NRRC Specific Regulations

Packaging and Transport of Radioactive Materials

NRRC-R-15-SR01

2023

هيئة الرقابة النووية والإشعاعية
Nuclear and Radiological Regulatory Commission

Specific Regulation

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Preamble

In accordance with the provisions of the Transport of Radioactive Materials Regulation (NRRC-R-15), approved by the NRRC's Board of Directors in resolution No. (R/1/1/2022), dated 20 April 2022, chapter (4) section (19) paragraph (52 (C)), this specific regulation provides detailed requirements for the implementation of the requirements stated in the Safe Transport of Radioactive Materials Regulation.

This specific regulation has been prepared on the basis of International Atomic Energy Agency (IAEA) standards, as well as the and the international best practices and the experiences of similar interna-tional regulatory bodies, and in accordance with the Kingdom's international commitments, and it has been approved by the NRRC's CEO resolution No. 1195, dated 11/05/2023.

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Chapter 1: Objective, Scope, and Definitions

Section 1: Objective

1. The objective of this Specific Regulation is to specify matters prescribed in Regulation on Safe Transport of Radioactive Materials (NRRC-R-15).

Section 2: Scope

2. Notwithstanding Article 1, this Specific Regulation shall not apply to any of the following:

    a. Non-radioactive solid objects with radioactive substances present on any surfaces in quantities not in excess of 0.4 Becquerel per square centimetres (Bq/cm^2) for beta emitter, gamma emitter and low toxicity alpha emitter, or 0.04 Bq/cm^2 for all other alpha emitters.

    b. Natural material and ores containing naturally occurring radionuclides that are either in their natural state, or have been processed only for purposes other than for the extraction of the radionuclides, and that are not intended to be processed for use of these radionuclides provided that the activity concentration level of the material does not exceed 10 times the values as prescribed by the NRRC in the Tenth Schedule Table I of this Specific Regulation, or calculated in accordance with the Tenth Schedule. For natural materials and ores containing naturally occurring radionuclides that are not in secular equilibrium the calculation of the activity concentrationshall be performed in accordance with the Tenth Schedule paragraph (4).

3. The safety provision stated in Regulation on Radiation Safety (NRRC-R-01) shall apply except where otherwise provided in this Specific Regulation.

4. For transport of radioactive material or nuclear material having subsidiary risks with other dangerous goods, the relevant transport legislation for dangerous goods of each of the countries through or into which the material is to be transported shall apply in addition to this Specific Regulation and other NRRC Regulations referred to in this Specific Regulation.

Section 3: Definition

5. In this Specific Regulation -

"A1"

The activity value of a special form radioactive material or nuclear material, and is used to determine the activity limits for the requirements of this Specific Regulation.

"A2"

The activity value of radioactive material or nuclear material, other than a special form radioactive material and is used to determine the activity limits for the requirements of this Specific Regulation.

Accident conditions of transport

Conditions that prevail during accident, being conditions similar to the conditions simulated by a combination of the tests specified in the Eighteenth Schedule with respect to a package.

Approve

Any form of approval associated with the transport of radioactive material or nuclear material issued by NRRC as prescribed in Regulation on Notification on and Authorization of Facilities and Activities With Radiation Sources (NRRC-R-02).

Annual dose limit

The limit of annual dose, whose value for the respective groups of the population is specified in the Regulation on Radiation Safety (NRRC-R-01), which must not be exceeded.

Cargo aircraft

Any aircraft, other than a passenger aircraft, which is carrying goods or property.

Confinement system

The assembly of fissile material and packaging components specified by the designer and agreed to by the NRRC as intended to preserve criticality safety.

Containment system

The assembly of components of the packaging specified by the designer as intended to retain the radioactive material during transport.

Courier service

Courier services hired by the consignor to provides carriage in an expedited manner with track and trace service.

Criticality

A self-sustaining chain process of nuclear fission that can be maintained without an additional source of neutrons.

Dangerous goods

Articles or substances as defined in accordance with any laws governing transport of dangerous goods in the Kingdom.

Defined deck area

An area on the weather deck of a vessel or of a vehicle deck of a roll-on/roll-off ship or a ferry which is allocated for the stowage of radioactive material or nuclear material.

Depleted uranium

Uranium containing a lesser mass percentage of uranium-235 than in the natural uranium.

Design

The description of fissile material excepted from fissile classification by the provisions of the Twentieth Schedule, special form radioactive material, low dispersible radioactive material, package or packaging which enables such an item to be fully identified and may include specifications, engineering drawings, reports demonstrating compliance with regulatory requirements and other relevant documentation.

Enriched uranium

Uranium containing a greater mass percentage of uranium-235 than 0.72%.

Fissile material

A material containing any of the fissile nuclides. Excluded from the definition of fissile material are the following:

a. Natural uranium or depleted uranium that is unirradiated;
b. Natural uranium or depleted uranium that has been irradiated in thermal reactors only;
c. Material with fissile nuclides less than a total of 0.25 g;
d. Any combination of (a), (b) and/or (c).

These exclusions are only valid if there is no other material with fissile nuclidesin the package or in the consignment if shipped unpackaged.

Fissile nuclides

Uranium-233, Uranium-235, Plutonium-239 and Plutonium-241.

Large freight container

A freight container that has an internal volume of more than 3 cubic metres (m^3).

LSA-I

a. 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;
b. Natural uranium, depleted uranium, natural thorium or their compounds or mixtures, providing they are unirradiated and in solid or liquid form;
c. Radioactive material or nuclear material for which the A_2 value is unlimited, excluding fissile material in quantities not excepted as specified in the Twentieth Schedule; or

d. Other radioactive material or nuclear material in which the activity is distributed throughout, and the estimated average specific activity does not exceed 30 times the values for activity concentration as determined by the NRRC, excluding fissile material in quantities not excepted as specified in the Twentieth Schedule.

LSA-II

a. Water with tritium concentration up to 0.8 terabecquerel per liter (TBq/l); or
b. Other material in which the activity is distributed throughout the material and the estimated average specific activity does not exceed $10^{-4}A_2/g$ for solid and gases, and 10^{-5} A_2/g for liquids.

LSA-III

Solids, excluding powders, in which-

a. The radioactive material or nuclear material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent such as concrete, bitumen or ceramic;
b. The estimated average specific activity of the solid, excluding any shielding material, does not exceed 2×10^{-3} A_2/g.

Low toxicity alpha emitters

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

Maximum normal operating pressure

The maximum pressure above atmospheric pressure at mean sea level that would develop in the containment system in a period of one year under the conditions of temperature and solar radiation corresponding to environmental conditions in the absence of venting, external cooling by an ancillary system, or operational controls during transport.

Natural uranium

Uranium which may be chemically separated containing the naturally occurring distribution of uranium isotopes (approximately 99.28% uranium-238 and 0.72% uranium-235 by mass).

Non-conforming package

A package which does not meet one or more of the requirements of this Specific Regulation with respect to a package.

Normal conditions of transport

Conditions that prevail during routine transport similar to the conditions simulated by tests specified in Part III of the Seventeenth Schedule with respect to a package.

Qualified person

A person who has special knowledge in the safety measures required in handling of radioactive material or nuclear material, and in the decontamination of things contaminated by radioactive material or nuclear material and who is approved by the NRRC.

S*mall freight container*

a freight container that has an internal volume of not more than 3 cubic metres (m^3).

Subcritical

Incapable of reaching criticality.

SCO-I

is a solid object on which-

a. the non-fixed contamination on the accessible surface averaged over 300 square centimetres (cm^2) (or the area of the surface if less than 300 cm^2) does not exceed 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 0.4 Bq/cm^2 for all other alpha emitters;
b. the fixed contamination on the accessible surface averaged over 300 square centimetres (cm^2) (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 4×10^3 Bq/cm^2 for all other alpha emitters; and
c. the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 square centimetres (cm^2) (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 4×10^3 Bq/cm^2 for all other alpha emitters.

SCO-II

is a solid object on which either the fixed or the non-fixed contamination on the surface exceeds the applicable limits specified for SCO-I but-

a. The non-fixed contamination on the accessible surface averaged over 300 square centimetres (cm^2)(or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 40 Bq/cm^2 for all other alpha emitters;
b. The fixed contamination on the accessible surface averaged over 300 square centimetres (cm^2)(or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 for all other alpha emitters; and
c. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 square centimetres (cm^2) (or the area of the surface if less than 300 cm^2) does not exceed 8 x 105 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 for all other alpha emitters.

SCO-III

is a large solid object which, because of its size, cannot be transported in a type of package described in this Regulation and for which:

a. All openings are sealed to prevent release of radioactive material during conditions defined in Article 102;
b. The inside of the object is as dry as practicable;
c. The non-fixed contamination on the external surfaces does not exceed the limits specified in Article 40;
d. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 does not exceed 8 x 10^5 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 for all other alpha emitters.

Specific activity

The activity of a radionuclide per unit mass of that nuclide or the article 17 of a material per unit mass of that material in which the radionuclides are essentially uniformly distributed.

Transport document

A document accompanying a package being transported and containing all the necessary information as specified in Article 108 and Article 109.

Transport Index (TI)

A number which is used to provide control over radiation exposure that is assigned to a package, overpack or freight container or to unpackaged LSA-I or SCO-I or SCO-III.

Transport plan

A plan that shall be prepared by consignor for the transportation of SCO-III.

Unirradiated thorium

Thorium containing not more than 10^{-7} grams (g) of uranium-233 per gram of thorium-232.

Unirradiated uranium

Uranium containing not more than 2×10^{3} becquerels (Bq) of plutonium per gram of uranium-235, not more than 9×10^{6} Bq of fission products per gram of uranium-235 and not more than 5×10^{-3} g of uranium-236 per gram of uranium-235.

Chapter 2: Requirements In Preparing Packages For Transport

Section 4: Classification of Packages

6. For the purpose of transporting radioactive and nuclear material in the Kingdom, there shall be five categories of packages that may be used for the transport of radioactive materials or nuclear materials, namely:

    a. Excepted package;

    b. Type A package;

    c. Type B package;

    d. Type C package; and

    e. Industrial package.

7. Type B package shall be further categorized into two categories, namely, Type B (U) package and Type B (M) package.

8. Industrial package shall be further categorized into three categories, namely, industrial package Type 1 (IP - 1), industrial package Type 2 (IP-2) and industrial package Type 3 (IP-3).

Section 5: Requirements for Excepted Package

9. An excepted package shall satisfy all the requirements specified in the First Schedule of this Regulation .

Section 6: Requirements for Type A Package

10. A Type A package shall satisfy all the requirements specified in the Second Schedule of this Regulation.

Section 7: Requirements for Type B Package

11. A Type B package shall satisfy all the requirements specified in the Third Schedule of this Regulation.

Section 8: Requirements for Type C Package

12. A Type C package shall satisfy all the requirements specified in the Fourth Schedule of this Regulation.

Section 9: Requirements for Industrial Package

13. An industrial package shall satisfy all the requirements specified in the Fifth Schedule of this Regulation.

Section 10: Requirements for Packages Containing Uranium Hexafluoride

14. Packages containing uranium hexafluoride shall comply with the requirements specified in the Sixth Schedule of this Regulation.

15. Packages designed to contain uranium hexafluoride shall comply with the requirements prescribed in this Regulation pertaining to the radioactive and fissile properties of the material.

Section 11: Requirements for Packages Containing Fissile Material

16. Packages containing fissile material shall comply with the requirements specified in the Seventh Schedule of this Regulation.

Section 12: The Use of Non-conforming Packages

17. The NRRC shall authorize the use of a non-conforming package in case the following requirements are met:

    a. In the opinion of the NRRC, conformity with the relevant requirements of this Specific Regulation and other relevant NRRC Regulation is impracticable; and
    b. Suitable measures to compensate for the known or the anticipated non-conformities are available and the NRRC believes that the overall level of safety and security in transport and in stowage is at least equivalent to that which would have been provided if all the relevant requirements of this Specific Regulation and other relevant NRRC Regulation had been met.

Section 13: Application for Authorization to Use Non-conforming Packages

18. An application for authorization to use non-conforming packages under Article 17 shall include a written statement describing the following:

    a. The manner and degree to which the package does not conform to the relevant requirements of this Specific Regulation;
    b. The Evidence supporting the applicant's assertion that it would be impossible to comply with the applicable requirements of this Specific Regulation.;
    c. The details of all measures that are proposed to be taken to compensate for the known or anticipated non-conformities; and
    d. Any additional information that the NRRC deems necessary to evaluate the application.

19. Any authorization issued by the NRRC pursuant to requirement in Article 17 of this Regulation shall be in writing, and shall be subject to the terms and conditions the NRRC deems necessary in the interests of health, safety, security, and environment.

Section 14: Additional Requirements for Packages Containing Material with Dangerous Properties, in Addition to Radioactive and Fissile Properties

20. A package to be used for the transport of radioactive material or nuclear material having dangerous properties, in addition to radioactive and fissile properties, shall comply with the following additional requirements:

    a. The package design shall take into account all the relevant dangerous properties, including explosiveness, flammability, pyrophoricity, toxicity and corrosiveness; and
    b. The package design shall take into account the formation of other dangerous substances that may result from the reaction between the radioactive content of the package and the environment in the event of any damage to the containment system.

Section 15: Additional Requirements for Packages to be Transported by Air

21. A package to be used for the transport of radioactive material or nuclear material substance by air shall comply with the following additional requirements:

    a. The temperature of the accessible surface of the package shall not exceed 5°C at an ambient temperature of 38°C with no account taken for insulation;

b. The integrity of the containment system of the package shall not be impaired if they were exposed to ambient temperatures ranging from -40°C to +55°C; and
c. If the package is designed to be used for the transport of radioactive material or nuclear material, the containment system of the package shall be so designed as to withstand, without leakage, an internal pressure which produces a pressure differential of not less than maximum normal operating pressure plus 95 kilopascals (kPa).

Section 16: The Use of Overpack

22. An overpack may be used by a consignor for the purpose of consolidating two or more packages into one handling unit for convenience of handling, stowage and carriage.

Chapter 3: Content Limits for Packages

Section 17: Content Limits for Excepted Package

23. An excepted package shall not contain an activity greater than:

a. The limits specified in columns (B) and (C) of the Eighth Schedule for each individual item and each package respectively where the radioactive material is enclosed in or is included as a component part of an instrument or other manufactured article; or
b. The limits specified in column (D) of the Eighth Schedule where the radioactive material or nuclear material is not enclosed in or is not included as a component of an instrument or other manufactured article.

24. An excepted package that contain any quantity of such article manu-

factured of unirradiated natural uranium, unirradiated depleted uranium or unirradiated natural thorium may be transported provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

Section 18: Content Limits for Industrial Package

25. The radioactive content of an industrial package containing LSA or SCO shall be so restricted that:

    a. The dose rate at 3 meters (m) from the unshielded material or object or collection of objects does not exceed 10 millisieverts per hour (mSv/h); and
    b. The activity in a single package shall not exceed the limit for conveyance specified in the Ninth Schedule.

26. The radioactive content of an industrial package containing non-combustible solid LSA-II or LSA-III material, if carried by air, shall not be greater than 3000 A_2.

Section 19: Content Limits for Type A Package

27. The radioactive content of a Type A package shall not be greater than A1 for a special form radioactive material or A_2 for all other forms of radioactive material, or nuclear material.

28. For the purpose of this Specific Regulation, the values of A_1 and A_2 shall be as specified in the Tenth Schedule.

Section 20: Content Limits for Type B Package

29. A Type B (U) package or Type B (M) package shall not contain:

a. Activity that is greater than what is authorized for the package design;
b. Radionuclides different from what is authorized for the package design; and
c. Radioactive material or nuclear material in a form or a physical or chemical state different from what is authorized for the package design as specified in the certificate of approval.

Section 21: Content Limits for Type B Package to Be Transported by Air

30. A Type B (U) package or Type B (M) package to be transported by air shall comply with the requirements specified in Article 21 and the radioactive content in the following :

a. Low dispersible radioactive materiashall not be greater than what has been authorized for the package design as specified in the certificate of approval;
b. Special form radioactive material shall not be greater than 3000 A_1 or 100000 A_2, whichever is the lower; and
c. (c) All other radioactive material shall not be greater than 3000 A_2.

Section 22: Content Limits for Type C Package

31. A Type C package shall not contain:

a. Activity greater than that which is authorized for the package design;
b. Radionuclides different from that which is authorized for the package design; and
c. Radioactive material or nuclear material in a form or a physical

or chemical state different from that which is authorized for the package design.

Section 23: Content Limits for Packages Containing Fissile Material

32. Unless as specified in the Seventh Schedule, packages containing fissile material shall not contain any of the following:

    a. A mass of fissile material different from that which is authorized for the package design;
    b. Any radionuclide or fissile material different from that which is authorized for the package design; and
    c. Content in a form, physical state, or chemical state, or in a spatial arrangement different from that which is authorized for the package design.

Section 24: Content Limits for Package Containing Uranium Hexafluoride

33. Packages containing uranium hexafluoride shall not contain any of the following:

    a. A mass of uranium hexafluoride greater than a value that would lead to unfilled space(ullage) smaller than 5% at the maximum temperature of the package as specified for the plant where the package shall be used;
    b. Uranium hexafluoride other than in solid form or at an internal pressure above atmospheric pressure when presented for transport; and
    c. A mass of uranium hexafluoride different from that authorized for the package design.

Section 25: Requirements for Special Form Radioactive Material

34. The design of a special form of radioactive material is subject to NRRC approval.

35. Radioactive material or nuclear material shall not be transported in a package as a special form of radioactive material unless it is designed in a way that satisfies the following requirements:

    a. One of its dimensions, at least, is not less than 5 millimetres (mm);
    b. It would not break or shatter if it is subjected to:

        i. The Impact Test, the Percussion Test and the Bending Test as specified in Part III of the Eleventh Schedule; or

        ii. Any other equivalent tests approved by the NRRC.
    c. It would not melt or disperse if it is subjected to:

        i. The Heat Test as specified in Part III of the Eleventh Schedule; or

        ii. Any other equivalent tests approved by the NRRC.
    d. The level of activity in the water if it were subjected to:

        i. the Leaching Assessment Test specified in Part III of the Eleventh Schedule, would not exceed 2 kilobecquerels (kBq); or

        ii. any other equivalent tests approved by the NRRC for sealed sources, would not exceed the limit set by the NRRC; and
    e. when a sealed capsule constitutes part of a special form radioactive material, the capsule is so manufactured that it can be opened only by destroying it.

Section 26: Requirements for Low Dispersible Radioactive Material

36. A package containing a low dispersible radioactive material shall be such that the total amount of radioactive material in the package shall comply with the following requirements:

    a. The dose rate at 3 meter (m) from the unshielded radioactive material does not exceed 10 millisieverts per hour (mSv/h);
    b. The airborne release in gaseous and particulate forms up to 100 micrometres (μm) aerodynamic equivalent diameter if it is subjected to the Enhanced Thermal Test and Impact Test as specified in Part II of the Eleventh Schedule, would not exceed 100 A_2; and
    c. The level of activity in the water would :

        i. Not exceed 100 A_2 if it is subjected to the test as specified in Part I of the Eleventh Schedule; or

        ii. Not exceed the limit set by the NRRC if it is subjected to any other equivalent tests approved by the NRRC.

Chapter 4 : Limits on Packages and Overpacks

Section 27: Limit on Dose Rate on External Surface of Excepted Package

37. The dose rate at any point on the external surface of an excepted package shall not exceed 5 microsieverts per hour (μSv/h).

Section 28: Limit on Dose Rate on External Surface of Package and Overpack

38. The maximum dose rate at any point on the external surface of an

overpack or of a package other than an excepted package shall not exceed 2 mSv/h.

39. Notwithstanding Article 38, the maximum dose rate at any point on the external surface of a package or an overpack to be transported under exclusive use shall not exceed 10 mSv/h.

Section 29: Limit for Non-fixed Contamination on the External or Internal Surface of Packaging

40. The non-fixed contamination on the external surface of any package shall be kept as low as is practicable and, under routine conditions of transport, shall not exceed 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, and 0.4 Bq/cm^2 for all other alpha emitters.

41. The limits specified in Article 40 are applicable when averaged over any area of 300 cm^2 of any part of the surface.

42. In the case of a freight container, an overpack, tanks or intermediate bulk container, the level of the non-fixed contamination on the external or the internal surfaces shall not exceed the limits as specified in Article 40.

43. Article 42 shall not apply to the internal surfaces of freight containers being used as packagings, either loaded or empty.

Section 30: Limit on Transport Index (TI) for Package and Overpack

44. Except for consignments under exclusive use, the transport index (TI) of any package or overpack shall not exceed 10.

Section 31: Limit on Criticality Safety Index (CSI) for Package or Overpack

45. Except for consignments under exclusive use, the criticality safety index (CSI) of any package or overpack shall not exceed 50.

Chapter 5: Marking, Labelling, and Placarding

Section 32: Application of Marking and Labelling

46. For each package or overpack, the United Nations Number and proper shipping name shall be in accordance with the Twelfth Schedule.

47. For international transport of packages requiring competent authority design or shipment approval, for which different approval types apply in the different countries concerned by the shipment, the United Nations Number, proper shipping name, categorization, labelling and marking shall be in accordance with the certificate of the country of origin of design.

Section 33: Marking of package

48. Each package of gross mass exceeding 50 kilograms (kg) shall have its permissible gross mass legibly and durably marked on the outside of the package.

49. Each package shall be legibly and durably marked on the outside of the package with an identification of either the consignor or consignee, or both.

50. For:

    a. Package other than excepted packages, the United Nations Num-

ber, preceded by the letters "UN", and the proper shipping name shall be legibly and durably marked on the outside of the package; and

b. Excepted packages, only the United Nations Number, preceded by the letters "UN", shall be required.

51. Each package which conforms to a Type A package design shall be legibly and durably marked on the outside of the package with:

a. The marking "TYPE A"; and
b. The international vehicle registration code (VRI Code) of the country of origin and the name of the manufacturers, or other identification of the package as determined by the NRRC.

52. Each package which conforms to a Type B package design shall be legibly and durably marked on the outside of the package with:

a. The identification mark assigned to that design by the NRRC;
b. A serial number to identify each package which conforms to that design; and
c. The marking "TYPE B (U)" for a Type B (U) package design or the marking "TYPE B(M)" for a Type B(M) package design.

53. Each package which conforms to a Type B (U), or Type B (M) package design shall be conspicuously and durably marked with a trefoil symbol which shall:

a. Conform to the model specified in Figure 1 of the Twenty Second Schedule;
b. Be placed on the outside of the package by embossing, stamping or other means; and
c. Be resistant to fire and water.

54. Each package which conforms to a Type C package design shall be:

    a. Legibly and durably marked on the outside of the package with:

        i. The identification mark assigned to that design by the NRRC;

        ii. A serial number to identify each package which conforms to that design; and

        iii. The marking "TYPE C" for a Type C package design.

    b. conspicuously and durably marked with a trefoil symbol which shall:

        i. Conform to the model specified in Figure 1 of the Thirteenth Schedule;

        ii. Be placed on the outside of the package by embossing, stamping or other means; and

        iii. Be resistant to fire and water.

55. Each package which conforms to an Industrial Package Type 1, Industrial package Type 2 or Industrial package Type 3 design shall be legibly and durably marked on the outside of the package with "TYPE IP-1", "TYPE IP-2" or "TYPE IP-3", as appropriate.

56. Each package which conform to an Industrial package Type 2 or Industrial package Type 3 design shall be legibly and durably marked on the outside of the package with the international vehicle registration code (VRI Code) of the country of origin and the name of the manufacturers or other identification of the package as determined by the NRRC.

57. Each package containing LSA-I or SCO-I material and transported under exclusive use, the outer surface of the package shall bear the marking "RADIOACTIVE LSA-I" or "RADIOACTIVE SCO-I", as appropriate.

Section 34: Labelling of Package and Overpack

58. Each package, other than an excepted package, and each overpack or freight container, except specified under Article 73, shall have labels which conforms to the labels specified in Figures 2, 3 or 4 of the Thirteenth Schedule according to the appropriate category.

59. Each package, overpack and freight container containing fissile material, other than fissile material as specified in the Twentieth Schedule, shall bear labels specified in Figure 5 of the Thirteenth Schedule.

60. The labels shall be affixed to the external side of two opposite sides of a package or an overpack, or to the external side of all the four sides of a freight container or tank.

61. The label specified in Figure 5 of the Thirteenth Schedule shall be affixed adjacent to the labels specified in Figures 2, 3 and 4 of the Thirteenth Schedule and these labels shall not cover the other markings.

62. Any labels which do not relate to the contents shall be removed or otherwise rendered invisible.

Section 35: Information Requirements on Labels

63. Each label shall contain information on the radioactive content, activity and transport index of the labelled package.

64. The respective symbols of radionuclides as specified in column (A) of Table I of the Tenth Schedule shall be used for the purpose of describing the radioactive content other than LSA-I.

65. For mixtures of radionuclides:

    a. The respective symbols of the most restrictive nuclides must be listed to the extent the space permits; and
    b. If inclusive of the group of LSA or SCO, it shall be shown by using "LSA-II", "LSA-III", "SCO-I" or "SCO-II", as appropriate, following the symbol of the radionuclide.

66. For LSA-I, the symbol "LSA-I" shall be used, and the name of the radionuclide is not necessary.

67. The maximum activity of the radioactive contents during transport, expressed in units of becquerels (Bq) using the appropriate SI prefix as specified in the Fourteenth Schedule shall be used for the purpose of describing the activity, but for a fissile material, the mass in units of grams (g) or multiples thereof, may be used.

68. For overpacks and freight containers, the "contents" and "activity" entries on the label shall bear the information required in Article 63, Article 64, Article 65 and Article 66, totaled together for the entire contents of the overpacks or the freight containers.

69. For overpacks or freight containers containing mixed loads of packages with different radionuclides, the "content" and "activity" entries may simply read "see transport documents".

70. Each package in category II-YELLOW or III-YELLOW shall have its transport index marked on its label.

Section 36: Labelling for Criticality Safety Index

71. Each label conforming to the model in Figure 5 of the Thirteenth Schedule shall be stated with the criticality safety index (CSI) as stated in the certificate of approval for special arrangement or the certificate of approval for the package design issued by the NRRC.

72. For overpacks and freight containers, the criticality safety index (CSI) on the label shall bear the information required in Article 71, totaled together for the fissile contents of the overpack or freight container.

Section 37: Placarding of Freight Container or Tank

73. Large freight container carrying unpackaged LSA-I material or SCO-I or packages other than excepted packages and tanks, shall bear four placards which shall conform with the model specified in Figure 6 of the Thirteenth Schedule and which shall be affixed in a vertical orientation to each side wall and each end wall of the freight container or tank; and any placards which do not relate to the contents shall be removed or otherwise rendered invisible.

74. As an alternative to the use of a label and a placard, it is permitted to use labels only as shown in Figures 2, 3 and 4 provided that they are enlarged so as to comply with the minimum dimensions as specified in Figure 6 of the Thirteenth Schedule.

75. Where an exclusive use consignment in the freight container or tank is unpackaged LSA-I or SCO-I or where an exclusive use consignment in a freight container is packaged radioactive material, the appropriate United Nations Number as specified in column (A) of the Twelfth Schedule shall also be displayed in black digits of not less than 65 mm high as follows:

a. In the lower half of the placard specified in Figure 6 of the Thirteenth Schedule and against the white background; or
b. On the placard as specified in Figure 7 of the Thirteenth Schedule.

76. For Article 75 (b), the subsidiary placard shall be affixed adjacent to either the main placard or the enlarged label, on all four sides of the freight cntainer or tank.

Section 38: Design of Labels and Placards

77. The labels and placards required by this Specific Regulation shall conform to the appropriate designs specified in Figures 1, 2, 3, 4, 5, 6 and 7 of the Thirteenth Schedule and shall conform to the colours specified in Figures 2, 3, 4, 5, 6 and 7 of the Thirteenth Schedule.

Chapter 6: Categorisation of Packages and Overpacks

Section 39: Categorization of Packages and Overpacks

78. All packages and overpacks to be transported shall be categorised into category I-WHITE, II-YELLOW or III-YELLOW in accordance with the conditions specified in the Fifteenth Schedule.

79. In determining the appropriate category of a package or an overpack -

a. Both the transport index and the surface dose rate conditions of the package or overpack shall be taken into account and where the transport index satisfies the condition for one category but the surface dose rate satisfies the condition for a different category, the package or overpack shall be assigned to the higher category;
b. Category I-WHITE, II-YELLOW and III-YELLOW shall be regarded as the lowest, medium and highest category respectively for the purpose of paragraph (a); and

c. The transport index shall be determined in accordance with the procedures specified in the Sixteenth Schedule.

80. Except under the provision of Article 44, a package and an overpack which contains packages to be transported under a special arrangement shall be assigned to category III-YELLOW.

Chapter 7: Responsibilities In Transport Of Packages

Section 40: Prohibition

81. Without prejudice to the Article 17, no person shall transport or cause to be transported any radioactive material or nuclear material unless:

a. It is packed in a package whose design meets all the requirements of this Specific Regulation and other Regulations reffered in this Specifc Regulation; and

b. The consignment is accompanied with proper transport document,

c. Packed, marked, labelled, categorised and placarded in accordance with all the requirements of this Specifc Regulation.

Section 41: Non-compliance

82. In the event of non-compliance with any limit applicable to dose rate as specified in Article 37, Article 38, and Article 39 or contamination as specified in Article 40, Article 41, Article 42 and Article 43:

a. The consignor shall be informed of the non-compliance by:

i. The carrier if the non-compliance is identified during transport; or

ii. The consignee if the non-compliance is identified at receipt;

b. the carrier, consignor or consignee, as appropriate, shall:

i. Take immediate steps to mitigate the consequences of the non- compliance;

ii. Investigate the non-compliance and its causes, circumstances and consequences;

iii. Take appropriate action to remedy the causes and circumstances that led to the non-compliance and to prevent a recurrence of circumstances similar to those that led to the non-compliance; and

iv. Communicate to the relevant competent authority on the causes of the non-compliance and on corrective or preventive actions taken or to be taken; and

c. The carrier or consignee shall communicate of the non-compliance to the consignor and relevant competent authority, respectively, as soon as practicable and it shall be immediate whenever an emergency exposure situation has developed or is developing.

Section 42: Transport of Empty Packaging

83. An empty packaging which had previously been used for the transport of radioactive material or nuclear material may be transported as an excepted package provided that:

a. It is in a well-maintained condition and securely closed;

b. 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;

c. the level of internal non-fixed contamination does not exceed one hundred times the levels specified in Article 40; and

d. any labels or placards which may have been displayed on it in compliance with the requirements of Chapter 5 are removed or otherwise rendered invisible.

Section 43: Reuse of Tank and Intermediate Bulk Container

84. A tank and intermediate bulk container which has been used for the transport of radioactive material or nuclear material may be reused for the storage or transport of other goods provided that it is de-contaminated below the level of 0.4 Bq/cm^2 for beta emitter, gamma emitter and low toxicity alpha emitter, and 0.04 Bq/cm^2 for all other alpha emitters.

Section 44: Notification of Loss

85. In the event of loss or suspected loss of a consignment or part of the consignment, the authorized person responsible for the consignment or any person who in the possession of the information shall notify the NRRC of such loss within twenty-four hours upon discovery of the loss or suspected loss.

Section 45: Non-delivery

86. In cases of non-delivery where neither the consignor nor the consignee can be identified, any person who is in possession of the package shall ensure that the package be placed in a safe and secure location and shall notify the NRRC within twenty-four hours upon discovery of the loss or suspected loss.

Chapter 8: Responsibilities of Consignors

Section 46: Packages Presented for Transport

87. The consignor shall ensure that all packages or overpacks comply with all the requirements as specified in Chapter 9 of this Specific Regulation and other NRRC Regulations referred to here, and shall take into account the ageing mechanisms of the design of the packages before the packages are presented for transport.

Section 47: Controls for Transport of Excepted Package

88. The consignor shall ensure that the dose rate at any point on the external surface of an excepted package does not exceed 5 μSv/h.

89. The consignor may transport 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 column (B) and (C) respectively of the Eighth Schedule in an excepted package provided that:

    a. The dose rate at 10 cm from any point on the external surface of any unpackaged instrument or article is not greater than 0.1 mSv/h;
    b. Each instrument or article bears the marking "RADIOACTIVE" except:

        i. Devices containing radioluminescent; and

        ii. Consumer products which do not individually exceed the activity limit for an exempt consignment or which have received approval from the NRRC, provided such products are transported in a package that bears the marking "RADIOACTIVE"

on an internal surface in such a manner that warning of the presence of radioactive material is visible on opening the package; and

c. The active material is completely enclosed by non-active component.

90. Radioactive material in forms other than those specified in Article 89 with an activity not exceeding the limit specified in column (D) of the Eighth Schedule may be transported in excepted package provided that:

a. The package retains its radioactive contents under routine conditions of transport; and

b. The package bears the marking "RADIOACTIVE" on an internal surface in such a manner that warning of the presence of radioactive material is visible on opening the package.

91. A manufactured article in which the sole radioactive material is unirradiated natural uranium, unirradiated depleted uranium or unirradiated natural thorium may be transported as an excepted package provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

Section 48: Control of Packages Containing Fissile Material

92. The consignor shall ensure that all packages containing fissile material comply with all the relevant requirements of this Specific Regulation.

93. The consignor shall ensure that fissile material is packed and transported in such a manner that its subcriticality is maintained under all conditions of transport.

Section 49: Control of Packages Containing Uranium Hexafluoride

94. The consignor shall ensure that all packages containing uranium hexafluoride comply with all the requirements of this Specific Regulation pertaining to the radioactive and fissile properties of the material.

95. The consignor shall ensure that for a package designed to contain 0.1 kg or more of uranium hexafluoride, the package shall be so designed so that it would meet the following requirements:

    a. Withstand without leakage and without unacceptable stress if it is tested hydraulically at an internal pressure of at least 1.38 megapascal (MPa);
    b. Withstand without loss or dispersal of the uranium hexafluoride if it is subjected to the Free Drop Test as specified in the Part III of Seventeenth Schedule; and
    c. Withstand without rupture of the containment system if it was subjected to the Thermal Test as specified in Part II of the Eighteenth Schedule.

96. The consignor shall ensure that a package designed to contain 0.1 kg or more of uranium hexafluoride shall not be provided with pressure relief devices.

Section 50: Control of LSA and SCO in Industrial Packages or Unpackaged

97. If the LSA or the SCO is to be transported in an industrial package, the consignor shall ensure that it is packed in a package as specified in the Nineteenth Schedule.

98. The consignor shall ensure that the total activity in a single hold or compartment of an inland watercraft, or in another conveyance, for carriage of LSA material or SCO in an industrial package or unpackaged does not exceed the limits specified in the Ninth Schedule. For SCO-III, the limits in Ninth Schedule may be exceeded provided that the transport plan contains precautions which are to be employed during transport to obtain an overall level of safety at least equivalent to that which would be provided if the limits had been applied.

99. The consignor may cause LSA-I (other than ores containing only naturally occurring radionuclides) or, subject to Article 100, SCO-I to be transported unpackaged if:

    a. The unpackaged material does not escape from the conveyance and the integrity of the shielding is not affected under the normal conditions of transport; and
    b. The conveyance is under exclusive use.

100. For SCO-I, as specified in Article 99 (b) shall only apply if:

    a. The accessible and inaccessible surface contamination is more than 4 Bq/cm^2 for beta emitter, gamma emitter and low toxicity alpha emitter, or 0.4 Bq/cm^2 for all other alpha emitters; or
    b. It is suspected that the non-fixed contamination on the inaccessible surface is more than 4 Bq/cm^2 for beta emitter, gamma emitter and low toxicity alpha emitter, or 0.4 Bq/cm^2 for all other alpha emitters.

101. The consignor shall ensure that LSA or SCO which contains fissile material is packed and transported in accordance with all the applicable requirements of this Specific Regulation.

102. For SCO-III, consignor shall ensure the following:

a. Transport shall be under exclusive use by road, rail, inland waterway, or sea;
b. Stacking shall not be permitted;
c. All activities associated with the shipment, including radiation protection, emergency response and any special precautions or special administrative or operational controls that are to be employed during transport shall be described in a transport plan. The transport plan shall demonstrate that the overall level of safety in transport is at least equivalent to that which would be provided if the requirements paragraph 12 of Second Schedule (only for the test specified in paragraph 18, preceded by the test specified in paragraph 9-16 in Part III of the Seventeenth Schedule) had been met;
d. The requirements of Part II of the Fifth Schedule for a Type IP-2 package shall be satisfied, except that the maximum damage referred to in paragraph 10-16 of Part III Seventeenth Schedule may be determined based on provisions in the transport plan, and the requirements of paragraph 17 in Part III Seventeenth Schedule are not applicable;
e. The object and any shielding are secured to the conveyance in accordance with paragraph 1 of Fourth Schedule; and
f. The shipment shall be subject to multilateral approval.

Section 51: Control of Package in Category I-WHITE

103. The consignor shall ensure that:

a. The dose rate at any point on the external surface of a package in category I-WHITE does not exceed 5 μSv/h; and

b. The transport index of a package in category I-WHITE does not exceed 0.

Section 52: Control of Package in Category II-YELLOW

104. The consignor shall ensure that:

a. The dose rate at any point on the external surface of a package in category II-YELLOW does not exceed 0.5 mSv/h; and
b. The transport index of a package in category II-YELLOW does not exceed 1.

Section 53: Control of Package in Category III-YELLOW

105. The consignor shall ensure that:

a. The dose rate at any point on the external surface of a package in category III-YELLOW does not exceed 2 mSv/h; and
b. The transport index of a package in category III-YELLOW does not exceed 10.

Section 54: Control of Package in Category III-YELLOW Under Exclusive Use

106. Notwithstanding Article 105, the consignor shall ensure that the dose rate at any point on the external surface of a package in 104 category III-YELLOW to be transported under exclusive use does not exceed 10 mSv/h.

107. Any package or overpack whose transport index is greater than 10, or any consignment whose criticality safety index is greater than 50 shall be transported only under exclusive use.

Section 55: Transport Document

108. The consignor shall ensure that a transport document is prepared for each consignment.

109. The transport document shall contain the following information, as applicable, in the order given below:

a. The consignor and consignee identification including their names and addresses;
b. Tthe proper shipping name, as specified in Article 46 and Article 47;
c. The United Nations Class Number "7";
d. The United Nations Number assigned to the material as specified in Article 46 and Article 47, preceded by the letters "UN";
e. The name or symbol of each radionuclide or for mixtures of radionuclides, an appropriate general description or a list of the most restrictive nuclides as specified in column (A) of Table I of the Thirteenth Schedule;
f. A description of the physical form of the material, chemical form of the material which can include a generic chemical description, or a notation that the material is a special form radioactive material or low dispersible radioactive material;
g. The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with the appropriate SI prefix as specified in the Fourteenth Schedule, but for fissile material, the total mass of the fissile material in units of grams (g), or appropriate multiples thereof, may be used in place of the activity;
h. The category of the package, that is, I-WHITE, II-YELLOW or III-YELLOW;

i. The transport index for categories II-YELLOW and III-YELLOW;
j. The criticality safety index for consignments including fissile material other than consignments excepted as specified in the Twentieth Schedule;
k. The identification mark of the NRRC or each competent authority approval certificate for special form radioactive material, low dispersible radioactive material, special arrangement, or package design or shipment, applicable to the consignment;
l. For consignments of more than one package, the information specified in Article 109 (a) to (k) shall be given for each package;
m. For packages in an overpack, freight container or conveyance, a detailed statement of the contents of each package within the overpack, freight container or conveyance and, where appropriate, of each overpack, freight container or conveyance shall be included and if packages are to be removed from the overpack, freight container or conveyance at a point of intermediate unloading, appropriate transport documents shall be made available;

    i. where a consignment to be shipped under exclusive use, the statement "EXCLUSIVE USE SHIPMENT"; and

    ii. the total activity of the consignment as a multiple of A_2 for LSA-II, LSA-III, SCO-I and SCO-II.

Section 56: Declaration

110. The consignor shall include in the transport document 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 labelled, and are in all respects in proper condition for transport by ……. (insert mode(s) of transport) according to the applicable regulations of the Kingdom and relevant international regulations".

111. If the intent of the declaration is already a condition of transport within a particular international convention to which the Kingdom is a party, the consignor need not provide a declaration as in Article 110 for that part of the transport covered by the convention.

112. The declaration shall be signed, stamped, and dated by the consignor.

Section 57: Removal or Covering of Labels

113. When an empty packaging as described in Article 84 is transported as an excepted package, the consignor shall remove old labels or otherwise render them invisible.

Section 58: Information for Carrier

114. The consignor shall provide in the transport documents a statement regarding actions, if any, that are required to be taken by the carrier.

115. The statement shall be in the languages deemed necessary by the carrier or the authorities concerned, and shall include at least the following information:

a. The supplementary operational instructions for loading, stowage, carriage, handling and unloading of the package, overpack or freight container including any special stowage provisions for the safe dissipation of heat in compliance with Article 143 (a) or a statement that no such instructions are necessary;any restriction

on the mode of transport or conveyance and any necessary routing instructions; and

b. An appropriate emergency response plan to the consignment.

116. The applicable competent authority certificates need not necessarily accompany the consignment, but the consignor shall make them available to the carrier before loading and unloading.

Section 59: Consignor's Notification

117. If a package is transported for the first time after the package design approval certificate is issued by a competent authority, the consignor shall ensure that a copy of the certificate is submitted and received by the NRRC or the competent authority of each country through or into which the package is to be transported, before the first shipment is made.

118. The consignor shall notify the NRRC and the competent authority of each country through or into which the consignment is to be transported if the following is involved:

a. Type B(U) package containing radioactive material or nuclear material with an activity greater than 3×10^3 A_1 or 3×10^3 A_2, as appropriate, or 1000 TBq, whichever is the lower;

b. Type B (M) package;

c. Type C package containing radioactive material or nuclear material with an activity greater than 3×10^3 A_1 or 3×10^3 A_2, as appropriate, or 1000 TBq, whichever is the lower; or

d. Any shipment under a special arrangement.

119. The notification shall include:

a. Sufficient information, including all applicable certificate numbers and identification marks, to enable the identification of the package;
b. Information on the date of the shipment, the expected date of arrival and the proposed routing;
c. The name of the radioactive material or nuclear material;
d. a description of the physical and chemical form of the radioactive material or low dispersible radioactive material; and
e. The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with an appropriate SI prefix as specified in the Fourteenth Schedule, except for fissile material, where the mass in units of grams (g), or multiples thereof, may be used in place of the activity.

120. The notification mentioned in Article 118 shall be in the hands of the NRRC or each competent authority at least seven days prior to the commencement of the shipment, but the consignor is not required to send the notification if the required information has been included in the application for approval of the shipment under Article 182.

Section 60: Package's Certificate and Operating Instructions

121. Before making any shipment, the consignor shall ensure that he has in his possession:

a. A copy of every certificate applicable to the package; and
b. A copy of the operating instructions with regard to the proper closing of the package and other preparations for the shipment.

Section 61: Requirement Before First Shipment

122. Prior to the first shipment of any package, the following requirements shall be fulfilled:

a. If the design pressure of the containment system exceeds 35 kPa, the consignor shall ensure that the containment system of the package conforms to the approved design requirements relating to the capability of system to maintain its integrity under that pressure;
b. For each Type B(U), Type B(M), Type C package and for each package containing fissile material, the consignor shall ensure that 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; and
c. For package containing fissile material, where neutron poisons are included as components of the package, the consignor shall check to confirm the presence and distribution of those neutron poisons.

Section 62: Requirement Before Each Shipment

123. The consignor shall ensure that before each shipment of any package, the following requirements are fulfilled:

a. For each packages, all the requirements specified in the relevant provisions of this Specific Regulation have been satisfied;
b. Lifting attachments which do not meet the requirements of paragraph 2 of the First Schedule have been removed or otherwise rendered incapable of being used for lifting the package, in accordance with paragraph 3 of the First Schedule;

c. All the requirements specified in the approval certificates have been satisfied for each package requiring competent authority's approval;

d. Each of Type B(U) package, Type B(M) package or Type C package shall be held until equilibrium conditions have been approached closely enough to demonstrate compliance with the requirements for temperature and pressure unless an exemption from these requirements has received unilateral approval;

e. Each of Type B(U), Type B(M) and Type C package shall be ensured by inspection and appropriate tests that all closures, valves or other openings of the containment system through which the radioactive contents might escape are properly closed and where appropriate, sealed in the manner that demonstrating compliance with the requirements of paragraph 9 of the Third Schedule and paragraph 3 of the Fourth Schedule, in accordance with instructions as set out by the designer, manufacturer or distributor of the package;

f. All the requirements specified in the approval certificates and the relevant provisions of this Specific Regulation have been satisfied for each special form radioactive material;

g. For packages containing fissile material, the measurement specified in paragraph 4(b) of the Seventh Schedule and the test to demonstrate closure of each package as specified in paragraph 7 of the Seventh Schedule are performed where applicable; and

h. For each low dispersible radioactive material, all the requirements specified in the approval certificates and the relevant provisions of this Specific Regulation have been satisfied.

Chapter 9: Responsibilities of Carriers

Section 63: Transport Index Limit for Conveyance

124. Except under the condition of exclusive use, the carrier shall ensure that the total number of packages, tanks, freight containers or overpacks aboard a single conveyance is limited such that the total sum of the transport indexes aboard the conveyance does not exceed the respective values specified in Table III of the Sixteenth Schedule.

125. Article 124 shall not apply to consignments of LSA-I as there shall be no limit on the sum of the transport indexes for consignments of LSA-I material.

Section 64: Limit for Non-fixed and Fixed Contamination of Conveyance

126. The carrier shall ensure that the non-fixed contamination of a conveyance or equipment or part thereof does not exceed 4 Bq/cm^2 for beta emitter, gamma emitter and low toxicity alpha emitters, and 0.4 Bq/cm^2 for all other alpha emitters, and the dose rate on any surface resulting from fixed contamination does not exceed 5 μSv/h.

127. Any conveyance or equipment or part thereof which has become contaminated above the limits specified in Article 126 or whose dose rate exceeds 5 μSv/h shall not be reused unless it is decontaminated by a qualified person and the residual dose rate on any surface resulting from fixed contamination after decontamination does not exceed 5 μSv/h.

128. A conveyance or equipment used regularly for the transport of radioactive material or nuclear material shall be periodically checked to de-

termine the level of contamination and the frequency of such checks shall be related to the likelihood of contamination.

129. The dose rate under conditions likely to be encountered in the normal conditions of transport shall not exceed 2 mSv/h at any point on, and 0.1 mSv/h at 2 m from the external surface of the conveyance.

130. Article 126 shall not apply to a freight container, tank, intermediate bulk container or conveyance dedicated to the transport of unpackaged radioactive material under exclusive use.

Section 65: Limits of Dose Rate for Conveyance Under Exclusive Use

131. For conveyance under exclusive use, the carrier shall ensure that the dose rate shall not exceed:

a. 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 the access of unauthorized persons to the interior of the enclosure;

ii. Provisions are made to secure the package or overpacks 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;

d. 2 mSv/h at any point 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 on the lower external surface of the vehicle; and

e. 0.1 mSv/h at any point 2 m 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 m from the vertical planes projected from the outer edges of the vehicle.

Section 66: Steps to Be Taken in Case of Accidents

132. In the event of an accident or incident during the transport of a package, the carrier shall take steps to implement the emergency response plan provided by the consignors.

Section 67: Steps to Be Taken on Discovering Damage or Leakage

133. If it is suspected or evident that the package is damaged or leaking, the carrier shall:

a. Iimmediately inform the NRRC ;
b. Immediately restrict access to the package; and
c. Make assessment on the extent of resulting contamination and the dose rate.

134. The scope of the assessment specified in Article 133 (c) shall include the package, the conveyance, the adjacent areas, the store and, if necessary, all other materials which have been carried in the same conveyance or stored together.

135. Additional steps for the protection of persons, property and the environment shall be taken, when necessary, in accordance with provisions established by the NRRC, the competent authority or international organizations.

Section 68: Package Not to Be Forwarded

136. The carrier shall ensure that a leaking package or a package with physical defect which results in the limits for contamination and dose rate on its external surface to be exceeded:

    a. Is not removed except under the supervision of the NRRC or any person authorized by the NRRC; and
    b. Is not forwarded until it is decontaminated, repaired or reconditioned.

Section 69: The Use of Conveyance

137. The carrier shall ensure that the conveyance used for the transport of packages complies with Section 64, 65 and 66.

138. Category II-YELLOW or III-YELLOW packages or overpacks shall not be carried in compartments occupied by passengers, except those exclusively reserved for couriers specially authorized to accompany such packages or overpacks.

139. No person other than the driver and/or his assistant is permitted in road vehicles carrying packages, overpacks or freight containers bearing category II-YELLOW or category III-YELLOW labels.

Section 70: Transport of Package, Overpack or Consignment Under Exclusive Use

140. The carrier shall ensure that any package or overpack having a transport index greater than 10, shall be transported only under exclusive use.

141. The carrier shall ensure that any consignment having a criticality safety index greater than 50, shall be transported only under exclusive use.

Section 71: Stowage During Transport and Storage in Transit

142. The carrier shall ensure that a consignment is securely stowed.

143. A package or an overpack may be carried or stored among packaged general cargo without any special stowage provisions if:

    a. Its average surface heat flux does not exceed 15 watts per square metre (W/m^2) and the immediate surrounding cargo is not in sacks or bags; and
    b. No specific requirements are imposed in the approval certificate.

144. The carrier shall ensure that loading of freight containers and accumulation of packages, overpacks and freight containers:

    a. Except under the condition of exclusive use, and for consignments of LSA-I material, the total number of packages, overpacks and freight containers aboard a single conveyance is limited such that the total sum of the transport indexes aboard the conveyance does not exceed the values specified in Table III of the Sixteenth Schedule;
    b. The dose rate under routine conditions of transport shall not exceed 2 mSv/h at any point on, and 0.1 mSv/h at 2 m from the external surface of the vehicle or freight container, except for consignments transported under exclusive use by road or rail, for which the radiation limits around the vehicle as specified in Article 131 (b) and (c); and
    c. The total sum of the criticality safety indexes in a freight container and aboard a conveyance does not exceed the values specified in Table IV of the Sixteenth Schedule.

Section 72: Segregation of Packages Containing Fissile Material During Transport and Storage in Transit

145. The carrier shall ensure that:

a. Any group 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 the group does not exceed 50;
b. Each group shall be stored so as to maintain a spacing of at least 6 m from other such groups; and
c. Where the total sum of the criticality safety indexes on board a conveyance or in a freight container exceeds 50, as permitted in Table IV of the Sixteenth Schedule, 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 conveyance carrying radioactive material.

Section 73: Placarding of Transport by Rail and Road

146. For rail and road vehicles carrying packages, overpacks, tanks or freight containers labelled with any of the labels as specified in Figures 2, 3, 4 or 5 of the Thirteenth Schedule or carrying unpackaged LSA-I material, SCO-I or SCO-III or consignments under exclusive use, the carrier shall display the placard shown in Figure 6 of the Thirteenth Schedule on each of:

a. The two external lateral walls in the case of a rail vehicle; and
b. The two external lateral walls and the external rear wall in the case of a road vehicle.

147. For rail and road vehicles without sides, the placards shall be affixed on the tanks or freight containers.

148. For vehicles without tanks or freight containers, the placards may be affixed directly on the cargo-carrying unit, provided that they are readily visible.

149. For rail and road vehicles which have insufficient area to allow the fixing of larger placards, the dimensions of the placard as described in Figure 6 of the Thirteenth Schedule may be reduced to 100 mm.

150. Any placards which do not relate to the contents shall be removed.

151. Where the consignment in or on the conveyance is:

a. Unpackaged LSA-I;
b. SCO-I;
c. SCO-III; or
d. A consignment of a single United Nations Number commodity as set out in column (B) of the Twelfth Schedule to be transported under exclusive use;

The appropriate United Nations Number as specified in column (A) of the Twelfth Schedule shall also be displayed, in black digits not less than 65 mm high, either in the lower half of the placard as specified in Figure 6 of the Thirteenth Schedule, and against the white background, or on the placard specified in Figure 7 of the Thirteenth Schedule.

152. When the placard as specified in Figure 7 of the Thirteenth Schedule is used for the purpose of Article 76, the subsidiary placard shall be affixed immediately adjacent to the main placard.

Section 74: Transport by Special Use Vessel

153. The carrier shall ensure that a package or overpack with a surface dose

rate greater than 2 mSv/h is not transported in a vessel except under special arrangement or exclusive use.

154. The transport of consignments by means of a special use vessel need not comply with the requirement of Article 124 if:

a. There is a radiation protection programme for the shipment approved by the NRRC or the competent authority of the flag state of the vessel and, if so required, by the competent authority at each port of call;
b. The stowage arrangement has been predetermined for the whole voyage, including any consignment to be loaded at ports of call en route; and
c. The loading, carriage and unloading of the consignment are supervised by persons qualified in the transport of radioactive material.

Section 75: Transport by Air port

155. The carrier shall ensure that the following are not transported by air:

a. A vented Type B (M) package;
b. A package requiring external cooling by an ancillary cooling system;
c. A package subject to operational controls during transport; and
d. package containing liquid pyrophoric materials.

156. The carrier shall ensure that a package or overpacks with a surface dose rate greater than 2 mSv/h, is not transported by air except under special arrangement.

157. A Type B (M) package or a consignment under exclusive use shall not be transported on any passenger aircraft.

Section 76: Segregation During Transport and Storage in Transit

158. The carrier shall, during transport and storage in transit, segregate packages, overpacks, freight containers and unpackaged radioactive material:

a. From workers in regularly occupied working areas by distances calculated using a dose criterion of 5 mSv in a year and conservative model parameters;
b. From members of the, in areas where the public has regular access, by distances calculated using a dose criterion of 1 mSv in a year and conservative model parameters;
c. From undeveloped photographic film by distances calculated using a radiation exposure criterion for undeveloped photographic film due to the transport of radioactive material of 0.1 mSv per consignment of such film; and
d. From other dangerous goods.

Chapter 10: Responsibilities of Consignees

Section 77: Examination of the Package

159. A consignee shall, as soon as practicable on receipt of a consignment and before opening it, examine the package for any defects to the package or leakage of its radioactive content.

160. If the package has or appeared to have defects or its radioactive content is found or appears to be leaking, the consignee shall:

a. Measure the dose rates on and at 1 m from the external surface of the package; and

b. Measure the activity of the non-fixed contamination on the external surface of the package.

161. The consignee shall report the result of the measurement carried out pursuant to Article 160 to the NRRC and the consignor:

a. Within 5 working days, if the dose rate exceeds the limits prescribed by this Specific Regulation; and
b. Forthwith, notwithstanding Article 160 (a), if the dose rate exceeds 10 mSv/h and 200 μSv/h respectively on and at 1 m from the external surface of the package.

162. The consignee shall retain records of all observations made pursuant to Article 160 and 161 in a form suitable for inspection for a period of at least seven years and if requested to do so, provide the NRRC with full access to such records.

Chapter 11: Approval for Special Form Radioactive Material and Low Dispersible Radioactive Material

Section 78: Design of Special Form Radioactive Material and Low Dispersible Radioactive Material

163. The design for special form radioactive material shall require unilateral approval.

164. The design for low dispersible radioactive material shall require multilateral approval.

165. An application for approval of a design for special form radioactive material and low dispersible radioactive material shall include:

a. A detailed description of the radioactive material or nuclear ma-

terial and if a capsule, the content of the capsule with particular reference made to both physical and chemical states;

b. A detailed statement of the design of any capsule to be used;

c. A statement of the results of the tests specified in Part II and Part III of the Eleventh Schedule, or evidence based on calculative methods to show that the special form radioactive material or low dispersible radioactive material meets the relevant requirements of this Specific Regulation;

d. Specification and evidence of the applicable management system; and

e. Any proposed pre-shipment actions for use in the consignment of special form radioactive material or low dispersible radioactive material.

Chapter 12 : Approval for Package Designs

Section 79: Design of Type B(U) and Type C package

166. Each design of Type B(U) and Type C package shall require unilateral approval.

167. An application for approval of a Type B(U) and Type C package design shall include:

a. A detailed description of the proposed radioactive contents with reference to its physical and chemical states and the nature of the radiation emitted;

b. A detailed statement of the design, including certified engineering drawings, schedules of materials and methods of manufacture;

c. A statement of the results of the tests specified in the Third Sched-

ule and Fourth Schedule or evidence based on calculations or other evidence that the design meets the relevant requirements of this Specific Regulation;

d. The proposed operating and maintenance instructions for the use of the package;

e. Information on the materials used to manufacture the containment system, its specification and the tests to be made if the package is designed to have a maximum normal operating pressure in excess of 100 kPa;

f. A statement and justification of any assumption made in the safety analysis relating to the characteristics of the fuel where the proposed radioactive content is an irradiated fuel;

g. Any special stowage provisions necessary to ensure the safe dissipation of heat from the package, with consideration given to the various modes of transport and type of conveyance or freight container to be used;

h. A reproducible illustration not larger than 21 cm by 30 cm showing the make-up of the package; and

i. Specification and evidence of the applicable management system programme.

168. If Type B(U) and Type C package is to be used for the transport of fissile material involving international transboundary movement, the design of such package shall require multilateral approval.

169. If Type B(U) package is to be used for the transport of low dispersible radioactive material involving international transboundary movement, the design of such package shall require multilateral approval.

Section 80: Design of Type B(M) Package

170. Each design of Type B(M) package shall require multilateral approval.

171. An application for the approval of a Type B(M) package design shall include:

a. All the information required in Article 167 for Type B (U) packages;
b. A list of the requirements specified in Part II of the Third Schedule which the proposed design does not conform to;
c. Any proposal for supplementary operational controls to be applied during transport which is not specified in this Specific Regulation but are necessary to ensure the safety of the package or to compensate for the deficiencies listed in paragraph (b);
d. A statement relating to any restrictions on the mode of transport and to any special loading, carriage, unloading or handling procedures; and
e. The range of ambient conditions (temperature, solar radiation) which are expected to be encountered during transport and which have been taken into account in the design.

172. The NRRC shall establish an approval certificate stating that the approved design meets the applicable requirements for Type B(M) packages and shall attribute to that design an identification mark.

Section 81: Package Design for Fissile Material

173. Each design of a package for the transport of fissile material which is not excepted according to the Twentieth Schedule from the requirements that apply specifically to packages containing fissile material shall require multilateral approval.

174. An application for approval shall include information necessary to satisfy the NRRC that the design meets all the requirements of this Specific Regulation pertaining to the transport of fissile material and evidence of management system.

175. The design of a package to be used for the transport of fissile material which is not excepted according to the Twentieth Schedule from the requirements that apply specifically to packages containing fissile material involving international transboundary movement, shall require multilateral approval.

Section 82: Package Design for Uranium Hexafluoride

176. An application for approval for the transport of 0.1 kg or more of uranium hexafluoride shall include information necessary to satisfy the NRRC that the design meets all the requirements of this Specific Regulation pertaining to the transport of uranium hexafluoride and evidence of management system.

177. The design for a package to be used for the transport of 0.1 kg or more of uranium hexafluoride involving international transboundary movement, shall require multilateral approval.

178. The approval certificate stating that the approved design meets the requirements of this Specific Regulation and shall attribute to that design an identification mark shall be applied to the NRRC.

Section 83: Serial Numbers

179. The manufacturer of a packaging or a special form radioactive material shall assign a serial number to each packaging or special form radioactive material manufactured to a design approved by the NRRC.

180. The manufacturer or the maker shall notify the NRRC of the serial numbers.

181. The serial number is maintained by the NRRC.

Chapter 13 : Approval for Certain Shipments

Section 84: Types of Certain Shipment

182. The following shipments shall require approval of the NRRC or, if it involves international transboundary movement, multilateral approval:

a. The shipment of a Type B(M) package not conforming with the requirement as specified in paragraph (5) of the Second Schedule or designed to allow controlled intermittent venting;
b. The shipment of a Type B(M) package containing radioactive material or nuclear material whose activity is greater than 3 x 10^3. A_1 or 3 x 10^3 A_2, as appropriate, or 1000 terabecquerels (TBq), whichever is the lower;
c. Tthe shipment of packages containing fissile materials if the sum of the criticality safety indexes of the packages in a single freight container or in a single conveyance exceeds 50. Excluded from this requirement shall be shipments by seagoing vessels, if the sum of the criticality safety indexes does not exceed 50 for any hold, compartment or defined deck area and the distance of 6 m between groups of packages or overpacks as required in Table IV of the Sixteenth Schedule is met;
d. The shipments by a special use vessel; and
e. The shipment of SCO-III

183. For the purpose of Article 182 (d), the radiation protection program for the shipment shall require the approval of the NRRC or, if it involves international transboundary movement, multilateral approval.

Section 85: Approval of Certain Shipment

184. An application for approval of a certain shipment shall provide the following information:

a. The period of time related to the shipment for which the approval is sought;
b. The actual radioactive contents of the package, the expected modes of transport, the type of conveyance and the probable or the proposed route; and
c. The details of how the special precautions, administrative or operational controls referred to in the package design approval certificates are to be put into effect.

Section 86: Approval of Shipment Under Special Arrangement

185. An application for approval of a shipment under special arrangement shall include the information necessary to satisfy the requirements specified by the NRRC that the overall level of safety in transport is at least equivalent to that which would have been provided if all the applicable requirements of this Specific Regulation had been met.

186. The application shall also include the following:

a. A statement why the package cannot be prepared in accordance with the applicable requirements of this Specific Regulation and which part of the regulatory requirements the package does not comply with; and

b. A statement of any special precautions, special administrative or operational controls which are to be employed during transport to compensate for the nonconformity with the applicable requirements of this Specific Regulation.

187. Each consignment transported under a special arrangement shall require multilateral approval if it involves international transboundary movement.

Chapter 14: Administrative Requirements

Section 87: Appointment of Carrier not Having Valid Authorization

188. The Appointment of carrier not having valid authorization by the NRRC shall require the approval of the NRRC:

Section 88: Foreign Approval

189. The NRRC may approve any prior approval issued by the competent authority of a foreign country with respect to the approval requirement of this Specific Regulation or other regulation reffered in this Specific regulatioon.

Section 89: Approval Certificates

190. The package design and certain shipment approval certificates may be combined into a single certificate.

Section 90: Identification Mark

191. Each approval certificate issued by the NRRC shall be assigned an

identification mark and the mark shall satisfy all the requirements specified in the Twenty Third Schedule.

Section 91: Safety and Security

192. The consignor, consignee, carrier or any person deems necessary by the NRRC shall establish and submit for approval a Radiation Protection Programme and Nuclear Security Plan for the handling, storage and transportation of radioactive material or nuclear material as prescribed by the NRRC in the relevant NRRC Regulations.

193. The Radiation Protection Program and Nuclear Security Plan documents shall be available, on request, for inspection by the NRRC.

Section 92: Occupational Exposure for Transport Activities

194. For occupational exposures arising from transport activities, where the effective dose:

a. Is between 1 millisieverts (mSv) and 6 mSv in a year, a dose assessment program via workplace monitoring or individual monitoring shall be conducted; and
b. Exceed 6 mSv in a year, a dose assessment program via individual monitoring shall be conducted.

195. When individual monitoring or workplace monitoring is conducted, appropriate records shall be kept up to date.

First Schedule

DESIGN REQUIREMENTS FOR EXCEPTED PACKAGES

[Article 9, Article 123 (b), Second Schedule, Third Schedule, Fourth Schedule, and Fifth Schedule]

(1) The design of an excepted package shall:

a. Relate to its mass, volume, and shape where it can be easily and safely transported;

b. Be designed to be properly secured in or on the conveyance during transport;

c. Be designed that any lifting attachments on the package will not fail and if failure of the attachment should occur, the ability of the package to meet other requirements of would not be impaired; and

d. Take into account appropriate safety factors to cover snatch lifting.

(2) Attachments or any other features on the outer surface of the excepted package which could be used for lifting shall:

e. Be so designed to support the mass of the package in accordance with the requirements in paragraphs (1)(c) and (d); or

f. Be removable or otherwise rendered incapable of being used during transport.

(3) The design of the package shall be designed and finished:

a. That its external surfaces are free from protruding features and can be easily decontaminated; and

b. That the outer layer of the package shall be designed as to prevent the collection and retention of water.

(4) Any features added to the package at the time of transport which are not part of the package shall not reduce its safety.

(5) The package shall be designed:

a. That is capable to withstand the effects under acceleration, vibration or vibration resonance which may occur under normal conditions of transport; and

b. That the effectiveness of the closing devices on the various receptacles as a whole shall not deteriorate and its nuts, bolts and other securing devices shall not become loose or be released unintentionally, even after repeated use.

(6) The materials of the packages and its components or structures shall be physically and chemically compatible with each other and with the radioactive contents and account shall be taken of their behavior under irradiation.

(7) All valves through which the radioactive contents could otherwise escape shall be protected against unauthorized operation.

(8) The package, in addition, shall comply with the Article 20 if it contains material with dangerous properties other than radioactive properties, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness.

(9) The design of the package shall take into account of the ambient temperatures and pressures that are likely to be encountered in normal conditions of transport.

(10) The package shall be so designed that it provides sufficient shielding to ensure that, under routine conditions of transport and with the maximum radioactive contents that the package is designed to contain, the dose rate at any point on the external surface of the package would not exceed the values specified in Article 37, Article 38 and Article 39 as applicable, with account taken of Article 144(b) and 131.

Second Schedule

DESIGN REQUIREMENTS FOR TYPE A PACKAGES

[Article 10, Article 182(a), Third Schedule, Fourth Schedule, and Fifth Schedule]

(1) A Type A package shall meet all the requirements specified in the First Schedule.

(2) The smallest overall external dimension of the package shall not be less than 10 cm.

(3) The package shall incorporate, on its external surface, a feature, such as a seal, which is not readily breakable and which, while intact, will be evidence that the package has not been opened.

(4) Any tie-down attachments on the package shall be designed that, under both normal and accident conditions of transport, the forces in those attachments shall not impair the ability of the package to meet all the requirements of this Specific Regulation.

(5) The design of the package shall take into account:

   a. The effect of temperature changes ranging from -40°C to 70°C on the components of the package;
   b. The effect of freezing temperatures on the package content in liquid form; and
   c. The potential degradation of package materials within a given temperature range.

(6) The design shall include a containment system securely closed by a

positive fastening device, where it cannot be open unintentionally or opened by a pressure which may arise from the package itself.

(7) If the containment system forms a separate unit of the package, it shall be capable of being securely closed by a positive fastening device which is independent of any other part of the package.

(8) The design of any component of the containment system shall take into account, where applicable:

a. The radiolytic decomposition of liquids and other vulnerable materials; and
b. The generation of gas by chemical reaction and radiolysis.

(9) The containment system shall retain its radioactive contents under reduction of ambient pressure until 60 kPa.

(10) All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.

(11) A radiation shield which encloses a component of the package specified as a part of the containment system shall be so designed as to prevent the unintentional release of that component from the shield and where the radiation shield and such component within it form a separate unit, the radiation shield shall be capable of being securely closed by a positive fastening device which is independent of any other structure of the package.

(12) A Type A package shall be so designed that if it were subjected to the tests to demonstrate its ability to withstand the normal conditions of transport as specified in Part III of the Seventeenth Schedule, it shall prevent:

a. Loss or dispersal of the radioactive contents; and
b. More than 20% increase in the maximum dose rate at the external surface of the package.

(13) The design of a Type A package intended to be used for the transport of liquids radioactive material, shall make provisions for ullage to accommodate variations in the temperature of the contents, dynamic effects, and filling dynamics.

(14) A Type A package designed to contain liquid radioactive material shall satisfy the following additional requirements:

a. As specified in paragraph (12)(a) except that the height of the drops for the Penetration Test and the Free Drop Test shall be increased to 1.7 m and 9 m respectively; and
b. Shall incorporate a containment system composed of primary inner and secondary outer containment components designed to ensure retention of the liquid contents with the secondary outer containment components in case the primary inner components leak, or alternatively, a sufficient absorbent material shall be provided to enable it to absorb twice the volume of its liquid contents and such absorbent material shall be suitably positioned so as to be in contact with the liquid in the event of leakage.

(15) A Type A package to be used for the transport of radioactive gases shall meet the additional requirements as specified in paragraph (14) (a) and the Article 21 if it is carried by air.

(16) The requirement specified in paragraph (15) shall not apply if the package is designed for the transport of tritium gas or noble gases.

(17) The design and manufacturing techniques shall be in accordance with national or international standards, or other requirements, acceptable

to the NRRC.

18. Special form radioactive material may be considered as a component of the containment system.

Third Schedule

DESIGN REQUIREMENTS FOR TYPE B PACKAGES

[Article 11, Article123 (e), Article 167 (b) and Article 167 (c), Fourth Schedule and Eighteenth Schedule]

PART I

General design requirements for Type B(U) package

(1) A Type B(U) package shall meet all the requirements specified in:

a. The First Schedule;
b. The Second Schedule except paragraph (12)(a); and
c. The requirements of Article 21 if carried by air.

(2) The package shall be so designed that, under the ambient conditions as specified in paragraphs (5) and (7), the heat generated within the package by the radioactive content shall not, under normal conditions of transport, as demonstrated by the test in the Part III of the Seventeenth Schedule, adversely affect the integrity of the package to meet all the applicable requirements of this Specific Regulation if it is left unattended for a period of one week.

(3) In complying with the requirement of paragraph (2), particular attention shall be paid to the effects of heat, which may:

a. Alter the arrangement, the geometrical form or the physical state of the radioactive contents or, if the radioactive content is enclosed in a can or a receptacle, cause the can, receptacle or the radioactive content to deform or melt;
b. Lessen the efficiency of the package through differential thermal expansion, cracking or melting of the radiation shielding material; or
c. In combination with moisture, accelerate corrosion.

TABLE 1: Insolation data

CASE	Form and location of surface (A)	Insolation for 12 hours per day (W/m2) (B)
1	Flat surfaces transported horizontally – downward facing	0
2	Flat surfaces transported horizontally – upward facing	800
3	Surfaces transported vertically	200[a1]
4	Other downward facing (not horizontal) surfaces	200[a]
5	All other surfaces	400[a]

(4) A package shall be so designed that, under the ambient condition specified in paragraph (6) and in the absence of insolation, the temperature of the accessible surfaces of a package shall not exceed 50°C, unless the package is transported under exclusive use.

[1]Alternatively, a sine function may be used, with an absorption coefficient adopted and the effects of possible reflection from neighbouring objects neglected

(5) Except as required in paragraph 17(a) for a package transported by air, the maximum temperature of any surface readily accessible during transport of a package under exclusive use shall not exceed 85°C in the absence of insolation under the ambient temperature of 38°C.

(6) Barriers or screens intended to give protection to persons shall not be subject to any test.

(7) Without prejudice to the requirement of Article 21, the ambient temperature shall be assumed to be 38°C.

(8) The solar insolation condition shall be assumed to be as specified in Table I.

(9) A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in paragraphs (16) and (17) of the Eighteenth Schedule shall be designed that such a protection will remain effective after the package is subjected to:

a. The tests for demonstrating its ability to withstand the normal conditions of transport as specified in Part III of the Seventeenth Schedule; and
b. A combination of the Mechanical Test Drop I and the Mechanical Test Drop II or the Mechanical Test Drop II and the Mechanical Test Drop III, as appropriate, as specified in the Eighteenth Schedule.

(10) Any thermal protection on the exterior of the package shall not be rendered ineffective by ripping, cutting, skidding, abrasion, or rough handling.

(11) A package shall be so designed that if it were subjected to the tests as

specified in Part III of the Seventeenth Schedule it would restrict the loss of radioactive content to not more than 10-6 A2 per hour.

(12) A package shall be so designed that if it were subjected to:

a. The tests for demonstrating its ability to withstand the accident conditions of transport, as specified in the Eighteenth Schedule;
b. The Mechanical Test Drop II, as specified in the Eighteenth Schedule;
c. The Thermal Test, as specified in the Eighteenth Schedule; and
d. The Water Immersion Test, as specified in the Eighteenth Schedule, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour.

(13) If the package were subjected to-

a. The Mechanical Test Drop III, as specified in the Eighteenth Schedule, for a package with a mass not greater than 500 kg, an overall density not greater than 1000 kilograms per cubic meter (kg/m3) based on external dimensions and radioactive contents greater than 1000 A_2 not as special form radioactive material; or
b. The Mechanical Test Drop I, as specified in the Eighteenth Schedule, for all other packages, it would meet the following requirements:

    i. Retain sufficient shielding to ensure that the dose rate at 1m from the surface of the package would not exceed 10 mSv/h 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 one week does not exceed 10 A_2 for krypton-85 and does not exceed A_2 for all other radionuclides.

(14) For the purpose of paragraphs (11) and (12), where the radioactive content of a package would be a mixture of different radionuclides, the value of A_2 for the mixture shall be determined in accordance with the method specified in the Tenth Schedule except for krypton-85, an effective A_2 (i) value equal to 10 A_2 may be used.

(15) The assessment referred to in paragraph (11) shall take into account the external contamination limits specified in Section 30.

(16) A package for radioactive content with an activity greater than 105 A_2 shall be designed that if it were subjected to the Enhanced Water Immersion Test, as specified in the Eighteenth Schedule, there would be no rupture of its containment system and its design shall not include a pressure relief system from the containment system which would allow the release of its radioactive content to the environment under the conditions of the tests specified in Part III of the Seventeenth Schedule and Eighteenth Schedule.

(17) Compliance with the permitted activity release limits shall depend neither upon filter nor upon a mechanical cooling system.

(18) A package shall be so designed that it shall never attain a maximum normal operating pressure exceeding a gauge pressure of 700 kPa. but if it were at the maximum normal operating pressure and subjected to:

a. The tests for demonstrating its ability to withstand the normal conditions of transport, as specified in Part III of the Seventeenth Schedule; or
b. The tests for demonstrating its ability to withstand the accident conditions of transport, as specified in the Eighteenth Schedule,
c. The level of strains in its containment system would not attain

values which would adversely affect the integrity of the package such that it would fail to meet the applicable requirements of this Specific Regulation.

(19) A package containing low dispersible radioactive material shall be designed that any features added to the low dispersible radioactive material that are not part of it or any internal components of the packaging shall not adversely affect the performance of the low dispersible radioactive material.

(20) Without prejudice to the Article 21, a package referred in paragraph (18) shall be so designed as to ensure that its integrity is not affected when used in an ambient temperature ranging from -40°C to +38°C.

(21) The package referred in paragraph (18) shall comply with the requirement of Article 21 if it is to be carried by air.

PART II

Design requirements for type B(M) packages

(22) A Type B(M) package shall meet all the requirements for Type B(U) package, as specified in Part I.

(23) Notwithstanding paragraph (20), the requirement for the ambient condition may be different from that which have been specified in Part I.

(24) The design of a Type B(M) package may incorporate a pressure release system for intermittent venting provided that the operational controls for the venting are acceptable to the NRRC.

Fourth Schedule

DESIGN REQUIREMENTS FOR TYPE C PACKAGES

[Article 12, Article 123 (e) and 167 (c)]

(1) A Type C package shall meet all the requirements specified in:

a. The First Schedule;

b. paragraphs (2) to (13) of the Second Schedule except paragraphs (3) to (7) and paragraph (12)(a); and

a. Paragraphs (16) to (19) of the Third Schedule.

(2) A Type C package shall be capable of meeting the assessment criteria prescribed for tests as specified in paragraphs (12) and (17) of the Third Schedule 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.

(3) For the purpose of assessment referred to in paragraph (2), it shall be deemed that the initial conditions for any thermal insulation of the packaging remains intact, the packaging is at the maximum normal operating pressure and the ambient temperature is 38°C.

(4) A Type C package shall be so designed that if it were subjected to:

a. The tests for demonstrating its ability to withstand the normal conditions of transport, as specified in Part III of the Seventeenth

Schedule, it would restrict the loss of radioactive contents to not more than 10-6 A2 per hour; and

b. He tests sequences in paragraph (2) of Part II of the Twenty First Schedule, it would meet the following requirements:

i. Retain sufficient shielding to ensure that the dose rate at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is design 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.

(5) For the purpose of paragraph (4) where the radioactive content of a package would be a mixture of different radionuclides, the value of A_2 for the mixture shall be determined in accordance with the method specified in the Tenth Schedule except for krypton-85, an effective A_2(i) value equal to 10 A_2 may be used.

(6) The assessment referred to in paragraph (4)(a), shall take into account the external contamination limits specified in Section 29.

(7) A Type C package shall be so designed that there will be no rapture of the containment system following performance of the Enhanced Water Immersion Test as specified in the Eighteenth Schedule.

(8) The packaging in addition, shall comply with the requirement of Article 21 if it is to be carried by air.

Fifth Schedule

DESIGN REQUIREMENTS FOR INDUSTRIAL PACKAGES

[Article 13]

PART I

Design requirements for Industrial Packages Type 1 (IP-1)

(1) An industrial package Type 1 (IP-1) shall meet all the requirements for excepted package, as specified in the First Schedule.

(2) The smallest overall external dimension of the package shall not be less than 10 cm.

(3) The package, in addition, shall comply with the Article 21 if it is to be carried by air.

PART II

(4) Design requirements for Industrial Packages Type 2 (IP- 2)

(5) An industrial package Type IP-2 (IP-2) shall meet all the requirements as specified in Part I for industrial packages Type 1 (IP-1).

(6) The package shall not lose or disperse its radioactive contents and shall not be more than 20% increase in the maximum dose rate at any point on its external surface if it were to be subjected to:

a. The Free Drop Test and the Stacking Test as specified in Part III

of the Seventeenth Schedule; or

b. Any other approved equivalent tests.

PART III

Design requirements for Industrial Packages Type 3 (IP-3)

(7) An industrial package Type 3 (IP-3) shall meet all the requirements for industrial package Type 1 (IP-1), as specified in Part I.

(8) It shall meet all the requirements for a Type A package, as specified in the Second Schedule.

PART IV

Alternative requirements for Type IP-2 and Type IP-3

(9) Packages may be used as Type IP-2 provided that:

a. They satisfy the requirements for Type IP-1 specified in Part I;

b. They are designed to conform to the standards prescribed in the chapter on General Recommendations on Packing of the United Nations Recommendations on the Transport of Dangerous Goods, or other requirements at least equivalent to those standards; and

c. When subjected to the tests required for UN Packing Group I or II, they would prevent:

i. Loss or dispersal of the radioactive contents; and

ii. More than a 20% increase in the maximum dose rate at the

external surface of the package.

(10) Tank containers may also be used as Type IP-2 or Type IP-3, provided that:

a. They satisfy the requirements for Type IP-1 specified in Part I;
b. They are designed to conform to the standards prescribed in the chapter on Recommendations on Multimodal Tank Transport of the United Nations Recommendations on the Transport of Dangerous Goods, or other requirements at least equivalent to those standards, and are capable of withstanding a test pressure of 265 kPa; and
c. They are designed so that any additional shielding which is provided shall be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of transport and of preventing more than a 20% increase in the maximum dose rate at the external surface of the tank containers.

(11) Tanks, other than tank containers, may also be used as Type IP-2 or Type IP-3 for transporting LSA-I and LSA-II liquids and gases as prescribed in the Nineteenth Schedule, provided that they conform to standards at least equivalent to those prescribed in paragraph (9).

(12) Freight containers may also be used as Type IP-2 or Type IP-3, provided that:

a. The radioactive contents are restricted to solid materials;
b. They satisfy the requirements for Type IP-1 specified in Part I;
c. They are designed to conform to the standards prescribed in the International Organization for Standardization document ISO 1496/1: “Series 1 Freight Containers - Specifications and Testing

- Part 1: General Cargo Containers" excluding dimensions and ratings; and

d. They shall be designed such that if subjected to the tests prescribed in that document and to the accelerations occurring during routine conditions of transport they would prevent:

   i. Loss or dispersal of the radioactive contents; and

   ii. More than a 20% increase in the maximum dose rate at the external surface of the freight container.

(13) Metal intermediate bulk containers may also be used as Type IP-2 or Type IP-3, provided that:

a. They satisfy the requirements for Type IP-1 specified in Part I; and

b. They are designed to conform to the standards prescribed in the chapter on Recommendations on Intermediate Bulk Containers (IBCs) of the United Nations Recommendations on the Transport of Dangerous Goods, for Packing Group I or II, and if they were subjected to the tests prescribed in that document, but with the drop test conducted in the most damaging orientation, they would prevent:

   i. Loss or dispersal of the radioactive contents; and

   ii. More than a 20% increase in the maximum dose rate at the external surface of the intermediate bulk container.

Sixth Schedule

DESIGN REQUIREMENTS FOR PACKAGES CONTAINING URANIUM HEXAFLUORIDE

[Article 14]

(1) Packages containing 0.1 kg or more of uranium hexafluoride shall be designed so that it would meet the following requirements:

a. Withstand without leakage and without unacceptable stress, as specified in the International Organization for Standardization document ISO 7195, the structural test as specified in paragraph (5);

b. Withstand without loss or dispersal of the uranium hexafluoride the Free Drop Test specified in Part III of the Seventeenth Schedule; and

c. Withstand without rupture of the containment system the Thermal Test specified in the Eighteenth Schedule.

(2) Packages designed to contain 0.1 kg or more of uranium hexafluoride shall not be provided with pressure relief devices.

(3) Except as allowed in paragraph (4), uranium hexafluoride in quantities of 0.1 kg or more shall also be packaged and transported in accordance with the provisions of the International Organization for Standardization document ISO 7195: "Packaging of Uranium Hexa-

fluoride (UF6) for Transport", and the requirements of paragraphs (1) and (2).

(4) Subject to the approval of the NRRC, packages designed to contain 0.1 kg or more of uranium hexafluoride may be transported if:

a. The packages are designed to international or national standards other than ISO 7195, provided an equivalent level of safety is maintained;
b. The packages are designed to withstand without leakage and without unacceptable stress, a test pressure of less than 2.76 MPa as specified in paragraph (5); or
c. The packages do not meet the requirement of paragraph (1)(c).

(5) Specimens that comprise or simulate packaging 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.

(6) For retesting of packaging referred to in paragraph (5), any other equivalent non-destructive testing may be applied subject to multilateral approval.

Seventh Schedule

REQUIREMENTS FOR PACKAGES CONTAINING FISSILE MATERIAL

[Article 16, Article 25 and Article 123 (g), Eleventh Schedule, Sixteenth Schedule, Eighteenth Schedule, and Twenty First Schedule]

PART I

General Requirements

(1) In maintaining subcriticality of fissile material during normal and accident conditions of transport; in particular, the following contingencies shall be considered:

a. Water leaking into or out of the packages;
b. The loss of efficiency of built-in neutron absorbers or moderator;
c. Rearrangement of the contents either within the package or as a result of loss from the package;
d. Reduction of spaces within or between packages;
e. Packages becoming immersed in water or buried in snow; and
f. Temperature changes.

(2) Packages containing fissile material shall meet the following requirements:

a. The smallest overall external dimension of the package shall not

be less than 10 cm;

b. Requirements as prescribed elsewhere in this Specific Regulation which pertain to the radioactive properties of the material; and

c. Specified in paragraphs (3) to (13), unless excepted by the Twentieth Schedule.

PART II

Contents specification for assessments of packages containing fissile material

(3) Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of paragraphs (8) to (12) 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.

(4) For irradiated nuclear fuel the assessments of paragraphs (8) to (12) shall be based on an isotopic composition demonstrated to provide:

a. The maximum neutron multiplication during the irradiation history; or

b. A conservative estimate of the neutron multiplication for the package assessments.

(5) After irradiation but prior to shipment, a measurement shall be performed to confirm the conservatism of the isotopic composition.

PART III

Geometry and temperature requirements

(6) The package, after being subjected to the tests specified in Part III of Seventeenth Schedule, must prevent the entry of a 10 cm cube.

(7) The package shall be designed for an ambient temperature range of -40 °C to +38 °C unless the NRRC specifies otherwise in the certificate of approval for the package design.

PART IV

Assessment of an individual package in isolation

(8) For a package in isolation, it shall be deemed that water can leak into or out of all void spaces of the package, including those within the containment system but if the design incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of error, absence of leakage may be deemed in respect of those void spaces.

(9) Special features referred to in paragraph (8) shall include the following:

a. Multiple high standard water barrier, each of which would remain watertight if the package were subject to the test prescribed in paragraph 12(b), a high degree of quality control in the manufacture, maintenance and repair of packaging's and tests to demonstrate the closure of each package before each shipment; or

b. For packages containing uranium hexafluoride only, with maximum uranium enrichment of 5 mass per cent uranium-235, it shall ensure that:

i. There is no physical contact between the valve or the plug and any other component of the packaging other than at its original point of attachment following the tests prescribed in

paragraph 13(b) and where, in addition, following the Thermal Test the valves or the plug remain leak tight; and

ii. A high degree of quality control in the manufacture, maintenance and repair of packaging's, couple with tests to demonstrate the closure of each package before each shipment.

(10) It shall be deemed 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 but when it can be demonstrated that the confinement system remains within the packaging following the tests prescribed in paragraph 13(b), close reflection of the package by at least 20 cm of water may be deemed in paragraph 11(c).

(11) The package shall be subcritical under the condition of paragraphs (8) and (9) with the package conditions that result in the maximum neutron multiplication consistent with:

a. Routine conditions of transport (incident free);
b. The test specified in paragraph 11(b); and
c. The test specified in paragraph 12(b).

(12) For packages to be transported by air:

a. The package shall be subcritical under conditions consistent with the Type C package tests specified in the Twenty First Schedule assuming reflection by at least 20 cm of water but no water in-leakage; and
b. In the assessment of paragraph (9) allowance shall not be made for special features of paragraph (8) unless:

i. Following the Type C package test specified in the Twenty

First Schedule; and

ii. Subsequently, the water in-leakage test of paragraph (6) of the Eighteenth Schedule, leakage of water into or out of the void spaces is prevented.

PART V

Assessment of package arrays under normal conditions of transport

(13) A number "N" shall be derived, such that five times "N" packages 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 arrangements 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 Part III of the Seventeenth Schedule.

PART VI

Assessment of package arrays under accident conditions of transport

(14) A number "N" shall be derived, such that two times "N" packages 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;
b. The tests specified in Part III of the Seventeenth Schedule followed by any of the following:

i. The tests specified in Mechanical Test Drop II, and either Mechanical Test Drop III for packages having a mass not greater than 500 kg and an overall density not greater than 1000 kg/m^3 based on the external dimension, or Mechanical Test Drop I for all other packages; followed by the Thermal Test and completed by the test specified in paragraph (4) of the Eighteenth Schedule and Water Leakage Test; or

ii. Water Immersion Test; and

c. Where any part of the fissile material escapes from the containment system following the test specified in paragraph (b), 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.

Eighth Schedule

ACTIVITY LIMIT FOR EXCEPTED PACKAGES

[Article 89, Article 90, Article 23 (a) and (b)]

PHYSICAL STATE OF CONTENTS (A)	Instrument and article		Materials Package limits[a] (D)
	Item limits[a] (B)	Package limits[a] (C)	
Solids:			
special form	10^{-2} A_1	A_1	10^{-3} A_1
other form	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	2×10^{-1} A_2	2×10^{-1} A2	2×10^{-2} A_2
special form	10^{-2} A_1	10^{-2} A^1	10^{-3} A_1
other form	10^{-2} A_2	10^{-2} A_2	10^{-3} A_2

[a]For mixtures of radionuclides, see Tenth Schedule.

Ninth Schedule

CONVEYANCE ACTIVITY LIMITS FOR LSA AND SCO IN INDUSTRIAL PACKAGES OR UNPACKAGED

[Article 25 (b) and Article 98]

NATURE OF MATERIAL (A)	ACTIVITY LIMIT FOR CONVEYANCES OTHER THAN BY INLAND WATERWAY (B)	Activity limit for a hold or compartment of an inland watercraft (C)
LSA-I	No limit	No limit
LSA-II and LSA-III		
Non-combustible solid	No limit	$100A_2$
Combustible solids	$100A_2$	$10A_2$
All liquids	$100A_2$	$10A_2$
All gases	$100A_2$	$10A_2$
SCO[a]	$100A_2$	$10A_2$

[a]For SCO-III see Article 102

Tenth Schedule

CONTENT LIMITS FOR TYPE A PACKAGES

[Article 28, Article 64, Article 109 (e), Third Schedule, Fourth Schedule, and Eighth Schedule]

(1) The requirements laid down in Article 27 and 28 shall be deemed to be complied with if the activity of the radioactive content of a Type A package does not exceed the A_1 and A_2 values given in Table I for individual radionuclides.

(2) For individual radionuclides which are not listed in Table I, Article 27 and 28 shall be deemed to be complied with if the values of A_1 and A_2 used are calculated such that:

a. For each radioactive decay chain in which:

i. 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 values of A1 and A2 to be applied shall be those corresponding to the parent nuclide of that chain; or

ii. 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; and

c. The values shall require multilateral approval.

(3) For mixtures of radionuclides, whose identities and respective activities are known, the requirements laid down in Article 27 and 28 shall be deemed to be complied with if the following conditions are met:

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

where

B(i) is the activity of radionuclide i as special form radioactive material and A_1 (i) is the A_1 value for radionuclide i; and

C(j) is the activity of radionuclide j as other than special form radioactive material and A_2 (j) is the A_2 value for radionuclide j.

(4) For mixtures of radionuclides, the basic radionuclide values 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 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_m 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.

(5) When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be:

a. Grouped and the lowest radionuclide value, as appropriate, for the radionuclides in each group may be used in applying formulas in paragraphs (3) and (4); or
b. Groups based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest radionuclide values for the alpha emitters or beta/gamma emitters, respectively.

(6) For the individual radionuclides or for mixtures of radionuclides for which relevant data are not available, Article 27 and 28 shall be deemed to be complied with if the values specified in Table II are used.

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Actinium (89)		
Ac-225 (a)	8×10^{-1}	6 x 10-3
Ac-227 (a)	9×10^{-1}	9×10^{-5}
Ac-228	6×10^{-1}	5×10^{-1}
Silver (47)		
Ag-105	2×10^{0}	2×10^{0}
Ag-108m (a)	7 x 10-1	7×10^{-1}
Ag-110m (a)	4×10^{-1}	4×10^{-1}
Ag^{-111}	2×10^{0}	6×10^{-1}
Aluminium (13)		
Al^{-26}	1×10^{-1}	1×10^{-1}
Americium (95)		
Am-241	1×10^{1}	1×10^{-3}
Am-242m (a)	1×10^{1}	1×10^{-3}
Am-243 (a)	5×10^{0}	1×10^{-3}
Argon (18)		
Ar-37	4×10^{1}	4×10^{1}
Ar-39	4×10^{1}	2×10^{1}
Ar-41	3×10^{-1}	3×10^{-1}
Arsenic (33)		
As-72	3×10^{-1}	3×10^{-1}
As-73	4×10^{1}	4×10^{1}
As-74	1×10^{0}	9×10^{-1}
As-76	3×10^{-1}	3×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
As-77	2×10^{1}	7×10^{-1}
Astatine (85)		
At-211 (a)	2×10^{1}	5×10^{-1}
Gold (79)		
Au-193	7×10^{0}	2×10^{0}
Au-194	1×10^{0}	1×10^{0}
Au-195	1×10^{1}	6×10^{0}
Au-198	1×10^{0}	6×10^{-1}
Au-199	1×10^{1}	6×10^{-1}
Barium (56)		
Ba-131 (a)	2×10^{0}	2×10^{0}
Ba-133	3×10^{0}	3×10^{0}
Ba-133m	2×10^{1}	6×10^{-1}
Ba-140 (a)	5×10^{-1}	3×10^{-1}
Beryllium (4)		
Be-7	2×10^{1}	2×10^{1}
Be-10	4×10^{1}	6×10^{-1}
Bismuth (83)		
Bi-205	7×10^{-1}	7×10^{-1}
Bi-206	3 x 10-^{1}	3×10^{-1}
Bi-207	7×10^{-1}	7×10^{-1}
Bi-210	1×10^{0}	6×10^{-1}
Bi-210m (a)	6×10^{-1}	2×10^{-2}
Bi-212 (a)	7×10^{-1}	6×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Berkelium (97)		
Bk-247	8×10^{0}	8×10^{-4}
Bk-249 (a)	4×10^{1}	3×10^{-1}
Bromine (35)		
Br-76	4×10^{-1}	4×10^{-1}
Br-77	3×10^{0}	3×10^{0}
Br-82	4×10^{-1}	4×10^{-1}
Carbon (6)		
C-11	1×10^{0}	6×10^{-1}
C-14	4×10^{1}	3×10^{0}
Calcium (20)		
Ca-41	Unlimited	Unlimited
Ca-45	4×10^{1}	1×10^{0}
Ca-47(a)	3×10^{0}	3×10^{-1}
Cadmium (48)		
Cd-109	3×10^{1}	2×10^{0}
Cd-113m	4×10^{1}	5×10^{-1}
Cd-115 (a)	3×10^{0}	4×10^{-1}
Cd-115m	5×10^{-1}	5×10^{-1}
Cerium (58)		
Ce-139	7×10^{0}	2×10^{0}
Ce-141	2×10^{1}	6×10^{-1}
Ce-143	9×10^{-1}	6×10^{-1}
Ce-144 (a)	2×10^{-1}	2×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Californium (98)		
Cf-248	4×10^{1}	6×10^{-3}
Cf-249	3×10^{0}	8×10^{-4}
Cf-250	2×10^{1}	2×10^{-3}
Cf-251	7×10^{0}	7×10^{-4}
Cf-252	1×10^{-1}	3×10^{-3}
Cf-253 (a)	4×10^{1}	4×10^{-2}
Cf-254	1×10^{-3}	1×10^{-3}
Chlorine (17)		
C1-36	1×10^{1}	6×10^{-1}
C1-38	2×10^{-1}	2×10^{-1}
Curium (96)		
Cm-240	4×10^{1}	2×10^{-2}
Cm-241	2×10^{0}	1×10^{0}
Cm-242	4×10^{1}	1×10^{-2}
Cm-243	9×10^{0}	1×10^{-3}
Cm-244	2×10^{1}	2×10^{-3}
Cm-245	9×10^{0}	9×10^{-4}
Cm-246	9×10^{0}	9×10^{-4}
Cm-247 (a)	3×10^{0}	1×10^{-3}
Cm-248	2×10^{-2}	3×10^{-4}
Cobalt (27)		
Co-55	5×10^{-1}	5×10^{-1}
Co-56	3×10^{-1}	3×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Co-57	1×10^{1}	1×10^{1}
Co-58	1×10^{0}	1×10^{0}
Co-58m	4×10^{1}	4×10^{1}
Co-60	4×10^{-1}	4×10^{-1}
Chromium (24)		
Cr-51	3×10^{1}	3×10^{1}
Cesium (55)		
Cs-129	4×10^{0}	4×10^{0}
Cs-131	3×10^{1}	3×10^{1}
Cs-132	1×10^{0}	1×10^{0}
Cs-134	7×10^{-1}	7×10^{-1}
Cs-134m	4×10^{1}	6×10^{-1}
Cs-135	4×10^{1}	1×10^{0}
Cs-136	5×10^{-1}	5×10^{-1}
Cs-137 (a)	2×10^{0}	6×10^{-1}
Copper (29)		
Cu-64	6×10^{0}	1×10^{0}
Cu-67	1×10^{1}	7×10^{-1}
Dysprosium (66)		
Dy-159	2×10^{1}	2×10^{1}
Dy-165	9×10^{-1}	6×10^{-1}
Dy-166(a)	9×10^{-1}	3×10^{-1}
Erbium (68)		
Er-169	4×10^{1}	1×10^{0}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Er-171	8×10^{-1}	5×10^{-1}
Europium (63)		
Eu-147	2×10^{0}	2×10^{0}
Eu-148	5×10^{-1}	5×10^{-1}
Eu-149	2×10^{1}	2×10^{1}
Eu-150 (short lived)	2×10^{0}	7×10^{-1}
Eu-150 (long lived)	7×10^{-1}	7×10^{-1}
Eu-152	1×10^{0}	1×10^{0}
Eu-152m	8×10^{-1}	8×10^{-1}
Eu-154	9×10^{-1}	6×10^{-1}
Eu-155	2×10^{1}	3×10^{0}
Eu-156	7×10^{-1}	7×10^{-1}
Fluorine (9)		
F-18	1×10^{0}	6×10^{-1}
Iron (26)	3×10^{-1}	3×10^{-1}
Fe-52 (a)	3×10^{-1}	3×10^{-1}
Fe-55	4×10^{1}	4×10^{1}
Fe-59	9×10^{-1}	9×10^{-1}
Fe-60 (a)	4×10^{1}	2×10^{-1}
Gallium (31)		
Ga-67	7×10^{0}	3×10^{0}
Ga-68	5×10^{-1}	5×10^{-1}
Ga-72	4×10^{-1}	$4 \times 1^{0-1}$
Gadolinium (64)		

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Gd-146 (a)	5×10^{-1}	5×10^{-1}
Gd-148	2×10^{1}	2×10^{-3}
Gd-153	1×10^{1}	9×10^{0}
Gd-159	3×10^{0}	6×10^{-1}
Germanium (32)		
Ge-68 (a)	5×10^{-1}	5×10^{-1}
Ge-71	4×10^{1}	4×10^{1}
Ge-77	3×10^{-1}	3×10^{-1}
Hafnium (72)		
Hf-172 (a)	6×10^{-1}	6×10^{-1}
Hf-175	3×10^{0}	3×10^{0}
Hf-181	2×10^{0}	5×10^{-1}
Hf-182	Unlimited	Unlimited
Mercury (80)		
Hg-194 (a)	1×10^{0}	1×10^{0}
Hg-195m (a)	3×10^{0}	7×10^{-1}
Hg-197	2×10^{1}	1×10^{1}
Hg-197m	1×10^{1}	4×10^{-1}
Hg-203	5×10^{0}	1×1^{00}
Holmium (67)		
Ho-166	4×10^{-1}	4×10^{-1}
Ho-166m	6×10^{-1}	5×10^{-1}
Iodine (53)		
I-123	6×10^{0}	3×10^{0}
I-124	1×10^{0}	1×10^{0}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
I-125	2×10^{1}	3×10^{0}
I-126	2×10^{0}	1×10^{0}
I-129	Unlimited	Unlimited
I-131	3×10^{0}	7 x 10-1
I-132	4×10^{-1}	4×10^{-1}
I-133	7×10^{-1}	6×10^{-1}
I-134	3×10^{-1}	3×10^{-1}
I-135 (a)	6×10^{-1}	6×10^{-1}
Indium (49)		
In-111	3×10^{0}	3×10^{0}
In-113m	4×10^{0}	2×10^{0}
In-114m (a)	1×10^{1}	5×10^{-1}
In-115m	7×10^{0}	1×10^{0}
Iridium (77)		
Ir-189 (a)	1×10^{1}	1×10^{1}
Ir-190	7×10^{-1}	$7 \times 1^{0-1}$
Ir-192	1×10^{0} (c)	6×10^{-1}
Ir-194	3×10^{-1}	3×10^{-1}
Potassium (19)		
K-40	9×10^{-1}	9×10^{-1}
K-42	2×10^{-1}	2×10^{-1}
K-43	7×10^{-1}	6×10^{-1}
Krypton (36)		
Kr-79	4×10^{0}	2×10^{0}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Kr-81	4×10^{1}	4×10^{1}
Kr-85	1×10^{1}	1×10^{1}
Kr-85m	8×10^{0}	3×10^{0}
Kr-87	2×10^{-1}	2×10^{-1}
Lanthanum (57)		
La-137	3×10^{1}	6×10^{0}
La-140	4×10^{-1}	4×10^{-1}
Lutetium (71)		
Lu-172	6×10^{-1}	6×10^{-1}
Lu-173	8×10^{0}	8×10^{0}
Lu-174	9×10^{0}	9×10^{0}
Lu-174m	2×10^{1}	1×10^{1}
Lu-177	3×10^{1}	7×10^{-1}
Magnesium (12)		
Mg-28 (a)	3×10^{-1}	3×10^{-1}
Manganese (25)		
Mn-52	3×10^{-1}	3×10^{-1}
Mn-53	Unlimited	Unlimited
Mn-54	1×10^{0}	1×10^{0}
Mn-56	3×10^{-1}	3×10^{-1}
Molybdenum (42)		
Mo-93	4×10^{1}	2×10^{1}
Mo-99 (a)	1×10^{0}	6×10^{-1}
Nitrogen (7)		

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
N-13	9×10^{-1}	6×10^{-1}
Sodium (11)		
Na-22	5×10^{-1}	5×10^{-1}
Na-24	2×10^{-1}	2×10^{-1}
Niobium (41)		
Nb-93m	4×10^{1}	3×10^{1}
Nb-94	7×10^{-1}	7×10^{-1}
Nb-95	1×10^{0}	1×10^{0}
Nb-97	9×10^{-1}	6×10^{-1}
Neodymium (60)		
Nd-147	6×10^{0}	6×10^{-1}
Nd-149	6×10^{-1}	5×10^{-1}
Nickel (28)		
Ni-59	Unlimited	Unlimited
Ni-63	4×10^{1}	3×10^{1}
Ni-65	4×10^{-1}	4×10^{-1}
Neptunium (93)		
Np-235	4×10^{1}	4×10^{1}
Np-236 (short lived)	2×10^{1}	2×10^{0}
Np-236 (long lived)	9×10^{0}	2×10^{-2}
Np-237	2×10^{1}	2×10^{-3}
Np-239	7×10^{0}	4×10^{-1}
Osmium (76)		
Os-185	1 x 100	1×10^{0}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Os-191	1×10^{1}	2×10^{0}
Os-191m	4×10^{1}	3×10^{1}
Os-193	2×10^{0}	6×10^{-1}
Os-194 (a)	3×10^{-1}	3×10^{-1}
Phosphorus (15)		
P-32	5×10^{-1}	5×10^{-1}
P-33	4×10^{1}	1×10^{0}
Protactinium (91)		
Pa-230 (a)	2×10^{0}	7×10^{-2}
Pa-231	4×10^{0}	4×10^{-4}
Pa-233	5×10^{0}	7×10^{-1}
Lead (82)		
Pb-201	1×10^{0}	1×10^{0}
Pb-202	4×10^{1}	2×10^{1}
Pb-203	4×10^{0}	3×10^{0}
Pb-205	Unlimited	Unlimited
Pb-210 (a)	1×10^{0}	5×10^{-2}
Pb-212 (a)	7×10^{-1}	2×10^{-1}
Palladium (46)		
Pd-103 (a)	4×10^{1}	4×10^{1}
Pd-107	Unlimited	Unlimited
Pd-109	2×10^{0}	5×10^{-1}
Promethium (61)		
Pm-143	3×10^{0}	3×10^{0}
Pm-144	7×10^{-1}	7×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Pm-145	3×10^{1}	1×10^{1}
Pm-147	4×10^{1}	2×10^{0}
Pm-148m (a)	8×10^{-1}	7×10^{-1}
Pm-149	2×10^{0}	6×10^{-1}
Pm-151	2×10^{0}	6×10^{-1}
Polonium (84)		
Po-210	4×10^{1}	2×10^{-2}
Praseodymium (59)		
Pr-142	4×10^{-1}	4×10^{-1}
Pr-143	3×10^{0}	6×10^{-1}
Platinum (78)		
Pt-188 (a)	1×10^{0}	8×10^{-1}
Pt-191	4×10^{0}	3×10^{0}
Pt-193	4×10^{1}	4×10^{1}
Pt-193m	4×10^{1}	5×10^{-1}
Pt-195m	1×10^{1}	5×10^{-1}
Pt-197	2×10^{1}	6×10^{-1}
Pt-197m	1×10^{1}	6×10^{-1}
Plutonium (94)		
Pu-236	3×10^{1}	3×10^{-3}
Pu-237	2×10^{1}	2×10^{1}
Pu-238	1×10^{1}	1×10^{-3}
Pu-239	1×10^{1}	1×10^{-3}
Pu-240	1×10^{1}	1×10^{-3}
Pu-241 (a)	4×10^{1}	6×10^{-2}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Pu-242	1×10^{1}	1×10^{-3}
Pu-244 (a)	4×10^{-1}	1×10^{-3}
Radium (88)		
Ra-223 (a)	4×10^{-1}	7×10^{-3}
Ra-224 (a)	4×10^{-1}	2×10^{-2}
Ra-225 (a)	2×10^{-1}	4×10^{-3}
Ra-226 (a)	2×10^{-1}	3×10^{-3}
Ra-228 (a)	6×10^{-1}	2×10^{-2}
Rubidium (37)		
Rb-81	2×10^{0}	8×10^{-1}
Rb-83 (a)	2×10^{0}	2×10^{0}
Rb-84	1×10^{0}	1×10^{0}
Rb-86	5×10^{-1}	5×10^{-1}
Rb-87	Unlimited	Unlimited
Rb natural	Unlimited	Unlimited
Rhenium (75)		
Re-184	1×10^{0}	1×10^{0}
Re-184m	3×10^{0}	1×10^{0}
Re-186	2×10^{0}	6×10^{-1}
Re-187	Unlimited	Unlimited
Re-188	4×10^{-1}	4×10^{-1}
Re-189 (a)	3 x 100	6×10^{-1}
Re natural	Unlimited	Unlimited
Rhodium (45)		

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Rh-99	2×10^{0}	2×10^{0}
Rh-101	4×10^{0}	3×10^{0}
Rh-102	5×10^{-1}	5×10^{-1}
Rh-102	2×10^{0}	2×10^{0}
Rh-103m	4×10^{1}	4×10^{1}
Rh-105	1 x 101	8×10^{-1}
Radon (86)		
Rn-222 (a)	3×10^{-1}	4×10^{-3}
Ruthenium (44)		
Ru-97	5×10^{0}	5×10^{0}
Ru-103 (a)	2×10^{0}	2×10^{0}
Ru-105	1×10^{0}	6×10^{-1}
Ru-106 (a)	2×10^{-1}	2×10^{-1}
Sulfur (16)		
S-35	4×10^{1}	3×10^{0}
Antimony (51)		
Sb-122	4×10^{-1}	4×10^{-1}
Sb-124	6×10^{-1}	6×10^{-1}
Sb-125	2×10^{0}	1×10^{0}
Sb-126	4×10^{-1}	4×10^{-1}
Scandium (21)		
Sc-44	5×10^{-1}	5×10^{-1}
Sc-46	5×10^{-1}	5×10^{-1}
Sc-47	1×10^{1}	7×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Sc-48	3×10^{-1}	3×10^{-1}
Selenium (34)		
Se-75	3×10^{0}	3×10^{0}
Se-79	4×10^{1}	2×10^{0}
Silicon (14)		
Si-31	6×10^{-1}	$6 \times 1^{0-1}$
Si-32	4×10^{1}	5×10^{-1}
Samarium (62)		
Sm-145	1×10^{1}	1×10^{1}
Sm-147	Unlimited	Unlimited
Sm-151	4×10^{1}	1 x 101
Sm-153	9×1^{00}	6×10^{-1}
Tin (50)		
Sn-113 (a)	4×10^{0}	2×10^{0}
Sn-117m	7×10^{0}	4×10^{-1}
Sn-119m	4×10^{1}	3×10^{1}
Sn-121m (a)	4×10^{1}	9×10^{-1}
Sn-123	8×10^{-1}	6×10^{-1}
Sn-125	4×10^{-1}	4×10^{-1}
Sn-126 (a)	6 x 10-$^{-1}$	4×10^{-1}
Strontium (38)		
Sr-82 (a)	2×10^{-1}	2×10^{-1}
Sr-85	2×10^{0}	2×10^{0}
Sr-85m	5×10^{0}	5×10^{0}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Sr-87m	3×10^{0}	3×10^{0}
Sr-89	6×10^{-1}	6×10^{-1}
Sr-90 (a)	3×10^{-1}	3×10^{-1}
Sr-91 (a)	3×10^{-1}	3×10^{-1}
Sr-92 (a)	1×10^{0}	3×10^{-1}
Tritium (1)		
T(H-3)	4×10^{1}	4×10^{1}
Tantalum (73)		
Ta-178 (long lived)	1×10^{0}	8×10^{-1}
Ta-179	3×10^{1}	3×10^{1}
Ta-182	9×10^{-1}	5×10^{-1}
Terbium (65)		
Tb-157	4×10^{1}	4×10^{1}
Tb-158	1×10^{0}	1×10^{0}
Tb-160	1×10^{0}	6×10^{-1}
Technetium (43)		
Tc-95m (a)	2×10^{0}	2×10^{0}
Tc-96	4 x 10-^{1}	4×10^{-1}
Tc-96m (a)	4×10^{-1}	4×10^{-1}
Tc-97	Unlimited	Unlimited
Tc-97m	4×10^{1}	1×10^{0}
Tc-98	8×10^{-1}	7×10^{-1}
Tc-99	4 x 101	9×10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Tc-99m	1×10^{1}	4×10^{0}
Tellurium (52)		
Te-121	2×10^{0}	2×10^{0}
Te-121m	5×10^{0}	3×10^{0}
Te-123m	8×10^{0}	1×10^{0}
Te-125m	2×10^{1}	9×10^{-1}
Te-127	2×10^{1}	7×10^{-1}
Te-127m (a)	2×10^{1}	$5 \times 1^{0-1}$
Te-129	7×10^{-1}	6×10^{-1}
Te-129m (a)	8×10^{-1}	4×10^{-1}
Te-131m (a)	7×10^{-1}	5×10^{-1}
Te-132 (a)	5×10^{-1}	4×10^{-1}
Thorium (90)		
Th-227	1×10^{1}	5×10^{-3}
Th-228 (a)	5×10^{-1}	1 x 10-^{3}
Th-229	5×10^{0}	5×10^{-4}
Th-230	1×10^{1}	1×10^{-3}
Th-231	4×10^{1}	2×10^{-2}
Th-232	Unlimited	Unlimited
Th-234 (a)	3×10^{-1}	3×10^{-1}
Th natural	Unlimited	Unlimited
Titanium (22)		
Ti-44 (a)	5×10^{-1}	4×10^{-1}
Thallium (81)		

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
T1-200	9×10^{-1}	9×10^{-1}
T1-201	1×10^{1}	4×10^{0}
T1-202	2×10^{0}	2×10^{0}
T1-204	1×10^{1}	7×10^{-1}
Thulium (69)		
Tm-167	7×10^{0}	8×10^{-1}
Tm-170	3×10^{0}	6×10^{-1}
Tm-171	4×10^{1}	4×10^{1}
Uranium (92)		
U-230 (fast lung absorption) (a), (d)	4×10^{1}	1×10^{-1}
U-230 (medium lung absorption) (a), (e)	4×10^{1}	4×10^{-3}
U-230 (slow lung absorption) (a), (f)	3×10^{1}	3×10^{-3}
U-232 (fast lung absorption) (d)	4×10^{1}	1×10^{-2}
U-232 (medium lung absorption) (e)	4×10^{1}	7×10^{-3}
U-232 (slow lung absorption) (f)	1×10^{1}	$1 \times 1^{0-3}$
U-233 (fast lung absorption) (d)	4×10^{1}	2×10^{-2}
U-233 (medium lung absorption) (e)	4×10^{1}	6×10^{-3}
U-233 (slow lung absorption) (f)	4×10^{1}	9×10^{-2}
U-234 (fast lung absorption) (d)	4×10^{1}	2×10^{-2}
U-234 (medium lung absorption) (e)	4×10^{1}	6×10^{-3}
U-234 (slow lung absorption) (f)	1×10^{1}	1 x 10-^{3}
U-236 (fast lung absorption) (d)	4×10^{1}	2×10^{-2}
U-236 (medium lung absorption) (e)	4×10^{1}	6×10^{-3}
U-236 (slow lung absorption) (f)	Unlimited	Unlimited

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
U-238 (all lung absorption types) (d), (e), (f)	Unlimited	Unlimited
U (natural)	Unlimited	Unlimited
U (enriched to 20% or less) (g)	Unlimited	Unlimited
U (dep)	Unlimited	Unlimited
Vanadium (23)		
V-48	4 x 10-^{1}	4 x 10^{-1}
V-49	4 x 10^{1}	4 x 10^{1}
Wolfram (74)		
W-178 (a)	9 x 10^{0}	5 x 10^{0}
W-181	3 x 10^{1}	3 x 10^{1}
W-185	4 x 10^{1}	8 x 10^{-1}
W-187	2 x 10^{0}	6 x 10^{-1}
W-188 (a)	4 x 10^{-1}	3 x 10-^{1}
Xe-135	3 x 10^{0}	2 x 10^{0}
Xenon (54)		
Xe-122 (a)	4 x 10^{-1}	4 x 10^{-1}
Xe-123	2 x 10^{0}	7 x 10^{-1}
Xe-127	4 x 10^{0}	2 x 10^{0}
Xe-131m	4 x 10^{1}	4 x 10^{1}
Xe-133	2 x10^{1}	1 x 10^{1}
Xe-135	3 x 10^{0}	2 x 10^{0}
Yttrium (39)		
Y-87 (a)	1 x 10^{0}	1 x 10^{0}
Y-88	4 x 10^{-1}	4 x 10^{-1}

RADIONUCLIDE (ATOMIC NUMBER) (A)	A_1 (TBQ) (B)	A_2 (TBq) (C)
Y-90	3×10^{-1}	3×10^{-1}
Y-91	6×10^{-1}	6×10^{-1}
Y-91m	2×10^{0}	2×10^{0}
Y-92	2×10^{-1}	2×10^{-1}
Y-93	3×10^{-1}	3×10^{-1}
Ytterbium (70)		
Yb-169	4×10^{0}	1×10^{0}
Yb-175	3×10^{1}	9×10^{-1}
Zink (30)		
Zn-65	2×10^{0}	2×10^{0}
Zn-69	3×10^{0}	6×10^{-1}
Zn-69m (a)	3×10^{0}	6×10^{-1}
Zirconium (40)		
Zr-88	3×10^{0}	3×10^{0}
Zr-93	Unlimited	Unlimited
Zr-95 (a)	2×10^{0}	8×10^{-1}
Zr-97 (a)	4×10^{-1}	4×10^{-1}

Note: The basic radionuclides activity concentration limit for exempt material and activity concentration limit for an exempt consignment are prescribed by the NRRC

[a] A_1 and/or A_2 values for these parent radionuclides include contributions from progeny radionuclides with half-lives of less than 10 days, as listed in the following:

Mg-28	Al-28
Ar-42	K-42
Ca-47	Sc-47
Ti-44	Sc-44
Fe-52	Mn-52m
Fe-60	Co-60m
Zn-69m	Zn-69
Ge-68	Ga-68
Rb-83	Kr-83m
Sr-82	Rb-82
Sr-90	Y-90
Sr-91	Y-91m
Sr-92	Y-92
Y-87	Sr-87m
Zr-95	Nb-95m
Zr-97	Nb-97m, Nb-97
Mo-99	Tc-99m
Tc-95m	Tc-95
Tc-96m	Tc-96
Ru-103	Rh-103m
Ru-106	Rh-106
Pd-103	Rh-103m
Ag-108m	Ag-108
Ag-110m	Ag-110
Cd-115	In-115m
In-114m	In-114
Sn-113	In-113m
Sn-121m	Sn-121
Sn-126	Sb-126m
Te-118	Sb-118
Te-127m	Te-127
Te-129m	Te-129
Te-131m	Te-131

Te-132	I-132
I-135	Xe-135m
Xe-122	I-122
Cs-137	Ba-137m
Ba-131	Cs-131
Ba-140	La-140
Ce-144	Pr-144m, Pr-144
Pm-148m	Pm-148
Gd-146	Eu-146
Dy-166	Ho-166
Hf-172	Lu-172
W-178	Ta-178
W-188	Re-188
Re-189	Os-189m
Os-194	Ir-194
Ir-189	Os-189m
Pt-188	Ir-188
Hg-194	Au-194
Hg-195m	Hg-195
Pb-210	Bi-210
Pb-212	Bi-212, Tl-208, Po-212
Bi-210m	Tl-206
Bi-212	Tl-208, Po-212
At-211	Po-211
Rn-222	Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Po-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Ra-225	Ac-225, Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ra-226	Rn-222, Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-228	Ac-228
Ac-225	Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ac-227	Fr-223
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212

Th-234	Pa-234m, Pa-234
Pa-230	Ac-226, Th-226, Fr-222, Ra-222, Rn-218, Po-214
U-230	Th-226, Ra-222, Rn-218, Po-214
U-235	Th-231
Pu-241	U-237
Pu-244	U-240, Np-240m
Am-242m	Am-242, Np-238
Am-243	Np-239
Cm-247	Pu-243
Bk-249	Am-245
Cf-253	Cm-249

[b]Parent radionuclides 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
Ag-108m	Ag-108
Cs-137	Ba-137m
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-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-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-natural	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-natural	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
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

[c]The quantity may be determined from a measurement of the rate of decay or a measurement of the dose rate at a prescribed distance from the source.

[d]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.

[e]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.

[f]These values apply to all compounds of uranium other than those specified in (d) and (e) above.

These values apply to unirradiated uranium only.

TABLE II: BASIC RADIONUCLIDE VALUES FOR UNKNOWN RADIONUCLIDES OR MIXTURE RADIONUCLIDES

RADIOACTIVE CONTENTS (A)	A1 (TBQ) (B	A2 (TBQ) (C)	Activity concentration limit 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	x 10^{1} 1	x 10^{4} 1
Only alpha emitting nuclides are known to be present	0.2	9 x 10^{-5}	x 10^{-1} 1	x 10^{3} 1
Neutron emitting nuclides are known to be present or no relevant data are available	0.001	9 x 10^{-5}	x 10^{-1} 1	x 10^{3} 1

Eleventh Schedule

TESTS FOR RADIOACTIVE MATERIAL

[Article 5, Article 35 (b)(i), (c)(i) and (d)(i), Article 36 (b, Article 36 (c)(1) and Article 165 (c)]

PART I

Leaching test for LSA-III Material

(1) Leaching test for LSA-III Material shall be as follows:

a. A solid material sample representing the entire contents of a package shall be immersed for seven days in water at the ambient temperature;

b. The volume of water to be used in the test shall be sufficient to ensure that at the end of the seven days 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;

c. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 milli Siemen per meter (mS/m) at 20°C; and

d. The total activity of the free volume of water shall be measured following the seven days immersion of the test sample.

PART II

Tests for Low Dispersible Radioactive Material

SECTION I

Test procedures

(2) The test procedure shall be as follows:

a. The specimen shall be subjected to the Impact Test and Enhanced Thermal Test;
b. A different specimen may be used for each of the tests; and
c. The tests shall be followed by the Leaching Test or any other approved equivalent tests.

Impact Test

(3) The impact test shall be as follows:

a. The specimen shall be subject to an impact on a target at a velocity of not less than 90 m/s, at such orientation as to suffer maximum damage; and
b. The target shall be as defined in paragraph (12) Part II of the Seventeenth Schedule, except that the target surface may be at any orientation as long as the surface is normal to the specimen path.

Enhanced Thermal Test

4. The specimen shall be subject to the test conditions as specified for Thermal Test in paragraph (18) in Part II of the Eighteenth Schedule, except that the exposure to the thermal environment shall be for a period of 60 minutes.

Leaching Test

(5) Leaching test shall be as follows:

a. A solid material sample representing the entire contents of a package shall be immersed for seven days in water at the ambient temperature;

b. The volume of water to be used in the test shall be sufficient to ensure that at the end of the seven days 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;

c. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 milli Siemen per meter (mS/m) at 20°C; and

d. The total activity of the free volume of water shall be measured following the seven-day immersion of the test sample.

SECTION II

Assessment of the Results

(6) After the specimen has been subjected to the applicable tests specified in Section I, an appropriate method of assessment shall be used to assure that the requirements of this Specific Regulation have been met.

(7) Parameters, data, and the method of calculations used in evaluation shall be those which are generally agreed to be reliable and conservative.

(8) The result of the tests shall be used to determine whether the applicable requirements as specified in Article 36 for low dispersible radioactive material have been met and any faults and damage to the specimen shall be identified and recorded.

PART III

Tests for Special Form Radioactive Material

SECTION I

Test Procedures

(9) The test procedure shall be as follows:

a. The specimen shall be subjected to the Impact Test, the Percussion Test, the Bending Test and the Heat Test;
b. A different specimen may be used for each of the tests; and
c. The tests shall be followed by the Leaching Assessment Test or any other approved equivalent tests.

Impact Test

(10) The Impact Test shall be as follows:

a. The specimen shall be dropped onto the target from a height of 9 m; and
b. The target shall be a flat horizontal surface with special characteristics such that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

Percussion Test

11. The Percussion Test shall be as follows:

    a. 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;
    b. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of (3.0±0.3) mm; and
    c. The lead shall be of the kind with hardness number 3.5 to 4.5 on the Vickers scale and its thickness shall be not more than 25 mm and it shall cover an area greater than that which is covered by the specimen.

12. A fresh surface of lead shall be used for each impact and the bar shall strike the specimen so as to cause maximum damage.

Bending Test

13. This test shall apply only to a long and slender specimen with a minimum length of 10 cm and a length to minimum width ratio of not less than 10.

14. The Bending test shall be as follows:

    a. The specimen shall be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp;
    b. 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;
    c. The bar shall strike the specimen so as to cause an impact equiv-

alent to that resulting from a free vertical drop of 1.4 kg through 1 m; and

d. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of (3.0±0.3) mm.

Heat Test

(15) A specimen shall be heated in air to a temperature of 800°C and held at that temperature for a period of 10 minutes and shall then be allowed to cool.

Leaching and Volumetric Leakage Assessment Test

(16) For a specimen which comprises or simulates an indispersible solid material, the Leaching Assessment Test shall be performed as follows:

a. the specimen shall be immersed for seven days in water at ambient temperature and the following steps shall be taken:

i. The volume of water to be used in the test shall be sufficient to ensure that at the end of the seven days 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 and 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 the specimen shall then be heated to a temperature of (50±5)°C and maintained at this temperature for four hours; and

iii. The activity of the water shall then be determined;

d. the specimen shall then be kept for at least seven days in still air at not less than 30°C and relative humidity not less than 90% and the following steps shall be taken:

i. The specimen shall be immersed in water of the same specification as in (a) above and the water with the specimen heated to (50±5)°C and maintained at this temperature for four hours; and

ii. The activity of the water shall then be determined.

(17) For a specimen which comprises or simulates a radioactive material or nuclear material enclosed in a sealed capsule, the test shall either be a Leaching Assessment Test or a Volumetric Leakage Assessment Test or any other approved equivalent tests.

(18) The Leaching Assessment Test for a specimen referred to in paragraph (17) shall be as follows:

a. The specimen shall be immersed in water at ambient temperature;
b. The water shall have an initial pH of 6-8 with a maximum conductivity of 1 mS/m at 20°C;
c. The water and the specimen shall be heated to a temperature of (50±5)°C and maintained at this temperature for four hours;
d. The activity of the water shall then be determined;
e. The specimen shall then be kept for at least seven days in still air at not less than 30°C and relative humidity of not less than 90%; and
f. The process in paragraphs (18) (a), (b) and (b) shall be repeated.

(19) A specimen that comprises or simulates radioactive material or nuclear material enclosed in a sealed capsule may be exempted from:

a. The Impact Test and Percussion Test provided the mass of the special form radioactive material:

i. Is less than 200g and they are alternatively subjected to the Class 4 impact test prescribed in the International Organization for Standardization document ISO 2919: "Sealed Radioactive Sources – Classification", or

ii. Is less than 500g and they are alternatively subjected to the Class 5 impact test prescribed in the International Organization for Standardization document ISO 2919: "Sealed Radioactive Sources – Classification", and

c. The Heat Test provided they are alternatively subjected to the Class 6 temperature test specified in the International Organization for Standardization document ISO 2919: "Sealed Radioactive Sources–Classification".

SECTION II

Assessment of the Results

(20) After the specimen has been subjected to the applicable tests specified in Section I, an appropriate method of assessment shall be used to assure that the requirements of this Specific Regulation have been met.

(21) Parameters, data, and the method of calculations used in evaluation shall be those which are generally agreed to be reliable and conservative.

(22) The result of the tests shall be used to determine whether the integrity of the special form radioactive material has been retained to the extent required by Article 36. and any faults and damage to the specimen shall be identified and recorded.

PART IV

(23) Part I and II of the Seventh Schedule shall be complied.

Twelfth Schedule

EXCERPTS FROM THE LIST OF UNITED NATIONS NUMBERS,
PROPER SHIPPING NAME AND DESCRIPTION AND SUBSIDIARY RISKS

[Section 33, Article 151 (c) and Thirteenth Schedule]

United Nations Number (A)	Proper Shipping Name (B)	Subsidiary risks (C)
2908	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE)EMPTY PACKAGING	
2909	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE ARTICLES MANUFACTURED FROM NATURAL URANIUM or DEPLETED URANIUM or NATURAL THORIUM	
2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - LIMITED QUANTITY OF MATERIAL	
2911	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - INSTRUMENTS or ARTICLES	
2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA - I), non fissile or fissile – excepted[b]	
2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECT (SCO-I or SCO-II) non fissile or fissile-excepted	
2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE, non-special form, non fissile or fissile-excepted	
2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, non fissile or fissile-excepted	
2917	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, non fissile or fissile-excepted	

2919	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, non fissile or fissile-excepted b	
2977	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, FISSILE	Corrosive UN) (Class 8
2978	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, non-fissile or fissile excepted	Corrosive UN Class) (8
3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA - II), non fissile or fissile-excepted	
3322	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA - III), non fissile or fissile-excepted	
3323	RADIOACTIVE MATERIAL, TYPE C PACKAGE, non fissile or fissile-excepted	
2324	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), FISSILE	
3325	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), FISSILE	
3326	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECT (SCO-I or SCO-II), FISSILE	
3327	RADIOACTIVE MATERIAL, TYPE A PACKAGE, FISSILE non-special form	
3328	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE	
3329	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, FISSILE	
3330	RADIOACTIVE MATERIAL, TYPE C PACKAGE, FISSILE	
3331	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, FISSILE	

3332	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM non fissile or fissile-excepted
3333	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, FISSILE
3507	URANIUM HEXAFLUORIDE, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE, less than 0.1 kg per package, non-fissile or fissile exceptedb

[b] The term "fissile-excepted" refers only to material excepted under Twentieth Schedule

Thirteenth Schedule

SIGNS, LABELS AND PLACARDS

[Article 77 , Article 58, Article 61, Article 71, Article 73, Article 146, Article 149 Article 54 b (i), Article 74, Article 75(b)]

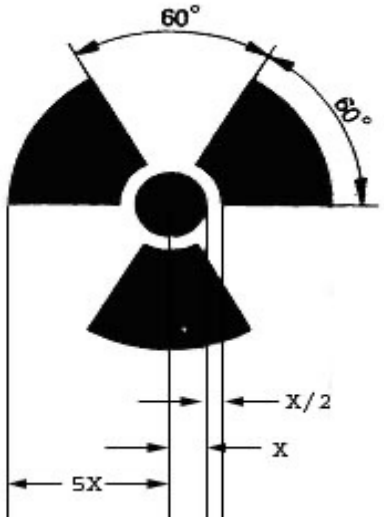

FIGURE 1: Basic trefoil symbol with proportions based on a central circle of radius X. The minimum allowable size of X shall be 4 mm.

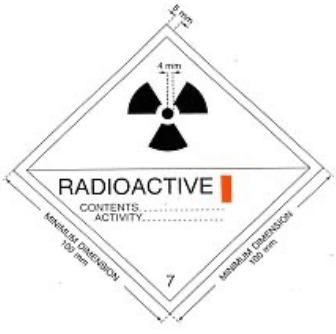

FIGURE 2: Category I-WHITE label. The background color of the label shall be white, the color of the trefoil and the printing shall be black, and the color of the category bar shall be red.

FIGURE 3: Category II-YELLOW label. The background color of the upper half of the label shall be yellow and of 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 of 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.

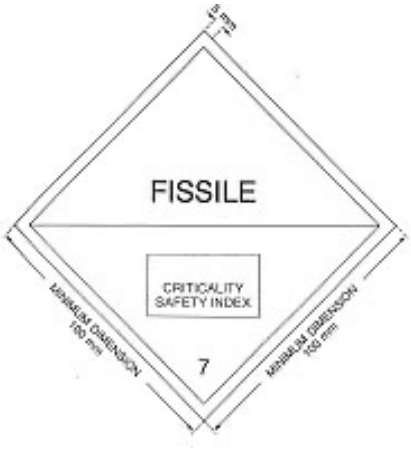

FIGURE 5: Criticality Safety Index (CSI) label. The background color of the label shall be white, the color of the printing shall be black.

FIGURE 6: Placard. Minimum dimensions are given; when larger dimension is used the relative proportions must be maintained. The figure "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.

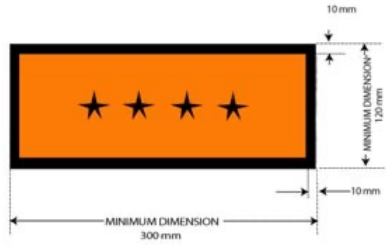

FIGURE 7: Placard for separate display of the United Nations Number. The background color of the placard shall be orange and the border and United Nations Number shall be black. The symbol "****" denotes the space in which the appropriate United Nations Number as specified in column (A); Twelfth Schedule shall be displayed.

Fourteenth Schedule

INTERNATIONAL SYSTEM OF UNITS SI PREFIXES

[Article 67, Article 109 (g) and Article119 (e)]

MULTIPLYING FACTOR (A)			Prefix (B)	Symbol (C)
1 000 000 000 000 000 000	=	10^{18}	exa	E
1 000 000 000 000 000	=	10^{15}	peta	P
1 000 000 000 000	=	10^{12}	tera	T
1 000 000 000	=	10^{9}	giga	G
1 000 000	=	10^{6}	mega	M
1 000	=	10^{3}	kilo	k
100	=	10^{2}	hecto	h
10	=	10^{1}	deka	da
0.1	=	10^{-1}	deci	d
0.01	=	10^{-2}	centi	c
0.001	=	10^{-3}	milli	m
0.000 001	=	10^{-6}	micro	μ
0.000 000 001	=	10^{-9}	nano	n
0.000 000 000 001	=	10^{-12}	pico	p
0.000 000 000 000 001	=	10^{-15}	femto	f
0.000 000 000 000 000 001	=	10^{-18}	atto	a

Fifteenth Schedule

CATEGORIES OF PACKAGES AND OVERPACKS

[Article 78]

Conditions		Prefix
TRANSPORT INDEX (A)	MAXIMUM DOSE RATE AT ANY POINT ON EXTERNAL SURFACE (B)	Category (C)
0 [a]	Not more than 0.005 mSv/h	I-WHITE
More than 0 but not more than 1 [a]	More than 0.005 mSv/h but not more than 0.5 mSv/h	II-YEL-LOW
More than 1 but not more than 10	More than 0.5 mSv/h but not more than 2 mSv/h	III-YEL-LOW
More than 10	More than 2 mSv/h but not more than 10 mSv/h	III-YELLOW [b]

[a]If the measured TI is not greater than 0.05, the value quoted may be zero.

[b]Shall also be transported under exclusive use.

Sixteenth Schedule

DETERMINATION OF TRANSPORT INDEX (TI) AND
CRITICALITY SAFETY INDEX (CSI)
[Article 124, Article 79(C), Article 144 (a) and (c), Article 145 (c) and 182 (c)]

(1) The TI for a package, overpack, freight container, or for unpackaged LSA-I or SCO-I, shall be the number derived in accordance with the procedure as follows:

   a. Determine the maximum dose rate in units of millisievert per hour (mSv/hr) at a distance of 1 m from the external surface of the package, overpack, freight container, or unpackaged LSA-I and SCO- I; and
   b. The value determined shall then be multiplied by 100.

(2) The TI for uranium ores, thorium ores or their concentrates shall be the maximum radiation dose rate at any point 1 m from the external surface of the load as specified in Table I.

(3) The TI for tanks, freight containers and unpackaged LSA-I or SCO-I shall be the value determined in paragraph (1)(a) above and shall then be multiplied by the appropriate factor specified in Table II.

(4) The number so obtained in paragraphs (1), (2) and (3) shall be rounded up to the first decimal place (e.g., 1.13 becomes 1.2) or where it is equal to 0.05 or less, the number shall be considered as zero.

(5) The TI for each overpack, freight container or conveyance shall be determined as:

   a. Either the sum of the TIs of all packages contained; or
   b. By direct measurement of dose rate, except in the case of non-rig-

id overpacks for which the TI shall be determined only as the sum of the TIs of all the packages.

(6) The CSI for packages containing fissile material shall be obtained by dividing the number 50 by the smaller of the values of N derived using the procedure specified in paragraphs (11) and (12) of the Seventh Schedule (i.e., CSI=50/N).

(7) The value of CSI may be zero, provided that an unlimited number of packages grouped together remains subcritical (i.e., N is effectively equal to infinity in both cases).

(8) The CSI for each overpack or freight container shall be determined as the sum of the CSIs of all packages contained.

(9) The same procedure shall be followed for determining the total sum of the CSIs in a consignment or aboard a conveyance.

TABLE 1. The maximum dose rate at any point 1 m from the external surface of uranium or thorium ores and concentrates

ORES / CONCENTRATES OF URANIUM OR THORIUM (A)	Dose rate (mSv/h) (B)
Ores and physical concentrates of uranium and thorium	0.4
Chemical concentrates of thorium	0.3
Chemical concentrates of uranium, other than uranium hexafluoride	0.02

TABLE II. Multiplication factors for determining transport index for large dimension loads

SIZE OF LOAD[A] (A)	Multiplication factor (B)
size of load ≤ 1 m2	1
1m2 < size of load ≤ 5m2	2
5m2 < size of load ≤ 20m2	3
size of load > 20m2	10

[a]Largest cross-sectional area of the load being measured.

TABLE III.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[a]	
(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

[a]Packages or overpacks carried in or on a vehicle which are in accordance with the provision of Article 131 may be transported by vessels provided that they are not removed from the vehicle at any time while on board the vessel.

TABLE IV. 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	Not applicable
Freight container – Large	50	100
Vehicle	50	100
Aircraft		
Passenger	50	Not applicable
Cargo	50	50
Inland water-way vessel	50	100
Seagoing vessela		
(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[b]	200[c]
Large freight containers	No limit[b]	No limit[c]

[a]Packages or overpacks carried in or on a vehicle which are in accordance with the provisions of Article 131 may be transported by vessels provided that they are not removed from the vehicle at any time while on board the vessel. In that case, the entries under the heading under exclusive use apply.

[b]The consignment shall be so handled and stowed that the total sum of CSI's in any group does not exceed 50, and that each group is handled and stowed so that the groups are separated from each other by at least 6 m.

[c]The consignment shall be so handled and stowed that the total sum of CSI's in any group does not exceed 100, and that each group is handled and stowed so that the groups are separated from each other by at least 6 m. The intervening space between groups may be occupied by other cargo in accordance with Article 158 (d).

Seventeenth Schedule

TEST PROCEDURES

[Article 5, Second Schedule, Third Schedule, Fourth Schedule, Sixth Schedule, Seventh Schedule, and Eleventh Schedule]

PART I

Demonstration of Compliance

(1) Demonstration of compliance with the performance standards required in this Specific Regulation shall be accomplished by any of the methods listed below or by a combination thereof:

a. Performance of tests with specimens representing;

ii. LSA-III material;

iii. special form radioactive material; or

iv. low dispersible radioactive material or with prototypes or sam-ples of the packaging,

where the contents of the specimen or the packaging for the tests shall simulate as closely as practicable the expected range of radioactive contents and the specimen or packaging to be tested shall be prepared as presented for transport;

a. Reference to previous satisfactory demonstrations of a sufficiently similar nature;

b. Performance of tests with models of appropriate scale incorporating those features which are significant with respect to the item under investigation when engineering experience has shown results of such tests to be suitable for design purposes and when a scale model is used, the need for adjusting certain test parameters, such as penetra-tor diameter or compressive load, shall be taken into account; and

c. Calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

(2) After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment shall be used to ensure that the requirements of this section have been ful-filled in compliance with the performance and acceptance standards prescribed in this Specific Regu-lation.

TEST FOR PACKAGES

PART II

Preparation of a specimen for testing

(3) All specimens shall be inspected before testing in order to identify and record faults or damage including the following:

a. Divergence from the design;
b. Defects in manufacture;
c. Corrosion or other deterioration; and
d. Distortion of features.

(4) The containment system of the package shall be clearly specified.

(5) The external features of the specimen shall be clearly identified so that reference may be made simply and clearly to any part of such a specimen.

PART III

Test procedures for demonstrating the ability of a package to withstand normal conditions of transport

(6) The specimen shall be subjected to the Free Drop Test, the Stacking Test, and the Pene-tration Test (in that order) proceeded in each case by the Water Spray Test.

7. The time interval between the conclusion of the Water Spray Test and the succeeding tests shall be:

   a. Such that the water has soaked into the maximum extent, without appreciable drying of the exterior of the specimen;
   b. In the absence of any evidence to the contrary, this interval shall be taken to be two hours if the water spray is applied from four directions simultaneously; and
   c. No time interval shall elapse, however if the water spray is applied from each of the four directions consecutively.

(8) One specimen may be used for all the test, provided that the requirements of paragraph (7) are fulfilled.

Water Spray Test

(9) The specimen shall be subjected to a water spray that simulates exposures to rainfall of approximately 5 cm per hour for at least one hour.

Free Drop Test

(10) The specimen shall be dropped onto a target so as to suffer maximum damage in respect of the safety features to be tested.

(11) The height of the drop shall be measured from the lowest point of the specimen to the upper surface of the target and shall be not less than the distance specified in Table 1 for the respec-tive mass specified therein.

(12) The target shall be a flat, horizontal surface with special characteristics such that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

(13) The Free Drop Test shall be as follows:

a. For a package with a rectangular shape and made of fiberboard or wood, with a mass not exceeding 50 kg, a separate specimen shall be subjected to a free drop onto each corner from a height of 0.3 m; and

b. For a package with a cylindrical shape and made of fiberboard or wood, with a mass not exceeding 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.

(14) If the package is meant to be used for the transport of radioactive liquids or gases, the specimen shall be subjected to a modified Free Drop Test in which it is dropped onto a target such that its containment system suffers the maximum damage.

(15) The height of the drop referred to in paragraph (14) is measured from the lowest part of the specimen to the upper surface of the target and shall be 9m where the target shall be as specified in paragraph (12).

(16) Where it can be demonstrated that the test specified in paragraph (20) is more severe for the specimen in question, then the test specified in paragraph (14) need not be carried out.

TABLE 1: Free drop distance for Free Drop Test

PACKAGE MASS (KG (A)	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
Package mass ≥ 15 000	0.3

[a]Largest cross-sectional area of the load being measured.

Stacking Test

(17) Unless the shape of the package totally prevents stacking, the specimen shall be sub-jected, for a period of twenty-four hours, to a compressive load equal to whichever is the greater of the following:

a. The equivalent of 5 times the mass of the actual package; and
b. the equivalent of 13 kPa multiplied by the vertically projected area of the package,
c. where 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.

Penetration Test

(18) The specimen shall be placed on a rigid, flat, and horizontal surface which shall not move significantly while the test is being carried out.

(19) The Penetration Test shall be carried out as follows:

a. A bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg shall be drop-ped 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 and the bar shall not be significantly deformed by the test per-formance; and
b. 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.

(20) If the package is meant to be used for the transport of radioactive liquids or gases, the Penetration Test shall be modified such that the drop height is increased from 1 m to 1.7 m.

(21) Where it can be demonstrated that the test specified in paragraph (14) is more severe for the specimen in question, then the test specified in paragraph (19) need not be carried out.

PART IV

Assessment of the Results

(22) After the specimen has been subjected to the applicable tests specified in Part III, an appropriate method of assessment shall be used to assure that the requirements of this Specific Regu-lation has been met.

(23) Parameters, data, and the method of calculations used in evaluation shall be those which are generally agreed to be reliable and conservative.

(24) The results of the tests shall be used to determine whether the integrity of the con-tainment system and shielding of the specimen has been retained to the extent required by this Spe-cific Regulation and any faults and damage to the specimen shall be identified and recorded.

(25) For packages containing fissile material, it shall also be determined whether the appli-cable requirements of this Specific Regulation pertaining to the transport of fissile material are fully met.

Eighteenth Schedule

TEST PROCEDURES DEMONSTRATING THE ABILITY OF A PACKAGE
TO WITHSTAND ACCIDENT CONDITIONS OF TRANSPORT
[Article 5, Seventeenth Schedule]

PART I

Sample preparation

(1) Part I and II of the Seventh Schedule shall be complied.

PART II

Test Procedures

(2) The specimen shall be subjected to the Mechanical Test and the Thermal Test, in that order.

(3) Following the tests referred to in paragraph (2), either the same specimen or a separate specimen shall be subjected to the Water Immersion Test.

(4) If the package is Type B(U) or Type B(M) packages containing more than 105 A_2, or Type C packages, the Water Immersion Test shall be modified such that the specimen is immersed under a head of water of at least 200 m for a period of not less than one hour but for demonstration purposes, an external gauge pressure of at least 2 megapascals (MPa) shall be deemed to meet the requirement.

(5) If the package is meant to be used for transporting fissile material, the specimen shall be subjected to an additional test, that is, the Water Leakage Test which shall be carried out after the Mechanical Test and the Thermal Test.

(6) The Water Leakage Test referred to in paragraph (5) is not necessary

for a package whose design has assumed greatest reactivity following any conceivable water in-leakage or out-leakage from the package.

Mechanical Test

(7) The Mechanical Test consisting of three different drop tests as follows:

a. Mechanical Test Drop I;
b. Mechanical Test Drop II; and
c. Mechanical Test Drop III,

and the applicable drop shall be chosen depending on the regulatory requirements of the package under test.

(8) The target shall be a flat, horizontal surface with special characteristics such that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

(9) The order in which the specimen is subjected to the drops shall be such that, on completion of the Mechanical Test, the specimen shall have suffered such damage as will lead to the maximum damage in the Thermal Test which follows.

Mechanical Test Drop I

(10) A specimen shall be dropped 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.

Mechanical Test Drop II

(11) A specimen shall be dropped so as to suffer the maximum damage onto a bar rigidly mounted perpendicularly on the target and 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.

(12) The bar shall be of solid mild steel of circular section (15.0±0.5) cm in diameter, 20 cm long and the upper end of the bar shall be flat and horizontal with its edges rounded off to a radius of not more than 6 mm.

13. A longer bar than the measurement specified in paragraph (12) shall be used if it would cause greater damage to the specimen.

Mechanical Test Drop III

(14) A 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.

(15) The mass shall consist of a solid mild steel plate 1 m by 1 m that fall in a horizontal attitude and the height of the drop referred to in paragraph (14) shall be measured from the underside of the plate to the highest point of the specimen.

Thermal Test

(16) The specimen shall be in thermal equilibrium under conditions of an ambient temperature of 38°C, subject to:

a. Solar insolation conditions specified in Table I of the Third Schedule; and

b. design maximum rate of internal heat generation within the package from the radioactive contents.

(17) Alternatively, any of these parameters referred to in paragraph (16) 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.

(18) The Thermal Test shall consist of:

a. The exposure of a specimen for a period of 30 minutes to a thermal environment which provides a heat flux at least equivalent to that of a hydrocarbon fuel/air fire in sufficiently quiescent ambient conditions to give a minimum average flame emissivity coefficient of 0.9 and an average temperature of at least 800°C, fully engulfing the specimen, with a surface absorptivity coefficient of 0.8; or value which that package may be demonstrated to possess if exposed to the fire specified; and

b. The exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table I of the Third Schedule and subject to the design maximum rate of internal heat generation within the package by the radioactive contents for a sufficient period to ensure that the temperatures in the specimen are everywhere decreasing and/or are approaching initial steady state conditions.

(19) Alternatively, any of these parameters referred to in paragraph (18) are allowed to have different values following cessation of heating, providing due account is taken of them in the subsequent assessment of package design.

(20) During and following the test, the specimen shall not be artificially cooled and any combustion of materials of the specimen shall be permitted to proceed naturally.

Water Immersion Test

(21) 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 to the specimen but for demonstration purposes, an external gauge pressure of at least 150 kPa shall be deemed to meet the requirement.

Water Leakage Test

(22) 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 of the specimen is expected.

(23) Enhanced water immersion test for Type B(U) and Type B(M) packages containing more than 105 A2 and Type C packages

(24) The specimen shall be immersed under a head of water of at least 200 m for a period of not less than one hour but for demonstration purposes, an external gauge pressure of at least 2 MPa shall be deemed to meet these conditions.

PART III

Assessment of the Test Results

(25) After the specimen has been subjected to the applicable tests specified in Part II, an appropriate method of assessment shall be used to assure that the requirements of this Specific Regulation have been met.

(26) Parameters, data, and the method of calculations used in evaluation shall be those which are generally agreed to be reliable and conservative.

(27) The result of the tests shall be used to determine whether the integrity of the containment system and shielding has been retained to the extent required by this Specific Regulation and any faults and damage to the specimen shall be identified and recorded.

(28) For packages containing fissile material, it shall also be determined whether the applicable requirements of this Specific Regulation pertaining to the transport of fissile material are fully met.

Nineteenth Schedule

INDUSTRIAL PACKAGE REQUIREMENTS FOR LSA MATERIAL AND SCO

[Article 97 and Fifth Schedule]

RADIOACTIVE CONTENTS (A)	Industrial package type	
	EXCLUSIVE USE (B)	NOT UNDER EXCLUSIVE USE (C)
Freight container – Small		
Solid[a]	Type IP-1	Type IP-1
Liquid	Type IP-1	Type IP-2
Freight container – Small		
Solid[a]	Type IP-2	Type IP-2
Liquid	Type IP-2	Type IP-3
LSA-III	Type IP-2	Type IP-3
SCO-I[a]	Type IP-1	Type IP-1
SCO-II	Type IP-2	Type IP-2

[a] Under the conditions specified in Article 99, LSA-I material and SCO-I may be transported unpackaged.

Twentieth Schedule

EXCEPTIONS FROM THE REQUIREMENTS FOR PACKAGES CONTAINING FISSILE MATERIAL

[Article 5, Article 59, Article 173, Article 175, Article 109 and Seventh Schedule]

(1) Fissile material to be transported in packaging is exempted from the requirements of this Specific Regulation that apply to fissile material and only one type of exemption is allowed per consignment if it meets one of the following provisions:

a. A mass limit per consignment such that:

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

b. Where X and Y are the mass limits defined in the Twenty Second Schedule, provided that the smallest external dimension of each package is not less than 10 cm and that either:

i. 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 conveyance;

ii. 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

iii. There is not more than 5 g of fissile material in any 10 liters volume of material, neither beryllium nor deuterium shall be present in quantities exceeding 1% of the applicable consignment mass limits provided in the Seventeenth Schedule, except for deuterium in natural concentration in hydrogen;

d. Not more than 1% by mass of uranium enriched in uranium-235 and a total plutonium and uranium-233 content not exceeding 1% of the mass of uranium-235, provided that the fissile material is distributed essentially homogenously throughout the material and provided further that if uranium-235 is present in metallic, oxide or carbides forms, it shall not form a lattice arrangement;

e. Not more than 2% by mass of liquid solutions of uranyl nitrate enriched in uranium-235, provided that the total plutonium and uranium-233 content does not exceed 0.002 % of the mass of uranium, and with minimum nitrogen to uranium atomic ratio (N/U) of 2; or

f. Not more than 1 kg of total plutonium provided that the content of plutonium-239 or plutonium-241 or their combination does not exceed 20% by mass.

Twenty First Schedule

TESTS FOR TYPE C PACKAGES

[Fourth Schedule and Seventh Schedule]

PART I

Sample preparation

1. Part I and II of the Seventh Schedule shall be complied.

PART II

Test Procedure

2. The specimen shall be subjected to the effect of each of the following test sequences in orders specified:

   a. Mechanical Test Drop I of the Eighteenth Schedule;
   b. Mechanical Test Drop III of the Eighteenth Schedule;
   c. Puncture Test;
   d. Enhanced Thermal Test; and
   e. Impact Test,

   and separate specimens are allowed to be used for each of the sequences (a) to (e).

Puncture Test

3. A specimen shall be subjected to the damaging effects of a vertical solid probe made of mild steel and 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 specified in paragraph (2)(a)-(e).

4. For a specimen representing a package having a mass of less than 250 kg, the tests are as follows:

a. It 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;
b. The probe shall be a 20 cm diameter cylindrical bar with the striking end forming a frustum of a right circular cone with the following dimensions: 30 cm height and 2.5 cm diameter at the top with its edge rounded off to a radius of not more than 6 mm; and
c. The target on which the specimen is placed 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.

5. For a specimen representing a package having a mass of 250 kg or more, the tests are as follows:

a. The base of the probe shall be placed on a target and the specimen dropped onto the probe;
b. 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;
c. The probe shall have the same properties and dimension as specified in subparagraph (4)(b) above, except that the length and mass of the probe shall be such as to incur maximum damage to the specimen; and
d. The target on which the specimen is placed shall be the same as specified in subparagraph (4)(c) above.

Enhanced Thermal Test

6. The conditions of this test shall be as specified in Thermal Test in Part II of the Eighteenth Schedule except that the exposure to the thermal environment shall be for a period of 60 minutes.

Impact Test

7. The specimen shall be subjected 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 and the target shall be a flat, horizontal surface with special characteristics such that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen except that the target surface may be at any orientation as long as the surface is normal to the specimen path.

PART III

Assessment of the Test Results

8. After the specimen has been subjected to the applicable tests specified in Part II, an appropriate method of assessment shall be used to assure that the requirements of this Specific Regulation have been met.

9. Parameters, data, and the method of calculations used in evaluation shall be those which are generally agreed to be reliable and conservative.

10. The result of the tests shall be used to determine whether the integrity of the containment system and shielding has been retained to the extent required by this Specific Regulation and any faults and damage to the specimen shall be identified and recorded.

11. For packages containing fissile material, it shall also be determined whether the applicable requirements of this Specific Regulation pertaining to the transport of fissile material are fully met.

Twenty Second Schedule

CONSIGNMENT MASS LIMITS FOR EXCEPTION FROM THE REQUIREMENTS FOR PACKAGES CONTAINING FISSILE MATERIAL

[Twentieth Schedule]

Freight container – Small	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 Other fissile material ((Y	400 250	290 180

[a] Under the conditions specified in Article 98, LSA-I material and SCO-I may be transported unpackaged.

Twenty Third Schedule

IDENTIFICATION MARK

[Article 191]

1. The identification mark shall be of the following generalized type:

"KSA/Number/Type code",

Where:

a. "KSA" represents the international vehicle registration identification code of Kingdom of Saudi Arabia;

b. "Number" represents the number assigned by the NRRC; and

c. "Type code" represents the following, used in the order listed:

Type code	Description
AF	Type A package design for fissile material
(B(U	Type B (U) package design
B(U)F	Type B (U) package design for fissile material
(B(M	Type B (M) package design
B(M)F	Type B (M) package design for fissile material
C	Type C package design
CF	Type C package design for fissile material
IF	industrial package design for fissile material
S	special form radioactive material
LD	low dispersible radioactive material
T	certain shipment
X	special arrangement

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

Type code	Description
H(U)	Unilateral approval
H(M)	Multilateral approval

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