IAEA Safety Standards

for protecting people and the environment

Application of the Concept of Exemption

General Safety Guide

No. GSG-17

IAEA
International Atomic Energy Agency

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 on the IAEA Internet site

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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: Vienna International Centre, 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 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 **Emergency Preparedness and Response** publications, **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.

APPLICATION OF THE CONCEPT OF EXEMPTION

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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. GSG-17

APPLICATION OF THE CONCEPT OF EXEMPTION

GENERAL SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

by Rafael Mariano Grossi
Director General

The IAEA's Statute authorizes it to "establish…standards of safety for protection of health and minimization of danger to life and property". These are standards that the IAEA must apply to its own operations, and that States can apply through their national regulations.

The IAEA started its safety standards programme in 1958 and there have been many developments since. As Director General, I am committed to ensuring that the IAEA maintains and improves upon this integrated, comprehensive and consistent set of up to date, user friendly and fit for purpose safety standards of high quality. Their proper application in the use of nuclear science and technology should offer a high level of protection for people and the environment across the world and provide the confidence necessary to allow for the ongoing use of nuclear technology for the benefit of all.

Safety is a national responsibility underpinned by a number of international conventions. The IAEA safety standards form a basis for these legal instruments and serve as a global reference to help parties meet their obligations. While safety standards are not legally binding on Member States, they are widely applied. They have become an indispensable reference point and a common denominator for the vast majority of Member States that have adopted these standards for use in national regulations to enhance safety in nuclear power generation, research reactors and fuel cycle facilities as well as in nuclear applications in medicine, industry, agriculture and research.

The IAEA safety standards are based on the practical experience of its Member States and produced through international consensus. The involvement of the members of the Safety Standards Committees, the Nuclear Security Guidance Committee and the Commission on Safety Standards is particularly important, and I am grateful to all those who contribute their knowledge and expertise to this endeavour.

The IAEA also uses these safety standards when it assists Member States through its review missions and advisory services. This helps Member States in the application of the standards and enables valuable experience and insight to be shared. Feedback from these missions and services, and lessons identified from events and experience in the use and application of the safety standards, are taken into account during their periodic revision.

I believe the IAEA safety standards and their application make an invaluable contribution to ensuring a high level of safety in the use of nuclear technology. I encourage all Member States to promote and apply these standards, and to work with the IAEA to uphold their quality now and 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 measures[1] 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

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

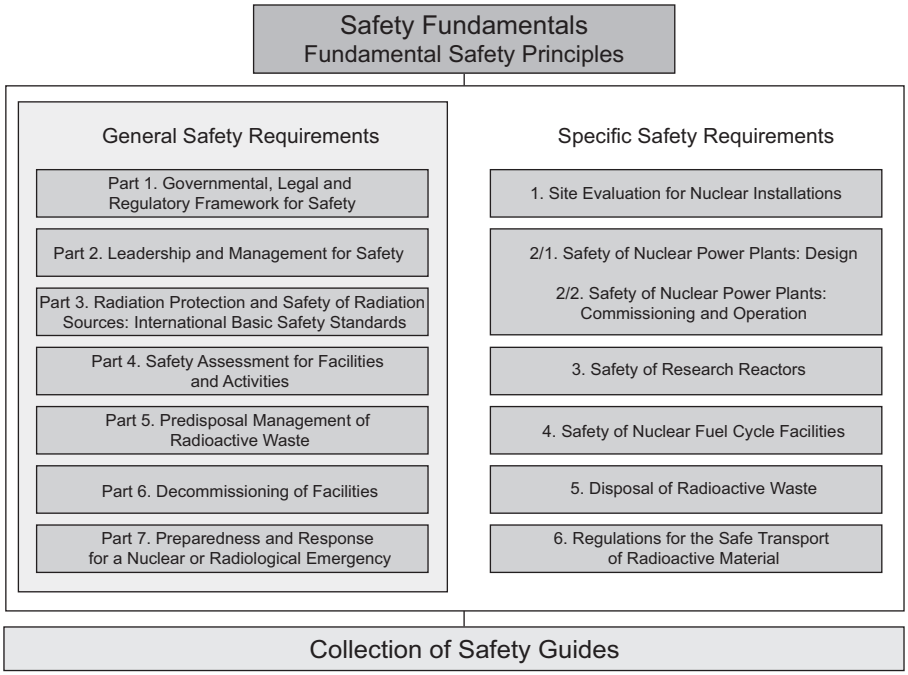

FIG. 1. The long term structure of the IAEA Safety Standards Series.

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 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 five Safety Standards Committees, for emergency preparedness and response (EPReSC) (as of 2016), 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.

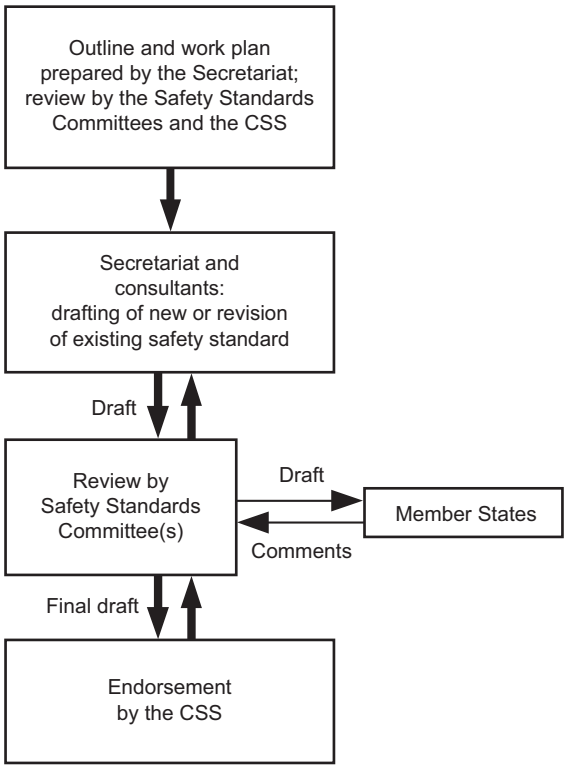

FIG. 2. The process for developing a new safety standard or revising an existing standard.

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 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 Nuclear Safety and Security Glossary (see https://www.iaea.org/resources/publications/iaea-nuclear-safety-and-security-glossary). 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.

CONTENTS

1. INTRODUCTION

BACKGROUND

1.1. IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [1], establishes requirements for the protection of people and the environment from harmful effects of ionizing radiation and for the safety of radiation sources. GSR Part 3 [1] addresses three types of exposure situation: planned exposure situations involving the deliberate introduction and operation of sources; emergency exposure situations; and existing exposure situations (exposure situations that already exist when a decision on control needs to be taken).

1.2. IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety [2], establishes requirements on the regulatory framework for all exposure situations. The scope of regulatory control in planned exposure situations is defined by the application of the concepts of exclusion, exemption and clearance. Exclusion is the deliberate excluding of a particular type of exposure from the scope of an instrument of regulatory control on the grounds that the type of exposure is not considered amenable to control through the regulatory instrument in question [3]. Exemption refers to the determination by a regulatory body that a source or practice[1] need not be subject to some or all aspects of regulatory control on the basis that the exposure and the potential exposure due to the source or practice are too small to warrant the application of those aspects or on the basis that exemption is the optimum option for protection irrespective of the actual level of the doses or risks [1, 3]. Clearance is the removal of regulatory control by the regulatory body or government from radioactive material or radioactive objects within notified or authorized practices [1, 3].

1.3. Requirement 8 of GSR Part 3 [1] makes provision for the exemption of practices and sources within practices and for the clearance of sources within notified or authorized practices, in accordance with the use of a graded approach.

[1] A practice is any human activity that introduces additional sources of exposure or additional exposure pathways, or that modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed [3].

Schedule I of GSR Part 3 [1] contains generic values for granting exemption and clearance of material containing radionuclides, as follows:

(a) The exemption of moderate amounts of material, based on activity or activity concentration of radionuclides (table I.1 of GSR Part 3 [1]);
(b) The exemption and clearance of bulk amounts of solid material containing radionuclides of artificial origin, based on activity concentration (table I.2 of GSR Part 3 [1]);
(c) The clearance of material containing radionuclides of natural origin, based on activity concentration (table I.3 of GSR Part 3 [1]).

Detailed recommendations on the application of the values in tables I.1 and I.2 of GSR Part 3 [1] for exemption purposes are provided in Sections 4 and 5 of this Safety Guide.

1.4. The exemption values for artificial radionuclides are derived from conservative exposure scenarios, as described in Ref. [4]. The exemption values for radionuclides of natural origin are mostly derived using a pragmatic approach that places greater emphasis on optimization of protection, considering the worldwide distribution of these radionuclides in material present in the environment. The scenario based dose calculations underlying the exemption levels were intentionally performed with a high degree of caution to ensure a sufficient level of protection. Hence, additional conservatism, either with respect to the practical aspects of verification of compliance with the exemption levels or to the formal embedding of these exemption levels in national regulations, needs to be avoided.

1.5. This Safety Guide, together with IAEA Safety Standards Series No. GSG-18, Application of the Concept of Clearance [5], supersedes IAEA Safety Standards Series No. RS-G-1.7, Application of the Concepts of Exclusion, Exemption and Clearance[2].

OBJECTIVE

1.6. The primary objective of this Safety Guide is to provide recommendations and guidance on the application of the concept of exemption within the framework

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Application of the Concepts of Exclusion, Exemption and Clearance, IAEA Safety Standards Series No. RS-G-1.7, IAEA, Vienna (2004).

of planned exposure situations. This includes recommendations on the application of the exemption levels in schedule I of GSR Part 3 [1] (hereinafter termed 'generic exemption'), the application of the concept of case by case exemption (hereinafter termed 'specific exemption'), and guidance on the exemption of surface contaminated items.

1.7. This Safety Guide explains the concept of exclusion. It also provides a suggested approach based on the application of screening values for decision making in existing exposure situations, including the trade of commodities.

1.8. This Safety Guide is mainly intended for governments, regulatory bodies and operating organizations, to assist them in the application of Requirement 8 of GSR Part 3 [1] in relation to the exemption of sources and practices from regulatory control. It will be of interest to persons or organizations that handle sources, materials containing radionuclides and/or radiation generators. It will also be of interest to technical service providers in radiation protection.

SCOPE

1.9. This Safety Guide addresses the exemption of practices or sources within practices from regulatory control, as established in Requirement 8 of GSR Part 3 [1] and as further described in schedule I of GSR Part 3 [1]. This Safety Guide is applicable to all facilities and activities for which the concept of exemption is relevant. It also addresses the application of a graded approach to the concept of exemption through the use of generic exemption and specific exemption.

1.10. In this Safety Guide, exemption from regulatory control solely refers to the radiological aspects of the justified practice or sources within the justified practice. Regulatory control to address non-radiation-related hazards may still be appropriate.

1.11. This Safety Guide explains the concept of exclusion and its relationship to exemption and clearance.

1.12. This Safety Guide primarily addresses exemption from regulatory control in planned exposure situations. Although the concept of exemption is only applicable to planned exposure situations, guidance on the application of a screening approach for decision making in managing certain existing exposure situations is also provided. Existing exposure situations include those involving construction

materials or residual radioactive material derived from past activities[3] and those following the transition from an emergency exposure situation. Emergency exposure situations are outside the scope of this Safety Guide, although the relationship between different exposure situations is explained.

1.13. This Safety Guide provides guidance on a possible screening approach for the international trade of non-food commodities containing radionuclides. Additional detailed technical information on radiation safety in the trade of commodities is provided in Ref. [6].

1.14. This Safety Guide does not address the application of the concept of clearance, which is addressed separately in GSG-18 [5].

1.15. Recommendations on applying the provisions for exemption in GSR Part 3 [1] to consumer products containing small amounts of radionuclides or radiation generators and to consumer products containing radionuclides as activation products are provided in IAEA Safety Standards Series No. SSG-36, Radiation Safety for Consumer Products [7].

1.16. The terms used in this Safety Guide are to be understood as defined and explained in GSR Part 3 [1] and the IAEA Nuclear Safety and Security Glossary [3].

STRUCTURE

1.17. Section 2 gives an overview of the basic definitions and concepts of exclusion, exemption and clearance, focusing on the application of the concept of exemption in planned exposure situations and the application of a screening approach to support decision making in existing exposure situations. Section 3 provides recommendations on the roles and responsibilities of the government, regulatory bodies and the applicant and on other organizational and administrative arrangements in relation to exemption.

1.18. Section 4 and Section 5 provide recommendations and guidance on the concepts of generic exemption and specific exemption, respectively. Section 6 provides recommendations and guidance on other exemption issues, such as monitoring and verification of compliance with exemption levels and revoking

[3] Any material contaminated by or containing radionuclides from past activities that were never subject to regulatory control or that were subject to regulatory control but not in accordance with the requirements of GSR Part 3 [1].

or revising exemptions, and Section 7 considers the use of screening values in existing exposure situations and provides recommendations on a generic approach to the trade of non-food commodities containing radionuclides.

1.19. Appendix I reproduces table I.1 and the exemption levels from table I.2 of GSR Part 3 [1], for convenience. Appendix II provides more detailed recommendations on monitoring and verification of compliance with exemption criteria. Annex I provides examples of determining exemption for materials containing more than one radionuclide. Annex II provides examples of dosimetric models for surface contaminated items, and Annex III provides two examples of the practical use of screening values for decision making as applied in existing exposure situations: the management of residual waste material in Japan after the accident at the Fukushima Daiichi nuclear power plant; and a screening approach for construction materials.

2. THE CONCEPTS OF EXCLUSION, EXEMPTION AND CLEARANCE

2.1. GSR Part 3 [1] establishes requirements for the protection of people and the environment from harmful effects of ionizing radiation and for the safety of radiation sources. GSR Part 3 [1] addresses all exposure situations and presents the concepts of exclusion, exemption and clearance. These concepts and their interrelationships, with special emphasis on the exemption of practices or sources within practices, are described in this section.

EXPOSURE SITUATIONS

2.2. GSR Part 3 [1] applies to all situations involving radiation exposure that is amenable to control, for three different types of exposure situation: planned exposure situations, emergency exposure situations and existing exposure situations. Paragraph 1.20 of GSR Part 3 [1] states:

> "Together, these three types of exposure situation cover all situations of exposure for which [GSR Part 3 applies]:
>
> (a) *A planned exposure situation* is a situation of exposure that arises from the planned operation of a source or from a planned activity that

results in an exposure due to a source. Since provision for protection and safety can be made before embarking on the activity concerned, the associated exposures and their likelihood of occurrence can be restricted from the outset. The primary means of controlling exposure in planned exposure situations is by good design of facilities, equipment and operating procedures, and by training. In planned exposure situations, exposure at some level can be expected to occur.…

(b) An *emergency exposure situation* is a situation of exposure that arises as a result of an accident, a malicious act or any other unexpected event, and requires prompt action in order to avoid or to reduce adverse consequences. Preventive measures and mitigatory actions have to be considered before an emergency exposure situation arises. However, once an emergency exposure situation actually arises, exposures can be reduced only by implementing protective actions.

(c) An *existing exposure situation* is a situation of exposure that already exists when a decision on the need for control needs to be taken. Existing exposure situations include situations of exposure to natural background radiation. They also include situations of exposure due to residual radioactive material that derives from past practices that were not subject to regulatory control or that remains after an emergency exposure situation."

2.3. GSR Part 3 [1] applies to radionuclides of natural origin and artificial radionuclides. Artificial radionuclides are deliberately produced by and/or used in practices, and therefore the requirements for planned exposure situations in section 3 of GSR Part 3 [1] apply. Such practices (or sources within these practices) then enter into the scope of the regulatory system using a graded approach. Within the legal and regulatory framework for planned exposure situations, the concepts of exemption and clearance are used to further define the scope of regulatory control.

2.4. For most materials containing radionuclides of natural origin, the requirements for existing exposure situations apply. The exception is exposure to materials containing radionuclides of natural origin exceeding 1 Bq/g for any radionuclide in the uranium or thorium decay chain and 10 Bq/g for ^{40}K, for which the requirements for planned exposure situations apply (see para. 3.4(a) of GSR Part 3 [1]).

2.5. In the case of exposure due to radionuclides in commodities (including food, feed, drinking water, agricultural fertilizer and soil amendments, and construction materials) or residual radioactive material in the environment, the requirements

for existing exposure situations apply regardless of whether the radionuclides are of artificial or natural origin (see para. 5.1(b) and (c)(ii) of GSR Part 3 [1]).

2.6. Materials containing radionuclides of natural origin with individual radionuclide activity concentrations below 1 Bq/g for nuclides from the uranium and thorium series and 10 Bq/g for ^{40}K often do not warrant regulatory control, unless in specific cases the regulatory body considers it appropriate. These activity concentration values were derived on the basis of the concept of exclusion (i.e. that any associated exposures were not amenable to control; see paras 2.7 and 2.8) and were selected by considering the upper end of the worldwide distribution of unmodified activity concentrations in soil.

THE CONCEPT OF EXCLUSION

2.7. Paragraph 1.42 of GSR Part 3 [1] states that the requirements of GSR Part 3 "apply to all situations involving radiation exposure that is amenable to control. Exposures deemed not to be amenable to control are excluded from the scope of [GSR Part 3]." For example, it is not feasible to control ^{40}K in the human body or cosmic radiation at the surface of the Earth (see footnote 8 to GSR Part 3 [1]). Other examples of excluded exposures are (a) unmodified concentrations of radionuclides of natural origin in soil, including those in high natural background radiation areas; (b) other primordial radionuclides (e.g. ^{87}Rb, ^{138}La, ^{147}Sm, ^{176}Lu) present in unmodified activity concentrations; and (c) fallout resulting from past atmospheric nuclear weapon tests.

2.8. Excluded exposures are exposures for which control measures are not required, regardless of the magnitude of such exposures. Therefore, sources leading to such exposures are excluded from regulatory control and are outside the scope of the requirements of GSR Part 3 [1].

THE CONCEPT OF EXEMPTION

2.9. GSR Part 3 [1] specifies the concept of exemption only in the context of practices, and sources within practices, in planned exposure situations. Requirement 8 of GSR Part 3 [1] states:

> "**The government or the regulatory body shall determine which practices or sources within practices are to be exempted from some or all of the requirements of [GSR Part 3]. The regulatory body shall approve which**

sources, including materials and objects, within notified practices or authorized practices may be cleared from regulatory control."

2.10. Exemption determines a priori which justified practices and sources within justified practices may be freed from the obligation to comply with some or all of the regulatory requirements for practices — in particular, the requirements relating to notification, registration and licensing — on the basis of meeting certain exemption criteria.

2.11. Paragraph I.1 in schedule I of GSR Part 3 [1] states:

> "The general criteria for exemption of a practice or a source within a practice from some or all of the requirements of [GSR Part 3] are that:
>
> (a) Radiation risks arising from the practice or from a source within the practice are sufficiently low as not to warrant regulatory control, with no appreciable likelihood of situations arising that could lead to a failure to meet the general criterion for exemption; or
> (b) Regulatory control of the practice or the source would yield no net benefit, in that no reasonable measures for regulatory control would achieve a worthwhile return in terms of reduction of individual doses or of health risks."

Criterion (a) refers to both normal exposures (i.e. exposures under normal operating conditions) and potential exposures (i.e. exposures potentially resulting from an anticipated operational occurrence or accident). In criterion (b), regulatory control might not be justified since it would not lead to any further optimization of protection, irrespective of the actual level of exposure.

2.12. With regard to the application of the concept of exemption for material containing radionuclides of natural origin, footnote 60 to GSR Part 3 [1] states:

> "Material containing radionuclides of natural origin at an activity concentration of less than 1 Bq/g for any radionuclide in the uranium decay chain or the thorium decay chain and of less than 10 Bq/g for ^{40}K is not subject to the requirements in Section 3 [of GSR Part 3] for planned exposure situations (para. 3.4(a) [of GSR Part 3]); hence, the concept of exemption from the requirements of [GSR Part 3] does not apply for such material."

2.13. Paragraph I.8 of GSR Part 3 [1] states that "Radioactive material arising from authorized discharges is exempt from any requirements for notification, registration or licensing unless otherwise specified by the regulatory body."

THE CONCEPT OF CLEARANCE

2.14. While exemption is used as part of a process to determine the nature and extent of regulatory control, clearance is intended to establish which material under regulatory control can be removed from this control. Therefore, a decision on granting clearance usually takes place during or after the planned activities with a source within a practice, while exemption refers instead to an a priori decision. Clearance is therefore different from exemption, even though the general criteria on which the concepts are based are very similar (see paras I.1 and I.10 of GSR Part 3 [1]).

2.15. Clearance may be granted by the regulatory body for the removal of regulatory control from radioactive material or radioactive objects within notified or authorized practices [3]. This can include surface contaminated objects (see para. I.13 of GSR Part 3 [1]). Any material or object within a notified or authorized practice that is radioactive (or becomes radioactive or surface contaminated during the conduct of activities within that practice) is implicitly expected to be considered as part of the notification and authorization processes. The removal of regulatory control from these materials or objects (either during the conduct of the practice or after its cessation) is an issue of clearance, not exemption. Examples include materials (including building materials) and objects that have become radioactive through activation in accelerator facilities or in nuclear power plants, or objects surface contaminated by unsealed sources. Recommendations on the clearance of materials and objects from a practice are provided separately in GSG-18 [5] and are not considered further in this Safety Guide.

THE ROLE OF EXEMPTION IN PLANNED EXPOSURE SITUATIONS

Application of the justification principle

2.16. Consideration should be given, in the context of granting exemptions, to the requirement of GSR Part 3 [1] for practices and sources to be justified. Paragraph 1.13 of GSR Part 3 [1] states:

> "The operation of facilities or the conduct of activities that introduce a new source of radiation, that change exposures or that change the likelihood of exposures has to be justified in the sense that the detriments that may be caused are outweighed by the individual and societal benefits that are expected. The comparison of detriments and benefits often goes beyond the consideration of protection and safety, and involves the consideration of economic, societal and environmental factors also."

2.17. Paragraph 3.11 of GSR Part 3 [1] explicitly states that "Exemption shall not be granted for practices deemed to be not justified." Consequently, exemption never overrides the justification principle.

2.18. Practices deemed not to be justified include those involving the deliberate addition of radioactive substances to food or beverages and those involving the unnecessary addition of radioactive substances to toys and personal jewellery or adornments (see para. 3.17 of GSR Part 3 [1]). Specific recommendations on the justification of consumer products (i.e. devices or manufactured items into which radionuclides have deliberately been incorporated) are provided in IAEA Safety Standards Series No. GSG-5, Justification of Practices, Including Non-Medical Human Imaging [8].

Graded approach

2.19. Paragraph 2.12 of GSR Part 3 [1] provides the basis for a graded approach and states that "The application of the requirements for the system of protection and safety shall be commensurate with the radiation risks associated with the exposure situation."

2.20. Requirement 6 of GSR Part 3 [1] states:

> "**The application of the requirements of [GSR Part 3] in planned exposure situations shall be commensurate with the characteristics of**

the practice or the source within a practice, and with the likelihood and magnitude of exposures."

2.21. Paragraph 4.5 of GSR Part 1 (Rev. 1) [2] states:

> "The regulatory body shall allocate resources commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach. Thus, for the lowest associated radiation risks, it may be appropriate for the regulatory body to exempt a particular activity from some or all aspects of regulatory control".

2.22. Paragraph 3.6 of GSR Part 3 [1] states that "The application of the requirements of [GSR Part 3] shall be in accordance with the graded approach and shall also conform to any requirements specified by the regulatory body." Exemption delineates the boundaries of the scope of regulatory control of planned exposure situations; therefore, it may be considered as the first step by which a graded approach is applied. If not exempted, the practice or source within the practice is within the scope of regulatory control, which is then also required to be applied in accordance with a graded approach commensurate with the radiation risks involved (see paras 2.18 and 2.31 of GSR Part 3 [1]).

2.23. In accordance with paras 2.18 and 2.31 of GSR Part 3 [1], the application of a graded approach is also required for existing exposure situations, for which the protection strategy is guided by reference levels. In such situations, a graded approach could include a decision to not apply any controls based on screening using either a dose criterion or a derived operational quantity to demonstrate that not applying controls is the optimum approach. In such a graded approach, where the screening values are exceeded, additional measures for protection and safety should be considered; below the screening levels, no further actions are necessary. In this way, the screening method is a decision aiding tool in existing exposure situations, similar to the use of exemption levels in planned exposure situations. A graded approach enables effective use of the resources of the regulatory body in that greater attention and resources can be focused on those practices and sources that give rise to more significant radiation risks.

Generic exemption and specific exemption

2.24. For practices involving sources, exemption can be applied either without further consideration (generic exemption; see Section 4) or through the imposition of specific conditions by the regulatory body (specific exemption; see Section 5). These conditions can refer to a specific type of practice, to specific requirements

under which activities involving sources can take place without regulatory control, or to a combination of both. Paragraph I.6 of GSR Part 3 [1] states that "Exemptions may be granted subject to conditions specified by the regulatory body, such as conditions relating to the physical or chemical form of the radioactive material, and to its use or the means of its disposal." This is referred to as 'specific exemption' in this Safety Guide.

2.25. Specific exemption is described in para. I.6 of GSR Part 3 [1], for instance for types of approved equipment containing radioactive material that are not otherwise automatically exempted without further consideration. There are other cases of specific exemption, which are described in detail in Section 5, such as the following;

(a) Consumer products (see para. 2.32 of SSG-36 [7]);
(b) Bulk amounts of solid material with radionuclides of natural origin (see para. I.4 of GSR Part 3 [1]);
(c) Surface contaminated items.

Other equipment containing radioactive material may also be considered for specific exemption; otherwise, in accordance with GSR Part 3 [1], this other equipment is required to be notified to the regulatory body and, where appropriate, authorized by the regulatory body.

Regulatory approach for non-exempted practices

2.26. If a practice or source within a practice does not meet the criteria for exemption (either generic exemption or specific exemption), it is required to be subject to regulatory control as described in section 3 of GSR Part 3 [1]. As part of a graded approach (see Requirement 6 of GSR Part 3 [1]), the person or organization responsible for the practice or source is required to submit a formal notification to the regulatory body (see Requirement 7 of GSR Part 3 [1]). Notification is sufficient for sources or practices for which exposures are unlikely to exceed a small fraction of the dose limits, and where the likelihood and magnitude of potential exposures and any other potential detrimental consequences are negligible (see para. 3.7 of GSR Part 3 [1]). Recommendations on the process of notification are provided in IAEA Safety Standards Series No. GSG-13, Functions and Processes of the Regulatory Body for Safety [9].

2.27. In cases where notification alone is not deemed sufficient, the person or organization responsible for the intended practice (i.e. the operating organization) is required to apply to the regulatory body for authorization (see para. 3.8 of

GSR Part 3 [1]). In accordance with the graded approach, the authorization may take the form of either a registration or a licence.

2.28. Registration is a form of authorization for facilities and activities of low or moderate risk whereby the person or organization responsible for the practice has, as appropriate, prepared and submitted a safety assessment of the facilities and equipment to the regulatory body. The practice or use is authorized with conditions or limitations as appropriate [3].

2.29. Practices for which registration is not considered sufficient should be authorized by means of licensing [3]. This requires a detailed safety assessment (see paras 5.4 and 5.9 of this Safety Guide) to be performed by the applicant and submitted to the regulatory body [1].

2.30. Figure 1 illustrates the concepts of exclusion and of exemption in planned exposure situations and the application of a screening method for decision making in existing exposure situations.

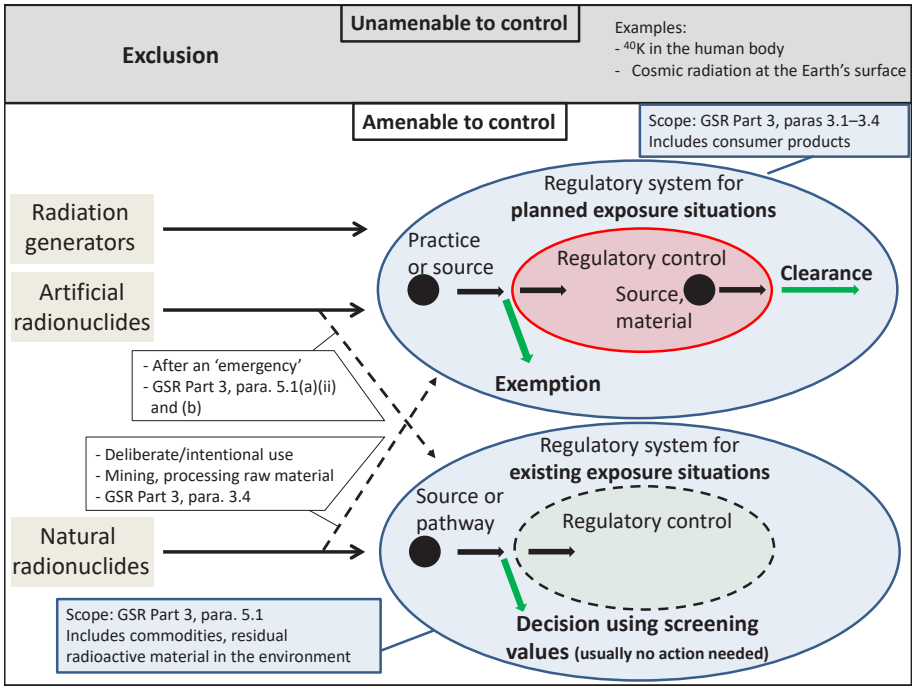

FIG. 1. The concepts of exclusion, exemption and clearance. Prior justification should be performed for sources or practices amenable to control.

3. ROLES AND RESPONSIBILITIES IN RELATION TO THE EXEMPTION OF PRACTICES AND SOURCES

GOVERNMENT AND REGULATORY BODY

3.1. The responsibilities of the government[4] with regard to protection and safety are set out in Requirement 2 of GSR Part 3 [1]. These responsibilities include establishing an effective legal and regulatory framework for protection and safety and establishing an independent regulatory body with the necessary legal authority, competence and resources.

3.2. The responsibilities of the regulatory body with regard to protection and safety are set out in Requirement 3 of GSR Part 3 [1].

3.3. With regard to the application of the concept of exemption, para. 3.10 of GSR Part 3 [1] states:

> "The government or the regulatory body shall determine which practices or sources within practices are to be exempted from some or all of the requirements of [GSR Part 3], including the requirements for notification, registration or licensing, using as the basis for this determination the criteria for exemption specified in Schedule I [of GSR Part 3] or any exemption levels specified by the regulatory body on the basis of these criteria."

3.4. The regulatory body should establish a framework for exemption using the criteria defined in schedule I of GSR Part 3 [1] as a basis. Within this framework, the regulatory body should provide the criteria for generic exemption and additional information relevant to specific exemptions. For specific exemption, interaction between the person responsible for the source or practice and the regulatory body may be necessary for the decision making process. There may be cases where specific exemptions are granted to certain types of product (see paras 5.3 and 5.13 of this Safety Guide), for which the regulatory body might also liaise with the manufacturer. Such interactions could range from simple information to a complete safety assessment, depending on the characteristics of the practice and the requirements of the regulatory body.

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[4] Since countries have different legal structures, the use of the term 'government' here is to be understood in a broad sense and is accordingly interchangeable with the term 'State'.

3.5. In some cases, the regulatory body may identify certain activities that need to be reviewed in order to make the decision regarding their exemption.

3.6. The regulatory body should ensure that the exemption framework is consistent with the overall regulatory framework for safety and, where appropriate, other regulatory frameworks. With regard to IAEA Safety Standards Series No. SSR-6 (Rev. 1), Regulations for the Safe Transport of Radioactive Material, 2018 Edition [10], para. I.5 of GSR Part 3 [1] states (references and footnote omitted):

> "The IAEA Regulations for the Safe Transport of Radioactive Material…do not apply to exempt material or exempt consignments…for which the activity concentration…does not exceed the relevant 'basic radionuclide value' given in the IAEA Transport Regulations.... Usually, such basic radionuclide values are numerically equal to the corresponding exempt activity concentrations or exempt activities given in Table I.1 [of GSR Part 3]".

APPLICANT

3.7. Requirement 4 of GSR Part 3 [1] states that "**The person or organization responsible for facilities and activities that give rise to radiation risks shall have the prime responsibility for protection and safety.**"

3.8. The person or organization responsible for facilities or activities that involve sources should verify if the practice or sources within the practice comply with the exemption criteria specified in accordance with Requirement 8 of GSR Part 3 [1]. This compliance might be verified directly by the applicant, or the regulatory body could be requested to confirm whether the intended practice or source is exempted. For example, following notification, the regulatory body could check whether the practice or source is subject to generic exemption and consider whether specific exemption (based on a safety assessment) is possible.

3.9. The applicant has the following responsibilities in relation to exemption:

(a) To comply with any conditions attached to the exemption and to periodically verify this compliance;
(b) To conduct an adequate safety assessment commensurate with the potential radiation risk from an intended practice, where such an assessment is requested by the regulatory body before issuing a specific exemption;

(c) To ensure that no modifications or changes are made to the practice or sources that would invalidate the exemption or any of the conditions of the exemption;
(d) To inform the regulatory body if any changes to the practice invalidate the exemption and the practice is therefore subject to notification, registration and licensing requirements, as appropriate.

4. GENERIC EXEMPTION OF PRACTICES OR SOURCES

4.1. The general criteria for exemption of a practice or a source within a practice from some or all of the requirements of GSR Part 3 [1] are set out in para. I.1 of GSR Part 3 [1]. These general criteria are subjective in nature and involve value judgements by the government or the regulatory body in establishing a regulatory framework for both generic exemption and specific exemption. The establishment and use of dose criteria for reaching a decision on exemption of a practice (see para. 4.2) assist in achieving a consistent and harmonized approach to the protection of workers and the public from radiation risks.

4.2. For artificial radionuclides, para. I.2 of GSR Part 3 [1] states:

> "A practice or a source within a practice may be exempted without further consideration from some or all of the requirements of [GSR Part 3] under the terms of para. I.1(a) [of GSR Part 3] provided that under all reasonably foreseeable circumstances the effective dose expected to be incurred by any individual (normally evaluated on the basis of a safety assessment) owing to the exempt practice or the exempt source within the practice is of the order of 10 μSv or less in a year. To take into account low probability scenarios, a different criterion could be used, namely that the effective dose expected to be incurred by any individual for such low probability scenarios does not exceed 1 mSv in a year."

The phrase "of the order of 10 μSv or less in a year" is intended to be considered a trivial dose. In this context, Ref. [11] uses the phrase "some tens of microsieverts per year"[5]. A lower boundary value of 10 μSv in a year was used for the derivation

[5] This is intended to cover the range 10–100 μSv in a year (see para. 67 of Ref. [11]).

of generic exemption levels, since an individual could be exposed to more than one exempted source.

4.3. Paragraph I.2 of GSR Part 3 [1] states that the effective annual dose expected to be incurred by any individual is to be "normally evaluated on the basis of a safety assessment". Although a detailed safety assessment would demonstrate compliance with the dose criteria, it is not always necessary to undertake such an assessment for sources for which exposures are expected to be very low. A list of sources that are automatically exempted without further consideration (i.e. generic exemption) is provided in para. I.3 of GSR Part 3 [1].

4.4. For automatic exemption without further consideration (i.e. generic exemption), values of total activity (Bq) and activity concentration (Bq/g) for a wide range of radionuclides have been derived (see para. I.3 and tables I.1 and I.2 of GSR Part 3 [1]). These generic exemption levels have been derived using models based on a set of limiting (bounding) exposure scenarios and conservative calculations (see footnote 59 to GSR Part 3 [1] and Refs [4, 12] of this Safety Guide), taking into account the most relevant exposure pathways (i.e. external irradiation, dust inhalation, ingestion and skin contamination).

4.5. In the generic exemption levels, a distinction is made between moderate amounts of material and bulk amounts of material. The term 'moderate amounts' refers to "practices involving small scale usage of activity where the quantities involved are at the most of the order of a tonne" (see footnote 58 to GSR Part 3 [1]). The term 'bulk amounts' can be taken as quantities of material that are greater than moderate amounts. The phrase "of the order of" should be interpreted in a pragmatic way to allow flexibility for classification of the amount of material as either moderate or bulk when considering the generic exemption levels. Recommendations on the practical application of the generic exemption levels for moderate amounts and bulk amounts of material are provided in paras 4.12–4.22.

4.6. The use of generic exemption levels for making decisions on granting exemption has practical benefits in that the levels are easy to apply. The use of generic exemption levels also leads to more consistency in decision making and promotes a harmonized approach to exemption between States.

4.7. For surface contaminated items, no generic exemption levels are specified in schedule I of GSR Part 3 [1]. Such items should be addressed as cases of specific exemption as described in paras 5.18–5.21 of this Safety Guide.

TABLE 1. APPLICABILITY OF THE GENERIC EXEMPTION LEVELS IN GSR PART 3 [1] TO MODERATE AMOUNTS AND BULK AMOUNTS OF MATERIAL

Type of radionuclide	Moderate amounts (solids, liquids, gases)	Bulk amounts (solids[a])
Artificial radionuclides	Table I.1 of GSR Part 3 [1]	Table I.2 of GSR Part 3 [1]
Radionuclides of natural origin	Table I.1 of GSR Part 3 [1]	Not applicable[b]

[a] No generic exemption levels are specified in GSR Part 3 [1] for bulk amounts of liquids or gases. Consequently, exemption should be considered on a case by case basis (specific exemption).

[b] Exemption is required to be considered on a case by case basis (specific exemption) using a dose criterion of the order of 1 mSv in a year (see para. I.4 of GSR Part 3 [1]).

4.8. No generic exemption levels are specified in schedule I of GSR Part 3 [1] for bulk amounts of material containing radionuclides of natural origin (see paras. 5.15–5.17).

4.9. Bulk amounts of materials should not be interpreted as several moderate amounts for exemption purposes.

4.10. Table 1 summarizes the applicability of the generic exemption levels for moderate or bulk amounts of material with artificial radionuclides or radionuclides of natural origin. For all other cases (e.g. liquids and gases in bulk amounts, surface contaminated items), specific exemption should be considered (see Section 5).

4.11. If a practice involves materials containing radionuclides for which exemption levels are not listed in tables I.1 or I.2 of GSR Part 3 [1], the applicant and/or the regulatory body may refer to publications (e.g. Ref. [12]) that provide values for additional radionuclides following the methodologies provided in Refs [4, 13].

GENERIC EXEMPTION LEVELS FOR MODERATE AMOUNTS OF MATERIAL

4.12. The generic exemption levels for moderate amounts of material, in terms of total activity and activity concentration, are presented in table I.1 of GSR Part 3 [1]

and are reproduced in Appendix I to this Safety Guide. The values were derived using conservative models based on the dose criteria in para. I.2 of GSR Part 3 [1] and rounded to powers of ten (see footnote 9 to Ref. [4]). The values apply to solids, liquids and gases [13].

4.13. As stated in para. I.3(a) of GSR Part 3 [1], generic exemption may be applied to the following (footnote omitted):

> "Material in a moderate amount for which either the total activity of an individual radionuclide present on the premises at any one time or the activity concentration as used in the practice does not exceed the applicable exemption level given in Table I.1 [of GSR Part 3]".

With regard to the total activity on the premises, if there are several locations in a single authorized facility, the total activity within the whole facility should be considered (i.e. each location should not be considered separately). Where a single owner has multiple facilities operating at separate sites, each of these facilities should be considered individually (i.e. as separate premises).

4.14. For material containing a mixture of radionuclides, the exemption levels in table I.1 of GSR Part 3 [1] are to be used, following the summation method described in para. I.7 of GSR Part 3 [1] (see also paras 4.23–4.28 of this Safety Guide).

4.15. In cases where the exemption levels in tables I.1 and I.2 of GSR Part 3 [1] cannot be met or cannot be applied, the practice or source could still be eligible for specific exemption, as described in Section 5 of this Safety Guide.

GENERIC EXEMPTION LEVELS FOR BULK AMOUNTS OF SOLID MATERIAL

4.16. As stated in para. I.3(b) of GSR Part 3 [1] (footnote omitted), generic exemption may be applied to "Material in bulk amount for which the activity concentration of a given radionuclide of artificial origin used in the practice does not exceed the relevant value given in Table I.2 [of GSR Part 3]".

4.17. The generic exemption criteria for bulk amounts of solid material and the exemption levels specified in table I.2 of GSR Part 3 [1] are only applicable to artificial radionuclides. In accordance with para. I.4 of GSR Part 3 [1], exemption of bulk quantities of material containing radionuclides of natural origin is to

be considered on a case by case basis (i.e. specific exemption), as described in paras 5.14–5.17 of this Safety Guide.

4.18. For bulk amounts of materials containing artificial radionuclides, the dose criteria stated in para. I.2 of GSR Part 3 [1] apply (i.e. the same as for moderate amounts).

4.19. For an intended practice involving bulk amounts of material containing artificial radionuclides, exemption without further consideration (generic exemption) may be granted if the activity concentration is less than or equal to the values specified in table I.2 of GSR Part 3 [1]. Since the intended practice involves bulk amounts of material (for which no upper limit on the amount is implied), there are no generic exemption levels in terms of total activity.

4.20. For materials containing a mixture of radionuclides, the exemption levels in table I.2 of GSR Part 3 [1] are to be used in accordance with the summation method described in para. I.7 of GSR Part 3 [1] (see also paras 4.23–4.28 of this Safety Guide).

4.21. The exemption levels for bulk amounts of solid material in table I.2 of GSR Part 3 [1] also apply to the clearance of materials without further consideration (see paras 2.14 and 2.15 of this Safety Guide). As such, materials that have been unconditionally cleared may also be exempted to prevent them from re-entering the system of regulatory control.

4.22. For bulk amounts of liquids and gases, specific exemption should be considered (see Section 5).

GENERIC EXEMPTION LEVELS FOR MIXTURES OF RADIONUCLIDES

4.23. Paragraph I.7 of GSR Part 3 [1] states (equation number omitted):

> "For exemption of radioactive material containing more than one radionuclide, on the basis of the levels given in Tables I.1…and I.2…[of GSR Part 3], the condition for exemption from some or all of the requirements of [GSR Part 3] is that the sum of the individual radionuclide activities or

activity concentrations, as appropriate, is less than the derived exemption level for the mixture (X_m), determined as follows:

$$X_m = \frac{1}{\sum_{i=1}^{n} \frac{f(i)}{X(i)}}$$

where

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

X(i) is the applicable exemption level for radionuclide *i* as given in Table I.1…or Table I.2 [of GSR Part 3];

and *n* is the number of radionuclides present."

4.24. As an alternative to the equation in para. I.7 of GSR Part 3 [1], the following formula can be used (weighted summation rule):

$$\sum_{i=1}^{n} \frac{C_i}{EL_i} \leq 1 \quad (1)$$

where

C_i is the activity concentration (Bq/g) or total activity (Bq) of the *i*th radionuclide in the material;

EL_i is the corresponding exemption level of the activity concentration or total activity in the material;

and *n* is the number of radionuclides present.

4.25. In the case of bulk amounts of solid material containing a mixture of natural and artificial radionuclides, the summation rule cannot be applied, and therefore a specific exemption should be considered. The dose criteria to be independently complied with are those given in para. I.2 of GSR Part 3 [1] for artificial radionuclides and in para. I.4 of GSR Part 3 [1] for radionuclides of natural origin.

4.26. In applying the equations in para. 4.23 or 4.24, it is important to take note of the footnotes to tables I.1 and I.2 of GSR Part 3 [1] regarding parent radionuclides and their progeny whose dose contributions are taken into account in the dose

calculations (thus requiring only the exemption level of the parent radionuclide to be considered).

4.27. Any radionuclide in a mixture of radionuclides whose contribution to the weighted summation is negligible can be ignored [14]. For example, radionuclides that together contribute less than 0.1 to the weighted summation can be ignored.

4.28. Examples of determining exemption for materials containing mixtures of radionuclides are provided in Annex I.

LIMITATIONS OF APPLICABILITY OF GENERIC EXEMPTION LEVELS

4.29. The values in tables I.1 and I.2 of GSR Part 3 [1] cannot be applied to all existing exposure situations because the concept of generic exemption is only related to planned exposure situations. However, the values of tables I.1 and I.2 of GSR Part 3 [1] can be used as screening values in certain cases, as described in Section 7.

4.30. For exemption of material in transport in accordance with SSR-6 (Rev. 1) [10], the generic exemption values in table I.1 of GSR Part 3 [1] are the same as those used in SSR-6 (Rev. 1) [10], and the values in table I.2 of GSR Part 3 [1] are all lower than or equal to those used in SSR-6 (Rev. 1) [10].

4.31. The values provided in tables I.1 and I.2 of GSR Part 3 [1] are not intended to be applied to the control of radioactive discharges or to the control of residual radioactive material in the environment (see para. I.9 of GSR Part 3 [1]).

DILUTION

4.32. Deliberate dilution of material, as opposed to the dilution that takes place in normal operations (i.e. when radioactivity is not a consideration), to meet the generic exemption levels given in tables I.1 and I.2 of GSR Part 3 [1] should not be permitted without the prior approval of the regulatory body.

GENERIC EXEMPTION OF PRACTICES USING RADIATION GENERATORS

4.33. As stated in para. I.3(c) of GSR Part 3 [1], the following equipment within a practice is automatically exempted without further consideration from the requirements of GSR Part 3 [1]:

> "Radiation generators of a type approved by the regulatory body, or in the form of an electronic tube, such as a cathode ray tube for the display of visual images, provided that:
>
> (i) They do not in normal operating conditions cause an ambient dose equivalent rate or a directional dose equivalent rate, as appropriate, exceeding 1 μSv/h at a distance of 0.1 m from any accessible surface of the equipment; or
> (ii) The maximum energy of the radiation generated is no greater than 5 keV."

4.34. Examples of such radiation generators include electron microscopes, electron beam welders, cathode ray tubes, high voltage electronic rectifiers and voltage regulators, vacuum switches, vacuum capacitors, magnetrons, transmitting tubes, and television and image tubes. Additional information can be found in Ref. [11].

4.35. Radiation generators that do not fulfil the conditions in para. I.3(c) of GSR Part 3 [1] might be granted a specific exemption, as described in Section 5.

5. SPECIFIC EXEMPTION OF PRACTICES OR SOURCES

5.1. In accordance with para. I.6 of GSR Part 3 [1], exemptions may be granted subject to conditions specified by the regulatory body (i.e. specific exemption; see para. 2.24 of this Safety Guide). Consequently, if a practice or source within a practice does not meet the criteria for generic exemption, or these criteria cannot be applied, a specific exemption might be considered.

5.2. To qualify for specific exemption, the applicant should demonstrate that the intended practice is justified and meets the general criteria for exemption described in para. I.1 of GSR Part 3 [1]. The regulatory body may decide

to grant a specific exemption with special consideration of para. I.1(b) of GSR Part 3 [1] and other relevant criteria to show that there would be no benefit in applying regulatory controls. The granting of a specific exemption should be based on a safety assessment that demonstrates compliance with these general criteria for exemption.

5.3. As described in para. 3.4, for specific exemption, interaction between the applicant and regulatory body may be necessary. However, there may be certain practices or sources for which no interaction is necessary between the applicant and the regulatory body, for example where consumer products meeting the exemption criteria have been available for many years and the exemption of such products can be included in the regulatory framework without the need for interaction.

SAFETY ASSESSMENT

5.4. A safety assessment is an assessment of all aspects of a practice that are relevant to protection and safety [3]. For the purposes of exemption, the assessment should evaluate the safety of an intended practice or source within a practice, considering the magnitude of any radiation risks and the adequacy of any safety measures. The assessment of radiation risks in terms of the expected likelihood and magnitude of exposure should consider exposures from normal operation as well as potential exposures from anticipated operational occurrences and accident conditions. Requirements for safety assessment are established in paras 3.29–3.36 of GSR Part 3 [1].

5.5. In accordance with para. 3.29 of GSR Part 3 [1], the person or organization responsible for facilities and activities is required to submit a safety assessment when applying for an authorization.

5.6. A specific safety assessment is usually needed in cases where a decision on specific exemption is to be made (i.e. when generic exemption cannot be applied). Such a safety assessment should demonstrate that the general criteria for exemption in para. I.1 of GSR Part 3 [1] are met.

5.7. The regulatory body may impose requirements on the method and structure of the safety assessment used to underpin an application for specific exemption. Examples of such requirements may include a complete characterization and description of the source and/or equipment containing the source (e.g. equipment and source description, function, radionuclide, activity, half-life, chemical and

physical form, number of sources or pieces of equipment to which specific exemption is being applied); a description of the safety measures (e.g. shielding, containment); a demonstration of the integrity of the source or equipment; a description of the operating conditions and maintenance programme; and an evaluation of doses in normal operation, anticipated operational occurrences and accident conditions.

5.8. With regard to consumer products, recommendations on safety assessment are provided in paras 3.30–3.35 of SSG-36 [7]. In such cases, the scope of the safety assessment should cover the lifetime of the consumer product, including production, storage, transport, use and disposal. Even though certain consumer products may be granted exemption, such an exemption normally relates to the end user. As such, the manufacturing of the products may still be under regulatory control, or regulatory control may be considered necessary if the number of consumer products exceeds a certain amount (see para. 3.33 of SSG-36 [7]), for instance in terms of storage, transport or disposal. Several limitations or conditions may thus be applied to the exemption of consumer products. These limitations and conditions will be based on the underlying safety assessment.

5.9. In general, the safety assessment for specific exemption of a practice (or of a source or equipment within a practice) should consider all the stages associated with the practice, source or equipment. On the basis of the results of the safety assessment, the regulatory body should then decide whether to (a) grant exemption without further conditions; (b) grant exemption with specific conditions (e.g. the number of consumer products); (c) exempt only certain practices within the chain of supply; or (d) refuse to grant exemption, and impose some form of regulatory control.

EXAMPLES OF THE APPLICATION OF SPECIFIC EXEMPTION

Consumer products

5.10. A consumer product is defined as a device or manufactured item into which radionuclides have deliberately been incorporated or produced by activation, or which generates ionizing radiation, and which can be sold or made available to members of the public without special surveillance or regulatory control after sale [3].

5.11. SSG-36 [7] provides recommendations on how the provisions for exemption specified in schedule I of GSR Part 3 [1] should be applied to consumer products.

In para. 1.1 of SSG-36 [7], the following categories of consumer products are identified:

(a) Products to which small amounts of radionuclides have been added, either for functional reasons or because of their physical or chemical properties;
(b) Equipment capable of generating radiation;
(c) Products that, as a result of being intentionally exposed to radiation, contain activation products.

5.12. As described in para. 4.1 of SSG-36 [7], consumer products include the following:

(a) Ionization chamber smoke detectors;
(b) Gaseous tritium light devices;
(c) Radioluminous products, such as clocks and watches;
(d) Certain lamps and lamp starters;
(e) Irradiated gemstones;
(f) Thoriated tungsten welding electrodes.

5.13. Some consumer products have been available for many years. For such products, the regulatory body may decide to grant specific exemption without the need for interaction in every case by confirming that an overarching safety assessment has been performed and is applicable to all consumer products of the same type.

Bulk amounts of solid material with radionuclides of natural origin

5.14. In accordance with para. 3.4(a) of GSR Part 3 [1], any practice involving material with an activity concentration of any radionuclide in the uranium or thorium decay chain above 1 Bq/g, or above 10 Bq/g for ^{40}K, is required to be treated as a planned exposure situation.

5.15. Paragraph I.4 of GSR Part 3 [1] states (footnote omitted):

> "For radionuclides of natural origin, exemption of bulk amounts of material is necessarily considered on a case by case basis by using a dose criterion of the order of 1 mSv in a year, commensurate with typical doses due to natural background levels of radiation."

This dose criterion should be interpreted as being the dose increment resulting from the practice (i.e. in addition to the dose from local background radiation). In

addition, the dose criterion of the order of 1 mSv in a year takes into account the dose contributions from the progeny radionuclides in the uranium and thorium decay series, as appropriate, but does not include the exposure due to radon. The phrase "of the order of 1 mSv" should be interpreted in a pragmatic way as including doses in the range 1–3 mSv.

5.16. In addition to a dose criterion of the order of 1 mSv in a year, the general criteria for exemption, especially the need for regulatory control of a practice or source to produce a net benefit (see para. I.1(b) of GSR Part 3 [1]), need to be considered.

5.17. The regulatory body may take into account several factors in deciding on the exemption of bulk amounts of material containing radionuclides of natural origin. These factors may include the amount of material involved; the magnitude of the exposures; the prevailing circumstances; societal implications; national or regional factors; past experience with the management of similar situations; and international guidance and good practice elsewhere.

Surface contaminated items

5.18. The models used to derive the exemption levels in terms of activity (Bq) and activity concentration (Bq/g) in schedule I of GSR Part 3 [1] do not specifically consider surface contaminated items. The exposure pathways from the direct handling, machining and processing of surface contaminated items might differ significantly from those for materials in which the activity is distributed throughout the volume. Consequently, meeting the exemption levels (in Bq or Bq/g) does not necessarily guarantee that the generic exemption criteria in paras I.1 and I.2 of GSR Part 3 [1] are met. It would be more appropriate to grant specific exemption based on surface contamination levels for such items.

5.19. It is expected that there will be less need to grant exemption for surface contaminated items that are intended to be used in a practice than there would be for material containing radionuclides. However, in cases where exemption of surface contaminated items (contaminated with artificial and/or natural radionuclides) is needed, specific exemption should be granted on a case by case basis. In applying for such an exemption, compliance with the general exemption criteria in para. I.1 of GSR Part 3 [1] should be demonstrated by an appropriate safety assessment. This safety assessment should include the following:

(a) The use of a dosimetric model that specifically considers exposures resulting from direct handling, processing or machining of surface contaminated

items. Annex II describes examples of dosimetric models for surface contaminated items that can be used for the assessment.

(b) An evaluation of exposures from both fixed and non-fixed (removable) contamination.

(c) A consideration of all relevant exposure pathways that might significantly contribute to exposures, such as the following:
    (i) External exposure from radiation emitted from the surface of contaminated items, including exposure of the skin from direct contact with the items;
    (ii) External exposure from contamination transferred to the skin by handling surface contaminated items;
    (iii) Internal exposure from inhalation of airborne activity resulting from resuspension (due to handling, machining or processing the items);
    (iv) Internal exposure from ingestion of activity as a result of handling surface contaminated items.

5.20. For surface contaminated items with a mixture of radionuclides, the recommendations in paras 4.23–4.28 should be followed.

5.21. The surface contamination values specified in para. 508 of SSR-6 (Rev. 1) [10] (i.e. 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, for removable surface contamination) were developed on the basis of a simplified dosimetric model constructed for purposes specific to transport. Therefore, an appropriate safety assessment is needed to determine the applicability of these surface contamination values for specific exemption. For many radionuclides and exposure scenarios, most of the existing dosimetric models (see Annex II) indicate that these surface contamination values comply with the general criteria for exemption specified in para. I.2 of GSR Part 3 [1].

Equipment containing radioactive material

5.22. Paragraph I.6 of GSR Part 3 [1] states:

> "Exemptions may be granted subject to conditions specified by the regulatory body, such as conditions relating to the physical or chemical form of the radioactive material, and to its use or the means of its disposal. In particular, such an exemption may be granted for equipment containing radioactive material that is not otherwise automatically exempted without

further consideration from some or all of the requirements of [GSR Part 3] under para. I.3(a) [of GSR Part 3] provided that:

(a) The equipment containing radioactive material is of a type approved by the regulatory body.
(b) The radioactive material:
    (i) Is in the form of a sealed source that effectively prevents any contact with the radioactive material and prevents its leakage; or
    (ii) Is in the form of an unsealed source in a small amount such as sources used for radioimmunoassay.
(c) In normal operating conditions, the equipment does not cause an ambient dose equivalent rate or a directional dose equivalent rate, as appropriate, exceeding 1 μSv/h at a distance of 0.1 m from any accessible surface of the equipment.
(d) Necessary conditions for disposal of the equipment have been specified by the regulatory body."

5.23. A safety assessment should be performed to support the initial application for type approval of the equipment, but the assessment might not need to be repeated for subsequent equipment of a similar type. Typical examples of equipment that is of a type approved by the regulatory body includes equipment used in medicine, industry and research, such as radioimmunoassay equipment, electron capture detectors and X ray fluorescence equipment.

Other specific exemptions

5.24. Other practices or sources in practices may be considered on a case by case basis for specific exemption based on a safety assessment. Such exemptions might include those for bulk amounts of radioactive gases and liquids. The safety assessment should take into account all the relevant exposure pathways and should demonstrate compliance with the general criteria for exemption specified in para. I.1 of GSR Part 3 [1].

SUMMARY FLOW CHARTS

5.25. Figures 2 and 3 summarize the main steps in granting generic exemption and specific exemption.

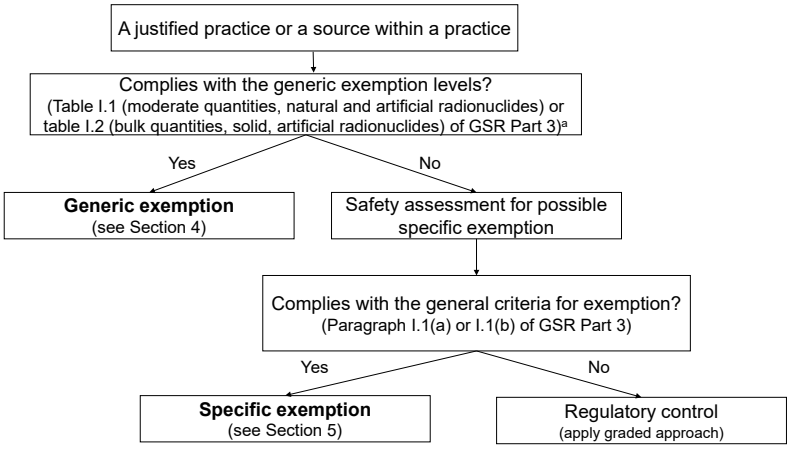

FIG. 2. Flow chart for granting generic exemption and specific exemption (excluding bulk materials containing radionuclides of natural origin).

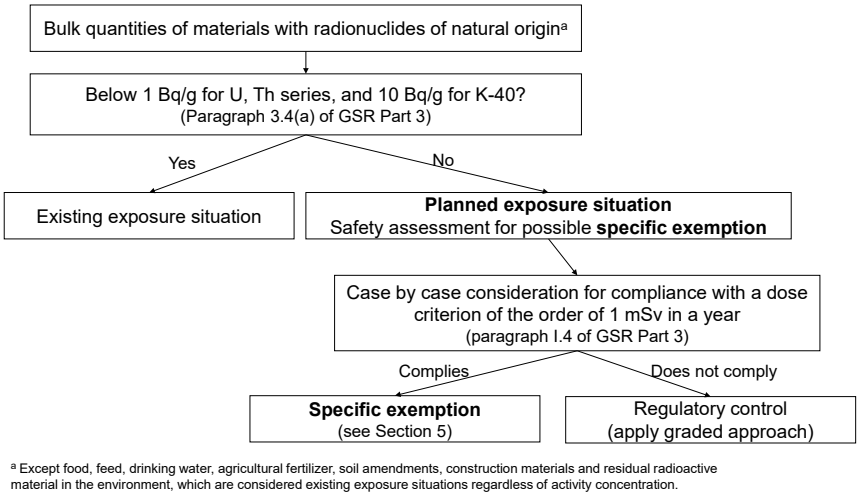

FIG. 3. Flow chart for granting specific exemption for bulk materials with radionuclides of natural origin.

6. VERIFICATION, REVISION AND REVOCATION OF EXEMPTION

VERIFICATION OF COMPLIANCE WITH EXEMPTION LEVELS

6.1. Before applying for exemption or taking any decision on exemption, appropriate measurements should be undertaken. These measurements should enable a reliable comparison with, as appropriate, the generic exemptions levels specified in para. I.3 of GSR Part 3 [1] or the criteria for specific exemption established by the regulatory body. It should be ensured that the following actions are completed:

(a) Representative samples or measurements are taken.
(b) The correct measurement and analytical methods are employed.
(c) The desired accuracy and precision of measurements are achieved.
(d) The measurement results are assigned to the correct source, material or type of equipment.
(e) The results are evaluated in accordance with established protocols.

6.2. In the verification process, averaging procedures to ensure representative values of activity or activity concentration should be an integral part of every step, and they should be selected in accordance with the type and amount of material and in accordance with statistical representativeness. Consideration should also be given to the possibility of localized higher activity concentrations within or on the surface of materials.

6.3. Verification should also be conducted of other conditions attached to specific exemption and in relation to any other circumstances relevant to the application of the exemption.

6.4. Appendix II provides detailed guidance on verification of compliance with the exemption levels.

REVOCATION AND REVISION OF EXEMPTIONS

6.5. It might be necessary for the regulatory body to revoke an exemption, for example when an initially exempted practice or source within a practice is no longer deemed justified or when the original criteria for exemption are withdrawn. Alternatively, the regulatory body might revise an exemption if the

original exemption criteria or the conditions attached to a specific exemption are changed. If an exemption was originally granted under specific conditions, one option might be to change these conditions instead of revoking the exemption.

6.6. If an exemption is revoked, the practice or source within the practice will no longer be outside the scope of regulatory control; the practice might even be prohibited if it is no longer justified.

6.7. An exemption may be considered to no longer be applicable, for instance if the process of verifying the activity or activity concentration demonstrates that a material does not, in fact, meet the exemption levels. This could be the result of an intended or unintended modification of the practice or source within the practice.

7. USE OF SCREENING VALUES IN EXISTING EXPOSURE SITUATIONS

7.1. In accordance with Requirement 8 of GSR Part 3 [1], the concept of exemption is applicable only to planned exposure situations. In existing exposure situations, decisions on optimization of protection and safety are guided by reference levels, typically expressed as an annual effective dose to the representative person in the range of 1–20 mSv (see para. 5.8 of GSR Part 3 [1]). Reference levels represent an upper value "above which it is not appropriate to plan to allow *exposures* to occur and below which *optimization of protection and safety* would continue to be implemented" [3]. However, it may also be useful to define a lower boundary below which no further controls are expected to be necessary. Such an 'exemption-like' approach based on screening values is proposed in this Safety Guide for managing certain existing exposure situations. For instance, this approach would support long term decision making in an existing exposure situation after the termination of a nuclear or radiological emergency, as well as in trade of commodities and use of construction materials.

7.2. In existing exposure situations, reference levels are required to be used in the optimization of protection and safety (see Requirement 48 of GSR Part 3 [1]). They should be used as tools for optimization in defining, selecting, analysing and benchmarking protection strategies. If an exemption-like process in such situations is appropriate, any derived screening levels should be based on dose criteria that are lower than or equal to the selected reference level for the existing exposure situation under consideration. In addition, the general criteria for exemption

specified in para. I.1 of GSR Part 3 [1] should be taken into consideration. In such cases, an annual effective dose of the order of 1 mSv or less is recommended. This value is consistent with the dose criteria for low probability scenarios for exemption of artificial radionuclides, as well as with the dose criteria for specific exemption of bulk amounts of materials containing radionuclides of natural origin. The regulatory body or other competent authority may decide to adopt a different value, depending on the prevailing circumstances.

7.3. For practical application, an approach using screening values expressed in terms of measurable quantities (derived from the dose criteria described in para. 7.2) is recommended. Such screening values should be defined by the regulatory body on the basis of the existing exposure situation to which the values are to be applied.

Existing exposure situations after the termination of a nuclear or radiological emergency

7.4. A large scale nuclear or radiological emergency involving a significant release of radioactive material to the environment could result in very widespread contamination, including a large quantity of contaminated materials and items. In such cases, it may become appropriate to consider exemptions based on operational screening values established in terms of a measurable quantity, for example activity concentration (Bq/g) or ambient dose equivalent rate (μSv/h). Annex III provides information of the use of screening values to support decision making with regard to the management of contaminated materials and items in Japan after the Fukushima Daiichi accident.

Construction materials containing radionuclides of natural origin

7.5. An approach based on screening levels is already used for decision making in relation to construction materials containing radionuclides of natural origin. In particular, an activity concentration index is used as a screening tool for identifying construction materials that might need to be subject to restrictions (see paras 4.17–4.27 of IAEA Safety Standards Series No. SSG-32, Protection of the Public Against Exposure Indoors due to Radon and Other Natural Sources of Radiation [15]). Further information is provided in Annex III.

Trade of commodities

7.6. Commodities used or consumed by the public, such as retail and wholesale goods, foodstuffs, and construction materials, might contain radioactive

substances. This Safety Guide provides general guidance on the trade of non-food commodities; further supporting technical information is provided in Ref. [6].

7.7. In accordance with para. 5.1 of GSR Part 3 [1], exposure due to commodities that incorporate radionuclides deriving from residual radioactive material (i.e. from past activities not subject to appropriate regulatory control, or following the termination of a nuclear or radiological emergency) should be managed as an existing exposure situation.

7.8. Paragraph 5.22 of GSR Part 3 [1] states:

> "The regulatory body or other relevant authority shall establish specific reference levels for exposure due to radionuclides in commodities such as construction materials, food and feed, and in drinking water, each of which shall typically be expressed as, or be based on, an annual effective dose to the representative person that generally does not exceed a value of about 1 mSv."

7.9. The regulatory body or other relevant authority is required to consider existing guideline levels for radionuclides in food as a result of a nuclear or radiological emergency and existing guideline levels for drinking water (see para. 5.23 of GSR Part 3 [1]). Criteria for radionuclide activity concentrations in food and drinking water (other than in the case of a nuclear or radiological emergency) are provided in Ref. [16].

7.10. Recommendations on adaptation or lifting of restrictions on non-food commodities implemented during the emergency response phase, including restrictions on the international trade of such commodities, are provided in IAEA Safety Standards Series No. GSG-11, Arrangements for the Termination of a Nuclear or Radiological Emergency [17].

7.11. For non-food commodities, radionuclides can either be on the external surface or be distributed throughout the volume of the commodity. The management of trade in such commodities could use a screening based approach for decision making, as follows:

(a) As a starting point, the values in table I.1 of GSR Part 3 [1] for moderate amounts of material containing artificial or natural radionuclides, and those in table I.2 of GSR Part 3 [1] for bulk amounts of solid material containing artificial radionuclides, may also serve as corresponding screening values for trade. If measurements demonstrate that activity concentrations are below

these levels, trade of non-food commodities can be permitted without further consideration. If activity concentrations in non-food commodities exceed the levels in tables I.1 and I.2 of GSR Part 3 [1], this does not necessarily mean that the trade should be restricted. Instead, it indicates that a case by case assessment is needed to determine compliance with specific reference levels, as required by para. 5.22 of GSR Part 3 [1]. This assessment should be based on realistic exposure scenarios.

(b) In the case of bulk amounts of materials with radionuclides of natural origin, a value of 1 Bq/g for each radionuclide in the uranium decay chain or the thorium decay chain and 10 Bq/g for ^{40}K (table I.3 of GSR Part 3 [1], clearance value) can be used for general screening purposes, although more conservative values may be necessary for building materials. If the measurement results are above these screening values, the requirements established in para. 5.22 of GSR Part 3 [1] are required to be considered.

(c) In the case of non-food commodities with surface contamination, a case by case assessment is needed to determine compliance with specific reference levels, as required by para. 5.22 of GSR Part 3 [1]. This assessment should be based on realistic exposure scenarios and adequate dosimetric models (e.g. see Annex II). As described in para. 5.21 of this Safety Guide, the surface contamination values specified in para. 508 of SSR-6 (Rev. 1) [10] (i.e. 0.4 Bq/cm^2 for alpha emitters and 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters) may be considered for use as screening values, where no other options are available, especially where prompt decisions are needed.

7.12. Confirmation that a non-food commodity meets the screening values described in para. 7.11 should be obtained at the first point of entry into trade. This does not imply the need for systematic monitoring of all traded commodities in every State, but authorities in exporting States should ensure that a system is established to prevent unauthorized trade of commodities with activity levels exceeding nationally established criteria. In general, it should not be necessary for each importing State to implement its own routine measurement programme solely for the purpose of monitoring commodities, particularly if there is confidence in the controls exercised by the exporting State.

7.13. In cases where there are reasonable grounds for believing that the annual effective dose to the representative person would exceed 1 mSv (see para. 5.22 of GSR Part 3 [1]), the government might still consider facilitation of trade based on societal, economic or other relevant factors, subject to the requirements in national regulations as well as any flexibility inherent in para. 5.22 of GSR Part 3 [1]. In general, to avoid unnecessary barriers to trade, States should coordinate their

regulatory strategies (and their implementation of those strategies), including strategies for monitoring commodities. Arrangements should be made to determine the actual activity concentration levels in commodities either by obtaining the information from the supplier or by monitoring activity concentration, as organized by the regulatory body or other relevant authority. Any measurements should be made using appropriate techniques and with equipment capable of measuring activity concentrations at levels below the values specified (see Appendix II).

7.14. Figure 4 summarizes the main steps in the use of screening values for decision making in the trade of non-food commodities.

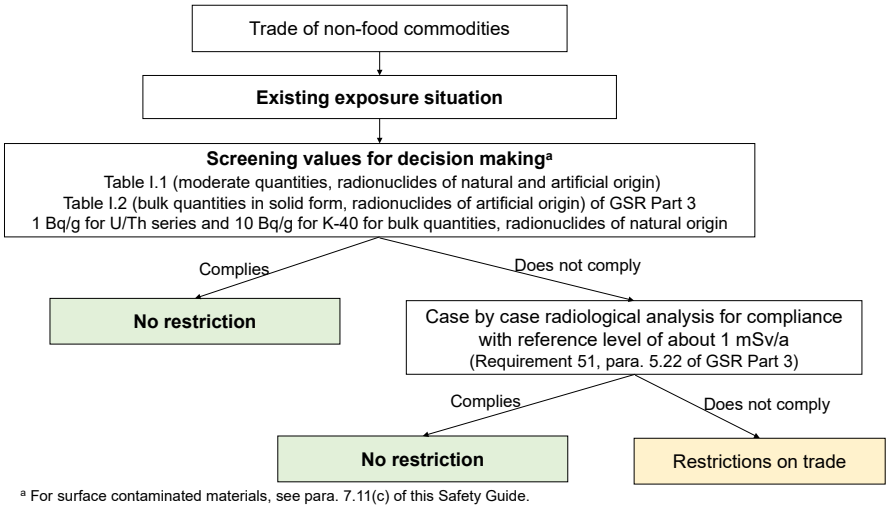

FIG. 4. Flow chart illustrating the use of screening values for decision making in trade of non-food commodities.

Appendix I
EXEMPTION LEVELS FROM SCHEDULE I OF GSR PART 3

I.1. This appendix reproduces table I.1 and the exemption levels from table I.2 of GSR Part 3 [1], for convenience.

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES
(reproduction of table I.1 of GSR Part 3 [1])

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
H-3	1×10^6	1×10^9
Be-7	1×10^3	1×10^7
Be-10	1×10^4	1×10^6
C-11	1×10^1	1×10^6
C-14	1×10^4	1×10^7
N-13	1×10^2	1×10^9
Ne-19	1×10^2	1×10^9
O-15	1×10^2	1×10^9
F-18	1×10^1	1×10^6
Na-22	1×10^1	1×10^6
Na-24	1×10^1	1×10^5
Mg-28	1×10^1	1×10^5
Al-26	1×10^1	1×10^5

For footnotes see p. 80.

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Si-31	1×10^3	1×10^6
Si-32	1×10^3	1×10^6
P-32	1×10^3	1×10^5
P-33	1×10^5	1×10^8
S-35	1×10^5	1×10^8
Cl-36	1×10^4	1×10^6
Cl-38	1×10^1	1×10^5
Cl-39	1×10^1	1×10^5
Ar-37	1×10^6	1×10^8
Ar-39	1×10^7	1×10^4
Ar-41	1×10^2	1×10^9
K-40	1×10^2	1×10^6
K-42	1×10^2	1×10^6
K-43	1×10^1	1×10^6
K-44	1×10^1	1×10^5
K-45	1×10^1	1×10^5
Ca-41	1×10^5	1×10^7
Ca-45	1×10^4	1×10^7

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ca-47	1×10^{1}	1×10^{6}
Sc-43	1×10^{1}	1×10^{6}
Sc-44	1×10^{1}	1×10^{5}
Sc-45	1×10^{2}	1×10^{7}
Sc-46	1×10^{1}	1×10^{6}
Sc-47	1×10^{2}	1×10^{6}
Sc-48	1×10^{1}	1×10^{5}
Sc-49	1×10^{3}	1×10^{5}
Ti-44	1×10^{1}	1×10^{5}
Ti-45	1×10^{1}	1×10^{6}
V-47	1×10^{1}	1×10^{5}
V-48	1×10^{1}	1×10^{5}
V-49	1×10^{4}	1×10^{7}
Cr-48	1×10^{2}	1×10^{6}
Cr-49	1×10^{1}	1×10^{6}
Cr-51	1×10^{3}	1×10^{7}
Mn-51	1×10^{1}	1×10^{5}
Mn-52	1×10^{1}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Mn-52m	1×10^{1}	1×10^{5}
Mn-53	1×10^{4}	1×10^{9}
Mn-54	1×10^{1}	1×10^{6}
Mn-56	1×10^{1}	1×10^{5}
Fe-52	1×10^{1}	1×10^{6}
Fe-55	1×10^{4}	1×10^{6}
Fe-59	1×10^{1}	1×10^{6}
Fe-60	1×10^{2}	1×10^{5}
Co-55	1×10^{1}	1×10^{6}
Co-56	1×10^{1}	1×10^{5}
Co-57	1×10^{2}	1×10^{6}
Co-58	1×10^{1}	1×10^{6}
Co-58m	1×10^{4}	1×10^{7}
Co-60	1×10^{1}	1×10^{5}
Co-60m	1×10^{3}	1×10^{6}
Co-61	1×10^{2}	1×10^{6}
Co-62m	1×10^{1}	1×10^{5}
Ni-56	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ni-57	1×10^{1}	1×10^{6}
Ni-59	1×10^{4}	1×10^{8}
Ni-63	1×10^{5}	1×10^{8}
Ni-65	1×10^{1}	1×10^{6}
Ni-66	1×10^{4}	1×10^{7}
Cu-60	1×10^{1}	1×10^{5}
Cu-61	1×10^{1}	1×10^{6}
Cu-64	1×10^{2}	1×10^{6}
Cu-67	1×10^{2}	1×10^{6}
Zn-62	1×10^{2}	1×10^{6}
Zn-63	1×10^{1}	1×10^{5}
Zn-65	1×10^{1}	1×10^{6}
Zn-69	1×10^{4}	1×10^{6}
Zn-69m	1×10^{2}	1×10^{6}
Zn-71m	1×10^{1}	1×10^{6}
Zn-72	1×10^{2}	1×10^{6}
Ga-65	1×10^{1}	1×10^{5}
Ga-66	1×10^{1}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ga-67	1×10^2	1×10^6
Ga-68	1×10^1	1×10^5
Ga-70	1×10^2	1×10^6
Ga-72	1×10^1	1×10^5
Ga-73	1×10^2	1×10^6
Ge-66	1×10^1	1×10^6
Ge-67	1×10^1	1×10^5
Ge-68[b]	1×10^1	1×10^5
Ge-69	1×10^1	1×10^6
Ge-71	1×10^4	1×10^8
Ge-75	1×10^3	1×10^6
Ge-77	1×10^1	1×10^5
Ge-78	1×10^2	1×10^6
As-69	1×10^1	1×10^5
As-70	1×10^1	1×10^5
As-71	1×10^1	1×10^6
As-72	1×10^1	1×10^5
As-73	1×10^3	1×10^7

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
As-74	1×10^{1}	1×10^{6}
As-76	1×10^{2}	1×10^{5}
As-77	1×10^{3}	1×10^{6}
As-78	1×10^{1}	1×10^{5}
Se-70	1×10^{1}	1×10^{6}
Se-73	1×10^{1}	1×10^{6}
Se-73m	1×10^{2}	1×10^{6}
Se-75	1×10^{2}	1×10^{6}
Se-79	1×10^{4}	1×10^{7}
Se-81	1×10^{3}	1×10^{6}
Se-81m	1×10^{3}	1×10^{7}
Se-83	1×10^{1}	1×10^{5}
Br-74	1×10^{1}	1×10^{5}
Br-74m	1×10^{1}	1×10^{5}
Br-75	1×10^{1}	1×10^{6}
Br-76	1×10^{1}	1×10^{5}
Br-77	1×10^{2}	1×10^{6}
Br-80	1×10^{2}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Br-80m	1×10^{3}	1×10^{7}
Br-82	1×10^{1}	1×10^{6}
Br-83	1×10^{3}	1×10^{6}
Br-84	1×10^{1}	1×10^{5}
Kr-74	1×10^{2}	1×10^{9}
Kr-76	1×10^{2}	1×10^{9}
Kr-77	1×10^{2}	1×10^{9}
Kr-79	1×10^{3}	1×10^{5}
Kr-81	1×10^{4}	1×10^{7}
Kr-81m	1×10^{3}	1×10^{10}
Kr-83m	1×10^{5}	1×10^{12}
Kr-85	1×10^{5}	1×10^{4}
Kr-85m	1×10^{3}	1×10^{10}
Kr-87	1×10^{2}	1×10^{9}
Kr-88	1×10^{2}	1×10^{9}
Rb-79	1×10^{1}	1×10^{5}
Rb-81	1×10^{1}	1×10^{6}
Rb-81m	1×10^{3}	1×10^{7}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Rb-82m	1×10^{1}	1×10^{6}
Rb-83[b]	1×10^{2}	1×10^{6}
Rb-84	1×10^{1}	1×10^{6}
Rb-86	1×10^{2}	1×10^{5}
Rb-87	1×10^{3}	1×10^{7}
Rb-88	1×10^{2}	1×10^{5}
Rb-89	1×10^{2}	1×10^{5}
Sr-80	1×10^{3}	1×10^{7}
Sr-81	1×10^{1}	1×10^{5}
Sr-82[b]	1×10^{1}	1×10^{5}
Sr-83	1×10^{1}	1×10^{6}
Sr-85	1×10^{2}	1×10^{6}
Sr-85m	1×10^{2}	1×10^{7}
Sr-87m	1×10^{2}	1×10^{6}
Sr-89	1×10^{3}	1×10^{6}
Sr-90[b]	1×10^{2}	1×10^{4}
Sr-91	1×10^{1}	1×10^{5}
Sr-92	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Y-86	1×10^{1}	1×10^{5}
Y-86m	1×10^{2}	1×10^{7}
Y-87[b]	1×10^{1}	1×10^{6}
Y-88	1×10^{1}	1×10^{6}
Y-90	1×10^{3}	1×10^{5}
Y-90m	1×10^{1}	1×10^{6}
Y-91	1×10^{3}	1×10^{6}
Y-91m	1×10^{2}	1×10^{6}
Y-92	1×10^{2}	1×10^{5}
Y-93	1×10^{2}	1×10^{5}
Y-94	1×10^{1}	1×10^{5}
Y-95	1×10^{1}	1×10^{5}
Zr-86	1×10^{2}	1×10^{7}
Zr-88	1×10^{2}	1×10^{6}
Zr-89	1×10^{1}	1×10^{6}
Zr-93[b]	1×10^{3}	1×10^{7}
Zr-95	1×10^{1}	1×10^{6}
Zr-97[b]	1×10^{1}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Nb-88	1×10^{1}	1×10^{5}
Nb-89	1×10^{1}	1×10^{5}
Nb-89m	1×10^{1}	1×10^{5}
Nb-90	1×10^{1}	1×10^{5}
Nb-93m	1×10^{4}	1×10^{7}
Nb-94	1×10^{1}	1×10^{6}
Nb-95	1×10^{1}	1×10^{6}
Nb-95m	1×10^{2}	1×10^{7}
Nb-96	1×10^{1}	1×10^{5}
Nb-97	1×10^{1}	1×10^{6}
Nb-98	1×10^{1}	1×10^{5}
Mo-90	1×10^{1}	1×10^{6}
Mo-93	1×10^{3}	1×10^{8}
Mo-93m	1×10^{1}	1×10^{6}
Mo-99	1×10^{2}	1×10^{6}
Mo-101	1×10^{1}	1×10^{6}
Tc-93	1×10^{1}	1×10^{6}
Tc-93m	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Tc-94	1×10^{1}	1×10^{6}
Tc-94m	1×10^{1}	1×10^{5}
Tc-95	1×10^{1}	1×10^{6}
Tc-95m	1×10^{1}	1×10^{6}
Tc-96	1×10^{1}	1×10^{6}
Tc-96m	1×10^{3}	1×10^{7}
Tc-97	1×10^{3}	1×10^{8}
Tc-97m	1×10^{3}	1×10^{7}
Tc-98	1×10^{1}	1×10^{6}
Tc-99	1×10^{4}	1×10^{7}
Tc-99m	1×10^{2}	1×10^{7}
Tc-101	1×10^{2}	1×10^{6}
Tc-104	1×10^{1}	1×10^{5}
Ru-94	1×10^{2}	1×10^{6}
Ru-97	1×10^{2}	1×10^{7}
Ru-103	1×10^{2}	1×10^{6}
Ru-105	1×10^{1}	1×10^{6}
Ru-106[b]	1×10^{2}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Rh-99	1×10^{1}	1×10^{6}
Rh-99m	1×10^{1}	1×10^{6}
Rh-100	1×10^{1}	1×10^{6}
Rh-101	1×10^{2}	1×10^{7}
Rh-101m	1×10^{2}	1×10^{7}
Rh-102	1×10^{1}	1×10^{6}
Rh-102m	1×10^{2}	1×10^{6}
Rh-103m	1×10^{4}	1×10^{8}
Rh-105	1×10^{2}	1×10^{7}
Rh-106m	1×10^{1}	1×10^{5}
Rh-107	1×10^{2}	1×10^{6}
Pd-100	1×10^{2}	1×10^{7}
Pd-101	1×10^{2}	1×10^{6}
Pd-103	1×10^{3}	1×10^{8}
Pd-107	1×10^{5}	1×10^{8}
Pd-109	1×10^{3}	1×10^{6}
Ag-102	1×10^{1}	1×10^{5}
Ag-103	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ag-104	1×10^{1}	1×10^{6}
Ag-104m	1×10^{1}	1×10^{6}
Ag-105	1×10^{2}	1×10^{6}
Ag-106	1×10^{1}	1×10^{6}
Ag-106m	1×10^{1}	1×10^{6}
Ag-108m	1×10^{1}	1×10^{6}
Ag-110m	1×10^{1}	1×10^{6}
Ag-111	1×10^{3}	1×10^{6}
Ag-112	1×10^{1}	1×10^{5}
Ag-115	1×10^{1}	1×10^{5}
Cd-104	1×10^{2}	1×10^{7}
Cd-107	1×10^{3}	1×10^{7}
Cd-109	1×10^{4}	1×10^{6}
Cd-113	1×10^{3}	1×10^{6}
Cd-113m	1×10^{3}	1×10^{6}
Cd-115	1×10^{2}	1×10^{6}
Cd-115m	1×10^{3}	1×10^{6}
Cd-117	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Cd-117m	1×10^{1}	1×10^{6}
In-109	1×10^{1}	1×10^{6}
In-110	1×10^{1}	1×10^{6}
In-110m	1×10^{1}	1×10^{5}
In-111	1×10^{2}	1×10^{6}
In-112	1×10^{2}	1×10^{6}
In-113m	1×10^{2}	1×10^{6}
In-114	1×10^{3}	1×10^{5}
In-114m	1×10^{2}	1×10^{6}
In-115	1×10^{3}	1×10^{5}
In-115m	1×10^{2}	1×10^{6}
In-116m	1×10^{1}	1×10^{5}
In-117	1×10^{1}	1×10^{6}
In-117m	1×10^{2}	1×10^{6}
In-119m	1×10^{2}	1×10^{5}
Sn-110	1×10^{2}	1×10^{7}
Sn-111	1×10^{2}	1×10^{6}
Sn-113	1×10^{3}	1×10^{7}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Sn-117m	1×10^2	1×10^6
Sn-119m	1×10^3	1×10^7
Sn-121	1×10^5	1×10^7
Sn-121m[b]	1×10^3	1×10^7
Sn-123	1×10^3	1×10^6
Sn-123m	1×10^2	1×10^6
Sn-125	1×10^2	1×10^5
Sn-126[b]	1×10^1	1×10^5
Sn-127	1×10^1	1×10^6
Sn-128	1×10^1	1×10^6
Sb-115	1×10^1	1×10^6
Sb-116	1×10^1	1×10^6
Sb-116m	1×10^1	1×10^5
Sb-117	1×10^2	1×10^7
Sb-118m	1×10^1	1×10^6
Sb-119	1×10^3	1×10^7
Sb-120	1×10^2	1×10^6
Sb-120m	1×10^1	1×10^6

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Sb-122	1×10^2	1×10^4
Sb-124	1×10^1	1×10^6
Sb-124m	1×10^2	1×10^6
Sb-125	1×10^2	1×10^6
Sb-126	1×10^1	1×10^5
Sb-126m	1×10^1	1×10^5
Sb-127	1×10^1	1×10^6
Sb-128	1×10^1	1×10^5
Sb-128m	1×10^1	1×10^5
Sb-129	1×10^1	1×10^6
Sb-130	1×10^1	1×10^5
Sb-131	1×10^1	1×10^6
Te-116	1×10^2	1×10^7
Te-121	1×10^1	1×10^6
Te-121m	1×10^2	1×10^6
Te-123	1×10^3	1×10^6
Te-123m	1×10^2	1×10^7
Te-125m	1×10^3	1×10^7

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Te-127	1×10^3	1×10^6
Te-127m	1×10^3	1×10^7
Te-129	1×10^2	1×10^6
Te-129m	1×10^3	1×10^6
Te-131	1×10^2	1×10^5
Te-131m	1×10^1	1×10^6
Te-132	1×10^2	1×10^7
Te-133	1×10^1	1×10^5
Te-133m	1×10^1	1×10^5
Te-134	1×10^1	1×10^6
I-120	1×10^1	1×10^5
I-120m	1×10^1	1×10^5
I-121	1×10^2	1×10^6
I-123	1×10^2	1×10^7
I-124	1×10^1	1×10^6
I-125	1×10^3	1×10^6
I-126	1×10^2	1×10^6
I-128	1×10^2	1×10^5

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
I-129	1×10^{2}	1×10^{5}
I-130	1×10^{1}	1×10^{6}
I-131	1×10^{2}	1×10^{6}
I-132	1×10^{1}	1×10^{5}
I-132m	1×10^{2}	1×10^{6}
I-133	1×10^{1}	1×10^{6}
I-134	1×10^{1}	1×10^{5}
I-135	1×10^{1}	1×10^{6}
Xe-120	1×10^{2}	1×10^{9}
Xe-121	1×10^{2}	1×10^{9}
Xe-122[b]	1×10^{2}	1×10^{9}
Xe-123	1×10^{2}	1×10^{9}
Xe-125	1×10^{3}	1×10^{9}
Xe-127	1×10^{3}	1×10^{5}
Xe-129m	1×10^{3}	1×10^{4}
Xe-131m	1×10^{4}	1×10^{4}
Xe-133m	1×10^{3}	1×10^{4}
Xe-133	1×10^{3}	1×10^{4}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Xe-135	1×10^{3}	1×10^{10}
Xe-135m	1×10^{2}	1×10^{9}
Xe-138	1×10^{2}	1×10^{9}
Cs-125	1×10^{1}	1×10^{4}
Cs-127	1×10^{2}	1×10^{5}
Cs-129	1×10^{2}	1×10^{5}
Cs-130	1×10^{2}	1×10^{6}
Cs-131	1×10^{3}	1×10^{6}
Cs-132	1×10^{1}	1×10^{5}
Cs-134m	1×10^{3}	1×10^{5}
Cs-134	1×10^{1}	1×10^{4}
Cs-135	1×10^{4}	1×10^{7}
Cs-135m	1×10^{1}	1×10^{6}
Cs-136	1×10^{1}	1×10^{5}
Cs-137[b]	1×10^{1}	1×10^{4}
Cs-138	1×10^{1}	1×10^{4}
Ba-126	1×10^{2}	1×10^{7}
Ba-128	1×10^{2}	1×10^{7}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ba-131	1×10^2	1×10^6
Ba-131m	1×10^2	1×10^7
Ba-133	1×10^2	1×10^6
Ba-133m	1×10^2	1×10^6
Ba-135m	1×10^2	1×10^6
Ba-137m	1×10^1	1×10^6
Ba-139	1×10^2	1×10^5
Ba-140[b]	1×10^1	1×10^5
Ba-141	1×10^2	1×10^5
Ba-142	1×10^2	1×10^6
La-131	1×10^1	1×10^6
La-132	1×10^1	1×10^6
La-135	1×10^3	1×10^7
La-137	1×10^3	1×10^7
La-138	1×10^1	1×10^6
La-140	1×10^1	1×10^5
La-141	1×10^2	1×10^5
La-142	1×10^1	1×10^5

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
La-143	1×10^{2}	1×10^{5}
Ce-134	1×10^{3}	1×10^{7}
Ce-135	1×10^{1}	1×10^{6}
Ce-137	1×10^{3}	1×10^{7}
Ce-137m	1×10^{3}	1×10^{6}
Ce-139	1×10^{2}	1×10^{6}
Ce-141	1×10^{2}	1×10^{7}
Ce-143	1×10^{2}	1×10^{6}
Ce-144[b]	1×10^{2}	1×10^{5}
Pr-136	1×10^{1}	1×10^{5}
Pr-137	1×10^{2}	1×10^{6}
Pr-138m	1×10^{1}	1×10^{6}
Pr-139	1×10^{2}	1×10^{7}
Pr-142	1×10^{2}	1×10^{5}
Pr-142m	1×10^{7}	1×10^{9}
Pr-143	1×10^{4}	1×10^{6}
Pr-144	1×10^{2}	1×10^{5}
Pr-145	1×10^{3}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Pr-147	1×10^{1}	1×10^{5}
Nd-136	1×10^{2}	1×10^{6}
Nd-138	1×10^{3}	1×10^{7}
Nd-139	1×10^{2}	1×10^{6}
Nd-139m	1×10^{1}	1×10^{6}
Nd-141	1×10^{2}	1×10^{7}
Nd-147	1×10^{2}	1×10^{6}
Nd-149	1×10^{2}	1×10^{6}
Nd-151	1×10^{1}	1×10^{5}
Pm-141	1×10^{1}	1×10^{5}
Pm-143	1×10^{2}	1×10^{6}
Pm-144	1×10^{1}	1×10^{6}
Pm-145	1×10^{3}	1×10^{7}
Pm-146	1×10^{1}	1×10^{6}
Pm-147	1×10^{4}	1×10^{7}
Pm-148	1×10^{1}	1×10^{5}
Pm-148m	1×10^{1}	1×10^{6}
Pm-149	1×10^{3}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Pm-150	1×10^{1}	1×10^{5}
Pm-151	1×10^{2}	1×10^{6}
Sm-141	1×10^{1}	1×10^{5}
Sm-141m	1×10^{1}	1×10^{6}
Sm-142	1×10^{2}	1×10^{7}
Sm-145	1×10^{2}	1×10^{7}
Sm-146	1×10^{1}	1×10^{5}
Sm-147	1×10^{1}	1×10^{4}
Sm-151	1×10^{4}	1×10^{8}
Sm-153	1×10^{2}	1×10^{6}
Sm-155	1×10^{2}	1×10^{6}
Sm-156	1×10^{2}	1×10^{6}
Eu-145	1×10^{1}	1×10^{6}
Eu-146	1×10^{1}	1×10^{6}
Eu-147	1×10^{2}	1×10^{6}
Eu-148	1×10^{1}	1×10^{6}
Eu-149	1×10^{2}	1×10^{7}
Eu-150	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Eu-150m	1×10^3	1×10^6
Eu-152	1×10^1	1×10^6
Eu-152m	1×10^2	1×10^6
Eu-154	1×10^1	1×10^6
Eu-155	1×10^2	1×10^7
Eu-156	1×10^1	1×10^6
Eu-157	1×10^2	1×10^6
Eu-158	1×10^1	1×10^5
Gd-145	1×10^1	1×10^5
Gd-146[b]	1×10^1	1×10^6
Gd-147	1×10^1	1×10^6
Gd-148	1×10^1	1×10^4
Gd-149	1×10^2	1×10^6
Gd-151	1×10^2	1×10^7
Gd-152	1×10^1	1×10^4
Gd-153	1×10^2	1×10^7
Gd-159	1×10^3	1×10^6
Tb-147	1×10^1	1×10^6

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Tb-149	1×10^{1}	1×10^{6}
Tb-150	1×10^{1}	1×10^{6}
Tb-151	1×10^{1}	1×10^{6}
Tb-153	1×10^{2}	1×10^{7}
Tb-154	1×10^{1}	1×10^{6}
Tb-155	1×10^{2}	1×10^{7}
Tb-156	1×10^{1}	1×10^{6}
Tb-156m (24.4 h)	1×10^{3}	1×10^{7}
Tb-156m′ (5 h)	1×10^{4}	1×10^{7}
Tb-157	1×10^{4}	1×10^{7}
Tb-158	1×10^{1}	1×10^{6}
Tb-160	1×10^{1}	1×10^{6}
Tb-161	1×10^{3}	1×10^{6}
Dy-155	1×10^{1}	1×10^{6}
Dy-157	1×10^{2}	1×10^{6}
Dy-159	1×10^{3}	1×10^{7}
Dy-165	1×10^{3}	1×10^{6}
Dy-166	1×10^{3}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ho-155	1×10^{2}	1×10^{6}
Ho-157	1×10^{2}	1×10^{6}
Ho-159	1×10^{2}	1×10^{6}
Ho-161	1×10^{2}	1×10^{7}
Ho-162	1×10^{2}	1×10^{7}
Ho-162m	1×10^{1}	1×10^{6}
Ho-164	1×10^{3}	1×10^{6}
Ho-164m	1×10^{3}	1×10^{7}
Ho-166	1×10^{3}	1×10^{5}
Ho-166m	1×10^{1}	1×10^{6}
Ho-167	1×10^{2}	1×10^{6}
Er-161	1×10^{1}	1×10^{6}
Er-165	1×10^{3}	1×10^{7}
Er-169	1×10^{4}	1×10^{7}
Er-171	1×10^{2}	1×10^{6}
Er-172	1×10^{2}	1×10^{6}
Tm-162	1×10^{1}	1×10^{6}
Tm-166	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Tm-167	1×10^{2}	1×10^{6}
Tm-170	1×10^{3}	1×10^{6}
Tm-171	1×10^{4}	1×10^{8}
Tm-172	1×10^{2}	1×10^{6}
Tm-173	1×10^{2}	1×10^{6}
Tm-175	1×10^{1}	1×10^{6}
Yb-162	1×10^{2}	1×10^{7}
Yb-166	1×10^{2}	1×10^{7}
Yb-167	1×10^{2}	1×10^{6}
Yb-169	1×10^{2}	1×10^{7}
Yb-175	1×10^{3}	1×10^{7}
Yb-177	1×10^{2}	1×10^{6}
Yb-178	1×10^{3}	1×10^{6}
Lu-169	1×10^{1}	1×10^{6}
Lu-170	1×10^{1}	1×10^{6}
Lu-171	1×10^{1}	1×10^{6}
Lu-172	1×10^{1}	1×10^{6}
Lu-173	1×10^{2}	1×10^{7}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Lu-174	1×10^{2}	1×10^{7}
Lu-174m	1×10^{2}	1×10^{7}
Lu-176	1×10^{2}	1×10^{6}
Lu-176m	1×10^{3}	1×10^{6}
Lu-177	1×10^{3}	1×10^{7}
Lu-177m	1×10^{1}	1×10^{6}
Lu-178	1×10^{2}	1×10^{5}
Lu-178m	1×10^{1}	1×10^{5}
Lu-179	1×10^{3}	1×10^{6}
Hf-170	1×10^{2}	1×10^{6}
Hf-172[b]	1×10^{1}	1×10^{6}
Hf-173	1×10^{2}	1×10^{6}
Hf-175	1×10^{2}	1×10^{6}
Hf-177m	1×10^{1}	1×10^{5}
Hf-178m	1×10^{1}	1×10^{6}
Hf-179m	1×10^{1}	1×10^{6}
Hf-180m	1×10^{1}	1×10^{6}
Hf-181	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Hf-182	1×10^{2}	1×10^{6}
Hf-182m	1×10^{1}	1×10^{6}
Hf-183	1×10^{1}	1×10^{6}
Hf-184	1×10^{2}	1×10^{6}
Ta-172	1×10^{1}	1×10^{6}
Ta-173	1×10^{1}	1×10^{6}
Ta-174	1×10^{1}	1×10^{6}
Ta-175	1×10^{1}	1×10^{6}
Ta-176	1×10^{1}	1×10^{6}
Ta-177	1×10^{2}	1×10^{7}
Ta-178	1×10^{1}	1×10^{6}
Ta-179	1×10^{3}	1×10^{7}
Ta-180	1×10^{1}	1×10^{6}
Ta-180m	1×10^{3}	1×10^{7}
Ta-182	1×10^{1}	1×10^{4}
Ta-182m	1×10^{2}	1×10^{6}
Ta-183	1×10^{2}	1×10^{6}
Ta-184	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ta-185	1×10^{2}	1×10^{5}
Ta-186	1×10^{1}	1×10^{5}
W-176	1×10^{2}	1×10^{6}
W-177	1×10^{1}	1×10^{6}
W-178[b]	1×10^{1}	1×10^{6}
W-179	1×10^{2}	1×10^{7}
W-181	1×10^{3}	1×10^{7}
W-185	1×10^{4}	1×10^{7}
W-187	1×10^{2}	1×10^{6}
W-188[b]	1×10^{2}	1×10^{5}
Re-177	1×10^{1}	1×10^{6}
Re-178	1×10^{1}	1×10^{6}
Re-181	1×10^{1}	1×10^{6}
Re-182	1×10^{1}	1×10^{6}
Re-182m	1×10^{1}	1×10^{6}
Re-184	1×10^{1}	1×10^{6}
Re-184m	1×10^{2}	1×10^{6}
Re-186	1×10^{3}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Re-186m	1×10^3	1×10^7
Re-187	1×10^6	1×10^9
Re-188	1×10^2	1×10^5
Re-188m	1×10^2	1×10^7
Re-189[b]	1×10^2	1×10^6
Os-180	1×10^2	1×10^7
Os-181	1×10^1	1×10^6
Os-182	1×10^2	1×10^6
Os-185	1×10^1	1×10^6
Os-189m	1×10^4	1×10^7
Os-191	1×10^2	1×10^7
Os-191m	1×10^3	1×10^7
Os-193	1×10^2	1×10^6
Os-194[b]	1×10^2	1×10^5
Ir-182	1×10^1	1×10^5
Ir-184	1×10^1	1×10^6
Ir-185	1×10^1	1×10^6
Ir-186	1×10^1	1×10^6

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Ir-186m	1×10^{1}	1×10^{6}
Ir-187	1×10^{2}	1×10^{6}
Ir-188	1×10^{1}	1×10^{6}
Ir-189[b]	1×10^{2}	1×10^{7}
Ir-190	1×10^{1}	1×10^{6}
Ir-190m (3.1 h)	1×10^{1}	1×10^{6}
Ir-190m′ (1.2 h)	1×10^{4}	1×10^{7}
Ir-192	1×10^{1}	1×10^{4}
Ir-192m	1×10^{2}	1×10^{7}
Ir-193m	1×10^{4}	1×10^{7}
Ir-194	1×10^{2}	1×10^{5}
Ir-194m	1×10^{1}	1×10^{6}
Ir-195	1×10^{2}	1×10^{6}
Ir-195m	1×10^{2}	1×10^{6}
Pt-186	1×10^{1}	1×10^{6}
Pt-188[b]	1×10^{1}	1×10^{6}
Pt-189	1×10^{2}	1×10^{6}
Pt-191	1×10^{2}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Pt-193	1×10^4	1×10^7
Pt-193m	1×10^3	1×10^7
Pt-195m	1×10^2	1×10^6
Pt-197	1×10^3	1×10^6
Pt-197m	1×10^2	1×10^6
Pt-199	1×10^2	1×10^6
Pt-200	1×10^2	1×10^6
Au-193	1×10^2	1×10^7
Au-194	1×10^1	1×10^6
Au-195	1×10^2	1×10^7
Au-198	1×10^2	1×10^6
Au-198m	1×10^1	1×10^6
Au-199	1×10^2	1×10^6
Au-200	1×10^2	1×10^5
Au-200m	1×10^1	1×10^6
Au-201	1×10^2	1×10^6
Hg-193	1×10^2	1×10^6
Hg-193m	1×10^1	1×10^6

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Hg-194[b]	1×10^{1}	1×10^{6}
Hg-195	1×10^{2}	1×10^{6}
Hg-195m[b]	1×10^{2}	1×10^{6}
Hg-197	1×10^{2}	1×10^{7}
Hg-197m	1×10^{2}	1×10^{6}
Hg-199m	1×10^{2}	1×10^{6}
Hg-203	1×10^{2}	1×10^{5}
Tl-194	1×10^{1}	1×10^{6}
Tl-194m	1×10^{1}	1×10^{6}
Tl-195	1×10^{1}	1×10^{6}
Tl-197	1×10^{2}	1×10^{6}
Tl-198	1×10^{1}	1×10^{6}
Tl-198m	1×10^{1}	1×10^{6}
Tl-199	1×10^{2}	1×10^{6}
Tl-200	1×10^{1}	1×10^{6}
Tl-201	1×10^{2}	1×10^{6}
Tl-202	1×10^{2}	1×10^{6}
Tl-204	1×10^{4}	1×10^{4}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Pb-195m	1×10^{1}	1×10^{6}
Pb-198	1×10^{2}	1×10^{6}
Pb-199	1×10^{1}	1×10^{6}
Pb-200	1×10^{2}	1×10^{6}
Pb-201	1×10^{1}	1×10^{6}
Pb-202	1×10^{3}	1×10^{6}
Pb-202m	1×10^{1}	1×10^{6}
Pb-203	1×10^{2}	1×10^{6}
Pb-205	1×10^{4}	1×10^{7}
Pb-209	1×10^{5}	1×10^{6}
Pb-210[b]	1×10^{1}	1×10^{4}
Pb-211	1×10^{2}	1×10^{6}
Pb-212[b]	1×10^{1}	1×10^{5}
Pb-214	1×10^{2}	1×10^{6}
Bi-200	1×10^{1}	1×10^{6}
Bi-201	1×10^{1}	1×10^{6}
Bi-202	1×10^{1}	1×10^{6}
Bi-203	1×10^{1}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Bi-205	1×10^{1}	1×10^{6}
Bi-206	1×10^{1}	1×10^{5}
Bi-207	1×10^{1}	1×10^{6}
Bi-210	1×10^{3}	1×10^{6}
Bi-210m[b]	1×10^{1}	1×10^{5}
Bi-212[b]	1×10^{1}	1×10^{5}
Bi-213	1×10^{2}	1×10^{6}
Bi-214	1×10^{1}	1×10^{5}
Po-203	1×10^{1}	1×10^{6}
Po-205	1×10^{1}	1×10^{6}
Po-206	1×10^{1}	1×10^{6}
Po-207	1×10^{1}	1×10^{6}
Po-208	1×10^{1}	1×10^{4}
Po-209	1×10^{1}	1×10^{4}
Po-210	1×10^{1}	1×10^{4}
At-207	1×10^{1}	1×10^{6}
At-211	1×10^{3}	1×10^{7}
Fr-222	1×10^{3}	1×10^{5}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Fr-223	1×10^{2}	1×10^{6}
Rn-220[b]	1×10^{4}	1×10^{7}
Rn-222[b]	1×10^{1}	1×10^{8}
Ra-223[b]	1×10^{2}	1×10^{5}
Ra-224[b]	1×10^{1}	1×10^{5}
Ra-225	1×10^{2}	1×10^{5}
Ra-226[b]	1×10^{1}	1×10^{4}
Ra-227	1×10^{2}	1×10^{6}
Ra-228[b]	1×10^{1}	1×10^{5}
Ac-224	1×10^{2}	1×10^{6}
Ac-225[b]	1×10^{1}	1×10^{4}
Ac-226	1×10^{2}	1×10^{5}
Ac-227[b]	1×10^{-1}	1×10^{3}
Ac-228	1×10^{1}	1×10^{6}
Th-226[b]	1×10^{3}	1×10^{7}
Th-227	1×10^{1}	1×10^{4}
Th-228[b]	1×10^{0}	1×10^{4}
Th-229[b]	1×10^{0}	1×10^{3}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Th-230	1×10^{0}	1×10^{4}
Th-231	1×10^{3}	1×10^{7}
Th-232	1×10^{1}	1×10^{4}
Th-234[b]	1×10^{3}	1×10^{5}
Pa-227	1×10^{1}	1×10^{6}
Pa-228	1×10^{1}	1×10^{6}
Pa-230	1×10^{1}	1×10^{6}
Pa-231	1×10^{0}	1×10^{3}
Pa-232	1×10^{1}	1×10^{6}
Pa-233	1×10^{2}	1×10^{7}
Pa-234	1×10^{1}	1×10^{6}
U-230[b]	1×10^{1}	1×10^{5}
U-231	1×10^{2}	1×10^{7}
U-232[b]	1×10^{0}	1×10^{3}
U-233	1×10^{1}	1×10^{4}
U-234	1×10^{1}	1×10^{4}
U-235[b]	1×10^{1}	1×10^{4}
U-236	1×10^{1}	1×10^{4}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
U-237	1×10^{2}	1×10^{6}
U-238[b]	1×10^{1}	1×10^{4}
U-239	1×10^{2}	1×10^{6}
U-240	1×10^{3}	1×10^{7}
U-240[b]	1×10^{1}	1×10^{6}
Np-232	1×10^{1}	1×10^{6}
Np-233	1×10^{2}	1×10^{7}
Np-234	1×10^{1}	1×10^{6}
Np-235	1×10^{3}	1×10^{7}
Np-236	1×10^{2}	1×10^{5}
Np-236m	1×10^{3}	1×10^{7}
Np-237[b]	1×10^{0}	1×10^{3}
Np-238	1×10^{2}	1×10^{6}
Np-239	1×10^{2}	1×10^{7}
Np-240	1×10^{1}	1×10^{6}
Pu-234	1×10^{2}	1×10^{7}
Pu-235	1×10^{2}	1×10^{7}
Pu-236	1×10^{1}	1×10^{4}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Pu-237	1×10^3	1×10^7
Pu-238	1×10^0	1×10^4
Pu-239	1×10^0	1×10^4
Pu-240	1×10^0	1×10^3
Pu-241	1×10^2	1×10^5
Pu-242	1×10^0	1×10^4
Pu-243	1×10^3	1×10^7
Pu-244	1×10^0	1×10^4
Pu-245	1×10^2	1×10^6
Pu-246	1×10^2	1×10^6
Am-237	1×10^2	1×10^6
Am-238	1×10^1	1×10^6
Am-239	1×10^2	1×10^6
Am-240	1×10^1	1×10^6
Am-241	1×10^0	1×10^4
Am-242	1×10^3	1×10^6
Am-242m[b]	1×10^0	1×10^4
Am-243[b]	1×10^0	1×10^3

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Am-244	1×10^{1}	1×10^{6}
Am-244m	1×10^{4}	1×10^{7}
Am-245	1×10^{3}	1×10^{6}
Am-246	1×10^{1}	1×10^{5}
Am-246m	1×10^{1}	1×10^{6}
Cm-238	1×10^{2}	1×10^{7}
Cm-240	1×10^{2}	1×10^{5}
Cm-241	1×10^{2}	1×10^{6}
Cm-242	1×10^{2}	1×10^{5}
Cm-243	1×10^{0}	1×10^{4}
Cm-244	1×10^{1}	1×10^{4}
Cm-245	1×10^{0}	1×10^{3}
Cm-246	1×10^{0}	1×10^{3}
Cm-247	1×10^{0}	1×10^{4}
Cm-248	1×10^{0}	1×10^{3}
Cm-249	1×10^{3}	1×10^{6}
Cm-250	1×10^{-1}	1×10^{3}
Bk-245	1×10^{2}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Bk-246	1×10^{1}	1×10^{6}
Bk-247	1×10^{0}	1×10^{4}
Bk-249	1×10^{3}	1×10^{6}
Bk-250	1×10^{1}	1×10^{6}
Cf-244	1×10^{4}	1×10^{7}
Cf-246	1×10^{3}	1×10^{6}
Cf-248	1×10^{1}	1×10^{4}
Cf-249	1×10^{0}	1×10^{3}
Cf-250	1×10^{1}	1×10^{4}
Cf-251	1×10^{0}	1×10^{3}
Cf-252	1×10^{1}	1×10^{4}
Cf-253	1×10^{2}	1×10^{5}
Cf-254	1×10^{0}	1×10^{3}
Es-250	1×10^{2}	1×10^{6}
Es-251	1×10^{2}	1×10^{7}
Es-253	1×10^{2}	1×10^{5}
Es-254	1×10^{1}	1×10^{4}
Es-254m	1×10^{2}	1×10^{6}

TABLE 2. LEVELS FOR EXEMPTION OF MODERATE AMOUNTS OF MATERIAL WITHOUT FURTHER CONSIDERATION: EXEMPT ACTIVITY CONCENTRATIONS AND EXEMPT ACTIVITIES OF RADIONUCLIDES

(reproduction of table I.1 of GSR Part 3 [1]) (cont.)

Radionuclide[a]	Activity concentration (Bq/g)	Activity (Bq)
Fm-252	1×10^3	1×10^6
Fm-253	1×10^2	1×10^6
Fm-254	1×10^4	1×10^7
Fm-255	1×10^3	1×10^6
Fm-257	1×10^1	1×10^5
Md-257	1×10^2	1×10^7
Md-258	1×10^2	1×10^5

[a] m and m′ denote metastable states of the radionuclide. The metastable state m′ is of higher energy than the metastable state m.

[b] Parent radionuclides and their progeny whose dose contributions are taken into account in the dose calculations (thus requiring only the exemption level of the parent radionuclide to be considered) are listed here:

Ge-68	Ga-68
Rb-83	Kr-83m
Sr-82	Rb-82
Sr-90	Y-90
Y-87	Sr-87m
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Ag-108m	Ag-108
Sn-121m	Sn-121 (0.776)
Sn-126	Sb-126m
Xe-122	I-122
Cs-137	Ba-137m
Ba-140	La-140
Ce-134	La-134
Ce-144	Pr-144

Gd-146	Eu-146
Hf-172	Lu-172
W-178	Ta-178
W-188	Re-188
Re-189	Os-189m (0.241)
Ir-189	Os-189m
Pt-188	Ir-188
Hg-194	Au-194
Hg-195m	Hg-195 (0.542)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)
Bi-210m	Tl-206
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Ac-225	Fr-221, At-217, Bi-213, Po-213 (0.978), Tl-209 (0.0216), Pb-209 (0.978)
Ac-227	Fr-223 (0.0138)
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212,Tl-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-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-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

Note: The exemption values (activity concentrations) presented in this table have been calculated on the basis of scenarios involving a moderate amount of material: "The calculated values apply to practices involving small scale usage of activity where the quantities involved are at the most of the order of a tonne" (see Ref. [13]). The regulatory body will need to establish the amounts for which the concentration values in this table may be applied, bearing in mind that for many radionuclides, in particular those for which there is no corresponding value given in Table I.2 [of GSR Part 3], a restriction on the amount is not meaningful. The exemption levels set out in this table and the exemption and clearance levels set out in Table I.2 [of GSR Part 3] are subject to the following considerations: (a) they were derived using a conservative model based on (i) the criteria of paras I.2 and I.11 [of GSR Part 3], respectively, and (ii) a series of limiting (bounding) scenarios for use and disposal (see Refs [13, 12] in the case of this table and Ref. [4] in the case of Table I.2 [of GSR Part 3]); (b) if there is more than one radionuclide, the derived exemption level or derived clearance level for the mixture is determined as specified in paras I.7 and I.14 [of GSR Part 3].

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1])

Radionuclide	Activity concentration (Bq/g)
H-3	100
Be-7	10
C-14	1
F-18	10
Na-22	0.1
Na-24	1
Si-31	1 000
P-32	1 000
P-33	1 000
S-35	100
Cl-36	1
Cl-38	10
K-42	100
K-43	10
Ca-45	100
Ca-47	10
Sc-46	0.1
Sc-47	100

For footnotes see p. 96.

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Sc-48	1
V-48	1
Cr-51	100
Mn-51	10
Mn-52	1
Mn-52m	10
Mn-53	100
Mn-54	0.1
Mn-56	10
Fe-52[a]	10
Fe-55	1 000
Fe-59	1
Co-55	10
Co-56	0.1
Co-57	1
Co-58	1
Co-58m	10 000
Co-60	0.1
Co-60m	1 000

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Co-61	100
Co-62m	10
Ni-59	100
Ni-63	100
Ni-65	10
Cu-64	100
Zn-65	0.1
Zn-69	1 000
Zn-69m[a]	10
Ga-72	10
Ge-71	10 000
As-73	1 000
As-74	10
As-76	10
As-77	1 000
Se-75	1
Br-82	1
Rb-86	100
Sr-85	1

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Sr-85m	100
Sr-87m	100
Sr-89	1 000
Sr-90[a]	1
Sr-91[a]	10
Sr-92	10
Y-90	1 000
Y-91	100
Y-91m	100
Y-92	100
Y-93	100
Zr-93	10
Zr-95[a]	1
Zr-97[a]	10
Nb-93m	10
Nb-94	0.1
Nb-95	1
Nb-97[a]	10
Nb-98	10

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Mo-90	10
Mo-93	10
Mo-99[a]	10
Mo-101[a]	10
Tc-96	1
Tc-96m	1 000
Tc-97	10
Tc-97m	100
Tc-99	1
Tc-99m	100
Ru-97	10
Ru-103[a]	1
Ru-105[a]	10
Ru-106[a]	0.1
Rh-103m	10 000
Rh-105	100
Pd-103[a]	1 000
Pd-109[a]	100
Ag-105	1

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Ag-110m[a]	0.1
Ag-111	100
Cd-109[a]	1
Cd-115[a]	10
Cd-115m[a]	100
In-111	10
In-113m	100
In-114m[a]	10
In-115m	100
Sn-113[a]	1
Sn-125	10
Sb-122	10
Sb-124	1
Sb-125[a]	0.1
Te-123m	1
Te-125m	1 000
Te-127	1 000
Te-127m[a]	10
Te-129	100

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Te-129m[a]	10
Te-131	100
Te-131m[a]	10
Te-132[a]	1
Te-133	10
Te-133m	10
Te-134	10
I-123	100
I-125	100
I-126	10
I-129	0.01
I-130	10
I-131	10
I-132	10
I-133	10
I-134	10
I-135	10
Cs-129	10
Cs-131	1 000

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Cs-132	10
Cs-134	0.1
Cs-134m	1 000
Cs-135	100
Cs-136	1
Cs-137[a]	0.1
Cs-138	10
Ba-131	10
Ba-140	1
La-140	1
Ce-139	1
Ce-141	100
Ce-143	10
Ce-144[a]	10
Pr-142	100
Pr-143	1 000
Nd-147	100
Nd-149	100
Pm-147	1 000

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Pm-149	1 000
Sm-151	1 000
Sm-153	100
Eu-152	0.1
Eu-152m	100
Eu-154	0.1
Eu-155	1
Gd-153	10
Gd-159	100
Tb-160	1
Dy-165	1 000
Dy-166	100
Ho-166	100
Er-169	1 000
Er-171	100
Tm-170	100
Tm-171	1 000
Yb-175	100
Lu-177	100

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Hf-181	1
Ta-182	0.1
W-181	10
W-185	1 000
W-187	10
Re-186	1 000
Re-188	100
Os-185	1
Os-191	100
Os-191m	1 000
Os-193	100
Ir-190	1
Ir-192	1
Ir-194	100
Pt-191	10
Pt-193m	1 000
Pt-197	1 000
Pt-197m	100
Au-198	10

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Au-199	100
Hg-197	100
Hg-197m	100
Hg-203	10
Tl-200	10
Tl-201	100
Tl-202	10
Tl-204	1
Pb-203	10
Bi-206	1
Bi-207	0.1
Po-203	10
Po-205	10
Po-207	10
At-211	1 000
Ra-225	10
Ra-227	100
Th-226	1 000
Th-229	0.1

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Pa-230	10
Pa-233	10
U-230	10
U-231	100
U-232[a]	0.1
U-233	1
U-236	10
U-237	100
U-239	100
U-240[a]	100
Np-237[a]	1
Np-239	100
Np-240	10
Pu-234	100
Pu-235	100
Pu-236	1
Pu-237	100
Pu-238	0.1
Pu-239	0.1

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Pu-240	0.1
Pu-241	10
Pu-242	0.1
Pu-243	1 000
Pu-244[a]	0.1
Am-241	0.1
Am-242	1 000
Am-242m[a]	0.1
Am-243[a]	0.1
Cm-242	10
Cm-243	1
Cm-244	1
Cm-245	0.1
Cm-246	0.1
Cm-247[a]	0.1
Cm-248	0.1
Bk-249	100
Cf-246	1 000
Cf-248	1

TABLE 3. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN
(reproduction of the exemption levels from table I.2 of GSR Part 3 [1]) (cont.)

Radionuclide	Activity concentration (Bq/g)
Cf-249	0.1
Cf-250	1
Cf-251	0.1
Cf-252	1
Cf-253	100
Cf-254	1
Es-253	100
Es-254[a]	0.1
Es-254m[a]	10
Fm-254	10 000
Fm-255	100

[a] Parent radionuclides, and their progeny whose dose contributions are taken into account in the dose calculations (thus requiring only the exemption level of the parent radionuclide to be considered), are listed here:

Fe-52	Mn-52m
Zn-69m	Zn-69
Sr-90	Y-90
Sr-91	Y-91m
Zr-95	Nb-95
Zr-97	Nb-97m, Nb-97
Nb-97	Nb-97m
Mo-99	Tc-99m
Mo-101	Tc-101
Ru-103	Rh-103m
Ru-105	Rh-105m
Ru-106	Rh-106

Pd-103	Rh-103m
Pd-109	Ag-109m
Ag-110m	Ag-110
Cd-109	Ag-109m
Cd-115	In-115m
Cd-115m	In-115m
In-114m	In-114
Sn-113	In-113m
Sb-125	Te-125m
Te-127m	Te-127
Te-129m	Te-129
Te-131m	Te-131
Te-132	I-132
Cs-137	Ba-137m
Ce-144	Pr-144, Pr-144m
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208
U-240	Np-240m, Np-240
Np-237	Pa-233
Pu-244	U-240, Np-240m, Np-240
Am-242m	Np-238
Am-243	Np-239
Cm-247	Pu-243
Es-254	Bk-250
Es-254m	Fm-254

Note: The exemption levels set out in Table I.1 [of GSR Part 3] and the exemption and clearance levels set out in this table are subject to the following considerations: (a) they were derived using a conservative model based on (i) the criteria of paras I.2 and I.11 [of GSR Part 3], respectively, and (ii) a series of limiting (bounding) scenarios for use and disposal (see Refs [13, 12] in the case of Table I.1 [of GSR Part 3] and Ref. [4] in the case of this table); (b) if there is more than one radionuclide, the derived exemption level or derived clearance level for the mixture is determined as specified in paras I.7 and I.14 [of GSR Part 3].

Appendix II

VERIFICATION OF COMPLIANCE WITH EXEMPTION LEVELS

II.1. For any exempted practice or source within a practice, monitoring should be considered as a means of demonstrating that the relevant exemption criteria are met.

II.2. The generic exemption levels in tables I.1 and I.2 of GSR Part 3 [1] are based on the assumption that radionuclides are homogeneously distributed within a material; consequently, in demonstrating compliance with these levels, monitoring should take into account averaging and representativeness. Averaging procedures in determining representative values of activity or activity concentration should be an integral part of every step in a verification process, and these procedures should be selected in accordance with the type, nature and amount of material under evaluation as well as in accordance with statistical representativeness. Consideration should also be given to the possibility of localized areas of concentrated activity (see also paras 4.34–4.37 of GSG-18 [5]).

II.3. Verification of compliance with the exemption criteria should be based on a procedure that may include taking direct measurements of the material, source or equipment and/or performing laboratory based measurements on representative samples of material. Verification should also include, as appropriate, the use of properly derived radionuclide relationships, such as secular or transient equilibrium conditions, and adequate traceability of the material and/or samples.

II.4. A graded approach should be applied to the monitoring of sources and materials to verify compliance with exemption criteria. This approach should take into account the volume, complexity and homogeneity of the material; the type of radionuclides; the levels of activity or activity concentration; and statistical representativeness.

II.5. An organizational structure with clear allocation of responsibilities and adequate resources should be established to plan and conduct monitoring to verify compliance with exemption criteria in a timely and effective manner. The corresponding management arrangements to be considered include the following:

(a) An inventory of the necessary resources, including financial and human resources, and monitoring equipment;
(b) Establishment of a quality management programme;

(c) Establishment of conditions for personnel (including, where appropriate, contractors) with respect to qualifications, expertise and training.

II.6. The following should be specified to assist the verification of compliance with exemption criteria:

(a) The number of samples needed to demonstrate compliance;
(b) The number of measurements (and, where appropriate, measurement locations) necessary to demonstrate compliance;
(c) The approach to dealing with mixtures of radionuclides and to establishing correlation factors (see para. II.16);
(d) The approach to dealing with uncertainties and detection limits.

SELECTION OF THE OPTIMUM MEASUREMENT STRATEGY TO VERIFY COMPLIANCE WITH EXEMPTION LEVELS

II.7. An optimum strategy for monitoring for compliance with exemption criteria should be developed in accordance with the graded approach, taking into account factors such as the characteristics of the source or material, monitoring costs, and the selection of appropriate methods. In deciding on a measurement strategy, the following steps should be considered:

(a) Optimizing the number of samples by grouping materials and aggregating samples. This should be done as uniformly as possible, with samples in a group being representative of the materials for which a decision on exemption is to be made.
(b) Quantitatively assessing mixtures of radionuclides, taking into account information about the history of the material.

II.8. The optimum monitoring strategy also includes selection of the most suitable measurement methods, use of appropriately calibrated equipment and any necessary pretreatment of samples prior to measurement.

II.9. The use of statistically based methods that take into account the degree of homogeneity of radionuclides in a material and the characteristics of the equipment used for measurements can significantly reduce monitoring costs. A material that is very likely to meet exemption levels could be assessed using a simplified monitoring scheme, whereas a material that might approach or exceed these levels may need more extensive monitoring [18]. The decision to apply

a simplified monitoring scheme should be based on reliable estimates of the content of radionuclides in the materials.

II.10. For verification of compliance with exemption levels, the following should be ensured:

(a) Samples are collected properly, and they are representative and traceable.
(b) Correct measurement and analytical methods are used.
(c) The measurement results have the necessary accuracy and precision.
(d) The measurement results are assigned to the proper material, source or equipment [19].

QUALITY MANAGEMENT TO VERIFY COMPLIANCE WITH EXEMPTION LEVELS

II.11. Quality management is an integral part of the decision making process for exemption of materials from regulatory control. Assurance of the quality of results ensures and demonstrates that the established criteria have been met and provides confidence in the monitoring strategy, the techniques and equipment used, the sampling and measurement methods, and the analysis and interpretation of results. The implementation of quality management should follow a graded approach commensurate with the scope and complexity of the monitoring programme. More details on quality management programmes are provided in Refs [18, 20].

SELECTION OF MONITORING TECHNIQUES TO VERIFY COMPLIANCE WITH EXEMPTION LEVELS

II.12. A monitoring technique consists of monitoring equipment and a corresponding protocol describing the equipment's use in either direct or indirect methods. For direct methods, the equipment is used to directly perform measurements on the material, source or equipment; for indirect methods, measurements are performed on secondary media such as wipes or on samples taken from the material.

II.13. Generally, three techniques can be used for monitoring purposes: surface scan, bulk measurement or the collection of representative samples that are subsequently analysed in a laboratory. The first two techniques are relatively low cost and may be sufficient in cases where the composition of radionuclides

is known and the key radionuclides are readily measurable. The third technique is usually more expensive but is usually a more precise method of analysing material with a complex mixture of radionuclides.

II.14. Where practicable, a material should be scanned directly to determine which fractions of material are clearly above or below the exemption levels. For radionuclides that cannot be confirmed by the direct measurements, representative sampling should be employed to characterize the material. A monitoring strategy could thus comprise more than one technique [18].

II.15. Typical radioanalytical laboratories will usually be equipped with some or all of the following instruments [19]: gas proportional detectors for alpha and beta counting; scintillation counters (e.g. NaI, LaBr) or high purity germanium gamma spectrometers for qualitative and quantitative analysis of gamma emitting radionuclides; low energy gamma or X ray detectors; solid state detectors for alpha spectrometric measurements; liquid scintillation counters for measurement of alpha and beta emitting radionuclides; and mass spectrometers. More information can be found in Ref. [20].

II.16. For materials containing mixtures of radionuclides, there could be information on the ratios of radionuclides in the correlation factors. Correlation factors can facilitate the estimation of activity concentrations of radionuclides that cannot be easily detected, such as low energy beta emitters including ^{3}H, ^{63}Ni and ^{14}C. Monitoring of such radionuclides normally involves laboratory measurements and/or radiochemistry.

II.17. When selecting measurement equipment, consideration should be given to how compliance with the exemption criteria (e.g. in terms of activity concentration) relates to the equipment's capabilities and to the material's characteristics. This will depend on the radionuclides and emitted radiation, the distribution of radionuclides within a material or item (throughout the volume or on the surface) and whether correlation factors can be used. More detailed information on monitoring of surface activity and activity within a material is presented in Refs [18, 20].

MONITORING CHALLENGES IN THE VERIFICATION OF COMPLIANCE WITH EXEMPTION LEVELS

Uncertainties

II.18. Every measurement result should include an estimate of its overall uncertainty, which is based on a complete assessment of the sources of uncertainty. An appropriate uncertainty evaluation is necessary to demonstrate compliance with exemption criteria. The following uncertainties, as appropriate, should be considered before making decisions on exemption:

(a) Uncertainties associated with sampling;
(b) Statistical uncertainties associated with counting, measurements and calibration;
(c) Uncertainties associated with variations in background radiation;
(d) Uncertainties associated with analytical methods;
(e) Uncertainties associated with the characteristics of the material (e.g. volume or mass, homogeneity, mixtures of radionuclides);
(f) Uncertainties associated with correlation factors between radionuclides.

More information can be found in Refs [20, 21].

Sampling

II.19. If a decision on exemption is based on activity concentration measurements of samples of the material, several issues should be addressed to ensure that the measurements provide the information necessary for the decision, such as the following:

(a) Sampling locations: Sampling should cover the regions where the radionuclides are expected to concentrate, while still ensuring that results are representative for exemption purposes.
(b) Number of samples: Increasing the number of samples provides a better estimate of the median value and the standard deviation of the activity concentrations in the material. The minimum number of samples needed for a selected statistical test depends on the type of test, the median value and standard deviation of the activity concentration, and the confidence intervals to be achieved.
(c) Sample size: The minimum sample size should be inferred from the analytical methods that will be used, with the aim of ensuring that the detection limit is well below the exemption levels (see para. II.20).

Detection limits

II.20. It should be ensured that monitoring techniques to verify exemption have a detection limit well below the corresponding exemption levels, for example in terms of activity, activity concentration or dose rate. A detailed description of the concept of detection limits in the monitoring of radioactivity can be found in Ref. [22]. A practical derivation of detection limits, indicating the parameters of interest, is provided in Ref. [19].

Measurement of alpha emitters, beta emitters and low energy gamma emitters

II.21. Measurements of alpha emitters, beta emitters and low energy gamma emitters are affected by self-absorption, which might lead to an incorrect conclusion that the exemption levels are met. Where self-absorption is expected to be significant, measurement techniques based on radiochemical separation should be used to determine the activity concentration in a material.

Inhomogeneity of radionuclides

II.22. If the presence of radionuclides is inhomogeneous within a material, determining the activity concentration of the material from a single measurement or sample will produce large uncertainties. These uncertainties can be reduced by mixing the material prior to monitoring or sampling and by performing a larger number of measurements or taking a larger number of samples. The procedures used to identify and mitigate the effects of inhomogeneity should be documented.

II.23. As noted in para. II.2, averaging procedures should be an integral part of the verification process. If inhomogeneities occur on a scale larger than the averaging mass, volume or area, average concentrations can be calculated relatively accurately, but care should then be taken to ensure that these large scale variations are adequately identified.

Equipment calibration

II.24. Equipment used to verify compliance with exemption levels should be calibrated under well defined and controlled conditions. However, conditions during actual monitoring (e.g. temperature, pressure, humidity) can differ from calibration conditions. Any such differences should be recognized, and, where appropriate, the measurement results should be corrected. Information on the calibration of various types of monitoring equipment is provided in Refs [23–26].

Background activity contribution

II.25. In the interpretation of measurements to verify compliance with exemption levels, the contribution of background radiation should be considered. For subtraction of a representative background, the levels of artificial radionuclides are usually negligible unless the material is from a radiologically contaminated site and, in any case, are normally relatively easy to determine. For radionuclides of natural origin, there can be large variations in the local background, even within a specific site; consequently, care should be taken to ensure that any background subtraction is representative. More information is provided in Ref. [18].

Radioactive material with other hazardous properties

II.26. For materials that are radioactive and have other hazardous properties (e.g. radioactively contaminated asbestos), verification of compliance with the radiological exemption criteria might not be sufficient to grant complete exemption from regulatory control. It may be necessary to involve other regulatory organizations, not just those associated with radiation safety.

REFERENCES

[1] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), IAEA, Vienna (2016).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Nuclear Safety and Security Glossary: Terminology Used in Nuclear Safety, Nuclear Security, Radiation Protection and Emergency Preparedness and Response, 2022 (Interim) Edition, IAEA, Vienna (2022).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Derivation of Activity Concentration Values for Exclusion, Exemption and Clearance, Safety Reports Series No. 44, IAEA, Vienna (2005).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, OECD NUCLEAR ENERGY AGENCY, Application of the Concept of Clearance, IAEA Safety Standards Series No. GSG-18, IAEA, Vienna (2023).

[6] INTERNATIONAL ATOMIC ENERGY AGENCY, OECD NUCLEAR ENERGY AGENCY, Radiation Safety in the Trade of Commodities, IAEA, Vienna (in preparation).

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, OECD NUCLEAR ENERGY AGENCY, Radiation Safety for Consumer Products, IAEA Safety Standards Series No. SSG-36, IAEA, Vienna (2016).

[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Justification of Practices, Including Non-Medical Human Imaging, IAEA Safety Standards Series No. GSG-5, IAEA, Vienna (2014).

[9] INTERNATIONAL ATOMIC ENERGY AGENCY, Functions and Processes of the Regulatory Body for Safety, IAEA Safety Standards Series No. GSG-13, IAEA, Vienna (2018).

[10] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, 2018 Edition, IAEA Safety Standards Series No. SSR-6 (Rev. 1), IAEA, Vienna (2018).

[11] INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Scope of Radiological Protection Control Measures, Publication 104, Elsevier, Oxford (2007).

[12] NATIONAL RADIOLOGICAL PROTECTION BOARD, Exempt Concentrations and Quantities for Radionuclides Not Included in the European Basic Safety Standards Directive, NRPB R-306, NRPB, Chilton, United Kingdom (1999).

[13] EUROPEAN COMMISSION, Principles and Methods for Establishing Concentrations and Quantities (Exemption Values) Below Which Reporting Is Not Required in the European Directive, Radiation Protection 65, Office for Official Publications of the European Communities, Luxembourg (1993).
[14] EUROPEAN COMMISSION, Evaluation of the Application of the Concepts of Exemption and Clearance for Practices According to Title III of Council Directive 96/29/Euratom of 13 May 1996 in EU Member States, Radiation Protection 134, Office for Official Publications of the European Communities, Luxembourg (2003).
[15] INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Protection of the Public against Exposure Indoors due to Radon and Other Natural Sources of Radiation, IAEA Safety Standards Series No. SSG-32, IAEA, Vienna (2015).
[16] JOINT FAO/IAEA DIVISION OF NUCLEAR TECHNIQUES IN FOOD AND AGRICULTURE, INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Criteria for Radionuclide Activity Concentrations for Food and Drinking Water, IAEA-TECDOC-1788, IAEA, Vienna (2016).
[17] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR OFFICE, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Arrangements for the Termination of a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-11, IAEA, Vienna (2018).
[18] INTERNATIONAL ATOMIC ENERGY AGENCY, Monitoring for Compliance with Exemption and Clearance Levels, Safety Reports Series No. 67, IAEA, Vienna (2012).
[19] INTERNATIONAL ATOMIC ENERGY AGENCY, Programmes and Systems for Source and Environmental Radiation Monitoring, Safety Reports Series No. 64, IAEA, Vienna (2010).
[20] NUCLEAR REGULATORY COMMISSION, Multi-Agency Radiological Laboratory Analytical Protocols Manual, Rep. NUREG-1576, Initial Report, NRC, Washington, DC (2004).
[21] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Uncertainty of Measurement — Part 3: Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO/IEC Guide 98-3:2008, ISO, Geneva (2008).
[22] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Determination of the Characteristic Limits (Decision Threshold, Detection Limit and Limits of the Coverage Interval) for Measurements of Ionizing Radiation — Fundamentals and Application, ISO 11929 — Part 1: Elementary Applications (2019); Part 2: Advanced Applications (2019), Part 3: Applications to Unfolding Methods (2019); Part 4: Guidelines to Applications (2022), ISO, Geneva.
[23] INTERNATIONAL ATOMIC ENERGY AGENCY, Calibration of Radiation Protection Monitoring Instruments, Safety Reports Series No. 16, IAEA, Vienna (2000).

[24] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Measurement of radioactivity — Measurement and evaluation of surface contamination, ISO 7503 — Part 1: General principles (2016), Part 2: Test method using wipe-test samples (2016), Part 3: Apparatus calibration (2016), ISO, Geneva.
[25] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025:2017, ISO, Geneva (2017).
[26] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Guidance for Gamma Spectrometry Measurement of Radioactive Waste, ISO 19017:2015, ISO, Geneva (2015).

Annex I

EXAMPLES OF DETERMINING EXEMPTION FOR MATERIALS CONTAINING MORE THAN ONE RADIONUCLIDE

I–1. The following two examples show how the exemption criteria can be determined when more than one radionuclide is involved.

EXAMPLE 1

I–2. This example is for 10 kg of a liquid material containing 5×10^4 Bq of ^{241}Pu and 9×10^3 Bq of ^{241}Am.

I–3. The generic exemption levels for moderate amounts of material are specified in table I.1 of GSR Part 3 [I–1], and the weighted summation rules for the activity and activity concentration result in the following:

(a) Method 1 (see the explanation and equation in para. 4.23):
   (i) Activity:
      — $f(^{241}\text{Pu}) = 5 \times 10^4 / (5 \times 10^4 + 9 \times 10^3) = 0.85$.
      — $f(^{241}\text{Am}) = 9 \times 10^3 / (5 \times 10^4 + 9 \times 10^3) = 0.15$.
      — Thus, the derived exemption level for the mixture, $X_m = 1 / ((0.85 / 1 \times 10^5) + (0.15 / 1 \times 10^4)) = 4.2 \times 10^4$ Bq.
      — The total activity is $5 \times 10^4 + 9 \times 10^3 = 5.9 \times 10^4$ Bq. This exceeds 4.2×10^4 Bq; thus, the exemption level is exceeded.
   (ii) Activity concentration:
      — $f(^{241}\text{Pu}) = 5 / (5 + 0.9) = 0.85$.
      — $f(^{241}\text{Am}) = 0.9 / (5 + 0.9) = 0.15$.
      — Thus, the derived exemption level for the mixture, $X_m = 1 / ((0.85 / 1 \times 10^2) + (0.15 / 1 \times 10^0)) = 6.2$ Bq/g.
      — The total activity concentration is $5 + 0.9 = 5.9$ Bq/g. This does not exceed 6.2 Bq/g; thus, the exemption level is not exceeded.

(b) Method 2 (see the explanation and equation in para. 4.24):
   (i) Activity: $5 \times 10^4 / 1 \times 10^5 + 9 \times 10^3 / 1 \times 10^4 = 0.5 + 0.9 = 1.4$. This exceeds 1; thus, the exemption level is exceeded.
   (ii) Activity concentration: $5 / 1 \times 10^2 + 0.9 / 1 \times 10^0 = 0.05 + 0.9 = 0.9$. This does not exceed 1; thus, the exemption level is not exceeded.

In either method, one of the two criteria for exemption (i.e. total activity and activity concentration) is met; consequently, the material can be exempted without further consideration (i.e. qualifies for generic exemption).

EXAMPLE 2

I–4. This example is for a bulk amount of solid material containing ^{132}Te at an activity concentration of 0.9 Bq/g and ^{132}I at an activity concentration of 0.9 Bq/g.

I–5. For bulk amounts of solid material, the exemption levels are specified in table I.2 of GSR Part 3 [I–1]:

(a) Iodine-132 is the progeny of ^{132}Te and, as shown in footnote a to table I.2 of GSR Part 3 [I–1], does not need to be considered separately. Consequently, only the activity concentration of the parent nuclide, ^{132}Te, has to be considered.
(b) The activity concentration of 0.9 Bq/g does not exceed the corresponding exemption level for ^{132}Te of 1 Bq/g from table I.2 of GSR Part 3 [I–1]. The material is, therefore, exempt without further consideration (i.e. qualifies for generic exemption).

REFERENCE TO ANNEX I

[I–1] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

Annex II
EXAMPLES OF DOSIMETRIC MODELS FOR SURFACE CONTAMINATED ITEMS

II–1. This annex briefly describes several dosimetric models that can be used to assess effective doses resulting from the use, direct handling, processing or machining of surface contaminated items.

EUROPEAN COMMISSION DOSIMETRIC MODEL

II–2. Reference [II–1] is a technical document describing the dosimetric model, exposure scenarios and parameters underlying the derivation of surface contamination clearance levels as recommended by the European Commission (Article 31, Group of Experts) and as published in Ref. [II–2]. Even though the methodology is for selecting clearance levels for residual surface contamination on metals (e.g. equipment, tools, scrap) arising from the dismantling of nuclear installations, it can be applied more generally to derive effective doses relating to surface contamination, including contamination on other solid, non-metallic objects or items.

II–3. The methodology evaluates the effective dose incurred by persons due to total surface contamination (fixed and removable) in two exposure scenarios: the processing of cleared scrap (transport, automated and manual processing) and the reuse of cleared items. The first scenario considers the transport, handling and sorting of cleared scrap, as well as its automated or manual processing and machining, such as pressing, shredding, milling and segmenting (e.g. thermal processing, sawing, grinding). The second scenario considers exposures from the continued reuse of cleared equipment from an authorized facility, including exposures due to inhalation of radionuclides from the cleaning, sanding or scrapping (thermal segmentation) of this equipment.

II–4. The exposure scenarios in Ref. [II–1] are constructed such that only the dominating exposure pathway is considered in each conservatively defined sub-scenario. This means that the corresponding annual effective dose contributions are considered separately and are not summed to yield a total effective dose (in contrast to other dosimetric models for surface contamination). The maximum dose contribution (from all sub-scenarios), then, determines the limiting value of the surface contamination clearance level. The exposure pathways considered are the skin dose from beta emitters, the external effective

dose from gamma emitters, the committed effective dose from inadvertent ingestion and the committed effective dose from inhalation.

IAEA COORDINATED RESEARCH PROJECT DOSIMETRIC MODEL

II–5. In 2001, the IAEA initiated a coordinated research project to review the scientific basis of the limits for removable surface contamination specified in the IAEA Transport Regulations (now published as IAEA Safety Standards Series No. SSR-6 (Rev. 1), Regulations for the Safe Transport of Radioactive Material, 2018 Edition [II–3]). These limits are based on a simple dosimetric model (see paras 508.1 and 508.2 of IAEA Safety Standards Series No. SSG-26 (Rev. 1), Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition) [II–4]). The findings and conclusions of the project, which was also tasked "to develop guidance material for evaluating the radiological significance of surface contamination to workers and the public in the light of state of the art research and technical developments and current transport practices", were published in Ref. [II–5].

II–6. The model in Ref. [II–5] evaluates the occupational dose incurred by transport workers handling various types of surface contaminated package[1], as well as the possible doses received by members of the public during transport operations. The model calculates the total annual effective dose per unit of non-fixed surface contamination (μSv/a per Bq/cm^2) with contributions from skin contamination (transfer of contamination), external exposure from the package surface, inhalation of resuspended activity and ingestion of activity transferred to the hands (secondary, hand-to-mouth ingestion). The model evaluations are considered to be conservative. The model has since been modified and extended for further use outside the domain of transport [II–6 to II–8].

DOSIMETRIC MODEL BY OGINO AND HATTORI

II–7. The model by Ogino and Hattori [II–8] is based on the IAEA model originally developed for transport safety [II–6]. The model was further developed by classifying surface contaminated objects into three general categories with independent flat areas (m^2): manually handled objects (0.1 m^2); closely handled objects (1 m^2); and remotely handled objects (10 m^2). Two scenarios are

[1] Packages used for the transport of radioactive material; however, only the exposures from the surface contamination on the outside of these packages are calculated.

considered: in the realistic scenario, the surface contamination is assumed to be distributed over one tenth of the central surface area of each object; in the low probability scenario, the entire surface of the objects is contaminated. The effects of uncertainty associated with the exposure scenarios were also examined using a probabilistic calculation [II–9].

RIVM-SUDOQU DOSIMETRIC MODEL

II–8. The RIVM-SUDOQU model [II–6, II–7] was developed with the aim of assessing public exposure and occupational exposure from scenarios relating to the handling and use of surface contaminated retail products, items and objects in indoor and outdoor environments. Since consumers may use the same product throughout the year, the removal of activity by resuspension and abrasion is explicitly considered by the dosimetric model. Surface contamination levels thus become time dependent, being reduced through product use as well as radioactive decay. This time dependency is incorporated into the RIVM-SUDOQU model through the use of mass balance equations. The model evaluates the total annual individual effective dose from all exposure pathways per unit of surface contamination (μSv/a per Bq/cm^2) based on the main exposure pathways (i.e. external exposure, inhalation, ingestion and skin contamination) for removable, fixed and total contamination levels.

II–9. The RIVM-SUDOQU model can also bypass the mass balance equations, and by doing so it converges towards the IAEA coordinated research project method in Ref. [II–5]. In this mode, the model can also assess occupational exposure scenarios usually characterized by the continuous flow of newly contaminated items for which the mass balance framework is redundant. Furthermore, a small adaptation of the RIVM-SUDOQU model produces the same approach used in the Ogino and Hattori model [II–8, II–9]. Consequently, the RIVM-SUDOQU model can be used as a benchmark in dosimetric modelling.

II–10. A pilot project also revealed the applicability of the RIVM-SUDOQU model in the derivation of radionuclide-specific surface contamination clearance levels based on deterministic calculations and reuse scenarios relevant to nuclear installations [II–10, II–11]. In a corresponding benchmarking study, several results were compared with those from other dosimetric models for surface contamination, such as the European Commission model described in paras II–2 to II–4. Further development of the RIVM-SUDOQU model allowed for detailed parameter sensitivity analyses and probabilistic dose evaluations.

RESRAD-BUILD DOSIMETRIC MODEL

II–11. The RESRAD-BUILD model [II–12] evaluates the radiation doses incurred while working or living inside buildings contaminated with residual radioactivity: on surfaces of floors, walls and ceilings; within building materials (e.g. drywall, concrete, pipes); or accumulated inside the building (e.g. in equipment, objects or filters). RESRAD-BUILD is a multicompartment[2] pathway analysis model that considers two specific types of exposure scenario: building occupancy scenarios and building renovation scenarios. The first type of scenario usually involves long term, chronic exposures, for example of residents, office workers and industrial workers. In these scenarios, contaminants may become airborne owing to normal use and cleaning of the building. In the second type of scenario, involving building decontamination and renovation, exposure to higher contamination levels typically occurs over shorter timescales (compared with building occupancy scenarios) but under controlled conditions. These scenarios include activities such as sanding a floor, chipping concrete and removing or installing drywall.

II–12. A model run can contain up to ten different sources, whose geometry can be a volume, surface area, line or point. By mechanical removal or erosion, source activity becomes airborne and is further analysed by an air quality compartment model. The model run can contain up to ten receptor points for which the total effective dose equivalent is calculated. The exposure pathways considered are external exposure to radiation from the source; external exposure to radiation from deposited activity on the floor; external exposure from submersion in airborne activity; inhalation of airborne activity; inhalation of radon decay products and tritiated water vapour; inadvertent ingestion of removable activity directly from the source; and inadvertent ingestion of activity deposited on building surfaces. The RESRAD-BUILD computer code can perform both deterministic and probabilistic dose analyses. It has been successfully applied to assess the potential dose distribution resulting from surface contamination using indoor occupational exposure scenarios [II–13].

[2] The building can contain up to three rooms.

REFERENCES TO ANNEX II

[II–1] EUROPEAN COMMISSION, Basis for the Definition of Surface Contamination Clearance Levels for the Recycling or Reuse of Metals Arising from the Dismantling of Nuclear Installations, Radiation Protection 101, Office for Official Publications of the European Communities, Luxembourg (1999).

[II–2] EUROPEAN COMMISSION, Recommended Radiological Protection Criteria for the Recycling of Metals from the Dismantling of Nuclear Installations, Radiation Protection 89, Office for Official Publications of the European Communities, Luxembourg (1998).

[II–3] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, 2018 Edition, IAEA Safety Standards Series No. SSR-6 (Rev. 1), IAEA, Vienna (2018).

[II–4] INTERNATIONAL ATOMIC ENERGY AGENCY, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition), IAEA Safety Standards Series No. SSG-26 (Rev. 1), IAEA, Vienna (2022).

[II–5] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiological Aspects of Non-fixed Contamination of Packages and Conveyances, IAEA-TECDOC-1449, IAEA, Vienna (2005).

[II–6] VAN DILLEN, T., SUDOQU: A new dose model to derive criteria for surface contamination of non-food (consumer) goods, containers and conveyances, Radiat. Prot. Dosim. 164 1–2 (2015) 160.

[II–7] VAN DILLEN, T., VAN DIJK, A., SUDOQU, a new dose-assessment methodology for radiological surface contamination, J. Radiol. Prot. 38 3 (2018) 1147.

[II–8] OGINO, H., HATTORI, T., Calculation of isotope-specific exemption levels for surface contamination, Appl. Radiat. Isot. 67 (2009) 1282.

[II–9] OGINO, H., HATTORI, T., Verification of validity of isotope-specific exemption levels for surface contamination using Monte Carlo calculation, Jpn J. Health Phys. 44 (2009) 400.

[II–10] RUSSO, F., MOMMAERT, C., VAN DILLEN, T., Clearance of surface-contaminated objects from the controlled area of a nuclear facility: Application of the SUDOQU methodology, Atw. Int. Z. Kernenergie 63 1 (2018).

[II–11] VAN DILLEN,T., Bel V, personal communication, 2023.

[II–12] YU, C., et al., User's Manual for RESRAD-BUILD Version 3, Rep. ANL/EAD/03-1, Argonne National Laboratory, IL (2003).

[II–13] KAMBOJ, S., YU, C., RABOVSKY, J., Potential Dose Distributions at Proposed Surface Radioactivity Clearance Levels Resulting from Occupational Scenarios, Rep. ANL/EVS/TM/11-3, Argonne National Laboratory, IL (2011).

Annex III

EXAMPLES OF SCREENING VALUES APPLIED IN CASES OF EXISTING EXPOSURE SITUATIONS

EXAMPLE 1: SCREENING VALUES APPLIED AFTER THE ACCIDENT AT THE FUKUSHIMA DAIICHI NUCLEAR POWER PLANT

Introduction

III–1. IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [III–1], uses the concept of exemption only within the context of planned exposure situations. However, within the context of the existing exposure situation after the accident at the Fukushima Daiichi nuclear power plant in Japan, certain screening values have been used in decision making with regard to the management of waste contaminated with radioactive material.

III–2. Following the Fukushima Daiichi accident, the Nuclear Safety Commission of Japan (NSC) issued more than 200 technical advisory documents up to 10 September 2012, based on the Act on Special Measures Concerning Nuclear Emergency Preparedness [III–2], which came into effect in 1999 after the Japan Nuclear Fuel Conversion Company (JCO) criticality accident in Japan. International Commission on Radiological Protection recommendations and the IAEA safety standards were taken into account in the development of these technical advisory documents.

III–3. For the optimization of protection for a member of the public in the existing exposure situation after the Fukushima Daiichi accident, the NSC advised selecting an appropriate reference level from the lower part of the 1–20 mSv/a band, with the long term objective of a 1 mSv/a reference level, as recommended by the International Commission on Radiological Protection [III–3]. Following this advice, the Government of Japan has set 1 mSv/a as the long term objective for the additional dose to a member of the public.

III–4. With respect to the treatment of contaminated waste generated from the accident, the NSC has provided advice to ensure that the additional dose to workers at the treatment facility and members of the public around the facility is kept to below 1 mSv/a, based on the advice of the NSC. Furthermore, the NSC has advised keeping the additional dose to a member of the public who lives in

the vicinity of the disposal facility after the termination of institutional control to below 10 μSv/a.

Management of large amounts of contaminated waste

III–5. The Great East Japan Earthquake and resulting tsunami generated a large amount of waste, part of which was contaminated by radionuclides released from the Fukushima Daiichi nuclear power plant. To effectively and safely treat the waste, the Ministry of the Environment of Japan set a screening value, in terms of radionuclide activity concentration, to distinguish the waste that could be treated under the conventional law on waste management [III–4] (i.e. waste below the screening value) from the waste that would be subject to additional radiation protection regulations (i.e. waste exceeding the screening value), as prescribed by the Act on Special Measures, promulgated on 30 August 2011 [III–5].

III–6. In the Act on Special Measures [III–5], the screening value has been set at 8000 Bq/kg for ^{134}Cs plus ^{137}Cs. This value is based on the criterion that the additional dose to a member of the public or a worker will be less than 1 mSv/a. If this screening value is exceeded, the waste is specified as 'designated waste' and additional treatment for radiation protection purposes is applied, such as the cement solidification of soot and dust, and periodic measurements are taken of radioactivity in gas and liquids discharged from the facility, in accordance with the Act on Special Measures [III–5]. If the screening value is not exceeded, the waste is subject to normal waste treatment by local authorities or operators under the conventional law on waste management [III–4]. Figure III–1 shows the flow diagram for the management of decontamination of waste and soil and 'specified waste' (i.e. based on the Act on Special Measures [III–5]).

Application of screening values in an existing exposure situation

III–7. GSR Part 3 [III–1] uses the concept of exemption only within the context of planned exposure situations. However, the screening values described in paras II–5 and II–6 can be considered an example of a similar decision making tool in the context of the existing exposure situation after the Fukushima Daiichi accident. A large amount of waste contaminated with radioactive material already existed when a decision on control had to be taken, and under the prevailing circumstances, the screening value for waste (8000 Bq/kg for ^{134}Cs plus ^{137}Cs) was set by the regulatory body.

III–8. The IAEA safety standards emphasize the importance of a graded approach in the regulation of facilities and activities. In particular, para. 4.5 of

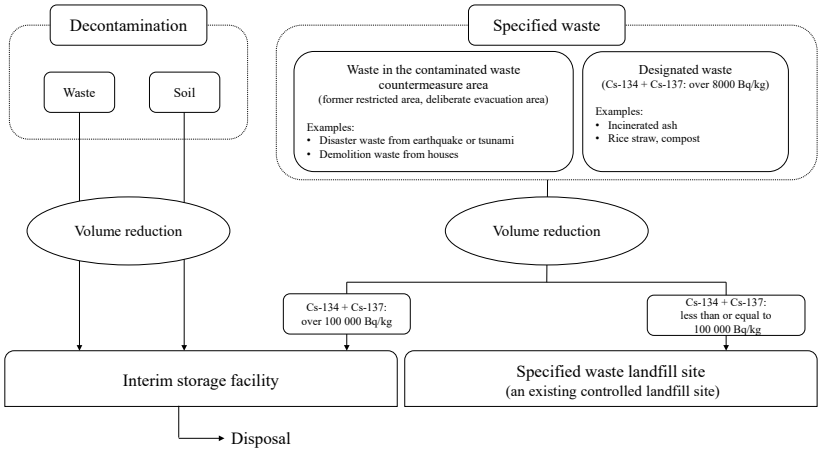

FIG. III–1. Flow diagram for treatment of decontamination of waste and soil and specified waste based on the Act on Special Measures in Fukushima Prefecture (modified from Ref. [III–7] with permission).

IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety [III–6], states:

> "The regulatory body shall allocate resources commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach. Thus, for the lowest associated radiation risks, it may be appropriate for the regulatory body to exempt a particular activity from some or all aspects of regulatory control".

The screening values applied to the specification of designated waste are an example of the implementation of the graded approach using an appropriate activity concentration level for waste.

Public perception

III–9. The screening value for waste was derived from a conservative scenario to ensure that the additional exposure remained below 1 mSv/a for a member of the public or a worker during the treatment of waste and below 10 μSv/a for a member of the public after the termination of institutional control. However, it has not always been accepted that waste at or below the screening value can be treated safely under the relevant standards set by the regulatory body. Some

waste treatment operators have set their own waste acceptance criteria below the screening value in consideration of the anxiety expressed by local residents and to help facilitate the treatment of waste.

Screening values for the control of surface contamination

III–10. Large amounts of removed soil and waste generated from decontamination activities have been regulated under the Act on Special Measures [III–5] and safely stored at temporary storage sites before being transported to the interim storage facility (see Fig. III–1). When the transport vehicle departs daily from the temporary storage sites after unloading the removed soil and waste, the ordinance by the Ministry of Health, Labour and Welfare of Japan [III–8] requires that the surface contamination level on the vehicle does not exceed 40 Bq/cm^2, which corresponds to 13 000 counts per minute (cpm) assuming the use of a typical Geiger–Müller (GM) survey meter with a 50 mm bore, which is widely used in Japan. If the survey meter reading exceeds 13 000 cpm, the surface is decontaminated. Thus, this is an example of a screening value being applied in decision making for the management of surface contamination in an existing exposure situation.

III–11. With respect to the control of surface contaminated objects, guidelines for planned exposure situations, emergency exposure situations and existing exposure situations have been developed by the Standardization Committee on Radiation Protection of the Japan Health Physics Society [III–9]. Table III–1 summarizes the main points of the guidelines. Objects are defined as valuable solid goods (e.g. vehicles, equipment) for which reuse or recycling has been justified; the term ‘commodities’ is used in the translation of the guidelines [III–9]. For the existing exposure situation, the guidelines recommend an individual effective dose criterion of less than 1–10 mSv/a, depending on the prevailing circumstances, and give an example of readings of the typical GM survey meter of 21 000 cpm, corresponding to an annual effective dose criterion of 1 mSv. Therefore, the screening value for the transport vehicle at the temporary storage sites described in para. III–10 satisfies the guidelines (i.e. 13 000 cpm < 21 000 cpm), which implies that the additional dose to a member of the public and to workers remains below 1 mSv/a.

TABLE III–1. SUMMARY OF GUIDELINES FOR MOVING OUT OBJECTS CONTAMINATED WITH RADIOACTIVE MATERIAL IN PLANNED EXPOSURE SITUATIONS, EMERGENCY EXPOSURE SITUATIONS AND EXISTING EXPOSURE SITUATIONS
(*modified from Ref. [III–9] with permission*)

	Planned exposure situation	Emergency exposure situation	Existing exposure situation
Dose criteria (effective dose)	Order of 10 μSv/a or less	Less than 10 mSv/a	Less than 1–10 mSv/a
Referred concept	Clearance	Generic criterion from IAEA GSR Part 7 [III–10]	Intervention
Basic purpose and concepts	Moving out from controlled area to general area Application of the concept of clearance to many relatively small objects moved out	Moving out from the area affected by radioactive material released in a nuclear or radiological emergency Justification and optimization One tenth of the maximum reference level of 20–100 mSv/a for an emergency exposure situation An upper bound of 1 mSv/a effective dose for international export	Moving out from the area affected by a nuclear or radiological emergency or an area in recovery from an accident to a less affected or ordinary area Justification and optimization The lower part of the 1–20 mSv/a band, which is the reference level in an existing exposure situation An upper bound of 1 mSv/a effective dose for international export

TABLE III–1. SUMMARY OF GUIDELINES FOR MOVING OUT OBJECTS CONTAMINATED WITH RADIOACTIVE MATERIAL IN PLANNED EXPOSURE SITUATIONS, EMERGENCY EXPOSURE SITUATIONS AND EXISTING EXPOSURE SITUATIONS
(*modified from Ref. [III–9] with permission*) (cont.)

	Planned exposure situation	Emergency exposure situation	Existing exposure situation
Exposure scenarios	Handling of small packages [III–11] Handling of general objects [III–12]	Handling of spent fuel casks [III–11] Handling of general objects [III–12]	Handling of spent fuel casks [III–11] Handling of general objects [III–12]
Examples of readings of typical GM survey meter widely used in Japan	1000 cpm (10 Bq/cm^2 of Co-60) 2300 cpm (10 Bq/cm^2 of Cs-137)	460 000 cpm (1900 Bq/cm^2 of I-131 + 19 Bq/cm^2 of Cs-134 + 19 Bq/cm^2 of Cs-137)	21 000 cpm (0.44 Bq/cm^2 of I-131 + 44 Bq/cm^2 of Cs-134 + 44 Bq/cm^2 of Cs-137), corresponding to the annual effective dose criterion of 1 mSv

EXAMPLE 2: SCREENING VALUES APPLIED FOR CONSTRUCTION MATERIALS

III–13. Building materials[1] and construction materials (hereinafter referred to collectively as 'construction materials') generally contain some levels of natural or artificial radionuclides. Radionuclide concentrations can depend on the geological origin of the materials and/or can result from (residual) contamination from either authorized or past practices, or from a nuclear or radiological emergency. Identification of construction materials and verification of compliance with Requirement 51 of GSR Part 3 [III–1] is not always straightforward. Therefore, the government and the regulatory body can apply certain screening values to aid the decision making process, as explained in Ref. [III–13].

III–14. Producers and manufacturers of construction materials, and importers, traders and construction companies, could be considered the responsible parties at different stages of the life cycle of such materials and therefore will be responsible for demonstrating compliance with regulations.

III–15. States have adopted various methods to deal with the regulation of construction materials. In accordance with a graded approach, restrictions on the use of construction materials for residential, public, industrial or other purposes could, for instance, be defined on the basis of activity concentration measurements.

III–16. Relevant guidance to characterize and control radioactivity in construction materials can be issued by an appropriate regulatory body or other competent authority in the areas of radiation protection or public health, or as building codes. The guidance needs to establish a means of identifying construction materials that could lead to doses to members of the public that are higher than the relevant reference level. In addition, the regulations and guidance need to include provisions for measurement quality, record keeping of measurement results, and the form and frequency of reporting.

III–17. Paragraph 5.22 of GSR Part 3 [III–1] specifies a reference level in terms of an annual effective dose of about 1 mSv for exposure due to radionuclides in construction materials. The reference level of about 1 mSv applies only to the dose received from exposure to gamma radiation from the construction materials (i.e. it excludes any additional dose from ^{222}Rn or ^{220}Rn released from these materials into indoor air) [III–14]. Realistic estimation of the annual effective

[1] Building materials are construction materials used for the construction of buildings, such as dwellings, offices, industrial premises and other workplaces.

dose to the representative person is complex and generally needs to be performed by radiation protection experts. Therefore, it is common practice to include the use of screening values in the guidance for practical purposes to provide a simpler means of demonstrating compliance with the reference level. Such screening values could involve the establishment and use of the following:

(a) Derived activity concentrations for the radionuclides of interest;
(b) A method for applying an 'activity index' (see para. III–18);
(c) Derived operational levels expressed in terms of gamma dose rates.

III–18. An activity index is a dimensionless quantity derived from measured activity concentrations of radionuclides that might be present in building and construction materials, typically ^{40}K, ^{226}Ra and ^{232}Th. Additional artificial radionuclides might need to be considered, where appropriate. Screening values can be expressed as an activity index against which the calculated index is to be compared to estimate whether the material complies with the dose reference level. Annexes I and II to Ref. [III–13] provide more guidance on the calculation of the activity index, as well as on measurement methods and dose calculation and modelling, derivation of screening values, and the use of gamma dose rates as operational screening values. (See also section 4 of IAEA Safety Standards Series No. SSG-32, Protection of the Public Against Exposure Indoors due to Radon and Other Natural Sources of Radiation [III–14].)

III–19. Where construction materials are not used as a bulk material but, for instance, as a superficial or decorative material, such as in tiles, gypsum board or granite decorations, a different screening value for the activity index may be applicable. For example, in China, the Czech Republic and Finland, the activity index for such superficial materials differs from the activity index for bulk materials [III–13].

III–20. Construction materials exceeding the relevant screening value for the measured or calculated quantity may still be used in a restricted manner or with certain conditions, in accordance with a graded approach. Examples of such conditional provisions in national regulations are provided in annex IV to Ref. [III–13].

REFERENCES TO ANNEX III

[III–1] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

[III–2] GOVERNMENT OF JAPAN, Act on Special Measures Concerning Nuclear Emergency Preparedness (Act No. 156), Government of Japan, Tokyo (1999) (in Japanese).

[III–3] INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Application of the Commission's Recommendations to the Protection of People Living in Long-term Contaminated Areas After a Nuclear Accident or a Radiation Emergency, Publication 111, Elsevier, Oxford (2009).

[III–4] GOVERNMENT OF JAPAN, Waste Management and Public Cleansing Law (Law No. 137), Government of Japan, Tokyo (1970) (in Japanese).

[III–5] GOVERNMENT OF JAPAN, Act on Special Measures Concerning the Handling of Environmental Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District off the Pacific Ocean Earthquake That Occurred on 11 March 2011 (Law No. 110), Government of Japan, Tokyo (2011) (in Japanese).

[III–6] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), IAEA, Vienna (2016).

[III–7] MINISTRY OF THE ENVIRONMENT, FY2014 Decontamination Report: A Compilation of Experiences to Date on Decontamination for the Living Environment Conducted by the Ministry of the Environment, Government of Japan, Tokyo (2015) (in Japanese).

[III–8] MINISTRY OF HEALTH, LABOUR AND WELFARE, Ordinance on Prevention of Ionizing Radiation Hazards at Works to Decontaminate Soil and Wastes Contaminated by Radioactive Materials Resulting from the Great East Japan Earthquake and Related Works (Ordinance No. 152), Government of Japan, Tokyo (2011).

[III–9] JAPANESE STANDARDIZATION COMMITTEE ON RADIATION PROTECTION, Summary of the three guidelines for moving out of commodities with radioactive contamination in planned, emergency and existing exposure situations, Jpn J. Health Phys. **52** 4 (2017) 311.

[III–10] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

[III–11] MUNAKATA, M. Applicable limits on non-fixed surface contamination for safe transport of radioactive materials, Packag. Transp. Storage Secur. Radioact. Mater. 24 (2013) 191.

[III–12] OGINO, H., HATTORI, T. Calculation of isotope-specific exemption levels for surface contamination, Appl. Radiat. Isot. 67 (2009) 1282.

[III–13] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulatory Control of Exposure due to Radionuclides in Building Materials and Construction Materials, Safety Reports Series No. 117, IAEA, Vienna (2023).

[III–14] INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Protection of the Public Against Exposure Indoors due to Radon and Other Natural Sources of Radiation, IAEA Safety Standards Series No. SSG-32, IAEA, Vienna (2015).

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