

IAEA Safety Standards

for protecting people and the environment

Regulations for the Safe Transport of Radioactive Material

2012 Edition

Specific Safety Requirements

No. SSR-6



IAEA

International Atomic Energy Agency



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IAEA SAFETY STANDARDS AND RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety. The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Information on the IAEA's safety standards programme is available at the IAEA Internet site

<http://www-ns.iaea.org/standards/>

The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at PO Box 100, 1400 Vienna, Austria.

All users of IAEA safety standards are invited to inform the IAEA of experience in their use (e.g. as a basis for national regulations, for safety reviews and for training courses) for the purpose of ensuring that they continue to meet users' needs. Information may be provided via the IAEA Internet site or by post, as above, or by email to Official.Mail@iaea.org.

RELATED PUBLICATIONS

The IAEA provides for the application of the standards and, under the terms of Articles III and VIII.C of its Statute, makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

Reports on safety and protection in nuclear activities are issued as **Safety Reports**, which provide practical examples and detailed methods that can be used in support of the safety standards.

Other safety related IAEA publications are issued as **Radiological Assessment Reports**, the International Nuclear Safety Group's **INSAG Reports**, **Technical Reports** and **TECDOCs**. The IAEA also issues reports on radiological accidents, training manuals and practical manuals, and other special safety related publications.

Security related publications are issued in the **IAEA Nuclear Security Series**.

The **IAEA Nuclear Energy Series** comprises informational publications to encourage and assist research on, and the development and practical application of, nuclear energy for peaceful purposes. It includes reports and guides on the status of and advances in technology, and on experience, good practices and practical examples in the areas of nuclear power, the nuclear fuel cycle, radioactive waste management and decommissioning.

REGULATIONS FOR THE
SAFE TRANSPORT OF
RADIOACTIVE MATERIAL

2012 Edition

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

IAEA SAFETY STANDARDS SERIES No. SSR-6

REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL

2012 Edition

SPECIFIC SAFETY REQUIREMENTS

This Safety Requirements publication includes
a CD-ROM containing the IAEA Safety Glossary:
2007 Edition (2007) and the Fundamental Safety Principles (2006),
each in Arabic, Chinese, English, French, Russian and Spanish versions.

The CD-ROM is also available for purchase separately.

See: <http://www-pub.iaea.org/MTCD/publications/publications.asp>

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2012

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Marketing and Sales Unit, Publishing Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
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fax: +43 1 2600 29302
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FOREWORD

by Yukiya Amano
Director General

The IAEA's Statute authorizes the Agency to “establish or adopt... standards of safety for protection of health and minimization of danger to life and property” — standards that the IAEA must use in its own operations, and which States can apply by means of their regulatory provisions for nuclear and radiation safety. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned. A comprehensive set of high quality standards under regular review is a key element of a stable and sustainable global safety regime, as is the IAEA's assistance in their application.

The IAEA commenced its safety standards programme in 1958. The emphasis placed on quality, fitness for purpose and continuous improvement has led to the widespread use of the IAEA standards throughout the world. The Safety Standards Series now includes unified Fundamental Safety Principles, which represent an international consensus on what must constitute a high level of protection and safety. With the strong support of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its standards.

Standards are only effective if they are properly applied in practice. The IAEA's safety services encompass design, siting and engineering safety, operational safety, radiation safety, safe transport of radioactive material and safe management of radioactive waste, as well as governmental organization, regulatory matters and safety culture in organizations. These safety services assist Member States in the application of the standards and enable valuable experience and insights to be shared.

Regulating safety is a national responsibility, and many States have decided to adopt the IAEA's standards for use in their national regulations. For parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by regulatory bodies and operators around the world to enhance safety in nuclear power generation and in nuclear applications in medicine, industry, agriculture and research.

Safety is not an end in itself but a prerequisite for the purpose of the protection of people in all States and of the environment — now and in the future. The risks associated with ionizing radiation must be assessed and controlled without unduly limiting the contribution of nuclear energy to equitable and sustainable development. Governments, regulatory bodies and operators everywhere must ensure that nuclear material and radiation sources are used beneficially, safely and ethically. The IAEA safety standards are designed to facilitate this, and I encourage all Member States to make use of them.

NOTE BY THE SECRETARIAT

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. The process of developing, reviewing and establishing the IAEA standards involves the IAEA Secretariat and all Member States, many of which are represented on the four IAEA safety standards committees and the IAEA Commission on Safety Standards.

The IAEA standards, as a key element of the global safety regime, are kept under regular review by the Secretariat, the safety standards committees and the Commission on Safety Standards. The Secretariat gathers information on experience in the application of the IAEA standards and information gained from the follow-up of events for the purpose of ensuring that the standards continue to meet users' needs. The present publication reflects feedback and experience accumulated until 2010 and it has been subject to the rigorous review process for standards.

Lessons that may be learned from studying the accident at the Fukushima Daiichi nuclear power plant in Japan following the disastrous earthquake and tsunami of 11 March 2011 will be reflected in this IAEA safety standard as revised and issued in the future.

THE IAEA SAFETY STANDARDS

BACKGROUND

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled.

Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety.

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences.

States have an obligation of diligence and duty of care, and are expected to fulfil their national and international undertakings and obligations.

International safety standards provide support for States in meeting their obligations under general principles of international law, such as those relating to environmental protection. International safety standards also promote and assure confidence in safety and facilitate international commerce and trade.

A global nuclear safety regime is in place and is being continuously improved. IAEA safety standards, which support the implementation of binding international instruments and national safety infrastructures, are a cornerstone of this global regime. The IAEA safety standards constitute a useful tool for contracting parties to assess their performance under these international conventions.

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish

fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation, and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste.

Safety measures and security measures¹ have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. They are issued in the IAEA Safety Standards Series, which has three categories (see Fig. 1).

Safety Fundamentals

Safety Fundamentals present the fundamental safety objective and principles of protection and safety, and provide the basis for the safety requirements.

Safety Requirements

An integrated and consistent set of Safety Requirements establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered ‘overarching’ requirements, are expressed as ‘shall’ statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures). The Safety

¹ See also publications issued in the IAEA Nuclear Security Series.

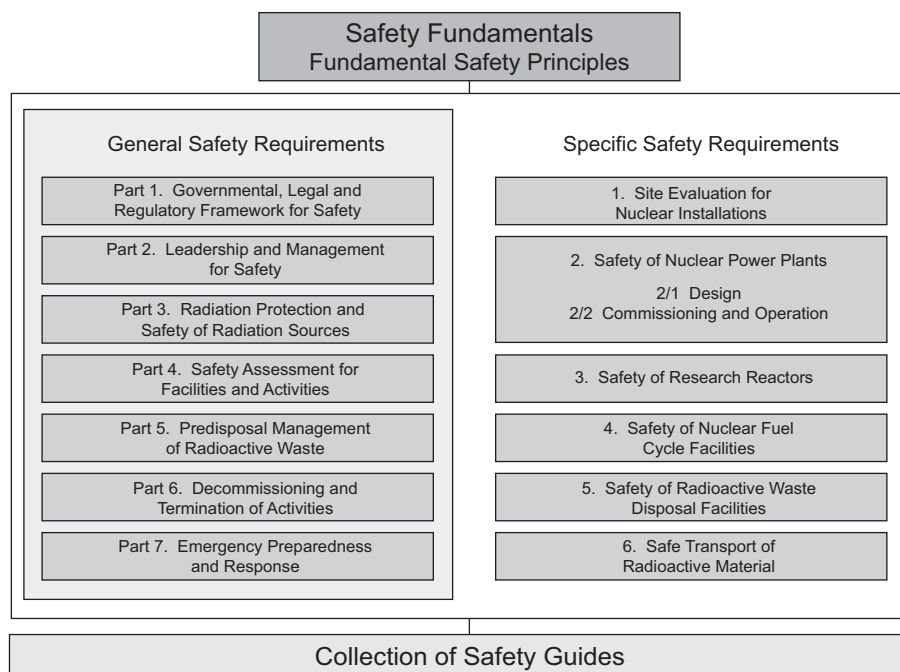


FIG. 1. The long term structure of the IAEA Safety Standards Series.

Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as ‘should’ statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be used by States as a reference for their national regulations in respect of facilities and activities.

The IAEA's Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA assisted operations.

The IAEA safety standards also form the basis for the IAEA's safety review services, and they are used by the IAEA in support of competence building, including the development of educational curricula and training courses.

International conventions contain requirements similar to those in the IAEA safety standards and make them binding on contracting parties. The IAEA safety standards, supplemented by international conventions, industry standards and detailed national requirements, establish a consistent basis for protecting people and the environment. There will also be some special aspects of safety that need to be assessed at the national level. For example, many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual States.

The scientific considerations underlying the IAEA safety standards provide an objective basis for decisions concerning safety; however, decision makers must also make informed judgements and must determine how best to balance the benefits of an action or an activity against the associated radiation risks and any other detrimental impacts to which it gives rise.

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and four safety standards committees, for nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

All IAEA Member States may nominate experts for the safety standards committees and may provide comments on draft standards. The membership of the Commission on Safety Standards is appointed by the Director General and includes senior governmental officials having responsibility for establishing national standards.

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards. It articulates the mandate of the IAEA, the vision for the future application of the

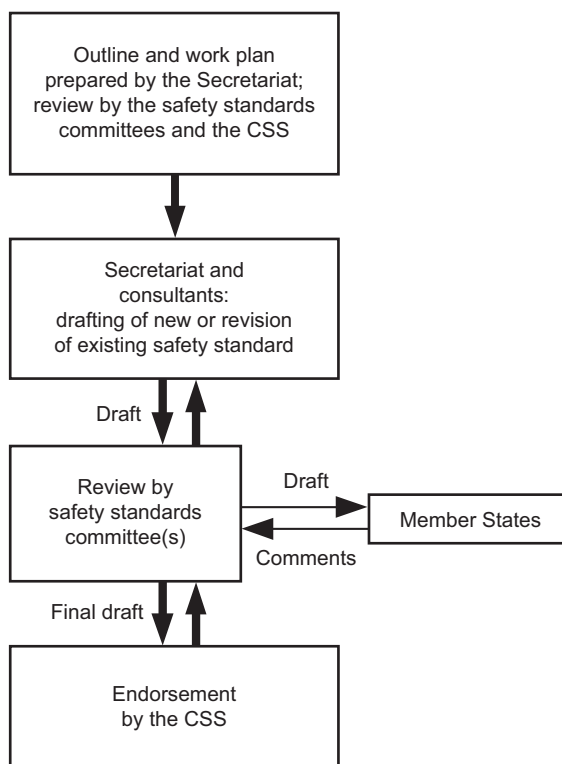


FIG. 2. The process for developing a new safety standard or revising an existing standard.

safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

Safety related terms are to be understood as defined in the IAEA Safety Glossary (see <http://www-ns.iaea.org/standards/safety-glossary.htm>). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard in the IAEA Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the body text, is included in support of statements in the body text, or describes methods of calculation, procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the safety standard. Material in an appendix has the same status as the body text, and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material under other authorship may be presented in annexes to the safety standards. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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Section I

INTRODUCTION

BACKGROUND

101. These Regulations establish standards of safety which provide an acceptable level of control of the radiation, criticality and thermal hazards to persons, property and the environment that are associated with the transport of *radioactive material*. These Regulations are based on the Fundamental Safety Principles, Safety Fundamentals No. SF-1 [1], jointly sponsored by the European Atomic Energy Community (EAEC), the Food and Agriculture Organization of the United Nations (FAO), the IAEA, the International Labour Organization (ILO), the International Maritime Organization (IMO), the OECD Nuclear Energy Agency (NEA), the Pan American Health Organization (PAHO), the United Nations Environment Programme (UNEP) and the World Health Organization (WHO), and on the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115 [2], jointly sponsored by the FAO, the IAEA, the ILO, the NEA, the PAHO and the WHO. Thus, compliance with these Regulations is deemed to satisfy the principles of the Basic Safety Standards in respect of transport. In accordance with Ref. [1], the prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.

102. This Safety Standard is supplemented by a hierarchy of Safety Guides, including: Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, IAEA Safety Standards Series No. TS-G-1.1 (Rev. 1) [3]; Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, IAEA Safety Standards Series No. TS-G-1.2 (ST-3) [4]; Compliance Assurance for the Safe Transport of Radioactive Material, IAEA Safety Standards Series No. TS-G-1.5 [5]; The Management System for the Safe Transport of Radioactive Material, IAEA Safety Standards Series No. TS-G-1.4 [6]; and Radiation Protection Programmes for the Transport of Radioactive Material, IAEA Safety Standards Series No. TS-G-1.3 [7].

103. In certain parts of these Regulations, a particular action is prescribed, but the responsibility for carrying out the action is not specifically assigned to any particular person. Such responsibility may vary according to the laws and customs of different countries and the international conventions into which these

countries have entered. For the purpose of these Regulations, it is not necessary to make this assignment, but only to identify the action itself. It remains the prerogative of each government to assign this responsibility.

OBJECTIVE

104. The objective of these Regulations is to establish requirements that must be satisfied to ensure safety and to protect persons, property and the environment from the effects of radiation in the transport of *radioactive material*. This protection is achieved by requiring:

- (a) Containment of the *radioactive contents*;
- (b) Control of external *radiation levels*;
- (c) Prevention of criticality;
- (d) Prevention of damage caused by heat.

These requirements are satisfied firstly by applying a graded approach to contents limits for *packages* and *conveyances* and to performance standards applied to *package designs*, depending upon the hazard of the *radioactive contents*. Secondly, they are satisfied by imposing conditions on the *design* and operation of *packages* and on the maintenance of *packagings*, including consideration of the nature of the *radioactive contents*. Finally, they are satisfied by requiring administrative controls, including, where appropriate, *approval* by *competent authorities*.

105. In the transport of *radioactive material*, the safety of persons and the protection of property and the environment are assured when these Regulations are complied with. Confidence in this regard is achieved through *management system* and *compliance assurance* programmes.

SCOPE

106. These Regulations apply to the transport of *radioactive material* by all modes on land, water, or in the air, including transport that is incidental to the use of the *radioactive material*. Transport comprises all operations and conditions associated with, and involved in, the movement of *radioactive material*; these include the *design*, manufacture, maintenance and repair of *packaging*, and the preparation, consigning, loading, carriage including in-transit storage, unloading and receipt at the final destination of loads of *radioactive material* and *packages*.

A graded approach is applied in specifying the performance standards in these Regulations, which are characterized in terms of three general severity levels:

- (a) Routine conditions of transport (incident free);
- (b) Normal conditions of transport (minor mishaps);
- (c) Accident conditions of transport.

107. These Regulations do not apply to any of the following:

- (a) *Radioactive material* that is an integral part of the means of transport.
- (b) *Radioactive material* moved within an establishment that is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways.
- (c) *Radioactive material* implanted or incorporated into a person or live animal for diagnosis or treatment.
- (d) *Radioactive material* in or on a person who is to be transported for medical treatment because the person has been subject to accidental or deliberate intake of *radioactive material* or to *contamination*.
- (e) *Radioactive material* in consumer products that have received regulatory approval, following their sale to the end user.
- (f) Natural material and ores containing naturally occurring radionuclides, which may have been processed, provided the activity concentration of the material does not exceed 10 times the values specified in Table 2, or calculated in accordance with paras 403(a) and 404–407. For natural materials and ores containing naturally occurring radionuclides that are not in secular equilibrium the calculation of the activity concentration shall be performed in accordance with para. 405.
- (g) Non-radioactive solid objects with radioactive substances present on any surface in quantities not in excess of the levels defined in para. 214.

108. These Regulations do not specify controls such as routeing or physical protection that may be instituted for reasons other than radiological safety. Any such controls shall take into account radiological and non-radiological hazards, and shall not detract from the standards of safety that these Regulations are intended to provide.

109. Measures should be taken to ensure that *radioactive material* is kept secure in transport so as to prevent theft or damage and to ensure that control of the material is not relinquished inappropriately (see Annex I).

110. For *radioactive material* having subsidiary risks, and for transport of *radioactive material* with other dangerous goods, the relevant transport regulations for dangerous goods shall apply in addition to these Regulations.

STRUCTURE

111. This publication is structured so that Section II defines the terms that are required for the purposes of these Regulations; Section III provides general provisions; Section IV provides activity limits and material restrictions used throughout these Regulations; Section V provides requirements and controls for transport; Section VI provides requirements for *radioactive material* and for *packagings* and *packages*; Section VII provides requirements for test procedures; and Section VIII provides requirements for *approvals* and administration.

Section II

DEFINITIONS

The following definitions shall apply for the purposes of these Regulations:

A_1 and A_2

201. A_1 shall mean the activity value of *special form radioactive material* that is listed in Table 2 or derived in Section IV and is used to determine the activity limits for the requirements of these Regulations. A_2 shall mean the activity value of *radioactive material*, other than *special form radioactive material*, that is listed in Table 2 or derived in Section IV and is used to determine the activity limits for the requirements of these Regulations.

Aircraft

202. *Cargo aircraft* shall mean any *aircraft*, other than a *passenger aircraft*, that is carrying goods or property.

203. *Passenger aircraft* shall mean an *aircraft* that carries any person other than a crew member, a *carrier's* employee in an official capacity, an authorized representative of an appropriate national authority, or a person accompanying a *consignment* or other cargo.

Approval

204. *Multilateral approval* shall mean *approval* by the relevant *competent authority* of the country of origin of the *design* or *shipment*, as applicable, and also, where the *consignment* is to be transported *through or into* any other country, *approval* by the *competent authority* of that country.

205. *Unilateral approval* shall mean an *approval* of a *design* that is required to be given by the *competent authority* of the country of origin of the *design* only.

Carrier

206. *Carrier* shall mean any person, organization or government undertaking the carriage of *radioactive material* by any means of transport. The term includes both *carriers* for hire or reward (known as common or contract *carriers* in some

countries) and *carriers* on own account (known as private *carriers* in some countries).

Competent authority

207. *Competent authority* shall mean any body or authority designated or otherwise recognized as such for any purpose in connection with these Regulations.

Compliance assurance

208. *Compliance assurance* shall mean a systematic programme of measures applied by a *competent authority* that is aimed at ensuring that the provisions of these Regulations are met in practice.

Confinement system

209. *Confinement system* shall mean the assembly of *fissile material* and *packaging* components specified by the designer and agreed to by the *competent authority* as intended to preserve criticality safety.

Consignee

210. *Consignee* shall mean any person, organization or government that is entitled to take delivery of a *consignment*.

Consignment

211. *Consignment* shall mean any *package* or *packages*, or load of *radioactive material*, presented by a *consignor* for transport.

Consignor

212. *Consignor* shall mean any person, organization or government that prepares a *consignment* for transport.

Containment system

213. *Containment system* shall mean the assembly of components of the *packaging* specified by the designer as intended to retain the *radioactive material* during transport.

Contamination

214. *Contamination* shall mean the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm² for beta and gamma emitters and *low toxicity alpha emitters*, or 0.04 Bq/cm² for all other alpha emitters.

215. *Non-fixed contamination* shall mean *contamination* that can be removed from a surface during routine conditions of transport.

216. *Fixed contamination* shall mean *contamination* other than *non-fixed contamination*.

Conveyance

217. *Conveyance* shall mean:

- (a) For transport by road or rail: any *vehicle*.
- (b) For transport by water: any *vessel*, or any hold, compartment, or *defined deck area* of a *vessel*.
- (c) For transport by air: any *aircraft*.

Criticality safety index

218. *Criticality safety index (CSI)* assigned to a *package*, *overpack* or *freight container* containing *fissile material* shall mean a number that is used to provide control over the accumulation of *packages*, *overpacks* or *freight containers* containing *fissile material*.

Defined deck area

219. *Defined deck area* shall mean the area of the weather deck of a *vessel*, or of a *vehicle* deck of a roll-on/roll-off ship or ferry, that is allocated for the stowage of *radioactive material*.

Design

220. *Design* shall mean the description of *fissile material* excepted under para. 417(f), *special form radioactive material*, *low dispersible radioactive material*, *package* or *packaging* that enables such an item to be fully identified. The description may include specifications, engineering drawings, reports

demonstrating compliance with regulatory requirements, and other relevant documentation.

Exclusive use

221. *Exclusive use* shall mean the sole use, by a single *consignor*, of a *conveyance* or of a *large freight container*, in respect of which all initial, intermediate and final loading and unloading and *shipment* are carried out in accordance with the directions of the *consignor* or *consignee*, where so required by these Regulations.

Fissile nuclides and fissile material

222. *Fissile nuclides* shall mean uranium-233, uranium-235, plutonium-239 and plutonium-241. *Fissile material* shall mean 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 nuclides* in the *package* or in the *consignment* if shipped unpackaged.

Freight container — small, large

223. *Freight container* shall mean an article of transport equipment that is of a permanent character and accordingly strong enough to be suitable for repeated use; specially designed to facilitate the transport of goods, by one or other modes of transport, without intermediate reloading, designed to be secured and/or readily handled, having fittings for these purposes. The term “*freight container*” does not include the *vehicle*.

A *small freight container* shall mean a *freight container* that has an internal volume of not more than 3 m³. A *large freight container* shall mean a *freight container* that has an internal volume of more than 3 m³.

Intermediate bulk container

224. *Intermediate bulk container (IBC)* shall mean a portable *packaging* that:

- (a) Has a capacity of not more than 3 m³;
- (b) Is designed for mechanical handling;
- (c) Is resistant to the stresses produced in handling and transport, as determined by tests.

Low dispersible radioactive material

225. *Low dispersible radioactive material* shall mean either a solid *radioactive material* or a solid *radioactive material* in a sealed capsule, that has limited dispersibility and is not in powder form.

Low specific activity material

226. *Low specific activity (LSA) material* shall mean *radioactive material* that by its nature has a limited *specific activity*, or *radioactive material* for which limits of estimated average *specific activity* apply. External shielding materials surrounding the *LSA material* shall not be considered in determining the estimated average *specific activity*.

Low toxicity alpha emitters

227. *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.

Management system

228. *Management system* shall mean a set of interrelated or interacting elements (system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner.

Maximum normal operating pressure

229. *Maximum normal operating pressure* shall mean 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.

Overpack

230. *Overpack* shall mean an enclosure used by a single *consignor* to contain one or more *packages* and to form one unit for convenience of handling and stowage during transport.

Package

231. *Package* shall mean the complete product of the packing operation, consisting of the *packaging* and its contents prepared for transport. The types of *package* covered by these Regulations that are subject to the activity limits and material restrictions of Section IV and meet the corresponding requirements are:

- (a) *Excepted package*;
- (b) *Industrial package Type 1 (Type IP-1)*;
- (c) *Industrial package Type 2 (Type IP-2)*;
- (d) *Industrial package Type 3 (Type IP-3)*;
- (e) *Type A package*;
- (f) *Type B(U) package*;
- (g) *Type B(M) package*;
- (h) *Type C package*.

Packages containing *fissile material* or uranium hexafluoride are subject to additional requirements.

Packaging

232. *Packaging* shall mean one or more receptacles and any other components or materials necessary for the receptacles to perform the containment and other safety functions.

Radiation level

233. *Radiation level* shall mean the corresponding dose rate expressed in millisieverts per hour or microsieverts per hour.

Radiation protection programme

234. *Radiation protection programme* shall mean systematic arrangements that are aimed at providing adequate consideration of radiation protection measures.

Radioactive contents

235. *Radioactive contents* shall mean the *radioactive material* together with any contaminated or activated solids, liquids and gases within the *packaging*.

Radioactive material

236. *Radioactive material* shall mean any material containing radionuclides where both the activity concentration and the total activity in the *consignment* exceed the values specified in paras 402–407.

Shipment

237. *Shipment* shall mean the specific movement of a *consignment* from origin to destination.

Special arrangement

238. *Special arrangement* shall mean those provisions, approved by the *competent authority*, under which *consignments* that do not satisfy all the applicable requirements of these Regulations may be transported.

Special form radioactive material

239. *Special form radioactive material* shall mean either an indispersible solid *radioactive material* or a sealed capsule containing *radioactive material*.

Specific activity

240. *Specific activity* of a radionuclide shall mean the activity per unit mass of that nuclide. The *specific activity* of a material shall mean the activity per unit mass of the material in which the radionuclides are essentially uniformly distributed.

Surface contaminated object

241. *Surface contaminated object (SCO)* shall mean a solid object that is not itself radioactive but which has *radioactive material* distributed on its surface.

Tank

242. *Tank* shall mean a portable *tank* (including a *tank* container), a road *tank vehicle*, a rail *tank* wagon or a receptacle that contains solids, liquids, or gases, having a capacity of not less than 450 L when used for the transport of gases.

Through or into

243. *Through or into* shall mean *through or into* the countries in which a *consignment* is transported but specifically excludes countries over which a *consignment* is carried by air, provided that there are no scheduled stops in those countries.

Transport index

244. *Transport index (TI)* assigned to a *package*, *overpack* or *freight container*, or to unpackaged *LSA-I* or *SCO-I*, shall mean a number that is used to provide control over radiation exposure.

Unirradiated thorium

245. *Unirradiated thorium* shall mean thorium containing not more than 10^{-7} g of uranium-233 per gram of thorium-232.

Unirradiated uranium

246. *Unirradiated uranium* shall mean *uranium* containing not more than 2×10^3 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.

Uranium — natural, depleted, enriched

247. *Natural uranium* shall mean *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).

DEFINITIONS

Depleted uranium shall mean *uranium* containing a lesser mass percentage of uranium-235 than *natural uranium*. *Enriched uranium* shall mean *uranium* containing a greater mass percentage of uranium-235 than 0.72%. In all cases, a very small mass percentage of uranium-234 is present.

Vehicle

248. *Vehicle* shall mean a road *vehicle* (including an articulated *vehicle*, i.e. a tractor and semi-trailer combination), railroad car or railway wagon. Each trailer shall be considered as a separate *vehicle*.

Vessel

249. *Vessel* shall mean any seagoing *vessel* or inland waterway craft used for carrying cargo.

This publication has been superseded by SSR-6 (Rev. 1).

Section III

GENERAL PROVISIONS

RADIATION PROTECTION

301. Doses to persons shall be below the relevant dose limits. Protection and safety shall be optimized in order that the magnitude of individual doses, the number of persons exposed and the likelihood of incurring exposure shall be kept as low as reasonably achievable, economic and social factors being taken into account, within the restriction that the doses to individuals are subject to dose constraints. A structured and systematic approach shall be adopted and shall include consideration of the interfaces between transport and other activities.

302. A *radiation protection programme* shall be established for the transport of *radioactive material*. The nature and extent of the measures to be employed in the programme shall be related to the magnitude and likelihood of radiation exposures. The programme shall incorporate the requirements of paras 301, 303–305, 311 and 562. Programme documents shall be available, on request, for inspection by the relevant *competent authority*.

303. For occupational exposures arising from transport activities, where it is assessed that the effective dose either:

- (a) Is likely to be between 1 and 6 mSv in a year, a dose assessment programme via workplace monitoring or individual monitoring shall be conducted; or
- (b) Is likely to exceed 6 mSv in a year, individual monitoring shall be conducted.

When individual monitoring or workplace monitoring is conducted, appropriate records shall be kept.

EMERGENCY RESPONSE

304. In the event of accidents or incidents during the transport of *radioactive material*, emergency provisions, as established by relevant national and/or international organizations, shall be observed to protect persons, property and the environment. Appropriate guidelines for such provisions are contained in Ref. [4].

305. Emergency procedures shall take into account the formation of other dangerous substances that may result from the reaction between the contents of a *consignment* and the environment in the event of an accident.

MANAGEMENT SYSTEM

306. A *management system* based on international, national or other standards acceptable to the *competent authority* shall be established and implemented for all activities within the scope of the Regulations, as identified in para. 106, to ensure compliance with the relevant provisions of these Regulations. Certification that the *design* specification has been fully implemented shall be available to the *competent authority*. The manufacturer, *consignor* or user shall be prepared:

- (a) To provide facilities for inspection during manufacture and use;
- (b) To demonstrate compliance with these Regulations to the *competent authority*.

Where *competent authority approval* is required, such *approval* shall take into account and be contingent upon the adequacy of the *management system*.

COMPLIANCE ASSURANCE

307. The *competent authority* shall assure compliance with these Regulations.

308. The relevant *competent authority* shall arrange for periodic assessments of the radiation doses to persons due to the transport of *radioactive material*, to ensure that the system of protection and safety complies with the Basic Safety Standards [2].

NON-COMPLIANCE

309. In the event of non-compliance with any limit in these Regulations applicable to *radiation level* or *contamination*:

- (a) The *consignor*, *consignee*, *carrier* and any organization involved during transport who may be affected, as appropriate, 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;
 - (iv) Communicate to the relevant *competent authority(ies)* on the causes of the non-compliance and on corrective or preventive actions taken or to be taken.
- (c) The communication of the non-compliance to the *consignor* and the relevant *competent authority(ies)*, respectively, shall be made as soon as practicable and it shall be immediate whenever an emergency exposure situation has developed or is developing.

SPECIAL ARRANGEMENT

310. *Consignments* for which conformity with the other provisions of these Regulations is impracticable shall not be transported except under *special arrangement*. Provided the *competent authority* is satisfied that conformity with the other provisions of these Regulations is impracticable and that the requisite standards of safety established by these Regulations have been demonstrated through means alternative to the other provisions, the *competent authority* may approve *special arrangement* transport operations for single or a planned series of multiple *consignments*. The overall level of safety in transport shall be at least equivalent to that which would be provided if all the applicable requirements had been met. For *consignments* of this type, *multilateral approval* shall be required.

TRAINING

311. Workers shall receive appropriate training concerning radiation protection, including the precautions to be observed in order to restrict their occupational exposure and the exposure of other persons who might be affected by their actions.

312. Persons engaged in the transport of *radioactive material* shall receive training in the contents of these Regulations commensurate with their responsibilities.

313. Individuals such as those who classify *radioactive material*; pack *radioactive material*; mark and label *radioactive material*; prepare transport documents for *radioactive material*; offer or accept *radioactive material* for transport; carry or handle *radioactive material* in transport; mark or placard or load or unload *packages* of *radioactive material* into or from transport *vehicles*, bulk *packagings* or *freight containers*; or are otherwise directly involved in the transport of *radioactive material* as determined by the *competent authority*; shall receive the following training:

- (a) General awareness/familiarization training:
 - (i) Each person shall receive training designed to provide familiarity with the general provisions of these Regulations.
 - (ii) Such training shall include a description of the categories of *radioactive material*; labelling, marking, placarding and *packaging* and segregation requirements; a description of the purpose and content of the *radioactive material* transport document; and a description of available emergency response documents.
- (b) Function specific training: Each person shall receive detailed training concerning specific *radioactive material* transport requirements that are applicable to the function that person performs;
- (c) Safety training: Commensurate with the risk of exposure in the event of a release and the functions performed, each person shall receive training on:
 - (i) Methods and procedures for accident avoidance, such as proper use of *package* handling equipment and appropriate methods of stowage of *radioactive material*.
 - (ii) Available emergency response information and how to use it.
 - (iii) General dangers presented by the various categories of *radioactive material* and how to prevent exposure to those hazards, including, if appropriate, the use of personal protective clothing and equipment.
 - (iv) Immediate procedures to be followed in the event of an unintentional release of *radioactive material*, including any emergency response procedures for which the person is responsible and personal protection procedures to be followed.

314. Records of all safety training undertaken shall be kept by the employer and made available to the employee if requested.

315. The training required in para. 313 shall be provided or verified upon employment in a position involving *radioactive material* transport and shall be periodically supplemented with retraining as deemed appropriate by the *competent authority*.

This publication has been superseded by SSR-6 (Rev. 1).

Section IV

ACTIVITY LIMITS AND CLASSIFICATION

GENERAL PROVISIONS

401. *Radioactive material* shall be assigned to one of the UN numbers specified in Table 1 in accordance with paras 408–434.

BASIC RADIONUCLIDE VALUES

402. The following basic values for individual radionuclides are given in Table 2:

- (a) A_1 and A_2 in TBq;
- (b) Activity concentration limits for exempt material in Bq/g;
- (c) Activity limits for exempt *consignments* in Bq.

DETERMINATION OF BASIC RADIONUCLIDE VALUES

403. For individual radionuclides:

- (a) That are not listed in Table 2, the determination of the basic radionuclide values referred to in para. 402 shall require *multilateral approval*. For these radionuclides, activity concentrations for exempt material and activity limits for exempt *consignments* shall be calculated in accordance with the principles established in the BSS [2]. It is permissible to use an A_2 value calculated using a dose coefficient for the appropriate lung absorption type, as recommended by the International Commission on Radiological Protection, if the chemical forms of each radionuclide under both normal and accident conditions of transport are taken into consideration. Alternatively, the radionuclide values in Table 3 may be used without obtaining *competent authority approval*.
- (b) In instruments or articles in which the *radioactive material* is enclosed in or is included as a component part of the instrument or other manufactured article and which meets para. 423(c), alternative basic radionuclide values to those in Table 2 for the activity limit for an exempt *consignment* are permitted and shall require *multilateral approval*. Such alternative activity limits for an exempt *consignment* shall be calculated in accordance with the principles set out in the BSS [2].

TABLE 1. EXCERPTS FROM THE LIST OF UN NUMBERS, PROPER SHIPPING NAMES AND DESCRIPTIONS

Assignment of UN numbers	PROPER SHIPPING NAME and description ^a
<i>Excepted package</i>	
UN 2908	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE — EMPTY PACKAGING
UN 2909	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE — ARTICLES MANUFACTURED FROM NATURAL URANIUM or DEPLETED URANIUM or NATURAL THORIUM
UN 2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE — LIMITED QUANTITY OF MATERIAL
UN 2911	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE — INSTRUMENTS or ARTICLES
UN 3507	URANIUM HEXAFLUORIDE, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE, less than 0.1 kg per package, non-fissile or fissile-excepted ^b
<i>Low specific activity material</i>	
UN 2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I), non-fissile or fissile-excepted ^b
UN 3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), non-fissile or fissile-excepted ^b
UN 3322	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), non-fissile or fissile-excepted ^b
UN 3324	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), FISSILE
UN 3325	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), FISSILE
<i>Surface contaminated objects</i>	
UN 2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), non-fissile or fissile-excepted ^b
UN 3326	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), FISSILE

TABLE 1. EXCERPTS FROM THE LIST OF UN NUMBERS, PROPER SHIPPING NAMES AND DESCRIPTIONS (cont.)

Assignment of UN numbers	PROPER SHIPPING NAME and description ^a
<i>Type A package</i>	
UN 2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE, non-special form, non-fissile or fissile-excepted ^b
UN 3327	RADIOACTIVE MATERIAL, TYPE A PACKAGE, FISSILE, non-special form
UN 3332	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, non-fissile or fissile-excepted ^b
UN 3333	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, FISSILE
<i>Type B(U) package</i>	
UN 2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, non-fissile or fissile-excepted ^b
UN 3328	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE
<i>Type B(M) package</i>	
UN 2917	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, non-fissile or fissile-excepted ^b
UN 3329	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, FISSILE
<i>Type C package</i>	
UN 3323	RADIOACTIVE MATERIAL, TYPE C PACKAGE, non-fissile or fissile-excepted ^b
UN 3330	RADIOACTIVE MATERIAL, TYPE C PACKAGE, FISSILE
<i>Special arrangement</i>	
UN 2919	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, non-fissile or fissile-excepted ^b
UN 3331	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, FISSILE
Uranium hexafluoride	
UN 2977	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, FISSILE

TABLE 1. EXCERPTS FROM THE LIST OF UN NUMBERS, PROPER SHIPPING NAMES AND DESCRIPTIONS (cont.)

Assignment of UN numbers	PROPER SHIPPING NAME and description ^a
UN 2978	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, non-fissile or fissile-excepted ^b

^a The “PROPER SHIPPING NAME” is found in the column “PROPER SHIPPING NAME and description” and is restricted to that part shown in CAPITAL LETTERS. In the cases of UN 2909, UN 2911, UN 2913 and UN 3326, where alternative proper shipping names are separated by the word “or”, only the relevant proper shipping name shall be used.

^b The term “fissile-excepted” refers only to material excepted under para. 417.

404. In the calculations of A_1 and A_2 for a radionuclide not listed in Table 2, a single radioactive decay chain in which the radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide, shall be considered as a single radionuclide; and the activity to be taken into account and the A_1 or A_2 value to be applied shall be that corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide, the parent and such daughter nuclides shall be considered as mixtures of different nuclides.

405. For mixtures of radionuclides, the basic radionuclide values referred to in para. 402 may be determined as follows:

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

where

$f(i)$ is the fraction of activity or activity concentration of radionuclide i in the mixture.

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

X_m is the derived value of A_1 or A_2 , or the activity concentration limit for exempt material or the activity limit for an exempt *consignment* in the case of a mixture.

Text continued on p. 46

TABLE 2. BASIC RADIONUCLIDE VALUES

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Actinium (89)				
Ac-225 (a)	8×10^{-1}	6×10^{-3}	1×10^1	1×10^4
Ac-227 (a)	9×10^{-1}	9×10^{-5}	1×10^{-1}	1×10^3
Ac-228	6×10^{-1}	5×10^{-1}	1×10^1	1×10^6
Silver (47)				
Ag-105	2×10^0	2×10^0	1×10^2	1×10^6
Ag-108m (a)	7×10^{-1}	7×10^{-1}	1×10^1 (b)	1×10^6 (b)
Ag-110m (a)	4×10^{-1}	4×10^{-1}	1×10^1	1×10^6
Ag-111	2×10^0	6×10^{-1}	1×10^3	1×10^6
Aluminium (13)				
Al-26	1×10^{-1}	1×10^{-1}	1×10^1	1×10^5
Americium (95)				
Am-241	1×10^1	1×10^{-3}	1×10^0	1×10^4
Am-242m (a)	1×10^1	1×10^{-3}	1×10^0 (b)	1×10^4 (b)
Am-243 (a)	5×10^0	1×10^{-3}	1×10^0 (b)	1×10^3 (b)
Argon (18)				
Ar-37	4×10^1	4×10^1	1×10^6	1×10^8
Ar-39	4×10^1	2×10^1	1×10^7	1×10^4
Ar-41	3×10^{-1}	3×10^{-1}	1×10^2	1×10^9
Arsenic (33)				
As-72	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
As-73	4×10^1	4×10^1	1×10^3	1×10^7
As-74	1×10^0	9×10^{-1}	1×10^1	1×10^6
As-76	3×10^{-1}	3×10^{-1}	1×10^2	1×10^5
As-77	2×10^1	7×10^{-1}	1×10^3	1×10^6
Astatine (85)				
At-211 (a)	2×10^1	5×10^{-1}	1×10^3	1×10^7

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TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Gold (79)				
Au-193	7×10^0	2×10^0	1×10^2	1×10^7
Au-194	1×10^0	1×10^0	1×10^1	1×10^6
Au-195	1×10^1	6×10^0	1×10^2	1×10^7
Au-198	1×10^0	6×10^{-1}	1×10^2	1×10^6
Au-199	1×10^1	6×10^{-1}	1×10^2	1×10^6
Barium (56)				
Ba-131 (a)	2×10^0	2×10^0	1×10^2	1×10^6
Ba-133	3×10^0	3×10^0	1×10^2	1×10^6
Ba-133m	2×10^1	6×10^{-1}	1×10^2	1×10^6
Ba-140 (a)	5×10^{-1}	3×10^{-1}	1×10^1 (b)	1×10^5 (b)
Beryllium (4)				
Be-7	2×10^1	2×10^1	1×10^3	1×10^7
Be-10	4×10^1	6×10^{-1}	1×10^4	1×10^6
Bismuth (83)				
Bi-205	7×10^{-1}	7×10^{-1}	1×10^1	1×10^6
Bi-206	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
Bi-207	7×10^{-1}	7×10^{-1}	1×10^1	1×10^6
Bi-210	1×10^0	6×10^{-1}	1×10^3	1×10^6
Bi-210m (a)	6×10^{-1}	2×10^{-2}	1×10^1	1×10^5
Bi-212 (a)	7×10^{-1}	6×10^{-1}	1×10^1 (b)	1×10^5 (b)
Berkelium (97)				
Bk-247	8×10^0	8×10^{-4}	1×10^0	1×10^4
Bk-249 (a)	4×10^1	3×10^{-1}	1×10^3	1×10^6
Bromine (35)				
Br-76	4×10^{-1}	4×10^{-1}	1×10^1	1×10^5
Br-77	3×10^0	3×10^0	1×10^2	1×10^6
Br-82	4×10^{-1}	4×10^{-1}	1×10^1	1×10^6

TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Carbon (6)				
C-11	1×10^0	6×10^{-1}	1×10^1	1×10^6
C-14	4×10^1	3×10^0	1×10^4	1×10^7
Calcium (20)				
Ca-41	Unlimited	Unlimited	1×10^5	1×10^7
Ca-45	4×10^1	1×10^0	1×10^4	1×10^7
Ca-47 (a)	3×10^0	3×10^{-1}	1×10^1	1×10^6
Cadmium (48)				
Cd-109	3×10^1	2×10^0	1×10^4	1×10^6
Cd-113m	4×10^1	5×10^{-1}	1×10^3	1×10^6
Cd-115 (a)	3×10^0	4×10^{-1}	1×10^2	1×10^6
Cd-115m	5×10^{-1}	5×10^{-1}	1×10^3	1×10^6
Cerium (58)				
Ce-139	7×10^0	2×10^0	1×10^2	1×10^6
Ce-141	2×10^1	6×10^{-1}	1×10^2	1×10^7
Ce-143	9×10^{-1}	6×10^{-1}	1×10^2	1×10^6
Ce-144 (a)	2×10^{-1}	2×10^{-1}	1×10^2 (b)	1×10^5 (b)
Californium (98)				
Cf-248	4×10^1	6×10^{-3}	1×10^1	1×10^4
Cf-249	3×10^0	8×10^{-4}	1×10^0	1×10^3
Cf-250	2×10^1	2×10^{-3}	1×10^1	1×10^4
Cf-251	7×10^0	7×10^{-4}	1×10^0	1×10^3
Cf-252	1×10^{-1}	3×10^{-3}	1×10^1	1×10^4
Cf-253 (a)	4×10^1	4×10^{-2}	1×10^2	1×10^5
Cf-254	1×10^{-3}	1×10^{-3}	1×10^0	1×10^3
Chlorine (17)				
Cl-36	1×10^1	6×10^{-1}	1×10^4	1×10^6

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TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Cl-38	2×10^{-1}	2×10^{-1}	1×10^1	1×10^5
Curium (96)				
Cm-240	4×10^1	2×10^{-2}	1×10^2	1×10^5
Cm-241	2×10^0	1×10^0	1×10^2	1×10^6
Cm-242	4×10^1	1×10^{-2}	1×10^2	1×10^5
Cm-243	9×10^0	1×10^{-3}	1×10^0	1×10^4
Cm-244	2×10^1	2×10^{-3}	1×10^1	1×10^4
Cm-245	9×10^0	9×10^{-4}	1×10^0	1×10^3
Cm-246	9×10^0	9×10^{-4}	1×10^0	1×10^3
Cm-247 (a)	3×10^0	1×10^{-3}	1×10^0	1×10^4
Cm-248	2×10^{-2}	3×10^{-4}	1×10^0	1×10^3
Cobalt (27)				
Co-55	5×10^{-1}	5×10^{-1}	1×10^1	1×10^6
Co-56	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
Co-57	1×10^1	1×10^1	1×10^2	1×10^6
Co-58	1×10^0	1×10^0	1×10^1	1×10^6
Co-58m	4×10^1	4×10^1	1×10^4	1×10^7
Co-60	4×10^{-1}	4×10^{-1}	1×10^1	1×10^5
Chromium (24)				
Cr-51	3×10^1	3×10^1	1×10^3	1×10^7
Caesium (55)				
Cs-129	4×10^0	4×10^0	1×10^2	1×10^5
Cs-131	3×10^1	3×10^1	1×10^3	1×10^6
Cs-132	1×10^0	1×10^0	1×10^1	1×10^5
Cs-134	7×10^{-1}	7×10^{-1}	1×10^1	1×10^4
Cs-134m	4×10^1	6×10^{-1}	1×10^3	1×10^5
Cs-135	4×10^1	1×10^0	1×10^4	1×10^7
Cs-136	5×10^{-1}	5×10^{-1}	1×10^1	1×10^5

TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Cs-137 (a)	2×10^0	6×10^{-1}	1×10^1 (b)	1×10^4 (b)
Copper (29)				
Cu-64	6×10^0	1×10^0	1×10^2	1×10^6
Cu-67	1×10^1	7×10^{-1}	1×10^2	1×10^6
Dysprosium (66)				
Dy-159	2×10^1	2×10^1	1×10^3	1×10^7
Dy-165	9×10^{-1}	6×10^{-1}	1×10^3	1×10^6
Dy-166 (a)	9×10^{-1}	3×10^{-1}	1×10^3	1×10^6
Erbium (68)				
Er-169	4×10^1	1×10^0	1×10^4	1×10^7
Er-171	8×10^{-1}	5×10^{-1}	1×10^2	1×10^6
Europium (63)				
Eu-147	2×10^0	2×10^0	1×10^2	1×10^6
Eu-148	5×10^{-1}	5×10^{-1}	1×10^1	1×10^6
Eu-149	2×10^1	2×10^1	1×10^2	1×10^7
Eu-150 (short lived)	2×10^0	7×10^{-1}	1×10^3	1×10^6
Eu-150 (long lived)	7×10^{-1}	7×10^{-1}	1×10^1	1×10^6
Eu-152	1×10^0	1×10^0	1×10^1	1×10^6
Eu-152m	8×10^{-1}	8×10^{-1}	1×10^2	1×10^6
Eu-154	9×10^{-1}	6×10^{-1}	1×10^1	1×10^6
Eu-155	2×10^1	3×10^0	1×10^2	1×10^7
Eu-156	7×10^{-1}	7×10^{-1}	1×10^1	1×10^6
Fluorine (9)				
F-18	1×10^0	6×10^{-1}	1×10^1	1×10^6
Iron (26)				
Fe-52 (a)	3×10^{-1}	3×10^{-1}	1×10^1	1×10^6
Fe-55	4×10^1	4×10^1	1×10^4	1×10^6

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TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Fe-59	9×10^{-1}	9×10^{-1}	1×10^1	1×10^6
Fe-60 (a)	4×10^1	2×10^{-1}	1×10^2	1×10^5
Gallium (31)				
Ga-67	7×10^0	3×10^0	1×10^2	1×10^6
Ga-68	5×10^{-1}	5×10^{-1}	1×10^1	1×10^5
Ga-72	4×10^{-1}	4×10^{-1}	1×10^1	1×10^5
Gadolinium (64)				
Gd-146 (a)	5×10^{-1}	5×10^{-1}	1×10^1	1×10^6
Gd-148	2×10^1	2×10^{-3}	1×10^1	1×10^4
Gd-153	1×10^1	9×10^0	1×10^2	1×10^7
Gd-159	3×10^0	6×10^{-1}	1×10^3	1×10^6
Germanium (32)				
Ge-68 (a)	5×10^{-1}	5×10^{-1}	1×10^1	1×10^5
Ge-71	4×10^1	4×10^1	1×10^4	1×10^8
Ge-77	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
Hafnium (72)				
Hf-172 (a)	6×10^{-1}	6×10^{-1}	1×10^1	1×10^6
Hf-175	3×10^0	3×10^0	1×10^2	1×10^6
Hf-181	2×10^0	5×10^{-1}	1×10^1	1×10^6
Hf-182	Unlimited	Unlimited	1×10^2	1×10^6
Mercury (80)				
Hg-194 (a)	1×10^0	1×10^0	1×10^1	1×10^6
Hg-195m (a)	3×10^0	7×10^{-1}	1×10^2	1×10^6
Hg-197	2×10^1	1×10^1	1×10^2	1×10^7
Hg-197m	1×10^1	4×10^{-1}	1×10^2	1×10^6
Hg-203	5×10^0	1×10^0	1×10^2	1×10^5
Holmium (67)				
Ho-166	4×10^{-1}	4×10^{-1}	1×10^3	1×10^5

TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Ho-166m	6×10^{-1}	5×10^{-1}	1×10^1	1×10^6
Iodine (53)				
I-123	6×10^0	3×10^0	1×10^2	1×10^7
I-124	1×10^0	1×10^0	1×10^1	1×10^6
I-125	2×10^1	3×10^0	1×10^3	1×10^6
I-126	2×10^0	1×10^0	1×10^2	1×10^6
I-129	Unlimited	Unlimited	1×10^2	1×10^5
I-131	3×10^0	7×10^{-1}	1×10^2	1×10^6
I-132	4×10^{-1}	4×10^{-1}	1×10^1	1×10^5
I-133	7×10^{-1}	6×10^{-1}	1×10^1	1×10^6
I-134	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
I-135 (a)	6×10^{-1}	6×10^{-1}	1×10^1	1×10^6
Indium (49)				
In-111	3×10^0	3×10^0	1×10^2	1×10^6
In-113m	4×10^0	2×10^0	1×10^2	1×10^6
In-114m (a)	1×10^1	5×10^{-1}	1×10^2	1×10^6
In-115m	7×10^0	1×10^0	1×10^2	1×10^6
Iridium (77)				
Ir-189 (a)	1×10^1	1×10^1	1×10^2	1×10^7
Ir-190	7×10^{-1}	7×10^{-1}	1×10^1	1×10^6
Ir-192	1×10^0 (c)	6×10^{-1}	1×10^1	1×10^4
Ir-194	3×10^{-1}	3×10^{-1}	1×10^2	1×10^5
Potassium (19)				
K-40	9×10^{-1}	9×10^{-1}	1×10^2	1×10^6
K-42	2×10^{-1}	2×10^{-1}	1×10^2	1×10^6
K-43	7×10^{-1}	6×10^{-1}	1×10^1	1×10^6

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TABLE 2. BASIC RADIONUCLIDE VALUES (cont.)

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt <i>consignment</i>
	(TBq)	(TBq)	(Bq/g)	(Bq)
Krypton (36)				
Kr-79	4×10^0	2×10^0	1×10^3	1×10^5
Kr-81	4×10^1	4×10^1	1×10^4	1×10^7
Kr-85	1×10^1	1×10^1	1×10^5	1×10^4
Kr-85m	8×10^0	3×10^0	1×10^3	1×10^{10}
Kr-87	2×10^{-1}	2×10^{-1}	1×10^2	1×10^9
Lanthanum (57)				
La-137	3×10^1	6×10^0	1×10^3	1×10^7
La-140	4×10^{-1}	4×10^{-1}	1×10^1	1×10^5
Lutetium (71)				
Lu-172	6×10^{-1}	6×10^{-1}	1×10^1	1×10^6
Lu-173	8×10^0	8×10^0	1×10^2	1×10^7
Lu-174	9×10^0	9×10^0	1×10^2	1×10^7
Lu-174m	2×10^1	1×10^1	1×10^2	1×10^7
Lu-177	3×10^1	7×10^{-1}	1×10^3	1×10^7
Magnesium (12)				
Mg-28 (a)	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
Manganese (25)				
Mn-52	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
Mn-53	Unlimited	Unlimited	1×10^4	1×10^9
Mn-54	1×10^0	1×10^0	1×10^1	1×10^6
Mn-56	3×10^{-1}	3×10^{-1}	1×10^1	1×10^5
Molybdenum (42)				
Mo-93	4×10^1	2×10^1	1×10^3	1×10^8
Mo-99 (a)	1×10^0	6×10^{-1}	1×10^2	1×10^6
Nitrogen (7)				
N-13	9×10^{-1}	6×10^{-1}	1×10^2	1×10^9