Transportation of Radioactive Material

Roy A. Parker, Ph.D.
Radiation Physics Consultant

Professional Symposium
American Association of Physicists in Medicine

Annual Meeting
August 6, 2013
Indianapolis, Indiana

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ABSTRACT

American Association of Physicist in Medicine
Professional Symposium

Department of Transportation Hazmat Employee Training for Shippers of Radioactive Materials
(Part I and Part II are sequential sessions)

Medical Physicists are frequently involved in shipping radioactive materials or supervising those who do. Current U.S. Department of Transportation Hazardous Material Regulations, 49 CFR Parts 171 - 185, require hazmat employees to have documented training specified in 49 CFR 172 Subpart H. A hazmat employee is defined as an individual who: (1) loads, unloads or handles hazardous material; (2) manufactures, tests, reconditions, repairs, modifies, marks or otherwise represents containers, drums or packagings as qualified for use in the transportation of hazardous materials; (3) prepares hazardous materials for transportation; (4) is responsible for safety of transporting hazardous materials; or (5) operates a vehicle used to transport hazardous materials. Recurrent training is required at least once every three years. (The IATA two year training interval is not applicable and is generally misunderstood.) FAA has escalated inspection and enforcement. Facilities who ship radiopharmaceuticals to other laboratories, return radiopharmaceuticals or radioactive sources to suppliers, or otherwise ship radioactive materials have been cited for failure to provide and document the required training. The interrelationship of transportation regulations, 49 CFR, IATA, ICAO and other transportation regulations, which are frequently misunderstood, will be explained.

The course will cover typical shipments by air and highway which are encountered in a medical institution. Items such as fissile materials, highway route controlled quantities, rail shipments, vessel shipments and such will be omitted; although specific questions may be addressed. A major objective of the course is to present the process of shipping radioactive material in a sequential and logical fashion. How radioactive materials for transportation purposes are defined by activity concentrations for exempt materials and activity limits for exempt consignments will be explained. Radioactive material shipments of excepted packages and Type A packages will be emphasized.

The program is designed to meet the function specific DOT training requirements for shippers of medical radioactive materials. General awareness training and security awareness training can be obtained from two free DOT training CDs. Safety training and security awareness training is generally satisfied by the training required under the institution's radioactive material license. For shippers of radioactive Yellow III labeled packages an in-depth written security plan and training are no longer required as of April 8, 2010. In general almost all shippers of medical radioactive material are now not required to have an in-depth security plan. Contents of general awareness training, security awareness training and in-depth security plans will be briefly outlined. It is the hazmat employer's responsibility to ensure that each hazmat employee is properly trained. No third party can fulfill that requirement. It is the hazmat employer's responsibility to determine the degree to which this course meets the employer's requirements, including contents of the course and the examination. Participants will gain sufficient knowledge to prepare hazmat training programs for others in their institutions. A handout will be posted which should be printed out and brought to the course for reference during the presentation. The handout will also satisfy part of the training documentation required by DOT. A feature handout section is a composite table which provides A_1, A_2, RQ, Exempt Concentration, and Exempt Consignment values in a single table in both Becquerel and Curie units. Course attendance will be certified through the AAPM CEU documentation system.

Educational Objectives:

1. Understand the regulatory requirements for shipping radioactive materials.
2. Understand the regulatory requirements for training of hazmat employees.
3. Comprehend how to classify, package, mark, label, document, placard, and transport radioactive materials.

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Section 1
Powerpoint Presentation
with provision for notes.

Hazmat Employee Training for Shippers of Radioactive Materials

AAPM Annual Meeting
Tuesday, August 6, 2013
Indianapolis, Indiana
Roy A. Parker, Ph.D.
Radiation Physics Consultant

Why Are We Here?

- Expectations of class
- Purpose of training
  - Understand shipping process
  - Meet regulatory requirements
  - Minimize liability Fines – New Jan 1, 2010
    - $55,000 except $110.000 death; serious illness, or injury; substantial property destruction
    - $495 minimum for training violations

Handout

- Abstract
- Section 1 – PowerPoint Presentation
- Section 2 – Use of International Standards and Regulations
- Section 3 – Tables
  - Type A1 and A2 Quantities – Exempt Concentration and Exempt Consignment Values – Reportable Quantities
  - IAEA Category 1 and Category 2 – Radionuclides and Activities

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBq
	Ci	Ci	Ci/g	Ci	Ci
Ac-225 (a)	8.0E-01	6.0E-03	1.0E+01	1.0E+04	0.037
	2.2E+01	1.6E-01	2.7E-10	2.7E-07	1
Ac-227 (a)	9.0E-01	9.0E-05	1.0E-01	1.0E+03	0.000037
	2.4E+01	2.4E-03	2.7E-12	2.7E-08	0.001
Ac-228	6.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.6E+01	1.4E+01	2.7E-10	2.7E-05	10
Ag-105	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Ag-108m (a) (bb)	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Ag-110m (a)	4.0E-01	4.0E-01	1.0E+01	1.0E+06	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-05	10
Ag-111	2.0E+00	6.0E-01	1.0E+03	1.0E+06	0.37
	5.4E+01	1.6E+01	2.7E-08	2.7E-05	10
Al-26	1.0E-01	1.0E-01	1.0E+01	1.0E+05	0.37
	2.7E+00	2.7E+00	2.7E-10	2.7E-06	10
Am-241	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Am-242m (a) (bb)	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Am-243 (a) (bb)	5.0E+00	1.0E-03	1.0E+00	1.0E+03	0.00037
	1.4E+02	2.7E-02	2.7E-11	2.7E-08	0.01
Ar-37	4.0E+01	4.0E+01	1.0E+06	1.0E+08	
	1.1E+03	1.1E+03	2.7E-05	2.7E-03	

Handout

- Section 4 – Radioactive Material UN Numbers and Proper Shipping Names
- Section 5 – Excepted Packages
- Section 6 – Type A Packaging Requirements
- Section 7 – Shipping Papers and Shipper's Dangerous Goods Declaration
- Section 8 - Examination

Overview

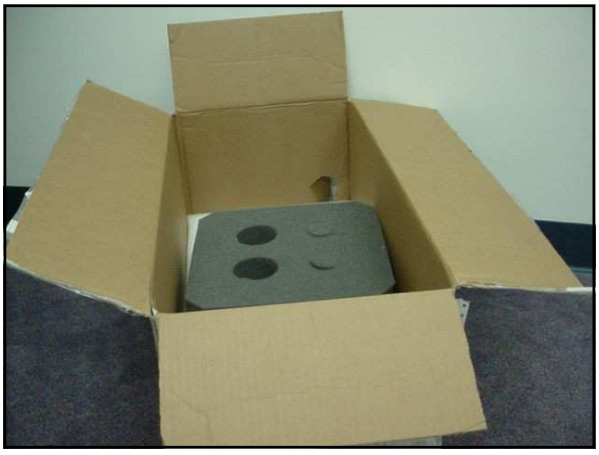
- Legalities: Use of International Standards and Regulations
- General Awareness
  - Hazard classes and divisions
- Definition of radioactive material in transportation
  - Exempt concentration
  - Exempt consignment

Overview - Classification

- Form: Special - Normal
- Quantities:
  - Limited Quantity (Excepted Packages)
  - Type A – Type B – Type C
  - Highway route controlled quantity
  - Reportable quantity (Hazardous substance)
- Proper shipping name and UN number

Overview - Packaging

- Excepted Package
- Industrial Package
- Type A Package
- Type B Package
- Type C Package
- Surface Contamination



Overview

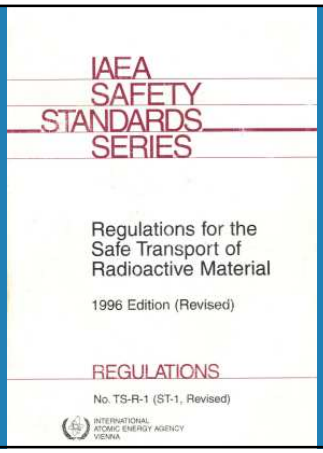
- Marking
- Labeling
- Shipping Paper
  - Shipper's Dangerous Goods Declaration
- Placarding
- Carriage

Overview

- Safety Training
  - Emergency response information
  - Emergency telephone number
  - Exposure to hazardous materials
  - Avoiding accidents handling packages
- Security
- Hazmat Training
  - Three Years
  - Employer Certification
- Examination

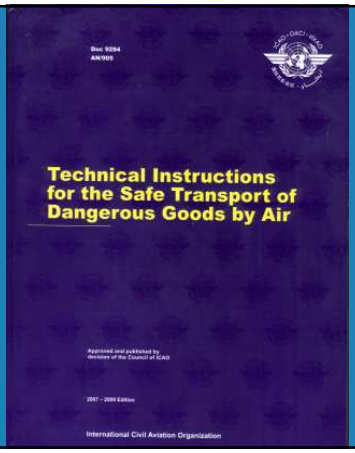
Transportation Regulations

- U.S. Department of Transportation
  - Hazardous Material Regulations 49 CFR 171-185
    - http://phmsa.dot.gov
    - http://hazmat.dot.gov More Direct
- IAEA International Atomic Agency
  - Safety Standards Series
  - Regulations for the Safe Transport of Radioactive Material
  - 1996 Edition Revised No. TS-R-1 (ST-1 Revised)



International Air Regulations

- ICAO International Civil Aviation Organization
  - Technical Instructions for the Safe Transport of Dangerous Goods by Air
  - 49 CFR 171.12, 171.22-171.26 provides for alternate means of classification, marking, labeling, and documentation in 49 CFR Parts 172 and 173



49 CFR Bridge to ICAO/IATA and IAEA

- HM-215F Published May 3, 2007
- Effective October 1, 2007
- Deletes 171.11
- New sections: 171.22, 171.23, 171.24 171.25, 171.26
- Problems! Stay tuned.

49 CFR Bridge to ICAO/IATA and IAEA

- Applicable to air and motor vehicle before or after air transport
- Hazardous substance RQ
- Highway transport complies with 49 CFR
- Placarding required
- ICAO/IATA on shipping paper not mandatory (not recommended)

49 CFR Bridge to ICAO/IATA and IAEA

- Highway Route Controlled Quantity
- Type B Package Competent Authority Certification and Revalidation
  - US, Canada, Japan and Denmark require revalidation for all Type B packages
- 49 CFR applies to radioactive material packages on passenger carrying aircraft
  - Medical or research
  - Transport Index does not exceed 3.0

49 CFR Bridge to ICAO/IATA and IAEA

- Excepted packages must adhere to 49 CFR
- A_1 and A_2 activity values must adhere to 49 CFR
- Definition of radioactive material must adhere to 49 CFR

International Air Regulations

- IATA International Air Transport Association
  - Dangerous Goods Regulations
    - It is not a regulation, but a policy
  - Used exclusively by airlines
  - Upward compatible with ICAO

IATA Dangerous Goods Regulations - Misconceptions

- IATA 1.5.0.3 Two year training meaningless
  - 49 CFR 172.704(c)(2) Three year training applies
- Type A Package - Must be marked USA DOT 7A Type A (49 CFR 178.350)
- Type A Package Documentation must be maintained for one year after last shipment (49 CFR 173.415)

In Commerce Interpretation

- Can be applicable to Colleges, Universities and State Institutions
- Careful
  - Is material going to be used for a fee charged service?
  - Do state regulations, e.g. State Police, radiation control agency apply?
- Radioactive material packages tendered to FedEx Express and other carriers are "in commerce."

U.S. Department of Transportation
Research and Special Programs Administration

NOV 19 2004

Mr. David Wilk
Director, Radiation Safety Department
University of South Alabama
257 USAH
Mobile, AL 36688-0002

Reference No.: 04-0256

Dear Mr. Wilk:

This responds to your letter requesting clarification on the applicability of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) to state agencies who offer for transportation or transport hazardous materials.

Your understanding of the HMR is correct. Hazardous materials transported for noncommercial purposes by a state agency, including state-chartered and funded universities, are not subject to the HMR. Thus, transportation of a hazardous material in state-owned or state-leased vehicles operated by state employees is not subject to the HMR. However, transportation conducted by a private entity under contract to a state agency is subject to all applicable HMR requirements. Similarly, hazardous materials offered for transportation by a state agency to a commercial carrier are subject to all applicable HMR requirements.

I trust this satisfies your inquiry.

Sincerely,

Hattie L. Mitchell
Chief, Regulatory Review and Reinvention
Office of Hazardous Materials

171.1

DOT Interpretation 04-0256

Your understanding of the HMR is correct. Hazardous materials transported for noncommercial purposes by a state agency, including state-chartered and funded universities, are not subject to the HMR. Thus, transportation of a hazardous material in state-owned or state-leased vehicles operated by state employees is not subject to the HMR. However, transportation conducted by a private entity under contract to a state agency is subject to all applicable HMR requirements. Similarly, hazardous materials offered for transportation by a state agency to a commercial carrier are subject to all applicable HMR requirements.

General Awareness Hazard Classifications

- Class 1 – Explosives
  - Division 1.1 Mass explosive hazard
  - Division 1.2 Projection hazard
  - Division 1.3 Fire, minor blast, minor projection
  - Division 1.4 No significant hazard
  - Division 1.5 Very insensitive mass explosion
  - Division 1.6 Extremely insensitive mass explosion

General Awareness Hazard Classifications

- Class 2 – Gases
  - Division 2.1 Flammable gas
  - Division 2.2 Non-flammable, non-toxic gas
  - Division 2.3 Toxi gas
- Class 3 – Flammable Liquids

General Awareness Hazard Classifications

- Class 4 – Flammable Solids; Spontaneous Combustion; Flammable when wet
  - Division 4.1 Flammable solids, self-reactive substances and solid desensitized explosives
  - Division 4.2 Spontaneous combustion
  - Division 4.3 Flammable when wet

General Awareness Hazard Classifications

- Class 5 Oxidizing Substances and Organic Peroxides
  - Division 5.1 Oxidizer
  - Division 5.2 Organic peroxides
- Class 6 Toxic and Infectious Substances
  - Division 6.1 Toxic substances
  - Division 6.2 Infectious substances

General Awareness Hazard Classifications

- Class 7 Radioactive material
- Class 8 Corrosives
- Class 9 Miscellaneous dangerous goods

General Awareness Packing Groups

- Packing Group I – High danger
- Packing Group II – Medium danger
- Packing Group III – Low danger

DOT Hazmat Training Information

- http://www.phmsa.dot.gov/hazmat/training/publications
- Hazmat General Awareness Familiarization Training CD FREE
- Hazmat Digipack 7.1 FREE
- Hazmat Transportation Training Modules 5.1 - $25
- Check catalog for other publications

Keys to Shipping Confusion

- Classify
- Package
- Mark
- Label
- Shipping Papers/Declaration
- Placarding
- Carriage

Classification

- Omitted from Presentation
  - Fissile U-233 U-235 Pu-239 Pu-241
    - Pu-238 no longer defined as fissile for transportation
  - Fissile Excepted - reverts to non-fissile classification
    - e.g. Does not exceed 15 grams
  - Low Specific Activity LSA
  - Surface Contaminated Object SCO
  - Type B and Type C Packages

Classification

- Form
- Quantity
- Proper Shipping Name & UN Number

Classification

- Form
  - Special
  - Other or Normal

Classification

- Quantity
  - Limited Quantity
  - Type A Quantity
  - Type B Quantity
  - Type C Quantity
  - Highway Route Control Quantity
  - Reportable Quantity

Classification

- Proper Shipping Name and UN Number
  - Excepted Package
  - Fissile (by packaging type)
  - Non-Fissile (by packaging type)

Definition of Radioactive Material for Transportation

- Activity Concentration for Exempt Material Bq/g (Ci/g)
  - About 67% higher than old 70 Bq/g
- Activity Limit for Exempt Consignment Bq (Ci)

Consignment Definitions

- IAEA: Consignment shall mean any package or packages, or load of radioactive material, presented by a consignor for transport.
- ICAO/IATA: Consignment is one or more packages of dangerous goods accepted by an operator from one shipper at one time and at one address, receipted for in one load and moving to one consignee at one destination address.

Consignment Definitions

- 49 CFR Consignment means a package or group of packages or load of radioactive material offered by a person for transport in the same shipment.

Definition of Radioactive Material - Example I-125

- Activity Concentration for Exempt Material
  - 2.7×10^{-8} Ci/g = 27 nCi/g
- Activity Limit for Exempt Consignment
  - 2.7×10^{-5} Ci = 27 µCi

Classification of Radioactive Material - Form

- Primary Containment
- Special Form - Performance specification
  - Design and Test Requirements
  - 30 Foot Free Drop
  - 800^0 C (1475^0 F) Ten minutes
  - Self Certification or Competent Authority
  - One year document retention after last shipment

Classification of Radioactive Material - Form

- Other or Normal Form (everything not special form)
- Normal form - historical term still in wide use

Classification of Radioactive Material - Quantity

- Type A and Type B are not nouns - they are adjectives to modify quantity or package
- Type A Quantity is the maximum activity that may be shipped in a Type A package
- A_1 - Special Form
- A_2 - Normal or Other Form
- Type B Quantity is any activity above a Type A quantity

Classification of Radioactive Material - Quantity

- Limited Quantity is an activity 10^{-3} or 10^{-4} of Type A Quantity that may be shipped in an Excepted Package
- Highway Route Controlled Quantity
  - 3000 x A_1 or 3000 x A_2 or 1000 TBq (~27,000 Ci) which ever is least
- Type C Quantity is a Highway Route Controlled Quantity transported by air

Classification of Radioactive Material - Quantity

- RQ Reportable Quantity (Hazardous Substance) US only
- Strictly a table look up (either it is or it "ain't")
  - Marking Requirement
  - Shipping Paper - Declaration Requirement
  - Reporting Requirement if released to environment

Classification of Radioactive Material - Domestic Differences

- Mo-99
  - Domestic A_2 = 20 Ci
  - International A_2 = 16 Ci
- Cf-252
  - Domestic A_1 = 2.7 Ci A_2 = 0.027 Ci
  - International A_1 = 1.4Ci A_2 = 0.081 Ci

Classification of Radioactive Material – Mixtures

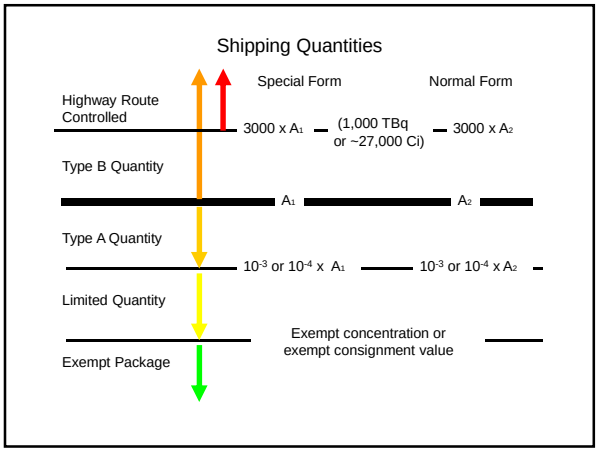
- See IATA Section 10.3.2.4
- See 49 CFR 173.433(d)

Classification of Radioactive Material – Unknown Nuclides

- See IATA Section 10.3.2.5
- See 49 CFR 173.433 Table 7 General Values for A_1 and A_2
- See 49 CFR 173.433 Table 8 General Exemption Values

Classification of Radioactive Material - Limited Quantities

Solids	Special	10^{-3} A_1
	Normal	10^{-3} A_2
Liquids	Normal	10^{-4} A_2
Gases	Tritium	0.02 A_2
	Special	10^{-3} A_1
	Normal	10^{-3} A_2



Classification of Radioactive Material – Quantity Examples

- 5 mCi I-125 Liquid:
  - A_2 = 81 Ci
  - RQ = 0.01 Ci
  - Limited Quantity Factor 10^{-4}
    - Limited Quantity
    - Not RQ

Classification of Radioactive Material – Quantity Examples

- 35,000 Ci Cs-137 Special Form: A_1 = 54 Ci RQ = 1 Ci
  - Type B Quantity - Highway Route Controlled Quantity
  - RQ Reportable Quantity
- 5 Ci Mo-99 Solid: A_2 = 16 Ci RQ = 100 Ci
  - Type A Quantity
  - Not RQ

Classification of Radioactive Material – Quantity Examples

- 200 mCi I-131 Solid: A_2 = 19 Ci RQ = 0.01 Ci (10^{-3})
  - Type A Quantity
  - RQ Reportable Quantity
- 175 Ci Ir-192 Special Form: A_1 = 27 Ci RQ = 10 Ci
  - Type B Quantity
  - RQ Reportable Quantity

Classification of Radioactive Material – Quantity Examples

- 300 mCi Tl-201 Solid: A_2 = 110 Ci RQ = 1000 Ci (10^{-3})
  - Type A Quantity
  - Not RQ
- 8 Ci Co-60 Special Form: A_1 = 11 Ci RQ = 10 Ci
  - Type A Quantity
  - Not RQ

Classification of Radioactive Material with Subrisk

- Small (49 CFR)
- Excepted Quantity (IATA)
- Subrisk Acceptable for Passenger Aircraft
- Cargo Aircraft Only Label - Criteria

Radioactive Material Proper Shipping Names and UN Numbers

1996 IAEA Regulations for the Safe Transport of Radioactive Material TS-R-1

UN	Proper Shipping Name for Excepted Packages
2910	Radioactive Material, Excepted Package - Limited Quantity of Material
2911	Radioactive Material, Excepted Package - Instruments or Articles
2909	Radioactive Material, Excepted Package - Articles Manufactured from Natural Uranium or Depleted Uranium or Natural Thorium
2908	Radioactive Material, Excepted Package - Empty Packaging

UN	Proper Shipping Name for Non-fissile or Fissile Excepted	UN	Proper Shipping Name for Fissile
2912	Radioactive Material, Low Specific Activity (LSA-I)		
3321	Radioactive Material, Low Specific Activity (LSA-II)	3324	Radioactive Material, Low Specific Activity (LSA-II), Fissile
3322	Radioactive Material, Low Specific Activity (LSA-III)	3325	Radioactive Material, Low Specific Activity (LSA-III), Fissile
2913	Radioactive Material, Surface Contaminated Objects (SCO-I or SCO-II)	3326	Radioactive Material, Surface Contaminated Objects (SCO-I or SCO-II), Fissile
2915	Radioactive Material, Type A Package	3327	Radioactive Material, Type A Package, Fissile
3332	Radioactive Material, Type A Package, Special Form	3333	Radioactive Material, Type A Package, Special Form, Fissile
2916	Radioactive Material, Type B(U) Package	3328	Radioactive Material, Type B(U) Package, Fissile
2917	Radioactive Material, Type B(M) Package	3329	Radioactive Material, Type B(M) Package, Fissile
3323	Radioactive Material, Type C Package	3330	Radioactive Material, Type C Package, Fissile
2919	Radioactive Material, Transported Under Special Arrangement	3331	Radioactive Material, Transported Under Special Arrangement, Fissile
2978	Radioactive Material, Uranium Hexafluoride (Corrosive)	2977	Radioactive Material, Uranium Hexafluoride, Fissile (Corrosive)

Package

- Excepted Package
- Industrial Package
- Type A Package
- Type B(U) Package
- Type B(M) Package
- Type C Package

Excepted Package

- General design requirements 49 CFR 173.410 and IATA 10.6.0, 10.6.1
- Old terminology "Strong, tight package"
- Maximum Surface Radiation Level 0.5 mrem/hr
- UN Number Marking

Example Excepted Package - Limited Quantity of Material

- 5 mCi I-125 Liquid A_2 = 81 Ci RQ = 0.01 Ci
- Limited Quantity 10^{-4} x A_2 = 8.1 mCi
- Package must meet general design requirements 173.410, IATA 10.6.0, 10.6.1
- Inner package marked "RADIOACTIVE"
- Maximum surface radiation must not exceed 0.5 mrem/hr
- Mark package UN2910

Example Excepted Package - Instruments or Articles

- Radioactive material an integral part of an instrument or articles which requires disassembly or destructive means to get to the radioactive material
- Maximum radiation level at 10 cm from surface of instrument or articles does not exceed 10 mrem/hr

Example Excepted Package - Instruments or Articles

		Item	Package
Solids	Special	10^{-2} A_1	A_1
	Other	10^{-2} A_2	A_2
Liquids	Other	10^{-3} A_2	10^{-1} A_2
Gases	Tritium	20 Ci	200 Ci
	Special	10^{-3} A_2	10^{-2} A_2
	Normal	10^{-3} A_2	10^{-2} A_2

Example Excepted Package - Instruments or Articles

- 100 mCi Cs-137 Special Form in a portable instrument
  - Maximum radiation level less than 10 mrem/hr at 10 cm from instrument surface
- Cs-137 A_1 = 54 Ci RQ = 1 Ci
- Instrument Excepted Package Factor 10^{-2} A_1 = 540 mCi
- Maximum items in package A_1 = 54 Ci
  - 540 Instruments max

Example Excepted Package - Instruments or Articles

- General design requirements 49 CFR 173.410 and IATA 10.6.0, 10.6.1
- Each instrument marked "RADIOACTIVE"
- Maximum surface radiation must not exceed 0.5 mrem/hr
- Mark package UN2911

Excepted Package - Reportable Quantity

- Dangerous Goods Declaration
  - UN2910 Modified Dangerous Goods Declaration
    - e.g. RQ Radioactive Material, Excepted Package - Limited Quantity of Material, UN2910, Activity in Bq units or multiple thereof.
    - Recommend full Shipper's Dangerous Good Declaration
  - UN2908, UN2909, UN2911 requires a full Shipper's Dangerous Goods Declaration

Excepted Package – Reportable Quantity

- Dangerous Goods Declaration
  - Emergency twenty-four hour telephone number
  - Shipment is acceptable for passenger carrying aircraft, but the medical or research certification is not required
  - Signed general package certification statement is required.

Excepted Package – Reportable Quantity

- RQ Marking
- Not required by regulation, but do so anyway to avoid having package bumped
- Dangerous Goods Declaration and Markings must be consistent.

Industrial Package

- For Low Specific Activity and Surface Contaminated Objects
- Industrial Package Type 1 IP-1
- Industrial Package Type 2 IP-2
- Industrial Package Type 3 IP-3

Type A Package

- To my current best knowledge
  - No Type A packages are available for purchase off the shelf that fully meet the Type A package documentation requirements
    - Except the PetNet packaging system for F-18
    - Except the Croft Type A Packages
  - No package testing company can fully provide complete Type A package documentation.

Type A Package

- Many shippers think that only the tests are required for Type A package documentation.
- Criteria
  - no loss or dispersal of radioactive contents
  - no loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

Type A Package

- Type A package documentation must address all the points in
  - 173.410 General Design Requirements
  - 173.412 Additional Design Requirements for Type A Packages
  - 173.465 Type A Packaging Tests
  - 173.466 Additional Tests for Type A Packages Designed for Liquids and Gases.

Type A Package

- www.rampac.energy.gov NEW URL
- Non-Certified Packaging – Refers to Type A packages

Type A Package

- 173.415 Maintain on file for one year after last shipment complete documentation of tests, and an engineering evaluation or comparative data showing that the construction methods, packaging design and materials of construction comply
- 178.350 Mark Package - USA DOT 7A TYPE A
- Security Seal – Means of communication

Type A Package Marking

- TYPE A
- Name of the manufacturer or other identification of the packaging specified by the competent authority
- Type A packages not manufactured in the U.S. must be marked Type A and the country of origin.

Permissible Package Surface Contamination

- Beta, Gamma, Low Toxicity Alpha
  - 49 CFR 173.443 - 0.4 Bq/cm^2 10^{-4} µCi/cm^2 220 dpm/cm^2
  - IATA 10.5.3.2(a) - 4 Bq/cm^2 10^{-3} µCi/cm^2 2200 dpm/cm^2
- All Other Alpha Emitters
  - 49 CFR 173.443 - 0.04 Bq/cm^2 10^{-5} µCi/cm^2 22 dpm/cm^2
  - IATA 10.5.2(b) - 0.4 Bq/cm^2 10^{-4} µCi/cm^2 220 dpm/cm^2
- US factor of ten lower
- Means the same thing

Permissible Package Surface Contamination

- Detection Efficiencies
  - Energy
  - Geometry
  - Removable
- US assume 10% removable efficiency
- May use higher criteria if removable efficiency established

Marking

- Do not confuse with a physical label; a marking may be on a "label"
- May be hand written
- Proper shipping name and UN number (omit class or division number)
- Package Specification - USA DOT 7A TYPE A

Marking

- Gross Weight if gross weight greater than 50 kg (110 pounds)
- Consignee's or Consignor's name and address (To/From)

Marking

- Orientation arrows (opposite sides) for liquids
  - Not required for radioactive materials

Labels

- Radioactive White I
- Radioactive Yellow II
- Radioactive Yellow III
- Cargo Aircraft Only

Transport Index

- Unit-*less*, dimension-*less*, pure number which is numerically equivalent to the maximum radiation level measured in mrem/hr at one meter from the surface of the package rounded up to the nearest tenth.
- Zero TI means the maximum radiation level at one meter from the surface of a package does not exceed 0.05 mrem/hr

Radioactive Category Labels

	Maximum Surface mrem/hr	Transport Index
White I	0.5	0
Yellow II	50	1.0
Yellow III	200	10.0

Non Exclusive Use

Radioactive Category Labels – Examples

Surface mR/hr	One Meter mR/hr	TI	Category
90	3.8	3.8	Yellow III
0.4	0.08	0.1	Yellow II
58	0.87	0.9	Yellow III
150	12.3	12.3	Yellow III
			Exclusive Use
48	1.3	1.3	Yellow III

Radioactive Category Labels – Examples

Surface mR/hr	One Meter mR/hr	TI	Category
230	9.8	9.8	Yellow III
			Exclusive Use
86	4.9	4.9	Yellow III
35	0.74	0.8	Yellow II
10	0.06	0.1	Yellow II
5	0.03	0	Yellow II

December 31, 2012 Deceased

Required January 1, 2013

Radioactive Category Labels

- Contents - Radionuclides
  - 95% of the activity/Type A ratios
  - Space permits - highest activity/Type A quantity ratios
- Activity - Becquerel Units
  - Mixtures - total activity
  - Individual nuclides in same package - individual activities
- TI for Yellow II and Yellow III labels

Labels

- Two radioactive category labels required on opposite sides of package
  - Zero TI is valid for Yellow II labeled package
- Two subsidiary labels, if required - adjacent to radioactive label
- Two Cargo Aircraft Only labels, if required - adjacent to radioactive label

Overpack

- Every inside package meets all transportation regulations
- Marking
  - Unique proper shipping names and UN numbers.
  - Gross weight of overpack if exceeds 50 kgs
  - OVERPACK (in lieu of package specification)
  - To/From

Overpack

- Labeling
  - Radioactive Category Label
    - Contents and Activity – may say "See Shipper's Declaration" if not sufficient room
    - Category based strictly on TI
    - TI either sum of TI's or direct measurement
    - Non-rigid overpack TI must be sum of TI's
  - Cargo Aircraft Only labels if applicable

Shipping Papers - 49 CFR

- RQ (if applicable)
- UN Number, Proper Shipping Name, Class
- Radionuclide, physical and chemical form, Activity Bq units
  - if Special Form omit physical and chemical form
- Transport Index and Radioactive Category Label

Shipping Papers - 49 CFR

- Type B Certificate Numbers (if applicable)
- Special Form Certificate Numbers (if applicable)
- Cargo Air Only (if applicable)
- Twenty-Four Hour Emergency Telephone Number

Shipping Papers - 49 CFR

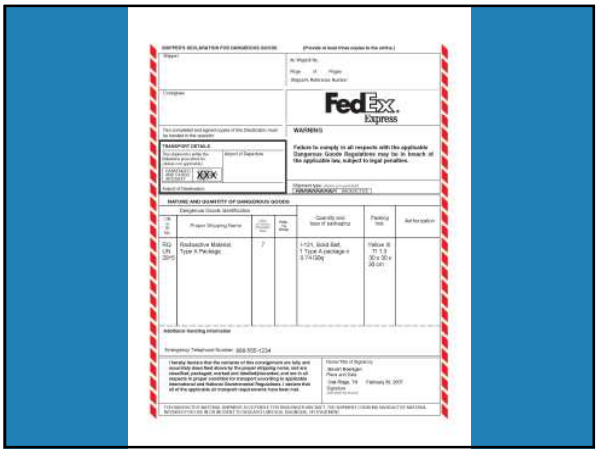
- Certification: This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation

Shipping Papers - 49 CFR

- Medical/Research Certification (if applicable): This shipment contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment. (TI must also be no greater than 3.0)

Shipping Papers - 49 CFR

- Certification for Air Shipment (if applicable): This shipment is within the limitations prescribed for passenger aircraft/cargo aircraft only (delete non-applicable)
  - I declare that all the applicable air transport requirements have been met
- Certification Signatures - printed or mechanical permitted



NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Identification				Quantity and type of packaging	Packing Inst.	Authorization
UN or ID No.	Proper Shipping Name	Class or Division (subsidiary risk)	Packing Group			
RQ UN 2915	Radioactive Material, Type A Package	7		I-131, Solid Salt, 1 Type A package x 0.74 GBq	Yellow III TI 1.3 30 x 30 x 30 cm	

NATURE AND QUANTITY OF DANGEROUS GOODS
UN Number or Identification Number, Proper Shipping name, Class or Division (subsidiary risk), Packing Group (if required), and all other required information.

RQ UN2915 Radioactive Material, Type A Package, 7

I-131, Solid Salt, 1 Type A Package x 0.74 GBq

Yellow III, TI 1.3, 30 x 30 x 30 cm

Example – Type A Package

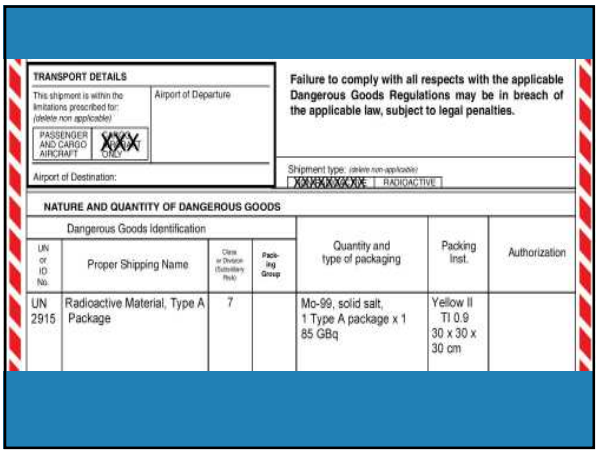
- Mo-99
- 185 GBq (5 Ci)
- Solid Salt

Example – Type A Package

- Marking
  - UN 2915 Radioactive Material, Type A Package
  - USA DOT 7A Type A
  - To
  - From

Example – Type A Package

- Labeling
  - Two Yellow II Radioactive Labels
    - Mo-99
    - 185 GBq
    - TI Block: 0.9



TRANSPORT DETAILS

This shipment is within the limitations prescribed for: (delete non applicable)

PASSENGER AND CARGO AIRCRAFT | CARGO AIRCRAFT ONLY XXX

Airport of Departure

Airport of Destination:

Failure to comply with all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

Shipment type: (delete non-applicable) XXXXXXXXX | RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification				Quantity and type of packaging	Packing Inst.	Authorization
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group			
UN 2915	Radioactive Material, Type A Package	7		Mo-99, solid salt, 1 Type A package x 1 85 GBq	Yellow II TI 0.9 30 x 30 x 30 cm	

Shipping Papers/Declarations Overpacks – Developing Issue

- 49 CFR does not explicitly prescribe shipping paper entries for overpacks, it only addresses packages.
- Package entries: radionuclide, activity, chemical or physics form, label category and transport index.
- Package could be interpreted to include overpacks.

Shipping Papers/Declarations Overpacks – Developing Issue

- IATA – Overpack Used
- IATA seems to require radionuclide, activity, chemical or physical form for individual packages, but
- Only label category for transport index for the overpack.

Shipping Papers/Declarations Overpacks – Developing Issue

- Carriers prefer the aparently permissible IATA format.
- Having label categories and transport indexes for each individual package, plus the label category and transport index for the overpack together on a shhipping paper/declaration is confusing and can lead to handling errors.

Shipping Papers/Declarations Overpacks – Developing Issue

- Regulatory citations against carriers and shippers are pending.

Placarding

- A vehicle is required to be placarded on front, rear and two sides if it is transporting one or more Radioactive Yellow III labeled packages
- A shipper is required to offer the carrier four placards when tendering a Radioactive Yellow III labeled package unless the vehicle is appropriately placarded

Carriage

- Shipping Papers
  - Accessible to driver when at controls of vehicle
  - If not in a Hazardous Material identifiable pouch on driver's door, then shipping papers must be placed on driver's seat when driver not in vehicle

Carriage

- Radioactive material must be blocked and braced in vehicle to prevent movement during normal transport.
- Maximum 50 TI in vehicle

Separation Distance

TI	Feet	TI	Feet
0.1-1.0	1	20.1-30.0	5
1.1-5.0	2	30.1-40.0	6
5.1-10.0	3	40.1-50.0	7
10.1-20.0	4		

Motor Carrier Safety Regulations 49 CFR 390-397

- Applies if vehicle required to be placarded
  - One or more Radioactive Yellow III packages
- Financial Responsibility
- Driver Qualifications
  - Two year DOT Medical
  - Commercial Driver's License with HazMat endorsement

Motor Carrier Safety Regulations 49 CFR 390-397

- Driving of Vehicle
- Hours of Service
- Inspection and Maintenance
- Hazardous Materials

Safety
Emergency Response Information

- Available away from package
- Not required to attached emergency instructions
- MSDS sheet not applicable to radioactive materials
- Emergency Response Guidebook (2012)

Safety
Emergency Response Guidebook

- Available for download at hazmat.dot.gov
- Facility Operators: Must be immediately available where hazardous material is received, stored or handled during transportation.
- Carrier: Maintain on board with shipping paper information, notice to pilot in command, or dangerous goods manifest

Twenty-Four Hour Telephone Emergency Number

- Effective October 1, 2010
- Shipper's name and Emergency Telephone Number of Shipper or Emergency Response Information (ERI) provider contracted by shipper.
- If shipper does not contract with ERI provider then name or contract number of third party who authorizes shipper to use the ERI provider under their contract.

Twenty-Four Hour Telephone Emergency Number

- Monitored at all times hazardous material is in transportation, including storage incidental to transportation
- Pagers may not be used
- Answering services may be used if forwarded immediately (risky)
- Answering services may be given appropriate information (risky)

Twenty-Four Hour Telephone Emergency Number

- Telephone number of person who is either knowledgeable of the hazardous material being shipped and has comprehensive emergency response and incident mitigation information for that material or who has immediate access to a person who posses such knowledge and information

Safety

- Exposures to hazardous materials
  - Copy or reference radiation safety training conducted under the Agreement State or NRC radioactive material license.
- Proper procedure for handling packages and avoiding accidents

Hazmat Training Security Awareness

- Key - accountability of radioactive material
- Written procedure for receipt of radioactive packages
- Written procedure for confirming receipt of radioactive packages shipped
- Free DOT Security Awareness Training CD-ROM
  - http://phmsa.dot.gov/hmt_security.htm

Hazmat Training In-Depth Training

- NEW HM-232F Issued March 1, 2010
  - Effective October 1, 2010
  - Voluntary Compliance April 8, 2010
- Old:
  - Yellow III
    Highway Route Control Quantity
- New:
  - IAEA Category II per package
  - Highway Route Control Quantity

Category 2 Radioactive Material

Radionuclide	Category 2	
	Terabequerels (TBq)	Curies (Ci)[1]
Americium-241	0.6	16
Californium-252	0.2	5.4
Curium-244	0.5	14
Cobalt-60	0.3	8.1
Cesium-137	1.0	27
Gadolinium-153	10.0	270
Iridium-192	0.8	22
Plutonium-238[2]	0.6	16
Promethium-147	400	11,000
Radium-226[a]	0.4	11
Selenium-75	2.0	54
Strontium-90 (Y-90)	10.0	270
Thulium-170	200	5,400
Ytterbium-169	3.0	81

[1] The values to be used to determine whether a license is required are given in TBq. Curie (Ci) values are provided for practical usefulness only and are rounded after conversion.

Hazmat Training In-Depth Training

- Written Security Plan
  - Personnel Security
  - Unauthorized Access
  - En-route Security
- New Site Specific
- New Annual Site Specific Assessment

Hazmat Training - 49 CFR 172 Subpart H

- Hazmat Employee
  - Loads, unload, handles
  - Tests, reconditions, repairs, modifies, marks, packaging
  - Prepares hazardous material for transportation
  - Operates a vehicle transporting hazardous materials

Hazmat Training - 49 CFR 172 Subpart H

- Training must be complete within 90 days after assignment to hazmat duties
- Recurrent training - 3 years (IATA 2 years not applicable)
- Subject Areas
  - General awareness and familiarization
  - Function specific
  - Safety training
  - Security Awareness Training
  - In-Depth Security Training

Hazmat Training Record Keeping

- Maintain during employment and 90 days thereafter
- Hazmat employees name
- Most recent Hazmat training completion date

Hazmat Training Record Keeping

- Description, copy or location of hazmat training materials
- Name and address of person providing training
- Certification hazmat employee has been trained and tested

Hazmat Training Certification and Instructor

- Employer certifies the training, not the course instructor
- No prerequisite qualifications for the course instructor
- Self training permitted
- Anyone may provide HazMat training provided it is complete, accurate and applicable to the HazMat operations being performed

Examination

- A ten question examination is provided in the download handout material.
- Employer should determine if examination is appropriate to meet his requirements for function specific training.

Thank You

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Section 2
49 CFR 171.12 and
Subpart C - 171.22, 171.23, 171.24, 171.25 and 171.26
Use of International Standards and Regulations

Use of International Standards and Regulations

Sec. 171.12 North American Shipments.

(a) Requirements for the use of the Transport Canada TDG Regulations. (1) A hazardous material transported from Canada to the United States, from the United States to Canada, or transiting the United States to Canada or a foreign destination may be offered for transportation or transported by motor carrier and rail in accordance with the Transport Canada TDG Regulations (IBR, see Sec. 171.7) as authorized in Sec. 171.22, provided the requirements in Sections 171.22 and 171.23, as applicable, and this section are met. In addition, a cargo tank motor vehicle, portable tank or rail tank car authorized by the Transport Canada TDG Regulations may be used for transportation to, from, or within the United States provided the cargo tank motor vehicle, portable tank or rail tank car conforms to the applicable requirements of this section. Except as otherwise provided in this subpart, the requirements in parts 172, 173, and 178 of this subchapter do not apply for a material transported in accordance with the Transport Canada TDG Regulations if all other requirements of this subpart and the TDG Regulations are met.

(2 General packaging requirements. When the provisions of this subchapter require a DOT specification or UN standard packaging to be used for transporting a hazardous material, a packaging authorized by the Transport Canada TDG Regulations may be used, subject to the limitations of this subpart, and only if it is equivalent to the corresponding DOT specification or UN packaging (see Sec. 173.24(d)(2) of this subchapter) authorized by this subchapter.

Sec. 171.22 Authorization and conditions for use of international standards and regulations.

(a) Authorized international standards and regulations. This subpart authorizes, with certain conditions and limitations, the offering for transportation and the transportation in commerce of hazardous materials to, from, or within the United States in accordance with the International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO Technical Instructions), the International Maritime Dangerous Goods Code (IMDG Code), Transport Canada's Transportation of Dangerous Goods Regulations (Transport Canada TDG Regulations), and the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material (IAEA Regulations) (IBR, see Sec. 171.7).

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(b) Limitations on the use of international standards and regulations. A hazardous material that is offered for transportation or transported in accordance with the international standards and regulations authorized in paragraph (a) of this section--
   (1) Is subject to the requirements of the applicable international standard or regulation and must be offered for transportation or transported in conformance with the applicable standard or regulation; and
   (2) Must conform to all applicable requirements of this subpart.

(c) Materials excepted from regulation under international standards and regulations. A material designated as a hazardous material under this subchapter, but excepted from or not subject to the international transport standards and regulations authorized in paragraph (a) of this section (e.g., paragraph 1.16 of the Transport Canada TDG Regulations excepts from regulation quantities of hazardous materials less than or equal to 500 kg gross transported by rail) must be transported in accordance with all applicable requirements of this subchapter.

(d) Materials not regulated under this subchapter. Materials not designated as hazardous materials under this subchapter but regulated by an international transport standard or regulation authorized in paragraph (a) of this section may be offered for transportation and transported in the United States in full compliance (i.e., packaged, marked, labeled, classed, described, stowed, segregated, secured) with the applicable international transport standard or regulation.

(e) Forbidden materials. No person may offer for transportation or transport a hazardous material that is a forbidden material or package as designated in--
   (1) Section 173.21 of this subchapter;
   (2) Column (3) of the Sec. 172.101 Table of this subchapter;
   (3) Column (9A) of the Sec. 172.101 Table of this subchapter when offered for transportation or transported on passenger aircraft or passenger railcar; or
   (4) Column (9B) of the Sec. 172.101 Table of this subchapter when offered for transportation or transported by cargo aircraft.

(f) Complete information and certification. (1) Except for shipments into the United States from Canada conforming to Sec. 171.12, each person importing a hazardous material into the United States must provide the forwarding agent at the place of entry into the United States timely and complete written information as to the requirements of this subchapter applicable to the particular shipment.
   (2) After May 4, 2009, the shipper, directly or through the forwarding agent at the place of entry, must provide the initial U.S. carrier with the shipper's certification required by Sec. 172.204 of this subchapter, unless the shipment is otherwise excepted from the certification requirement. Except for shipments for which the certification requirement does not apply, a carrier may not accept a hazardous material for transportation unless provided a shipper's certification.
   (3) All shipping paper information and package markings required in accordance with this subchapter must be in English. The use of shipping papers and a package marked with both English and a language other than English, in order to dually comply with this subchapter and the regulations of a foreign entity, is permitted under this subchapter.
   (4) Each person who provides for transportation or receives for transportation (see Sec. Sec. 174.24, 175.30, 176.24 and 177.817 of this subchapter) a shipping paper must retain a copy of the shipping paper or an electronic image thereof that is accessible at or through its principal place of business in accordance with Sec. 172.201(e) of this part.

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(g) Additional requirements for the use of international standards and regulations. All shipments offered for transportation or transported in the United States in accordance with this subpart must conform to the following requirements of this subchapter, as applicable:
   (1) The emergency response information requirements in subpart G of part 172 of this subchapter;
   (2) The training requirements in subpart H of part 172 of this subchapter, including function-specific training in the use of the international transport standards and regulations authorized in paragraph (a) of this section, as applicable;
   (3) The security requirements in subpart I of part 172 of this subchapter;
   (4) The incident reporting requirements in Sec. Sec. 171.15 and 171.16 of this part for incidents occurring within the jurisdiction of the United States including on board vessels in the navigable waters of the United States and aboard aircraft of United States registry anywhere in air commerce;
   (5) The general packaging requirements in Sec. Sec. 173.24 and 173.24a of this subchapter;
   (6) The requirements for the reuse, reconditioning, and remanufacture of packagings in Sec. 173.28 of this subchapter; and
   (7) The registration requirements in subpart G of part 107 of this chapter.

Sec. 171.23 Requirements for specific materials and packagings transported under the ICAO Technical Instructions, IMDG Code, Transport Canada TDG Regulations, or the IAEA Regulations.

All shipments offered for transportation or transported in the United States under the ICAO Technical Instructions, IMDG Code, Transport Canada TDG Regulations, or the IAEA Regulations (IBR, see Sec. 171.7) must conform to the requirements of this section, as applicable.

(a) Conditions and requirements for cylinders--
   (1) Except as provided in this paragraph, a filled cylinder (pressure receptacle) manufactured to other than a DOT specification or a UN standard in accordance with part 178 of this subchapter, or a DOT exemption or special permit cylinder or a cylinder used as a fire extinguisher in conformance with Sec. 173.309(a) of this subchapter, may not be transported to, from, or within the United States.
   (2) Cylinders (including UN pressure receptacles) transported to, from, or within the United States must conform to the applicable requirements of this subchapter. Unless otherwise excepted in this subchapter, a cylinder must not be transported unless--
      (i) The cylinder is manufactured, inspected and tested in accordance with a DOT specification or a UN standard prescribed in part 178 of this subchapter, except that cylinders not conforming to these requirements must meet the requirements in paragraphs (a)(3), (a)(4) or (a)(5) of this section;
      (ii) The cylinder is equipped with a pressure relief device in accordance with Sec. 173.301(f) of this subchapter and conforms to the applicable requirements in part 173 of this subchapter for the hazardous material involved;

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(iii) The openings on an aluminum cylinder in oxygen service conform to the requirements of this paragraph, except when the cylinder is used for aircraft parts or used aboard an aircraft in accordance with the applicable airworthiness requirements and operating regulations. An aluminum DOT specification cylinder must have an opening configured with straight (parallel) threads. A UN pressure receptacle may have straight (parallel) or tapered threads provided the UN pressure receptacle is marked with the thread type, e.g. ``17E, 25E, 18P, or 25P'' and fitted with the properly marked valve; and

(iv) A UN pressure receptacle is marked with ``USA'' as a country of approval in conformance with Sec. Sec. 178.69 and 178.70 of this subchapter.

(3) Importation of cylinders for discharge within a single port area: A cylinder manufactured to other than a DOT specification or UN standard in accordance with part 178 of this subchapter and certified as being in conformance with the transportation regulations of another country may be authorized, upon written request to and approval by the Associate Administrator, for transportation within a single port area, provided--

(i) The cylinder is transported in a closed freight container;

(ii) The cylinder is certified by the importer to provide a level of safety at least equivalent to that required by the regulations in this subchapter for a comparable DOT specification or UN cylinder; and

(iii) The cylinder is not refilled for export unless in compliance with paragraph (a)(3) of this section.

(4) Filling of cylinders for export or for use on board a vessel: A cylinder not manufactured, inspected, tested and marked in accordance with part 178 of this subchapter, or a cylinder manufactured to other than a UN standard, DOT specification, exemption or special permit, may be filled with a gas in the United States and offered for transportation and transported for export or alternatively, for use on board a vessel, if the following conditions are met:

(i) The cylinder has been requalified and marked with the month and year of requalification in accordance with subpart C of part 180 of this subchapter, or has been requalified as authorized by the Associate Administrator;

(ii) In addition to other requirements of this subchapter, the maximum filling ensity, service pressure, and pressure relief device for each cylinder conform to the requirements of this part for the gas involved; and

(iii) The bill of lading or other shipping paper identifies the cylinder and includes the following certification: ``This cylinder has (These cylinders have) been qualified, as required, and filled in accordance with the DOT requirements for export.''

(5) Cylinders not equipped with pressure relief devices: A DOT specification or a UN cylinder manufactured, inspected, tested and marked in accordance with part 178 of this subchapter and otherwise conforms to the requirements of part 173 for the gas involved, except that the cylinder is not equipped with a pressure relief device may be filled with a gas and offered for transportation and transported for export if the following conditions are met:

(i) Each DOT specification cylinder or UN pressure receptacle must be plainly and durably marked ``For Export Only'';

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(ii) The shipping paper must carry the following certification: ``This cylinder has (These cylinders have) been retested and refilled in accordance with the DOT requirements for export."; and

(iii) The emergency response information provided with the shipment and available from the emergency response telephone contact person must indicate that the pressure receptacles are not fitted with pressure relief devices and provide appropriate guidance for exposure to fire.

(b) Conditions and requirements specific to certain materials—

(5) Hazardous substances. Except for Class 7 (radioactive) materials, a material meeting the definition of a hazardous substance as defined in Sec. 171.8, must conform to the shipping paper requirements in Sec. 172.203(c) of this subchapter and the marking requirements in Sec. 172.324 of this subchapter:

(i) The proper shipping name must identify the hazardous substance by name, or the name of the substance must be entered in parentheses in association with the basic description and marked on the package in association with the proper shipping name. If the hazardous substance meets the definition for a hazardous waste, the waste code (for example, D001), may be used to identify the hazardous substance;

(ii) The shipping paper and the package markings must identify at least two hazardous substances with the lowest reportable quantities (RQs) when the material contains two or more hazardous substances; and

(iii) The letters ``RQ" must be entered on the shipping paper either before or after the basic description, and marked on the package in association with the proper shipping name for each hazardous substance listed.

(11) Class 7 (radioactive) materials.

(i) Highway route controlled quantities (see Sec. 173.403 of this subchapter) must be shipped in accordance with Sec. Sec. 172.203(d)(4) and (d)(10); 172.507, and 173.22(c) of this subchapter;

(ii) For fissile materials and Type B, Type B(U), and Type B(M) packagings, the competent authority certification and any necessary revalidation must be obtained from the appropriate competent authorities as specified in Sec. Sec. 173.471, 173.472, and 173.473 of this subchapter, and all requirements of the certificates and revalidations must be met;

(iii) Type A package contents are limited in accordance with Sec. 173.431 of this subchapter;

(iv) The country of origin for the shipment must have adopted the edition of TS-R-1 of the IAEA Regulations referenced in Sec. 171.7;

(v) The shipment must conform to the requirements of Sec. 173.448, when applicable;

(vi) The definition for ``radioactive material" in Sec. 173.403 of this subchapter must be applied to radioactive materials transported under the provisions of this subpart;

(vii) Except for limited quantities, the shipment must conform to the requirements of Sec. 172.204(c)(4) of this subchapter; and

(viii) Excepted packages of radioactive material, instruments or articles, or articles containing natural uranium or thorium must conform to the requirements of Sec. Sec. 173.421, 173.424, or 173.426 of this subchapter, as appropriate.

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Sec. 171.24 Additional requirements for the use of the ICAO Technical Instructions.

(a) A hazardous material that is offered for transportation or transported within the United States by aircraft, and by motor vehicle or rail either before or after being transported by aircraft in accordance with the ICAO Technical Instructions (IBR, see Sec. 171.7), as authorized in paragraph (a) of Sec. 171.22, must conform to the requirements in Sec. 171.22, as applicable, and this section.
(b) Any person who offers for transportation or transports a hazardous material in accordance with the ICAO Technical Instructions must comply with the following additional conditions and requirements:
    (1) All applicable requirements in parts 171 and 175 of this subchapter (also see 14 CFR 121.135, 121.401, 121.433a, 135.323, 135.327 and 135.333);
    (2) The quantity limits prescribed in the ICAO Technical Instructions for transportation by passenger-carrying or cargo aircraft, as applicable;
    (3) The conditions or requirements of a United States variation, when specified in the ICAO Technical Instructions.
(c) Highway transportation. For transportation by highway prior to or after transportation by aircraft, a shipment must conform to the applicable requirements of part 177 of this subchapter, and the motor vehicle must be placarded in accordance with subpart F of part 172.
(d) Conditions and requirements specific to certain materials. Hazardous materials offered for transportation or transported in accordance with the ICAO Technical Instructions must conform to the following specific conditions and requirements, as applicable:

Sec. 171.26 Additional requirements for the use of the IAEA Regulations.

A Class 7 (radioactive) material being imported into or exported from the United States or passing through the United States in the course of being shipped between places outside the United States may be offered for transportation or transported in accordance with the IAEA Regulations (IBR, see Sec. 171.7) as authorized in paragraph (a) of Sec. 171.22, provided the requirements in Sec. 171.22, as applicable, are met.

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Section 3

Table: Type A_1 and A_2 Quantities - Exempt Concentrations and Exempt Consignment Values - Reportable Quantities

Table: Category 1 and 2 Radioactive Materials

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Ac-225 (a)	8.0E-01	6.0E-03	1.0E+01	1.0E+04	0.037
	2.2E+01	1.6E-01	2.7E-10	2.7E-07	1
Ac-227 (a)	9.0E-01	9.0E-05	1.0E-01	1.0E+03	0.000037
	2.4E+01	2.4E-03	2.7E-12	2.7E-08	0.001
Ac-228	6.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.6E+01	1.4E+01	2.7E-10	2.7E-05	10
Ag-105	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Ag-108m (a) (bb)	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Ag-110m (a)	4.0E-01	4.0E-01	1.0E+01	1.0E+06	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-05	10
Ag-111	2.0E+00	6.0E-01	1.0E+03	1.0E+06	0.37
	5.4E+01	1.6E+01	2.7E-08	2.7E-05	10
Al-26	1.0E-01	1.0E-01	1.0E+01	1.0E+05	0.37
	2.7E+00	2.7E+00	2.7E-10	2.7E-06	10
Am-241	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Am-242m (a) (bb)	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Am-243 (a) (bb)	5.0E+00	1.0E-03	1.0E+00	1.0E+03	0.00037
	1.4E+02	2.7E-02	2.7E-11	2.7E-08	0.01
Ar-37	4.0E+01	4.0E+01	1.0E+06	1.0E+08	
	1.1E+03	1.1E+03	2.7E-05	2.7E-03	
Ar-39	4.0E+01	2.0E+01	1.0E+07	1.0E+04	37
	1.1E+03	5.4E+02	2.7E-04	2.7E-07	1000
Ar-41	3.0E-01	3.0E-01	1.0E+02	1.0E+09	0.37
	8.1E+00	8.1E+00	2.7E-09	2.7E-02	10
As-72	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
As-73	4.0E+01	4.0E+01	1.0E+03	1.0E+07	3.7
	1.1E+03	1.1E+03	2.7E-08	2.7E-04	100
As-74	1.0E+00	9.0E-01	1.0E+01	1.0E+06	0.37
	2.7E+01	2.4E+01	2.7E-10	2.7E-05	10
As-76	3.0E-01	3.0E-01	1.0E+02	1.0E+05	3.7
	8.1E+00	8.1E+00	2.7E-09	2.7E-06	100
As-77	2.0E+01	7.0E-01	1.0E+03	1.0E+06	37
	5.4E+02	1.9E+01	2.7E-08	2.7E-05	1000
At-211 (a)	2.0E+01	5.0E-01	1.0E+03	1.0E+07	3.7
	5.4E+02	1.4E+01	2.7E-08	2.7E-04	100
Au-193	7.0E+00	2.0E+00	1.0E+02	1.0E+07	3.7
	1.9E+02	5.4E+01	2.7E-09	2.7E-04	100
Au-194	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Au-195	1.0E+01	6.0E+00	1.0E+02	1.0E+07	3.7
	2.7E+02	1.6E+02	2.7E-09	2.7E-04	100
Au-198	1.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	2.7E+01	1.6E+01	2.7E-09	2.7E-05	100
Au-199	1.0E+01	6.0E-01	1.0E+02	1.0E+06	3.7
	2.7E+02	1.6E+01	2.7E-09	2.7E-05	100
Ba-131 (a)	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Ba-133	3.0E+00	3.0E+00	1.0E+02	1.0E+06	0.37
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	10
Ba-133m	2.0E+01	6.0E-01	1.0E+02	1.0E+06	3.7
	5.4E+02	1.6E+01	2.7E-09	2.7E-05	100
Ba-140 (a) (bb)	5.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	1.4E+01	8.1E+00	2.7E-10	2.7E-06	10
Be-7	2.0E+01	2.0E+01	1.0E+03	1.0E+07	3.7
	5.4E+02	5.4E+02	2.7E-08	2.7E-04	100

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Be-10	4.0E+01	6.0E-01	1.0E+04	1.0E+06	
	1.1E+03	1.6E+01	2.7E-07	2.7E-05	
Bi-205	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Bi-206	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Bi-207	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Bi-210	1.0E+00	6.0E-01	1.0E+03	1.0E+06	0.37
	2.7E+01	1.6E+01	2.7E-08	2.7E-05	10
Bi-210m (a)	6.0E-01	2.0E-02	1.0E+01	1.0E+05	0.0037
	1.6E+01	5.4E-01	2.7E-10	2.7E-06	0.1
Bi-212 (a) (bb)	7.0E-01	6.0E-01	1.0E+01	1.0E+05	3.7
	1.9E+01	1.6E+01	2.7E-10	2.7E-06	100
Bk-247	8.0E+00	8.0E-04	1.0E+00	1.0E+04	0.00037
	2.2E+02	2.2E-02	2.7E-11	2.7E-07	0.01
Bk-249 (a)	4.0E+01	3.0E-01	1.0E+03	1.0E+06	0.037
	1.1E+03	8.1E+00	2.7E-08	2.7E-05	1
Br-76	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
Br-77	3.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	100
Br-82	4.0E-01	4.0E-01	1.0E+01	1.0E+06	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-05	10
C-11	1.0E+00	6.0E-01	1.0E+01	1.0E+06	37
	2.7E+01	1.6E+01	2.7E-10	2.7E-05	1000
C-14	4.0E+01	3.0E+00	1.0E+04	1.0E+07	0.37
	1.1E+03	8.1E+01	2.7E-07	2.7E-04	10
Ca-41	Unlimited	Unlimited	1.0E+05	1.0E+07	0.37
	Unlimited	Unlimited	2.7E-06	2.7E-04	10
Ca-45	4.0E+01	1.0E+00	1.0E+04	1.0E+07	0.37
	1.1E+03	2.7E+01	2.7E-07	2.7E-04	10
Ca-47 (a)	3.0E+00	3.0E-01	1.0E+01	1.0E+06	0.37
	8.1E+01	8.1E+00	2.7E-10	2.7E-05	10
Cd-109	3.0E+01	2.0E+00	1.0E+04	1.0E+06	0.037
	8.1E+02	5.4E+01	2.7E-07	2.7E-05	1
Cd-113m	4.0E+01	5.0E-01	1.0E+03	1.0E+06	0.0037
	1.1E+03	1.4E+01	2.7E-08	2.7E-05	0.1
Cd-115 (a)	3.0E+00	4.0E-01	1.0E+02	1.0E+06	3.7
	8.1E+01	1.1E+01	2.7E-09	2.7E-05	100
Cd-115m	5.0E-01	5.0E-01	1.0E+03	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-08	2.7E-05	10
Ce-139	7.0E+00	2.0E+00	1.0E+02	1.0E+06	3.7
	1.9E+02	5.4E+01	2.7E-09	2.7E-05	100
Ce-141	2.0E+01	6.0E-01	1.0E+02	1.0E+07	0.37
	5.4E+02	1.6E+01	2.7E-09	2.7E-04	10
Ce-143	9.0E-01	6.0E-01	1.0E+02	1.0E+06	3.7
	2.4E+01	1.6E+01	2.7E-09	2.7E-05	100
Ce-144 (a) (bb)	2.0E-01	2.0E-01	1.0E+02	1.0E+05	0.037
	5.4E+00	5.4E+00	2.7E-09	2.7E-06	1
Cf-248	4.0E+01	6.0E-03	1.0E+01	1.0E+04	0.0037
	1.1E+03	1.6E-01	2.7E-10	2.7E-07	0.1
Cf-249	3.0E+00	8.0E-04	1.0E+00	1.0E+03	0.00037
	8.1E+01	2.2E-02	2.7E-11	2.7E-08	0.01
Cf-250	2.0E+01	2.0E-03	1.0E+01	1.0E+04	0.00037
	5.4E+02	5.4E-02	2.7E-10	2.7E-07	0.01
Cf-251	7.0E+00	7.0E-04	1.0E+00	1.0E+03	0.00037
	1.9E+02	1.9E-02	2.7E-11	2.7E-08	0.01

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Cf-252 (h)	5.0E-02	3.0E-03	1.0E+01	1.0E+04	0.0037
	1.4E+00	8.1E-02	2.7E-10	2.7E-07	0.1
Domestic Use Only	1.0E-01	1.0E-03	1.0E+01	1.0E+04	0.0037
Domestic Use Only	2.7E+00	2.7E-02	2.7E-10	2.7E-07	0.1
Cf-253 (a)	4.0E+01	4.0E-02	1.0E+02	1.0E+05	0.37
	1.1E+03	1.1E+00	2.7E-09	2.7E-06	10
Cf-254	1.0E-03	1.0E-03	1.0E+00	1.0E+03	0.0037
	2.7E-02	2.7E-02	2.7E-11	2.7E-08	0.1
Cl-36	1.0E+01	6.0E-01	1.0E+04	1.0E+06	0.37
	2.7E+02	1.6E+01	2.7E-07	2.7E-05	10
Cl-38	2.0E-01	2.0E-01	1.0E+01	1.0E+05	3.7
	5.4E+00	5.4E+00	2.7E-10	2.7E-06	100
Cm-240	4.0E+01	2.0E-02	1.0E+02	1.0E+05	0.037
	1.1E+03	5.4E-01	2.7E-09	2.7E-06	1
Cm-241	2.0E+00	1.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	2.7E+01	2.7E-09	2.7E-05	10
Cm-242	4.0E+01	1.0E-02	1.0E+02	1.0E+05	0.037
	1.1E+03	2.7E-01	2.7E-09	2.7E-06	1
Cm-243	9.0E+00	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.4E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Cm-244	2.0E+01	2.0E-03	1.0E+01	1.0E+04	0.00037
	5.4E+02	5.4E-02	2.7E-10	2.7E-07	0.01
Cm-245	9.0E+00	9.0E-04	1.0E+00	1.0E+03	0.00037
	2.4E+02	2.4E-02	2.7E-11	2.7E-08	0.01
Cm-246	9.0E+00	9.0E-04	1.0E+00	1.0E+03	0.00037
	2.4E+02	2.4E-02	2.7E-11	2.7E-08	0.01
Cm-247 (a)	3.0E+00	1.0E-03	1.0E+00	1.0E+04	0.00037
	8.1E+01	2.7E-02	2.7E-11	2.7E-07	0.01
Cm-248	2.0E-02	3.0E-04	1.0E+00	1.0E+03	0.000037
	5.4E-01	8.1E-03	2.7E-11	2.7E-08	0.001
Co-55	5.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Co-56	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Co-57	1.0E+01	1.0E+01	1.0E+02	1.0E+06	3.7
	2.7E+02	2.7E+02	2.7E-09	2.7E-05	100
Co-58	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Co-58m	4.0E+01	4.0E+01	1.0E+04	1.0E+07	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-04	1000
Co-60	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
Cr-51	3.0E+01	3.0E+01	1.0E+03	1.0E+07	
	8.1E+02	8.1E+02	2.7E-08	2.7E-04	
Cs-129	4.0E+00	4.0E+00	1.0E+02	1.0E+05	3.7
	1.1E+02	1.1E+02	2.7E-09	2.7E-06	100
Cs-131	3.0E+01	3.0E+01	1.0E+03	1.0E+06	37
	8.1E+02	8.1E+02	2.7E-08	2.7E-05	1000
Cs-132	1.0E+00	1.0E+00	1.0E+01	1.0E+05	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-06	10
Cs-134	7.0E-01	7.0E-01	1.0E+01	1.0E+04	0.037
	1.9E+01	1.9E+01	2.7E-10	2.7E-07	1
Cs-134m	4.0E+01	6.0E-01	1.0E+03	1.0E+05	37
	1.1E+03	1.6E+01	2.7E-08	2.7E-06	1000
Cs-135	4.0E+01	1.0E+00	1.0E+04	1.0E+07	0.37
	1.1E+03	2.7E+01	2.7E-07	2.7E-04	10
Cs-136	5.0E-01	5.0E-01	1.0E+01	1.0E+05	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-06	10
Cs-137 (a) (bb)	2.0E+00	6.0E-01	1.0E+01	1.0E+04	0.037
	5.4E+01	1.6E+01	2.7E-10	2.7E-07	1

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Cu-64	6.0E+00	1.0E+00	1.0E+02	1.0E+06	37
	1.6E+02	2.7E+01	2.7E-09	2.7E-05	1000
Cu-67	1.0E+01	7.0E-01	1.0E+02	1.0E+06	3.7
	2.7E+02	1.9E+01	2.7E-09	2.7E-05	100
Dy-159	2.0E+01	2.0E+01	1.0E+03	1.0E+07	3.7
	5.4E+02	5.4E+02	2.7E-08	2.7E-04	100
Dy-165	9.0E-01	6.0E-01	1.0E+03	1.0E+06	37
	2.4E+01	1.6E+01	2.7E-08	2.7E-05	1000
Dy-166 (a)	9.0E-01	3.0E-01	1.0E+03	1.0E+06	0.37
	2.4E+01	8.1E+00	2.7E-08	2.7E-05	10
Er-169	4.0E+01	1.0E+00	1.0E+04	1.0E+07	3.7
	1.1E+03	2.7E+01	2.7E-07	2.7E-04	100
Er-171	8.0E-01	5.0E-01	1.0E+02	1.0E+06	3.7
	2.2E+01	1.4E+01	2.7E-09	2.7E-05	100
Eu-147	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Eu-148	5.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Eu-149	2.0E+01	2.0E+01	1.0E+02	1.0E+07	3.7
	5.4E+02	5.4E+02	2.7E-09	2.7E-04	100
Eu-150 (short lived)	2.0E+00	7.0E-01	1.0E+03	1.0E+06	37
	5.4E+01	1.9E+01	2.7E-08	2.7E-05	1000
Eu-150 (long lived)	7.0 x 10-1	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Eu-152	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Eu-152m	8.0E-01	8.0E-01	1.0E+02	1.0E+06	3.7
	2.2E+01	2.2E+01	2.7E-09	2.7E-05	100
Eu-154	9.0E-01	6.0E-01	1.0E+01	1.0E+06	0.37
	2.4E+01	1.6E+01	2.7E-10	2.7E-05	10
Eu-155	2.0E+01	3.0E+00	1.0E+02	1.0E+07	0.37
	5.4E+02	8.1E+01	2.7E-09	2.7E-04	10
Eu-156	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
F-18	1.0E+00	6.0E-01	1.0E+01	1.0E+06	37
	2.7E+01	1.6E+01	2.7E-10	2.7E-05	1000
Fe-52 (a)	3.0E-01	3.0E-01	1.0E+01	1.0E+06	3.7
	8.1E+00	8.1E+00	2.7E-10	2.7E-05	100
Fe-55	4.0E+01	4.0E+01	1.0E+04	1.0E+06	3.7
	1.1E+03	1.1E+03	2.7E-07	2.7E-05	100
Fe-59	9.0E-01	9.0E-01	1.0E+01	1.0E+06	0.37
	2.4E+01	2.4E+01	2.7E-10	2.7E-05	10
Fe-60 (a)	4.0E+01	2.0E-01	1.0E+02	1.0E+05	0.0037
	1.1E+03	5.4E+00	2.7E-09	2.7E-06	0.1
Ga-67	7.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	1.9E+02	8.1E+01	2.7E-09	2.7E-05	100
Ga-68	5.0E-01	5.0E-01	1.0E+01	1.0E+05	37
	1.4E+01	1.4E+01	2.7E-10	2.7E-06	1000
Ga-72	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
Gd-146 (a)	5.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Gd-148	2.0E+01	2.0E-03	1.0E+01	1.0E+04	0.000037
	5.4E+02	5.4E-02	2.7E-10	2.7E-07	0.001
Gd-153	1.0E+01	9.0E+00	1.0E+02	1.0E+07	0.37
	2.7E+02	2.4E+02	2.7E-09	2.7E-04	10
Gd-159	3.0E+00	6.0E-01	1.0E+03	1.0E+06	37
	8.1E+01	1.6E+01	2.7E-08	2.7E-05	1000
Ge-68 (a)	5.0E-01	5.0E-01	1.0E+01	1.0E+05	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-06	10

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Ge-71	4.0E+01	4.0E+01	1.0E+04	1.0E+08	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-03	1000
Ge-77	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Hf-172 (a)	6.0E-01	6.0E-01	1.0E+01	1.0E+06	0.037
	1.6E+01	1.6E+01	2.7E-10	2.7E-05	1
Hf-175	3.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	100
Hf-181	2.0E+00	5.0E-01	1.0E+01	1.0E+06	0.37
	5.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Hf-182	Unlimited	Unlimited	1.0E+02	1.0E+06	0.0037
	Unlimited	Unlimited	2.7E-09	2.7E-05	0.1
Hg-194 (a)	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.0037
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	0.1
Hg-195m (a)	3.0E+00	7.0E-01	1.0E+02	1.0E+06	3.7
	8.1E+01	1.9E+01	2.7E-09	2.7E-05	100
Hg-197	2.0E+01	1.0E+01	1.0E+02	1.0E+07	37
	5.4E+02	2.7E+02	2.7E-09	2.7E-04	1000
Hg-197m	1.0E+01	4.0E-01	1.0E+02	1.0E+06	37
	2.7E+02	1.1E+01	2.7E-09	2.7E-05	1000
Hg-203	5.0E+00	1.0E+00	1.0E+02	1.0E+05	0.37
	1.4E+02	2.7E+01	2.7E-09	2.7E-06	10
Ho-166	4.0E-01	4.0E-01	1.0E+03	1.0E+05	3.7
	1.1E+01	1.1E+01	2.7E-08	2.7E-06	100
Ho-166m	6.0E-01	5.0E-01	1.0E+01	1.0E+06	0.037
	1.6E+01	1.4E+01	2.7E-10	2.7E-05	1
I-123	6.0E+00	3.0E+00	1.0E+02	1.0E+07	0.37
	1.6E+02	8.1E+01	2.7E-09	2.7E-04	10
I-124	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.0037
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	0.1
I-125	2.0E+01	3.0E+00	1.0E+03	1.0E+06	0.00037
	5.4E+02	8.1E+01	2.7E-08	2.7E-05	0.01
I-126	2.0E+00	1.0E+00	1.0E+02	1.0E+06	0.00037
	5.4E+01	2.7E+01	2.7E-09	2.7E-05	0.01
I-129	Unlimited	Unlimited	1.0E+02	1.0E+05	0.000037
	Unlimited	Unlimited	2.7E-09	2.7E-06	0.001
I-131	3.0E+00	7.0E-01	1.0E+02	1.0E+06	0.00037
	8.1E+01	1.9E+01	2.7E-09	2.7E-05	0.01
I-132	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
I-133	7.0E-01	6.0E-01	1.0E+01	1.0E+06	0.0037
	1.9E+01	1.6E+01	2.7E-10	2.7E-05	0.1
I-134	3.0E-01	3.0E-01	1.0E+01	1.0E+05	3.7
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	100
I-135 (a)	6.0E-01	6.0E-01	1.0E+01	1.0E+06	0.37
	1.6E+01	1.6E+01	2.7E-10	2.7E-05	10
In-111	3.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	100
In-113m	4.0E+00	2.0E+00	1.0E+02	1.0E+06	37
	1.1E+02	5.4E+01	2.7E-09	2.7E-05	1000
In-114m (a)	1.0E+01	5.0E-01	1.0E+02	1.0E+06	0.37
	2.7E+02	1.4E+01	2.7E-09	2.7E-05	10
In-115m	7.0E+00	1.0E+00	1.0E+02	1.0E+06	3.7
	1.9E+02	2.7E+01	2.7E-09	2.7E-05	100
Ir-189 (a)	1.0E+01	1.0E+01	1.0E+02	1.0E+07	3.7
	2.7E+02	2.7E+02	2.7E-09	2.7E-04	100
Ir-190	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Ir-192 (c)	1.0E+00	6.0E-01	1.0E+01	1.0E+04	0.37
	2.7E+01	1.6E+01	2.7E-10	2.7E-07	10

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Ir-194	3.0E-01	3.0E-01	1.0E+02	1.0E+05	3.7
	8.1E+00	8.1E+00	2.7E-09	2.7E-06	100
K-40	9.0E-01	9.0E-01	1.0E+02	1.0E+06	0.037
	2.4E+01	2.4E+01	2.7E-09	2.7E-05	1
K-42	2.0E-01	2.0E-01	1.0E+02	1.0E+06	3.7
	5.4E+00	5.4E+00	2.7E-09	2.7E-05	100
K-43	7.0E-01	6.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.6E+01	2.7E-10	2.7E-05	10
Kr-81	4.0E+01	4.0E+01	1.0E+04	1.0E+07	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-04	1000
Kr-85	1.0E+01	1.0E+01	1.0E+05	1.0E+04	37
	2.7E+02	2.7E+02	2.7E-06	2.7E-07	1000
Kr-85m	8.0E+00	3.0E+00	1.0E+03	1.0E+10	3.7
	2.2E+02	8.1E+01	2.7E-08	2.7E-01	100
Kr-87	2.0E-01	2.0E-01	1.0E+02	1.0E+09	0.37
	5.4E+00	5.4E+00	2.7E-09	2.7E-02	10
La-137	3.0E+01	6.0E+00	1.0E+03	1.0E+07	0.37
	8.1E+02	1.6E+02	2.7E-08	2.7E-04	10
La-140	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
Lu-172	6.0E-01	6.0E-01	1.0E+01	1.0E+06	0.37
	1.6E+01	1.6E+01	2.7E-10	2.7E-05	10
Lu-173	8.0E+00	8.0E+00	1.0E+02	1.0E+07	3.7
	2.2E+02	2.2E+02	2.7E-09	2.7E-04	100
Lu-174	9.0E+00	9.0E+00	1.0E+02	1.0E+07	0.37
	2.4E+02	2.4E+02	2.7E-09	2.7E-04	10
Lu-174m	2.0E+01	1.0E+01	1.0E+02	1.0E+07	0.37
	5.4E+02	2.7E+02	2.7E-09	2.7E-04	10
Lu-177	3.0E+01	7.0E-01	1.0E+03	1.0E+07	3.7
	8.1E+02	1.9E+01	2.7E-08	2.7E-04	100
Mg-28 (a)	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Mn-52	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Mn-53	Unlimited	Unlimited	1.0E+04	1.0E+09	37
	Unlimited	Unlimited	2.7E-07	2.7E-02	1000
Mn-54	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Mn-56	3.0E-01	3.0E-01	1.0E+01	1.0E+05	3.7
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	100
Mo-93	4.0E+01	2.0E+01	1.0E+03	1.0E+08	3.7
	1.1E+03	5.4E+02	2.7E-08	2.7E-03	100
Mo-99 (a) (i)	1.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	2.7E+01	1.6E+01	2.7E-09	2.7E-05	100
Domestic Use Only	1.0E+00	7.4E-01	1.0E+02	1.0E+06	3.7
Domestic Use Only	2.7E+01	2.0E+01	2.7E-09	2.7E-05	100
N-13	9.0E-01	6.0E-01	1.0E+02	1.0E+09	
	2.4E+01	1.6E+01	2.7E-09	2.7E-02	
Na-22	5.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Na-24	2.0E-01	2.0E-01	1.0E+01	1.0E+05	0.37
	5.4E+00	5.4E+00	2.7E-10	2.7E-06	10
Nb-93m	4.0E+01	3.0E+01	1.0E+04	1.0E+07	3.7
	1.1E+03	8.1E+02	2.7E-07	2.7E-04	100
Nb-94	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Nb-95	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Nb-97	9.0E-01	6.0E-01	1.0E+01	1.0E+06	3.7
	2.4E+01	1.6E+01	2.7E-10	2.7E-05	100

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Nd-147	6.0E+00	6.0E-01	1.0E+02	1.0E+06	0.37
	1.6E+02	1.6E+01	2.7E-09	2.7E-05	10
Nd-149	6.0E-01	5.0E-01	1.0E+02	1.0E+06	3.7
	1.6E+01	1.4E+01	2.7E-09	2.7E-05	100
Ni-59	Unlimited	Unlimited	1.0E+04	1.0E+08	3.7
	Unlimited	Unlimited	2.7E-07	2.7E-03	100
Ni-63	4.0E+01	3.0E+01	1.0E+05	1.0E+08	3.7
	1.1E+03	8.1E+02	2.7E-06	2.7E-03	100
Ni-65	4.0E-01	4.0E-01	1.0E+01	1.0E+06	3.7
	1.1E+01	1.1E+01	2.7E-10	2.7E-05	100
Np-235	4.0E+01	4.0E+01	1.0E+03	1.0E+07	37
	1.1E+03	1.1E+03	2.7E-08	2.7E-04	1000
Np-236 (short-lived)	2.0E+01	2.0E+00	1.0E+03	1.0E+07	0.0037
	5.4E+02	5.4E+01	2.7E-08	2.7E-04	0.1
Np-236 (long-lived)	9.0E+00	2.0E-02	1.0E+02	1.0E+05	3.7
	2.4E+02	5.4E-01	2.7E-09	2.7E-06	100
Np-237	2.0E+01	2.0E-03	1.0E+00	1.0E+03	0.00037
	5.4E+02	5.4E-02	2.7E-11	2.7E-08	0.01
Np-239	7.0E+00	4.0E-01	1.0E+02	1.0E+07	3.7
	1.9E+02	1.1E+01	2.7E-09	2.7E-04	100
Os-185	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Os-191	1.0E+01	2.0E+00	1.0E+02	1.0E+07	3.7
	2.7E+02	5.4E+01	2.7E-09	2.7E-04	100
Os-191m	4.0E+01	3.0E+01	1.0E+03	1.0E+07	37
	1.1E+03	8.1E+02	2.7E-08	2.7E-04	1000
Os-193	2.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	5.4E+01	1.6E+01	2.7E-09	2.7E-05	100
Os-194 (a)	3.0E-01	3.0E-01	1.0E+02	1.0E+05	0.037
	8.1E+00	8.1E+00	2.7E-09	2.7E-06	1
P-32	5.0E-01	5.0E-01	1.0E+03	1.0E+05	0.0037
	1.4E+01	1.4E+01	2.7E-08	2.7E-06	0.1
P-33	4.0E+01	1.0E+00	1.0E+05	1.0E+08	0.037
	1.1E+03	2.7E+01	2.7E-06	2.7E-03	1
Pa-230 (a)	2.0E+00	7.0E-02	1.0E+01	1.0E+06	0.37
	5.4E+01	1.9E+00	2.7E-10	2.7E-05	10
Pa-231	4.0E+00	4.0E-04	1.0E+00	1.0E+03	0.00037
	1.1E+02	1.1E-02	2.7E-11	2.7E-08	0.01
Pa-233	5.0E+00	7.0E-01	1.0E+02	1.0E+07	3.7
	1.4E+02	1.9E+01	2.7E-09	2.7E-04	100
Pb-201	1.0E+00	1.0E+00	1.0E+01	1.0E+06	3.7
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	100
Pb-202	4.0E+01	2.0E+01	1.0E+03	1.0E+06	0.037
	1.1E+03	5.4E+02	2.7E-08	2.7E-05	1
Pb-203	4.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	1.1E+02	8.1E+01	2.7E-09	2.7E-05	100
Pb-205	Unlimited	Unlimited	1.0E+04	1.0E+07	3.7
	Unlimited	Unlimited	2.7E-07	2.7E-04	100
Pb-210 (a) (bb)	1.0E+00	5.0E-02	1.0E+01	1.0E+04	0.00037
	2.7E+01	1.4E+00	2.7E-10	2.7E-07	0.01
Pb-212 (a) (bb)	7.0E-01	2.0E-01	1.0E+01	1.0E+05	0.37
	1.9E+01	5.4E+00	2.7E-10	2.7E-06	10
Pd-103 (a)	4.0E+01	4.0E+01	1.0E+03	1.0E+08	3.7
	1.1E+03	1.1E+03	2.7E-08	2.7E-03	100
Pd-107	Unlimited	Unlimited	1.0E+05	1.0E+08	3.7
	Unlimited	Unlimited	2.7E-06	2.7E-03	100
Pd-109	2.0E+00	5.0E-01	1.0E+03	1.0E+06	37
	5.4E+01	1.4E+01	2.7E-08	2.7E-05	1000

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Pm-143	3.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	100
Pm-144	7.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.9E+01	2.7E-10	2.7E-05	10
Pm-145	3.0E+01	1.0E+01	1.0E+03	1.0E+07	3.7
	8.1E+02	2.7E+02	2.7E-08	2.7E-04	100
Pm-147	4.0E+01	2.0E+00	1.0E+04	1.0E+07	0.37
	1.1E+03	5.4E+01	2.7E-07	2.7E-04	10
Pm-148m (a)	8.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	2.2E+01	1.9E+01	2.7E-10	2.7E-05	10
Pm-149	2.0E+00	6.0E-01	1.0E+03	1.0E+06	3.7
	5.4E+01	1.6E+01	2.7E-08	2.7E-05	100
Pm-151	2.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	5.4E+01	1.6E+01	2.7E-09	2.7E-05	100
Po-210	4.0E+01	2.0E-02	1.0E+01	1.0E+04	0.00037
	1.1E+03	5.4E-01	2.7E-10	2.7E-07	0.01
Pr-142	4.0E-01	4.0E-01	1.0E+02	1.0E+05	3.7
	1.1E+01	1.1E+01	2.7E-09	2.7E-06	100
Pr-143	3.0E+00	6.0E-01	1.0E+04	1.0E+06	0.37
	8.1E+01	1.6E+01	2.7E-07	2.7E-05	10
Pt-188 (a)	1.0E+00	8.0E-01	1.0E+01	1.0E+06	3.7
	2.7E+01	2.2E+01	2.7E-10	2.7E-05	100
Pt-191	4.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	1.1E+02	8.1E+01	2.7E-09	2.7E-05	100
Pt-193	4.0E+01	4.0E+01	1.0E+04	1.0E+07	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-04	1000
Pt-193m	4.0E+01	5.0E-01	1.0E+03	1.0E+07	3.7
	1.1E+03	1.4E+01	2.7E-08	2.7E-04	100
Pt-195m	1.0E+01	5.0E-01	1.0E+02	1.0E+06	3.7
	2.7E+02	1.4E+01	2.7E-09	2.7E-05	100
Pt-197	2.0E+01	6.0E-01	1.0E+03	1.0E+06	37
	5.4E+02	1.6E+01	2.7E-08	2.7E-05	1000
Pt-197m	1.0E+01	6.0E-01	1.0E+02	1.0E+06	37
	2.7E+02	1.6E+01	2.7E-09	2.7E-05	1000
Pu-236	3.0E+01	3.0E-03	1.0E+01	1.0E+04	0.0037
	8.1E+02	8.1E-02	2.7E-10	2.7E-07	0.1
Pu-237	2.0E+01	2.0E+01	1.0E+03	1.0E+07	37
	5.4E+02	5.4E+02	2.7E-08	2.7E-04	1000
Pu-238	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Pu-239	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Pu-240	1.0E+01	1.0E-03	1.0E+00	1.0E+03	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-08	0.01
Pu-241 (a)	4.0E+01	6.0E-02	1.0E+02	1.0E+05	0.037
	1.1E+03	1.6E+00	2.7E-09	2.7E-06	1
Pu-242	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Pu-244 (a)	4.0E-01	1.0E-03	1.0E+00	1.0E+04	0.00037
	1.1E+01	2.7E-02	2.7E-11	2.7E-07	0.01
Ra-223 (a) (bb)	4.0E-01	7.0E-03	1.0E+02	1.0E+05	0.037
	1.1E+01	1.9E-01	2.7E-09	2.7E-06	1
Ra-224 (a) (bb)	4.0E-01	2.0E-02	1.0E+01	1.0E+05	0.37
	1.1E+01	5.4E-01	2.7E-10	2.7E-06	10
Ra-225 (a)	2.0E-01	4.0E-03	1.0E+02	1.0E+05	0.037
	5.4E+00	1.1E-01	2.7E-09	2.7E-06	1
Ra-226 (a) (bb)	2.0E-01	3.0E-03	1.0E+01	1.0E+04	0.0037
	5.4E+00	8.1E-02	2.7E-10	2.7E-07	0.1
Ra-228 (a) (bb)	6.0E-01	2.0E-02	1.0E+01	1.0E+05	0.0037
	1.6E+01	5.4E-01	2.7E-10	2.7E-06	0.1

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Rb-81	2.0E+00	8.0E-01	1.0E+01	1.0E+06	3.7
	5.4E+01	2.2E+01	2.7E-10	2.7E-05	100
Rb-83 (a)	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Rb-84	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Rb-86	5.0E-01	5.0E-01	1.0E+02	1.0E+05	0.37
	1.4E+01	1.4E+01	2.7E-09	2.7E-06	10
Rb-87	Unlimited	Unlimited	1.0E+04	1.0E+07	0.37
	Unlimited	Unlimited	2.7E-07	2.7E-04	10
Rb(nat)	Unlimited	Unlimited	1.0E+04	1.0E+07	
	Unlimited	Unlimited	2.7E-07	2.7E-04	
Re-184	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Re-184m	3.0E+00	1.0E+00	1.0E+02	1.0E+06	0.37
	8.1E+01	2.7E+01	2.7E-09	2.7E-05	10
Re-186	2.0E+00	6.0E-01	1.0E+03	1.0E+06	3.7
	5.4E+01	1.6E+01	2.7E-08	2.7E-05	100
Re-187	Unlimited	Unlimited	1.0E+06	1.0E+09	37
	Unlimited	Unlimited	2.7E-05	2.7E-02	1000
Re-188	4.0E-01	4.0E-01	1.0E+02	1.0E+05	37
	1.1E+01	1.1E+01	2.7E-09	2.7E-06	1000
Re-189 (a)	3.0E+00	6.0E-01	1.0E+02	1.0E+06	37
	8.1E+01	1.6E+01	2.7E-09	2.7E-05	1000
Re(nat)	Unlimited	Unlimited	1.0E+06	1.0E+09	
	Unlimited	Unlimited	2.7E-05	2.7E-02	
Rh-99	2.0E+00	2.0E+00	1.0E+01	1.0E+06	
	5.4E+01	5.4E+01	2.7E-10	2.7E-05	
Rh-101	4.0E+00	3.0E+00	1.0E+02	1.0E+07	0.37
	1.1E+02	8.1E+01	2.7E-09	2.7E-04	10
Rh-102	5.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Rh-102m	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Rh-103m	4.0E+01	4.0E+01	1.0E+04	1.0E+08	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-03	1000
Rh-105	1.0E+01	8.0E-01	1.0E+02	1.0E+07	3.7
	2.7E+02	2.2E+01	2.7E-09	2.7E-04	100
Rn-222 (a) (bb)	3.0E-01	4.0E-03	1.0E+01	1.0E+08	0.0037
	8.1E+00	1.1E-01	2.7E-10	2.7E-03	0.1
Ru-97	5.0E+00	5.0E+00	1.0E+02	1.0E+07	37
	1.4E+02	1.4E+02	2.7E-09	2.7E-04	1000
Ru-103 (a)	2.0E+00	2.0E+00	1.0E+02	1.0E+06	3.7
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	100
Ru-105	1.0E+00	6.0E-01	1.0E+01	1.0E+06	
	2.7E+01	1.6E+01	2.7E-10	2.7E-05	
Ru-106 (a) (bb)	2.0E-01	2.0E-01	1.0E+02	1.0E+05	
	5.4E+00	5.4E+00	2.7E-09	2.7E-06	
S-35	4.0E+01	3.0E+00	1.0E+05	1.0E+08	0.037
	1.1E+03	8.1E+01	2.7E-06	2.7E-03	1
Sb-122	4.0E-01	4.0E-01	1.0E+02	1.0E+04	0.37
	1.1E+01	1.1E+01	2.7E-09	2.7E-07	10
Sb-124	6.0E-01	6.0E-01	1.0E+01	1.0E+06	0.37
	1.6E+01	1.6E+01	2.7E-10	2.7E-05	10
Sb-125	2.0E+00	1.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	2.7E+01	2.7E-09	2.7E-05	10
Sb-126	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
Sc-44	5.0E-01	5.0E-01	1.0E+01	1.0E+05	3.7
	1.4E+01	1.4E+01	2.7E-10	2.7E-06	100

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Sc-46	5.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.4E+01	1.4E+01	2.7E-10	2.7E-05	10
Sc-47	1.0E+01	7.0E-01	1.0E+02	1.0E+06	3.7
	2.7E+02	1.9E+01	2.7E-09	2.7E-05	100
Sc-48	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Se-75	3.0E+00	3.0E+00	1.0E+02	1.0E+06	0.37
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	10
Se-79	4.0E+01	2.0E+00	1.0E+04	1.0E+07	0.37
	1.1E+03	5.4E+01	2.7E-07	2.7E-04	10
Si-31	6.0E-01	6.0E-01	1.0E+03	1.0E+06	37
	1.6E+01	1.6E+01	2.7E-08	2.7E-05	1000
Si-32	4.0E+01	5.0E-01	1.0E+03	1.0E+06	0.037
	1.1E+03	1.4E+01	2.7E-08	2.7E-05	1
Sm-145	1.0E+01	1.0E+01	1.0E+02	1.0E+07	3.7
	2.7E+02	2.7E+02	2.7E-09	2.7E-04	100
Sm-147	Unlimited	Unlimited	1.0E+01	1.0E+04	0.00037
	Unlimited	Unlimited	2.7E-10	2.7E-07	0.01
Sm-151	4.0E+01	1.0E+01	1.0E+04	1.0E+08	0.37
	1.1E+03	2.7E+02	2.7E-07	2.7E-03	10
Sm-153	9.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	2.4E+02	1.6E+01	2.7E-09	2.7E-05	100
Sn-113 (a)	4.0E+00	2.0E+00	1.0E+03	1.0E+07	0.37
	1.1E+02	5.4E+01	2.7E-08	2.7E-04	10
Sn-117m	7.0E+00	4.0E-01	1.0E+02	1.0E+06	3.7
	1.9E+02	1.1E+01	2.7E-09	2.7E-05	100
Sn-119m	4.0E+01	3.0E+01	1.0E+03	1.0E+07	0.37
	1.1E+03	8.1E+02	2.7E-08	2.7E-04	10
Sn-121m (a)	4.0E+01	9.0E-01	1.0E+03	1.0E+07	0.37
	1.1E+03	2.4E+01	2.7E-08	2.7E-04	10
Sn-123	8.0E-01	6.0E-01	1.0E+03	1.0E+06	0.37
	2.2E+01	1.6E+01	2.7E-08	2.7E-05	10
Sn-125	4.0E-01	4.0E-01	1.0E+02	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-09	2.7E-06	10
Sn-126 (a)	6.0E-01	4.0E-01	1.0E+01	1.0E+05	0.037
	1.6E+01	1.1E+01	2.7E-10	2.7E-06	1
Sr-82 (a)	2.0E-01	2.0E-01	1.0E+01	1.0E+05	
	5.4E+00	5.4E+00	2.7E-10	2.7E-06	
Sr-85	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Sr-85m	5.0E+00	5.0E+00	1.0E+02	1.0E+07	37
	1.4E+02	1.4E+02	2.7E-09	2.7E-04	1000
Sr-87m	3.0E+00	3.0E+00	1.0E+02	1.0E+06	3.7
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	100
Sr-89	6.0E-01	6.0E-01	1.0E+03	1.0E+06	0.37
	1.6E+01	1.6E+01	2.7E-08	2.7E-05	10
Sr-90 (a) (bb)	3.0E-01	3.0E-01	1.0E+02	1.0E+04	0.0037
	8.1E+00	8.1E+00	2.7E-09	2.7E-07	0.1
Sr-91 (a)	3.0E-01	3.0E-01	1.0E+01	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-10	2.7E-06	10
Sr-92 (a)	1.0E+00	3.0E-01	1.0E+01	1.0E+06	3.7
	2.7E+01	8.1E+00	2.7E-10	2.7E-05	100
T(H-3)	4.0E+01	4.0E+01	1.0E+06	1.0E+09	3.7
	1.1E+03	1.1E+03	2.7E-05	2.7E-02	100
Ta-178 (long-lived)	1.0E+00	8.0E-01	1.0E+01	1.0E+06	37
	2.7E+01	2.2E+01	2.7E-10	2.7E-05	1000
Ta-179	3.0E+01	3.0E+01	1.0E+03	1.0E+07	37
	8.1E+02	8.1E+02	2.7E-08	2.7E-04	1000
Ta-182	9.0E-01	5.0E-01	1.0E+01	1.0E+04	0.37
	2.4E+01	1.4E+01	2.7E-10	2.7E-07	10

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Tb-157	4.0E+01	4.0E+01	1.0E+04	1.0E+07	3.7
	1.1E+03	1.1E+03	2.7E-07	2.7E-04	100
Tb-158	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Tb-160	1.0E+00	6.0E-01	1.0E+01	1.0E+06	0.37
	2.7E+01	1.6E+01	2.7E-10	2.7E-05	10
Tc-95m (a)	2.0E+00	2.0E+00	1.0E+01	1.0E+06	
	5.4E+01	5.4E+01	2.7E-10	2.7E-05	
Tc-96	4.0E-01	4.0E-01	1.0E+01	1.0E+06	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-05	10
Tc-96m (a)	4.0E-01	4.0E-01	1.0E+03	1.0E+07	37
	1.1E+01	1.1E+01	2.7E-08	2.7E-04	1000
Tc-97	Unlimited	Unlimited	1.0E+03	1.0E+08	3.7
	Unlimited	Unlimited	2.7E-08	2.7E-03	100
Tc-97m	4.0E+01	1.0E+00	1.0E+03	1.0E+07	3.7
	1.1E+03	2.7E+01	2.7E-08	2.7E-04	100
Tc-98	8.0E-01	7.0E-01	1.0E+01	1.0E+06	0.37
	2.2E+01	1.9E+01	2.7E-10	2.7E-05	10
Tc-99	4.0E+01	9.0E-01	1.0E+04	1.0E+07	0.37
	1.1E+03	2.4E+01	2.7E-07	2.7E-04	10
Tc-99m	1.0E+01	4.0E+00	1.0E+02	1.0E+07	3.7
	2.7E+02	1.1E+02	2.7E-09	2.7E-04	100
Te-121	2.0E+00	2.0E+00	1.0E+01	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-10	2.7E-05	10
Te-121m	5.0E+00	3.0E+00	1.0E+02	1.0E+05	0.37
	1.4E+02	8.1E+01	2.7E-09	2.7E-06	10
Te-123m	8.0E+00	1.0E+00	1.0E+02	1.0E+07	0.37
	2.2E+02	2.7E+01	2.7E-09	2.7E-04	10
Te-125m	2.0E+01	9.0E-01	1.0E+03	1.0E+07	0.37
	5.4E+02	2.4E+01	2.7E-08	2.7E-04	10
Te-127	2.0E+01	7.0E-01	1.0E+03	1.0E+06	37
	5.4E+02	1.9E+01	2.7E-08	2.7E-05	1000
Te-127m (a)	2.0E+01	5.0E-01	1.0E+03	1.0E+07	0.37
	5.4E+02	1.4E+01	2.7E-08	2.7E-04	10
Te-129	7.0E-01	6.0E-01	1.0E+02	1.0E+06	37
	1.9E+01	1.6E+01	2.7E-09	2.7E-05	1000
Te-129m (a)	8.0E-01	4.0E-01	1.0E+03	1.0E+06	0.37
	2.2E+01	1.1E+01	2.7E-08	2.7E-05	10
Te-131m (a)	7.0E-01	5.0E-01	1.0E+01	1.0E+06	0.37
	1.9E+01	1.4E+01	2.7E-10	2.7E-05	10
Te-132 (a)	5.0E-01	4.0E-01	1.0E+02	1.0E+07	0.37
	1.4E+01	1.1E+01	2.7E-09	2.7E-04	10
Th-227	1.0E+01	5.0E-03	1.0E+01	1.0E+04	0.037
	2.7E+02	1.4E-01	2.7E-10	2.7E-07	1
Th-228 (a) (bb)	5.0E-01	1.0E-03	1.0E+00	1.0E+04	0.00037
	1.4E+01	2.7E-02	2.7E-11	2.7E-07	0.01
Th-229 (bb)	5.0E+00	5.0E-04	1.0E+00	1.0E+03	0.000037
	1.4E+02	1.4E-02	2.7E-11	2.7E-08	0.001
Th-230	1.0E+01	1.0E-03	1.0E+00	1.0E+04	0.00037
	2.7E+02	2.7E-02	2.7E-11	2.7E-07	0.01
Th-231	4.0E+01	2.0E-02	1.0E+03	1.0E+07	3.7
	1.1E+03	5.4E-01	2.7E-08	2.7E-04	100
Th-232	Unlimited	Unlimited	1.0E+01	1.0E+04	0.000037
	Unlimited	Unlimited	2.7E-10	2.7E-07	0.001
Th-234 (a) (bb)	3.0E-01	3.0E-01	1.0E+03	1.0E+05	3.7
	8.1E+00	8.1E+00	2.7E-08	2.7E-06	100
Th(nat) (bb)	Unlimited	Unlimited	1.0E+00	1.0E+03	
	Unlimited	Unlimited	2.7E-11	2.7E-08	
Ti-44 (a)	5.0E-01	4.0E-01	1.0E+01	1.0E+05	0.037
	1.4E+01	1.1E+01	2.7E-10	2.7E-06	1

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
Tl-200	9.0E-01	9.0E-01	1.0E+01	1.0E+06	0.37
	2.4E+01	2.4E+01	2.7E-10	2.7E-05	10
Tl-201	1.0E+01	4.0E+00	1.0E+02	1.0E+06	37
	2.7E+02	1.1E+02	2.7E-09	2.7E-05	1000
Tl-202	2.0E+00	2.0E+00	1.0E+02	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	10
Tl-204	1.0E+01	7.0E-01	1.0E+04	1.0E+04	0.37
	2.7E+02	1.9E+01	2.7E-07	2.7E-07	10
Tm-167	7.0E+00	8.0E-01	1.0E+02	1.0E+06	3.7
	1.9E+02	2.2E+01	2.7E-09	2.7E-05	100
Tm-170	3.0E+00	6.0E-01	1.0E+03	1.0E+06	0.37
	8.1E+01	1.6E+01	2.7E-08	2.7E-05	10
Tm-171	4.0E+01	4.0E+01	1.0E+04	1.0E+08	3.7
	1.1E+03	1.1E+03	2.7E-07	2.7E-03	100
U-230 (fast lung absorption)	4.0E+01	1.0E-01	1.0E+01	1.0E+05	0.037
(a)(d)(bb)(dd)(ee)(ff)	1.1E+03	2.7E+00	2.7E-10	2.7E-06	1
U-230 (medium lung absorption)	4.0E+01	4.0E-03	1.0E+01	1.0E+04	0.037
(a)(e)(ee)	1.1E+03	1.1E-01	2.7E-10	2.7E-07	1
U-230 (slow lung absorption)	3.0E+01	3.0E-03	1.0E+01	1.0E+04	0.037
(a)(f)(ff)	8.1E+02	8.1E-02	2.7E-10	2.7E-07	1
U-232 (fast lung absorption)	4.0E+01	1.0E-02	1.0E+00	1.0E+03	0.00037
(d)(bb)(dd)	1.1E+03	2.7E-01	2.7E-11	2.7E-08	0.01
U-232 (medium lung absorption)	4.0E+01	7.0E-03	1.0E+01	1.0E+04	0.00037
(e)(ee)	1.1E+03	1.9E-01	2.7E-10	2.7E-07	0.01
	1.0E+01	1.0E-03	1.0E+01	1.0E+04	0.00037
U-232 (slow lung absorption) (f)(ff)	2.7E+02	2.7E-02	2.7E-10	2.7E-07	0.01
	4.0E+01	9.0E-02	1.0E+01	1.0E+04	0.0037
U-233 (fast lung absorption) (d)(dd)	1.1E+03	2.4E+00	2.7E-10	2.7E-07	0.1
U-233 (medium lung absorption)	4.0E+01	2.0E-02	1.0E+02	1.0E+05	0.0037
(e)(ee)	1.1E+03	5.4E-01	2.7E-09	2.7E-06	0.1
	4.0E+01	6.0E-03	1.0E+01	1.0E+05	0.0037
U-233 (slow lung absorption) (f)(ff)	1.1E+03	1.6E-01	2.7E-10	2.7E-06	0.1
	4.0E+01	9.0E-02	1.0E+01	1.0E+04	0.0037
U-234 (fast lung absorption) (d)(dd)	1.1E+03	2.4E+00	2.7E-10	2.7E-07	0.1
U-234 (medium lung absorption)	4.0E+01	2.0E-02	1.0E+02	1.0E+05	0.0037
(e)(ee)	1.1E+03	5.4E-01	2.7E-09	2.7E-06	0.1
	4.0E+01	6.0E-03	1.0E+01	1.0E+05	0.0037
U-234 (slow lung absorption) (f)(ff)	1.1E+03	1.6E-01	2.7E-10	2.7E-06	0.1
U-235 (all lung absorption types)	Unlimited	Unlimited	1.0E+01	1.0E+04	0.0037
(a)(d)(e)(f)(bb)(dd)(ee)(ff)	Unlimited	Unlimited	2.7E-10	2.7E-07	0.1
	Unlimited	Unlimited	1.0E+01	1.0E+04	0.0037
U-236 (fast lung absorption) (d)(dd)	Unlimited	Unlimited	2.7E-10	2.7E-07	0.1
U-236 (medium lung absorption)	4.0E+01	2.0E-02	1.0E+02	1.0E+05	0.0037
(e)(ee)	1.1E+03	5.4E-01	2.7E-09	2.7E-06	0.1
	4.0E+01	6.0E-03	1.0E+01	1.0E+04	0.0037
U-236 (slow lung absorption) (f)(ff)	1.1E+03	1.6E-01	2.7E-10	2.7E-07	0.1
U-238 (all lung absorption types)	Unlimited	Unlimited	1.0E+01	1.0E+04	0.0037
(d)(e)(f)(bb)(dd)(ee)(ff)	Unlimited	Unlimited	2.7E-10	2.7E-07	0.1
U (nat) (bb)	Unlimited	Unlimited	1.0E+00	1.0E+03	0
	Unlimited	Unlimited	2.7E-11	2.7E-08	**
	Unlimited	Unlimited	1.0E+00	1.0E+03	0
U (enriched to 20% or less)(g)(gg)	Unlimited	Unlimited	2.7E-11	2.7E-08	***
U (dep)	Unlimited	Unlimited	1.0E+00	1.0E+03	0
	Unlimited	Unlimited	2.7E-11	2.7E-08	***
V-48	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10
V-49	4.0E+01	4.0E+01	1.0E+04	1.0E+07	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-04	1000
W-178 (a)	9.0E+00	5.0E+00	1.0E+01	1.0E+06	3.7
	2.4E+02	1.4E+02	2.7E-10	2.7E-05	100

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Radionuclide	A_1	A_2	Exempt Concentration	Exempt Consignment	Reportable Quantity
	TBq	TBq	Bq/g	Bq	TBQ
	Ci	Ci	Ci/g	Ci	Ci
W-181	3.0E+01	3.0E+01	1.0E+03	1.0E+07	3.7
	8.1E+02	8.1E+02	2.7E-08	2.7E-04	100
W-185	4.0E+01	8.0E-01	1.0E+04	1.0E+07	0.37
	1.1E+03	2.2E+01	2.7E-07	2.7E-04	10
W-187	2.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	5.4E+01	1.6E+01	2.7E-09	2.7E-05	100
W-188 (a)	4.0E-01	3.0E-01	1.0E+02	1.0E+05	0.37
	1.1E+01	8.1E+00	2.7E-09	2.7E-06	10
Xe-122 (a)	4.0E-01	4.0E-01	1.0E+02	1.0E+09	3.7
	1.1E+01	1.1E+01	2.7E-09	2.7E-02	100
Xe-123	2.0E+00	7.0E-01	1.0E+02	1.0E+09	0.37
	5.4E+01	1.9E+01	2.7E-09	2.7E-02	10
Xe-127	4.0E+00	2.0E+00	1.0E+03	1.0E+05	3.7
	1.1E+02	5.4E+01	2.7E-08	2.7E-06	100
Xe-131m	4.0E+01	4.0E+01	1.0E+04	1.0E+04	37
	1.1E+03	1.1E+03	2.7E-07	2.7E-07	1000
Xe-133	2.0E+01	1.0E+01	1.0E+03	1.0E+04	37
	5.4E+02	2.7E+02	2.7E-08	2.7E-07	1000
Xe-135	3.0E+00	2.0E+00	1.0E+03	1.0E+10	3.7
	8.1E+01	5.4E+01	2.7E-08	2.7E-01	100
Y-87 (a)	1.0E+00	1.0E+00	1.0E+01	1.0E+06	0.37
	2.7E+01	2.7E+01	2.7E-10	2.7E-05	10
Y-88	4.0E-01	4.0E-01	1.0E+01	1.0E+06	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-05	10
Y-90	3.0E-01	3.0E-01	1.0E+03	1.0E+05	0.37
	8.1E+00	8.1E+00	2.7E-08	2.7E-06	10
Y-91	6.0E-01	6.0E-01	1.0E+03	1.0E+06	0.37
	1.6E+01	1.6E+01	2.7E-08	2.7E-05	10
Y-91m	2.0E+00	2.0E+00	1.0E+02	1.0E+06	37
	5.4E+01	5.4E+01	2.7E-09	2.7E-05	1000
Y-92	2.0E-01	2.0E-01	1.0E+02	1.0E+05	3.7
	5.4E+00	5.4E+00	2.7E-09	2.7E-06	100
Y-93	3.0E-01	3.0E-01	1.0E+02	1.0E+05	3.7
	8.1E+00	8.1E+00	2.7E-09	2.7E-06	100
Yb-169	4.0E+00	1.0E+00	1.0E+02	1.0E+07	0.37
	1.1E+02	2.7E+01	2.7E-09	2.7E-04	10
Yb-175	3.0E+01	9.0E-01	1.0E+03	1.0E+07	3.7
	8.1E+02	2.4E+01	2.7E-08	2.7E-04	100
Zn-65	2.0E+00	2.0E+00	1.0E+01	1.0E+06	0.37
	5.4E+01	5.4E+01	2.7E-10	2.7E-05	10
Zn-69	3.0E+00	6.0E-01	1.0E+04	1.0E+06	37
	8.1E+01	1.6E+01	2.7E-07	2.7E-05	1000
Zn-69m (a)	3.0E+00	6.0E-01	1.0E+02	1.0E+06	3.7
	8.1E+01	1.6E+01	2.7E-09	2.7E-05	100
Zr-88	3.0E+00	3.0E+00	1.0E+02	1.0E+06	0.37
	8.1E+01	8.1E+01	2.7E-09	2.7E-05	10
Zr-93 (bb)	Unlimited	Unlimited	1.0E+03	1.0E+07	0.037
	Unlimited	Unlimited	2.7E-08	2.7E-04	1
Zr-95 (a)	2.0E+00	8.0E-01	1.0E+01	1.0E+06	0.37
	5.4E+01	2.2E+01	2.7E-10	2.7E-05	10
Zr-97 (a)(bb)	4.0E-01	4.0E-01	1.0E+01	1.0E+05	0.37
	1.1E+01	1.1E+01	2.7E-10	2.7E-06	10

Type A_1 and A_2 Quantities - Exempt Contrations and Consingment Values - Reportable Quantities

Legend:
m Radioactive metastable or isomeric state

Type A Quantity Notes

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

b The values of A1 and A2 in curies (Ci) are approximate and for information only; the regulatory standard units are Terabecquerels (TBq), (see Sec. 171.10).

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

d These values apply only to compounds of uranium that take the chemical form of UF6, U02F2 and U02(N03)2 in both normal and accident conditions of transport.

e These values apply only to compounds of uranium that take the chemical form of U03, UF4, UC14 and hexavalent compounds in both normal and accident conditions of transport.

f These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.

g These values apply to unirradiated uranium only.

h A1 = 0.1 TBq (2.7 Ci) and A2 = 0.001 TBq (0.027 Ci) for Cf-252 for domestic use.

i A2 = 0.74 TBq (20 Ci) for Mo-99 for domestic use.

Exempt Concentration and Exempt Consignment Notes

aa [Reserved]

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

Sr-90 Y-90
Zr-93 Nb-93m
Zr-97 Nb-97
Ru-106 Rh-106
Cs-137 Ba-137m
Ce-134 La-134
Ce-144 Pr-144
Ba-140 La-140
Bi-212 Tl-208 (0.36), Po-212 (0.64)
Pb-210 Bi-210, Po-210
Pb-212 Bi-212, Tl-208 (0.36), Po-212 (0.64)
Rn-220 Po-216
Rn-222 Po-218, Pb-214, Bi-214, Po-214
Ra-223 Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224 Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212 (0.64)
Ra-226 Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228 Ac-228
Th-226 Ra-222, Rn-218, Po-214
Th-228 Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229 Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-234 Pa-234m
U-230 Th-226, Ra-222, Rn-218, Po-214
U-232 Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235 Th-231
U-238 Th-234, Pa-234m
U-nat Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240 Np-240m
Np-237 Pa-233
Am-242m Am-242
Am-243 Np-239

cc [Reserved]

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

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

ff These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.

gg These values apply to unirradiated uranium only.

RQ Reportable Quantity Notes

Not all Reportable Quantities (RQ) have been listed in this table, only those RQ values for which there are corresponding A_1 and A_2 values have been listed. For a complete listing of RQ value see 49 CFR 172.101, Appendix A, Table 2.

The RQs for all radionuclides apply to chemical compounds containing the radionuclides and elemental forms regardless of the diameter of pieces of solid material.

The RQ of one curie applies to all radionuclides not otherwise listed. Whenever the RQs in 49 CFR 172.101, Appendix A, TABLE 1--HAZARDOUS SUBSTANCES OTHER THAN RADIONUCLIDES and this table conflict, the lowest RQ shall apply. For example, uranyl acetate and uranyl nitrate have RQs shown in TABLE 1 of 100 pounds, equivalent to about one-tenth the RQ level for uranium-238 in this table.

** The method to determine the RQs for mixtures or solutions of radionuclides can be found in paragraph 7 of the note preceding 49 CFR 172.101 Appendix A, TABLE 1. RQs for the following four common radionuclide mixtures are provided: radium-226 in secular equilibrium with its daughters (0.053 curie); natural uranium (0.1 curie); natural uranium in secular equilibrium with its daughters (0.052 curie); and natural thorium in secular equilibrium with its daughters (0.011 curie).

*** Indicates that the name was added by RSPA because it appears in the list of radionuclides in 49 CFR 173.435. The reportable quantity (RQ), if not specifically listed elsewhere in 49 CFR 172.101 Appendix A, shall be determined in accordance with the procedures in paragraph 7 of 49 CFR 172.101 Appendix A.

Disclaimer: The purpose of this information is for instructional purposes and although the complier of this information has taken every reasonable effort to avoid errors any user of this data assumes full and sole responsibility for its use.

Correction of Errors and Comments Requested: The complier would greatly appreciate receiving notice of any errors in this compliation or other other comments:

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Category 1 and 2 Radioactive Material

Radioactive material	Category 1		Category 2	
	Terabequerels (TBq)	Curies (Ci)[1]	Terabequerels (TBq)	Curies (Ci)[1]
Americium-241	60	1,600	0.6	16
Americium-241/Be	60	1,600	0.6	16
Californium-252	20	540	0.2	5.4
Curium-244	50	1,400	0.5	14
Cobalt-60	30	810	0.3	8.1
Cesium-137	100	2,700	1.0	27
Gadolinium-153	1,000	27,000	10.0	270
Iridium-192	80	2,200	0.8	22
Plutonium-238[2]	60	1,600	0.6	16
Plutonium-239/Be[2]	60	1,600	0.6	16
Promethium-147	40,000	1,100,000	400	11,000
Radium-226[a]	40	1,100	0.4	11
Selenium-75	200	5,400	2.0	54
Strontium-90 (Y-90)	1,000	27,000	10.0	270
Thulium-170	20,000	540,000	200	5,400
Ytterbium-169	300	8,100	3.0	81

[1] The values to be used to determine whether a license is required are given in TBq. Curie (Ci) values are provided for practical usefulness only and are rounded after conversion.
[2] The limits for Pu-238 and Pu-239/Be in this table apply for imports to the U.S. The limits for exports of Pu-238 and Pu-239/Be can be found in § 110.21.
[a] Discrete sources of radium-226.

Calculation of Shipments Containing Multiple Sources or Radionuclides

The "sum of fractions" methodology for evaluating combinations of radionuclides being transported, is to be used when import or export shipments contain multiple sources or multiple radionuclides. The threshold limit values used in a sum of the fractions calculation must be the metric values (i.e., TBq).

I. If multiple sources and/or multiple radionuclides are present in an import or export shipment, the sum of the fractions of the activity of each radionuclides must be determined to verify the shipment is less than the Category 1 or 2 limits of Table 1, as appropriate. If the calculated sum of the fractions ratio, using the following equation, is greater than or equal to 1.0, then the import or export shipment exceeds the threshold limits of Table 1 and the applicable security provisions of this part apply.

II. Use the equation below to calculate the sum of the fractions ratio by inserting the actual activity of the applicable radionuclides or of the individual sources (of the same radionuclides) in the numerator of the equation and the corresponding threshold activity limit from the Table 1 in the denominator of the equation. Ensure the numerator and denominator values are in the same units and all calculations must be performed using the TBq (i.e., metric) values of Table 1.

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R_1 = activity for radionuclides or source number 1
R_2 = activity for radionuclides or source number 2
R_N = activity for radionuclides or source number n
AR_1 = activity limit for radionuclides or source number 1
AR_2 = activity limit for radionuclides or source number 2
AR_N = activity limit for radionuclides or source number n

$$\sum_{1}^{n}\left[\frac{R_1}{AR_1}+\frac{R_2}{AR_2}+\frac{R_n}{AR_n}\right]\geq 1$$

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Section 4
Table: Radioactive Material
Proper Shipping Names and UN Numbers

Radioactive Material Proper Shipping Names and UN Numbers

1996 IAEA Regulations for the Safe Transport of Radioactive Material TS-R-1

UN	Proper Shipping Name for Excepted Packages
2910	Radioactive Material, Excepted Package - Limited Quantity of Material
2911	Radioactive Material, Excepted Package - Instruments *or* Articles
2909	Radioactive Material, Excepted Package - Articles Manufactured from Natural Uranium *or* Depleted Uranium *or* Natural Thorium
2908	Radioactive Material, Excepted Package - Empty Packaging

UN	Proper Shipping Name for Non-fissile or Fissile Excepted	UN	Proper Shipping Name for Fissile
2912	Radioactive Material, Low Specific Activity (LSA-I)		
3321	Radioactive Material, Low Specific Activity (LSA-II)	3324	Radioactive Material, Low Specific Activity (LSA-II), Fissile
3322	Radioactive Material, Low Specific Activity (LSA-III)	3325	Radioactive Material, Low Specific Activity (LSA-III), Fissile
2913	Radioactive Material, Surface Contaminated Objects (SCO-I *or* SCO-II)	3326	Radioactive Material, Surface Contaminated Objects (SCO-I *or* SCO-II), Fissile
2915	Radioactive Material, Type A Package	3327	Radioactive Material, Type A Package, Fissile
3332	Radioactive Material, Type A Package, Special Form	3333	Radioactive Material, Type A Package, Special Form, Fissile
2916	Radioactive Material, Type B(U) Package	3328	Radioactive Material, Type B(U) Package, Fissile
2917	Radioactive Material, Type B(M) Package	3329	Radioactive Material, Type B(M) Package, Fissile
3323	Radioactive Material, Type C Package	3330	Radioactive Material, Type C Package, Fissile
2919	Radioactive Material, Transported Under Special Arrangement	3331	Radioactive Material, Transported Under Special Arrangement, Fissile
2978	Radioactive Material, Uranium Hexafluoride (Corrosive)	2977	Radioactive Material, Uranium Hexafluoride, Fissile (Corrosive)

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Section 5
Examples of Excepted Packages: Limited Quantities of Radioactive Materials Instruments *and* Articles

Radioactive Materials Transportation Seminar

Excepted Package
Limited Quantity of Material
Instruments and Articles

State	Form	Material	Instruments and Articles	
		Package Limit	Item Limit	Package Limit
Solids	Special Form	10^{-3} A_1	10^{-2} A_1	A_1
	Normal Form	10^{-3} A_2	10^{-2} A_2	A_2
Liquids	(Not Tritium)	10^{-4} A_2	10^{-3} A_2	10^{-1} A_2
Gases	Tritium	20 Ci	20 Ci	200 Ci
	Special Form	10^{-3} A_1	10^{-3} A_1	10^{-2} A_1
	Normal Form	10^{-3} A_2	10^{-3} A_2	10^{-2} A_2

1. Can 3 mCi I-125 as a liquid be shipped as an excepted package - limited quantity of radioactive material?
   a. Liquid implies that it is normal form. Therefore, the A_2 quantity is applicable and the A_2 quantity for I-125 is 81 Ci.
   b. The material quantity limit is 10^{-4} A_2 where A_2 = 81 Ci is 8.11 mCi therefore 3 mCi of I-125 may be shipped as a limited quantity of radioactive material.
   c. The package must meet the general packaging requirements.
   d. The inner package must be marked "Radioactive"
   e. The maximum radiation level on the surface of the package must not exceed 0.5 mrem/hr.
   f. The package must be marked UN2910. Alternatively the Radioactive Material - Excepted Package label may be used.
   g. 49 CFR requirements met.
   h. IATA: The air waybill should contain the following statement in the "Handling Information" box (not required by 49 CFR):
      Radioactive Material, excepted package - limited quantity of material, UN2910.

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2. Can a 100 mCi Cs-137 special form sealed source in a portable density gauge be shipped as an excepted package - instrument.

   a. Special form indicates that the A_1 quantity is applicable and the A_1 quantity for Cs-137 is 54 Ci. The instrument quantity limit in an excepted package is 10^{-2} A_1 where A_1 = 54 Ci is 540 mCi, therefore 100 mCi of Cs-137 as special form sealed source may be shipped as an instrument in an excepted package provided the maximum radiation level at 4 inches from the instrument does not exceed 10 millirem per hour.

   b. Since the package limit for this item is A_1 = 54 Ci then a maximum of 540 such instruments may be placed in the excepted package provided the conditions below are met.

   c. The package must meet the general packaging requirements.
   d. Each instrument is marked "Radioactive"
   e. The maximum radiation level on the surface of the package must not exceed 0.5 mrem/hr.
   f. The package must be marked UN2911. Alternatively the Radioactive Material - Excepted Package label may be used.
   g. 49 CFR requirements met
   h. IATA: The air waybill should contain the following statement in the "Handling Information" box (not required by 49 CFR):
      Radioactive Material, excepted package - instrument(s), UN2911

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Section 6
Type A Packaging Requirements

Type A Packaging

49 CFR 173.415(a) reads:

> (a) DOT Specification 7A (Sec. 178.350 of this subchapter) 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 shall 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. Use of Specification 7A packagings designed in accordance with the requirements of Sec. 178.350 of this subchapter in effect on June 30, 1983 (see 49 CFR Part 178 revised as of October 1, 1982), is not authorized after April 1, 1997.

A foreign-made Type A packaging is governed by 49 CFR 173.415(d):

> (d) Any foreign-made packaging that meets the standards in IAEA ``Safety Series No. 6'' and bears the marking ``Type A'' and was used for the import of Class 7 (radioactive) materials. Such packagings may be subsequently used for domestic and export shipments of Class 7 (radioactive) materials provided the offeror obtains the applicable documentation of tests and engineering evaluations and maintains the documentation on file in accordance with paragraph (a) of this section. 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.

Complete documentation is understood contain all of the following and each item should be address even if it is not applicable:

1. 49 CFR 173.410 General design requirements.

> In addition to the requirements of subparts A and B of this part, each package used for the shipment of Class 7 (radioactive) materials must be designed so that--
>
> (a) The package can be easily handled and properly secured in or on a conveyance during transport.
>
> (b) Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of this subpart. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.
>
> (c) The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.
>
> (d) The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.
>
> (e) Each feature that is added to the package will not reduce the safety of the package.

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(f) The package will be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (see Secs. 173.24, 173.24a, and 173.24b).

(g) The materials of construction of the packaging and any components or structure will be physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation will be taken into account.

(h) All valves through which the package contents could escape will be protected against unauthorized operation;

(i) For transport by air--

(1) The temperature of the accessible surfaces of the package will not exceed 50 deg.C (122 deg.F) at an ambient temperature of 38 deg.C (100 deg.F) with no account taken for insulation;

(2) The integrity of containment will not be impaired if the package is exposed to ambient temperatures ranging from -40 deg.C (-40 deg.F) to +55 deg.C (131 deg.F); and

(3) Packages containing liquid contents will be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than 95 kPa (13.8 lb/sq. in.).

2. 49 CFR 173.412 Additional design requirements for Type A packages.

In addition to meeting the general design requirements prescribed in Sec. 173.410, each Type A packaging must be designed so that--

(a) The outside of the packaging incorporates a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been opened. In the case of packages shipped in closed transport vehicles in exclusive use, the cargo compartment, instead of the individual packages, may be sealed.

(b) The smallest external dimension of the package is not less than 10 centimeters (4 inches).

(c) Containment and shielding is maintained during transportation and storage in a temperature range of -40 deg.C (-40 deg.F) to 70 deg.C (158 deg.F). Special attention shall be given to liquid contents and to the potential degradation of the packaging materials within the temperature range.

(d) The packaging must include a containment system securely closed by a positive fastening device that cannot be opened unintentionally or by pressure that may arise within the package during normal transport. Special form Class 7 (radioactive) material, as demonstrated in accordance with Sec. 173.469, may be considered as a component of the containment system. If the containment system forms a separate unit of the package, it must be securely closed by a positive fastening device that is independent of any other part of the package.

(e) For each component of the containment system account is taken, where applicable, of radiolytic decomposition of materials and the generation of gas by chemical reaction and radiolysis.

(f) The containment system will retain its radioactive contents under the reduction of ambient pressure to 25 kPa (3.6 pounds per square inch).

(g) Each valve, other than a pressure relief device, is provided with an enclosure to retain any leakage.

(h) Any radiation shield that encloses a component of the packaging specified as part of the containment system will prevent the unintentional escape of that component from the shield.

(i) Failure of any tie-down attachment that is a structural part of the packaging, under both normal and accident conditions, must not impair the ability of the package to meet other requirements of this subpart.

(j) When evaluated against the performance requirements of this section and the tests specified in Sec. 173.465 or using any of the methods authorized by Sec. 173.461(a), the packaging will prevent--

(1) Loss or dispersal of the radioactive contents; and

(2) A significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test.

(k) Each packaging designed for liquids will--

(1) Be designed to provide for ullage to accommodate variations in temperature of the contents, dynamic effects and filling dynamics;

(2) Meet the conditions prescribed in paragraph (j) of this section when subjected to the tests specified in Sec. 173.466 or evaluated against these tests by any of the methods authorized by Sec. 173.461(a); and

(3) Either--

(i) Have sufficient suitable absorbent material to absorb twice the volume of the liquid contents. The absorbent material must be compatible with the package contents and suitably positioned to contact the liquid in the event of leakage; or

(ii) Have a containment system composed of primary inner and secondary outer containment components designed to assure retention of the liquid contents within the secondary outer component in the event that the primary inner component leaks.

(l) Each package designed for gases, other than tritium not exceeding 40 TBq (1000Ci) or noble gases not exceeding the A2 value appropriate for the noble gas, will be able to prevent loss or dispersal of contents when the package is subjected to the tests prescribed in Sec. 173.466 or evaluated against these tests by any of the methods authorized by Sec. 173.461(a).

3. 49 CFR 173.465 Type A packaging tests.

(a) The packaging, with contents, must be capable of withstanding the water spray, free drop, stacking and penetration tests prescribed in this section. One prototype may be used for all tests if the requirements of paragraph (b) of this section are met.

(b) Water spray test. The water spray test must precede each test or test sequence prescribed in this section. The water spray test must simulate exposure to rainfall of approximately 5 centimeters (2 inches) per hour for at least one hour. The time interval between the end of the water spray test and the beginning of the next test must be such that the water has soaked in to the maximum extent without appreciable drying of the exterior of the specimen. In the absence of evidence to the contrary, this interval may be assumed to be two hours if the water spray is applied from four different directions simultaneously. However, no time interval may elapse if the water spray is applied from each of the four directions consecutively.

(c) Free drop test. The specimen must drop onto the target so as to suffer maximum damage to the safety features being tested, and:

(1) The height of the drop measured from the lowest point of the specimen to the upper surface of the target may not be less than the distance specified in Table 12, for the applicable package mass. The

target must be as specified in Sec. 173.465(c)(5). Table 12 is as follows:

Table 12.--Free Drop Distance for Testing Packages to Normal Conditions of Transport

Packaging mass	Free drop distance	
Kilograms (pounds)	Meters	(Feet)
< Mass 5000 (11,000).....	1.2	(4)
5,000 (11,000) Mass to 10,000 (22,000)....	0.9	(3)
10,000 (22,000) Mass to 15,000 (33,000)...	0.6	(2)
> 15,000 (33,000) Mass.....	0.3	(1)

(2) For packages containing fissile material, the free drop test specified in paragraph (c)(1) of this section must be preceded by a free drop from a height of 0.3 meter (1 foot) on each corner, or in the case of cylindrical packages, onto each of the quarters of each rim.

(3) For fiberboard or wood rectangular packages with a mass of 50 kilograms (110 pounds) or less, a separate specimen must be subjected to a free drop onto each corner from a height of 0.3 meter (1 foot).

(4) For cylindrical fiberboard packages with a mass of 100 kilograms (220 pounds) or less, a separate specimen must be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 meter (1 foot).

(5) The target for the free drop test must be a flat, horizontal surface of such mass and rigidity that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

(d) Stacking test. (1) The specimen must be subjected for a period of at least 24 hours to a compressive load equivalent to the greater of the following:

(i) Five times the mass of the actual package; or

(ii) The equivalent of 13 kilopascals (1.9 pounds per square inch) multiplied by the vertically projected area of the package.

(2) The compressive load must be applied uniformly to two opposite sides of the specimen, one of which must be the base on which the package would normally rest.

(e) Penetration test. For the penetration test, the specimen must be placed on a rigid, flat, horizontal surface that will not move significantly while the test is being performed.

(1) A bar of 3.2 centimeters (1.25 inches) in diameter with a hemispherical end and a mass of 6 kilograms (13.2 pounds) must be dropped and directed to fall with its longitudinal axis vertical, onto the center of the weakest part of the specimen, so that, if it penetrates far enough, it will hit the containment system. The bar may not be significantly deformed by the test; and

(2) The height of the drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen must be 1 meter (3.3 feet) or greater.

4. 49 CFR 173.466 Additional tests for Type A packagings designed for liquids and gases.

(a) In addition to the tests prescribed in Sec. 173.465, Type A packagings designed for liquids and gases must be capable of withstanding the following tests:

(1) Free drop test. The packaging specimen must drop onto the target so as to suffer the maximum damage to its containment. The height of the drop measured from the lowest part of the packaging specimen to the upper surface of the target must be 9 meters (30 feet) or greater. The target must be as specified in Sec. 173.465(c)(5).

(2) Penetration test. The specimen must be subjected to the test specified in Sec. 173.465(e) except that the height of the drop must be 1.7 meters (5.5 feet).

Section 7
Examples of Shipping Papers and Declarations

Shipping Paper/Declaration

1. 49 CFR U.S. Regulations

   RQ UN2915, Radioactive material, Type A Package, 7
   I-131 solid salt 740 MBq
   TI 2.5 Yellow III
   Type B Certificate Number (if applicable) USA/9999/B(U)
   Cargo Aircraft Only (if applicable)
   Twenty-four hour telephone number

   Certification (if not private carrier):
   This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper conditions for transportation according to the applicable regulations of the Department of Transportation.

   Certification for medical or research and TI not greater than 3.0
   This shipment contains radioactive material intended for or use in, or incident to, research, or medical diagnosis or treatment.

   Certifications for air shipment
   This shipment is within the limitations prescribed for passenger aircraft/cargo aircraft only (delete non-applicable)

   I declare that all the applicable air transport requirements have been met. (Mandatory October 1, 2006)

   Certification signatures: printed or mechanical permitted.

2. IATA Declarations
   Transport Details:
   This shipment is within the limitations prescribed for PASSENGER AND CARGO AIRCRAFT / CARGO AIRCRAFT ONLY (delete non-applicable)

   Shipment Type:
   NON-RADIOACTIVE / RADIOACTIVE (delete non-applicable)

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Nature and Quantity of Goods:
- Dangerous Goods Identification
  - Reportable Quantity: RQ (if applicable)
  - UN or ID No: UN2915
  - Proper Shipping Name: Radioactive Material, Type A Package
  - Class or Division: 7
  - Packing Group: not applicable unless subsidiary risk
  - Subsidiary Risk: if applicable class or division number
- Quantity and Type of Packing:
  - I-131, solid salt, 1 Type A package x 740 MBq
- Packing Instructions:
  - Yellow III, 2.5 TI, 30 cm x 30 cm x 30 cm
- Authorization:
  - Special Form certificate number when applicable (not required for domestic shipment) (attach copy for international shipments) e.g. USA/1234/S
  - Type B Package certificate number when applicable (attach copy for international shipments) e.g. USA/9876/B(U)
- Additional Handling Information:
  - Twenty four hour emergency number if no other place on declaration
  - Research or Medical use certification if not built into form I declare that all the applicable air transport requirements have been met.
  - This shipment may be carried on passenger aircraft outside U.S. jurisdiction.
- Basic certification statement preprinted on IATA Declarations.
- Signature Block
  - Name and Title of individual signing declaration
  - Place and Date of signing the declaration
  - Signature: May be written or in the form of a printed or stamped facsimile of the signature.

Alterations and Amendments: Must be signed by the shipper with the same signature used to sign the declaration.

3. Free Form IATA Declarations (recommended)
   The Nature and Quantity of Goods section may be completed by clearly separating each sequence of information using commas and separate lines. e.g.

   RQ UN2915 Radioactive Material, Type A Package, 7
   I-131, solid salt, 1 DOT 7A Type A package x 740 MBq
   Yellow III, 2.5 TI, 30 cm x 30 cm x 30 cm
   USA/1234/S, USA/9876/B(U) (when applicable)

Section 8
Examination

Radioactive Materials Transportation Seminar

Name _____

Company _____

Course Location: AAPM Indianapolis, Indiana Date: August 6, 2013
Instructor: Roy A. Parker, Ph.D.

1. Transport Index is defined as:
   A. The maximum radiation level in units of mrem/hr and rounded up to the next tenth mrem/hr measured at one meter from the surface of a radioactive material package.
   B. The maximum radiation level in units of mrem/hr and rounded up to the next tenth mrem/hr measured at the surface of a radioactive material package.
   C. The average radiation level in units of mrem/hr and rounded up to the next tenth mrem/hr measured at one meter from the surface of a radioactive material package.
   D. The maximum radiation level in units of mrem/hr and rounded up to the next tenth mrem/hr measured at two meters from the surface of a radioactive material package.

2. A Curie, millicurie, microcurie, Becquerel, gigabecquerel or terabecquerel represents a measure of the:
   A. Quantity of radioactive material in lieu of a weight or volume measurement.
   B. Weight of the package containing the radioactive material.
   C. Sum of the length, width and height of the package containing the radioactive material.
   D. Total number of packages transported on a vehicle.

3. Radioactive placards are not required on the vehicle when transporting one or more Radioactive Yellow-III labeled packages.
   A. True
   B. False

4. An radionuclide which has a specific activity below its listed "activity concentration limit for exempt material" is required to be shipped as a hazardous material or dangerous goods commodity.
   A. True
   B. False

5. A package containing 30 Ci of Iridium-192 as special form material is properly classified as:
   A. Limited Quantity
   B. Type A Quantity
   C. Type B Quantity
   D. Low Specific Activity
   E. Highway Route Controlled Quantity

6. A total activity of 5 mCi of Iodine-125 in liquid form may be shipped as a Radioactive Material, Excepted Package - Limited Quantity of Material, provided that the surface radiation level on the package does not exceed 0.5 mrem/hr.
   A. True
   B. False

7. When a radioactive material package is required to be labeled with a Radioactive White I, Radioactive Yellow II or Radioactive Yellow III label, then two such labels are required on opposite sides of the package.
   A. True
   B. False

8. A package which has a maximum 75 mrem/hr surface reading and the TI = 0.9 is properly categorized and labeled as:
   A. Radioactive White I
   B. Radioactive Yellow II
   C. Radioactive Yellow III
   D. Cargo-Only Aircraft
   E. Highway Route Controlled Quantity

9. A 5 Ci Molybdenum-99 generator is being shipped to Gotham City General Hospital for medical purposes. The package has a maximum 60 mrem/hr surface reading and the TI = 3.5. This package can be transported on a passenger carrying aircraft.
   A. True
   B. False

10. The following contains all the information for a correct descriptive entry on a declaration or shipping paper:

    UN2915, Radioactive material, Type A Package, 7
    Mo-99, solid salt, 1 Type A package x 111 GBq,
    Radioactive Yellow II, TI 0.8, Dimensions 38 cm x 38 cm x 46 cm.

    A. True
    B. False