documents: General Entries

(a) *Contents.* When a description of hazardous material is required to be included on a shipping paper, that description must conform to the following requirements:

172.201(a) (1) When a hazardous material and a non-hazardous material are described on the same shipping paper, the required hazardous material description entries and required additional entries:

(i) Must be entered first, or

(ii) Must be entered in a color that clearly contrasts with any description on the shipping paper of a material not subject to the requirements, except that a description on a reproduction of a shipping paper may be highlighted, rather than printed, in a contrasting color, or

(iii) Must be identified by the entry of an "X" placed before the proper shipping name in a column captioned "HM". (The "X" may be replaced by "RQ", if appropriate.)

(2) The required shipping description on a shipping paper and all copies used for transportation purposes, must be legible and printed (manually or mechanically) in English.

(3) Unless it is specifically authorized, the shipping description may not contain any code or abbreviation.

(4) A shipping paper may contain additional information concerning the material provided the information is not inconsistent with the required description. Additional information must be placed after the required basic description.

172.201(b) (b) *Name of shipper.* A shipping paper for a shipment by water must contain the name of the shipper.

172.201(c) (c) *Continuation page.* A shipping paper may consist of more than one page, if each page is consecutively numbered and the first page bears a notation specifying the total number of pages included in the shipping paper. For example, "Page 1 of 4 pages".

- 172.201(d)
172.604(3)
- (d) *Emergency response telephone number.* A shipping paper must contain an emergency response telephone number entered immediately following the description of the hazardous material. It may be entered only once in a clearly visible location if the number applies to each hazardous material on the shipping paper and if it is indicated that the number is for emergency response information (for example: "EMERGENCY CONTACT...."). Further requirements regarding the monitoring of this number will be found in the section on Emergency Response Information.

Transport Documents: Description of Hazardous Material

- 172.202(a)
172.101
- (a) The shipping description of a hazardous material on the shipping paper must include:
- (1) The proper shipping name prescribed for the material in Column 2 of the hazardous materials table (172.101);
 - (2) The hazard class or division prescribed for the material as shown in Column 3 of the hazardous materials table (class names or subsidiary hazard class or division number may be entered following the numerical hazard class, or following the basic description). The hazard class need not be included for the entry "Combustible liquid, n.o.s.";
 - (3) The identification number prescribed for the material as shown in Column 4 of the hazardous materials table;
- 172.202(a)
- (4) The packing group, in Roman numerals, prescribed for the material in Column 5 of the hazardous materials table, if any. The packing group may be preceded by the letters "PG" (e.g., "PG II"); and
- 172.202(a)(5)
- (5) Except for empty packagings, cylinders for Class 2 (compressed gases) materials, and bulk packagings, the total quantity (by net or gross mass, capacity, or as otherwise appropriate), including the unit of measurement, of the hazardous material covered by the description (e.g., "800 lbs", "55 gal.", "3629 kg", or "208 L"). For cylinders for Class 2 (compressed gases) materials and bulk packagings, some indication of total quantity must be shown (e.g., "10 cylinders" or "1 cargo tank").
- 173.29
- 172.202(b)
- (b) The basic description specified above in paragraphs (a)(1), (2), (3) and (4) must be shown in sequence with no additional information interspersed. For example: "Gasoline, 3, UN 1203, PG II".
- 172.202(c)
- (c) The total quantity of the material covered by one description must appear before or after, or both before and after, the description required and authorized. The type of packaging and destination marks may be entered in any appropriate manner before or after the basic description. Abbreviations may be used to express units of measurement and types of packagings.

- 172.202(d) (d) Technical and chemical group names may be entered in parentheses between the proper shipping name and hazard class or following the basic description. An appropriate modifier, such as "contains" or "containing", and/or percentage of the technical constituent may also be used. For example: "Flammable liquids, n.o.s. (contains Xylene and Benzene), 3, UN 1993, PG II".
- 172.202(e) (e) A material may not be offered for transportation or transported when its description on a shipping paper includes a hazard class or an identification number specified in the hazardous materials table, unless it really is a hazardous material according to the US regulations, or UN Recommendations, or the ICAO Technical Instructions or the IMDG Code.

Transport Documents: Description of Radioactive Material:

- 172.203(d) (a) The description for a shipment of a Class 7 material must include the following additional entries as appropriate.
- 172.203(d)(2)
173.433(f) (1) The name of the radionuclides as taken from the listing of radionuclides in 173.435. Symbols which conform to established radiation protection terminology are authorized, i.e., ⁹⁹Mo, ⁶⁰Co, etc. For mixtures of radionuclides the radionuclides that must be shown are those which in essence comprise 95% of the hazard. Specifically, for mixtures, the radionuclides (n) that must be shown on shipping papers, may be determined on the basis of the following formula:

$$\sum_{i=1}^n a_i / A_i \geq 0.95 \quad \sum_{i=1}^{n+m} a_i / A_i$$

where:

- n + m = all the radionuclides in the mixture,
 m = the radionuclides that do not need to be considered,
 a_i = the activity of radionuclide i in the mixture, and
 A_i = the A₁ or A₂ value, as appropriate for radionuclide i.

- 172.203(d)(3) (2) A description of the physical and chemical form of the material, if the material is not in special form (a generic chemical description is acceptable for chemical form).
- 172.203(d)(4) (3) The activity contained in each package of the shipment in terms of the appropriate SI units (e.g. Becquerel, Terabecquerel, etc.) or in terms of the appropriate SI units followed by the customary units (e.g. Curies, millicuries, etc.). Abbreviations are authorized.

- (4) For the shipment of a package containing a highway route controlled quantity of Class 7 materials, the words "Highway route controlled quantity" must be entered in association with the basic description.
- 172.203(d)(5) (5) The category of label applied to each package in the shipment. For example: "RADIOACTIVE WHITE-I".
- 172.203(d)(6) (6) The transport index assigned to each package in the shipment bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels.
- 172.203(d)(7)
173.453 (7) For a shipment of fissile-excepted Class 7 materials, the words "Fissile Excepted" if the package is excepted.
- 172.203(d)(8)
173.471 (8) For a package approved by the U.S. Department of Energy (DOE) or U.S. Nuclear Regulatory Commission (NRC), a notation of the package identification marking as prescribed in the applicable DOE or NRC approval.
- 172.203(d)(9)
173.473 (9) For an export shipment or a shipment in a foreign made package, a notation of the package identification marking as prescribed in the applicable International Atomic Energy Agency (IAEA) Certificate of Competent Authority which has been issued for the package.
- 172.203(d)(10) (10) For a shipment consigned as exclusive use:
- (i) An indication that the shipment is consigned as exclusive use; or
- (ii) If all the descriptions on the shipping paper are consigned as exclusive use, then the statement "Exclusive Use Shipment" may be entered only once on the shipping paper in a clearly visible location.
- 173.441(c) (iii) For shipments exceeding a radiation level of 2 mSv/h (200 mrem/h) or a Transport Index of 10, made under exclusive use, the offeror must provide specific written instructions for maintenance of the exclusive use shipment controls to the carrier. The instructions must be included with the shipping paper information. The instructions must be sufficient so that, when followed, they will cause the carrier to avoid actions that will unnecessarily delay delivery or unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.
- 172.203(f) (11) When a package containing a hazardous material is offered for transportation by air and its transportation aboard passenger-carrying aircraft is prohibited, the words "Cargo aircraft only" must be entered after the basic description.
- 172.203(g) (12) The shipping paper for a rail car containing a hazardous material must contain the notation "Placarded" followed by the name of the placard required for the rail car.

- 172.203(i) (13) Each shipment by water must have the following shipping paper entries:
- (i) Identification of the type of packagings such as barrels, drums, cylinders, and boxes.
 - (ii) The number of each type of package including those in a freight container or on a pallet.
 - (iii) The gross mass of each type of package or the individual gross mass of each package.

Transport Documents : Certifications

- 172.204(a) (a) Except as provided in paragraphs (b) and (c) below, each person who offers a hazardous material for transportation must certify that the material is offered for transportation by printing (manually or mechanically) on the shipping paper containing the required shipping description the certification contained in paragraph (1) or the certification (declaration) containing the language contained in paragraph (2) below.
- (1) "This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation." [NOTE: In line one of the certification, the words "herein-named" may be substituted for the words "above-named".]
 - (2) "I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations."
- 172.204(b) (b) Exceptions:
- (1) Except for hazardous waste, no certification is required for hazardous materials offered for transportation by motor vehicle and transported:
 - (i) In a cargo tank supplied by the carrier, or
 - (ii) By the shipper as a private carrier except for a hazardous material that is to be reshipped or transferred from one carrier to another.
- 172.204(b) (2) No certification is required for the return of an empty tank car which previously contained a hazardous material and which has not been cleaned or purged.

- 172.204(c) (c) For transport by aircraft:
- (1) A certification containing the following language may be used in place of the above certification:
- "I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and in proper condition for carriage by air according to applicable national governmental regulations."
- 172.204(c)(2)
175.30 (2) Two copies of the certification are required for transportation by air. The originating aircraft operator must retain one copy of each shipping paper for 90 days.
- 172.204(c)(3) (3) The following statement must be added to the required certification:
- "This shipment is within the limitations prescribed for passenger aircraft/cargo aircraft only (delete whichever one is not applicable)."
- 172.204(c)(4) (4) For transportation aboard a passenger-carrying aircraft, a printed certificate must be signed (mechanically or manually) stating that the shipment contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment.
- 172.204(d) (d) The certifications required above by paragraphs (a) or (c):
- (1) Must be legibly signed by a principal, officer, partner, or employee of the shipper or his agent; and
- (2) May be legibly signed manually, by typewriter, or by other mechanical means.

Transport Documents: Emergency Response Information

- 172.600(c) (a) No person may offer for transportation, accept for transportation, transfer, store or otherwise handle during transportation a hazardous material unless the emergency response information described below is immediately available for use at all times the hazardous material is present. This information also has to be available to Federal, state or local government agencies, and to those responding to incidents involving the material.

- 172.602(a) (b) The information required includes:
- (1) Basic description and technical name of the hazardous material;
 - (2) Immediate hazards to health;
 - (3) Risks of fire or explosion;
 - (4) Immediate precautions to be taken in the event of an accident or incident;
 - (5) Immediate methods for handling fires;
 - (6) Initial methods for handling spills or leaks in the absence of fire; and
 - (7) Preliminary first aid measures.
- 172.602(b) (c) The information must be:
- (1) Printed legibly in English;
 - (2) Available for use away from the package containing the hazardous material; and
 - (3) Presented:
 - (i) On a shipping paper;
 - (ii) In a document other than a shipping paper, that includes both the basic description and technical name of the hazardous material and the emergency response information required; or
 - (iii) Related to the information on a shipping paper, a written notification to the pilot in command, or a dangerous cargo manifest, in a separate document, in a manner that cross-references the description of the hazardous material on the shipping paper with the emergency response information contained in the document. Documents such as the ICAO "Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods", the IMO "Emergency Procedures for Ships Carrying Dangerous Goods" or equivalent documents may be used for this purpose.
- 172.602(c) (d) Carriers must maintain the emergency response information in the same manner as prescribed for shipping papers and must be immediately available to train crew personnel, drivers of motor vehicles, flight crew members and bridge personnel on vessels for use in the event of incidents.
- (e) Facility operators must maintain the information in a location that is immediately accessible to facility personnel whenever the hazardous material is present.

B.11. STORAGE AND DISPATCH

No Specific Provisions.

B.12. CARRIAGE

Carriage by highway

- 177.816(a) (a) In addition to hazmat employee training, no carrier may transport a hazardous material by highway unless each hazmat employee who will operate a motor vehicle has received further training on the procedures necessary for the safe operation of that motor vehicle.
- 177.817(e) (b) A driver of a motor vehicle containing hazardous material must ensure that the shipping papers are readily available and recognizable by authorities in the event of an accident or inspection.
- 177.825(a) (c) A carrier or any person operating a motor vehicle that requires a "RADIOACTIVE" placard must:
- (1) Ensure that the vehicle is operated on routes that minimize radiological risk, considering accident rates, transit time, population density and activities, time of day and the day of week. This does not apply:
 - (i) When there is only one practicable highway route available;
 - (ii) When the shipment is a highway route controlled quantity.
 - (2) Tell the driver which route to take and that the vehicle contains "Class 7 radioactive materials".
- 177.825(b) (d) A highway route controlled quantity shipment must follow preferred routes. These routes must be selected by the carrier, or the person operating the vehicle to reduce time in transit over the preferred route segment of the trip. Generally the preferred routes use the Interstate System highways. States may designate preferred routes through written notice to the DOT.
- 177.825(c) (e) A carrier who operates a motor vehicle which contains a highway route controlled quantity must also prepare a written route plan and supply a copy before departure to the driver and to the shipper. This must include the origin and destination points, the route selected, all planned stops, and estimated departure and arrival times and telephone numbers which will access emergency assistance in each State to be entered.

- 177.825(d) (f) No person may transport a highway route controlled quantity shipment on a public highway unless:
- (1) The driver is trained as referenced in (a) above and in B.13 below;
 - (2) A copy of the record of training is in the immediate possession of the driver;
 - (3) The route plan is in the immediate possession of the driver and the vehicle is operated by the driver in accordance with the route plan.

- 107 Subpart G (g) There are also registration and liability insurance requirements associated with highway route controlled shipments.

B.13. OTHER PROVISIONS

Emergency Response/Incidents

- 172.604(a) (a) A person who offers a hazardous material for transportation must provide a 24-hour emergency response telephone number (including area code or international access code) for use in the event of an emergency involving the hazardous material.

- (b) The emergency response telephone number must be:
- (1) Monitored at all times the hazardous material is in transportation including storage incidental to transportation.
 - (2) The number of a person who is either knowledgeable of the hazards of the material being shipped, has comprehensive emergency response and incident mitigation information, or has immediate access to a person who has such information.
 - (3) Entered on the shipping paper

- 172.604(b) (c) The emergency response telephone number can be the number of an agency or organization capable of providing the necessary information, but in this case the offeror must ensure that the agency or organization has received current information on the material before it is offered for transportation.

- 171.15 (d) A carrier must give immediate notification of significant incidents to the DOT. The types of incidents include fatalities, damage exceeding \$50,000, general public evacuation or spills. If needed, the reporting requirements are listed in 171.16.
- 171.16
- 177.807

- 174.750-Rail (e) When contamination is involved, the carrier also has to notify the offeror (and the FAA if an air shipment), isolate the spill, and not place the unit back in service until decontaminated.
- 175.45-Air
- 175.700(b)
- 176.710-Sea
- 177.861-Road

Training

- 172.700
173.422(b)(3)
171.8 *Hazmat
employee/
employer*
173.1(b)
174.7(b)
175.20(b)
176.13(b)
177.801
- (a) Almost anyone involved in the handling and transport of radioactive material must undergo hazmat employee training prior to performing such duties. The training must be a systematic program that ensures that the person has general awareness and familiarity training, is able to recognize and identify hazardous materials, has knowledge of specific functional requirements applicable to the job and has knowledge of emergency response information and self-protection measures and accident prevention methods and procedures.
- 172.704(a) (b) Hazmat employee training must include: general awareness/familiarization training, function specific training, safety training, and OSHA or EPA training.
- 172.704(c) (c) Initial training, and recurrent training at least once every three years is required. Relevant training from a previous employer may be used to satisfy the requirements provided a current record is obtained from the previous employer.
- 172.704(d) (d) Records of current training, inclusive of the preceding three years must be created and retained for as long as that employee is employed by that employer as a hazmat employee and for 90 days thereafter.

Licensing

- 30.41(a) (a) Generally, radioactive material may only be transferred to those authorized to possess it and such authorization (or exemption) must be confirmed before transfer. Specifically, byproduct material may only be transferred by NRC (or Agreement State) licensees to:
- 30.41(b)
- (1) The Department of Energy;
- (2) The agency in an Agreement State which regulates radioactive material;
- (3) Anyone exempt for the licensing requirements of the Atomic Energy Act or the Agreement State;
- (4) Any person authorized to receive such byproduct material under the terms of a specific or general license issued by the NRC or Agreement State.
- 100.20-30 (5) A person abroad in accordance with an NRC general export license;
- (6) Anyone else specifically authorized by the NRC in writing.
- 30.41(d) (b) The licensee transferring the radioactive material must verify that the transferee's license authorizes the receipt of the type, form, and quantity of the byproduct material transferred. Several methods are allowed, the simplest is to have and read a current copy of the transferee's license.

Quality Control

- 173.474 (a) Prior to the first use of any packaging for the shipment of Class 7 material, the offeror must determine that:
- (1) The packaging meets the quality of design and construction requirements as specified; and
 - (2) The effectiveness of the shielding, containment and, when required, the heat transfer characteristics of the package, are within the limits specified for the package design.
- (b) Before each shipment of any radioactive materials package the offeror must ensure that:
- 173.475(a) (1) The packaging is proper for the contents to be shipped;
- 173.475(b) (2) The packaging is in unimpaired physical condition, except for superficial marks;
- 173.475(c) (3) Each closure device is properly installed, secured and free of defects;
- 173.475(d) (4) For fissile material, each moderator and neutron absorber, if required to be present is present and in proper condition;
- 173.475(e) (5) Each special instruction for filling, closing and preparation has been followed;
- 173.475(f) (6) Each closure, valve or other opening is properly closed and sealed;
- 173.475(g) (7) Each packaging containing liquid in excess of an A_2 quantity and intended for air shipment has been tested to show that it will not leak under an ambient atmospheric pressure of not more than 25 kPa absolute.
- 173.475(h) (8) The internal pressure of the containment system will not exceed the design pressure during transportation.
- 173.475(i) (9) External radiation and contamination levels are within the allowable limits specified.
- 71.101-137 (c) Each licensee involved with designing, purchasing, fabricating, handling, shipping, storing, cleaning, assembling, inspecting, operating, maintaining, repairing or modifying an NRC approved packaging must establish, maintain and execute a quality assurance program meeting the requirements described in 10 CFR 71 Subpart H.

Schedule 5

LOW SPECIFIC ACTIVITY (LSA-I)

UN No.
2912 as applicable

LSA-I is the first of three groups of radioactive material which, by its nature, has a limited specific activity or for which limits of estimated average specific activity apply.

1. MATERIALS

- (a) See Common Provision B.1.(a).
- 173.427(a)(3)
173.453 (b) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (≤ 15 g), and to situations where criticality is impossible under any circumstances such as very dilute solutions and mixtures.
- 173.427(a)(1) (c) The external dose rate must not exceed 10 mSv/h (1 rem/h) at 3 meters from the unshielded material.
- 173.427(d)
20.2005 (d) Except for transportation by aircraft, LSA material with very low concentrations of ^3H or ^{14}C ($0.05 \mu\text{Ci/g}$ or 1.85 kBq/g) in liquid scintillation media or animal tissue are excepted from the radioactive material shipping requirements when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions relating to that hazard class.
- 173.403
71.4
LSA-I (e) LSA-I — Radioactive material meeting one of the following requirements:
- (1) Ores containing only naturally occurring radionuclides (e.g., uranium, thorium) and uranium or thorium concentrates of such ores; or
 - (2) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures; or
 - (3) Class 7 material, other than fissile material, for which the A_2 value is unlimited; or
 - (4) Mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the Class 7 material is essentially uniformly distributed and the average specific activity does not exceed $10^6 A_2/\text{g}$.

2. PACKAGING/PACKAGE

(a) LSA-I material must be packaged as follows:

- 173.427(b)(1)
173.427(a)(6)(vii)
- (1) In an industrial package type IP-1, unless it is a non-exclusive use liquid shipment which requires an IP-2 package. Exclusive use air transport may only use an IP-1 package.
- 173.427(b)(5)
- (2) Any Type B, Type B(U), or Type B(M) package authorized. (This is a very unlikely option for LSA-I.) NRC certified packages are also subject to the conditions in the certificate.
- 174.427(b)(2)
173.412(a)
173.412(b)
173.412(c)
173.412(k)
- (3) For domestic use only, in a DOT Specification 7A Type A package. However, certain Type A package requirements do not have to be met. These include: the security seal, the minimum 10 cm dimension, the containment and shielding integrity temperature range requirements, and the specific requirements for liquids.
- 173.427(b)(3)
- (4) In a strong, tight package that prevents leakage of the radioactive contents under normal conditions of transport, if it is an exclusive use, domestic transport and the material in each package does not exceed an A₂ quantity.
- 173.427(c)(1)
- (5) For a solid material, exclusive use shipment in strong, tight bulk packagings. However, the general design requirements do not apply.
- 173.427(c)(2)
- (6) For liquid material, exclusive use shipment in certain specification tank cars (103CW, 111A60W7), or cargo motor vehicles (MC 310, MC 311, MC 312 MC 331, DOT 412). Bottom openings and trailer-on-flat-car service are not authorized.

3. MAXIMUM RADIATION LEVELS

173.427(a)(5) See Common Provision B.3.

4. CONTAMINATION

173.427(a)(4) See Common Provision B.4.

5. DECONTAMINATION

- (a) See Common Provision B.5.
- 176.715
- (b) For transport by water vessel — Each hold, compartment, or deck area used for the transportation of low specific activity or surface contaminated object Class 7 materials under exclusive use conditions must be surveyed with appropriate radiation detection instruments after each use. Such holds, compartments, and deck areas may not be used again until the radiation dose rate at every accessible surface is less than 0.005 mSv/h (0.5 mrem/h), and the non-fixed (removable) radioactive surface contamination is not greater than the limits in Common Provision B.4(a).
- 173.443

6. MIXED CONTENTS

See Common Provision B.6.

7. LOADING AND SEGREGATION

- (a) See Common Provisions B.7.
- 177.842(c)
174.700 (b) For transport by highway or railroad, the LSA-I material must be loaded so as to avoid spillage and scattering of loose materials.
- 173.427(a)(6) (c) For exclusive use shipments:
 - (1) They must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded.
 - (2) There must be no loose Class 7 material in the conveyance, however, when the conveyance is the packaging there must be no leakage of material from the conveyance.
 - (3) Packages must be braced so as to prevent shifting of lading under normal transport conditions.

8. MARKING AND LABELING

- (a) **For international shipments** — See Common Provision B.8.
- 173.427(a)(6)(vi
) (b) **For domestic, exclusive use transportation only:** Packages are excepted from the specification marking and labeling requirements. However, the exterior of each nonbulk package must be stenciled or otherwise marked RADIOACTIVE-LSA and nonbulk packages that contain a hazardous substance must also be stenciled or otherwise marked with the letters RQ in association with the above marking.

9. PLACARDING

- (a) See Common Provision B.9.
- 173.427(a)(6)(v)
172.504
Table 1
footnote 1 (b) Except for unconcentrated uranium or thorium ores, the RADIOACTIVE placard is also required for exclusive use shipments of low specific activity material.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision B.10.
- 172.203(d)(11) (b) The group notation of LSA-I as an additional description.
- 173427(a)(iv) (c) **For exclusive use shipments:** Specific instructions for the maintenance of exclusive use controls must be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information.

11. STORAGE AND DISPATCH

No Specific Provisions.

12. CARRIAGE

See Common Provision B.12.

13. OTHER PROVISIONS

See Common Provision B.13.

Schedule 6

LOW SPECIFIC ACTIVITY (LSA-II)

UN No.
2912 as applicable

LSA-II is the second of three groups of radioactive material which, by its nature, has a limited specific activity or for which limits of estimated average specific activity apply.

1. MATERIALS

- (a) See Common Provision B.1.(a).
- 173.427(a)(3)
173.453 (b) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (≤ 15 g), and to situations where criticality is impossible under any circumstances such as very dilute solutions and mixtures.
- 173.427(a)(1) (c) The external dose rate must not exceed 10 mSv/h (1 rem/h) at 3 meters from the unshielded material.
- 173.427(d)
20.2005 (d) Except for transportation by aircraft, LSA material with very low concentrations of ^3H or ^{14}C ($0.05 \mu\text{Ci/g}$ or 1.85 kBq/g) in liquid scintillation media or animal tissue are excepted from the radioactive material shipping requirements when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions relating to that hazard class.
- 173.403
LSA-II (e) LSA-II — Radioactive material meeting one of the following requirements:
- (1) Water with tritium concentration up to 0.8 TBq/liter (20.0 Ci/liter); or
 - (2) Material in which the Class 7 material is distributed throughout and the average specific activity does not exceed $10^{-4} \text{ A}_2/\text{g}$ for solids and gases, and $10^{-5} \text{ A}_2/\text{g}$ for liquids.

2. PACKAGING/PACKAGE

(a) LSA-II material must be packaged as follows:

- 173.427(b)(1)
173.427(a)(6)(vii)
- (1) In an industrial package type IP-2, unless it is a non-exclusive use liquid or gas shipment which requires an IP-3 package. Exclusive use air transport may only use an IP-2 package.
- 173.427(b)(5)
- (2) Any Type B, Type B(U), or Type B(M) package authorized. NRC certified packages are also subject to the conditions in the certificate.
- 173.427(b)(2)
174.412(a)
174.412(b)
174.412(c)
174.412(k)
- (3) For domestic use only, in a DOT Specification 7A Type A package. However, certain Type A package requirements do not have to be met. These include: the security seal, the minimum 10 cm dimension, the containment and shielding integrity temperature range requirements, and the specific requirements for liquids.
- 174.427(b)(3)
- (4) In a strong, tight package that prevents leakage of the radioactive contents under normal conditions of transport, if it is an exclusive use, domestic transport and the material in each package does not exceed an A₂ quantity.
- 173.427(b)(4)
71.10(b)(2)
71.52
- (5) If the external dose rate from the unshielded Class 7 material exceeds 10 mSv/h, an NRC approved package must be used. Up to April 1, 1999 this can be essentially an NRC certified Type A package (see Appendix A) with additional tie down requirements. After April 1, 1999, an appropriate Type B package will be required. Use of NRC certified packages is subject to the conditions in the certificate.

3. MAXIMUM RADIATION LEVELS

173.427(a)(5) See Common Provision B.3.

4. CONTAMINATION

173.427(a)(4) See Common Provision B.4.

5. DECONTAMINATION

(a) See Common Provision B.5.

- 176.715
- (b) For transport by water vessel — Each hold, compartment, or deck area used for the transportation of low specific activity or surface contaminated object Class 7 materials under exclusive use conditions must be surveyed with appropriate radiation detection instruments after each use. Such holds, compartments, and deck areas may not be used again until the radiation dose rate at every accessible surface is less than 0.005 mSv/h (0.5 mrem/h), and the non-fixed (removable) radioactive surface contamination is not greater than the limits in Common Provision B.4(a).
- 173.443

6. MIXED CONTENTS

See Common Provision B.6.

7. LOADING AND SEGREGATION

- (a) See Common Provisions B.7.
- 177.842(c)
174.700 (b) For transport by highway or railroad, the LSA-II material must be loaded so as to avoid spillage and scattering of loose materials.
- 173.427(a)(6) (c) For exclusive use shipments:
 - (1) They must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded.
 - (2) There must be no loose Class 7 material in the conveyance, however, when the conveyance is the packaging there must be no leakage of material from the conveyance.
 - (3) Packages must be braced so as to prevent shifting of lading under normal transport conditions.
- 173.427(a)(2) (d) For combustible solids, and all liquids and gases, the activity limit for any single conveyance is 100 A₂.

8. MARKING AND LABELING

- (a) **For international shipments** — see Common Provision B.8.
- 173.427(a)(6)(vi)
) (b) **For domestic, exclusive use transportation only**— Packages are excepted from the specification marking and labeling requirements. However, the exterior of each nonbulk package must be stenciled or otherwise marked RADIOACTIVE-LSA and nonbulk packages that contain a hazardous substance must also be stenciled or otherwise marked with the letters RQ in association with the above marking.

9. PLACARDING

- (a) See Common Provision B.9.
- 173.427(a)(6)(v)
172.504
Table 1
footnote 1 (b) The RADIOACTIVE placard is also required for exclusive use shipments of low specific activity material.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision B.10.
- 172.203(d)(11) (b) The group notation of LSA-II as an additional description.
- 173.427(a)(iv) (c) **For exclusive use shipments:** Specific instructions for the maintenance of exclusive use controls must be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information.

11. STORAGE AND DISPATCH

No Specific Provisions.

12. CARRIAGE

See Common Provision B.12.

13. OTHER PROVISIONS

See Common Provision B.13.

Schedule 7

LOW SPECIFIC ACTIVITY (LSA-III)

UN No.
2912 as applicable

LSA-III is the third of three groups of radioactive material which, by its nature, has a limited specific activity or for which limits of estimated average specific activity apply.

1. MATERIALS

- (a) See Common Provision B.1.(a).
- 173.427(a)(3)
173.453 (b) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (≤ 15 g), and to situations where criticality is impossible under any circumstances such as very dilute solutions and mixtures.
- 173.427(a)(1) (c) The external dose rate must not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 meters from the unshielded material;
- 173.427(d)
20.2005 (d) Except for transportation by aircraft, LSA material with very low concentrations of ^3H or ^{14}C ($0.05 \mu\text{Ci/g}$ or 1.85 kBq/g) in liquid scintillation media or animal tissue are excepted from the radioactive material shipping requirements when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions relating to that hazard class.
- 173.403
LSA-III (e) LSA-III. Solids (e.g., consolidated wastes, activated materials) that meet a specific 7 day leach test requirement (173.468) and in which:
- (1) The Class 7 material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed throughout in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.); and
 - (2) The Class 7 material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 material per package by leaching when placed in water for seven days would not exceed 0.1 A_2 ; and
 - (3) The average specific activity of the solid does not exceed $2 \times 10^{-3} \text{ A}_2/\text{g}$.

2. PACKAGING/PACKAGE

(a) LSA-III material must be packaged as follows:

- 173.427(b)(1)
173.427(a)(6)(vii)
- (1) In an industrial package type IP-2, if exclusive use or in an industrial package type IP-3 if non-exclusive use. Exclusive use air transport may only use an IP-2 package.
- 173.427(b)(5)
- (2) Any Type B, Type B(U), or Type B(M) package authorized. NRC certified packages are also subject to the conditions in the certificate.
- 173.427(b)(2)
173.412(a)
173.412(b)
173.412(c)
173.412(k)
- (3) For domestic use only, in a DOT Specification 7A Type A package. However, certain Type A package requirements do not have to be met. These include: the security seal, the minimum 10 cm dimension, the containment and shielding integrity temperature range requirements, and the specific requirements for liquids.
- 173.427(b)(3)
- (4) In a strong, tight package that prevents leakage of the radioactive contents under normal conditions of transport, if it is an exclusive use, domestic transport and the material in each package does not exceed an A₂ quantity.
- 173.427(b)(4)
71.10(b)(2)
71.52
- (5) If the external dose rate from the unshielded Class 7 material exceeds 10 mSv/h, an NRC approved package must be used. Up to April 1, 1999 this can be essentially an NRC certified Type A package (see Appendix A) with additional tie down requirements. After April 1, 1999, an appropriate Type B package will be required. NRC certified packages are also subject to the conditions in the certificate.

3. MAXIMUM RADIATION LEVELS

173.427(a)(5) See Common Provision B.3.

4. CONTAMINATION

173.427(a)(4) See Common Provision B.4.

5. DECONTAMINATION

(a) See Common Provision B.5.

176.715

(b) **For transport by water vessel:** Each hold, compartment, or deck area used for the transportation of low specific activity or surface contaminated object Class 7 materials under exclusive use conditions must be surveyed with appropriate radiation detection instruments after each use. Such holds, compartments, and deck areas may not be used again until the radiation dose rate at every accessible surface is less than 0.005 mSv/h (0.5 mrem/h), and the non-fixed (removable) radioactive surface contamination is not greater than the limits in Common Provision B.4(a).

173.443

6. MIXED CONTENTS

See Common Provision B.6.

7. LOADING AND SEGREGATION

- (a) See Common Provisions B.7.
- 177.842(c)
174.700 (b) **For transport by highway or railroad:** The LSA-III material must be loaded so as to avoid spillage and scattering of loose materials.
- 173.427(a)(6) (c) **For exclusive use shipments:**
- (1) They must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded.
 - (2) There must be no loose Class 7 material in the conveyance, however, when the conveyance is the packaging there must be no leakage of material from the conveyance.
 - (3) Packages must be braced so as to prevent shifting of lading under normal transport conditions.
- 173.427(a)(2) (d) For combustible solids, and all liquids and gases, the activity limit for any single conveyance is 100 A₂.

8. MARKING AND LABELING

- (a) **For international shipments** — See Common Provision B.8.
- 173.427(a)(6)(vi)
) (b) **For domestic, exclusive use transportation only**— Packages are excepted from the specification marking and labeling requirements. However, the exterior of each nonbulk package must be stenciled or otherwise marked RADIOACTIVE-LSA and nonbulk packages that contain a hazardous substance must also be stenciled or otherwise marked with the letters RQ in association with the above marking.

9. PLACARDING

- (a) See Common Provision B.9.
- 173.427(a)(6)(v)
172.504
Table 1
footnote 1 (b) The RADIOACTIVE placard is also required for exclusive use shipments of low specific activity material.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision B.10.
- 172.203(d)(11) (b) The group notation of LSA-III as an additional description.
- 173.427(a)(iv) (c) **For exclusive use shipments:** Specific instructions for the maintenance of exclusive use controls must be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information.

11. STORAGE AND DISPATCH

No Specific Provisions.

12. CARRIAGE

See Common Provision B.12.

13. OTHER PROVISIONS

See Common Provision B.13.

Schedule 8

SURFACE CONTAMINATED OBJECT (SCO-I AND SCO-II)

UN No.
2913 as applicable

A surface contaminated object (SCO) is a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces. There are two groups, SCO-I and SCO-II, which differ in the maximum level of contamination permitted.

1. MATERIALS

- (a) See Common Provision B.1.(a).
- 173.427(a)(3)
173.453 (b) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (≤ 15 g), and to situations where criticality is impossible under any circumstances such as very dilute solutions and mixtures.
- 173.427(a)(1) (c) The external dose rate must not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 meters from the unshielded material;
- 173.403
SCO-I
SCO-II (d) A surface contaminated object is classified as SCO-I or SCO-II according to the fixed and non-fixed surface contamination limits specified in the table below. Contamination limits are averaged over a 300 cm² area (or the area of the surface if less than 300 cm²).

SCO Contamination Limits				
Category of SCO	Type of emitters	Type of contamination		
		Non-fixed on accessible surface	Fixed on accessible surface	Sum of fixed and non-fixed on the inaccessible surface
SCO-I	Beta/gamma emitters and low toxicity alpha emitters	4 Bq/cm ² (10 ⁻⁴ μ Ci/cm ²)	4 x 10 ⁴ Bq/cm ² (1 μ Ci/cm ²)	4 x 10 ⁴ Bq/cm ² (1 μ Ci/cm ²)
	All other alpha emitters	0.4 Bq/cm ² (10 ⁻⁵ μ Ci/cm ²)	4 x 10 ³ Bq/cm ² (0.1 μ Ci/cm ²)	4 x 10 ³ Bq/cm ² (0.1 μ Ci/cm ²)
SCO-II	Beta/gamma emitters and low toxicity alpha emitters	400 Bq/cm ² (10 ⁻² μ Ci/cm ²)	8 x 10 ⁵ Bq/cm ² (20 μ Ci/cm ²)	8 x 10 ⁵ Bq/cm ² (20 μ Ci/cm ²)
	All other alpha emitters	40 Bq/cm ² (10 ⁻³ μ Ci/cm ²)	8 x 10 ⁴ Bq/cm ² (2 μ Ci/cm ²)	8 x 10 ⁴ Bq/cm ² (2 μ Ci/cm ²)

2. PACKAGING/PACKAGE

(a) SCO material must be packaged as follows:

- 173.427(b)(1)
173.427(a)(6)(vii)
- (1) For SCO-I, in an industrial package type IP-1.
For SCO-II, in an industrial package type IP-2.
These packages must be used for exclusive use air transport.
- 173.427(b)(5)
- (2) Any Type B, Type B(U), or Type B(M) package authorized. NRC certified packages are also subject to the conditions in the certificate.
- 174.427(b)(2)
173.412(a)
173.412(b)
173.412(c)
- (3) For domestic use only, in a DOT Specification 7A Type A package. However, certain Type A package requirements do not have to be met. These include: the security seal, the minimum 10 cm dimension, and the containment and shielding integrity temperature range requirements.
- 173.427(b)(3)
- (4) In a strong, tight package that prevents leakage of the radioactive contents under normal conditions of transport, if it is an exclusive use, domestic transport and the material in each package does not exceed an A₂ quantity.
- 173.427(c)(1)
173 Subpart B
- (5) SCO-I only may be shipped as an exclusive use shipment in strong, tight bulk packagings. However, the general design requirements do not apply.
- 173.427(b)(4)
71.10(b)(2)
71.52
- (6) For SCO-II only, if the Class 7 material is greater than an A₂ quantity or the external dose rate exceeds 10 mSv/h from the unshielded material then an NRC approved package must be used. Up to April 1, 1999 this can be essentially an NRC certified Type A package (see Appendix A) with additional tie down requirements. After April 1, 1999, an appropriate Type B package will be required. NRC certified packages are also subject to the conditions in the certificate.

3. MAXIMUM RADIATION LEVELS

173.427(a)(5) See Common Provision B.3.

4. CONTAMINATION

173.427(a)(4) See Common Provision B.4.

5. DECONTAMINATION

- (a) See Common Provision B.5.
- 176.715
- (b) For transport by water vessel — Each hold, compartment, or deck area used for the transportation of low specific activity or surface contaminated object Class 7 materials under exclusive use conditions must be surveyed with appropriate radiation detection instruments after each use. Such holds, compartments, and deck areas may not be used again until the radiation dose rate at every accessible surface is less than 0.005 mSv/h (0.5 mrem/h), and the non-fixed (removable) radioactive surface contamination is not greater than the limits in Common Provision B.4(a).

6. MIXED CONTENTS

See Common Provision B.6.

7. LOADING AND SEGREGATION

- (a) See Common Provisions B.7.
- 177.842(c)
174.700 (b) For transport by highway or railroad, the SCO material must be loaded so as to avoid spillage and scattering of loose materials.
- 173.427(a)(6) (c) For exclusive use shipments:
- (1) They must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded.
 - (2) There must be no loose Class 7 material in the conveyance, however, when the conveyance is the packaging there must be no leakage of material from the conveyance.
 - (3) Packages must be braced so as to prevent shifting of lading under normal transport conditions.
- 173.427(a)(2) (d) The activity limit for any single conveyance is 100 A₂.

8. MARKING AND LABELING

- (a) For international shipments, See Common Provision B.8.
- 173.427(a)(6)(vi)
) (b) **For domestic, exclusive use transportation only**— Packages are excepted from the specification marking and labeling requirements. However, the exterior of each nonbulk package must be stenciled or otherwise marked RADIOACTIVE-SCO and nonbulk packages that contain a hazardous substance must also be stenciled or otherwise marked with the letters RQ in association with the above marking.

9. PLACARDING

- (a) See Common Provision B.9.
- 173.427(a)(6)(v)
172.504
Table 1
footnote 1 (b) The RADIOACTIVE placard is also required for exclusive use shipments of surface contaminated objects.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision B.10.
- 172.203(d)(11) (b) The group notation of SCO-I or SCO-II in association with the proper shipping name.
- 173.427(a)(iv) (c) **For exclusive use shipments:** Specific instructions for the maintenance of exclusive use controls must be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information.

11. STORAGE AND DISPATCH

No specific provisions.

12. CARRIAGE

See Common Provision B.12.

13. OTHER PROVISIONS

See Common Provision B.13.

Schedule 9

RADIOACTIVE MATERIAL IN TYPE A PACKAGES

UN No.
2975, 2976, 2978, 2979, 2980, 2981, 2982, 2974 as applicable

Radioactive material in quantities representing a limited radiation risk may be carried in a Type A package which must be designed to withstand normal conditions of transport.

1. MATERIALS

- (a) See Common Provision B.1.
- 173.431(a) (b) Except for LSA material and SCO (see Schedules 5 through 8), a Type A package may not contain a quantity of Class 7 materials greater than A_1 for special form or A_2 for normal form material.
- 173.418 (c) *Pyrophoric Class 7 materials*, as referenced in the hazardous materials table (172.101), in quantities not exceeding A_2 per package, must be transported in DOT Specification 7A packagings constructed of materials that will not react with, nor be decomposed by, the contents. Contents of the package must be:
- 173.453
- (1) In solid form and must not be fissile unless fissile excepted;
 - (2) Contained in sealed and corrosion resistant receptacles with positive closures (friction or slip-fit covers or stoppers are not authorized);
 - (3) Free of water and contaminants that would increase the reactivity of the material; and
 - (4) Inerted to prevent self-ignition during transport by either—
 - (i) Mixing with large volumes of inerting materials, such as graphite, dry sand, or other suitable inerting material, or blended into a matrix of hardened concrete; or
 - (ii) Filling the innermost receptacle with an appropriate inert gas or liquid.

- 173.419 (d) *Oxidizing Class 7 materials*, as referenced in the hazardous materials table (172.101), in quantities not exceeding an A₂ per package, must be transported in DOT Specification 7A packagings. This transport may be undertaken provided that:
- (1) The contents are:
 - (i) Not fissile;
 - (ii) Packed in inside packagings of glass, metal or compatible plastic; and
 - (iii) Cushioned with a material that will not react with the contents.
 - (2) The outside packaging is made of wood, metal, or plastic.
 - (3) For shipment by air, the maximum quantity in any package may not exceed 11.3 kilograms (25 pounds).

2. PACKAGING/PACKAGE

- (a) The Class 7 (radioactive) material must be in a Type A, or better, packaging (see Appendix A).
- 173.415 (b) The following packages are authorized for shipment if they do not contain quantities exceeding A₁ or A₂, as appropriate:
- 173.415(a)
173.350 (1) *DOT Specification 7A Type A general packaging*. Each offeror of a Specification 7A package must maintain on file for at least one year after the latest shipment, and must provide to DOT on request, complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification.
- 173.415(b)
173.471 (2) *Any other Type A fissile packaging* (See Schedule 11). It must also be shipped in accordance with certain requirements. These include registration with the NRC as a party to the packaging approval, and ID marking on the packaging and shipping papers. Before export the offeror must have the Competent Authority Approval Certificate for the package design, or become a registered user of the package. This must then be copied and sent to the Competent Authority of each country into or through which the package will be transported.
- 173.415(b)
173.471 (3) *Any authorized Type B, B(U) or B(M) packaging* (See Schedule 10).

- 173.415(d) (4) *Any foreign-made Type A packaging* which meets the standards in IAEA "Safety Series No. 6" and bears the marking "Type A" and was used for the import of Class 7 materials. Such packagings may be subsequently used for domestic and export shipments of Class 7 materials provided the offeror obtains the applicable documentation of tests and engineering evaluations and maintains the documentation on file. These packagings must conform with requirements of the country of origin (as indicated by the packaging marking) and the IAEA regulations applicable to Type A packagings.
- 173.420 (c) *Uranium hexafluoride* (fissile excepted and non-fissile).
- 173.420(a) (1) In addition to any other applicable requirements, uranium hexafluoride, fissile excepted or non-fissile, must be offered for transportation as follows:
- (i) Before initial filling and during periodic inspection and test, packagings must be cleaned in accordance with American National Standard N14.1.
- 173.420(a)(2) (ii) Packagings must be designed, fabricated, inspected, tested and marked in accordance with various American National Standards, DOT specifications and ASME Codes.
- (iii) The uranium hexafluoride must be in solid form.
- (iv) The volume of solid uranium hexafluoride, except solid depleted uranium hexafluoride, at 20°C (68°F) may not exceed 61% of the certified volumetric capacity of the packaging. The volume of solid depleted uranium hexafluoride at 20°C (68°F) may not exceed 62% of the certified volumetric capacity of the packaging.
- (v) The pressure in the package at 20°C (68°F) must be less than 101.3 kPa (14.8 psia).
- 173.420(b) (2) Packagings for uranium hexafluoride must be periodically inspected, tested, marked and otherwise conform with the American National Standard N14.1-1990.
- 173.420(c) (3) Each repair to a packaging for uranium hexafluoride must be performed in accordance with American National Standard N14.1-1990.

3. MAXIMUM RADIATION LEVELS

See Common Provision B.3.

4. CONTAMINATION

See Common Provision B.4.

5. DECONTAMINATION

See Common Provision B.5.

6. MIXED CONTENTS

See Common Provision B.6.

7. LOADING AND SEGREGATION

See Common Provision B.7.

8. MARKING AND LABELING

(a) See Common Provision B.8.

178.350(b) (b) Each Specification 7A packaging must be marked on the outside "USA DOT 7A Type A" and "Radioactive Material."

172.310(b) (c) Each packaging must be marked on the outside of the package, in letters at least 13 mm (0.5 inch) high, with the words "TYPE A" as appropriate. A packaging which does not conform to Type A requirements may not be so marked.

9. PLACARDING

(a) See Common Provision B.9.

172.505 (b) In addition to the RADIOACTIVE placard, each transport vehicle, portable tank or freight container that contains 454 kg (1001 pounds) or more gross weight of fissile or low specific activity uranium hexafluoride must be placarded with a CORROSIVE placard on each side and each end.

10. TRANSPORT DOCUMENTS

See Common Provision B.10.

11. STORAGE AND DISPATCH

No Specific Provisions.

12. CARRIAGE

See Common Provision B.12.

13. OTHER PROVISIONS

See Common Provision B.13.

Schedule 10

RADIOACTIVE MATERIAL IN TYPE B PACKAGES

UN No.
2982, 2974 as applicable

Highly radioactive material may be carried in a Type B package. This is a package designed so that it is unlikely to release its radioactive contents or lose its shielding integrity in an accident.

1. MATERIALS

- (a) See Common Provision B.1.
- 173.431(b) (b) The limits on activity contained in a Type B, Type B(U), or Type B(M) package are specified in the package's approval certificate or specification.
- 173.431(b)
173.416(c)-(e) (c) Some specification packages have materials limits related to potential decomposition and/or decay heat (see below). Limits for NRC certified packages are specified in the package's approval certificate.

2. PACKAGING/PACKAGE

- 71.13
173.401 (a) For international shipments, Type B(M) packages (multilateral approval) require approval from the competent authority of the country of origin and the competent authority of each country through which it travels (excluding air overflights). In the IAEA regulations, Type B(U) packages (unilateral approval) only require approval from the competent authority of the country of origin. However, in the USA there is really no distinction between Type B(M), and Type B(U) because the regulations require revalidation of Type B(U) packages by the competent authority.
- 173.416(b)
- 71.13(a) (b) The Type B package designation is for older packages approved prior to the (U) or (M) designation, and for DOT Specification Type B packaging when transported within the USA. Multilateral approval of these packages is required for shipments outside the USA.
- 71.13(a)(2)

- 173.416 (c) Each of the following packages is authorized for shipment of quantities exceeding A_1 or A_2 , as appropriate:
- 173.416(a) (1) *Any NRC-approved Type B, Type B(U) or Type B(M) packaging.* To get an approval certificate the package must meet the requirements given in Appendix I. It must also be shipped in accordance with certain requirements. These include registration with the NRC as a party to the packaging approval, and ID marking on the packaging and shipping papers. NRC licensees must have an NRC-approved quality assurance program as well as meet all the general provisions and operating controls and procedures of 10 CFR 71. Before export the offeror must have the Competent Authority Approval Certificate for the package design, and/or become a registered user of the package. This must then be copied and sent to the Competent Authority of each country into or through which the package will be transported.
- 173.471
- 71.12

- 173.416(b) (2) *Any foreign-made Type B, B(U) or B(M) packaging* that meets the applicable requirements of the regulations of the International Atomic Energy Agency (IAEA) in its "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6" and for which the foreign competent authority certificate has been revalidated by DOT.
- 173.473(a)(1)
- 173.416(b) (i) These packagings are authorized only for export and import shipments.
- 173.473(a) (ii) The shipper must be registered with the US Competent Authority as a user of the package, and if requested by the carrier, must supply the competent authority certificates.
- (2)-(3)
- 173.473(b), (c) (iii) The ID number must be marked on the packaging and shipping papers.
- 173.473(d) (iv) The shipper must fulfil all requirements of the foreign competent authority certificate and the US Competent Authority revalidation. NRC licensees must have an NRC-approved quality assurance program as well as meet all the general provisions and operating controls and procedures of 10 CFR 71.
- 71.16
- 173.416 (3) *Any of the following DOT Specification packagings* used in accordance with the constraints detailed below: 6M; 20WC with a 2R inner container, 20WC with a Type A inner container, 21WC with a 2R inner container. These do not require a packaging approval certificate, or registration of the shipper with the NRC. However, the shipper must have a copy of the specification. NRC licensees must have an NRC-approved quality assurance program, as well as meet all the general provisions and operating controls and procedures of 10 CFR 71. Shipments of these packages outside the USA need multilateral approval.
- 71.14
- 173.416(c) (i) *DOT Specification 6M (178.354) metal packaging* may only be used for solid or gaseous materials that will not undergo pressure-generating decomposition at temperatures up to 121°C (250°F) and that do not generate more than 10 watts of radioactive decay heat.

- 173.416(d) (ii) *DOT Specification 20WC* (178.362), wooden protective jacket, with a single, snug-fitting inner *DOT Specification 2R* (178.360) may be used for contents in other than special form. For liquid contents, the inner packaging must be able to pass the normal conditions of transport tests, and meet the additional requirements for liquids (see Appendix A).
- 173.412(j)
173.412(k)
- 173.416(e) (iii) *DOT Specification 20WC* (178.362), wooden protective jacket, with a single, snug-fitting inner *DOT Specification 7A* packaging that has a metal outer wall may be used for contents in special form only. Radioactive decay heat may not exceed 100 watts.
- 173.416(f) (iv) *DOT Specification 21WC* (178.364), wooden protective overpack, with a single inner *DOT Specification 2R* (178.360) may be used for contents in special form only. Contents must be loaded within the inner packaging in such a manner as to prevent loose movement during transportation. The inner packaging must be securely positioned and centered within the overpack so that there will be no significant displacement of the inner packaging if subjected to the 9 meter (30 feet) drop test.
- 71.73(c)(1)

3. MAXIMUM RADIATION LEVELS

See Common Provision B.3.

4. CONTAMINATION

See Common Provision B.4.

5. DECONTAMINATION

See Common Provision B.5.

6. MIXED CONTENTS

See Common Provision B.6.

7. LOADING AND SEGREGATION

See Common Provision B.7.

8. MARKING AND LABELING

- (a) See Common Provision B.8.
- 172.310(c)
172 App. B (b) Each Type B, Type B(U) or Type B(M) packaging must be marked on the outside of the package with the radiation trefoil symbol.

- 172.310(b) (c) Each packaging must be marked on the outside of the package, in letters at least 13 mm (0.5 inch) high, with the words "TYPE B" as appropriate. A packaging which does not conform to Type B requirements may not be so marked.

9. PLACARDING

See Common Provision B.9.

10. TRANSPORT DOCUMENTS

See Common Provision B.10.

11. STORAGE AND DISPATCH

See Common Provision B.11.

12. CARRIAGE

- (a) See Common Provision B.12.

- 175.700(d) (b) Type B(M) packages may not be used on passenger carrying aircraft.

13. OTHER PROVISIONS

See Common Provision B.13.

Schedule 11

FISSILE RADIOACTIVE MATERIAL

UN No.
2918, 2977 as applicable

173.453 Radioactive material which is also fissile material (except those fissile materials which are fissile-excepted) must be packaged, transported and stored so as to meet the requirements for nuclear criticality safety.

1. MATERIALS

173.403 (a) Fissile material is uranium-233, uranium-235, plutonium-238, plutonium-239, *Fissile plutonium-241, or any combination of these radionuclides, except for unirradiated material natural uranium and depleted uranium, and natural uranium or depleted uranium which has been irradiated in thermal reactors.*

173.453 (b) When the quantity of fissile material is small (≤ 15 g), and when criticality is 71.53 impossible under any circumstances such as in very dilute solutions and mixtures, the material may be fissile exempt. In this case the material may be shipped according to its other properties and another Schedule will apply.

2. PACKAGING/PACKAGE

173.417(a) **Packagings for not more than an A₁ or A₂ quantity**

173.417(a)(1) (a) *DOT Specification 6L (178.352), metal packaging.*

173.417(a)(2) (b) *DOT Specification 6M (178.354), metal packaging.*

173.417(a)(3) (c) *Any authorized Type A packaging (See Schedule 9.2). The quantities of fissile material allowed in these packagings are limited by quantity per package or by the amount of moderator per package. Greater quantities are allowed for fissile controlled shipments. Details on the quantity limits are given in 10 CFR 71.18, 20, 22 and 24.*

173.417(a)(4) (d) *Any other NRC-approved Type A or Type B, Type B(U), or Type B(M) fissile material packaging (See Appendix A for requirements).*

173.417(a)(5) (e) *Any other Type A or Type B, Type B(U), or Type B(M) packaging that also meets the requirements for fissile material packaging in Section V of the International Atomic Energy Agency "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6," . The foreign competent authority certificate for such packagings must be revalidated by the U.S. Competent Authority. These packages are authorized only for export and import shipments.*

173.473

- 173.417(a)(6) (f) *A 55-gallon 1A2 steel drum*, meeting the manufacturer's requirements for performance oriented packagings (Subpart M of Part 178) at the packing group I performance level. The quantity may not exceed 350 grams of uranium-235 in any non-pyrophoric form, enriched to any degree in the uranium-235 isotope. There are several other constraints on the quantity of material, and the packaging.

Packagings for contents exceeding an A₁ or A₂ quantity

- 173.417(b)(1) (a) *DOT Specification 6L* (178.352), metal packaging. These packages may contain only uranium-235, plutonium-239, or plutonium-241, as metal, oxide, or compounds that do not decompose at temperatures up to 149°C (300°F). Radioactive decay heat output may not exceed 5 watts. Class 7 materials in normal form must be packaged in one or more tightly sealed metal or polyethylene bottles within a DOT Specification 2R (178.360) containment vessel. Authorized contents are limited according to the amount of moderation present.

- 173.417(b)(2) (b) *DOT Specification 6M* (178.354), metal packaging. These packages must contain only solid Class 7 materials that will not decompose at temperatures up to 121°C (250°F). Radioactive decay heat output may not exceed 10 watts. Class 7 materials in other than special form must be packaged in one or more tightly sealed metal cans or polyethylene bottles within a DOT Specification 2R (178.360) containment vessel.

- (i) For fissile material with a criticality Transport Index equal to 0.0, the limits on the quantities of fissile Class 7 materials are: 1.6 kilograms of uranium-235; 0.9 kilograms of plutonium (except that due to the 10-watt thermal decay heat limitation, the limit for plutonium-238 is 0.02 kilograms); and 0.5 kilograms of uranium-233. The maximum ratio of hydrogen to fissile material may not exceed three, including all of the sources of hydrogen within the DOT Specification 2R containment vessel.

- (ii) For fissile material with a criticality Transport Index greater than 0.0, the maximum quantities of fissile material and other restrictions are given in 173.417(b)(2) Table 5.

- 173.417(b)(3) (c) *Any NRC-approved Type B, Type B(U) or Type B(M) fissile packaging*. To get an approval certificate the package must meet the requirements given in Appendix I. It must also be shipped in accordance with certain requirements. These include registration with the NRC as a party to the packaging approval, and ID marking on the packaging and shipping papers. Before export the offeror must have the Competent Authority Approval Certificate for the package design, or become a registered user of the package. This must then be copied and sent to the Competent Authority of each country into or through which the package will be transported.
- 173.471

- 173.417(b)(4) (d) *Any Type B, B(U) or B(M) packaging that meets the IAEA requirements for fissile Class 7 materials and for which the foreign competent authority certificate has been revalidated by DOT. The requirements are given in Section V of the regulations of the International Atomic Energy Agency in its "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6".*
- (1) These packagings are authorized only for export and import shipments.
- 173.473 (2) Shipper must be registered with the US Competent Authority as a user of the package, and if requested by the carrier, must supply the competent authority certificates.
- (3) The ID number must be marked on the packaging and shipping papers.
- (4) The shipper must fulfil all requirements of the foreign competent authority certificate and the US Competent Authority revalidation.

Fissile Uranium Hexafluoride

- 173.420(a) (a) In addition to any other applicable requirements, fissile uranium hexafluoride must be offered for transportation as follows:
- (1) Before initial filling and during periodic inspection and test, packagings must be cleaned in accordance with American National Standard N14.1.
- (2) Packagings must be designed, fabricated, inspected, tested and marked in accordance with various American National Standards, DOT specifications and ASME Codes.
- (3) The uranium hexafluoride must be in solid form.
- (4) The volume of solid uranium hexafluoride, except solid depleted uranium hexafluoride, at 20°C (68°F) may not exceed 61% of the certified volumetric capacity of the packaging. The volume of solid depleted uranium hexafluoride at 20°C (68°F) may not exceed 62% of the certified volumetric capacity of the packaging.
- (5) The pressure in the package at 20°C (68°F) must be less than 101.3 kPa (14.8 psia).
- 173.420(b) (b) Packagings for uranium hexafluoride must be periodically inspected, tested, marked and otherwise conform with the American National Standard N14.1-1990.
- 173.420(c) (c) Each repair to a packaging for uranium hexafluoride must be performed in accordance with American National Standard N14.1-1990.

Packagings for fissile uranium hexafluoride

- 173.417(a)(7) (a) *Any DOT Specification 7A metal cylinder may be used for the transport of residual "heels" of enriched solid uranium hexafluoride without a protective overpack in not more than an A₂ quantity. The maximum quantity is a function of a variety of parameters including the cylinder dimensions, and the uranium enrichment.*
- 173.417(a)(8)
173.417(b)(5) (b) *DOT Specification 20PF-1, 20PF-2, or 20PF-3 (178.356), or Specification 21PF-1A, 21PF-1B, or 21PF-2 (178.358) phenolic-foam insulated overpack with snug fitting inner metal cylinders. However, the Specification 21PF-2 may only be used for not more than an A₂ quantity. These must meet all general requirements for hazmat packagings, the general design requirements, and the additional design requirements for Type A packagings. They must also be handled and packed in accordance with DOE Report ORO-651 or ANSI N14.1. Quantities of uranium hexafluoride allowed vary for each specification package.*

3. MAXIMUM RADIATION LEVELS

See Common Provision B.3.

4. CONTAMINATION

See Common Provision B.4.

5. DECONTAMINATION

See Common Provision B.5.

6. MIXED CONTENTS

- (a) See Common Provision B.6.

7. LOADING AND SEGREGATION

- (a) See Common Provision B.7.

Loading and Segregation: Transport Indexes

- 173.459(a) (b) *Mixing of fissile material packages with other types of Class 7 materials is authorized only if the transport index of any single package does not exceed 10 and the total transport index in any conveyance or storage location does not exceed 50.*

- 173.459(b) (c) Fissile packages may be shipped with an external radiation level greater than 0.1 mSv/hr (10 mrem/h) at 1 meter (3.3 feet), and combined with other packages of the same or different designs in a fissile material, controlled shipment, if:
- (1) Each package in the shipment has been assigned a transport index for nuclear criticality control purposes;
 - (2) The nuclear criticality control transport index does not exceed 10 for any single package;
- 173.459(b) (3) The total nuclear criticality control transport index does not exceed 100 for all packages in the shipment; and
- (4) The shipment is not transported by vessel. Vessel transportation is allowed if the entire vessel is chartered for use by a single offeror under exclusive use conditions and the entire shipment operation is approved in advance by the Associate Administrator for Hazardous Materials Safety.
- 173.459(c) (d) A fissile material, controlled shipment of packages may be combined with other packages of the same or different design when each package has been assigned a nuclear criticality control transport index, and may be combined with other fissile packages into a fissile material, controlled shipment, if:
- (1) The nuclear criticality control transport index which has been assigned in the package approval does not exceed 50 for any single package;
 - (2) The total nuclear criticality control transport index for all packages in the shipment does not exceed 100; and
 - (3) The shipment is not transported by vessel. Vessel transportation is allowed if the entire vessel is chartered for use by a single offeror under exclusive use conditions and the entire shipment operation is approved in advance by the Associate Administrator for Hazardous Materials Safety.

Loading and Segregation: Railroad

- 174.700(d) (a) Each fissile material, controlled shipment must be transported in accordance with one of the methods described in Section 12. The transport controls must be adequate to assure that no fissile material, controlled shipment is transported in the same transport vehicle with any other fissile Class 7 material shipment. In loading and storage areas, each fissile material, controlled shipment must be segregated by a distance of at least 6 meters (20 feet) from other packages required to bear one of the RADIOACTIVE labels.

Loading and Segregation: Highway

- 177.842(f)
- (a) Each fissile material, controlled shipment must be transported in accordance with one of the methods described in Section 12. The transport controls must be adequate to assure that no fissile material, controlled shipment is transported in the same transport vehicle with any other fissile Class 7 material shipment. In loading and storage areas each fissile material, controlled shipment must be segregated by a distance of at least 6 meters (20 feet) from any other package required to bear one of the RADIOACTIVE labels.
 - (b) The total transport index for packages containing fissile material may not exceed 100.

Loading and Segregation: Aircraft

- 175.703(c)
- (a) No person may carry in an aircraft a fissile material, controlled shipment, except:
 - (1) In a cargo aircraft only which has been assigned for the exclusive use of the shipper for the specific shipment of fissile Class 7 material. Instructions for the exclusive use must be developed by the shipper and carrier, and the instructions issued with the shipping papers; or
 - (2) In an aircraft in which there are no other packages required to bear a RADIOACTIVE label. Specific arrangements must be made between the shipper and carrier, with instructions to that effect issued with the shipping papers.

Loading and Segregation: Water Vessel

- 176.700(d)
- (a) Each fissile material, controlled shipment must be stowed in a separate hold, compartment, or defined deck area and be separated by a distance of at least six meters (20 feet) from all other RADIOACTIVE YELLOW-II or YELLOW-III labeled packages.
- 176.704(e)
- (b) Each group of fissile packages must be separated from other Class 7 radioactive material by a distance of at least six meters (20 feet) at all times.

8. MARKING AND LABELING

- (a) See Common Provision B.8.
- 172.403(g)(2)
- (b) For Uranium-233, Uranium-235, the weight in grams or kilograms of fissile radionuclides may be inserted in the contents portion of the RADIOACTIVE label instead of activity units. For plutonium-238, plutonium-239, and plutonium-241, the weight in grams or kilograms of fissile radionuclides may be inserted in addition to the activity units.

9. PLACARDING

See Common Provision B.9.

10. TRANSPORT DOCUMENTS

- (a) See Common Provision B.10.
- 172.203(d)(4) (b) For Uranium-233, and Uranium-235, the weight in grams or kilograms of fissile radionuclides may be inserted on the shipping papers instead of activity units. For plutonium-238, plutonium-239, and plutonium-241 the weight in grams or kilograms of fissile radionuclides may be inserted in addition to the activity units.
- 172.203(d)(7) (c) For a fissile material, controlled shipment, the additional notation must be entered on the shipping papers: "Warning-Fissile material, controlled shipment. Do not load more than * * * packages per vehicle." (Asterisks to be replaced by appropriate number.) "In loading and storage areas, keep at least 6 meters (20 feet) from other packages bearing radioactive labels"; and
- 172.203(d)(7) (e) If a fissile material, controlled shipment is to be transported by water, the supplementary notation on the shipping papers must also include the following statement: "For shipment by water, only one fissile material, controlled shipment is permitted in each hold."
- (f) For export shipments, the multilateral approval certificate for the fissile material package design is required from the competent authority of each country through or into which the package is to be transported..

11. STORAGE AND DISPATCH

No Specific Provisions.

12. CARRIAGE

- 173.457 (a) Shipments of fissile material packages that have been assigned a transport index of greater than 10 for nuclear criticality control purposes must be transported as fissile material, controlled shipments.
- 173.457(a) (b) For fissile material, controlled shipments, the offeror or carrier, as appropriate, must incorporate transportation controls which:
 - (1) Provide nuclear criticality safety;
 - (2) Protect against loading, storing, or transporting that shipment with any other fissile material; and
 - (3) Include in the shipping papers the additional descriptions required in Section 10.

- 173.457(b) (c) Fissile material, controlled shipments must be transported:
- 71.59(c) (1) In an exclusive use conveyance;
- (2) Except for shipments by aircraft, in a conveyance with an escort having the capability, equipment, authority, and instructions to provide administrative controls necessary to assure compliance with this section;
- (3) In a conveyance containing no other packages of any Class 7 material required to bear one of the RADIOACTIVE labels. Specific arrangements must be made between the offeror and the carrier, with instructions to that effect issued with the shipping papers; or
- (4) Under any other procedure approved by the Associate Administrator for Hazardous Materials Safety.

13. OTHER PROVISIONS

- (a) See Common Provision B.13.

Physical Protection

- 73.20(a) (a) Anyone who ships formula quantities (Category I) of strategic special nuclear material must establish and maintain or make arrangements for a physical protection system which will have as its objective to provide high assurance that activities involving special nuclear material are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.
- (b) The physical protection system must be designed to protect against threats of theft or diversion of strategic special nuclear material and radiological sabotage. Detailed requirements to meet these objectives can be found in 10 CFR 73.25, 73.26 and 73.27.
- 73.37 (c) Physical protection requirements also apply to those who ship irradiated reactor fuel in excess of 100 grams in net weight of irradiated fuel, which has a total external radiation level in excess of 100 rem/h at a distance of 3 feet in air.
- 73.67(e)
73.67(g) (d) Lesser physical protection requirements apply to special nuclear material of moderate strategic significance (Category II) and of low strategic significance (Category III).

73.2

(e) The following table summarizes the quantities of material in each of Category I, II, and III.

	²³⁵ U enriched <10%	²³⁵ U enriched ≥ 10%, <20%	Strategic SNM ²³⁵ U enriched ≥ 20%, ²³³ U, Pu
Category III Low Strategic Significance	≥ 10 kg	<10 kg >1 kg	> 15 g (g = g ²³⁵ U + g ²³³ U + g Pu)
Category II Moderate Strategic Significance	N/A	≥ 10 kg	> 1 kg (g = g ²³⁵ U + 2(g ²³³ U + g Pu))
Category I Formula Quantity	N/A	N/A	>5 kg (g = g ²³⁵ U + 2.5(g ²³³ U + g Pu))

Appendix C

PACKAGING/PACKAGE DESIGN AND TEST REQUIREMENTS

The purpose of this appendix is to provide a summary in one place of all of the design and test requirements for the various types of packages used in the transport of radioactive material. The requirements are of necessity rather terse and therefore the regulatory references should be read to provide the exact wording of the requirement.

Appendix C

PACKAGING/PACKAGE DESIGN AND TEST REQUIREMENTS (Continued)										
References		Requirements	49 CFR					10 CFR		
10 CFR	49 CFR		Small Quantity	Excepted	IP Type 1	IP Type 2	IP Type 3	Type A	>Type A	Type B
		<i>General requirements for hazmat packagings and packages:</i>								
		Designed etc. so that under conditions normally incident to transportation:								
	173.24(b)(1)	No identifiable release	X	X	X	X	X	X		
	173.24(b)(2)	Effectiveness of packages not reduced	X	X	X	X	X	X		
	173.24(b)(3)	No reduction in effectiveness from spontaneous pressure increase	X	X	X	X	X	X		
	173.24(e)	Packagings compatible with lading	X	X	X	X	X	X		
	173.24(f)	Closures secure, leakproof, adequate	X	X	X	X	X	X		
	173.24(g)	Venting only permitted under certain circumstances	X	X	X	X	X	X		
	173.24(h)	Ullage for liquid expansion	X	X	X	X	X	X		
	172.312	Liquids packed with closures upward	X	X	X	X	X	X		
	173.25(a)(5)	Not overpacked with Class 8, Packing Group I, or Div. 5.1 materials	X	X	X	X	X	X		
	173.24(i)	For air transport:	X	X	X	X	X	X		
	173.27(c)	Meet pressure requirements	X	X	X	X	X	X		
	173.27(d)	Closures secure	X	X	X	X	X	X		
	173.27(e)	Absorbent materials for liquids	X	X	X	X	X	X		
	173.27(g)	Valves of cylinders protected	X	X	X	X	X	X		
	173.27(h)	No tank cars or cargo tanks	X	X	X	X	X	X		
		<i>General requirements for non-bulk hazmat packagings and packages:</i>								
	173.24a(a)(1)	Closures for inner liquid packages upright	X	X	X	X	X	X		
	173.24a(a)(2)	Friction not likely to generate heat	X	X	X	X	X	X		
	173.24a(a)(3)	Secured and cushioned to prevent breakage, leakage, movement	X	X	X	X	X	X		
	173.24a(a)(4)	No nails, staples protruding inside to damage inner packagings	X	X	X	X	X	X		
	173.24a(a)(5)	Capable of withstanding vibration	X	X	X	X	X	X		

* Fissile requirements are in addition to other packaging type requirements.

PACKAGING/PACKAGE DESIGN AND TEST REQUIREMENTS (Continued)

References		Requirements	49 CFR					10 CFR			
10 CFR	49 CFR		Small Quantity	Excepted	IP Type 1	IP Type 2	IP Type 3	Type A	>Type A	Type B	Fissile *
	173.410	<i>General design requirements for Class 7 packages:</i>									
71.45(a)	173.410(a)	Easily handled and secured	X	X	X	X	X	X			
	173.410(b)	Lifting attachments able to cope with load	X	X	X	X	X	X			
	173.410(c)	Surface free from protruding features and easily decontaminated	X	X	X	X	X	X	X	X	X
	173.410(d)	Avoidance of crevices where water can collect	X	X	X	X	X	X			
	173.410(e)	Added features will not reduce safety	X	X	X	X	X	X			
71.71(c)(5)	173.410(f)	Capable of withstanding normal vibration, acceleration	X	X	X	X	X	X			
71.43(d)	173.410(g)	Physically and chemically compatible construction materials	X	X	X	X	X	X	X	X	X
71.43(e)	173.410(h)	Any valves protected against unauthorized operation	X	X	X	X	X	X	X	X	X
	173.410(i)	For air transport:									
	173.410(i)(1)	Maximum surface temperature of 50 °C	X	X	X	X	X	X			
	173.410(i)(2)	Capable of withstanding maximum and minimum temperatures	X	X	X	X	X	X			
	173.410(i)(3)	For liquids, no leakage with pressure differential \geq 95kPa	X	X	X	X	X	X			
	173.4	<i>Small quantity exception requirements:</i>									
		Except for temperature sensing devices, each inner receptacle:									
	173.4(2)(i)	Must not be liquid-full at 55 °C	X								
	173.4(2)(ii)	Made of plastic \geq 0.2 mm, or earthenware, glass or metal	X								
	173.4(3)	Inner receptacle with a removable closure must have closure secured	X								
		Inner receptacle securely packed with cushioning/absorbent material that:									
	173.4(4)(i)	Does not react chemically with material	X								
	173.4(4)(ii)	Absorbs entire contents if liquid	X								
	173.4(5)	Inside packaging securely packed in a strong outside packaging	X								
	173.4(6)(i)	Pass drop tests from 1.8 m	X								
	173.4(6)(ii)	Pass compressive test of 3 m stack of identical packages for 24 h	X								
	178.606(c)										
	173.4(8)	Gross mass not exceed 29 kg	X								

* Fissile requirements are in addition to other packaging type requirements.

PACKAGING/PACKAGE DESIGN AND TEST REQUIREMENTS (Continued)

References		Requirements	49 CFR					10 CFR			
10 CFR	49 CFR		Small Quantity	Excepted	IP Type 1	IP Type 2	IP Type 3	Type A	>Type A	Type B	Fissile *
71.43, 71.45	173.412	<i>Additional design requirements for Type A packages/general standards:</i>									
71.43(b)	173.412(a)	Incorporate a seal to indicate if package opened					X	X	X	X	X
71.43(a)	173.412(b)	Smallest external dimension of 10 cm					X	X	X	X	X
	173.412(c)	Containment and shielding maintained over temp. range -40 °C to 70 °C					X	X			
71.43(c)	173.412(d)	Containment with positive closing device that cannot be opened unintentionally or by pressure during transport					X	X	X	X	X
	173.412(e)	Radiolytic decomposition and gas generation taken into account					X	X			
71.71(c)(3)	173.412(f)	Retain contents under pressure reduction to 25 kPa					X	X	X	X	X
71.71(c)(4)		Withstand pressure increase of 140 kPa absolute							X	X	X
71.43(e)	173.412(g)	Enclosure for valves to retain any leakage, except relief valves					X	X	X	X	X
	173.412(h)	Radiation shield enclosing a containment component will prevent escape of component from shield					X	X			
71.45(b)(1,2)		Any tie-downs must meet strength requirements							X	X	X
71.45(b)(3)	173.412(i)	Failure of tie down must not impair package meeting requirements					X	X	X	X	X
71.43(f)	173.412(j)	Pass normal conditions of transport tests:									
71.51(a)(1)											
71.71(c)(6)	173.465(b)	Water spray test - 5 cm/h for 1 h					X	X	X	X	X
71.71(c)(7)	173.465(c)(1)	Free drop test - height depends on package mass				X	X	X	X	X	X
71.71(c)(8)	173.465(2-4)	Additional corner drop test				If	fibre	board	/wood	(mass)	X
71.71(c)(9)	173.465(d)	Stacking test/compression test				X	X	X	X	X	X
71.71(c)(10)	173.465(e)	Penetration test from 1 m					X	X	X	X	X
71.71(c)(1)		Ambient temperature of 38 °C							X	X	X
71.71(c)(2)		Ambient temperature of -40 °C							X	X	X
	173.412(k)	For liquids:									
	173.412(k)(1)	Allow for ullage						X			
	173.412(k)(3)	Have absorbent material for 2 times the liquid volume						X			
	173.412(k)(3)	or Have primary inner & sec. outer container to assure liquid retention						X			
	173.412(l)	For liquids and gases (except ≤ 40 TBq ³ H or ≤ A ₂ noble gases)									
	173.466(a)(1)	Pass free drop test from 9 m						X			
	173.466(a)(2)	Pass penetration test from 1.7 m						X			

* Fissile requirements are in addition to other packaging type requirements.

PACKAGING/PACKAGE DESIGN AND TEST REQUIREMENTS (Continued)

References		Requirements	49 CFR					10 CFR			
10 CFR	49 CFR		Small Quantity	Excepted	IP Type 1	IP Type 2	IP Type 3	Type A	>Type A	Type B	Fissile *
71.43(g)	173.442(a) 173.442(b)	Heat generated by contents will not affect package integrity	X	X	X	X	X	X	X	X	X
	173.442(b)(1)	Maximum package surface temperature in still air at 38 °C	X	X	X	X	X	X	X	X	X
	173.442(b)(2)	50 °C for non-exclusive use shipment	X	X	X	X	X	X	X	X	X
71.43(h)	173.442(b)(2)	85 °C for exclusive use shipment	X	X	X	X	X	X	X	X	X
		May not incorporate a feature to allow continuous venting during transport									
71.51		<i>Additional requirements for Type B packages:</i>									
71.51(a)(2)		Pass accident conditions of transport tests (w/o filters or cooling systems)									
71.73(c)(1)		Free drop test - 9 m								X	X
71.73(c)(2)		Crush test for light/low density/ ≥1000 A ₂ packages only								X	X
71.73(c)(3)		Puncture test - 1 m onto 15 cm diameter bar								X	X
71.73(c)(4)		Thermal test - 800 °C for 30 minutes								X	X
71.73(c)(5)		Immersion - for some fissile packages 0.9 m								X	X
71.73(c)(6)		Immersion - 15 m, 150 kPa (separate specimen)								X	X
71.55		<i>General requirements for fissile packages:</i>									
71.55(b),(c)		Remain subcritical under a variety of circumstances including:									
		Water inleakage, liquid contents leaking out (or be excepted to this)									X
71.55(d)		Normal conditions of transport tests									X
71.55(e)		Accident conditions of transport tests									X
71.59(a)		Value of N derived, and a TI for criticality control assigned									X
		<i>Special requirement for irradiated nuclear fuel shipments:</i>									
71.61		Containment system withstand 2 MPa for ≥ 1 h w/o buckling or inleakage								>37 PBq	>37 PBq

* Fissile requirements are in addition to other packaging type requirements.

PACKAGING/PACKAGE DESIGN AND TEST REQUIREMENTS (Continued)

References		Requirements	49 CFR				10 CFR				
10 CFR	49 CFR		Small Quantity	Excepted	IP Type 1	IP Type 2	IP Type 3	Type A	>Type A	Type B	Fissile *
71.63		<p><i>Special requirements for plutonium:</i></p> <p>If >0.74 TBq per package: Must be shipped as solid Separate inner container to restrict loss of Pu under test conditions (Except solid fuel, metal or metal alloy)</p> <p>If by air in NRC Certified Package: Pass accident condition tests for air transport of Pu Impact test \geq 129 m/s Compression load test - 31,800 kg Conical puncture test - 227 kg, 3 m drop 45° steel angle puncture test Jet fuel fire test - 60 minutes Immersion test - 0.9 m Individual free fall impact test - terminal velocity Individual deep immersion test - 4 MPa</p>									
71.63(a)											
71.63(b)											
71.88(a)(4)											
71.64(a)(1)											
71.74(a)(1)											
71.74(a)(2)											
71.74(a)(3)											
71.74(a)(4)											
71.74(a)(5)											
71.74(a)(6)											
71.74(b)											
71.74(c)											

* Fissile requirements are in addition to other packaging type requirements.

Appendix D

SEPARATION DISTANCES FOR MODES OTHER THAN HIGHWAY

Separation Distances: Aircraft

- 175.701(a) (a) No person may carry in a passenger-carrying aircraft any package required to be labeled RADIOACTIVE YELLOW-II, or RADIOACTIVE YELLOW-III unless the package is placed in the aircraft in accordance with the minimum separation distances prescribed in paragraph (b) or (c) below.
- (b) Separation distances:
- 173.701(b) (1) Except as provided in paragraph (c) of this section, the minimum separation distances prescribed in paragraphs (b)(2) and (b)(3) of this section are determined by measuring the shortest distance between the surfaces of the Class 7 materials package and the surfaces bounding the space occupied by passengers or animals. If more than one package of Class 7 materials is placed in a passenger-carrying aircraft, the minimum separation distance for these packages must be determined in accordance with paragraphs (b)(2) and (b)(3) of this section on the basis of the sum of the transport index numbers of the individual packages or overpacks.
- 173.701(b) (2) The table below prescribes minimum separation distances that must be maintained in passenger-carrying aircraft between Class 7 materials labeled RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III and passengers and crew.
- (3) Class 7 materials in packages, overpacks or freight containers labeled RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III must be separated from live animals by a distance of at least 0.5 meters (20 in) for journeys not exceeding 24 hours, and by a distance of at least 1.0 meters (39 in) for journeys longer than 24 hours.

Transport index or sum of transport indexes of all packages in the aircraft or predesignated area	Minimum separation distances	
	Centimeters	Inches
0.1 to 1.0	30	12
1.1 to 2.0	50	20
2.1 to 3.0	70	28
3.1 to 4.0	85	34
4.1 to 5.0	100	40
5.1 to 6.0	115	46
6.1 to 7.0	130	52
7.1 to 8.0	145	57
8.1 to 9.0	155	61
9.1 to 10.0	165	65
10.1 to 11.0	175	69
11.1 to 12.0	185	73
12.1 to 13.0	195	77
13.1 to 14.0	205	81
14.1 to 15.0	215	85
15.1 to 16.0	225	89
16.1 to 17.0	235	93
17.1 to 18.0	245	97
18.1 to 20.0	260	102
20.1 to 25.0	290	114
25.1 to 30.0	320	126
30.1 to 35.0	350	138
35.1 to 40.0	375	178
40.1 to 45.0	400	157
45.1 to 50.0	425	167

173.701(c)

(c) Predesignated areas. A package required to be labeled RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III may be carried in a passenger-carrying aircraft in accordance with a system of predesignated areas established by the aircraft operator. Each aircraft operator that elects to use a system of predesignated areas must submit a detailed description of the proposed system to the Associate Administrator for Hazardous Materials Safety for approval prior to implementation of the system. A proposed system of predesignated areas is approved if the Associate Administrator for Hazardous Materials Safety determines that it is designed to assure that:

- (1) The packages can be placed in each predesignated area in accordance with the minimum separation distances prescribed in paragraph (b)(2) of this section; and
- (2) The predesignated areas are separated from each other by a minimum distance equal to at least four times the distances required by paragraphs (b)(1) and (b)(2) of this section for the predesignated area containing packages with the largest sum of transport indexes.

Separation Distances: Railroad

174.700(c)

- (a) Each package of Class 7 material bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels may not be placed closer than 0.9 meter (3 feet) to an area (or dividing partition between areas) which may be continuously occupied by any passenger, rail employee, or shipment of one or more animals, nor closer than 4.5 meters (15 feet) to any package containing undeveloped film (if so marked). If more than one package of Class 7 materials is present, the distance must be computed from the table below on the basis of the total transport index number (determined by adding together the transport index numbers on the labels of the individual packages) of packages in the rail car or storage area.

Total transport index	Minimum separation distance to nearest undeveloped film		Minimum distance to area of persons or minimum distance from dividing partition of a combination car	
	Meters	Feet	Meters	Feet
None	0	0	0	0
0.1 to 10.0	4.5	15	0.9	3
10.1 to 20.0	6.7	22	1.2	4
20.1 to 30.0	7.7	29	1.5	5
30.1 to 40.0	10.0	33	1.8	6
40.1 to 50.0	10.9	36	2.1	7

Note: The distance in this table must be measured from the nearest point on the nearest packages of Class 7 materials.

Separation Distances: Water vessel

176.708(a)

- (a) The table below provides the segregation distances which apply to the stowage of packages of Class 7 materials on board a vessel.

176.708(b)

- (b) RADIOACTIVE YELLOW-II or YELLOW-III labeled packages may not be stowed any closer to living accommodations, regularly occupied working spaces, spaces that may be continually occupied by any person (except those spaces exclusively reserved for couriers specifically authorized to accompany such packages), or undeveloped film than the distances specified in the table below.

Sum of transport indexes of the packages	Minimum distance in feet from living quarters or regularly occupied working space		Minimum distance in feet from undeveloped film and plates																																			
			1 day voyage			2 day voyage			4 day voyage			10 day voyage			20 day voyage			30 day voyage			40 day voyage			50 day voyage														
			Cargo thickness in feet (unit density)																																			
	Nil	3	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6
0.1 to 0.5	5	X	6	X	X	8	X	X	11	X	X	17	4	X	25	6	X	30	7	X	35	8	X	42	10	X	50	12	X	70	17	X	78	19	X	84	21	X
0.1 to 0.5	6	X	8	X	X	11	X	X	16	4	X	25	6	X	35	8	X	42	10	X	50	12	X	61	14	X	70	17	X	78	19	X	84	21	X	90	22	X
1.1 to 2	9	X	11	X	X	16	4	X	22	5	X	35	8	X	50	12	X	61	14	X	74	18	X	86	20	X	100	24	X	105	25	X	120	30	X	126	33	X
2.1 to 3	10	X	14	X	X	19	5	X	27	6	X	42	10	X	61	14	X	74	18	X	86	20	X	100	24	X	115	28	X	120	30	X	135	33	X	141	36	X
3.1 to 5	13	X	17	4	X	25	6	X	35	8	X	55	13	X	78	19	X	96	23	X	110	26	X	135	33	X	155	37	X	165	40	X	180	45	X	198	51	X
5.1 to 10	19	X	25	6	X	35	8	X	50	12	X	78	19	X	110	26	X	135	33	X	165	40	X	210	51	X	240	60	X	255	65	X	280	75	X	315	90	X
10.1 to 20	26	6	35	8	X	50	12	X	69	17	X	110	26	X	155	37	9	190	46	11	220	53	13	250	63	15	270	68	16	285	73	17	300	79	19	330	94	22
20.1 to 30	32	8	43	10	X	61	14	X	85	20	X	135	32	8	190	45	11	235	56	13	270	65	16	305	72	17	325	81	18	345	87	20	380	95	23	420	108	26
30.1 to 50	42	10	55	13	X	78	19	X	110	26	X	175	42	10	245	58	14	300	73	17	350	84	20	390	94	22	450	108	24	480	118	28	510	130	30	550	144	33
50.1 to 100 ...	59	14	78	19	X	110	26	X	155	37	9	245	59	14	350	82	20	430	105	24	515	118	28	550	130	32	600	150	35	630	165	37	660	180	42	690	210	45
100.1 to 150 .	72	17	96	23	X	135	32	8	190	46	11	300	72	17	425	100	24	525	125	30	600	145	35	(?)	165	39	(?)	205	49	(?)	235	57	(?)	265	63	(?)	295	71
150.1 to 200 .	84	20	110	26	9	155	37	9	200	53	13	350	84	20	490	115	28	600	140	35	(?)	165	40	(?)	190	45	(?)	225	54	(?)	255	62	(?)	285	70	(?)	315	78
200.1 to 300 .	105	24	135	32	X	190	46	11	270	64	15	425	105	25	600	145	35	(?)	180	42	(?)	205	49	(?)	230	55	(?)	260	65	(?)	290	73	(?)	320	81	(?)	350	89
300.1 to 400 .	120	28	160	37	9	220	53	13	310	75	18	500	120	28	(?)	165	40	(?)	205	49	(?)	235	57	(?)	265	63	(?)	300	75	(?)	330	82	(?)	360	90	(?)	390	99

NOTE:

- (1) X— indicates that thickness of screening cargo is sufficient without any additional segregation distance.
- (2) By using 6 feet of intervening unit density cargo for persons and 10 feet for film and plates, no distance shielding is necessary for any length of voyage specified.
- (3) Using 1 steel bulkhead or steel deck — multiply segregation distance by 0.8. Using 2 steel bulkheads or steel decks — multiply segregation distance by 0.64.
- (4) " Cargo of Unit Density" means cargo stowed at a density of 1 ton (long) per 36 cubic feet; where the density is less than this the depth of cargo specified must be increased in proportion.
- (5) " Minimum distance" means the least in any direction whether vertical or horizontal from the outer surface of the nearest package.
- (6) The total consignment on board at any time must not exceed transport indexes totaling 200 except if carried under the provisions of §176.704(f). The figures below the double line of the table should be used in such a contingency.
- (7) Not to be carried unless screening by other cargo and bulkheads can be arranged in accordance with the other columns.

176.708(c) (c) Where only one consignment of a Class 7 material is to be loaded on board a vessel under exclusive use conditions, the appropriate segregation distance may be established by demonstrating that the direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 0.0075 mSv/h (0.75 mrem/h).

176.708(d) (d) More than one consignment may be loaded on board a vessel with the appropriate segregation distance established by demonstrating that direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 0.0075 mSv/h (0.75 mrem/h), provided that:

- (1) The vessel has been chartered for the exclusive use of a competent person specialized in the carriage of Class 7 material; and
 - (2) Stowage arrangements have been predetermined for the entire voyage, including any Class 7 material to be loaded at ports of call en route.
- 176.708(e) (e) The radiation level must be measured by a responsible person skilled in the use of monitoring instruments.