

**CPR PART 4**

**REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL  
IN THE PHILIPPINES**

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**REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL  
IN THE PHILIPPINES**

**CPR PART 4**

**I. GENERAL PROVISIONS**

**Section 1. Purpose.**

- (a) The regulations in this Part establish standards of safety to protect persons, property and the environment from the hazardous effects of radiation associated with the transport of radioactive material in the Philippines.
- (b) This Part also establishes:
  - (1) Requirements for packagings and packages, preparation for shipment, and transport of radioactive materials; and
  - (2) Procedures and standards for the control of shipments and for the approval of packagings and packages.

**Section 2. Scope.**

- (a) The regulations in this Part shall apply to the transport of radioactive material in the Philippines by air, land or water.
- (b) The regulations in this Part do not apply to:
  - (1) Radioactive material that is an integral part of the means of transport (e.g. nuclear-propelled vehicles);
  - (2) Radioactive material moved within an establishment which is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
  - (3) Radioactive material implanted or incorporated into a person or live animal either for diagnostic or therapeutic purposes;
  - (4) Natural material and ores containing naturally occurring radionuclide which are not intended to be processed for the purpose of using this radionuclide, provided further that, the activity concentration of the radioactive material does not exceed ten (10) times the specified  $A_1$  and  $A_2$  values for radionuclides; and
  - (5) Radioactive material in consumer products which have received regulatory approval, following their sale to the end user.
- (c) The regulations in this Part do not require a license for common and contract carriers and freight forwarders who transport or store radioactive material in the regular course of carriage or storage incident thereto.
- (d) As it deems appropriate or necessary, specific provisions of the IAEA Safety Standards Series No. TS-R-1 (ST-1, Revised), "Regulations for the Safe Transport of Radioactive

Material”, which are not addressed in this Part, may be enforced pursuant to PNRI Administrative Order No. 1, Series of 2000.

- (e) The requirements of this Part are in addition to, and not in substitution for, other requirements of the Code of PNRI Regulations.
- (f) Nothing in this Part relieves any person from complying with applicable regulations of other government agencies having jurisdiction over the means of transport.

### **Section 3. Definitions.**

As used in this Part\*:

- (a) “**A<sub>1</sub>**” means the maximum activity of special form radioactive material permitted in a Type A package;
- (b) “**A<sub>2</sub>**” means the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package;
- (c) “**Carrier**” means any person, including freight forwarders, engaged in the transport of radioactive material by land, air or water, as a common or contract carrier, or private entity;
- (d) “**Certificate of Transport (CT)**” means the document certifying that the package meets the requirements for the safe transport of radioactive material in accordance with this Part;
- (e) “**Competent Authority**” means the Philippine Nuclear Research Institute and its duly authorized representative;
- (f) “**Consignee**” means any person which receives a consignment;
- (g) “**Consignment**” means any package or packages, or load of radioactive material, presented by a consignor for transport;
- (h) “**Consignor**” means any person which prepares a consignment for transport, and is named as consignor in the transport documents;
- (i) “**Containment System**” means the components of the packaging intended to retain and contain the radioactive material during transport;
- (j) “**Contamination**” means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm<sup>2</sup> for all other alpha emitters,
  - (1) “**Non-fixed Contamination**” means contamination that can be removed from a surface during routine conditions of transport,
  - (2) “**Fixed Contamination**” means contamination other than non-fixed contamination;
- (k) “**Criticality Safety Index**” means the number that is assigned to a package (or overpack, freight container, or conveyance) containing fissile material, which is used to provide control over the accumulation of groups of such packages for the purpose of preventing unintentional criticality;
- (l) “**Excepted Package**” means a package in which the radioactive material content is restricted to such low levels that the potential hazards are insignificant and therefore no testing is required with regard to containment or shielding integrity;

- (m) “**Exclusive Use**” means the sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee;
- (n) “**Fissile Material**” means uranium-233, uranium-235, plutonium-239, plutonium-241, or any combination of these radionuclides except:  
(1) natural uranium or depleted uranium which is unirradiated, and  
(2) natural uranium or depleted uranium which has been irradiated in thermal reactors only;
- (o) “**Freight Container**” means an article of transport equipment designed to facilitate the transport of goods, either packaged or unpackaged, by one or more modes of transport without intermediate reloading;
- (p) “**Industrial Package**” means a package used to transport certain low specific activity material and surface contaminated objects;
- (q) “**Licensee**” means the consignor or consignee who is a holder of a PNRI license issued pursuant to Code of PNRI Regulations;
- (r) “**Low Dispersible Radioactive Material**” means either a solid radioactive material or a solid radioactive material in a sealed capsule, that has limited dispersibility and is not in powder form;
- (s) “**Low Specific Activity (LSA) Material**” means radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply. External shielding materials surrounding the LSA material shall not be considered in determining the estimated average specific activity;
- **LSA-I**
    - (i) Uranium and thorium ores and concentrates of such ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;
    - (ii) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures;
    - (iii) Radioactive material for which the  $A_2$  value is unlimited, excluding fissile material in quantities not excepted under **Section 51A**; or
    - (iv) Other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in **Sections 21-22**.
  - **LSA-II**
    - (i) Water with tritium concentration up to 0.8 TBq/L; or
    - (ii) Other material in which the activity is distributed throughout and the estimated average specific activity does not exceed  $10^{-4} A_2/g$  for solids and gases, and  $10^{-5} A_2/g$  for liquids.
  - **LSA-III**

Solids (e.g., consolidated wastes, activated materials), excluding powders, in which:

    - (i) The radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent such as concrete, bitumen, ceramic, etc.;
    - (ii) The radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble matrix, so that, even under loss of packaging, the loss of radioactive material per package by leaching when placed in water for seven days would not exceed **0.1  $A_2$** ; and
    - (iii) The estimated average specific activity of the solid, excluding any shielding material, does not exceed  $2 \times 10^{-3} A_2/g$ ;

- (t) **“Overpack”** means an enclosure such as box or bag which is used by a single consignor to facilitate as a handling unit a consignment of one or more packages for convenience of handling, stowage and carriage;
- (u) **“Package”** means the packaging together with its radioactive contents as presented for transport;
- (v) **“Packaging”** means the assembly of components necessary to enclose the radioactive contents completely. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging;
- (w) **“Person”** means:
- (1) any individual, firm, partnership, association, trust, estate, private or public body, whether corporate or not, or government agency other than PNRI, or any province, city, municipality, or any political subdivision or entity within the Philippines; and
  - (2) any legal successor, representative, agent or agency of the foregoing;
- (x) **“Quality Assurance”** means a systematic program of controls and inspections applied by the licensee, in the transport of radioactive material aimed at providing adequate confidence that the standard of safety prescribed in this Part is achieved in practice;
- (y) **“Radiation Level”** means the corresponding dose rate expressed in millisieverts per hour (mSv/h);
- (z) **“Radioactive Contents”** means the radioactive material together with any contaminated or activated solids, liquids and gases within the packaging;
- (aa) **“Radioactive Material”** means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the basic radionuclide values specified in this Part;
- (bb) **“Shipment”** means the specific movement of a consignment from origin to destination;
- (cc) **“Special Arrangement”** means the provisions for transport, approved by the competent authority, under which consignments that do not satisfy all the applicable requirements of this Part may be transported;
- (dd) **“Special Form Radioactive Material”** means either an indispersible solid radioactive material or a sealed capsule containing radioactive material;
- (ee) **“Specific Activity”** means the activity per unit mass of a particular radionuclide or, as the case may be, the activity per unit mass or volume of the material in which the radionuclides are essentially uniformly distributed;
- (ff) **“Surface Contaminated Object (SCO)”** means a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces;
- **SCO-I:** A solid object on which:
    - (i) the *non-fixed contamination* on the accessible surface averaged over 300 cm<sup>2</sup> ( or the area of the surface if less than 300 cm<sup>2</sup>) does not exceed **4 Bq/cm<sup>2</sup>** for beta and gamma emitters and low toxicity alpha emitters, or **0.4 Bq/cm<sup>2</sup>** for all other alpha emitters; and
    - (ii) the *fixed contamination* on the accessible surface averaged over 300 cm<sup>2</sup> does not exceed **4 x 10<sup>4</sup> Bq/cm<sup>2</sup>** for beta and gamma emitters and low toxicity alpha

- emitters, or  $4 \times 10^3 \text{ Bq/cm}^2$  for all other alpha emitters; and
- (iii) the *non-fixed contamination* plus the *fixed contamination* on the inaccessible surface averaged over  $300 \text{ cm}^2$  does not exceed  $4 \times 10^4 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $4 \times 10^3 \text{ Bq/cm}^2$  for all other alpha emitters.
- **SCO-II:** A solid object on which either the fixed or non-fixed contamination on the surface exceeds the applicable limits specified for SCO-I above and on which:
    - (i) the *non-fixed contamination* on the accessible surface averaged over  $300 \text{ cm}^2$  (or the area of the surface if less than  $300 \text{ cm}^2$ ) does not exceed  $400 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $40 \text{ Bq/cm}^2$  for all other alpha emitters; and
    - (ii) the *fixed contamination* on the accessible surface averaged over  $300 \text{ cm}^2$  does not exceed  $8 \times 10^5 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $8 \times 10^4 \text{ Bq/cm}^2$  for all other alpha emitters; and
    - (iii) the *non-fixed contamination* plus the *fixed contamination* on the inaccessible surface averaged over  $300 \text{ cm}^2$  does not exceed  $8 \times 10^5 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $8 \times 10^4 \text{ Bq/cm}^2$  for all other alpha emitters;
- (gg) “**Transport Index**” means the dimensionless number assigned to a package, overpack or freight container, or to unpackaged LSA-I or SCO-I, which is used to provide control over radiation exposure during transport or storage in transit;
- (hh) “**Type A Package**” means a package, overpack or freight container wherein the activity of the radioactive content shall not be greater than  $A_1$ , for special form radioactive material; or  $A_2$ , for all other radioactive material; and
- (ii) “**Type B Package**” means a package, overpack or freight container wherein the activity of the radioactive content is greater than that of a Type A package.
- **Type B (M) package** means a Type B package that requires **multilateral approval** or the approval by the relevant competent authority of the country of origin of the design or shipment and of each country through or into which the consignment is to be transported.
  - **Type B (U) package** means a Type B package that requires **unilateral approval** or an approval of a design to be given only by the competent authority of the country of origin of the design.
- \*Note:** *Terms defined in the Act and in other Parts of the Code of PNRI Regulations (CPR) shall have the same meaning when used in this Part to the extent that such terms are not specifically defined in this Part.*

#### **Section 4. Interpretation.**

Except as specifically authorized by the PNRI Director in writing, no interpretation of the meaning of the regulations in this Part by any officer or employee of PNRI other than a written interpretation of the Director will be recognized to be binding upon PNRI.

#### **Section 5. Communication.**

All communication and reports concerning the regulations in this Part should be addressed to the Director, Philippine Nuclear Research Institute, Commonwealth Avenue, Diliman, Quezon City, Philippines.



## **Section 6. Specific Regulatory Exemptions.**

PNRI may, on its own initiative or upon application by any concerned person, grant exemptions from the requirements in this Part as it determines are authorized by law and will not endanger life, property and the public interest.

## **Section 7. Transport Regulations Addressed by Other National Modal Agencies.**

PNRI shall apply, as may be practicable, specific provisions of the International Maritime Dangerous Goods (IMDG) Code, Safety of Life at Sea (SOLAS), International Air Transport Association (IATA) Dangerous Goods Regulations, International Civil Aviation Organization (ICAO) Technical Instructions, and relevant regulations adopted by other national modal agencies on transport.

## **Section 8. Additional Requirements.**

PNRI may, by rule, regulation, or order, impose such requirements in addition to those established in these regulations, as it deems appropriate or necessary in the national interest to protect health or to minimize danger to life or property.

## **Section 9. Radiation Safety.**

- (a) Each licensee shall establish a radiation protection program for the transport of radioactive materials. The nature and extent of the radiation protection measures shall be related to the magnitude and likelihood of radiation exposures. A structured and systematic approach to optimize protection and safety shall be adopted and shall include consideration of the interfaces between transport and other activities. The program shall incorporate the requirements of **Sections 9 and 10**.
- (b) Transport workers shall receive appropriate training on radiation safety and the precautions to be observed in order to ensure restriction of their exposure and that of other individuals who might be affected by their actions. The radiation doses to these individuals involved in the transport activity must be periodically assessed to ensure that the system of protection and safety employed in the activity complies with regulations for radiation protection.
- (c) For occupational exposures arising from transport activities, if it is assessed that:
  - (1) the effective dose is most unlikely to exceed **1 mSv** in a year, it shall not be required to perform special work patterns, detailed monitoring, dose assessment programs or individual record keeping.
  - (2) the effective dose is likely to be between **1 and 6 mSv** in a year, it shall be required to conduct a dose assessment program through workplace monitoring or individual monitoring.
  - (3) the effective dose is likely to exceed **6 mSv** in a year, it shall be required to conduct individual monitoring.

Appropriate records shall be kept when individual monitoring or workplace monitoring is conducted.

- (d) Radioactive material shall be segregated sufficiently from workers and from members of the public so as not to exceed a dose of **5 mSv** in a year to workers in regularly occupied working areas and **1 mSv** in a year to the critical group in areas where the public has regular access.

- (e) Radioactive material shall be sufficiently segregated from undeveloped photographic film to ensure that the radiation exposure of undeveloped photographic film be limited to **0.1 mSv** per consignment of such film.

#### **Section 10. Emergency Response.**

- (a) In the event of accidents or incidents during the transport of radioactive material, the consignor and the carrier shall observe emergency response measures as established by relevant organizations. Such measures should include at least the following actions:
  - (1) Immediate notification of PNRI, police and fire authorities;
  - (2) Rescue of victims and administration of emergency medical aid to those injured;
  - (3) Control of fire, spillage, leakage and spread of contamination;
  - (4) Identification of hazards and determining actions required to prevent further threat to human life, property or the environment;
  - (5) Installation of radiation signages and barriers to minimize exposures to the public and responding authorities; and
  - (6) Decontamination of personnel and restoring the vicinity to a safe state.
- (b) Emergency procedures shall take into account the formation of other dangerous substances that may result from reaction between the contents of a consignment and the environment in the event of an accidental break of the containment system.
- (c) The transport vehicle for the radioactive consignment shall be equipped to respond to any transport accident.

#### **Section 11. Quality Assurance.**

The licensee shall establish and implement quality assurance programs, as applicable, based on international, national or other standards acceptable to PNRI for the design, manufacture, testing, documentation, use, maintenance and inspection of all special form radioactive material, low dispersible radioactive material and packages, and for transport and in-transit storage operations. Validation of the certification that the design specification has been fully implemented shall be available to PNRI. The licensee shall be prepared to provide facilities for inspection by PNRI to demonstrate that all packagings are periodically inspected and, as necessary, repaired and maintained in good condition so that they continue to comply with all relevant requirements and specifications, even after repeated use.

#### **Section 12. Special Arrangement.**

- (a) If consignments do not satisfy all the applicable requirements of this Part, it may be transported under a special arrangement operation approved by PNRI, provided that the overall level of safety in transport shall be at least equivalent to that level of safety if all the requirements had been met.
- (b) A consignment that is delivered for international transport under special arrangement shall require multilateral approval.

## II. ACTIVITY LIMITS AND MATERIAL RESTRICTIONS

### Section 21. Determination of Basic Radionuclide Values.

- (a) The following basic values for individual radionuclides are given in **Table I**:
- (1)  $A_1$  and  $A_2$  in Tbq;
  - (2) activity concentration for exempt material in Bq/g; and
  - (3) activity limits for exempt consignments in Bq.
- (b) For individual radionuclides which are not listed in **Table I**, the determination of the basic radionuclide values referred in (a) of this section shall require competent authority approval or, for international transport, multilateral approval. Alternatively, the radionuclide values in **Table II** may be used without obtaining competent authority approval.
- (c) In the calculations of  $A_1$  and  $A_2$  for a radionuclide not in **Table I**, a single radioactive decay chain in which the radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide, shall be considered as a single radionuclide; and the activity to be taken into account and the  $A_1$  or  $A_2$  value to be applied shall be those corresponding to the parent nuclide of that chain.
- (d) In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and such daughter nuclides shall be considered as mixtures of different nuclides.
- (e) The basic radionuclide values for mixtures of radionuclides may be determined as follows:

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

where:

**f(i)** is the fraction of activity or activity concentration of radionuclide **i** in the mixture;

**X(i)** is the appropriate value of  $A_1$  or  $A_2$ , or the activity concentration for exempt material or the activity limit for an exempt consignment as appropriate for the radionuclide **i**; and

**X<sub>m</sub>** is the derived value of  $A_1$  or  $A_2$ , or the activity concentration for exempt material or the activity limit for an exempt consignment in the case of a mixture.

**TABLE I. BASIC RADIONUCLIDE VALUES**

Radionuclide (atomic number)	$A_1$	$A_2$	Activity concentration for exempt material	Activity limit for an exempt consignment
	(Tbq)	(Tbq)	(Bq/g)	(Bq)
Actinium (89)				
Ac-225 (a)	$8 \times 10^{-1}$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Ac-227 (a)	$9 \times 10^{-1}$	$9 \times 10^{-5}$	$1 \times 10^{-1}$	$1 \times 10^3$
Ac-228	$6 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Silver (47)				
Ag-105	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ag-108m (a)	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^6$ (b)

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Ag-110m (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ag-111	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Aluminum (13)				
Al-26	$1 \times 10^{-1}$	$1 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Americium (95)				
Am-241	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Am-242m (a)	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^4$ (b)
Am-243 (a)	$5 \times 10^0$	$1 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Argon (18)				
Ar-37	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^6$	$1 \times 10^8$
Ar-39	$4 \times 10^1$	$2 \times 10^1$	$1 \times 10^7$	$1 \times 10^4$
Ar-41	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Arsenic (33)				
As-72	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
As-73	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
As-74	$1 \times 10^0$	$9 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
As-76	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
As-77	$2 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Astatine (85)				
At-211 (a)	$2 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Gold (79)				
Au-193	$7 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Au-194	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Au-195	$1 \times 10^1$	$6 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Au-198	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Au-199	$1 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Barium (56)				
Ba-131 (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ba-133	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ba-133m	$2 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Ba-140 (a)	$5 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Beryllium (4)				
Be-7	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Be-10	$4 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Bismuth (83)				
Bi-205	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Bi-206	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Bi-207	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Bi-210	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Bi-210m (a)	$6 \times 10^{-1}$	$2 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^5$
Bi-212 (a)	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Berkelium (97)				
Bk-247	$8 \times 10^0$	$8 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^4$
Bk-249 (a)	$4 \times 10^1$	$3 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Bromine (35)				
Br-76	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Br-77	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Br-82	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Carbon (6)				
C-11	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
C-14	$4 \times 10^1$	$3 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Calcium (20)				
Ca-41	Unlimited	Unlimited	$1 \times 10^5$	$1 \times 10^7$
Ca-45	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Ca-47 (a)	$3 \times 10^0$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Cadmium (48)				

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Cd-109	$3 \times 10^1$	$2 \times 10^0$	$1 \times 10^4$	$1 \times 10^6$
Cd-113m	$4 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Cd-115 (a)	$3 \times 10^0$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Cd-115m	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Cerium (58)				
Ce-139	$7 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ce-141	$2 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^2$
Ce-143	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Ce-144 (a)	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$ (b)	$1 \times 10^5$ (b)
Californium (98)				
Cf-248	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cf-249	$3 \times 10^0$	$8 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cf-250	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cf-251	$7 \times 10^0$	$7 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cf-252	$5 \times 10^{-2}$	$3 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cf-253 (a)	$4 \times 10^1$	$4 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Cf-254	$1 \times 10^{-3}$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^3$
Chlorine (17)				
Cl-36	$1 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Cl-38	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Curium (96)				
Cm-240	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Cm-241	$2 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Cm-242	$4 \times 10^1$	$1 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Cm-243	$9 \times 10^0$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Cm-244	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cm-245	$9 \times 10^0$	$9 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cm-246	$9 \times 10^0$	$9 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cm-247 (a)	$3 \times 10^0$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Cm-248	$2 \times 10^{-2}$	$3 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cobalt (27)				
Co-55	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Co-56	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Co-57	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^6$
Co-58	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Co-58m	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Co-60	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Chromium (24)				
Cr-51	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Cesium (55)				
Cs-129	$4 \times 10^0$	$4 \times 10^0$	$1 \times 10^2$	$1 \times 10^5$
Cs-131	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^6$
Cs-132	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^5$
Cs-134	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^4$
Cs-134m	$4 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
Cs-135	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Cs-136	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Cs-137 (a)	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
Copper (29)				
Cu-64	$6 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Cu-67	$1 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Dysprosium (66)				
Dy-159	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Dy-165	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Dy-166 (a)	$9 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Erbium (68)				

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Er-169	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Er-171	$8 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Europium (63)				
Eu-147	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Eu-148	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Eu-149	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Eu-150 (short lived)	$2 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Eu-150 (long lived)	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Eu-152	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Eu-152m	$8 \times 10^{-1}$	$8 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Eu-154	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Eu-155	$2 \times 10^1$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Eu-156	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Fluorine (9)				
F-18	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Iron (26)				
Fe-52 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Fe-55	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^6$
Fe-59	$9 \times 10^{-1}$	$9 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Fe-60 (a)	$4 \times 10^1$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Gallium (31)				
Ga-67	$7 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ga-68	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Ga-72	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Gadolinium (64)				
Gd-146 (a)	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Gd-148	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Gd-153	$1 \times 10^1$	$9 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Gd-159	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Germanium (32)				
Ge-68 (a)	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Ge-71	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Ge-77	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Hafnium (72)				
Hf-172 (a)	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Hf-175	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Hf-181	$2 \times 10^0$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Hf-182	Unlimited	Unlimited	$1 \times 10^2$	$1 \times 10^6$
Mercury (80)				
Hg-194 (a)	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Hg-195m (a)	$3 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Hg-197	$2 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Hg-197m	$1 \times 10^1$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Hg-203	$5 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^5$
Holmium (67)				
Ho-166	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
Ho-166m	$6 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Iodine (53)				
I-123	$6 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
I-124	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
I-125	$2 \times 10^1$	$3 \times 10^0$	$1 \times 10^3$	$1 \times 10^6$
I-126	$2 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
I-129	Unlimited	Unlimited	$1 \times 10^2$	$1 \times 10^5$
I-131	$3 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
I-132	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
I-133	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^6$

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
I-134	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
I-135 (a)	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Indium (49)				
In-111	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
In-113m	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
In-114m (a)	$1 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
In-115m	$7 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Iridium (77)				
Ir-189 (a)	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Ir-190	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ir-192	$1 \times 10^0$ (c)	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^4$
Ir-194	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Potassium (19)				
K-40	$9 \times 10^{-1}$	$9 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
K-42	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
K-43	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Krypton (36)				
Kr-81	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Kr-85	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^5$	$1 \times 10^4$
Kr-85m	$8 \times 10^0$	$3 \times 10^0$	$1 \times 10^3$	$1 \times 10^{10}$
Kr-87	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Lanthanum (57)				
La-137	$3 \times 10^1$	$6 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
La-140	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Lutetium (71)				
Lu-172	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Lu-173	$8 \times 10^0$	$8 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Lu-174	$9 \times 10^0$	$9 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Lu-174m	$2 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Lu-177	$3 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Magnesium (12)				
Mg-28 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Manganese (25)				
Mn-52	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Mn-53	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^9$
Mn-54	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Mn-56	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Molybdenum (42)				
Mo-93	$4 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^8$
Mo-99 (a)	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Nitrogen (7)				
N-13	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Sodium (11)				
Na-22	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Na-24	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Niobium (41)				
Nb-93m	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Nb-94	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Nb-95	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Nb-97	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Neodymium (60)				
Nd-147	$6 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Nd-149	$6 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Nickel (28)				
Ni-59	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^8$
Ni-63	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^5$	$1 \times 10^8$

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Ni-65	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Neptunium (93)				
Np-235	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Np-236 (short lived)	$2 \times 10^1$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
Np-236 (long lived)	$9 \times 10^0$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Np-237	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Np-239	$7 \times 10^0$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Osmium (76)				
Os-185	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Os-191	$1 \times 10^1$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Os-191m	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Os-193	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Os-194 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Phosphorus (15)				
P-32	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
P-33	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^5$	$1 \times 10^8$
Protactinium (91)				
Pa-230 (a)	$2 \times 10^0$	$7 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^6$
Pa-231	$4 \times 10^0$	$4 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Pa-233	$5 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Lead (82)				
Pb-201	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Pb-202	$4 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^6$
Pb-203	$4 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Pb-205	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^7$
Pb-210 (a)	$1 \times 10^0$	$5 \times 10^{-2}$	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
Pb-212 (a)	$7 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Palladium (46)				
Pd-103 (a)	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^3$	$1 \times 10^8$
Pd-107	Unlimited	Unlimited	$1 \times 10^5$	$1 \times 10^8$
Pd-109	$2 \times 10^0$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Promethium (61)				
Pm-143	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Pm-144	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Pm-145	$3 \times 10^1$	$1 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Pm-147	$4 \times 10^1$	$2 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Pm-148m (a)	$8 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Pm-149	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Pm-151	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Polonium (84)				
Po-210	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^4$
Praseodymium (59)				
Pr-142	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Pr-143	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Platinum (78)				
Pt-188 (a)	$1 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Pt-191	$4 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Pt-193	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Pt-193m	$4 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Pt-195m	$1 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Pt-197	$2 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Pt-197m	$1 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Plutonium (94)				
Pu-236	$3 \times 10^1$	$3 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Pu-237	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Pu-238	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$



Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Pu-239	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Pu-240	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^3$
Pu-241 (a)	$4 \times 10^1$	$6 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Pu-242	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Pu-244 (a)	$4 \times 10^{-1}$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Radium (88)				
Ra-223 (a)	$4 \times 10^{-1}$	$7 \times 10^{-3}$	$1 \times 10^2$ (b)	$1 \times 10^5$ (b)
Ra-224 (a)	$4 \times 10^{-1}$	$2 \times 10^{-2}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Ra-225 (a)	$2 \times 10^{-1}$	$4 \times 10^{-3}$	$1 \times 10^2$	$1 \times 10^5$
Ra-226 (a)	$2 \times 10^{-1}$	$3 \times 10^{-3}$	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
Ra-228 (a)	$6 \times 10^{-1}$	$2 \times 10^{-2}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Rubidium (37)				
Rb-81	$2 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Rb-83 (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Rb-84	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Rb-86	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Rb-87	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^7$
Rb (nat)	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^7$
Rhenium (75)				
Re-184	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Re-184m	$3 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Re-186	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Re-187	Unlimited	Unlimited	$1 \times 10^6$	$1 \times 10^9$
Re-188	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Re-189 (a)	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Re (nat)	Unlimited	Unlimited	$1 \times 10^6$	$1 \times 10^9$
Rhodium (45)				
Rh-99	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Rh-101	$4 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Rh-102	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Rh-102m	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Rh-103m	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Rh-105	$1 \times 10^1$	$8 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Radon (86)				
Rn-222 (a)	$3 \times 10^{-1}$	$4 \times 10^{-3}$	$1 \times 10^1$ (b)	$1 \times 10^3$ (b)
Ruthenium (44)				
Ru-97	$5 \times 10^0$	$5 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Ru-103 (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ru-105	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ru-106 (a)	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$ (b)	$1 \times 10^5$ (b)
Sulphur (16)				
S-35	$4 \times 10^1$	$3 \times 10^0$	$1 \times 10^5$	$1 \times 10^8$
Antimony (51)				
Sb-122	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^4$
Sb-124	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Sb-125	$2 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Sb-126	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Scandium (21)				
Sc-44	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Sc-46	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Sc-47	$1 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Sc-48	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Selenium (34)				
Se-75	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Se-79	$4 \times 10^1$	$2 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Silicon (14)				

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Si-31	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Si-32	$4 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Samarium (62)				
Sm-145	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Sm-147	Unlimited	Unlimited	$1 \times 10^1$	$1 \times 10^4$
Sm-151	$4 \times 10^1$	$1 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Sm-153	$9 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Tin (50)				
Sn-113 (a)	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
Sn-117m	$7 \times 10^0$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Sn-119m	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Sn-121m (a)	$4 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Sn-123	$8 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Sn-125	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Sn-126 (a)	$6 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Strontium (38)				
Sr-82 (a)	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Sr-85	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Sr-85m	$5 \times 10^0$	$5 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Sr-87m	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Sr-89	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Sr-90 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$ (b)	$1 \times 10^4$ (b)
Sr-91 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Sr-92 (a)	$1 \times 10^0$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tritium (1)				
T(H-3)	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^6$	$1 \times 10^9$
Tantalum (73)				
Ta-178 (long lived)	$1 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ta-179	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Ta-182	$9 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^4$
Terbium (65)				
Tb-157	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Tb-158	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Tb-160	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Technetium (43)				
Tc-95m (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Tc-96	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tc-96m (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Tc-97	Unlimited	Unlimited	$1 \times 10^3$	$1 \times 10^8$
Tc-97m	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
Tc-98	$8 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tc-99	$4 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^7$
Tc-99m	$1 \times 10^1$	$4 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Tellurium (52)				
Te-121	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Te-121m	$5 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^5$
Te-123m	$8 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Te-125m	$2 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Te-127	$2 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Te-127m (a)	$2 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Te-129	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Te-129m (a)	$8 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Te-131m (a)	$7 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Te-132 (a)	$5 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Thorium (90)				
Th-227	$1 \times 10^1$	$5 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Th-228 (a)	$5 \times 10^{-1}$	$1 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^4$ (b)
Th-229	$5 \times 10^0$	$5 \times 10^{-4}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Th-230	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Th-231	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^3$	$1 \times 10^7$
Th-232	Unlimited	Unlimited	$1 \times 10^1$	$1 \times 10^4$
Th-234 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^3$ (b)	$1 \times 10^5$ (b)
Th (nat)	Unlimited	Unlimited	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Titanium (22)				
Ti-44 (a)	$5 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Thallium (81)				
Tl-200	$9 \times 10^{-1}$	$9 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tl-201	$1 \times 10^1$	$4 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Tl-202	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Tl-204	$1 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^4$
Thulium (69)				
Tm-167	$7 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Tm-170	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Tm-171	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Uranium (92)				
U-230 (fast lung absorption)	$4 \times 10^1$	$1 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
U-230 (medium lung absorption)(a)(e)	$4 \times 10^1$	$4 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-230 (slow lung absorption)	$3 \times 10^1$	$3 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-232 (fast lung absorption)(d)	$4 \times 10^1$	$1 \times 10^{-2}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
U-232 (medium lung absorption)(e)	$4 \times 10^1$	$7 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-232 (slow lung absorption)(f)	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-233 (fast lung absorption)(d)	$4 \times 10^1$	$9 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^4$
U-233 (medium lung absorption)(e)	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
U-233 (slow lung absorption)(f)	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^5$
U-234 (fast lung absorption)(d)	$4 \times 10^1$	$9 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^4$
U-234 (medium lung absorption)(e)	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
U-234 (slow lung absorption)(f)	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^5$
U-235 (all lung absorption types) (a),(d),(e),(f)	Unlimited	Unlimited	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
U-236 (fast lung absorption)(d)	Unlimited	Unlimited	$1 \times 10^1$	$1 \times 10^4$
U-236 (medium lung absorption)(e)	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
U-236 (slow lung absorption)(f)	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-238 (all lung absorption types) (d),(e),(f)	Unlimited	Unlimited	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
U (nat)	Unlimited	Unlimited	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)

Radionuclide (atomic number)	A <sub>1</sub>	A <sub>2</sub>	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
U (enriched to 20% or less)(g)	Unlimited	Unlimited	$1 \times 10^0$	$1 \times 10^3$
U (dep)	Unlimited	Unlimited	$1 \times 10^0$	$1 \times 10^3$
Vanadium (23)				
V-48	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
V-49	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Tungsten (74)				
W-178 (a)	$9 \times 10^0$	$5 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
W-181	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
W-185	$4 \times 10^1$	$8 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^7$
W-187	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
W-188 (a)	$4 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Xenon (54)				
Xe-122 (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Xe-123	$2 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Xe-127	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^5$
Xe-131m	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^4$
Xe-133	$2 \times 10^1$	$1 \times 10^1$	$1 \times 10^3$	$1 \times 10^4$
Xe-135	$3 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^{10}$
Yttrium (39)				
Y-87 (a)	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Y-88	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Y-90	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
Y-91	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Y-91m	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Y-92	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Y-93	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Ytterbium (70)				
Yb-169	$4 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Yb-175	$3 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Zinc (30)				
Zn-65	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Zn-69	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Zn-69m (a)	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Zirconium (40)				
Zr-88	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Zr-93	Unlimited	Unlimited	$1 \times 10^3$ (b)	$1 \times 10^7$ (b)
Zr-95 (a)	$2 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Zr-97 (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)

(1) A<sub>1</sub> and/or A<sub>2</sub> values include contributions from daughter nuclides with half-lives less than 10 days.

(2) 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

- (3) 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.
- (4) These values apply only to compounds of uranium that take the chemical form of  $UF_6$ ,  $UO_2F_2$  and  $UO_2(NO_3)_2$  in both normal and accident conditions of transport.
- (5) These values apply only to compounds of uranium that take the chemical form of  $UO_3$ ,  $UF_4$ ,  $UCl_4$  and hexavalent compounds in both normal and accident conditions of transport.
- (6) These values apply to all compounds of uranium other than those specified in (4) and (5) above.
- (7) These values apply to *unirradiated uranium* only.

**Table II. BASIC RADIONUCLIDE VALUES FOR UNKNOWN RADIONUCLIDES OR MIXTURES**

Radioactive Contents	$A_1$ (TBq)	$A_2$ (TBq)	Activity Concentration for Exempt Material (Bq/g)	Activity Limit for an Exempt Consignment (Bq)
Only beta or gamma emitting nuclides are known to be present	0.1	0.02	$1 \times 10^1$	$1 \times 10^4$
Only alpha emitting nuclides	0.2	$9 \times 10^{-5}$	$1 \times 10^{-1}$	$1 \times 10^3$

are known to be present				
No relevant data are available	0.001	$9 \times 10^{-5}$	$1 \times 10^{-1}$	$1 \times 10^3$

- (f) When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped based on the total alpha activity and the total beta/gamma activity when these are known, and the lowest radionuclide value, as appropriate, for the radionuclides in each group may be used in the formula above.
- (g) The radionuclide values for unknown radionuclides or mixtures are given in **Table II**.

## Section 22. Contents Limits for Packages.

### (a) Excepted Packages

- (1) Excepted packages shall not contain radioactive material, other than articles manufactured of natural uranium, depleted uranium or natural thorium, with activities greater than the following:
- where radioactive material is enclosed in or is included as a component part of an instrument or other manufactured article, the item and package limits specified in **columns 2 and 3**, respectively, of **Table III**; and
  - where radioactive material is not so enclosed in or is not included as a component of an instrument or other manufactured article, the package limits specified in **column 4** of **Table III**.
- (2) An excepted package may contain any quantity of articles manufactured of natural uranium, depleted uranium or natural thorium provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

**TABLE III. ACTIVITY LIMITS FOR EXCEPTED PACKAGES**

Physical State of Contents	Instrument or Article		Materials Package Limits
	Item Limits	Package Limits	
Solids:			
Special form	$10^{-2} A_1$	$A_1$	$10^{-3} A_1$
other forms	$10^{-2} A_2$	$A_2$	$10^{-3} A_2$
Liquids	$10^{-3} A_2$	$10^{-1} A_2$	$10^{-4} A_2$
Gases			
Tritium	$2 \times 10^{-2} A_2$	$2 \times 10^{-1} A_2$	$2 \times 10^{-2} A_2$
Special form	$10^{-3} A_1$	$10^{-2} A_1$	$10^{-3} A_1$
other forms	$10^{-3} A_2$	$10^{-2} A_2$	$10^{-3} A_2$

### (b) Type A Packages

- (1) Type A packages shall not contain activities greater than the following:
- for special form radioactive material --  $A_1$ ; or
  - for all other radioactive material --  $A_2$ .
- (2) For mixtures of radionuclides whose identities and respective activities are known, the radioactive contents of a Type A package:

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

where:

- B(i)** is the activity of radionuclide **i** as special form radioactive material and
- A<sub>1</sub>(i)** is the **A<sub>1</sub>** value for radionuclide **i**;
- C(j)** is the activity of radionuclide **j** as other than special form radioactive material; and
- A<sub>2</sub>(j)** is the **A<sub>2</sub>** value for radionuclide **j**.

**(c) Type B(U) and Type B(M) Packages**

- (1) Type B(U) and Type B(M) packages shall not contain:
  - (i) activities greater than those authorized for the package design,
  - (ii) radionuclides different from those authorized for the package design, or
  - (iii) contents in a form, or a physical or chemical state different from those authorized for the package design, as specified in their certificates of approval.
- (2) Type B(U) and Type B(M) packages transported by air shall not contain activities greater than the following:
  - (i) for low dispersible radioactive material -- as authorized for the package design,
  - (ii) for special form radioactive material -- 3000 **A<sub>1</sub>** or 100,000 **A<sub>2</sub>**, whichever is lower, or
  - (iii) for all other radioactive material -- 3000 **A<sub>2</sub>**.

**(d) Type C Packages**

Type C packages shall not contain:

- (1) activities greater than those authorized for the package design,
- (2) radionuclides different from those authorized for the package design, or
- (3) contents in a form, or physical or chemical state different from those authorized for the package design, as specified in their certificates of approval.

**(e) Packages Containing Fissile Material**

Packages containing fissile material shall not contain:

- (1) a mass of fissile material different from that authorized for the package design,
- (2) any radionuclide or fissile material different from those authorized for the package design, or
- (3) Contents in a form or physical or chemical state, or in a spatial arrangement, different from those authorized for the package design, as specified in their certificates of approval where appropriate.

**(f) Packages Containing Uranium Hexafluoride**

The mass of uranium hexafluoride in a package shall not exceed a value that would lead to an ullage smaller than 5% at the maximum temperature of the package. The uranium hexafluoride shall be in solid form and the internal pressure of the package shall be below atmospheric pressure when presented for transport.

### III. REQUIREMENTS AND CONTROLS FOR TRANSPORT

#### Section 23. Requirements For First Use of Packaging.

Prior to the first use of any packaging for the shipment of licensed radioactive material:

- (a) If the design pressure of the containment system exceeds **35 kPa** (gauge), the licensee shall test the containment system at an internal pressure at least 50% higher than the maximum

normal operating pressure to verify the capability of that system to maintain its structural integrity at that pressure.

- (b) For each Type B(U), Type B(M) and Type C package and for each package containing fissile material, the licensee shall ensure the effectiveness of its shielding and containment and, where necessary, the heat transfer characteristics and the effectiveness of the confinement system, are within the limits applicable to or specified for the approved design.
- (c) For packages containing fissile material, the licensee shall perform dimensional and material inspection of pertinent packaging components and welds to confirm the presence and distribution of neutron poisons.

#### **Section 24. Requirements Before Each Shipment.**

Prior to each shipment of licensed material, the licensee shall ensure that the package satisfies the requirements specified in the relevant provisions of this Part and all the requirements in the approval certificates. The licensee shall further determine that:

- (a) The packaging is proper and appropriate for the contents to be shipped;
- (b) Any structural part of the package, which could be used to lift or tie-down the package during transport, is rendered inoperable for that purpose unless it satisfies design requirements specified in **Section 44 (b)** of this Part;
- (c) The outside of the packaging is conspicuously and durably marked with its serial/ID number, gross weight, appropriate type (e.g., "Type A") the package design conforms to, and an identification of either the consignor or consignee, or both;
- (d) The package is in an unimpaired physical condition except for superficial defects such as marks and dents;
- (e) Each closure device of the packaging, including any required gasket, is properly installed and secured and free of defects;
- (f) Any system for containing liquid is sealed and has space or other specified provision for expansion of liquid;
- (g) Any pressure relief device is operable and set in accordance with the certificate of compliance for the package;
- (h) The package has been loaded and closed in accordance with written procedures;
- (i) The package meets the following requirements for removable contamination:
  - (1) The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable.
  - (2) The non-fixed contamination on the external surfaces of any package, under routine conditions of transport, does not exceed the following limits averaged over any area of 300 cm<sup>2</sup> of any part of the surface:
    - (i) beta and Gamma emitters and low toxicity Alpha emitters - **4 Bq/cm<sup>2</sup>**
    - (ii) all other Alpha emitting radionuclides - **0.4 Bq/cm<sup>2</sup>**.
  - (3) In the case of packages transported as exclusive use shipments by rail or highway only, the non-fixed radioactive contamination at the beginning of transport does not exceed **one-tenth** the levels in **(i)(2)** of this Section;
- (j) External radiation levels around the package and around the vehicle, if applicable, will not



exceed **2mSv/h** at any point on the external surface of the package at any time during transportation. The transport index (TI) shall not exceed **10.0**;

- (k) The package is prepared such that in still air at 38°C and in the shade, no accessible surface of the package would have a temperature exceeding 50°C in a non-exclusive use shipment or 85°C in an exclusive use shipment. Accessible package surface temperatures shall not exceed these limits at any time during transport;
- (l) The package does not incorporate a feature intended to allow continuous venting during transport; and
- (m) In addition to the radioactive and fissile properties of the contents of the package, any other dangerous properties, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness, be taken into account in the packing, labeling, marking, placarding, storage and transport.

**Section 25. Determination of Transport Index.**

- (a) The transport index (TI) for a package, overpack, or freight container, or for unpackaged LSA-I or SCO-I, shall be the number derived in accordance with the following procedure:
  - (1) Determine the maximum radiation level in mSv/h at a distance of one (1) meter from the external surfaces of the package. The determined value shall be multiplied by 100 and the resulting number is the transport index. For uranium and thorium ores and their concentrates, the maximum radiation level at any point 1 m from the external surface of the load may be taken as:
    - (i) 0.4 mSv/h for ores and physical concentrates of uranium and thorium;
    - (ii) 0.3 mSv/h for chemical concentrates of thorium;
    - (iii) 0.02 mSv/h for chemical concentrates of uranium, other than uranium hexafluoride.
  - (2) For tanks, freight containers and unpackaged LSA-1 and SCO-1, the value determined in step (1) above shall be multiplied by the appropriate factor from **Table IV**.
  - (3) The value obtained in steps (1) and (2) above shall be rounded up to the first decimal place (e.g. 1.13 becomes 1.1), except that a value of **0.05** or less may be considered as zero.

**TABLE IV. MULTIPLICATION FACTORS FOR LARGE DIMENSION LOADS**

Size of Load <sup>a</sup>	Multiplication Factor
size of load ≤ 1m <sup>2</sup>	1
1 m <sup>2</sup> < size of load ≤ 5 m <sup>2</sup>	2
5 m <sup>2</sup> < size of load ≤ 20 m <sup>2</sup>	3
20 m <sup>2</sup> < size of load	10

<sup>a</sup> Largest cross-sectional area of the load being measured.

- (b) The transport index for each overpack, freight container or conveyance shall be determined as either the sum of the TIs of all the packages contained, or by direct measurement of radiation level, except in the case of non-rigid overpacks for which the transport index shall be determined only as the sum of the TIs of all the packages.

**Section 26. Determination of Criticality Safety Index (CSI).**

- (a) The criticality safety index for packages containing fissile material shall be obtained by

dividing the number **50** by the smaller of the two values of **N** derived in **Section 51(E-F)** (i.e. **CSI=50/N**). The value of the criticality safety index may be zero, provided that an unlimited number of packages are subcritical.

- (b) The criticality safety index for each consignment shall be determined as the sum of the CSIs of all the packages contained in that consignment.

### **Section 27. Categories of Packages and Overpacks.**

Packages and overpacks shall be assigned to either Category I-WHITE, Category II-YELLOW or Category III-YELLOW in accordance with the conditions specified in Table **V** and with the following requirements:

- (a) For a package or overpack, both the transport index and the surface radiation level conditions shall be taken into account in determining the appropriate category. Where the transport index satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package or overpack shall be assigned to the higher category. For this purpose, Category I-WHITE shall be regarded as the lowest category.
- (b) The transport index shall be determined following the procedures specified in this Part.
- (c) If the surface radiation level is greater than **2 mSv/h**, the package or overpack shall be transported under **exclusive use** and under the provisions of the appropriate means of conveyance.
- (d) A package or an overpack which contains packages transported under a special **arrangement** shall be assigned to **Category III-YELLOW**.

### **Section 28. Marking, Labeling and Placarding.**

#### (a) **Marking.**

- (1) Each package shall be legibly and durably marked on the outside of the packaging with an identification, consisting of the name and address of either the consignor or consignee, or both, or any information identifying a way-bill or transport document which contains this information. Other required markings include the type of package that it conforms to (e.g. "TYPE A", "TYPE B (U)", "TYPE B (M)", etc.).
- (2) Each package of gross mass exceeding **50 kg** shall have its permissible gross mass legibly and durably marked on the outside of the packaging.
- (3) Where LSA-I or SCO-I material is contained in receptacles or wrapping materials and is transported under exclusive use, the outer surface of these receptacles or wrapping materials may bear the marking 'RADIOACTIVE LSA-I' or 'RADIOACTIVE SCO-I' as appropriate.

#### (b) **Labeling.**

- (1) Each package, overpack and freight container shall bear the labels which conform to the models in **Figure 2, Figure 3, or Figure 4**; and to the model in **Figure 5** if it contains fissile material.
- (2) The labels conforming to these model figures shall be affixed to the two opposite sides of the outside of a package or overpack or on the outside of all four sides of a freight container or tank.
- (3) When an empty packaging is transported as an excepted package under this Part, the previously displayed labels shall be removed or covered and shall not be visible.

**TABLE V. CATEGORIES OF PACKAGES AND OVERPACKS**

<b>CONDITIONS</b>		<b>CATEGORY</b>
<b>Transport Index</b>	<b>Maximum radiation level at any point on external surface</b>	
0 <sup>a</sup>	Not more than 0.005 mSv/h	I-WHITE
More than 0 but not more than 1 <sup>a</sup>	More than 0.005 mSv/h but not more than 0.5 mSv/h	II-YELLOW
More than 1 but not more than 10	More than 0.5 mSv/h but not more than 2mSv/h	III-YELLOW
More than 10	More than 2 mSv/h but not more than 10 mSv/h	III-YELLOW <sup>b</sup>

<sup>a</sup> If the measured TI is not greater than 0.05, the value quoted may be zero.

<sup>b</sup> Shall also be transported under exclusive use.

(c) **Placarding.**

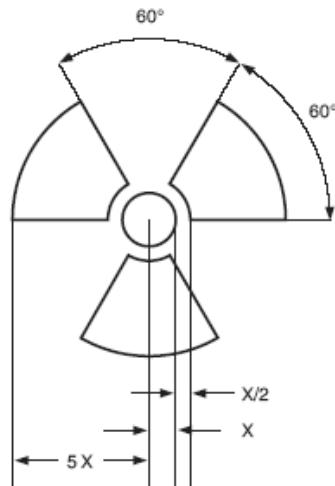
- (1) Large freight containers carrying packages other than excepted packages, and tanks shall bear four placards which conform with the model given in **Figure 6**. The placards shall be affixed in a vertical orientation to each side wall and each end wall of the large freight container or tank. Any placards which do not relate to the contents shall be removed.
- (2) Instead of using both labels and placards, PNRI permits as an alternative the use of enlarged labels only, as shown in Fig. 2, Fig. 3, Fig. 4, and Fig. 5 as may be appropriate, with dimensions of the minimum size shown in Fig. 6.

**Section 29. Consignor's Responsibilities.**

**A. Transport of Radioactive Materials in the Philippines.**

- (a) Each consignor (licensee) who transports radioactive material to and from one authorized location to another by land, air, or sea shall prepare a **Certificate of Transport** which contains the necessary information for assuring that the package can be transported safely in accordance with this Part.

**FIGURES**



**Figure 1.** *Basic trefoil symbol with proportions based on a central circle of radius X. The minimum allowable size of X shall be 4 mm.*



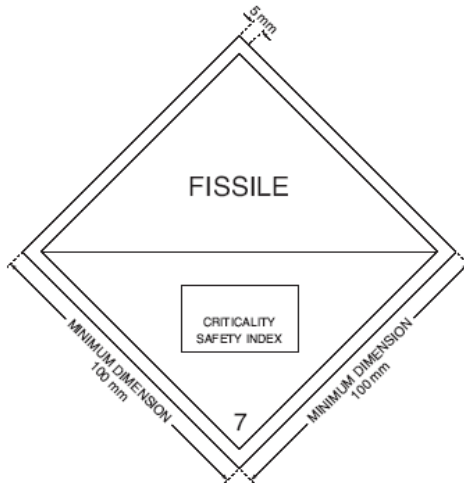
**Figure 2.** *Category I-WHITE label. The background color of the label shall be white, the color of the trefoil and the printing shall be black, and the color of the category bar shall be red.*



**Figure 3.** *Category II-YELLOW label. The background color of the upper half of the label shall be yellow and the lower half white, the color of the trefoil and the printing shall be black, and the color of the category bars shall be red.*



**Figure 4. Category III-YELLOW label.** The background color of the upper half of the label shall be yellow and the lower half white, the color of the trefoil and the printing shall be black, and the color of the category bars shall be red.



**Figure 5. Criticality safety index label.** The background color of the label shall be white, the color of the printing shall be black.



**Figure 6. Placard.** The number '7' shall not be less than 25 mm high. The background color of the upper half of the placard shall be yellow and of the lower half white, the color of the trefoil and the printing shall be black. The use of the word "RADIOACTIVE" in the bottom half is optional to allow the alternative use of this placard to display the appropriate United Nations number for the consignment.



**Figure 7.** Placard for separate display of United Nations number. The background color of the placard shall be orange and the border and United Nations number shall be black. The symbol “\*\*\*\*” denotes the space in which the appropriate United Nations number for radioactive material, as specified in Table VI, shall be displayed.

- (b) The Certificate of Transport shall include the following information, as may be applicable:
- (1) Date of issuance, and if appropriate, an expiration date;
  - (2) Name, address, telephone/telefax number or e-mail address of the consignor (licensee) and PNRI license number;
  - (3) Name and address of the RHSO of the consignor;
  - (4) Description (name or symbol of each radionuclide, physical and chemical form and activity) of the radioactive material that will be transported;
  - (5) Description of the package (category and dimension);
  - (6) Measured dose rate on specific points of the package;
  - (7) Transport index (for categories II-YELLOW and III-YELLOW only) and, if appropriate, any restrictions on the mode of transport and routing instructions;
  - (8) Location, address and telephone number of the origin of the transport package;
  - (9) Location, address and telephone number of the destination of the transport package;
  - (10) Name, address and PNRI license number of the consignee (licensee);
  - (11) Identification of the mode of transport. If transport is handled by a carrier/forwarder, indicate its name and other relevant information; and
  - (12) Signature of consignor’s RHSO or consignor’s representative responsible for the approval of the Certificate of Transport.
- (c) The consignor shall present the Certificate of Transport and relevant transport documents to PNRI prior to transporting the package. He shall then secure from PNRI a written authorization to transport.
- (d) The consignor shall include in the Certificate of Transport a **declaration** in the following terms or in terms having an equivalent meaning:
- “I hereby declare that the contents of this consignment are classified, packed, marked and labeled, and are, in all respects, in proper condition for the safe transport of **RADIOACTIVE MATERIALS** in accordance with PNRI regulations and with applicable national governmental regulations.”

## **B. Transport of Radioactive Materials Outside the Philippines.**

- (a) Each consignor (licensee) who transports radioactive materials to another country shall prepare and present to PNRI a **Certificate of Transport** that contains the following information, as may be applicable, together with the relevant shipping documents:
- (1) Name, address, telephone number, and license number of consignor/licensee;

- (2) Name, address, telephone number, and license number of consignee/licensee;
  - (3) Location, address and telephone number of authorized origin of consignment;
  - (4) Location, address and telephone number of final destination of consignment;
  - (5) Name, address, and telephone number of carrier/forwarder authorized by consignor;
  - (6) The proper shipping name, as specified in **Table VI**;
  - (7) The United Nations Class number "7";
  - (8) The United Nations number assigned to the material as specified in **Table VI**, preceded by the letters "UN";
  - (9) The name or symbol of each radionuclide contained in the package, or, for mixtures of radionuclides, an appropriate general description or a list of the most restrictive nuclides;
  - (10) A description of the physical and chemical form of the radioactive material, or a notation that the material is special form radioactive material or low dispersible radioactive material;
  - (11) The maximum activity (Bq) of the radioactive contents during transport. For fissile material, the mass of the fissile material in units of grams;
  - (12) The category of the package, i.e. I-WHITE, II-YELLOW, III-YELLOW;
  - (13) The transport index (categories II-YELLOW and III-YELLOW only);
  - (14) The criticality safety index for consignments including fissile material other than consignments excepted under **Section 51(A)**;
  - (15) The identification mark for each competent authority approval certificate applicable to the consignment;
  - (16) Any instructions and restrictions on the mode of transport, type of vehicle, freight container;
  - (17) For consignments of packages in an overpack or freight container, a detailed statement of the contents of each package within the overpack or freight container;
  - (18) Where a consignment is required to be shipped under exclusive use, the statement "**EXCLUSIVE USE SHIPMENT**";
  - (19) For LSA-II, LSA-III, SCO-1 AND SCO-II, the total activity of the consignment as a multiple of  $A_2$ ;
  - (20) Identification and signature of the designated Radiological Health and Safety Officer (RHSO) of the consignor who is authorized to issue the Certificate of Transport; and
  - (21) Date of issuance and expected expiration of shipping documents;
- (b) The consignor shall present the Certificate of Transport and relevant transport documents to PNRI prior to transporting the package. He shall then secure from PNRI a written authorization to transport.
- (c) The consignor shall ensure that before the first shipment of any package requiring competent authority approval, copies of each applicable competent authority certificate applying to that package design have been submitted to the competent authority of each country through or into which the consignment is to be transported.
- (d) The consignor shall, prior to the commencement of the shipment of the following, notify the competent authority of each country through or into which the consignment is to be transported:
- (1) Type C packages containing radioactive material with an activity greater than 3000  $A_1$  or 3000  $A_2$ , as appropriate, or 1000 TBq, whichever is lower;
  - (2) Type B(U) packages containing radioactive material with an activity greater than 3000  $A_1$  or 3000  $A_2$ , as appropriate, or 1000 TBq, whichever is lower;
  - (3) Type B(M) packages;
  - (4) Shipment under special arrangement.
- (e) The consignment notification shall include:
- (1) Sufficient information to enable the identification of the package or packages including

- all applicable certificate numbers and identification marks;
- (2) Information on the date of shipment, the expected date of arrival and proposed routing;
  - (3) The names of the radioactive materials or nuclides;
  - (4) Descriptions of the physical and chemical forms of the radioactive material, or whether it is special form radioactive material or low dispersible radioactive material; and
  - (5) The maximum activity of the radioactive contents during transport expressed in becquerels (Bq); and for fissile material, the mass in units of grams (g), or multiples thereof.
- (f) The consignor is not required to send a separate notification if the required information has been included in the application for shipment approval.
- (g) Consignor's Declaration
- (1) The consignor shall include in the Certificate of Transport a declaration in the following terms or in terms having an equivalent meaning:

"I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packed, marked and labeled, and are, in all respects, in proper condition for transport in accordance with applicable international and national governmental regulations."

**TABLE VI. EXCERPTS FROM LIST OF UNITED NATIONS NUMBERS, PROPER SHIPPING NAMES AND DESCRIPTIONS, AND THEIR RELATIONSHIP TO THE SCHEDULES**

Schedule	UN No.	PROPER SHIPPING NAME <sup>a</sup> <i>and description</i>
1	2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE -- LIMITED QUANTITY OF MATERIAL
2	2911	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE -- INSTRUMENTS OR ARTICLES
3	2909	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE -- ARTICLES MANUFACTURED FROM NATURAL URANIUM OR DEPLETED URANIUM OR NATURAL THORIUM
4	2908	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE -- EMPTY PACKAGING
5	2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-1), <i>non-fissile or fissile-excepted</i> <sup>b</sup>
6	3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), <i>non-fissile or fissile-excepted</i> <sup>b</sup>
7	3322	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), <i>non-fissile or fissile-excepted</i> <sup>b</sup>
8	2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I OR SCO-II), <i>non-fissile or fissile-excepted</i> <sup>b</sup>
9	2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE,



Schedule	UN No.	PROPER SHIPPING NAME <sup>a</sup> <i>and description</i>
		non-special form, <i>non-fissile or fissile-excepted</i> <sup>b</sup>
9	3332	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, <i>non-fissile or fissile-excepted</i> <sup>b</sup>
10	2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, <i>non-fissile or fissile-excepted</i> <sup>b</sup>
11	2917	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, <i>non-fissile or fissile-excepted</i> <sup>b</sup>
12	3323	RADIOACTIVE MATERIAL, TYPE C PACKAGE, <i>non-fissile or fissile-excepted</i> <sup>b</sup>
14	2919	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, <i>non-fissile or fissile-excepted</i> <sup>b</sup>
<sup>c</sup>	2978	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, <i>non-fissile or fissile-excepted</i> <sup>b</sup> [corrosive, UN Class 8]
6+13	3324	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), FISSILE
7+13	3325	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), FISSILE
8+13	3326	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I OR SCO-II), FISSILE
9+13	3327	RADIOACTIVE MATERIAL, TYPE A PACKAGE, FISSILE, non-special form
9+13	3333	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, FISSILE
10+13	3328	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE
11+13	3329	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, FISSILE
12+13	3330	RADIOACTIVE MATERIAL, TYPE C PACKAGE, FISSILE
14+13	3331	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, FISSILE
<sup>c</sup> +13	2977	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, FISSILE [corrosive, UN Class 8]

<sup>a</sup> The "PROPER SHIPPING NAME" is restricted to that part shown in CAPITAL LETTERS. In the case of UN 2909 and UN 2911 where alternative PROPER SHIPPING NAMES are separated by the word "or", only the relevant PROPER SHIPPING NAME shall be used.

<sup>b</sup> "Fissile-excepted" applies only to those packages complying with **Section 51A**.

<sup>c</sup> UN 2977 and UN 2978 are special cases without a unique relationship with the Schedules.

- (2) If the intent of the declaration is already a condition of transport within a particular international convention, the consignor need not provide such a declaration for that part of the transport covered by the convention.
- (3) The declaration shall be signed and dated by the consignor or his authorized representative.

### **C. Removal or Covering of Labels**

The consignor shall remove or cover the labels in an **empty packaging** which had previously contained radioactive material before he may transport it as an excepted package.

### **D. Information for Carriers**

- (a) The consignor shall include in the transport documents a statement regarding actions, if any, that are required to be taken by the carrier concerning loading, unloading, stowage, carriage and handling of the package, overpack or freight container; restrictions on the mode of transport; and emergency arrangements appropriate to the consignment.
- (b) The consignor shall make available to the carrier the applicable PNRI certificates before loading and unloading.

### **E. Possession of Certificates and Instructions**

The consignor shall have in his or her possession a copy of each certificate required under **Section 61** of this Part, as applicable, and a copy of the instructions with regard to the proper closing of the package and other preparations for shipment before making any shipment under the terms of the certificates.

## **Section 30. Additional Requirements Relating to Transport by Road and by Rail.**

- (a) Each package, overpack, or freight container shall be labeled as shown in **Fig. 2, Fig. 3, Fig. 4 or Fig. 5**.
- (b) Rail and road vehicles carrying labeled packages, overpacks or freight containers, or carrying consignments under exclusive use, shall display the placard shown in **Fig. 6** on each of:
  - (1) the two external lateral walls in the case of rail vehicle;
  - (2) the two external lateral walls and the external rear wall in the case of a road vehicle.
- (c) In the case of a vehicle without sides, the placards may be affixed directly on the cargo carrying unit provided that they are readily visible; in the case of physically large tanks or freight containers, the placards on the tanks or freight containers shall suffice. In the case of vehicles which have insufficient area to allow the fixing of larger placards, the dimensions of the placard as described in Fig. 6 may be reduced to 100 mm. Any placards which do not relate to the contents shall be removed.
- (d) Where the consignment in or on the vehicle is unpackaged LSA-1 material or SCO-I or where an exclusive use consignment is packaged radioactive material with a single United Nations number, the appropriate United Nations number shown in **Table VI** shall also be displayed, in black digits not less than 65 mm high, either:
  - (1) in the lower half of the placard shown in **Fig. 6**, against the white background, or
  - (2) on the placard shown in **Fig. 7**.

- (e) For consignments under exclusive use, the radiation level shall not exceed:
- (1) **10 mSv/h** at any point on the external surface of any package or overpack, and may only exceed **2 mSv/h** provided that:
    - (i) the vehicle is equipped with an enclosure which, during routine conditions of transport, prevents access of unauthorized persons to the interior of the enclosure;
    - (ii) provisions are made to secure the package or overpack so that its position within the vehicle enclosure remains fixed during routine conditions of transport; and
    - (iii) there is no loading or unloading during the shipment;
  - (2) **2 mSv/h** at any surface on the outer surfaces of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and the lower external surface of the vehicle;
  - (3) **0.1 mSv/h** at any point 2 meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, if the load is transported in an open vehicle, at any point 2 meters from the vertical planes projected from the outer edges of the vehicle; and
  - (4) **0.02 mSv/h** in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when persons occupying these positions are provided with special health supervision, personnel radiation exposure monitoring devices, and training in radiation safety.
- (f) In the case of road vehicles, no persons other than the driver and assistants shall be permitted in vehicles carrying packages, overpacks, or freight containers bearing Category II - YELLOW or III - YELLOW labels.

### **Section 31. Additional Requirements Relating to Transport by Air.**

- (a) Type B (M) packages and consignments under exclusive use shall not be transported on passenger aircraft.
- (b) Vented Type B (M) packages, packages which require external cooling by an ancillary cooling system, packages subject to operational controls during transport, and packages containing pyrophoric materials shall not be transported by air.
- (c) Packages or overpacks having a surface radiation level greater than **2 mSv/h** shall not be transported by air except by special arrangement.

### **Section 32. Additional Requirements Relating to Transport by Sea and Inland Waters, or by Special Use Vessel.**

- (a) Packages or overpacks having a surface radiation level greater than **2 mSv/h** shall not be transported by vessel except under special arrangement, unless being carried in or on a vehicle under exclusive use in accordance with **Section 30(e)** and that the packages or overpacks are not removed from the vehicle at any time while on board the vessel.
- (b) The transport of consignments by means of a special use vessel which is dedicated to the purpose of carrying radioactive material shall be excepted from specific requirements on radiation levels and transport indexes provided that the following conditions are met:
  - (1) A radiation protection program for the shipment shall be approved by PNRI;
  - (2) Stowage arrangements shall be predetermined for the whole voyage including any consignments to be loaded at ports of call en route; and

- (3) The loading, carriage and unloading of the consignments shall be supervised by persons qualified in the transport of radioactive material.

### **Section 33. Transport of Other Goods.**

- (a) A package shall not contain any other items except such articles and documents as are necessary for the use of the radioactive material.
- (b) Tanks and intermediate bulk containers used for the transport of radioactive material shall not be used for the storage or transport of other goods unless decontaminated below the level of **0.4 Bq/cm<sup>2</sup>** for beta and gamma emitters and low toxicity alpha emitters and **0.04 Bq/cm<sup>2</sup>** for all other alpha emitters.
- (c) The transport of other goods with consignments being transported under exclusive use shall be permitted provided that the arrangements are controlled only by the consignor and it is not prohibited by other regulations, as determined by the competent authority.
- (d) Consignments shall be segregated from other dangerous goods during transport in compliance with other relevant transport regulations for dangerous goods and, where applicable, with the regulations of the cognizant transport organizations, as well as these regulations.

### **Section 34. Requirements and Controls for Transport of Excepted Packages.**

- (a) Excepted packages shall be subject to the following provisions:
  - (1) The requirements specified in **Sections 24(m), 24(i)(2), 28(a) and 29C**;
  - (2) The requirements for excepted packages specified in **Section 45**; and
  - (3) If the excepted package contains fissile material, one of the fissile exceptions provided by **Section 51A** shall apply and the requirement of **Section 48(b)** shall be met.
- (b) The radiation level at any point on the external surface of an excepted package shall not exceed **5µSv/h**.
- (c) An excepted package may contain radioactive material which is enclosed in or is included as a component part of an instrument or other manufactured article, with activity not exceeding the item and package limits specified in **columns 2 and 3** respectively of **Table III**, provided that:
  - (1) the radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article is not greater than 0.1 mSv/h;
  - (2) each instrument or article (except radioluminescent time-pieces or devices) bears the marking "**RADIOACTIVE**"; and
  - (3) the active material is completely enclosed by non-active components.
- (d) An excepted package may contain radioactive material which is not so enclosed in or is not included as a component of an instrument or other manufactured article, with an activity not exceeding the limit specified in **column 4** of **Table III**, provided that:
  - (1) the package retains its radioactive contents under routine conditions of transport; and
  - (2) the package bears the marking "**RADIOACTIVE**" on an internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package.

- (e) An excepted package may contain any quantity of articles manufactured of natural uranium, depleted uranium or natural thorium provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.
- (f) An **empty packaging** which had previously contained radioactive material may be transported as an **excepted package** provided that:
  - (1) It is in a well maintained condition and securely closed;
  - (2) The outer surface of any uranium or thorium in its structure is covered with an inactive sheath made of metal or some other substantial material;
  - (3) The level of internal non-fixed contamination does not exceed one hundred times the levels specified in **Section 24(i)(2)**; and
  - (4) Any labels which may have been displayed on it are no longer visible.

**Section 35. Requirements and Controls for Transport of LSA Material and SCO in Industrial Packages or Unpackaged.**

- (a) The quantity of LSA material or SCO in a single Industrial Package shall be so restricted that the external radiation level at 3 m from the unshielded material or object or collection of objects does not exceed **10 mSv/h**.
- (b) LSA material and SCO which is or contains fissile material shall meet the applicable requirements in **Section 36 B and Section 51**.
- (c) LSA material and SCO in groups LSA-I and SCO-I may be transported unpackaged under the following conditions:
  - (1) All unpackaged material other than ores containing only naturally occurring radionuclides shall be transported in such a manner that under routine conditions of transport there will be no escape of the radioactive contents from the conveyance nor will there be any loss of shielding;
  - (2) Each conveyance shall be under exclusive use, except when only transporting SCO-I on which the contamination on the accessible and inaccessible surfaces is not greater than ten times the applicable level specified in **Section 3 (j)**; and
  - (3) For SCO-1 where it is suspected that non-fixed contamination exists on accessible surfaces in excess of the values specified in **Section 3 (ff) (i)**, measures shall be taken to ensure that the radioactive material is not released into the conveyance.
- (d) LSA material and SCO, except as otherwise specified in **(c)** of this **Section**, shall be packaged in accordance with **Table VII**.
- (e) The total activity in a single hold or compartment of an inland water craft, or in another conveyance, for carriage of LSA material and SCO in Type IP-1, Type IP-2, Type IP-3 or unpackaged, shall not exceed the limits shown in **Table VIII**.

**Section 36. Transport and Storage in Transit.**

**A. Segregation and stowage during transport and storage in transit.**

- (a) Consignments shall be securely stowed.
- (b) Packages, overpacks and freight containers containing radioactive materials shall be segregated during transport and during storage in transit:
  - (1) From places occupied by people so as not to exceed a dose of **5 mSv** in a year to workers in regularly occupied working areas and **1 mSv** in a year to the critical group;
  - (2) From undeveloped photographic film to ensure that the radiation exposure of

undeveloped photographic film be limited to **0.1 mSv** per consignment of such film;  
and

- (3) From other consignments declared as dangerous goods.
- (c) Category II-YELLOW or III-YELLOW packages or overpacks shall not be carried in compartments occupied by passengers, except those exclusively reserved for couriers especially authorized to accompany such packages or overpacks.
- (d) A package or overpack may be carried or stored among packaged general cargo without special stowage provisions, provided that its average surface **heat flux** does not exceed **15 W/m<sup>2</sup>** and that the immediately surrounding cargo is not in sacks or bags.
- (e) The number of category II-YELLOW and category III-YELLOW packages, overpacks and freight containers stored in any one storage area, such as transit area, terminal building, store-room or assembly yard shall be so limited that the total **sum of the transport indexes** in any individual group of such packages does not exceed **50**. Groups of such packages shall be stored so as to maintain a spacing of at least **6 meters** from other groups of such packages, overpacks, freight containers, etc. There shall be not more than 100 Category II-YELLOW or 5 Category III-YELLOW packages in any one group. Where packages of both categories are present, 1 Category III-YELLOW package shall be taken as equivalent to 20 packages of Category II-YELLOW.

**TABLE VII. INDUSTRIAL PACKAGE REQUIREMENTS FOR LSA MATERIAL AND SCO**

Radioactive Contents	Industrial Package Type	
	Exclusive Use	Not Under Exclusive Use
LSA-I		
Solid <sup>a</sup>	Type IP-1	Type IP-1
Liquid	Type IP-1	Type IP-2
LSA-II		
Solid	Type IP-2	Type IP-2
Liquid and Gas	Type IP-2	Type IP-3
LSA-III	Type IP-2	Type IP-3
SCO-1 <sup>a</sup>	Type IP-1	Type IP-1
SCO-II	Type IP-2	Type IP-2

<sup>a</sup> Under the conditions specified in **Section 35 (c)**, LSA-I material and SCO-I may be transported unpackaged.

**TABLE VIII. CONVEYANCE ACTIVITY LIMITS FOR LSA MATERIAL AND SCO IN INDUSTRIAL PACKAGES OR UNPACKAGED**

Nature of Material	Activity Limit for Conveyances other than by Inland Waterway	Activity Limit for a Hold or Compartment of an Inland Water Craft
LSA-I	No limit	No limit
LSA-II and LSA-III non-combustible solids	No limit	100 A <sub>2</sub>
LSA-II and LSA-III Combustible solids, and all liquids and gases	100 A <sub>2</sub>	10 A <sub>2</sub>
SCO	100 A <sub>2</sub>	10 A <sub>2</sub>

**TABLE IX. TI LIMITS FOR FREIGHT CONTAINERS AND CONVEYANCES NOT UNDER EXCLUSIVE USE**

Type of freight container or conveyance	Limit on total sum of Transport Indexes in a freight container or aboard a conveyance
Freight container - Small	50
Freight container - Large	50
Vehicle	50
Aircraft	
Passenger	50
Cargo	200
Inland water-way vessel	50
Seagoing vessel	
(1) Hold, compartment or defined deck area:	
Packages, overpacks, small freight containers	50
Large freight containers	200
(2) Total vessel:	
Packages, overpacks, small freight containers	200
Large freight containers	No limit

- (f) The total number of packages, overpacks or freight containers aboard a single conveyance shall be so limited that the total sum of the transport indexes aboard the conveyance does not exceed the values shown in **Table IX**.
- (g) There shall be no limit on the sum of the transport indexes of consignments transported under exclusive use aboard a single conveyance and for consignments of LSA-1 material.
- (h) The radiation **level** under routine conditions of transport shall not exceed **2 mSv/h** at any point on, and 0.1 mSv/h at 2 meters from, the external surface of the conveyance.
- (i) The total sum of the criticality safety indexes (CSIs) in a freight container and aboard a conveyance shall not exceed the values shown in **Table X**.
- (j) The transport **index** of any individual package shall not exceed **10**. Any package or overpack having either a transport index greater than 10, or any consignment having a criticality safety index greater than 50, shall be transported only under **exclusive use**.

**B. Segregation of packages containing fissile material.**

- (a) The number of packages, overpacks and freight containers containing fissile material stored in transit in any one storage area shall be so limited that the total sum of the **criticality safety indexes** in any group of such packages, overpacks or freight containers does not exceed **50**. Each group shall be stored so as to maintain a spacing of at least **6 m** from other groups of such packages, overpacks or freight containers.
- (b) Where the total sum of the CSIs on board a conveyance or in a freight container exceeds 50, storage shall be such as to maintain a spacing of at least 6 m from other groups of packages, overpacks or freight containers containing fissile material or other conveyances carrying radioactive material.

**Section 37. Customs Operation.**

- (a) Each licensee shall submit to PNRI for verification true copies of transport documents, bill of lading, or airway bill of a radioactive material shipment from a foreign source that will arrive or have arrived at the Philippine Port of Entry. A verified shipment will be issued a PNRI Request for Release for submission to the Customs Officer in compliance with the requirements for the release of such package from the customs cargo hold area;

**TABLE X. CSI LIMITS FOR FREIGHT CONTAINERS AND CONVEYANCES CONTAINING FISSILE MATERIAL**

Type of freight container or conveyance	Limit on total sum of criticality safety indexes in a freight container or aboard a conveyance	
	Not under exclusive use	Under exclusive use
Freight container - Small	50	n.a
Freight container - Large	50	100
Vehicle	50	100
Aircraft		
Passenger	50	n.a.
Cargo	50	100
Inland water-way vessel	50	100
Seagoing vessel		
(1) Hold, compartment or defined deck area:		
Packages, overpacks, small freight containers	50	100
Large freight containers	50	100
(2) Total vessel:		
Packages, overpacks, small freight containers	200	200
Large freight containers	No limit	No limit

- (b) The licensee shall ensure that in the examination of packages containing radioactive material by customs officials, clearance formalities shall be carried out as quickly as possible, to eliminate delays in customs clearance which may decrease the usefulness of valuable radioactive material;
- (c) The licensee shall ensure that any necessary internal inspection of the radioactive contents of a package shall be carried out only in a place where adequate means of controlling radiation exposure are provided and in the presence of qualified persons; and
- (d) The licensee shall ensure that any package opened on customs instructions shall, before being forwarded to the consignee, be restored to its original condition.

**Section 38. Delivery and Receipt of Consignments.**

- (a) Prior to delivery of a package to a carrier for transport, the licensee/consignor shall ensure that any special instructions needed to safely open the package have been sent to, or otherwise made available to, the consignee for the consignee's use.
- (b) Each licensee/consignee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity shall make arrangements to receive:



- (1) The package when the carrier offers it for delivery; or
  - (2) Notification of the arrival of the package at the indicated destination and to take possession of the package expeditiously.
- (c) Each licensee shall :
- (1) Monitor the external surfaces of a labeled package for radioactive contamination unless the package contains only radioactive material in the form of a gas or in special form as defined in this Part.
  - (2) Monitor the external surfaces of a labeled package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity.
  - (3) Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are wet, crushed or damaged.
- (d) The licensee/consignee shall perform the monitoring required in paragraph (c) of this Section as soon as practicable after receipt of the package at the licensee's facility.
- (e) The licensee/consignee shall immediately notify the final delivery carrier and the PNRI when:
- (1) Removable radioactive contamination on the surface of the package exceeds the limits specified in this Part; or
  - (2) External radiation levels on the package exceed the external radiation standards for packages.
- (f) Each licensee shall:
- (1) Establish, maintain, retain written procedures for safely opening packages in which radioactive material is received; and
  - (2) Ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened.
- (g) If special form sources are transported to and from a work site in licensee-owned or operated vehicles, the licensee shall monitor the radiation levels of the external surfaces of the package to ensure that the source is still properly lodged in its shield.
- (h) The licensee shall place undeliverable consignments in a safe location, inform the PNRI as soon as possible about the consignment and request for instructions on further action.

#### **IV. REQUIREMENTS FOR RADIOACTIVE MATERIALS AND FOR PACKAGINGS AND PACKAGES.**

##### **Section 41. Requirements for LSA-III Material.**

**LSA-III material** shall be a solid of such a nature that if the entire contents of a package were subjected to the test specified in **Section 52** the activity in the water would not exceed **0.1A<sub>2</sub>**.

##### **Section 42. Requirements for Special Form Radioactive Material.**

- (a) It shall have at least one dimension not less than **5 mm**.
- (b) It shall be of such nature that if it is subjected to the tests in **Section 53**, it shall meet the following requirements:
  - (1) It would not break or shatter under the impact, percussion and bending tests, as

- applicable;
- (2) It would not melt or disperse in the heat test, as applicable; and
- (3) The activity in the water from the leaching tests would not exceed **2kBq**; or alternatively for sealed sources, the leakage rate for the volumetric leakage assessment test would not exceed the applicable acceptance threshold acceptable to the PNRI.

- (c) A sealed capsule that constitutes part of the special form radioactive material shall be so manufactured that it can be opened only by destroying it.

#### **Section 43. Requirements for Low Dispersible Radioactive Material.**

Low dispersible radioactive material shall be such that the total amount of this radioactive material in a package shall meet the following requirements:

- (a) The radiation level at 3 m from the unshielded radioactive material does not exceed **10 mSv/h**;
- (b) If subjected to the **enhanced thermal and impact tests** specified in **Section 55 (j)(3)** and **(j)(4)**, the airborne release in gaseous and particulate forms of up to 100  $\mu\text{m}$  aerodynamic equivalent diameter would not exceed 100  $A_2$ . A separate specimen may be used for each test; and
- (c) If subjected to the test specified in **Section 52**, the activity in the water would not exceed 100  $A_2$ . In the application of this test, the damaging effects of the tests specified in (b) above shall be taken into account.

#### **Section 44. General Requirements for All Packagings and Packages.**

- (a) The package shall be so designed in relation to its mass, volume and shape that it can be easily and safely transported; and that it can be properly secured in or on the conveyance during transport.
- (b) The design shall be such that any lifting attachments on the package will not fail when used as intended and, if failure of the attachments should occur, the ability of the package to meet the other requirements of this Part would not be impaired. The design shall take account of appropriate safety factors to cover snatch lifting.
- (c) Attachments and any other features on the outer surface of the package which could be used for lifting shall be designed either to support its mass or shall be removable or otherwise rendered incapable of being used during transport.
- (d) As far as practicable, the external surfaces of the packagings shall be free from protruding features and can be easily decontaminated.
- (e) As far as practicable, the outer layer of the package shall not allow the collection and retention of water.
- (f) Any features added to the package at the time of transport that are not part of the package shall not reduce its safety.
- (g) The package shall be capable of withstanding the effects of any acceleration or vibration

such that nuts, bolts and other securing devices shall not become loose or be released unintentionally, even after repeated use.

- (h) The materials of the packaging and any component or structure shall be physically and chemically compatible with each other and with the radioactive contents.
- (i) All valves through which the radioactive contents could otherwise escape shall be protected against unauthorized operation.
- (j) The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.
- (k) The quantity of radioactive material in a package shall not exceed the relevant limits specified in each type of package.
- (l) The package design shall take into account the other dangerous properties of the radioactive content, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness.
- (m) Packages transported by air shall satisfy the following additional requirements:
  - (1) The temperature of the accessible surfaces shall not exceed 50°C at an ambient temperature of 38°C with no account taken for insolation.
  - (2) Design shall be such that, if exposed to ambient temperatures ranging from - 40oC to +55°C, the integrity of containment would not be impaired.
  - (3) The containment system shall be able to withstand without leakage a reduction in ambient pressure to 5 kPa.

#### **Section 45. Requirements for Excepted Packages**

An excepted package shall be designed to meet the requirements of **Section 44** of this Part.

#### **Section 46. Requirements for Industrial Packages**

- (a) An Industrial Package Type 1 (Type IP-1) design shall meet the requirements of **Section 44** of this Part. The smallest overall external dimension of the package shall not be less than **ten (10) cm**.
- (b) An Industrial Package Type 2 (Type IP-2) design shall meet the requirements of **Section 44** of this Part. If the package is subjected to a Free-Drop test and Stacking test, it should prevent the loss or dispersal of the radioactive contents and loss of shielding integrity which would result in more than a 20% increase in radiation level at any external surface of the package.
- (c) An Industrial Package Type 3 (Type IP-3) design shall meet the requirements for Type IP-1 and the requirements for a Type A package.

#### **Section 47. Requirements for Packages Containing Uranium Hexafluoride**

- (a) Each package designed to contain 0.1 kg or more of uranium hexafluoride shall be designed so that it would:
  - (1) withstand without leakage and without unacceptable stress the structural test pressure of at least 1.38 MPa;

- (2) withstand without loss or dispersal of the uranium hexafluoride the free drop test; and
  - (3) withstand without rupture of the containment system the test specified in **Section (55) (g) (2)**.
- (b) Packages designed to contain 0.1 kg or more of uranium hexafluoride shall not be provided with pressure relief devices.
- (c) Subject to the approval of PNRI, packages designed to contain 0.1 kg or more of uranium hexafluoride may be transported if:
- (1) the packages are designed to meet the requirements in (a) of this Section;
  - (2) the packages are designed to withstand without leakage and without unacceptable stress a test pressure less than 2.76 MPa; or
  - (3) for packages designed to contain 9000 kg or more of uranium hexafluoride, the packages do not withstand without rupture of the containment system the thermal test.

#### **Section 48. Requirements for Type A Packages.**

- (a) Type A packages shall meet the requirements of **Section 44** of this Part.
- (b) The smallest overall external dimension of the package shall not be less than **ten (10) cm**.
- (c) The outside of the package shall have a seal which is not readily breakable under normal and accident conditions of transport.
- (d) Any tie-down attachments on the package shall be so designed that, under normal and accident conditions of transport, the forces in those attachments shall not impair the ability of the package to meet the requirements of these regulations.
- (e) The design of the package shall take into account temperatures ranging from  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  for the components of the packaging.
- (f) The design of any component of the containment system shall take into account, where applicable, the radiolytic decomposition of liquids and other vulnerable materials and the generation of gas by chemical reaction and radiolysis.
- (g) All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.
- (h) The package design shall include a containment system and radiation shield that is securely closed by a positive fastening device and so designed to prevent loss of shielding integrity and loss or dispersal of the radioactive contents, whether liquid, solid, or gaseous.
- (i) Special form radioactive material may be considered as a component of the containment system.
- (j) The containment system shall retain its radioactive contents under a reduction of ambient pressure to 60 kPa.
- (k) The design of a package intended for liquid radioactive material shall make provision for ullage to accommodate variations in the temperature of the contents, dynamic effects and filling dynamics.
- (l) A package designed for gases shall prevent loss or dispersal of the radioactive contents if the package were subjected to the tests specified in **Section 55 (f)**. A Type A package designed for tritium gas or for noble gases shall be excepted from this requirement.

#### **Section 49. Requirements for Type B Packages.**

- (a) A **Type B(U)** package shall:
- (1) meet the requirements of **Section 44** of this Part;
  - (2) meet the requirements specified in **Section 48 (b) to (k)**;
  - (3) be so designed that under the ambient temperature of 38°C, heat generated within the package by the radioactive contents shall not, under normal conditions of transport, adversely affect the package in such a way that it would fail to meet the applicable requirements for containment and shielding if left unattended for one week;
  - (4) be so designed such that under the ambient temperature of 38°C, except as required in **Section 44 (m) (1)**, the temperature of the accessible surfaces of the package shall not exceed 50°C, unless the package is transported under exclusive use.
  - (5) be so designed that its thermal protection shall be capable to withstand the thermal test; tests for demonstrating ability to withstand normal conditions of transport; and mechanical test specified in **Section 55**;
  - (6) be so designed that, if it were subjected to:
    - (i) the tests for demonstrating ability to withstand normal conditions of transport specified in **Section 55 (e)**, it would restrict the loss of radioactive contents to not more than  $10^{-6} A_2$  per hour; and
    - (ii) the tests for demonstrating ability to withstand accident conditions of transport specified in **Section 55 (g)**: mechanical test for drop II, thermal test and water immersion test and
      - (ii.a) the mechanical test for drop III, when the package has a mass not greater than 500 kg, an overall density not greater than  $1000 \text{ kg/m}^3$  based on the external dimensions, and radioactive contents greater than  $1000 A_2$  not as special form radioactive material, or
      - (ii.b) the mechanical test for drop I, for all other packages,it would meet the following requirements:
      - (i) retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv with the maximum radioactive contents which the package is designed to contain; and
      - (ii) restrict the accumulated loss of radioactive contents in a period of 1 week to not more than  $10 A_2$  for krypton-85 and not more than  $A_2$  for all other radionuclides;
  - (7) be so designed that for radioactive contents with activity greater than  $10^5 A_2$ , there would be no rupture of the containment system if subjected to the enhanced water immersion test specified in **Section 55 (h)**;
  - (8) depend neither upon filters nor upon a mechanical cooling system in complying with the permitted activity release limits;
  - (9) not include a pressure relief system from the containment system which would allow the release of radioactive material to the environment under the normal and accident conditions for transport;
  - (10) be so designed that if it were at the maximum normal operating pressure and it were subjected to the tests for demonstrating the ability to withstand the normal conditions of transport specified in **Section 55 (e)** and the accident conditions of transport specified in **Section 55 (g)**, the level of strains in the containment system would not attain values which would adversely affect the package in such a way that it would fail to meet the applicable requirements;
  - (11) not have a maximum normal operating pressure in excess of a gauge pressure of **700 kPa**; and
  - (12) be designed for an ambient temperature range from **-40°C to +38°C**.
- (b) A **Type B (M)** package shall meet the requirements for a Type B (U) package except that for packages to be transported solely within the Philippines, conditions other than those

specified in this Part may be assumed with the approval of PNRI.

**Section 50. Requirements for Type C Packages.**

- (a) Type C packages shall meet the requirements in **Section 49 (a) (1) to (a) (4) and (a) (8) to (a) (12)**.
- (b) A package shall be capable of meeting the assessment criteria prescribed for tests specified in **Section 49(a)(6)(ii)** and **Section 49(a)(10)** after burial in an environment defined by a thermal conductivity of 0.33 W/(m-K) and a temperature of 38°C in the steady state.
- (c) A package shall be so designed that, if it were at the maximum normal operating pressure and subjected to:
  - (1) the tests for demonstrating ability to withstand normal conditions of transport specified in **Section 55 (e)**, it would restrict the loss of radioactive contents to not more than 10<sup>6</sup> A<sub>2</sub> per hour; and
  - (2) the test sequences in **Section 55 (j)**: mechanical test for drop I and drop III, puncture/tearing test, enhanced thermal test, and impact test, it would meet the following requirements:
    - (i) retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv with the maximum radioactive contents which the package is designed to contain; and
    - (ii) restrict the accumulated loss of radioactive contents in a period of 1 week to not more than 10 A<sub>2</sub> for krypton-85 and not more than A<sub>2</sub> for all other radionuclides.
- (d) A package shall be so designed that there will be no rupture of the containment system following performance of the enhanced water immersion test specified in **Section 55(h)**.

**Section 51. Requirements for Packages Containing Fissile Material.**

- (a) Fissile material shall be transported so as to maintain subcriticality during normal and accident conditions of transport; in particular, the following contingencies shall be considered:
  - (1) water leaking into or out of packages;
  - (2) the loss of efficiency of built-in neutron absorbers or moderators;
  - (3) rearrangement of the contents either within the package or as a result of loss from the package;
  - (4) reduction of spaces within or between packages;
  - (5) packages becoming immersed in water or buried in snow; and
  - (6) temperature changes; and
- (b) The smallest overall dimension of the package shall not be less than **10 cm**.

**A. Exceptions from the requirements for packages containing fissile material**

Fissile material meeting one of the following provisions is excepted from the requirements for packages containing fissile material:

- (a) A mass limit per consignment such that:

$$\frac{\text{mass of Uranium-235 (g)}}{X} + \frac{\text{mass of other fissile material (g)}}{Y} < 1$$

Where X and Y are the mass limits defined in Table **XI**, provided that either:

- (1) each individual package contains not more than 15 g of fissile material; for unpackaged material, this quantity limitation shall apply to the consignment being carried in or on the conveyance, or
- (2) the fissile material is a homogeneous hydrogenous solution or mixture where the ratio of fissile nuclides to hydrogen is less than 5% by mass, or
- (3) there is not more than 5 g of fissile material in any 10 liter volume of material.

Neither beryllium nor deuterium shall be present in quantities exceeding 0.1% of the fissile material mass.

**TABLE XI. CONSIGNMENT MASS LIMITS FOR EXCEPTIONS FROM THE REQUIREMENTS FOR PACKAGES CONTAINING FISSILE MATERIAL**

Fissile Material	Fissile material mass (g) mixed with substances having an average hydrogen density less than or equal to water	Fissile material mass (g) mixed with substances having an average hydrogen density greater than water
Uranium-235 (X)	400	290
Other fissile material (Y)	250	180

- (b) Uranium enriched in uranium-235 to a maximum of 1% by mass, and with a total plutonium and uranium-233 content not exceeding 1% of the mass of uranium-235, provided that the fissile material is distributed essentially homogeneously throughout the material. If uranium-235 is present in metallic, oxide or carbide forms, it shall not form a lattice arrangement.
- (c) Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2% by mass, with a total plutonium and uranium-233 content not exceeding 0.002% of the mass of uranium, and with a minimum nitrogen to uranium atomic ration (N/U) of 2.
- (d) Packages containing, individually, a total plutonium mass not more than 1 kg, of which not more than 20% by mass may consist of plutonium-239, plutonium-241 or any combination of those radionuclides.

**B. Contents specification for assessments of packages containing fissile material**

- (a) Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of **D to F of this Section** shall be performed assuming that each parameter that is not known has the value which gives the maximum neutron multiplication consistent with the known conditions and parameters in these assessments.
- (b) For irradiated nuclear fuel, the assessments of **D to F of this Section** shall be based on an isotopic composition demonstrated to provide:
  - (1) the maximum neutron multiplication during the irradiation history, or
  - (2) a conservative estimate of the neuron multiplication for the package assessments. After irradiation but prior to shipment, a measurement shall be performed to confirm the conservatism of the isotopic composition.

**C. Geometry and temperature requirements**

- (a) The packaging, after being subjected to the tests for demonstrating ability to withstand normal conditions of transport, must prevent the entry of a 10 cm cube.

- (b) The package shall be designed for an ambient temperature range of  $-40^{\circ}\text{C}$  to  $+38^{\circ}\text{C}$  unless PNRI specifies otherwise in the certificate of approval for the package design.

**D. Assessment of an individual package in isolation**

- (a) For a package in isolation, it shall be assumed that water can leak into or out of all void spaces of the package, including those within the containment system. Special features shall include the following:
  - (1) Multiple high standard water barriers, each of which would remain watertight if the package were subject to the tests for demonstrating ability to withstand normal conditions of transport, a high degree of quality control in the manufacture, maintenance and repair of packagings and tests to demonstrate the closure of each package before each shipment; or
  - (2) For packages containing uranium hexafluoride only:
    - (i) there is no physical contact between the valve and any other component of the packaging other than at its original point of attachment following the tests for demonstrating ability to withstand normal conditions of transport, and the valves remain leaktight following the thermal test in **Section 55(g)(2)**; and
    - (ii) a high degree of quality control in the manufacture, maintenance and repair of packagings coupled with tests to demonstrate closure of each package before each shipment.
- (b) It shall be assumed that the confinement system shall be closely reflected by at least 20 cm of water or such greater reflection as may additionally be provided by the surrounding material of the packaging.
- (c) The package shall be subcritical under the conditions of paragraphs (a) and (b) above with the package conditions that result in the maximum neutron multiplication consistent with:
  - (1) routine conditions of transport (incident free);
  - (2) the tests specified in **E(b) of this Section**; and
  - (3) the tests specified in **F (b) of this Section**.
- (d) For packages to be transported by air:
  - (1) the package shall be subcritical under conditions consistent with the tests in **Section 55(j)(1)** assuming reflection by at least 20 cm of water but no water in leakage; and
  - (2) allowance shall not be made for special features of **D (a) of this Section** unless, following the tests specified in **Section 55 (j) (1)** and **55(i)**, leakage of water into or out of the void spaces is prevented.

**E. Assessment of package arrays under normal conditions of transport**

A number "N" shall be derived, such that **five** times "N" shall be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

- (a) There shall not be anything between the packages, and the package arrangement shall be reflected on all sides by at least 20 cm of water; and
- (b) The state of the packages shall be their assessed or demonstrated condition if they had been subjected to the tests specified in **Section 55(e)**.

**F. Assessment of package arrays under accident conditions of transport**

A number "N" shall be derived, such that **two** times "N" shall be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:



- (a) Hydrogenous moderation between packages, and the package arrangement reflected on all sides by at least 20 cm of water; and
- (b) The tests for demonstrating ability to withstand normal conditions of transport specified in **Section 55(e)** followed by whichever of the following is the more limiting:
  - (1) the tests for demonstrating ability to withstand accident conditions of transport specified in **Section 55(g)** and completed by the water leakage test for packages containing fissile material specified in **Section 55(i)**; or
  - (2) the water immersion test specified in **Section 55(g) (3)**.
- (c) Where any part of the fissile material escapes from the containment system following the tests specified in (b) above, it shall be assumed that fissile material escapes from each package in the array and all of the fissile material shall be arranged in the configuration and moderation that results in the maximum neutron multiplication with close reflection by at least **20 cm** of water.

## V. TEST PROCEDURES

### Section 52. Test for LSA-III Material.

A solid material sample representing the entire contents of the package shall be immersed for **7 days** in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20<sup>0</sup>C. The total activity of the free volume of water shall be measured following the 7 day immersion of the test sample.

### Section 53. Tests for Special Form Radioactive Material.

#### (a) Test Methods

- (1) **Impact test:** The specimen shall drop onto the target from a height of **9 m**.
- (2) **Percussion test:** The specimen shall be placed on a sheet of lead which is supported by a smooth solid surface and struck by the flat face of a mild steel bar so as to cause an impact equivalent to that resulting from a free drop of **1.4 kg through 1 m**. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of  $(3.0 \pm 0.3)$  mm. The lead, of hardness number 3.5 to 4.5 on the Vickers scale and not more than 25 mm thick, shall cover an area greater than that covered by the specimen. A fresh surface of lead shall be used for each impact. The bar shall strike the specimen so as to cause maximum damage.
- (3) **Bending test:** The test shall apply only to long, slender sources with both a minimum length of 10 cm and a length to minimum width ratio of not less than 10. The specimen shall be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp. The orientation of the specimen shall be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel bar. The bar shall strike the specimen so as to cause an impact equivalent to that resulting from a free vertical drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of  $(3.0 \pm 0.3)$  mm.
- (4) **Heat test:** The specimen shall be heated in air to a temperature of **800<sup>0</sup>C** and held at that temperature for a period of 10 minutes and shall then be allowed to cool.

(b) **Leaching and Volumetric Leakage Assessment Methods**

- (1) The leaching assessment for specimens which comprise or simulate indispersible solid material shall be performed as follows:
  - (i) The specimen shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20°C.
  - (ii) The water with specimen shall then be heated to a temperature of  $(50 \pm 5)^{\circ}\text{C}$  and maintained at this temperature for 4 hours.
  - (iii) The activity of the water shall then be determined.
  - (iv) The specimen shall then be kept for at least 7 days in still air at not less than 30°C and relative humidity not less than 90 %.
  - (v) The specimen shall then be immersed in water of the same specification as in (1) above and the water with the specimen heated to  $(50 \pm 5)^{\circ}\text{C}$  and maintained at this temperature for 4 hours.
  - (vi) The activity of the water shall then be determined.
- (2) Either a leaching assessment or a volumetric leakage assessment shall be performed for specimens which comprise or simulate radioactive material enclosed in a sealed capsule.
- (3) The alternative volumetric leakage assessment shall comprise any of the tests prescribed in ISO 9978: "Radiation Protection – Sealed Radioactive Sources – Leakage Test Methods", which are acceptable to the PNRI.

**Section 54. Tests for Low Dispersible Radioactive Material.**

A specimen that comprises or simulates low dispersible radioactive material shall be subjected to the enhanced thermal test specified in **Section 55(j)(3)**, the impact test specified in **Section 55(j)(4)**, and the leach test specified in **Section 52** and it shall be determined if the requirements for low dispersible radioactive material have been met.

**Section 55. Tests for Packages.**

(a) **Preparation of a specimen for testing**

- (1) All specimens shall be inspected before testing in order to identify and record faults or damage including the following:
  - (i) divergence from the design;
  - (ii) defects in manufacture;
  - (iii) corrosion or other deterioration; and
  - (iv) distortion of features.
- (2) The containment system of the package shall be clearly specified.
- (3) The external features of the specimen shall be clearly identified so that reference may be made simply and clearly to any part of such specimen.

(b) **Testing the integrity of the containment system and shielding and assessing criticality safety**

- (1) The specimens shall be subjected to each of the applicable tests specified in **(d) to (j) of this Section**;
- (2) Faults and damage shall be identified and recorded;
- (3) It shall be determined whether the integrity of the containment system and shielding has been retained for the package under test; and
- (4) For packages containing fissile material, it shall be determined whether the

assumptions and conditions used in the assessments required by **Section 51** for one or more packages are valid.

(c) **Target for drop tests**

The target for the drop tests shall be a flat, horizontal surface of such a character 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) **Test for packagings designed to contain uranium hexafluoride**

Specimens that comprise or simulate packagings designed to contain 0.1 kg or more of uranium hexafluoride shall be tested hydraulically at an internal pressure of at least 1.38 MPa but, when the test pressure is less than 2.76 MPa, the design shall require multilateral approval. For retesting packagings, any other equivalent nondestructive testing may be applied subject to multilateral approval.

(e) **Tests for demonstrating ability to withstand normal conditions of transport**

Specimens of the package shall be subjected to the water spray test until such time that the water has soaked in to the maximum extent, without appreciable drying of the exterior of the specimen, before each of the following tests:

- (1) **Water spray test.** The specimen shall be subjected to a water spray test that simulates exposure to rainfall of approximately **5 cm per hour** for at least **one hour**.
- (2) **Free drop test.** The specimen shall drop onto the target so as to suffer maximum damage in respect of the safety features to be tested.
  - (i) The height of drop measured from the lowest point of the specimen to the upper surface of the target shall not be less than the distance specified in **Table XII** for the applicable mass.
  - (ii) For rectangular fibreboard or wood packages not exceeding a mass of **50 kg**, a separate specimen shall be subjected to a free drop onto each corner from a height of 0.3 m.
  - (iii) For cylindrical fibreboard packages not exceeding a mass of **100 kg**, a separate specimen shall be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m.

**TABLE XII. FREE DROP DISTANCE FOR TESTING PACKAGES TO NORMAL CONDITIONS OF TRANSPORT**

<b>Package mass (kg)</b>	<b>Free drop distance (m)</b>
Package mass < 5 000	1.2
5 000 ≤ Package mass < 10 000	0.9
10 000 ≤ Package mass < 15 000	0.6
15 000 ≤ Package mass	0.3

- (3) **Stacking test.** Unless the shape of the packaging effectively prevents stacking, the specimen shall be subjected, for a period of 24 hours, to a compressive load equal to the greater of the following:
  - (i) The equivalent of 5 times the mass of the actual package; and
  - (ii) The equivalent of 13 kPa multiplied by the vertically projected area of the package.

The load shall be applied uniformly to two opposite sides of the specimen, one of which shall be the base on which the package would typically rest.
- (4) **Penetration test.** The specimen shall be placed on a rigid, flat, horizontal surface

which will not move significantly while the test is being carried out.

- (i) A bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg shall 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 sufficiently far, it will hit the containment system. The bar shall not be significantly deformed by the test performance.
  - (ii) The height of drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen shall be 1 m.
- (f) **Additional tests for Type A packages designed for liquids and gases**
- (1) **Free drop test.** The specimen shall drop onto the target so as to suffer the maximum damage in respect of containment. The height of the drop measured from the lowest part of the specimen to the upper surface of the target shall be 9 m.
  - (2) **Penetration test.** The specimen shall be subjected to the test in **Section 55 (e) (4)** except that the height of drop shall be increased to 1.7 m.
- (g) **Tests for demonstrating ability to withstand accident conditions of transport**
- (1) **Mechanical test**
    - (i) **Drop I.** The specimen shall drop onto the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the specimen to the upper surface of the target shall be 9 m.
    - (ii) **Drop II.** The specimen shall drop so as to suffer the maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the specimen to the upper surface of the bar shall be 1 m. The bar shall be of solid mild steel of circular section,  $(15.0 \pm 0.5)$  cm in diameter and 20 cm long unless a longer would cause greater damage. The upper end of the bar shall be flat and horizontal with its edges rounded off to a radius of not more than 6mm.
    - (iii) **Drop III.** The specimen shall be subjected to a dynamic crush test by positioning the specimen on the target so as to suffer maximum damage by the drop of a 500 kg mass from 9 m onto the specimen. The mass shall consist of a solid mild steel plate 1 m by 1 m and shall fall in a horizontal attitude. The height of the drop shall be measured from the underside of the plate to the highest point of the specimen.
  - (1) **Thermal test.** The specimen shall be in thermal equilibrium under conditions of an ambient temperature of 38°C, subject to the solar insolation conditions and subject to the design maximum rate of internal heat generation within the package from the radioactive contents. Alternatively, any of these parameters are allowed to have different values prior to and during the test, provided due account is taken of them in the subsequent assessment of package response.
  - (2) **Water immersion test.** The specimen shall be immersed under a head of water of at least 15 m for a period of not less than eight hours in the attitude which will lead to maximum damage. For demonstration purposes, an external gauge pressure of at least 150 kPa shall be considered to meet these conditions.
- (h) **Enhanced water immersion test for Type B (U) and Type B (M) packages containing more than  $10^5$  A<sub>2</sub> and Type C packages.**
- The specimen shall be immersed under a head of water of at least 200 m for a period of not less than one hour. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.
- (i) **Water leakage test for packages containing fissile material.**
- (1) Packages for which water in-leakage or out-leakage to the extent which results in greatest reactivity has been assumed for purposes of assessment shall be excepted

from the test.

- (2) The specimen shall be subjected to mechanical tests specified in **Section 55(g)(1)(ii)** and either **Section 55(g)(1)(i)** or **Section 55(g)(1)(iii)** as required by **Section 51F(b)(1)** and thermal test specified in **Section 55(g)(2)**.
- (3) The specimen shall be immersed under a head of water of at least **0.9 m** for a period of not less than **eight hours** and in the attitude for which maximum leakage is expected.

(j) **Tests for Type C packages**

- (1) Specimens shall be subjected to the effects of each of the following test sequences:
  - (i) **Mechanical tests** (Drop I and Drop III), puncture/tearing test and enhanced thermal test; and
  - (ii) **Impact test.**

Separate specimens are allowed to be used for each of the sequences above.
- (2) **Puncture/tearing test.** The specimen shall be subjected to the damaging effects of a solid probe made of mild steel. The orientation of the probe to the surface of the specimen shall be such as to cause maximum damage at the conclusion of the test sequence **(j) (1) (i)** above.
  - (i) The specimen, representing a package having a mass less than 250 kg, shall be placed on a target and subjected to a probe having a mass of **250 kg** falling from a height of **3 m** above the intended impact point. For this test the probe shall be a 20 cm diameter cylindrical bar with the striking end forming a frustum of a right circular cone with a 30 cm height and 2.5 cm diameter at the top.
  - (ii) For packages having a mass of 250 kg or more, the base of the probe shall be placed on a target and the specimen dropped onto the probe. The height of the drop, measured from the point of impact with the specimen to the upper surface of the probe shall be 3 m. The probe shall have the same properties and dimensions as in (i) above except that the length and mass of the probe shall be such as to incur maximum damage to the specimen.
- (3) **Enhanced thermal test.** The conditions shall be the same as in **Section 55 (g) (2)**, except that the exposure to the thermal environment shall be for a period of **60 minutes**.
- (4) **Impact test.** The specimen shall be subject to an impact on a target at a velocity of not less than 90 m/s, at such an orientation as to suffer maximum damage.

## VI. APPROVAL AND ADMINISTRATIVE REQUIREMENTS

### Section 61. Approval Certificates.

- (a) Each licensee shall secure from the PNRI an approval certificate for the following:
  - (1) special arrangements
  - (2) certain shipments
  - (3) radiation protection program for special use vessels
- (b) A licensee shall secure from the Competent Authority of the country of origin of the package a design approval certificate for the following:
  - (1) special form radioactive material
  - (2) low dispersible radioactive material
  - (3) packages containing 0.1 kg or more of uranium hexafluoride
  - (4) all packages containing fissile material unless excepted by **Section 51 (A)**
  - (5) Type B(U) packages and Type B(M) packages
  - (6) Type C packages

- (c) Prior to shipment through and into the Philippines of a package, the design of which has been approved and issued by the Competent Authority of a foreign country, each licensee shall secure from PNRI a validation or endorsement of the original certificate of package design approval.
- (d) The package design and shipment **approval** certificates may be combined into a single certificate.
- (e) The design for special form radioactive material shall require **unilateral** approval. The design for low dispersible radioactive material shall require **multilateral** approval.

## **Section 62. Contents of Approval Certificates.**

- (a) An **approval certificate** shall include the following information:
  - (1) Type of certificate.
  - (2) The competent authority identification mark.
  - (3) The issue date and an expiry date;
  - (4) Any restrictions on the modes of transport, type of conveyance, freight container, and any necessary routing instructions;
  - (5) A specification of the authorized radioactive content, including any restrictions on the radioactive contents;
  - (6) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including special stowage provisions for the safe dissipation of heat;
  - (7) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to shipment;
  - (8) A specification of the applicable quality assurance program;
  - (9) Any emergency arrangements deemed necessary by PNRI;
  - (10) Reference to the identity of the applicant; and
  - (11) Signature and identification of the certifying official.
- (b) A special form radioactive material and low dispersible radioactive material approval certificate shall include, in addition to **(a)** above, the following information:
  - (1) List of applicable national and international regulations, including the IAEA Regulations for the Safe Transport of Radioactive Materials under which the special form radioactive material or low dispersible radioactive material is approved;
  - (2) The identification of the special form radioactive material or low dispersible radioactive material;
  - (3) A description of the special form radioactive material or low dispersible radioactive material; and
  - (4) Design specifications for the special form radioactive material or low dispersible radioactive material which may include references to drawings.
- (c) A design approval certificate shall include, in addition to **(a)** above, the following information:
  - (1) Identification of the packaging;
  - (2) List of applicable national and international regulations under which the design is approved;
  - (3) The statement:  
"This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported."
  - (4) References to certificates for alternative radioactive contents, or other competent authority validation, or additional technical data or information deemed appropriate by PNRI;
  - (5) Description of the packaging by a reference to the drawings or specification of the

- design, including materials of manufacture, gross mass, general outside dimensions and appearance; and
- (6) Specification of the design by reference to the drawings.
- (d) A special arrangement approval certificate shall include, in addition to **(a)** above, the following information:
- (1) Mode(s) of transport;
  - (2) List of applicable national and international regulations under which the special arrangement is approved;
  - (3) The statement:  
“This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.”
  - (4) References to certificates for alternative radioactive contents, or other competent authority validation, or additional technical data or information deemed appropriate by PNRI;
  - (5) Description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance;
  - (6) Additionally, for packages containing fissile material:
    - (i) a detailed description of the authorized radioactive contents;
    - (ii) the value of the criticality safety index;
    - (iii) reference to the documentation that demonstrates the criticality safety of the contents;
    - (iv) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;
    - (v) any allowance for a change in neutron multiplication assumed in the criticality assessment; and
    - (vi) the ambient temperature range for which the special arrangement has been approved; and
  - (7) Description of the compensatory measures to be applied as a result of the shipment being under special arrangement.
- (e) A shipment approval certificate shall include, in addition to **(a)** above, the following information:
- (1) Reference to the applicable design approval certificate(s);
  - (2) List of applicable national and international regulations under which the shipment is approved; and
  - (3) The statement:  
“This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.”

**Section 63. Notification and Registration of Serial Numbers.**

The licensee shall inform the PNRI for registration of the serial number of each packaging with approved design.

**Section 64. Competent Authority Identification Marks.**

- (a) Each approval certificate issued by a competent authority shall be assigned an identification mark. The mark shall be of the following generalized type:

**VRI/Number/Type Code**

Where:

- **VRI** represents the international vehicle registration identification code of the country issuing the certificate; VRI for the Philippines is **RP**.
- The **Number** shall be unique and specific to the particular design or shipment and assigned by the Competent Authority. The shipment approval identification mark shall be clearly related to the design approval identification mark.
- The **Type Code** shall indicate the type of approval certificate issued.

(b) The following type codes shall be used:

<b>AF</b>	Type A package design for fissile material
<b>B (U)</b>	Type B (U) package design [B (U) F if for fissile material]
<b>B (M)</b>	Type B (M) package design [B (M) F if for fissile material]
<b>C</b>	Type C package design [CF if for fissile material]
<b>IF</b>	Industrial package design for fissile material
<b>S</b>	Special form radioactive material
<b>LD</b>	Low dispersible radioactive material
<b>T</b>	Shipment
<b>X</b>	Special arrangement

In the case of package designs for non-fissile or fissile excepted uranium hexafluoride, where none of the above codes apply, the following type codes shall be used:

<b>H (U)</b>	Unilateral approval
<b>H (M)</b>	Multilateral approval

- (c) The revision of a certificate shall be indicated by a parenthetical expression following the identification mark on the certificate. For example, A/132/B(M)F-96(Rev.2) would indicate revision 2 of the Type B(M) package design approved for fissile material, requiring multilateral approval, for which the competent authority of Austria has assigned the design number 132 (to be marked on both the package and on the package design approval certificate).
- (d) Additional symbols may be added in brackets to the end of the identification mark.
- (e) It is not necessary to alter the identification mark on the packaging each time that a revision to the design certificate is made.

#### Section 65. Validation of Certificates.

**Multilateral approval** may be by validation of the original certificate issued by the



competent authority of the country of origin of the design or shipment. Such validation may take the form of an endorsement on the original certificate or the issuance of a separate endorsement, annex, supplement, etc., by the competent authority of the country through or into which the shipment is made.

## **VII. RECORDS, REPORTS AND NOTIFICATION**

### **Section 71. Records.**

- (a) Each licensee shall maintain and keep for a period of three (3) years records of each shipment of licensed material transported in accordance with this Part. Such records must be signed and authenticated, accordingly by authorized personnel of the licensee.
- (b) Each licensee shall make available for PNRI inspection, upon reasonable notification, records required in this Part.

### **Section 72. Reports.**

Each licensee shall report to the PNRI Director within thirty (30) days:

- (a) Any instance in which a significant reduction is observed in the effectiveness of any authorized packaging during transport;
- (b) Detailed information of significant defects in the packaging after first or subsequent use, including the measures employed to repair the defects and prevent their recurrence; and
- (c) Any transport incident or accident that had occurred, of which the report shall, as a minimum, include:
  - (1) The kind, quantity and the chemical and physical form of the radioactive materials involved;
  - (2) A description of the circumstances of the incident or accident;
  - (3) Radiation exposures of individuals involved in the incident/accident, the circumstances under which such exposures occurred, and exposures to the public; and
  - (4) Corrective steps taken and planned to prevent recurrence.

### **Section 73. Notification of Incidents.**

- (a) Each licensee shall immediately notify PNRI, by telephone or any fast means of communication, of any incident involving theft, hijacking, or loss of a radioactive package in the course of transport thereof; or any accident involving the transport carrier that could or could have caused damage to the packaging resulting to a significant reduction of the effectiveness of the packaging to contain the radioactive material.
- (b) Each licensee may request the assistance of PNRI in case of an accident that may result into a radiological emergency in the course of transporting radioactive material.

### **VIII. INSPECTION AND ENFORCEMENT**

#### **Section 81. Tests and Inspection.**

The licensee, or its authorized carrier, shall permit the PNRI at all reasonable times to perform tests or inspect the licensed material, packaging, premises, and facilities in which the licensed material or packaging is used, provided, constructed, fabricated, tested, stored, or shipped to assure compliance with the regulations of this Part.

#### **Section 82. Violations.**

- (a) A notice of violation may be issued to the licensee who may be found to have violated the regulations of this Part, or any order or rule issued hereunder.
- (b) Any license may be modified, suspended or revoked, after due process, for any violation which PNRI determines to adversely affect the health and safety of the radiation workers and the public.
- (c) Any person who willfully violates, attempts to violate, or conspires to violate, any provision of this Part, rule or order issued pursuant to this Part, may be guilty of a crime, and upon conviction, may be punished by a fine or imprisonment, or both, as provided by Sections 64 and 65 of Republic Act No. 5207.

### **IX. EFFECTIVITY**

#### **Section 91. Effective Date.**

The regulations in this Part shall take effect **fifteen (15) days** following the publication in the Official Gazette or in a newspaper of general circulation.

**APPROVED:**

**(Sgd.) ALUMANDA M. DELA ROSA, Ph.D.**  
**Director, PNRI**

Date: July 30, 2004