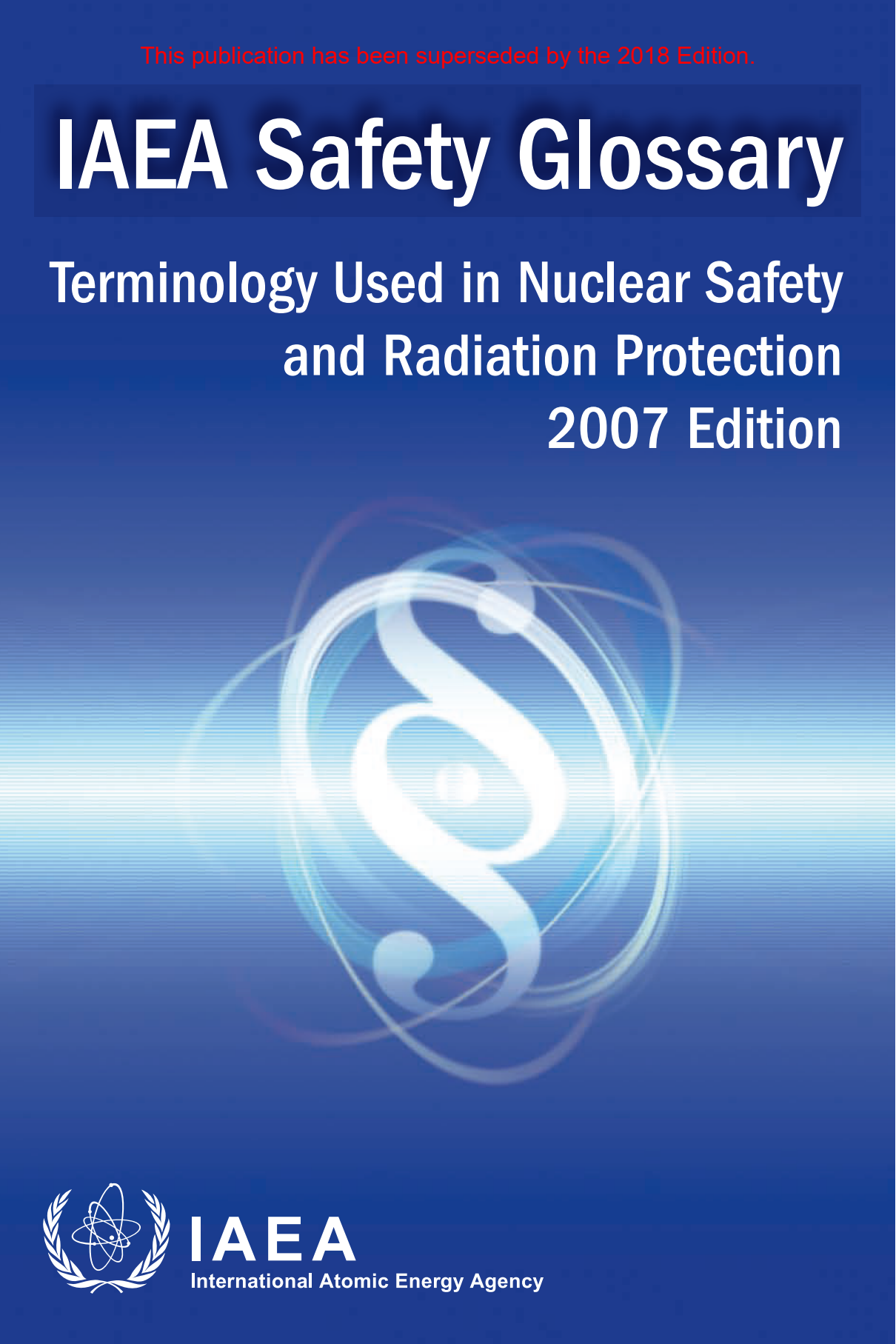
IAEA Safety Glossary

Terminology Used in Nuclear Safety and Radiation Protection 2007 Edition



IAEA
International Atomic Energy Agency

IAEA SAFETY 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, and also general safety (i.e. all these areas of safety). The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Safety standards are coded according to their coverage: nuclear safety (NS), radiation safety (RS), transport safety (TS), waste safety (WS) and general safety (GS).

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

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

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

OTHER SAFETY RELATED PUBLICATIONS

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

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

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

IAEA SAFETY GLOSSARY

TERMINOLOGY USED IN NUCLEAR SAFETY AND RADIATION PROTECTION

2007 EDITION

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

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TERMINOLOGY USED IN NUCLEAR SAFETY AND RADIATION PROTECTION

2007 EDITION

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2007

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FOREWORD

In developing and establishing standards of safety for protecting people and the environment from harmful effects of ionizing radiation and for the safety of facilities and activities that give rise to radiation risks, clear communication on scientific and technical concepts is essential. The principles, requirements and recommendations that are established and explained in the IAEA's safety standards and elaborated upon in other publications must be clearly expressed. To this end, this Safety Glossary defines and explains technical terms used in IAEA safety standards and other safety related publications, and provides information on their usage.

The primary purpose of the Safety Glossary is to harmonize terminology and usage in the IAEA safety standards for protecting people and the environment from harmful effects of ionizing radiation, and in their application. Once definitions of terms have been established, they are, in general, intended to be observed in safety standards and other safety related publications and in the work of the IAEA Department of Nuclear Safety and Security generally.

The achievement of consistently high quality in its publications contributes to the authority and credibility of the IAEA, and thus to its influence and effectiveness. High quality in publications and documents is achieved not only by review to ensure that the relevant requirements are met, but also by managing their preparation so as to achieve high quality in their drafting.

The Safety Glossary provides guidance primarily for the drafters and reviewers of safety standards, including IAEA technical officers and consultants and bodies for the endorsement of safety standards. The Safety Glossary is also a source of information for users of IAEA safety standards and other safety and security related IAEA publications and for other IAEA staff — notably writers, editors, translators, revisers and interpreters.

Users of the Safety Glossary, in particular drafters of national legislation, should be aware that the terms included have been chosen and the definitions and explanations given have been drafted for the purpose mentioned above. Terminology and usage may differ in other contexts, such as in binding international legal instruments and in the publications of other organizations.

It is recognized that the Safety Glossary will be of wider interest, and it is therefore now issued as an IAEA publication. It is intended to issue a CD-ROM that will include this Safety Glossary (2007 Edition) and versions of the publication in the other five official languages of the IAEA: Arabic, Chinese, French, Russian and Spanish. These other five versions will also be made available for downloading from the Safety Glossary web site.

It is intended to revise and update the Safety Glossary periodically in the light of changes in terminology and usage in the safety standards due to developments in technology and changes in regulatory approaches in Member States. The IAEA Secretariat invites the submission of feedback concerning the definitions of technical terms and the explanations of their usage given in the Safety Glossary from users of the IAEA safety standards (in English and in translation) and other safety related publications. A change form is provided on the Safety Glossary web site — http://www-ns.iaea.org/standards/safety-glossary.htm — for the submission of information or suggestions for consideration in a revision of the Safety Glossary.

The first version of the Safety Glossary, which was compiled and developed by I. Barraclough, was issued in 2000. The Safety Glossary, 2007 Edition, is a revised and updated version. In revising the Safety Glossary, account has been taken of safety standards issued since 2000 and of the comments and suggestions submitted in the revision process and in the course of its translation. The IAEA gratefully acknowledges the contributions of all those who provided comments and suggestions on the Safety Glossary. The IAEA officer responsible for this glossary is D. Delves of the Department of Nuclear Safety and Security.

EDITORIAL NOTE

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INTRODUCTION

BACKGROUND

Terminology in IAEA safety standards

The IAEA's safety standards for nuclear installations, radiation protection, radioactive waste management and the transport of radioactive material have historically been developed in four separate programmes. For nuclear installations and radioactive waste management, safety standards programmes were set up to coordinate the development of standards covering the different parts of the subject. The radiation and transport safety standards programmes have each been centred on one key set of safety requirements — the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the Basic Safety Standards, BSS) [1] and the Regulations for the Safe Transport of Radioactive Material (the Transport Regulations) [2], respectively — with other safety requirements and guidance elaborating on particular parts of these central publications. Each of the four groups of safety standards had developed its own terminology:

(a) In 1986, the IAEA published a Radiation Protection Glossary[1] in the former IAEA Safety Series, which provided, in English, French, Russian and Spanish, a collection of fundamental terms associated with radiation protection and their definitions. Many of the terms and definitions in this publication are now obsolete, and the Basic Safety Standards issued in 1996 [1] included more up to date definitions of key terms in radiation protection and safety.
(b) In 1982, a Waste Management Glossary was published by the IAEA as IAEA-TECDOC-264. A revised and updated version was issued in 1988 as IAEA-TECDOC-447, a third edition was published in 1993 and a fourth edition was published in 2003 [3].
(c) In nuclear safety, compilations of terms and definitions were produced for internal use, but not published. Nevertheless, the lists of definitions given in the Nuclear Safety Standards Codes published by the IAEA in 1988 provide a core set of the fundamental terms.

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection Glossary (Safety Guide), Safety Series No. 76, IAEA, Vienna (1986).

(d) The definitions in the 2005 edition of the IAEA Transport Regulations [2] represent the current core terminology for transport safety.

With the creation of the Department of Nuclear Safety in 1996, and the adoption of a harmonized procedure for the preparation and review of safety standards in all areas[2], the need for greater consistency in the use of terminology became apparent. The incorporation into the Department of the Office of Nuclear Security in 2004 further extended its scope. This Safety Glossary is intended to contribute towards harmonizing the use of terminology in IAEA safety standards and the IAEA's other safety and security related publications.

Scope of 'protection and safety' and coverage of 'nuclear security'

In the context of the IAEA's Major Programme on Nuclear Safety and Security, '(radiation) protection and (nuclear) safety' denotes the protection of people and the environment against radiation risks, and the safety of facilities and activities that give rise to radiation risks. 'Nuclear safety' is usually abbreviated to 'safety' in IAEA publications. In IAEA safety standards, 'safety' means 'nuclear safety' unless otherwise stated. 'Protection and safety' (i.e. radiation protection and nuclear safety) encompasses the safety of nuclear installations, radiation safety, the safety of radioactive waste management and safety in the transport of radioactive material; it does not include aspects of safety not related to radiation.

Safety is concerned with both radiation risks under normal circumstances and radiation risks as a consequence of incidents, as well as with other possible direct consequences of a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation. 'Radiation' in this context means ionizing radiation. 'Incidents' includes initiating events, accident precursors, near misses, accidents and unauthorized acts (including malicious and non-malicious acts).

'Safety measures' include actions to prevent incidents and arrangements put in place to mitigate their consequences if they were to occur. 'Nuclear security' denotes the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Preparation and Review of Safety Related IAEA Publications (Version 2.2), IAEA, Vienna (1998).

Safety measures and security measures have in common the aim of protecting human life and health and the environment. The safety standards concern the security of facilities and activities to the extent that they require 'security for safety' measures that contribute to both safety and security, such as:

(a) Appropriate provisions in the design and construction of nuclear installations and other facilities;
(b) Controls on access to nuclear installations and other facilities to prevent the loss of, and the unauthorized removal, possession, transfer and use of, radioactive material;
(c) Arrangements for mitigating the consequences of accidents and failures, which also facilitate measures for dealing with breaches in security that give rise to radiation risks;
(d) Measures for the security of the management of radioactive sources and radioactive material.

GENERAL REMARKS

Purpose

The Safety Glossary serves a number of different purposes:

(a) To explain the meanings of technical terms that may be unfamiliar to the reader;
(b) To explain any special meanings ascribed to common words or terms (since words can have several different meanings, it may be necessary to clarify which meaning is intended, particularly for non-native English speakers);
(c) To define precisely how terms — whose general meaning may be clear to readers — are used in a particular publication or set of publications, in order to avoid ambiguity concerning some important aspect(s) of their meaning;
(d) To explain the connections or differences between similar or related terms, or the specific meanings of the same technical term in different contexts;
(e) To clarify and, if possible, reconcile differences in the usage of specialist terms in different subject areas, since such differences in usage may be potentially misleading;

(f) To recommend terms that should be used in IAEA publications and documents (and those that should not), and the definitions that should be ascribed to them.

Definitions of the type used in legal texts such as the Convention on Nuclear Safety [4] or the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5], or in regulations such as the Transport Regulations [2], are intended primarily for purpose (c) and, in some cases, do not serve the other purposes at all. Furthermore, definitions of this nature tend to be tailored to the needs of the specific text to which they relate, and hence are often not generally applicable. The 'definitions' included in other safety standards are, however, less easily classified, tending towards a mixture of definition and explanation, and of context specific and generally applicable definitions and/or explanations.

For the purposes of the Safety Glossary, an effort has been made to distinguish between the 'definition' — material that could be used in the definitions in an individual publication — and 'explanation', which is provided to assist drafters and reviewers but is not part of the 'definition'. However, this distinction is not always as clear cut as might be wished.

Note that a glossary is not the place to specify requirements or guidance. The definition of a term should contain the conditions that must be met in order for the term to be applicable, but not other conditions. This is best illustrated by an example. The definition of *regulatory body* indicates the conditions that must be met in order for an organization to be described as a *regulatory body*, but not the attributes of a *regulatory body* as required by IAEA safety standards. Hence, the definition specifies that it is "designated by the government of a State as having legal authority for conducting the regulatory process" — otherwise, it is not a *regulatory body*. However, the definition does not, for example, specify that it is "independent of organizations or bodies charged with the promotion of nuclear technologies" — it can be a *regulatory body* without being independent, even though it would then not satisfy the IAEA Safety Requirements on legal and governmental infrastructure for safety.

Scope

The scope of the Safety Glossary is necessarily limited, and is intended to focus on the key terms that are specific to, or that are used in a specific way in, protection and safety (and, to a limited extent, security). A number of general categories of terms that may be used in safety related publications have been specifically excluded from this Safety Glossary (except where a specific point

needs to be made about a specific term). These groups of excluded terms include:

(a) Basic terms from radiation and nuclear physics (e.g. alpha particle, decay, fission, radionuclide). An understanding of these terms is assumed.
(b) The specialized terminology of fields other than protection and safety (e.g. geology, seismology, meteorology, medicine and computing). This terminology may be used in protection and safety contexts, but the definition of such terms is left to the experts in the relevant fields.
(c) Very specialized terminology from a specific field within protection and safety (e.g. the detailed terminology of dosimetry and safety assessment). If necessary, such terminology can be defined in the specialized publications to which it is relevant.

USE OF THE SAFETY GLOSSARY

Interpretation of entries in the Safety Glossary

The entry for each term starts with one or more recommended definition(s)[3]. Alternative definitions are given:

(a) If the term is used in two or more distinct safety related contexts (e.g. the term *clearance*, which is used for an administrative mechanism for removing material from regulatory control and for a biological process affecting the movement of inhaled radionuclides in the body); or
(b) If it is necessary to include in this Safety Glossary an established definition that is still needed but is not considered suitable as a general definition (this includes, in particular, some of the definitions from the Basic Safety Standards [1] and the Transport Regulations [2] that may need to be retained in supporting publications but which would not be the preferred general definitions); or
(c) To include definitions of which drafters and reviewers of IAEA publications should be aware, even though they are unlikely to be used in

[3] A few terms are included without a recommended definition. In most such cases, the term in question is the general (unqualified) term used to group a number of qualified terms, and has no special meaning in unqualified form (e.g. *action level*, *recording level*, etc., are listed under *level*, but level itself is not defined). In some cases guidance is given on usage for terms with no agreed definition (e.g. *terrorism*).

IAEA publications (definitions in the main safety related conventions are an important example of this group); or

(d) For a small number of basic terms that have two distinct definitions, depending on whether they are being used in a scientific or regulatory (i.e. standards) context. An important example in the context of protection and safety is the adjective *radioactive*. Scientifically, something is described as radioactive if it exhibits the phenomenon of radioactivity or — in the somewhat less precise, but generally accepted, usage — if it contains any substance that exhibits radioactivity. Scientifically, therefore, virtually any material (including material that is considered to be waste) is radioactive. However, it is common regulatory practice to define terms such as *radioactive material* and *radioactive waste* in such a way as to include only that material or waste that is subject to regulation by virtue of the radiological hazard that it poses. Although the exact specifications vary from State to State, this typically excludes material and waste with very low concentrations of radionuclides and those that contain only 'natural' concentrations of naturally occurring radionuclides.

Different definitions of a given term are numbered. Unless otherwise indicated in the text, drafters should use the most appropriate definition for their purposes.

In most cases, the recommended definition(s) is/are followed by further information as appropriate, such as:

(a) Particular notes of caution, such as for terms that do not mean what they might appear to mean (e.g. annual dose), or potential conflicts with other safety or security related terminology; denoted by !
(b) Explanation of the context(s) in which the term is normally used (and, in some cases, contexts in which it should not be used); denoted by ⓘ
(c) Reference to related terms: synonyms, terms with similar but not identical meanings, 'contrasting' terms, and terms that supersede or are superseded by the term being described; denoted by ⓘ
(d) Miscellaneous information: for example, the units in which a quantity is normally measured, recommended parameter values and references; denoted by ⓘ.

This supplementary information is not part of the definition, but it is included to assist drafters and reviewers in understanding how to use (or not to use) the term in question. Note that the use of *italics* in the text denotes a **term** or ***subterm*** with an entry in the Safety Glossary. The use of ***bold italics*** in the text denotes a subterm.

Use by drafters

Drafters of safety and security related IAEA publications — particularly safety standards — should, as far as possible, use the terms in this Safety Glossary with the meanings given. Terms should also be used consistently, especially in safety standards. Variety of expression — a virtue in most forms of writing — should be avoided if there is any possibility of causing confusion or ambiguity. Terms that are not listed in this Safety Glossary may be used, provided that there is no suitable alternative term listed in the Safety Glossary.

A publication may contain a list of key terms used in that publication and their definitions. However, the first question concerning the inclusion of the definition of any term in a publication should always be whether the term actually needs to be defined. Terms should be defined explicitly in a publication only if a definition is essential to the correct understanding of that publication. If the term is used with its normal meaning, or if its meaning in a particular publication will be obvious to the reader from the context, then there should be no need for a definition. A term whose meaning is imprecise may need to be defined, if the imprecision actually detracts from a correct understanding of the text; in many cases, however, the precise meaning of a term will not matter for the purposes of a given publication. Similarly, obvious derivatives of a defined term need not themselves be defined unless there is some specific ambiguity that needs to be addressed.

If it is considered necessary to include a term in a list of definitions in an individual publication, the recommended definition should be used wherever possible. If the recommended definition is not suitable (e.g. if the subject of the publication falls outside the scope of the existing definition), the wording of the definition may be modified, but its meaning should not be changed. The technical officer responsible for the Safety Glossary should be informed of any such modifications to the wording of definitions.

Similarly, definitions of any additional — usually more specialized — terms needed in a specific publication can be provided by the drafters or the technical officer responsible for the publication, and included either in the text (in the main body of the text or footnotes) or in a list of definitions. Such definitions should be copied for information to the technical officer responsible for the Safety Glossary.

Some terms and usages that have been used in the past and/or are used in the publications of other organizations, but whose use is discouraged in IAEA publications, are included in the Safety Glossary. Such terms are listed in square brackets, and should be used only if they are essential to refer to other publications; alternative terms for use in IAEA publications are recommended. Similarly, some definitions are in square brackets, indicating

that they have been included for information but should not be used as working definitions for IAEA publications.

Terms defined in this Safety Glossary are likely to be used in informing the public on matters concerning nuclear safety and security and radiation risks, and in covering these matters in the news media. The technical terms that must be used to explain difficult concepts will be interpreted and employed by writers, journalists and broadcasters who do not have a clear understanding of their significance. It must be borne in mind by drafters, reviewers and editors that certain terms that have specific and clear meanings in their scientific or technical context may be subject to misrepresentation or misunderstanding in a more general context. The incautious use of language can and does give rise to widespread false impressions among the public that are difficult or impossible to correct. In attempting to summarize, interpret and simplify technical texts so as to communicate with a broader audience, therefore, care must be taken not to oversimplify by omitting conditions and qualifications, and not to mislead in using terms with both scientific and more general meanings. Potentially misleading words include, for example, 'attributable', 'contamination', '[excess, statistical] deaths', 'exposure', 'illicit trafficking [in nuclear or radioactive material]', 'nuclear [terrorism, trafficking]', 'protection', 'radioactive', 'risk' and 'safe', and their related words and phrases. This caution applies in particular to matters of life and health, especially fatal accidents and other major incidents, and other emotionally charged subjects.

Finally, there are cases where special 'safety' or 'IAEA' meanings are attached so strongly to words that the use of those words in their everyday sense could cause confusion. Examples include 'activity', 'critical', 'justification', 'practice', 'requirement', 'recommendation', 'guide' and 'standard' (and also 'shall' and 'should'). Although it would be unreasonable to prohibit the use of such words in their everyday sense in any IAEA publications, particular care should be taken to ensure that they are not used in a manner that could be ambiguous.

The technical officer for a publication is responsible for ensuring that any definitions given in that publication are in accordance with these rules.

Use by reviewers

Reviewers should consider whether each term included in a list of definitions in an individual publication really needs to be defined, and if so, whether a list of definitions (as opposed to the text or a footnote) is the most appropriate place for the definition. (Reviewers should also consider, of course, whether any terms not defined in the publication need to be defined.)

If a draft safety standard or other safety related publication gives a definition different from that recommended in the Safety Glossary, reviewers should check:

(a) That the definition recommended in the Safety Glossary could not reasonably have been used;
(b) That the definition given in the draft publication reflects essentially the same meaning as the recommended definition.

Reviewers should make any appropriate recommendations to the IAEA technical officer responsible for the publication.

FUTURE DEVELOPMENT OF THE SAFETY GLOSSARY

The Safety Glossary is intended to be reviewed and revised to represent current terminology accurately. However, it is also intended to encourage stability and harmonization in terminology and definitions. There is, therefore, a controlled process for making changes to the Safety Glossary.

Proposed additions, deletions and changes should be submitted to the IAEA technical officer responsible for the Safety Glossary, together with an explanation of the reason for the proposal. Please see the Foreword.

The proposals received will be reviewed, and the possible implications of any proposed change for safety related publications already issued and those in preparation will be taken into account. The Safety Glossary can be reviewed, revised and reissued as necessary, subject to appropriate consultation.

A

A_1

The *activity* value of *special form radioactive material* which is listed in Table I or derived in Section IV[4] and is used to determine the *activity limits* for the *requirements* of [the Transport] Regulations. (From Ref. [2].)

- A_1 is the maximum *activity* of *special form radioactive material* that can be transported in a *Type A package*. Fractions and multiples of A_1 are also used as criteria for other *package* types, etc.
- The corresponding value for any other form of *radioactive material* is A_2.

A_2

The *activity* value of *radioactive material*, other than *special form radioactive material*, which is listed in Table I or derived in Section IV[4] and is used to determine the *activity limits* for the *requirements* of these Regulations. (From Ref. [2].)

- A_2 is the maximum *activity* of any *radioactive material* other than *special form radioactive material* that can be transported in a *Type A package*. Fractions and multiples of A_2 are also used as criteria for other *package* types, etc.
- The corresponding value for *special form radioactive material* is A_1.

abnormal operation

See *plant states: anticipated operational occurrence.*

absorbed dose

See *dose quantities.*

absorbed fraction

The fraction of energy emitted as a specified *radiation* type in a specified *source region* that is absorbed in a specified *target tissue.*

[4] Of Ref. [2].

absorption

1. See *sorption*.

2. See *lung absorption type*.

absorption type, lung

See *lung absorption type*.

acceptable limit

See *limit*.

acceptance criteria

Specified bounds on the value of a *functional indicator* or *condition indicator* used to assess the ability of a *structure, system or component* to perform its *design* function.

accident

1. Any unintended *event*, including operating errors, equipment *failures* and other mishaps, the consequences or potential consequences of which are not negligible from the point of view of *protection* or *safety*.

accident conditions. See *plant states*.

beyond design basis accident. See *plant states*.

criticality accident. An *accident* involving *criticality*.
ⓘ Typically, in a *facility* in which *fissile material* is used.

design basis accident. See *plant states*.

nuclear accident. [Any *accident* involving *facilities* or *activities* from which a release of *radioactive material* occurs or is likely to occur and which has resulted or may result in an international transboundary release that could be of radiological *safety* significance for another State.] (From Ref. [6].)

! This is not explicitly stated to be a definition of *nuclear accident*, but it is derived from the statement of the scope of application in Article 1 of the Convention on Early Notification of a Nuclear Accident. However, this Convention has a limited scope of application, and it is unreasonable to consider a *nuclear accident* to be only an accident that results or may result in an international transboundary release.

severe accident. See *plant states.*

2. See *event* and *INES.*

ⓘ There remains a fundamental mismatch between the terminology used in *safety standards* and that used in *INES.* In short, *events* that would be considered accidents according to the *safety standards* definition may be accidents or '*incidents*' (i.e. not accidents) in *INES* terminology. See *INES* for a more extensive discussion.

accident conditions

See *plant states.*

accident management

See *plant states.*

accident with off-site risk

See *INES.*

accident without off-site risk

See *INES.*

accident precursor

An *initiating event* that could lead to *accident conditions.*

action level

See *level: action level.*
emergency action level (EAL). See *level: action level.*

activation

The *process* of inducing *radioactivity*.

ⓘ Most commonly used to refer to the induction of *radioactivity* in moderators, coolants, and structural and shielding materials, caused by irradiation with neutrons.

ⓘ The BSS definition — "The production of radionuclides by irradiation." [1] — is technically adequate; however, the term 'production' gives a connotation that this is being done intentionally rather than, as is normally the case, incidentally.

! Care may be needed to avoid confusion when using the term *activation* in its everyday sense of bringing into action (e.g. of *safety systems*, for which 'actuation' may be used).

activation product

A radionuclide produced by *activation*.

ⓘ Often used to distinguish from *fission products*. For example, in *decommissioning waste* comprising structural materials from a *nuclear facility*, *activation products* might typically be found primarily within the matrix of the material, whereas *fission products* are more likely to be present in the form of *contamination* on surfaces.

active component

A *component* whose functioning depends on an external input such as actuation, mechanical movement or supply of power.

ⓘ I.e. any *component* that is not a *passive component*.

ⓘ Examples of *active components* are pumps, fans, relays and transistors. It is emphasized that this definition is necessarily general in nature, as is the corresponding definition of *passive component*. Certain *components*, such as rupture discs, check valves, *safety* valves, injectors and some solid state electronic devices, have characteristics that require special consideration before designation as an *active* or *passive component*.

ⓘ Contrasting term: *passive component*.

activity

1. The quantity A for an amount of radionuclide in a given energy state at a given time, defined as:

$$A(t) = \frac{\mathrm{d}N}{\mathrm{d}t}$$

where dN is the expectation value of the number of spontaneous nuclear transformations from the given energy state in the time interval dt. (From Ref. [1].)

- The rate at which nuclear transformations occur in a *radioactive material*. The equation is sometimes given as:

$$A(t) = -\frac{\mathrm{d}N}{\mathrm{d}t}$$

  where N is the number of nuclei of the radionuclide, and hence the rate of change of N with time is negative. Numerically, the two forms are identical.
- The SI unit of activity is the reciprocal second (s^{-1}), termed the *becquerel* (Bq). (From Ref. [1].)
- Formerly expressed in *curies* (Ci); *activity* values may be given in Ci (with the equivalent in Bq in parentheses) if they are being quoted from a reference that uses Ci as the unit.

specific activity. Of a material, for the purposes of the Transport Regulations, the *activity* per unit mass of the material in which the radionuclides are essentially uniformly distributed. (From Ref. [2].)
Of a radionuclide, the *activity* per unit mass of that nuclide. Of a material, the *activity* per unit mass or volume of the material in which the radionuclides are essentially uniformly distributed.

- The distinction in usage between *specific activity* and ***activity concentration*** is controversial. Some regard the terms as synonymous, and may favour one or the other (as above). ISO 921 [7] distinguishes between *specific activity* as the *activity* per unit mass and *activity concentration* as the *activity* per unit volume. Another common distinction is that *specific activity* is used (usually as *activity* per unit mass) with reference to a pure sample of a radionuclide or, less strictly, to cases where a radionuclide is intrinsically present in the material (e.g. carbon-14 in organic materials, uranium-235 in *natural uranium*), even if the abundance of the radionuclide is artificially changed. In this usage, *activity concentration* (which may be *activity* per unit mass or per unit volume) is used for any other situation (e.g. when the *activity* is in the form of *contamination* in or on a material).
- In general, the term *activity concentration* is more widely applicable, is more self-evident in meaning, and is less likely than *specific activity* to be confused with unrelated terms (such as 'specified activities'). ***Activity concentration*** is therefore preferred to *specific activity* for general use in *safety* related *IAEA publications.*

2. See *facilities and activities.*

activity concentration

See *activity: specific activity.*

activity median aerodynamic diameter (AMAD)

The value of aerodynamic diameter[5] such that 50% of the airborne *activity* in a specified aerosol is associated with particles smaller than the *AMAD*, and 50% of the *activity* is associated with particles larger than the *AMAD*.

- ⓘ Used in internal dosimetry for simplification as a single 'average' value of aerodynamic diameter representative of the aerosol as a whole.
- ⓘ The *AMAD* is used for particle sizes for which deposition depends principally on inertial impaction and sedimentation (i.e. typically those greater than about 0.5 μm). For smaller particles, deposition typically depends primarily on *diffusion*, and the ***activity median thermodynamic diameter (AMTD)*** — defined in an analogous way to the *AMAD*, but with reference to the thermodynamic diameter[5] of the particles — is used.

activity median thermodynamic diameter (AMTD)

See *activity median aerodynamic diameter (AMAD)*.

actuated equipment

An assembly of *prime movers* and *driven equipment* used to accomplish one or more *safety tasks.*

actuation device

A *component* that directly controls the motive power for *actuated equipment*.

- ⓘ Examples of *actuation devices* include circuit breakers and relays that *control* the distribution and use of electric power and pilot valves controlling hydraulic or pneumatic fluids.

acute exposure

See *exposure situations.*

[5] The aerodynamic diameter of an airborne particle is the diameter that a sphere of unit density would need to have in order to have the same terminal velocity when settling in air as the particle of interest. The thermodynamic diameter of an airborne particle is the diameter that a sphere of unit density would need to have in order to have the same *diffusion* coefficient in air as the particle of interest.

acute intake

See *intake* (2).

additive risk projection model

See *risk projection model*.

adsorption

See *sorption*.

advection

The movement of a substance or the transfer of heat by the motion of the gas (usually air) or liquid (usually water) in which it is present.

ⓘ Sometimes used with the more common meaning — transfer of heat by the horizontal motion of the air — but in *IAEA publications* is more often used in a more general sense, particularly in *safety assessment*, to describe the movement of a radionuclide due to the movement of the liquid in which it is dissolved or suspended.

ⓘ Usually contrasted with *diffusion*, where the radionuclide moves relative to the carrying medium.

aerodynamic dispersion

See *dispersion*.

ageing

General *process* in which characteristics of a *structure, system or component* gradually change with time or use.

ⓘ Although the term *ageing* is defined in a neutral sense — the changes involved in *ageing* may have no effect on *protection* or *safety*, or could even have a beneficial effect — it is most commonly used with a connotation of changes that are (or could be) detrimental to *protection and safety* (i.e. as a synonym of *ageing degradation*).

non-physical ageing. The *process* of becoming out of date (i.e. obsolete) owing to the evolution of knowledge and technology and associated changes in codes and standards.

ⓘ Examples of *non-physical ageing* effects include the lack of an effective *containment* or *emergency* core cooling *system*, the lack of *safety design*

features (such as *diversity*, separation or *redundancy*), the unavailability of qualified spare parts for old equipment, incompatibility between old and new equipment, and outdated *procedures* or documentation (e.g. which thus do not comply with current regulations).

- ⓘ Strictly, this is not always *ageing* as defined above, because it is sometimes not due to changes in the *structure, system or component* itself. Nevertheless, the effects on *protection and safety*, and the solutions that need to be adopted, are often very similar to those for *physical ageing*.
- ⓘ The term ***technological obsolescence*** is also used.

physical ageing. *Ageing* of *structures, systems and components* due to physical, chemical and/or biological *processes* (*ageing* mechanisms).

- ⓘ Examples of *ageing* mechanisms include wear, thermal or *radiation* embrittlement, corrosion and microbiological fouling.
- ⓘ The term ***material ageing*** is also used.

ageing degradation

Ageing effects that could impair the ability of a *structure, system or component* to function within its *acceptance criteria*.

- ⓘ Examples include reduction in diameter due to wear of a rotating shaft, loss in material toughness due to *radiation* embrittlement or thermal *ageing*, and cracking of a material due to fatigue or stress corrosion cracking.

ageing management

Engineering, *operations* and *maintenance* actions to control within *acceptable limits* the *ageing degradation* of *structures, systems and components*.

- ⓘ Examples of engineering actions include *design*, *qualification* and *failure analysis*. Examples of *operations* actions include surveillance, carrying out operating *procedures* within specified *limits* and performing environmental measurements.
- ⓘ ***Life management*** (or ***lifetime management***) is the integration of *ageing management* with economic planning: (1) to optimize the *operation*, *maintenance* and *service life* of *structures, systems and components*; (2) to maintain an acceptable level of performance and *safety*; and (3) to maximize the return on investment over the *service life* of the *facility*.

agricultural countermeasure

See *countermeasure*.

air kerma

See *kerma*.

aircraft

cargo aircraft. Any *aircraft*, other than a *passenger aircraft*, which is carrying goods or property. (From Ref. [2].)

passenger aircraft. An *aircraft* that carries any person other than a crew member, a *carrier*'s employee in an official capacity, an authorized representative of an appropriate national authority, or a person accompanying a *consignment*. (From Ref. [2].)

ALARA (as low as reasonably achievable)

See *optimization of protection (and safety)*.

alert

See *emergency class.*

ambient dose equivalent

See *dose equivalent quantities.*

analysis

ⓘ Often used interchangeably with *assessment*, especially in more specific terms such as '*safety analysis*'. In general, however, *analysis* suggests the *process* and result of a study aimed at understanding the subject of the *analysis*, while *assessment* may also include determinations or judgements of acceptability. *Analysis* is also often associated with the use of a specific technique. Hence, one or more forms of *analysis* may be used in *assessment*.

cost–benefit analysis. A systematic economic evaluation of the positive effects (benefits) and negative effects (disbenefits, including monetary costs) of undertaking an action.

ⓘ A decision aiding technique commonly used in the *optimization of protection and safety*. This and other techniques are discussed in Ref. [8].

event tree analysis. An inductive technique that starts by hypothesizing the occurrence of basic *initiating events* and proceeds through their logical propagation to *system failure events.*

ⓘ The *event* tree is the diagrammatic illustration of alternative outcomes of specified *initiating events.*

ⓘ *Fault tree analysis* considers similar chains of *events*, but starts at the other end (i.e. with the 'results' rather than the 'causes'). The completed *event* trees and fault trees for a given set of *events* would be similar to one another.

fault tree analysis. A deductive technique that starts by hypothesizing and defining *failure events* and systematically deduces the *events* or combinations of *events* that caused the *failure events* to occur.

ⓘ The fault tree is the diagrammatic illustration of the *events.*

ⓘ *Event tree analysis* considers similar chains of *events*, but starts at the other end (i.e. with the 'causes' rather than the 'results'). The completed *event* trees and fault trees for a given set of *events* would be similar to one another.

safety analysis. Evaluation of the potential hazards associated with the conduct of an *activity.*

ⓘ *Safety analysis* is often used interchangeably with *safety assessment*. However, when the distinction is important, *safety analysis* should be used for the study of *safety*, and *safety assessment* for the evaluation of *safety* — for example, evaluation of the magnitude of hazards, evaluation of the performance of *safety measures* and judgement of their adequacy, or quantification of the overall radiological impact or *safety* of a *facility* or *activity.*

sensitivity analysis. A quantitative examination of how the behaviour of a *system* varies with change, usually in the values of the governing parameters.

ⓘ A common approach is parameter variation, in which the variation of results is investigated for changes in the value of one or more input parameters within a reasonable range around selected reference or mean values, and perturbation *analysis*, in which the variations of results with respect to changes in the values of all the input parameters are obtained by applying differential or integral *analysis.*

uncertainty analysis. An *analysis* to estimate the uncertainties and error bounds of the quantities involved in, and the results from, the solution of a problem.

annual dose

See *dose concepts.*

annual limit on exposure (ALE)

See *limit*.

annual limit on intake (ALI)

See *limit*.

annual risk

See *risk* (3).

anomaly

See *INES*.

anticipated operational occurrence

See *plant states*.

anticipated transient without scram (ATWS)

For a nuclear reactor, an *accident* for which the *initiating event* is an *anticipated operational occurrence* and in which the fast shutdown *system* of the reactor fails to function.

applicant

A *legal person* who applies to a *regulatory body* for *authorization* to undertake specified *activities*.

ⓘ Strictly, an *applicant* would be such from the time at which an application is submitted until the requested *authorization* is either granted or refused. However, the term is often used a little more loosely than this, particularly in cases where the *authorization process* is long and complex.

approval

The granting of consent by a *regulatory body*.

ⓘ Typically used to represent any form of consent from the *regulatory body* that does not meet the definition of *authorization*. However, the usage in the Transport Regulations [2] (see *multilateral approval* and *unilateral approval*

below — the term *approval* is not separately defined) is that *approval* is essentially synonymous with *authorization*.

multilateral approval. *Approval* by the relevant *competent authority* of the *country of origin* of the *design* or *shipment*, as applicable, and also, where the *consignment* is to be transported through or into any other country, *approval* by the *competent authority* of that country. The term 'through or into' specifically excludes 'over', i.e. the *approval* and *notification requirements* shall not apply to a country over which *radioactive material* is carried in an *aircraft*, provided that there is no scheduled stop in that country. (From Ref. [2].)

unilateral approval. An *approval* of a *design* which is *required* to be given by the *competent authority* of the *country of origin* of the *design* only. (From Ref. [2].)

area

controlled area. A defined area in which specific *protection* measures and *safety* provisions are or could be *required* for controlling *normal exposures* or preventing the spread of *contamination* during normal working conditions, and preventing or limiting the extent of *potential exposures*.

ⓘ A *controlled area* is often within a *supervised area*, but need not be.

ⓘ The term ***radiation area*** is sometimes used to describe a similar concept, but *controlled area* is preferred in *IAEA publications*.

operations area. A geographical area that contains an *authorized facility*. It is enclosed by a physical *barrier* (the ***operations boundary***) to prevent unauthorized access, by means of which the management of the *authorized facility* can exercise direct authority.

ⓘ This applies to larger *facilities*.

[*radiation area*]. See *controlled area*.

site area. A geographical area that contains an *authorized facility, authorized activity* or *source*, and within which the management of the *authorized facility* or *authorized activity* may directly initiate *emergency actions*.

ⓘ This is typically the area within the *security* perimeter fence or other designated property marker. It may also be the *controlled area* around a

radiography *source* or a cordoned off area established by *first responders* around a suspected hazard.

- ⓘ This area is often identical to the *operations area*, except in situations (e.g. *research reactors*, *irradiation installations*) where the *authorized facility* is on a site where other *activities* are being carried out beyond the *operations area*, but where the management of the *authorized facility* can be given some degree of authority over the whole *site area*.
- ⓘ The ***site boundary*** is the boundary of the *site area*.
- ⓘ The term *activity* is used here in the sense of *activity* (2).

supervised area. A defined area not designated a *controlled area* but for which *occupational exposure* conditions are kept under review, even though no specific *protection* measures or *safety* provisions are normally needed.

- ⓘ See also *controlled area*.

area monitoring

See *monitoring* (1).

area survey

See *survey*.

arrangements (for emergency response)

See *emergency response arrangements*.

assessment

1. The *process*, and the result, of analysing systematically and evaluating the hazards associated with *sources* and *practices*, and associated *protection and safety* measures.

- ⓘ *Assessment* is often aimed at quantifying performance measures for comparison with criteria.
- ⓘ In *IAEA publications*, *assessment* should be distinguished from *analysis*. *Assessment* is aimed at providing information that forms the basis of a decision on whether or not something is satisfactory. Various kinds of *analysis* may be used as tools in doing this. Hence an *assessment* may include a number of *analyses*.

consequence assessment. *Assessment* of the radiological consequences (e.g. *doses*, *activity concentrations*)[6] of *normal operation* and possible *accidents* associated with an *authorized facility* or part thereof.

ⓘ This differs from *risk assessment* in that probabilities are not included in the *assessment*.

dose assessment. *Assessment* of the *dose(s)* to an individual or group of people.

ⓘ For example, *assessment* of the *dose* received by or *committed* to by an individual on the basis of results from *workplace monitoring* or *bioassay.*

ⓘ The term *exposure assessment* is also sometimes used.

exposure assessment. See *assessment* (1), *dose assessment.*

performance assessment. *Assessment* of the performance of a *system* or subsystem and its implications for *protection and safety* at an *authorized facility.*

ⓘ This differs from *safety assessment* in that it can be applied to parts of an *authorized facility* (and its environment), and does not necessarily require the *assessment* of radiological impacts.

risk assessment. *Assessment* of the radiological *risks* associated with *normal operation* and possible *accidents* involving a *source* or *practice.*

ⓘ This will normally include *consequence assessment*, together with some *assessment* of the probability of those consequences arising.

safety assessment. 1. *Assessment* of all aspects of a *practice* that are relevant to *protection and safety*; for an *authorized facility*, this includes *siting*, *design* and *operation* of the *facility.*

ⓘ This will normally include *risk assessment.*

ⓘ See also *probabilistic safety assessment (PSA)*.

[6] Care should be taken when discussing 'consequences' in this context to distinguish between radiological consequences of events causing *exposure*, such as *doses*, and the health consequences, such as cancers, that could result from *doses.* 'Consequences' of the former type generally imply a probability of experiencing 'consequences' of the latter type. See also *end point.*

2. *Analysis* to predict the performance of an overall *system* and its impact, where the performance measure is the radiological impact or some other global measure of the impact on *safety*.

3. The systematic *process* that is carried out throughout the *design process* to ensure that all the relevant *safety requirements* are met by the proposed (or actual) *design*. *Safety assessment* includes, but is not limited to, the formal *safety analysis*.

ⓘ See Ref. [9].

threat assessment. The *process* of analysing systematically the hazards associated with *facilities*, *activities* or *sources* within or beyond the borders of a State in order to identify:

(a) Those *events* and the associated areas for which *protective actions* may be *required* within the State;
(b) The actions that would be effective in mitigating the consequences of such *events*.

ⓘ The term *threat assessment* does not imply that any threat, in the sense of an intention and capability to cause harm, has been made in relation to such *facilities*, *activities* or *sources*.

2. *Activities* carried out to determine that *requirements* are met and that *processes* are adequate and effective, and to encourage managers to implement improvements, including *safety* improvements.

ⓘ This usage originated in *quality assurance* and related fields.

! The IAEA is revising the *requirements* and guidance in the subject area of *quality assurance* for new *safety standards* on *management systems* for the *safety* of nuclear *facilities and activities* involving the use of *ionizing radiation*. The term *management system* has been adopted in the revised standards instead of the terms *quality assurance* and *quality assurance* programme.

ⓘ *Assessment activities* may include reviewing, checking, inspecting, testing, surveillance, auditing, peer evaluation and technical review. These *activities* can be divided into two broad categories: *independent assessment* and *self-assessment*.

independent assessment. *Assessments* such as *audits* or surveillances carried out to determine the extent to which the *requirements* for the *management system* are fulfilled, to evaluate the effectiveness of the *management system* and to identify opportunities for improvement. They can be conducted by or on behalf of the organization itself for internal

purposes, by interested parties such as customers and regulators (or by other persons on their behalf), or by external independent organizations.

- This definition applies in *management systems* and related fields.
- Persons conducting *independent assessments* do not participate directly in the work being assessed.
- *Independent assessment activities* include internal and external *audit*, surveillance, peer evaluation and technical review, which are focused on *safety* aspects and areas where problems have been found.
- An *audit* is used in the sense of a documented activity performed to determine by investigation, examination and evaluation of objective evidence the adequacy of, and adherence to, established *procedures*, instructions, specifications, codes, standards, administrative or operational programmes and other applicable documents, and the effectiveness of their implementation.

self-assessment. A routine and continuing *process* conducted by *senior management* and management at other levels to evaluate the effectiveness of performance in all areas of their responsibility.

- This definition applies in *management systems* and related fields.
- *Self-assessment activities* include review, surveillance and discrete checks, which are focused on preventing, or identifying and correcting, management problems that hinder the achievement of the organization's objectives, particularly *safety* objectives.
- *Self-assessment* provides an overall view of the performance of the organization and the degree of maturity of the *management system*. It also helps to identify areas for improvement in the organization, to determine priorities, and to set a baseline for further improvement.
- *Senior management* means the person who, or group of people which, directs, controls and assesses an organization at the highest level.
- The term ***management self-assessment*** is also used, notably in the IAEA's *safety standards* on *quality assurance* in nuclear power plants.

assisted (by the IAEA) operation

An *operation* undertaken by a State or group of States to which assistance is provided by or through the IAEA in the form of materials, services, equipment, *facilities* or information pursuant to an agreement between the IAEA and that State or group of States.

atmospheric dispersion

See *dispersion*.

attenuation

The reduction in intensity of *radiation* passing through matter due to *processes* such as *absorption* and scattering.

ⓘ By analogy, also used in other situations in which some radiological property, characteristic or parameter is gradually reduced in the course of passing through a medium (e.g. the reduction in *activity concentration* in groundwater passing through the *geosphere* due to *processes* such as *sorption*).

attributable risk

See *risk* (3).

audit

See *assessment* (2): *independent assessment*.

authorization

The granting by a *regulatory body* or other governmental body of written permission for an *operator* to perform specified *activities.*

ⓘ *Authorization* could include, for example, licensing, certification or *registration*.

ⓘ The term *authorization* is also sometimes used to describe the document granting such permission.

ⓘ *Authorization* is normally a more formal *process* than *approval*.

authorized activity

See *facilities and activities.*

authorized discharge

See *discharge* (1).

authorized facility

See *facilities and activities.*

authorized limit

See *limit*.

authorized termination of responsibility

The release by the *regulatory body* of an *operator* (or a former *operator*) from any further regulatory responsibilities in relation to an *authorized facility* or *authorized activity.*

ⓘ This may be a separate *process* from termination of an *authorization*, e.g. termination of the responsibility to maintain active *institutional control* over a *repository.*

authorized transfer

The transfer of regulatory responsibility for specified *radioactive material* from one *operator* to another.

! This does not necessarily involve any movement of the material itself.

authorized use

See *use.*

availability

The fraction of time for which a *system* is capable of fulfilling its intended purpose.

ⓘ *Reliability* represents essentially the same information, but in a different form.

avertable dose

See *dose concepts.*

averted dose

See *dose concepts.*

B

backfill

Material used to refill excavated portions of a *repository* after *waste* has been emplaced.

background

The *dose* or *dose rate* (or an observed measure related to the *dose* or *dose rate*) attributable to all *sources* other than the one(s) specified.

ⓘ Strictly, this applies to measurements of *dose rate* or count rate from a sample, where the *background dose rate* or count rate must be subtracted from all measurements. However, *background* is used more generally, in any situation in which a particular *source* (or group of *sources*) is under consideration, to refer to the effects of other *sources*. It is also applied to quantities other than *doses* or *dose rates*, such as *activity concentrations* in environmental media.

natural background. The *doses*, *dose rates* or *activity concentrations* associated with *natural sources* or any other *sources* in the environment that are not amenable to *control*.

ⓘ This is normally considered to include *doses*, *dose rates* or *activity concentrations* associated with *natural sources*, global fallout (but not local fallout) from atmospheric nuclear weapon tests and the Chernobyl *accident*.

barrier

A physical obstruction that prevents or inhibits the movement of people, radionuclides or some other phenomenon (e.g. fire), or provides shielding against *radiation*.

ⓘ See also *cladding (material)*, *containment*, *defence in depth*.

intrusion barrier. *Components* of a *repository* designed to prevent inadvertent access to the *waste* by humans, animals or plants.

multiple barriers. Two or more natural or engineered *barriers* used to isolate *radioactive waste* in, and prevent *migration* of radionuclides from, a *repository*.

! The term 'chemical *barrier*' is sometimes used in the context of *waste disposal* to describe the chemical effect of a material that enhances the extent to which radionuclides react chemically with the material or with the host rock, thus inhibiting the *migration* of the radionuclides. As defined above, this is not

strictly a *barrier* (unless the material also constitutes a physical *barrier*), but the effect may be equivalent to that of a *barrier*, and it may therefore be convenient to regard it as such.

becquerel (Bq)

The SI unit of *activity*, equal to one transformation per second.

ⓘ Supersedes the non-SI unit *curie (Ci)*. 1 Bq = 27 pCi (2.7×10^{-11} Ci) approximately. 1 Ci = 3.7×10^{10} Bq.

beyond design basis accident

See *plant states*.

bioassay

Any *procedure* used to determine the nature, *activity*, location or retention of radionuclides in the body by direct (in vivo) measurement or by in vitro analysis of material excreted or otherwise removed from the body.

biological half-life

See *half-life* (2).

biosphere

That part of the environment normally inhabited by living organisms.

ⓘ In practice, the *biosphere* is not usually defined with great precision, but is generally taken to include the atmosphere and the Earth's surface, including the soil and surface water bodies, seas and oceans and their sediments. There is no generally accepted definition of the depth below the surface at which soil or sediment ceases to be part of the *biosphere*, but this might typically be taken to be the depth affected by basic human actions, in particular farming.

ⓘ In *waste safety* in particular, the *biosphere* is normally distinguished from the *geosphere*.

buffer

Any substance placed around a *waste package* in a *repository* to serve as a *barrier* to restrict the access of groundwater to the *waste package* and to reduce by *sorption* and precipitation the rate of eventual *migration* of radionuclides from the *waste*.

ⓘ The above definition is clearly specific to *waste safety*. The term *buffer* (e.g. in *buffer* solution) is also used, in its normal scientific sense (and therefore normally without specific definition), in a variety of contexts.

burnable absorber

Neutron absorbing material, used to control *reactivity*, with particular capability of being depleted by neutron *absorption*.

burnable poison

See *burnable absorber* and *poison*.

bypass

1. A device to inhibit, deliberately but temporarily, the functioning of a circuit or *system* by, for example, short circuiting the contacts of a relay.

maintenance bypass. A *bypass* of *safety system* equipment during *maintenance*, testing or *repair*.

operational bypass. A *bypass* of certain *protective actions* when they are not necessary in a particular mode of plant *operation*.

! An *operational bypass* may be used when the *protective action* prevents, or might prevent, reliable *operation* in the required mode.

2. A route that allows *fission products* released from a reactor core to enter the environment without passing through the *containment* or other enclosure designed to confine and reduce a release in the event of an *emergency*.

ⓘ This route may be established intentionally by the *operator* or as a result of the *event*.

C

calibration

A measurement of, or adjustment to, an instrument, *component* or *system* to ensure that its accuracy or response is acceptable.

model calibration. The *process* whereby *model* predictions are compared with field observations and/or experimental measurements from the *system* being modelled, and the *model* is adjusted if necessary to achieve a best fit to the measured and/or observed data.

! This usage of the term is not universally accepted. The terms *model validation* and *model verification* are more commonly used to describe related *processes* in relation to *models.*

canister, waste

See *container, waste.*

cargo aircraft

See *aircraft*.

carrier

Any person, organization or government undertaking the carriage of *radioactive material* by any means of *transport*. The term includes both *carriers* for hire or reward (known as common or contract *carriers* in some countries) and *carriers* on own account (known as private *carriers* in some countries). (From Ref. [2].)

cause

direct cause. The *latent weakness* that allows or causes the *observed cause* of an *initiating event* to happen, including the reasons for the *latent weakness.*

ⓘ Corrective actions designed to address *direct causes* are sometimes termed *repairs.*

latent weakness. An undetected degradation in an element of a *safety layer*.

ⓘ Such a degradation could lead to that element failing to perform as expected if it were called upon to perform a function.

observed cause. The *failure*, action, omission or condition that directly leads to an *initiating event*.

root cause. The fundamental cause of an *initiating event*, correction of which will prevent recurrence of the *initiating event* (i.e. the *root cause* is the *failure* to detect and correct the relevant *latent weakness(es)* and the reasons for that *failure*).

ⓘ Corrective actions designed to address *root causes* are sometimes termed ***remedies*** (also *remedial actions*).

channel

An arrangement of interconnected *components* within a *system* that initiates a single output. A *channel* loses its identity where single output signals are combined with signals from other *channels* (e.g. from a *monitoring channel* or a *safety* actuation *channel*).

ⓘ The above definition is specific to a particular area of *nuclear safety*. The term *channel* is also used in its normal senses (and therefore normally without specific definition) in a variety of contexts.

characterization

1. Determination of the nature and *activity* of radionuclides present in a specified place.

ⓘ For example, determination of the radionuclides present in a *bioassay* sample or in an area contaminated with *radioactive material* (e.g. as a first step in planning *remediation*). For the latter example, care should be taken to avoid confusion with the existing, and different, definition of the term *site characterization*.

2. Determination of the character of something.

ⓘ This is the standard dictionary definition, and would not need to be included in an individual glossary. It is included here only to distinguish the normal usage from the more restricted usage indicated in (1).

site characterization. Detailed surface and subsurface investigations and *activities* at a site to determine the radiological conditions at the site or to

evaluate candidate *disposal* sites to obtain information to determine the suitability of the site for a *repository* and to evaluate the long term performance of a *repository* at the site.

ⓘ *Site characterization* is a stage in the *siting* of a *repository*; it follows *area survey* and precedes *site confirmation*.

ⓘ *Site characterization* may also refer to the *siting process* for any other *authorized facility*. See also *site evaluation*, which includes *site characterization* and is not specific to a *repository* site, and *area survey*.

waste characterization. Determination of the physical, chemical and radiological properties of the *waste* to establish the need for further adjustment, *treatment* or *conditioning*, or its suitability for further handling, *processing*, *storage* or *disposal*.

chemisorption

See *sorption*.

child

ⓘ In dosimetry (e.g. in tables of *dose per unit intake* values), a *child* is often assumed to be a 10 year old. If such an assumption is made, it should be clearly stated. See also *infant* and *reference individual*.

chronic exposure

See *exposure situations.*

chronic intake

See *intake* (2).

chronic potential exposure

See *exposure situations.*

cladding (material)

1. An external layer of material applied directly to another material to provide protection in a chemically reactive environment (e.g. cladding over ferritic material to prevent corrosion).

2. Typically, the tube of material that houses the *nuclear fuel* pellets and provides the *containment* of *radioactive* species produced during fission.

- ⓘ It may also provide structural support.
- ⓘ The cladding tube, together with the end cups or plugs, also typically provides structural support.

cleanup

See *remediation*.

clearance

1. Removal of *radioactive material* or *radioactive* objects within authorized *practices* from any further *regulatory control* by the *regulatory body*.

- ⓘ Removal from *control* in this context refers to *control* applied for *radiation protection* purposes.
- ⓘ Conceptually, *clearance* — freeing certain materials or objects in authorized *practices* from further *control* — is closely linked to, but distinct from and not to be confused with, *exemption* — determining that *controls* do not need to be applied to certain *sources* and *practices*.
- ⓘ Various terms are used in different States to describe this concept, e.g. 'free release'.
- ⓘ A number of issues relating to the concept of *clearance* and its relationship to other concepts were resolved in Ref. [10].

2. The net effect of the biological *processes* by which radionuclides are removed from a tissue, organ or area of the body.

- ⓘ The ***clearance rate*** is the rate at which this occurs.

clearance level

See *level*.

clearance rate

See *clearance* (2).

cliff edge effect

In a nuclear power plant, an instance of severely abnormal plant behaviour caused by an abrupt transition from one plant status to another following a small *deviation* in a plant parameter, and thus a sudden large variation in plant conditions in response to a small variation in an input.

closure[7]

1. Administrative and technical actions directed at a *repository* at the end of its *operating lifetime* — e.g. covering of the disposed *waste* (for a *near surface repository*) or backfilling and/or sealing (for a *geological repository* and the passages leading to it) — and the termination and completion of *activities* in any associated *structures.*

ⓘ For other *facilities*, the term *decommissioning* is used.

2. [The completion of all *operations* at some time after the emplacement of *spent fuel* or *radioactive waste* in a *disposal facility.* This includes the final engineering or other work required to bring the *facility* to a condition that will be safe in the long term.] (From Ref. [5].)

cloud shine

Gamma *radiation* from radionuclides in an airborne plume.

coincidence

A feature of *protection system design* such that two or more overlapping or simultaneous output signals from several *channels* are necessary in order to produce a *protective action* signal by the *logic.*

collective dose

See *dose concepts.*

collective effective dose

See *dose quantities.*

[7] The terms *siting*, *design*, *construction*, *commissioning*, *operation* and *decommissioning* are normally used to delineate the six major stages of the lifetime of an *authorized facility* and of the associated *licensing process.* In the special case of *waste disposal facilities*, *decommissioning* is replaced in this sequence by *closure.*

commissioning[7]

The *process* by means of which *systems* and *components* of *facilities and activities*, having been constructed, are made operational and verified to be in accordance with the *design* and to have met the *required* performance criteria.

ⓘ *Commissioning* may include both non-nuclear and/or non-radioactive and nuclear and/or *radioactive* testing.

committed dose

1. See *dose concepts.*

2. See *dose* (2).

committed effective dose

See *dose quantities.*

committed equivalent dose

See *dose quantities.*

common cause failure

See *failure.*

common mode failure

See *failure.*

competent authority

[Any national or international *regulatory body* or authority designated or otherwise recognized as such for any purpose in connection with [the Transport] Regulations.] (From Ref. [2].)

! This term should be used only with reference to the Transport Regulations. Otherwise, the more general term *regulatory body* should be used.

compliance assurance

A systematic programme of measures applied by a *competent authority* which is aimed at ensuring that the provisions of [the Transport] Regulations are met in practice. (From Ref. [2].)

ⓘ The term may be used in a variety of contexts with essentially the same meaning, but often without explicit definition.

component

See *structures, systems and components* and *core components.*

computational model

See *model.*

computer system validation

See *validation* (1).

computer system verification

See *verification* (1).

conceptual model

See *model.*

condition based maintenance

See *maintenance: predictive maintenance.*

condition indicator

See *indicator.*

condition monitoring

See *monitoring* (2).

conditional probability value (CPV)

The upper bound for the conditional probability that a particular type of *event* will cause unacceptable radiological consequences.

ⓘ The term is used in the detailed *event screening process* for *site evaluation*.

conditional risk

See *risk* (3).

conditioning

See *waste management, radioactive* (1).

configuration management

The *process* of identifying and documenting the characteristics of a *facility*'s *structures, systems and components* (including computer *systems* and software), and of ensuring that changes to these characteristics are properly developed, assessed, approved, issued, implemented, verified, recorded and incorporated into the *facility* documentation.

ⓘ 'Configuration' is used in the sense of the physical, functional and operational characteristics of the *structures, systems and components* and parts of a *facility.*

confinement

Prevention or *control* of releases of *radioactive material* to the environment in *operation* or in *accidents.*

ⓘ *Confinement* is closely related in meaning to *containment*, but *confinement* is typically used to refer to the *safety function* of preventing the 'escape' of *radioactive material*, whereas *containment* refers to the means for achieving that function.

! The Transport Regulations adopt a different distinction between *confinement* and *containment*, namely that *confinement* relates to preventing criticality and *containment* to preventing releases (see *confinement system* and *containment system*).

ⓘ The main issue here is the differences in usage between *nuclear safety* and *transport safety.* Both terms, *containment* and *confinement*, are used in both areas (in the Transport Regulations, in the form of *confinement system* and *containment system*), and the usages of *containment* are (it seems) conceptually consistent, but the usages of *confinement* are not. *Confinement* in *nuclear safety* is the *safety function* that is performed by *containment*. A *confinement system* as defined in the Transport Regulations has the primary function of controlling *criticality* (as compared with the *containment system*, the function of which is to prevent leakage of *radioactive material*). Discussions with experts in the field have confirmed that a distinct term is needed to describe this distinct concept, and that *confinement* is the term that has become established, but have failed to reveal any compelling reasons for the choice of that particular word.

confinement system

The assembly of *fissile material* and *packaging components* specified by the designer and agreed to by the *competent authority* as intended to preserve criticality *safety*. (From Ref. [2].)

! This usage is specific to the Transport Regulations. See *confinement* for more general usage.

consequence assessment

See *assessment* (1).

consignee

Any person, organization or government which receives a *consignment*. (From Ref. [2].)

consignment

Any *package* or *packages*, or load of *radioactive material*, presented by a *consignor* for *transport*. (From Ref. [2].)

consignor

Any person, organization or government which prepares a *consignment* for *transport*. (From Ref. [2].)

construction[7]

The *process* of manufacturing and assembling the *components* of a *facility*, the carrying out of civil works, the installation of *components* and equipment and the performance of associated tests.

consumer product

Device such as a smoke detector, luminous dial or ion generating tube that contains a small amount of *radioactive substances*. (From Ref. [1].)

ⓘ More generally, an item readily available to *members of the public* without any *requirements* being imposed related to any *radiation source* therein.

container, waste

The vessel into which the *waste form* is placed for handling, *transport*, *storage* and/or eventual *disposal*; also the outer *barrier* protecting the *waste* from external intrusions. The *waste container* is a *component* of the *waste package*. For example, molten *high level waste* glass would be poured into a specially designed *container* (*canister*), where it would cool and solidify.

! Note that the term ***waste canister*** is considered to be a specific term for a *container* for *spent fuel* or vitrified *high level waste*.

containment

Methods or physical *structures* designed to prevent or *control* the release and the *dispersion* of *radioactive substances*.

ⓘ Although related to *confinement*, *containment* is normally used to refer to methods or *structures* that perform a *confinement* function, namely preventing or controlling the release of *radioactive substances* and their *dispersion* in the environment. See *confinement* for a more extensive discussion.

containment system

The assembly of *components* of the *packaging* specified by the designer as intended to retain the *radioactive material* during *transport*. (From Ref. [2].)

ⓘ Unlike *confinement system*, this term is consistent with the general *safety* usage of *containment*.

contamination

1. *Radioactive substances* on surfaces, or within solids, liquids or gases (including the human body), where their presence is unintended or undesirable, or the *process* giving rise to their presence in such places.

ⓘ Also used less formally to refer to a quantity, namely the *activity* on a surface (or on a unit area of a surface).

ⓘ *Contamination* does not include residual *radioactive material* remaining at a site after the completion of *decommissioning*.

! The term *contamination* may have a connotation that is not intended. The term *contamination* refers only to the presence of *radioactivity*, and gives no indication of the magnitude of the hazard involved.

2. The presence of a *radioactive substance* on a surface in quantities in excess of 0.4 Bq/cm^2 for beta and gamma emitters and *low toxicity alpha emitters*, or 0.04 Bq/cm^2 for all other alpha emitters. (From Ref. [2].)

ⓘ This is a regulatory definition of *contamination*, specific to the Transport Regulations. Levels below 0.4 Bq/cm^2 or 0.04 Bq/cm^2 would still be considered *contamination* according to the scientific definition (1).

fixed contamination. *Contamination* other than *non-fixed contamination*. (From Ref. [2].)

non-fixed contamination. *Contamination* that can be removed from a surface during routine conditions of *transport*. (From Ref. [2].)

contamination zone

A zone in which special protective measures are necessary, owing to actual or potential air *contamination* or loose surface *contamination* in excess of a specified level.

control

1. The function or power or (usually as *controls*) means of directing, regulating or restraining.

ⓘ It should be noted that the usual meaning of the English word *control* in *safety* related contexts is somewhat 'stronger' (more active) than that of its usual translations and other similar words in some other languages. For example, '*control*' typically implies not only checking or *monitoring* something but also ensuring that corrective or *enforcement* measures are taken if the results of the checking or *monitoring* indicate such a need. This is in contrast, for example, to the more limited usage of the equivalent word in French and Spanish.

institutional control. *Control* of a *radioactive waste* site by an authority or institution designated under the laws of a State. This *control* may be active (*monitoring*, surveillance, remedial work) or passive (land use *control*) and may be a factor in the *design* of a *nuclear facility* (e.g. *near surface repository*).

ⓘ Most commonly used to describe *controls* over a *repository* after *closure* or a *facility* undergoing *decommissioning*.

ⓘ Also refers to the *controls* placed on a site that has been released from *regulatory control* under the condition of observing specified restrictions on its future use to ensure that these restrictions are complied with.

ⓘ The term *institutional control* is more general than *regulatory control* (i.e. *regulatory control* may be thought of as a special form of *institutional control*). In particular, *institutional control* measures may be passive, they may be imposed for reasons not related to *protection* or *safety* (although they may nevertheless have some impact on *protection and safety*), they may be applied by organizations that do not meet the definition of a *regulatory body*, and they may apply in situations which do not fall within the scope of *facilities and activities*. As a result, some form of *institutional control* may be considered more likely to endure further into the future than *regulatory control*.

regulatory control. Any form of *control* or regulation applied to *facilities* or *activities* by a *regulatory body* for reasons relating to *radiation protection* or to the *safety* or *security of radioactive sources*. (From Ref. [11].)

! See also *institutional control*.

2. A standard of comparison used to check the inferences deduced from an experiment.

ⓘ In *protection and safety*, a *control* is most commonly a sample or a group of people that has not been exposed to *radiation* from a particular *source*; the occurrence of particular effects in a sample or group of people that has been exposed is compared with that in the *control* to provide some indication of the effects that may be attributable to the *exposure*. For example, a case–*control* study is a common type of epidemiological study in which the incidence of *health effects* (the 'cases') in a population that has been exposed to *radiation* from a particular *source* is compared with the incidence in a similar population (the '*control*') that has not been exposed, to investigate whether *exposure* due to that *source* may be causing *health effects*.

controlled area

See *area*.

conveyance

(a) For *transport* by road or rail: any *vehicle*.
(b) For *transport* by water: any *vessel*, or any hold, compartment, or *defined deck area* of a *vessel*.
(c) For *transport* by air: any *aircraft*. (From Ref. [2].)

core components

The elements of a reactor core, other than *fuel assemblies*, that are used to provide structural support of the core construction, or the tools, devices or other items that are inserted into the reactor core for core *monitoring*, flow *control* or other technological purposes and are treated as core elements.

ⓘ Examples of *core components* are *reactivity control* devices or shutdown devices, neutron *sources*, dummy *fuel*, *fuel* channels, instrumentation, flow restrictors and *burnable absorbers.*

corrective maintenance

See *maintenance.*

cost–benefit analysis

See *analysis.*

countermeasure

An action aimed at alleviating the radiological consequences of an *accident*.

ⓘ *Countermeasures* are forms of *intervention* They may be *protective actions* or *remedial actions*, and these more specific terms should be used where possible.

agricultural countermeasure. Action taken to reduce *contamination* of food, agricultural or forestry products before they reach consumers. (From Ref. [1].)

ⓘ Note that restrictions on the sale, movement or use of contaminated food, agricultural or forestry products (i.e. measures to prevent their reaching consumers) are *countermeasures*, but are not considered to be *agricultural countermeasures.*

cradle to grave approach

An approach in which all the stages in the *lifetime* of a *facility*, *activity* or product are taken into consideration.

ⓘ For example, the *cradle to grave approach* to the *safety* and *security of radioactive sources.*

ⓘ See *ageing management.*

ⓘ See *life cycle management*.

critical *(adjective)*

! In view of the number of special meanings attached to this word, particular care should be taken when using the adjective '*critical*' in its more common English senses (i.e. to mean extremely important, or as a derivative of the verb 'criticize').

1. Having a *reactivity* of zero.

ⓘ Also used, more loosely, when the *reactivity* is greater than zero. See *criticality*.

2. Relating to the highest *doses* or *risks* attributable to a specified *source*.

ⓘ As in, for example, *critical group*, *critical* pathway or *critical* radionuclide.

3. Capable of sustaining a nuclear chain reaction.

ⓘ As in, for example, *critical* mass.

critical assembly

An assembly containing *fissile material* intended to sustain a controlled fission chain reaction at a low power level, used to investigate reactor core geometry and composition.

critical group

A group of *members of the public* which is reasonably homogeneous with respect to its *exposure* for a given *radiation source* and is typical of individuals receiving the highest *effective dose* or *equivalent dose* (as applicable) from the given *source*. (From Ref. [1].)

ⓘ The deletion from this definition of the phrase "and given *exposure pathway*" implies that there will not be a number of *critical groups* for a given *source*. Some non-IAEA publications, notably those of the International Commission on Radiological Protection [12], use a definition of *critical group* that makes no such reference to a given *exposure pathway*, implying that there is only one *critical group* for a given *source*, namely the one with the highest total *exposure* from all *exposure pathways*.

ⓘ Application of the term to *potential exposures*, such as those that may occur in the future as a result of *radioactive waste disposal*, is complicated by the facts that both the *dose* (if it occurs) and the probability of receiving the *dose* are relevant, and that these two parameters are essentially independent of one another. Hence, a group can be homogeneous with respect to *dose* but not *risk*, and, more importantly, vice versa. A commonly adopted solution is to define a *critical group* — often a *hypothetical critical group* — that is

reasonably homogeneous with respect to *risk* and is typical of those people who might be subject to the highest *risk*.

hypothetical critical group. A group of hypothetical individuals which is reasonably homogeneous with respect to the *risk* to which its members are subject from a given *radiation source*, and is representative of the individuals likely to be most at *risk* from the given *source.*

critical level

See *minimum significant activity (MSA)*.

criticality

The state of a nuclear chain reacting medium when the chain reaction is just self-sustaining (or *critical*), i.e. when the *reactivity* is zero.

ⓘ Often used, slightly more loosely, to refer to states in which the *reactivity* is greater than zero.

criticality accident

See *accident*.

criticality safety index (CSI)

A number assigned to a *package*, *overpack* or *freight container* containing *fissile material* which is used to provide *control* over the accumulation of *packages*, *overpacks* or *freight containers* containing *fissile material*. (From Ref. [2].)

ⓘ The *procedure* for calculating the *criticality safety index* and the restrictions on the total sum of the *criticality safety index* in a *freight container* or aboard a *conveyance* are prescribed in paras 528 and 529 of the Transport Regulations [2].

[curie (Ci)]

Unit of *activity*, equal to 3.7×10^{10} Bq (exactly).

ⓘ Superseded by the *becquerel (Bq)*. *Activity* values may be given in Ci (with the equivalent in Bq in parentheses) if they are being quoted from a reference which uses that unit.

ⓘ Originally, the *activity* of a gram of radium.

D

dangerous source

See *source* (2).

[de minimis]

- ! The appropriate terminology of *exemption*, *clearance*, etc., should be used in *IAEA publications.*
- ⓘ A general term used historically to describe concepts that would now be referred to by terms such as *exemption* or *clearance.* The term is also sometimes used to describe a related (and controversial) philosophy that *assessments* of *collective dose* should exclude that portion delivered at very low *individual dose rates.*
- ⓘ The term *de minimis* is still used in some specific contexts, such as the London Convention 1972 [13].
- ⓘ Derived from the maxim '*de minimis* non curat lex' (the law does not concern itself with trivia).

decay constant, λ

For a radionuclide in a particular energy state, the quotient of dP by dt, where dP is the probability of a given nucleus undergoing a spontaneous nuclear transition from that energy state in the time interval dt.

$$\lambda = \frac{\mathrm{d}P}{\mathrm{d}t} = -\frac{1}{N}\frac{\mathrm{d}N}{\mathrm{d}t} = \frac{A}{N}$$

where N is the number of nuclei of concern existing at time t and A is the *activity.*

- ⓘ Unit: reciprocal second (s^{-1}).
- ⓘ The *activity* is the *decay constant* multiplied by the number of nuclei of the radionuclide present.
- ⓘ The *decay constant* is related to the *radioactive half-life,* $T_{1/2}$, of the radionuclide by the expression:

$$\lambda = \frac{\ln 2}{T_{1/2}}$$

decision limit

See *minimum significant activity (MSA)*.

decommissioning[7]

1. Administrative and technical actions taken to allow the removal of some or all of the *regulatory controls* from a *facility* (except for a *repository* or for certain *nuclear facilities* used for the *disposal* of residues from the mining and processing of *radioactive material*, which are 'closed' and not 'decommissioned').

- ! *Decommissioning* typically includes dismantling of the *facility* (or part thereof), but in the IAEA's usage this need not be the case. A facility could, for example, be *decommissioned* without dismantling and the existing *structures* subsequently put to another use (after *decontamination*).
- ⓘ The use of the term *decommissioning* implies that no further use of the *facility* (or part thereof) for its existing purpose is foreseen.
- ⓘ *Decommissioning* actions are taken at the end of the *operating lifetime* of a *facility* to retire it from service with due regard for the health and *safety* of workers and *members of the public* and the *protection* of the environment. Subject to national legal and regulatory *requirements*, a *facility* (or its remaining parts) may also be considered decommissioned if it is incorporated into a new or existing *facility*, or even if the site on which it is located is still under *regulatory control* or *institutional control*.
- ⓘ The actions will need to be such as to ensure the long term *protection* of the public and the environment, and typically include reducing the levels of residual radionuclides in the materials and on the site of the *facility* so that the materials can be safely recycled, reused or disposed of as *exempt waste* or as *radioactive waste* and the site can be released for *unrestricted use* or otherwise reused.
- ⓘ For a *repository*, the corresponding term is *closure*.

2. [All steps leading to the release of a *nuclear facility*, other than a *disposal facility*, from *regulatory control*. These steps include the *processes* of *decontamination* and dismantling.] (From Ref. [5].)

decommissioning plan

A document containing detailed information on the proposed *decommissioning* of a *facility*.

decontamination

The complete or partial removal of *contamination* by a deliberate physical, chemical or biological *process*.

ⓘ This definition is intended to include a wide range of *processes* for removing *contamination* from people, equipment and buildings, but to exclude the removal of radionuclides from within the human body or the removal of radionuclides by natural weathering or *migration processes*, which are not considered to be *decontamination*.
ⓘ See *remediation*.

decontamination factor

The ratio of the *activity* per unit area (or per unit mass or volume) before a particular *decontamination* technique is applied to the *activity* per unit area (or per unit mass or volume) after application of the technique.

ⓘ This ratio may be specified for a particular radionuclide or for gross *activity*.
ⓘ The *background activity* may be first deducted from the *activity* per unit area both before and after a particular *decontamination* technique is applied.

deep sea disposal

See *disposal* (3).

defence in depth

1. A hierarchical deployment of different levels of diverse equipment and *procedures* to prevent the escalation of *anticipated operational occurrences* and to maintain the effectiveness of physical *barriers* placed between a *radiation source* or *radioactive material* and *workers*, *members of the public* or the environment, in *operational states* and, for some *barriers*, in *accident conditions*.

ⓘ The objectives of *defence in depth* are:

(a) To compensate for potential human and *component failures*;
(b) To maintain the effectiveness of the *barriers* by averting damage to the *facility* and to the *barriers* themselves;
(c) To protect *workers*, *members of the public* and the environment from harm in *accident conditions* in the *event* that these *barriers* are not fully effective.

ⓘ INSAG defines five levels of *defence in depth*:

(a) Level 1: Prevention of *abnormal operation* and *failures*.
(b) Level 2: *Control* of *abnormal operation* and detection of *failures*.
(c) Level 3: *Control* of *accidents* within the *design basis*.
(d) Level 4: *Control* of severe plant conditions, including prevention of *accident* progression and mitigation of the consequences of *severe accidents*.

(e) Level 5: Mitigation of radiological consequences of significant releases of *radioactive material*.

ⓘ The levels of defence are sometimes grouped into three *safety layers*: hardware, software and management *control*.
ⓘ In the context of *waste disposal*, the term *multiple barriers* is used to describe a similar concept.
ⓘ See Ref. [14] for further information.

2. The application of more than one protective measure for a given *safety* objective, such that the objective is achieved even if one of the protective measures fails. (From Ref. [1].)

defined deck area

The area of the weather deck of a *vessel*, or of a *vehicle* deck of a roll-on/roll-off ship or a ferry, which is allocated for the stowage of *radioactive material*. (From Ref. [2].)

dependability

A general term describing the overall trustworthiness of a *system*; i.e. the extent to which reliance can justifiably be placed on this *system*. *Reliability*, *availability* and *safety* are attributes of *dependability*.

depleted uranium

See *uranium*.

derived air concentration (DAC)

A *derived limit* on the *activity concentration* in air of a specified radionuclide, calculated such that *Reference Man*, breathing air with constant *contamination* at the *DAC* while performing light physical activity for a working year, would receive an *intake* corresponding to the *annual limit on intake* for the radionuclide in question.

ⓘ The parameter values recommended by the International Commission on Radiological Protection for calculating *DACs* are a breathing rate of 1.2 m^3/h and a working year of 2000 h [15].

derived limit

See *limit*.

design

1. The *process* and the result of developing a concept, detailed plans, supporting calculations and specifications for a *facility* and its parts.[7]

2. The description of *special form radioactive material*, *low dispersible radioactive material*, *package* or *packaging* which enables such an item to be fully identified. The description may include specifications, engineering drawings, reports demonstrating compliance with regulatory *requirements*, and other relevant documentation. (From Ref. [2].)

ⓘ This is a much more restricted definition than (1), and is specific to the Transport Regulations.

design basis

The range of conditions and *events* taken explicitly into account in the *design* of a *facility*, according to established criteria, such that the *facility* can withstand them without exceeding *authorized limits* by the planned *operation* of *safety systems*.

ⓘ Used as a noun, with the definition above. Also often used as an adjective, applied to specific categories of conditions or *events* to mean 'included in the *design basis*'; as, for example, in *design basis accident*, *design basis external events* and *design basis* earthquake.

design basis accident

See *plant states*.

design basis external events

The *external event(s)* or combination(s) of *external events* considered in the *design basis* of all or any part of a *facility*.

design basis probability value (DBPV)

A value of the annual probability for a particular type of *event* to cause unacceptable radiological consequences. It is the ratio between the *screening probability level* and the *conditional probability value.*

ⓘ The term is used in the detailed *event screening process* for *site evaluation*.

design life

See *life.*

detection limit

See *minimum detectable activity (MDA)*.

determination level

See *minimum detectable activity (MDA)*.

deterministic analysis

Analysis using, for key parameters, single numerical values (taken to have a probability of 1), leading to a single value for the result.

ⓘ In *nuclear safety*, for example, this implies focusing on *accident* types, releases and consequences, without considering the probabilities of different *event* sequences.

ⓘ Typically used with either 'best estimate' or 'conservative' values, based on expert judgement and knowledge of the phenomena being modelled.

ⓘ Contrasting terms: *probabilistic analysis* or *stochastic analysis.* See *probabilistic analysis.*

deterministic effect

See *health effects (of radiation)*.

detriment

See *radiation detriment.*

deviation

A departure from specified *requirements.* See also *INES.*

diagnostic exposure

See *exposure, types of: medical exposure.*

diffusion

The movement of radionuclides relative to the medium in which they are distributed, under the influence of a concentration gradient.

ⓘ Usually used for the movement of airborne radionuclides (e.g. from *discharges* or resulting from an *accident*) relative to the air, and for movement of dissolved radionuclides (e.g. in groundwater or surface water, from *migration* following *waste disposal*, or in surface water from *discharges*) relative to the water.

ⓘ See also *advection* (where the radionuclide does not move relative to the carrying medium, but moves with it) and *dispersion*.

direct cause

See *cause.*

direct disposal

See *disposal* (1).

directional dose equivalent

See *dose equivalent quantities.*

discharge

1. Planned and controlled release of (usually gaseous or liquid) *radioactive material* to the environment.

ⓘ Strictly, the act or *process* of releasing the material, but also used to describe the material released.

authorized discharge. *Discharge* in accordance with an *authorization*.

radioactive discharges. *Radioactive* substances arising from a *source* within a *practice* which are discharged as gases, aerosols, liquids or solids to the environment, generally with the purpose of dilution and *dispersion*. (From Ref. [1].)

2. [A planned and controlled release to the environment, as a legitimate *practice*, within *limits* authorized by the *regulatory body*, of liquid or gaseous *radioactive material* that originate from regulated *nuclear facilities* during *normal operation*.] (From Ref. [5].)

dispersal

The spreading of *radioactive material* in the environment.

ⓘ In normal language synonymous with *dispersion*, but tends to be used in a general sense, not implying the involvement of any particular *processes* or phenomena, e.g. the uncontrolled spreading of material that has escaped from *confinement,* or as a result of damage to (or the destruction of) a *sealed source*, *special form radioactive material* or *low dispersible radioactive material*.

dispersion

The spreading of radionuclides in air (***aerodynamic dispersion***) or water (***hydrodynamic dispersion***) resulting mainly from physical *processes* affecting the velocity of different molecules in the medium.

ⓘ Often used in a more general sense combining all *processes* (including molecular *diffusion*) that result in the spreading of a plume. The terms ***atmospheric dispersion*** and ***hydrodynamic dispersion*** are used in this more general sense for plumes in air and water, respectively.

ⓘ In normal language synonymous with *dispersal*, but *dispersion* is mostly used more specifically as defined above, whereas *dispersal* is typically (though not universally) used as a more general expression.

ⓘ See also *advection* and *diffusion*.

disposal

1. Emplacement of *waste* in an appropriate *facility* without the intention of retrieval.

ⓘ In some States, the term *disposal* is used to include *discharges* of effluents to the environment.

ⓘ In some States, the term *disposal* is used administratively in such a way as to include, for example, incineration of *waste* or the transfer of *waste* between *operators*.

! In *IAEA publications*, *disposal* should be used only in accordance with the more restrictive definition given above.

! In many cases, the only element of this definition that is important is the distinction between *disposal* (with no intent to retrieve) and *storage* (with intent to retrieve). In such cases, a definition is not necessary; the distinction can be made in the form of a footnote at the first use of the term *disposal* or

storage (e.g. "The use of the term *disposal* indicates that there is no intention to retrieve the *waste*. If retrieval of the *waste* at any time in the future is intended, the term *storage* is used.").

! The term *disposal* implies that retrieval is not intended; it does not mean that retrieval is not possible.

ⓘ For *storage* in a combined *storage* and *disposal facility*, for which a decision may be made at the time of its *closure* whether to remove the *waste* stored during the *operation* of the *storage facility* or to dispose of it by encasing it in concrete, the question of intention of retrieval may be left open until the time of *closure* of the *facility*.

ⓘ Contrasted with *storage*.

direct disposal. *Disposal* of *spent fuel* as *waste*.

geological disposal. *Disposal* in a *geological repository*.

ⓘ See also *repository*.

ⓘ The term 'intermediate *disposal*' is sometimes used for the *disposal* of *low and intermediate level waste*, e.g. in boreholes (i.e. between *near surface disposal* and *geological disposal*).

near surface disposal. *Disposal*, with or without engineered *barriers*, in a *near surface repository*.

sub-seabed disposal. *Disposal* in a *geological repository* in the rock underlying the seabed.

2. [The emplacement of *spent fuel* or *radioactive waste* in an appropriate *facility* without the intention of retrieval.] (From Ref. [5].)

3. The act or *process* of getting rid of *waste*, without the intention of retrieval.

ⓘ The terms *deep sea disposal* and *seabed disposal* do not strictly satisfy definitions (1) or (2), but are consistent with the everyday meaning of *disposal* and are used as such.

deep sea disposal. *Disposal* of *waste* packaged in *containers* on the deep ocean floor.

! The commonly used, but informal, term 'sea dumping' should not be used in *IAEA publications*.

ⓘ As practised until 1982 in accordance with the *requirements* of the London Convention 1972 [13].

seabed disposal. Emplacement of *waste* packaged in suitable *containers* at some depth into the sedimentary layers of the deep ocean floor.

ⓘ This may be achieved by direct emplacement, or by placing the *waste* in specially designed 'penetrators' which, when dropped into the sea, embed themselves in the sediment.

disposal facility

Synonymous with *repository.*

disposition

Consignment of, or arrangements for the *consignment* of, *radioactive waste* for some specified (interim or final) destination, for example for the purpose of *processing*, *disposal* or *storage*.

disused source

See *source* (2).

diversity

The presence of two or more redundant *systems* or *components* to perform an identified function, where the different *systems* or *components* have different attributes so as to reduce the possibility of *common cause failure*, including *common mode failure.*

ⓘ Examples of such attributes are: different *operating conditions*, different working principles or different *design* teams (which provide ***functional diversity***), and different sizes of equipment, different manufacturers, and types of equipment that use different physical methods (which provide ***physical diversity***).

dose

1. A measure of the energy deposited by *radiation* in a target.

ⓘ For definitions of the most important such measures, see *dose quantities* and *dose concepts.*

2. *Absorbed dose*, *committed equivalent dose*, *committed effective dose*, *effective dose*, *equivalent dose* or *organ dose*, as indicated by the context.

committed dose. *committed equivalent dose* or *committed effective dose.*

dose and dose rate effectiveness factor (DDREF)

The ratio between the *risk* or *radiation detriment* per unit *effective dose* for high *doses* and/or *dose rates* and that for low *doses* and *dose rates.*

ⓘ Used in the estimation of *risk coefficients* for low *doses* and *dose rates* from observations and epidemiological findings at high *doses* and *dose rates.*

ⓘ Supersedes the *dose rate effectiveness factor (DREF)*.

dose assessment

See *assessment* (1).

dose coefficient

ⓘ Used by the International Commission on Radiological Protection and others as a synonym for *dose per unit intake*, but sometimes also used to describe other coefficients linking quantities or concentrations of *activity* to *doses* or *dose rates*, such as the external *dose rate* at a specified distance above a surface with a deposit of a specified *activity* per unit area of a specified radionuclide. To avoid confusion, the term *dose coefficient* should be used with care.

[dose commitment]

See *dose concepts.*

dose concepts

annual dose. The *dose* due to *external exposure* in a year plus the *committed dose* from *intakes* of radionuclides in that year.

ⓘ The *individual dose*, unless otherwise stated.

! This is not, in general, the same as the *dose* actually delivered during the year in question, which would include *doses* from radionuclides remaining in the body from *intakes* in previous years, and would exclude *doses* delivered in future years from *intakes* of radionuclides during the year in question.

avertable dose. The *dose* that could be averted if a *countermeasure* or set of *countermeasures* were to be applied.

averted dose. The *dose* prevented by the application of a *countermeasure* or set of *countermeasures*, i.e. the difference between the *projected dose* if the *countermeasure(s)* had not been applied and the actual *projected dose.*

collective dose. The total *radiation dose* incurred by a population.

- This is the sum of all of the *individual doses* to members of the population. If the *doses* continue for longer than a year, then the *annual individual doses* must also be integrated over time. Unless otherwise specified, the time over which the *dose* is integrated is infinite; if a finite upper limit is applied to the time integration, the *collective dose* is described as 'truncated' at that time.
- Unless otherwise specified, the relevant *dose* is normally the *effective dose* (see *collective effective dose* for the formal definition).
- Unit: man-sievert (man Sv). This is, strictly, just a *sievert*, but the unit man-sievert is used to distinguish the *collective dose* from the *individual dose* which a dosimeter would measure (just as, for example, 'person-hours' are used to measure the total effort devoted to a task, as opposed to the elapsed time that would be shown by a clock).
- Contrasting term: *individual dose.*

committed dose. The *lifetime dose* expected to result from an *intake.*

- This term partially supersedes *dose commitment*.

[***dose commitment.*** The total *dose* that would eventually result from an *event* (e.g. a release of *radioactive material*), a deliberate action or a finite portion of a *practice*.]

- More specific and precise terms such as *committed dose* or *collective dose* should be used as appropriate.

individual dose. The *dose* incurred by an individual.

- Contrasting term: *collective dose.*

lifetime dose. The total *dose* received by an individual during his or her lifetime.

- In practice, often approximated as the sum of the *annual doses* incurred. Since *annual doses* include *committed doses*, some parts of some of the *annual doses* may not actually be delivered within the lifetime of the individual, and therefore this may overestimate the true *lifetime dose.*
- For prospective *assessments* of *lifetime dose*, a lifetime is normally interpreted as 70 years.

projected dose. The *dose* that would be expected to be incurred if a specified *countermeasure* or set of *countermeasures* — or, in particular, no *countermeasures* — were to be taken.

residual dose. In a *chronic exposure* situation, the *dose* expected to be incurred in the future after *intervention* has been terminated (or a decision has been taken not to intervene).

dose constraint

1. A prospective restriction on the *individual dose* delivered by a *source*, which serves as an upper bound on the *dose* in *optimization* of *protection and safety* for the *source.*

! For *medical exposure*, *dose constraint* levels should be interpreted as *guidance levels*, except when used in optimizing the *protection* of persons exposed for medical research purposes or of persons, other than *workers*, who assist in the care, support or comfort of exposed patients.

2. A prospective and *source* related restriction on the *individual dose* delivered by the *source* which serves as a bound in the *optimization of protection and safety* of the *source*. For *occupational exposures*, the *dose constraint* is a *source* related value of *individual dose* used to limit the range of options considered in the *process* of *optimization*. For *public exposure*, the *dose constraint* is an upper bound on the *annual doses* that *members of the public* should receive from the planned *operation* of any controlled *source.* The *dose* to which the *dose constraint* applies is the *annual dose* to any *critical group*, summed over all *exposure pathways*, arising from the predicted *operation* of the controlled *source.* The *dose constraint* for each *source* is intended to ensure that the sum of *doses* to the *critical group* from all controlled *sources* remains within the *dose limit*. For *medical exposure* the *dose constraint* levels should be interpreted as *guidance levels*, except when used in optimizing the *protection* of persons exposed for medical research purposes or of persons, other than *workers*, who assist in the care, support or comfort of exposed patients. (From Ref. [1].)

! This definition goes somewhat further than the International Commission on Radiological Protection's explanation of the *dose constraint* concept [16].

dose conversion convention

The assumed relationship between *potential alpha energy exposure* and *effective dose.*

ⓘ Used to estimate *doses* from measured or estimated *exposure* to *radon*.
ⓘ Unit: mSv per J·h/m^3.

[dose equivalent]

The product of the *absorbed dose* at a point in the tissue or organ and the appropriate *quality factor* for the type of *radiation* giving rise to the *dose.*

ⓘ A measure of the *dose* to a tissue or organ designed to reflect the amount of harm caused.
ⓘ A quantity used by the International Commission on Radiation Units and Measurements in defining the operational quantities *ambient dose equivalent*, *directional dose equivalent* and *personal dose equivalent* (see *dose equivalent quantities*). The quantity *dose equivalent* has been superseded for *radiation protection* purposes by *equivalent dose*. (From Ref. [1].)

[*effective dose equivalent, H_E*]. A measure of *dose* designed to reflect the *risk* associated with the *dose*, calculated as the weighted sum of the *dose equivalents* in the different tissues of the body.
ⓘ Superseded by *effective dose*.

dose equivalent quantities

ambient dose equivalent, $H^*(d)$. The *dose equivalent* that would be produced by the corresponding aligned and expanded field in the *ICRU sphere* at a depth *d* on the radius opposing the direction of the aligned field.
ⓘ Parameter defined at a point in a *radiation* field. Used as a directly measurable proxy (i.e. substitute) for *effective dose* for use in *monitoring* of *external exposure*.
ⓘ The recommended value of *d* for *strongly penetrating radiation* is 10 mm.

directional dose equivalent, $H'(d,\Omega)$. The *dose equivalent* that would be produced by the corresponding expanded field in the *ICRU sphere* at a depth *d* on a radius in a specified direction Ω.
ⓘ Parameter defined at a point in a *radiation* field. Used as a directly measurable proxy (i.e. substitute) for *equivalent dose* in the skin for use in *monitoring* of *external exposure*.
ⓘ The recommended value of *d* for *weakly penetrating radiation* is 0.07 mm.

[*individual dose equivalent, penetrating, $H_p(d)$*]. See *dose equivalent quantities*: *personal dose equivalent*.

[*individual dose equivalent, superficial, $H_s(d)$*]. See *dose equivalent quantities*: *personal dose equivalent*.

personal dose equivalent, $H_p(d)$. The *dose equivalent* in soft tissue below a specified point on the body at an appropriate depth *d*.

- Parameter used in the BSS as a directly measurable proxy (i.e. substitute) for *equivalent dose* in tissues or organs or (with d = 10 mm) for *effective dose*, in *individual monitoring* of *external exposure*.
- The recommended values of d are 10 mm for *strongly penetrating radiation* and 0.07 mm for *weakly penetrating radiation*. 'Soft tissue' is commonly interpreted as the *ICRU sphere*.
- Recommended by the International Commission on Radiation Units and Measurements [17, 18] as a simplification of the two separate terms ***individual dose equivalent, penetrating, Hp(d)***, and ***individual dose equivalent, superficial, Hs(d)***, defined in Ref. [19].

dose limit

See *limit*.

dose per unit intake

The *committed effective dose* resulting from *intake*, by a specified means (usually ingestion or inhalation), of unit *activity* of a specified radionuclide in a specified chemical form.

- Values are specified in the BSS [1] and recommended by the International Commission on Radiological Protection [20].
- For *intakes*, synonymous with *dose coefficient*.
- Unit: Sv/Bq.

dose quantities

absorbed dose, D. The fundamental dosimetric quantity D, defined as:

$$D = \frac{\mathrm{d}\bar{\varepsilon}}{\mathrm{d}m}$$

where $\mathrm{d}\bar{\varepsilon}$ is the mean energy imparted by *ionizing radiation* to matter in a volume element and $\mathrm{d}m$ is the mass of matter in the volume element. (From Ref. [1].)

- The energy can be averaged over any defined volume, the average *dose* being equal to the total energy imparted in the volume divided by the mass in the volume.
- *Absorbed dose* is defined at a point; for the average *dose* in a tissue or organ, see *organ dose*.
- Unit: *gray (Gy)*, equal to 1 J/kg (formerly, the *rad* was used).

collective effective dose, S. The total *effective dose S* to a population, defined as:

$$S = \sum_i E_i N_i$$

where E_i is the average *effective dose* in the population subgroup *i* and N_i is the number of individuals in the subgroup. It can also be defined by the integral:

$$S = \int_0^\infty E \frac{\mathrm{d}N}{\mathrm{d}E} \mathrm{d}E$$

where

$$\frac{\mathrm{d}N}{\mathrm{d}E} \mathrm{d}E$$

is the number of individuals receiving an *effective dose* between E and $E + \mathrm{d}E$.[8]

The *collective effective dose* S_k committed by an *event*, a deliberate action or a finite portion of a *practice* k is given by:

$$S_\mathrm{k} = \int \dot{S}_\mathrm{k}(t) \mathrm{d}t$$

where $\dot{S}_\mathrm{k}$ is the *collective effective dose rate* at time *t* caused by *k*. (From Ref. [1].)

committed effective dose, E(τ). The quantity $E(\tau)$, defined as:

$$E(\tau) = \sum_\mathrm{T} w_\mathrm{T} H_\mathrm{T}(\tau)$$

[8] Although the upper limit for the integral could in principle be infinite, in most *assessments* of *collective dose* the component associated with *individual doses* or *dose rates* that are higher than the thresholds for the induction of *deterministic effects* would be considered separately.

where $H_T(\tau)$ is the *committed equivalent dose* to tissue T over the integration time τ and w_T is the *tissue weighting factor* for tissue T. When τ is not specified, it will be taken to be 50 years for adults and the time to age 70 years for *intakes* by children. (From Ref. [1].)

committed equivalent dose, $H_T(\tau)$. The quantity $H_T(\tau)$, defined as:

$$H_T(\tau) = \int_{t_0}^{t_0+\tau} \dot{H}_T(t)\mathrm{d}t$$

where t_0 is the time of *intake*, $\dot{H}_T(t)$ is the *equivalent dose rate* at time t in organ or tissue T and τ is the time elapsed after an *intake* of *radioactive substances*. When τ is not specified, it will be taken to be 50 years for adults and the time to age 70 years for *intakes* by children. (From Ref. [1].)

effective dose, E. The quantity E, defined as a summation of the tissue *equivalent doses*, each multiplied by the appropriate *tissue weighting factor*:

$$E = \sum_T w_T H_T$$

where H_T is the *equivalent dose* in tissue T and w_T is the *tissue weighting factor* for tissue T. From the definition of *equivalent dose*, it follows that:

$$E = \sum_T w_T \sum_R w_R D_{T,R}$$

where w_R is the *radiation weighting factor* for *radiation* R and $D_{T,R}$ is the average *absorbed dose* in the organ or tissue T. (From Ref. [1].)

- The unit of *effective dose* is the *sievert (Sv)*, equal to 1 J/kg. The *rem*, equal to 0.01 Sv, is sometimes used as a unit of *equivalent dose* and *effective dose*. This should not be used in *IAEA publications*, except when quoting directly from other publications, in which case the value in *sieverts* should be added in parentheses.
- *Effective dose* is a measure of *dose* designed to reflect the amount of *radiation detriment* likely to result from the *dose*.
- Values of *effective dose* from any type(s) of *radiation* and mode(s) of *exposure* can be compared directly.

equivalent dose, H_T. The quantity $H_{T,R}$, defined as:

$$H_{T,R} = w_R D_{T,R}$$

where $D_{T,R}$ is the *absorbed dose* delivered by *radiation* type R averaged over a tissue or organ T and w_R is the *radiation weighting factor* for *radiation* type R. When the *radiation* field is composed of different *radiation* types with different values of w_R the *equivalent dose* is:

$$H_T = \sum_R w_R D_{T,R} \text{ (from Ref. [1])}$$

ⓘ The unit of *equivalent dose* is the *sievert (Sv)*, equal to 1 J/kg. The *rem*, equal to 0.01 Sv, is sometimes used as a unit of *equivalent dose* and *effective dose*. This should not be used in *IAEA publications*, except when quoting directly from other publications, in which case the value in *sieverts* should be added in parentheses.

ⓘ *Equivalent dose* is a measure of the *dose* to a tissue or organ designed to reflect the amount of harm caused.

ⓘ Values of *equivalent dose* to a specified tissue from any type(s) of *radiation* can be compared directly.

organ dose. The mean *absorbed dose* D_T in a specified tissue or organ T of the human body, given by:

$$D_T = \frac{1}{m_T}\int_{m_T} D \, \mathrm{d}m = \frac{\varepsilon_T}{m_T}$$

where m_T is the mass of the tissue or organ, D is the *absorbed dose* in the mass element dm and ε_T is the total energy imparted.

ⓘ Sometimes called tissue *dose*.

dose rate

! Although *dose rate* could, in principle, be defined over any unit of time (e.g. an *annual dose* is technically a *dose rate*), in *IAEA publications* the term *dose rate* should be used only in the context of short periods of time, e.g. *dose* per second or *dose* per hour.

[dose rate effectiveness factor (DREF)]

The ratio between the *risk* per unit *effective dose* for high *dose rates* and that for low *dose rates*.

ⓘ Superseded by *dose and dose rate effectiveness factor (DDREF)*.

double contingency principle

See *single failure criterion*.

driven equipment

A *component* such as a pump or valve that is operated by a *prime mover*.

dry storage

See *storage*.

E

early effect

See *health effects (of radiation)*.

effective dose

See *dose quantities.*

[effective dose equivalent]

See *dose equivalent.*

effective half-life

See *half-life* (2).

emergency

A non-routine situation that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human health and *safety*, quality of life, property or the environment. This includes *nuclear and radiological emergencies* and conventional *emergencies* such as fires, release of hazardous chemicals, storms or earthquakes. It includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

nuclear or radiological emergency. An *emergency* in which there is, or is perceived to be, a hazard due to:

(a) The energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction; or
(b) *Radiation exposure.*

ⓘ Points (a) and (b) approximately represent *nuclear and radiological emergencies*, respectively. However, this is not an exact distinction.

ⓘ ***Radiation emergency*** is used in some cases when an explicit distinction in the nature of the hazard is immaterial (e.g. national *radiation emergency* plan), and it has essentially the same meaning.

transnational emergency. A *nuclear or radiological emergency* of actual, potential or perceived radiological significance for more than one State. This includes:

(1) A *significant transboundary release* of *radioactive material* (however, a *transnational emergency* does not necessarily imply a *significant transboundary release* of *radioactive material*);
(2) A *general emergency* at a *facility* or other *event* that could result in a *significant transboundary release* (atmospheric or aquatic) of *radioactive material*;
(3) Discovery of the loss or illicit removal of a *dangerous source* that has been transported across, or is suspected of having been transported across, a national border;
(4) An *emergency* resulting in significant disruption to international trade or travel;
(5) An *emergency* warranting the taking of *protective actions* for foreign nationals or embassies in the State in which it occurs;
(6) An *emergency* resulting or potentially resulting in *severe deterministic effects* and involving a fault and/or problem (such as in equipment or software) that could have serious implications for *safety* internationally;
(7) An *emergency* resulting in or potentially resulting in great concern among the population of more than one State owing to the actual or perceived radiological hazard.

emergency action

An action performed to mitigate the impact of an *emergency* on human health and *safety*, property or the environment.

emergency action level (EAL)

See *level: action level*.

emergency class

A set of conditions that warrant a similar immediate *emergency response*.

ⓘ This is the term used for communicating to the *response organizations* and the public the level of response needed. The *events* that belong to a given *emergency class* are defined by criteria specific to the installation, *source* or *practice*, which, if exceeded, indicate classification at the prescribed level. For each *emergency class*, the initial actions of the *response organizations* are predefined.

ⓘ The IAEA defines three *emergency classes*, namely (in order of increasing severity) *alert*, *site area emergency* and *general emergency*. In alphabetical order:

alert. An *event* involving an unknown or significant decrease in the level of *protection* for the public or *on-site* personnel.

ⓘ When an *alert* is declared, the state of readiness of the *on-site* and *off-site response organizations* is increased and additional *assessments* are made.

general emergency. An *event* resulting in an actual release, or substantial probability of a release, requiring implementation of *urgent protective actions off-site.*

ⓘ This includes: (1) actual or projected damage to the reactor core or large amounts of *spent fuel*; or (2) releases *off-site* resulting in *doses* exceeding *intervention levels* for *urgent protective actions* within hours.

ⓘ When a *general emergency* is declared, *urgent protective actions* are recommended immediately for the public near the *facility.*

site area emergency. An *event* resulting in a major decrease in the level of *protection* for the public or *on-site* personnel.

ⓘ This includes: (1) a major decrease in the level of *protection* provided to the reactor core or large amounts of *spent fuel*; or (2) conditions where any additional *failures* could result in damage to the reactor core or *spent fuel*; or (3) high *doses on-site.*

ⓘ When a *site area emergency* is declared, preparations should be made to take *protective actions off-site* and to control the *doses* to *on-site* personnel.

emergency classification

The *process* whereby an authorized official classifies an *emergency* in order to declare the applicable *emergency class.*

ⓘ Upon declaration of the *emergency class*, the *response organizations* initiate the predefined response actions for that *emergency class.*

emergency exposure

See *exposure, types of.*

emergency phase

The period of time from the detection of conditions warranting an *emergency response* until the completion of all the actions taken in anticipation of or in response to the radiological conditions expected in the first few months of the *emergency.* This phase typically ends when the situation is under *control*, the *off-site* radiological conditions have been characterized sufficiently well to

identify where food restrictions and *temporary relocation* are *required*, and all *required* food restrictions and *temporary relocations* have been implemented.

initial phase. The period of time from the detection of conditions that warrant the performance of response actions that must be taken promptly in order to be effective until those actions have been completed. These actions include *mitigatory actions* by the *operator* and *urgent protective actions on the site* and *off the site.*

emergency plan

1. A description of the objectives, policy and concept of *operations* for the response to an *emergency* and of the *structure*, authorities and responsibilities for a systematic, coordinated and effective response. The *emergency plan* serves as the basis for the development of other plans, *procedures* and checklists.

- ⓘ *Emergency plans* are prepared at several different levels: national, local and *facility*. They may include all *activities* planned to be carried out by all relevant organizations and authorities, or may be primarily concerned with the actions to be carried out by a particular organization. The term ***overall emergency plan*** is sometimes used for clarification when the former meaning is intended.
- ⓘ Details regarding the accomplishment of specific tasks outlined in an *emergency plan* are contained in *emergency procedures.*

2. A set of *procedures* to be implemented in the *event* of an *accident*. (From Ref. [1].)

emergency preparedness

The capability to take actions that will effectively mitigate the consequences of an *emergency* for human health and *safety*, quality of life, property and the environment.

emergency procedures

A set of instructions describing in detail the actions to be taken by response personnel in an *emergency.*

emergency response

The performance of actions to mitigate the consequences of an *emergency* for human health and *safety*, quality of life, property and the environment. It may also provide a basis for the resumption of normal social and economic activity.

emergency response arrangements

The integrated set of infrastructural elements necessary to provide the capability for performing a specified function or task *required* in response to a *nuclear or radiological emergency*. These elements may include authorities and responsibilities, organization, coordination, personnel, plans, *procedures*, *facilities*, equipment or training.

emergency services

The local *off-site response organizations* that are generally available and that perform *emergency response* functions. These may include police, firefighters and rescue brigades, ambulance services and *control* teams for hazardous materials.

emergency worker

A *worker* who may be exposed in excess of occupational *dose limits* while performing actions to mitigate the consequences of an *emergency* for human health and *safety*, quality of life, property and the environment.

emergency zones

The *precautionary action zone* and/or the *urgent protective action planning zone*.

precautionary action zone. An area around a *facility* for which *arrangements* have been made to take *urgent protective actions* in the *event* of a *nuclear or radiological emergency* to reduce the *risk* of *severe deterministic effects off the site*. *Protective actions* within this area are to be taken before or shortly after a release of *radioactive material* or an *exposure* on the basis of the prevailing conditions at the *facility*.

urgent protective action planning zone. An area around a *facility* for which *arrangements* have been made to take *urgent protective actions* in the *event* of a *nuclear or radiological emergency* to avert *doses off the site* in accordance with international *safety standards*. *Protective actions* within this area are to be taken on the basis of *environmental monitoring* — or, as appropriate, the prevailing conditions at the *facility*.

employer

A *legal person* with recognized responsibility, commitment and duties towards a *worker* in his or her employment by virtue of a mutually agreed relationship. (From Ref. [1].)

! A self-employed person is regarded as being both an *employer* and a *worker*.

end point

1. The final stage of a *process*, especially the point at which an effect is observed.

ⓘ Used, somewhat loosely, to describe a range of different results or consequences. For example, the term 'biological *end point*' is used to describe a *health effect* (or a probability of that *health effect*) that could result from *exposure*.

2. A radiological or other measure of *protection* or *safety* that is the calculated result of an *analysis* or *assessment*.

ⓘ Common *end points* include estimates of *dose* or *risk*, estimated frequency or probability of an *event* or type of *event* (such as core damage), expected number of *health effects* in a population, predicted environmental concentrations of radionuclides, etc.

3. A predetermined criterion defining the point at which a specific task or *process* will be considered completed.

ⓘ This usage often occurs in contexts such as *decontamination* or *remediation*, where the *end point* is typically the level of *contamination* beyond which further *decontamination* or *remediation* is considered unnecessary. (In such a context, this criterion may also be an *end point* in the sense of definition (2) — such criteria are often calculated on the basis of a level of *dose* or *risk* that is considered acceptable — but its application to the actual *decontamination* or *remediation operations* is in the sense of definition (3).)

end state

1. The state of *radioactive waste* in the final stage of *radioactive waste management*, in which the *waste* is passively safe and does not depend on *institutional control*.

ⓘ In the context of *radioactive waste management*, the *end state* includes both *disposal* and, if an adequate *safety case* can be made, indefinite *storage*.

2. A predetermined criterion defining the point at which a specific task or *process* is to be considered completed.

ⓘ Used in relation to *decommissioning activities* as the final state of *decommissioning*.

energy fluence

See *fluence.*

enforcement

The application by a *regulatory body* of sanctions against an *operator*, intended to correct and, as appropriate, penalize non-compliance with conditions of an *authorization*.

enriched uranium

See *uranium*.

entrance surface dose

Absorbed dose in the centre of the field at the surface of entry of *radiation* for a patient undergoing a radiodiagnostic examination, expressed in air and with backscatter. (From Ref. [1].)

environmental monitoring

See *monitoring* (1).

equilibrium, radioactive

The state of a *radioactive* decay chain (or part thereof) where the *activity* of each radionuclide in the chain (or part of the chain) is the same.

ⓘ This state is achieved when the parent nuclide has a much longer *half-life* than any of the progeny, and after a time equal to several times the *half-life* of the longest lived of the progeny. Hence, the term 'secular equilibrium' is also used (with secular in this context meaning 'eventual').

equilibrium equivalent concentration

The *activity concentration* of *radon* or *thoron* in *radioactive equilibrium* with its short lived progeny that would have the same *potential alpha energy* concentration as the actual (non-equilibrium) mixture.

ⓘ The *equilibrium equivalent concentration* of *radon* is given by

$$EEC\ radon = 0.104 \times C(^{218}Po) + 0.514 \times C(^{214}Pb) + 0.382 \times C(^{214}Bi)$$

where $C(x)$ is the concentration of nuclide x in air. 1 Bq/m^3 *EEC radon* corresponds to 5.56×10^{-6} mJ/m^3.

ⓘ The *equilibrium equivalent concentration* of *thoron* is given by

$$EEC\ thoron = 0.913 \times C(^{212}Pb) + 0.087 \times C(^{212}Bi)$$

where $C(x)$ is the concentration of nuclide x in air. 1 Bq/m^3 *EEC thoron* corresponds to 7.57×10^{-5} mJ/m^3.

equilibrium factor

The ratio of the *equilibrium equivalent concentration* of *radon* to the actual *radon* concentration. (From Ref. [1].)

equipment qualification

See *qualification*.

equivalent dose

See *dose quantities.*

evacuation

The rapid, temporary removal of people from an area to avoid or reduce short term *radiation exposure* in an *emergency.*

ⓘ *Evacuation* is an *urgent protective action* (a form of *intervention*). If people are removed from the area for a longer period of time (more than a few months), the term *relocation* is used.

ⓘ *Evacuation* may be performed as a precautionary action based on plant conditions within the *precautionary action zone.*

event

In the context of the reporting and *analysis* of *events*, an *event* is any occurrence unintended by the *operator*, including operating error, equipment *failure* or other mishap, and deliberate action on the part of others, the consequences or potential consequences of which are not negligible from the point of view of *protection* or *safety.*

! As with *INES*, the terminology related to the reporting and *analysis* of *events* is not always consistent with the terminology used in *safety standards*, and

great care should be taken to avoid confusion. In particular, the definition of *event* given above is identical in essence to the *safety standards* definition (1) of *accident*. This difference derives from the fact that *event* reporting and *analysis* is concerned directly with the question of whether an *event* that could develop into an *accident* with significant consequences actually does so; terms such as *accident* are used only to describe the end result, and therefore other terms are needed to describe the earlier stages.

ⓘ See *initiating event* and *initiating event: postulated initiating event*.

Events (including *anticipated operational occurrences*)			Circumstances		
Incidents (including *initiating events*, *accident precursors* and *near misses*)		*Scenarios:* postulated *incidents*	Situations (including *operating conditions*, *accident conditions*)		*Scenarios:* hypothetical situations
Accidents (unintentional causes)	Intentional causes (unauthorized acts: *malicious* and non-malicious) (e.g. *sabotage*, theft)	E.g. acute *potential exposure*	*Operational states*, *design basis accident* conditions	*Nuclear and radiological emergencies*, *beyond design basis accident* conditions	E.g. *chronic potential exposure*

Notes: A *scenario* is a postulated or assumed set of conditions and/or *events*. A *scenario* may represent the conditions at a single point in time or a single *event*, or a time history of conditions and/or *events*.

Anticipated operational occurrences; *beyond design basis accidents*; *design basis accidents*: see *plant states*.

Attributes: these terms use the following attributes: acute and chronic; actual and postulated; unintentional and intentional causes; *malicious* and non-malicious; *design basis accident* and *beyond design basis accident*; nuclear and radiological.

Definitions:

Circumstance(s): A fact, occurrence or condition, especially (in plural) the time, place, manner, cause, occasion, etc., or surroundings of an act or *event*; (in plural) the external conditions that affect or might affect an action.

Occurrence: The act or an instance of occurring, i.e. coming into being as an *event* or *process* at or during some time; happening. The act or an instance of existing or being encountered in some place or conditions.

Situation: A set of circumstances; a state of affairs.

event tree analysis

See *analysis.*

excepted package

See *package.*

exception

ⓘ The terms *exception* and excepted are sometimes used to describe cases in which some of the *requirements* or guidance in *safety standards* are deemed not to apply. In this regard, the effect of *exception* may be compared with those of *exemption* and *exclusion*. However, the terms *exemption* and *exclusion* are necessarily linked to specific reasons for non-application, whereas *exception* is not. This is in fact a normal usage of the English term *exception*, not a specialized term. The term *excepted package* in the Transport Regulations is an example of this usage; *packages* may be excepted from specified *requirements* of the Transport Regulations if they satisfy conditions specified in the Transport Regulations.

excess relative risk

See *risk* (3).

excess risk

See *risk* (3).

excluded exposure

See *exclusion*.

exclusion

The deliberate *exclusion* of a particular category of *exposure* from the scope of an instrument of *regulatory control* on the grounds that it is not considered amenable to *control* through the regulatory instrument in question. Such *exposure* is termed ***excluded exposure***.

ⓘ This term is most commonly applied to those *exposures* from *natural sources* that are least amenable to *control*, such as cosmic *radiation* at the Earth's surface, potassium-40 in the human body or *naturally occurring radioactive*

material in which the *activity concentrations* of natural radionuclides are below the relevant values given in IAEA *safety standards*.

ⓘ The concept is related to those of *clearance* (which is normally used in relation to materials) and *exemption* (which relates to *practices* or *sources*).

exclusive use

The sole use, by a single *consignor*, of a *conveyance* or of a *large freight container*, in respect of which all initial, intermediate and final loading and unloading is carried out in accordance with the directions of the *consignor* or *consignee*. (From Ref. [2].)

exempt waste

See *waste*.

exemption

The determination by a *regulatory body* that a *source* or *practice* need not be subject to some or all aspects of *regulatory control* on the basis that the *exposure* (including *potential exposure*) due to the *source* or *practice* is too small to warrant the application of those aspects or that this is the optimum option for *protection* irrespective of the actual level of the *doses* or *risks*.

ⓘ See also *clearance* (1) and *exclusion*.

exemption level

See *level*.

exposure

1. The act or condition of being subject to irradiation.

! *Exposure* should not be used as a synonym for *dose*. *Dose* is a measure of the effects of *exposure*.

ⓘ *Exposure* can be divided into categories according to its nature and duration (see *exposure situations*) or according to the *source* of the *exposure*, the people exposed and/or the circumstances under which they are exposed (see *exposure, types of*).

external exposure. *Exposure* to *radiation* from a *source* outside the body.

ⓘ Contrasted with *internal exposure*.

internal exposure. *Exposure* to *radiation* from a *source* within the body.
ⓘ Contrasted with *external exposure.*

2. The sum of the electrical charges of all of the ions of one sign produced in air by X rays or gamma *radiation* when all electrons liberated by photons in a suitably small element of volume of air are completely stopped in air, divided by the mass of the air in the volume element.
ⓘ Unit: C/kg (in the past, the *röntgen (R)* was used).

3. The time integral of the *potential alpha energy* concentration in air, or of the corresponding *equilibrium equivalent concentration*, to which an individual is exposed over a given period (e.g. a year).
ⓘ Used in connection with *exposure* to *radon* and *thoron* progeny.
ⓘ The SI unit is $J \cdot h/m^3$ for *potential alpha energy* concentration or $Bq \cdot h/m^3$ for *equilibrium equivalent concentration*.

4. [“The product of the air concentration of a radionuclide to which a person is exposed and the time of *exposure.* More generally, when the air concentration varies with time, the time integral of the air concentration of a radionuclide to which a person is exposed, integrated over the time of *exposure.*”]
ⓘ This definition, quoted verbatim from Ref. [21], reflects a loose usage of *exposure* found particularly in the context of airborne *radon*. This usage is listed here for information, but it is discouraged.

exposure, types of

diagnostic exposure. See *exposure, types of: medical exposure.*

emergency exposure. *Exposure* received in an *emergency.* This may include unplanned *exposures* resulting directly from the *emergency* and planned *exposures* to persons undertaking actions to mitigate the consequences of the *emergency.*
ⓘ *Emergency exposure* may be *occupational exposure* or *public exposure.*

excluded exposure. See *exclusion*.

medical exposure. *Exposure* incurred by patients as part of their own medical or dental diagnosis (***diagnostic exposure***) or treatment (***therapeutic exposure***); by persons, other than those occupationally exposed, knowingly while voluntarily helping in the support and comfort

of patients; and by volunteers in a programme of biomedical research involving their *exposure*.

occupational exposure. All *exposure* of *workers* incurred in the course of their work, with the *exception* of *excluded exposures* and *exposures* from exempt *practices* or *exempt sources*.

public exposure. *Exposure* incurred by *members of the public* from *radiation sources*, excluding any *occupational* or *medical exposure* and the normal local *natural background radiation* but including *exposure* from *authorized sources* and *practices* and from *intervention* situations. (From Ref. [1].)

therapeutic exposure. See *exposure, types of: medical exposure*.

exposure assessment

See *assessment* (1).

exposure pathway

A route by which *radiation* or radionuclides can reach humans and cause *exposure*.

ⓘ An *exposure pathway* may be very simple, e.g. *external exposure* from airborne radionuclides, or a more complex chain, e.g. *internal exposure* from drinking milk from cows that ate grass contaminated with deposited radionuclides.

exposure situations

acute exposure. *Exposure* received within a short period of time.

ⓘ Normally used to refer to *exposure* of sufficiently short duration that the resulting *doses* can be treated as instantaneous (e.g. less than an hour).

ⓘ Usually contrasted with *chronic exposure* and *transitory exposure*.

chronic exposure. *Exposure* persisting in time. (From Ref. [1].)

! The adjective 'chronic' relates only to the duration of *exposure*, and does not imply anything about the magnitude of the *doses* involved.

ⓘ Normally used to refer to *exposures* persisting for many years as a result of long lived radionuclides in the environment. *Exposure* that is too protracted to be described as *acute exposure*, but does not persist for many years, is sometimes described as ***transitory exposure***.

ⓘ The International Commission on Radiological Protection uses the term ***prolonged exposure*** to describe the same concept as *chronic exposure*. Both terms are contrasted with *acute exposure* (and *transitory exposure*; see above).

chronic potential exposure. *Potential exposure*, the probability of occurrence of which persists in time.

ⓘ In a *chronic potential exposure* situation, the *exposure*, if it occurs, may be *acute exposure* or *chronic exposure*; it is the potential for the *exposure* to occur that persists in time.

ⓘ This describes a situation in which, for example, long lived radionuclides are present in a place such that people would not normally be exposed to the *radiation*, but where future human actions could result in *exposure*.

ⓘ The term 'potential *chronic exposure*' would describe a situation (as yet only hypothetical) of *potential exposure* in which the *exposure*, if it occurred, would be *chronic exposure*. To date, however, no particular need for this term has been identified.

normal exposure. *Exposure* that is expected to occur under the normal *operating conditions* of a *facility* or *activity*, including possible minor mishaps that can be kept under *control*, i.e. during *normal operation* and *anticipated operational occurrences*.

potential exposure. *Exposure* that is not expected to occur with certainty but that may result from an *accident* at a *source* or owing to an *event* or sequence of *events* of a probabilistic nature, including equipment *failures* and operating errors. (From Ref. [1].)

ⓘ Such *events* could also include *accidents* or future *events* influencing the integrity of a *repository*.

prolonged exposure. See *exposure situations: chronic exposure*.

transitory exposure. See *exposure situations: chronic exposure*.

external event

Events unconnected with the *operation* of a *facility* or the conduct of an *activity* that could have an effect on the *safety* of the *facility* or *activity*.

ⓘ Typical examples of *external events* for *nuclear facilities* include earthquakes, tornadoes, tsunamis and aircraft crashes.

external exposure

See *exposure* (1).

external zone

The area immediately surrounding a proposed *site area* in which population distribution and density, and land and water uses, are considered with respect to their effects on the possible implementation of *emergency* measures.

- ⓘ Used in the context of *siting* of *facilities*.
- ⓘ This is the area that would be the *emergency zones* if the *facility* were in place.

F

facilities and activities[9]

A general term encompassing *nuclear facilities*, uses of all *sources* of *ionizing radiation*, all *radioactive waste management activities*, *transport* of *radioactive material* and any other *practice* or circumstances in which people may be exposed to *radiation* from naturally occurring or artificial *sources*.

- ⓘ ***Facilities*** includes: *nuclear facilities*; *irradiation installations*; some mining and raw material processing *facilities* such as uranium mines; *radioactive waste management facilities*; and any other places where *radioactive material* is produced, processed, used, handled, stored or disposed of — or where *radiation generators* are installed — on such a scale that consideration of *protection and safety* is *required*.
  Activities includes: the production, use, import and export of *radiation sources* for industrial, research and medical purposes; the *transport* of *radioactive material*; the *decommissioning* of *facilities*; *radioactive waste management activities* such as the *discharge* of effluents; and some aspects of the *remediation* of sites affected by residues from past *activities*.
- ⓘ This term is intended to provide an alternative to the terminology of *sources* and *practices* (or *intervention*) to refer to general categories of situations. For example, a *practice* may involve many different *facilities and/or activities*, whereas the general definition (1) of *source* is too broad in some cases: a *facility or activity* might constitute a *source*, or might involve the use of many *sources*, depending upon the interpretation used.
- ⓘ The term *facilities and activities* is very general, and includes those for which little or no *regulatory control* may be necessary or achievable: the more specific terms ***authorized facility*** and ***authorized activity*** should be used to distinguish those *facilities and activities* for which any form of *authorization* has been given.
- ⓘ In the Fundamental Safety Principles (Safety Fundamentals), the term '*facilities and activities* — existing and new — utilized for peaceful purposes' is abbreviated for convenience to *facilities and activities* as a general term encompassing any human activity that may cause people to be exposed to *radiation risks* arising from naturally occurring or artificial *sources* (see Ref. [22], para. 1.9).

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[9] A small number of 'catch-all' terms — namely: *facilities and activities*; *[mining and milling]*; *protection and safety*; and *structures, systems and components* — are defined in the Safety Glossary. These terms may be used in exactly the form listed to describe a whole group of things without cumbersome repetition, or slight variations of the terms may be used to refer to particular subgroups. Although the definitions include an indication of the meanings of the separate elements of the terms, these are not intended to be applied rigidly: if precise reference is needed to particular items covered by the catch-all term, more precise terms should be used.

facility

See *facilities and activities.*

failure

Inability of a *structure, system or component* to function within *acceptance criteria*.

! Note that the *structure, system or component* is considered to fail when it becomes incapable of functioning, whether or not this is needed at that time. A *failure* in, for example, a backup *system* may not be manifest until the *system* is called upon to function, either during testing or on *failure* of the *system* it is backing up.

common cause failure. *Failure* of two or more *structures, systems and components* due to a single specific *event* or cause.

ⓘ For example, a *design* deficiency, a manufacturing deficiency, *operation* and *maintenance* errors, a natural phenomenon, a human induced *event*, saturation of signals, or an unintended cascading effect from any other *operation* or *failure* within the plant or from a change in ambient conditions.

common mode failure. *Failure* of two or more *structures, systems and components* in the same manner or mode due to a single *event* or cause.

ⓘ I.e. *common mode failure* is a type of *common cause failure* in which the *structures, systems and components* fail in the same way.

failure mode

The manner or state in which a *structure, system or component* fails.

far field

The *geosphere* outside a *repository*, comprising the surrounding geological strata, at a distance from the *repository* such that, for modelling purposes, the *repository* may be considered a single entity and the effects of individual *waste packages* are not distinguished.

ⓘ For practical purposes, this is often interpreted simply as the *geosphere* beyond the *near field*.

fault tree analysis

See *analysis*.

first responders

The first members of an *emergency service* to respond at the scene of an *emergency*.

fissile *(adjective)*

Capable of undergoing fission by interaction with slow neutrons.

ⓘ More restrictive than *fissionable*.

fissile material

Uranium-233, uranium-235, plutonium-239, plutonium-241 or any combination of these radionuclides. Excepted from this definition are:

(a) *Natural uranium* or *depleted uranium* which is unirradiated;
(b) *Natural uranium* or *depleted uranium* which has been irradiated in thermal reactors only. (From Ref. [2].)

ⓘ As with *radioactive material*, this is not a scientific definition, but one designed to serve a specific regulatory purpose.

fission fragment

A nucleus resulting from nuclear fission carrying kinetic energy from that fission.

ⓘ Used only in contexts where the particles themselves have kinetic energy and thus could represent a hazard, irrespective of whether the particles are *radioactive*. Otherwise, the more usual term *fission product* is used.

fission product

A radionuclide produced by nuclear fission.

ⓘ Used in contexts where the *radiation* emitted by the radionuclide is the potential hazard.

fissionable *(adjective)*

Capable of undergoing fission.
ⓘ cf. *fissile.*

fixed contamination

See *contamination* (2).

fluence

ⓘ A measure of the strength of a *radiation* field. Commonly used without qualification to mean *particle fluence.*

energy fluence, Ψ. A measure of the energy density of a *radiation* field, defined as:

$$\Psi = \frac{\mathrm{d}R}{\mathrm{d}a}$$

where dR is the *radiation* energy incident on a sphere of cross-sectional area da.
ⓘ The *energy fluence* rate

$$\frac{\mathrm{d}\Psi}{\mathrm{d}t}$$

is denoted by a lower case ψ.
ⓘ See Ref. [23].

particle fluence, Φ. A measure of the density of particles in a *radiation* field, defined as:

$$\Phi = \frac{\mathrm{d}N}{\mathrm{d}a}$$

where dN is the number of particles incident on a sphere of cross-sectional area da.
ⓘ The *particle fluence* rate

$$\frac{\mathrm{d}\Phi}{\mathrm{d}t}$$

is denoted by a lower case ϕ.
ⓘ See Ref. [23].

fractional absorption in the gastrointestinal tract, f_1

The fraction of an ingested element that is directly absorbed to body fluids. (From Ref. [21].)

ⓘ Often referred to colloquially as *gut transfer factor* or 'f_1 value'.

ⓘ See also *lung absorption type*, a similar concept for *activity* in the respiratory tract.

freight container

An article of *transport* equipment designed to facilitate the *transport* of goods, either packaged or unpackaged, by one or more modes of *transport* without intermediate reloading, which is of a permanent enclosed character, rigid and strong enough for repeated use, and must be fitted with devices facilitating its handling, particularly in transfer between *conveyances* and from one mode of *transport* to another. A ***small freight container*** is that which has either any overall outer dimension less than 1.5 m, or an internal volume of not more than 3 m^3. Any other *freight container* is considered to be a ***large freight container***. (From Ref. [2].)

fresh fuel

See *nuclear fuel*.

fuel

See *nuclear fuel*.

fuel assembly

A set of *fuel elements* and associated *components* which are loaded into and subsequently removed from a reactor core as a single unit.

fuel cycle

See *nuclear fuel cycle.*

fuel element

A rod of *nuclear fuel*, its *cladding* and any associated *components* necessary to form a structural entity.

ⓘ Commonly referred to as ***fuel rod*** in light water reactors.

fuel rod

See *fuel element*.

functional diversity

See *diversity*.

functional indicator

See *indicator*.

functional isolation

Prevention of influences from the mode of *operation* or *failure* of one circuit or *system* on another.

G

gap release

Release, especially in a reactor core, of *fission products* from the *fuel* pin gap, which occurs immediately after *failure* of the *fuel* cladding and is the first radiological indication of *fuel* damage or *fuel failure.*

general emergency

See *emergency class.*

geological disposal

See *disposal* (1).

geological repository

See *repository.*

geosphere

Those parts of the lithosphere not considered to be part of the *biosphere.*

ⓘ In *safety assessment*, usually used to distinguish the subsoil and rock (below the depth affected by normal human *activities*, in particular agriculture) from the soil that is part of the *biosphere.*

grace period

The period of time during which a *safety function* is ensured in an *event* with no necessity for action by personnel.

ⓘ Typical *grace periods* range from 20 min to 12 h. The period of grace may be achieved by means of the automation of actuations, the adoption of passive *systems* or the inherent characteristics of a material (such as the heat capacity of the *containment structure*), or by any combination of these.

graded approach

1. For a system of *control*, such as a regulatory system or a *safety system*, a *process* or method in which the stringency of the *control* measures and conditions to be applied is commensurate, to the extent practicable, with the

likelihood and possible consequences of, and the level of *risk* associated with, a loss of *control*.

ⓘ An example of a *graded approach* in general would be a structured method by means of which the stringency of application of *requirements* is varied in accordance with the circumstances, the regulatory systems used, the *management systems* used, etc. For example, a method in which:

(1) The significance and complexity of a product or service are determined;
(2) The potential impacts of the product or service on health, *safety*, *security*, the environment, and the achieving of quality and the organization's objectives are determined;
(3) The consequences if a product fails or if a service is carried out incorrectly are taken into account.

2. An application of *safety requirements* that is commensurate with the characteristics of the *practice* or *source* and with the magnitude and likelihood of the *exposures*.

ⓘ See also *exclusion*, *exemption* and *clearance* and *optimization*.

gray (Gy)

The SI unit of *kerma* and *absorbed dose*, equal to 1 J/kg.

ground shine

Gamma *radiation* from radionuclides deposited on the ground.

guidance level

See *level*.

guidance level for medical exposure

See *level*.

gut transfer factor

See *fractional absorption in the gastrointestinal tract*, f_1.

H

habit survey

See *survey*.

half-life, $T_{½}$

1. For a radionuclide, the time required for the *activity* to decrease, by a *radioactive* decay *process*, by half.

ⓘ Where it is necessary to distinguish this from other *half-lives* (see (2)), the term *radioactive half-life* should be used.

ⓘ The *half-life* is related to the *decay constant,* λ, by the expression:

$$T_{1/2} = \frac{\ln 2}{\lambda}$$

2. The time taken for the quantity of a specified material (e.g. a radionuclide) in a specified place to decrease by half as a result of any specified *process* or *processes* that follow similar exponential patterns to *radioactive* decay.

biological half-life. The time taken for the quantity of a material in a specified tissue, organ or region of the body (or any other specified biota) to halve as a result of biological *processes.*

effective half-life, $T_{\mathbf{eff}}$**.** The time taken for the *activity* of a radionuclide in a specified place to halve as a result of all relevant *processes.*

$$\frac{1}{T_{\text{eff}}} = \sum_{\text{i}} \frac{1}{T_{\text{i}}}$$

where T_{i} is the *half-life* for *process* i.

radioactive half-life. For a radionuclide, the time required for the *activity* to decrease, by a *radioactive* decay *process*, by half.

ⓘ The term ***physical half-life*** is also used for this concept.

health effects (of radiation)

deterministic effect. A *health effect of radiation* for which generally a threshold level of *dose* exists above which the severity of the effect is greater for a higher *dose.* Such an effect is described as a *severe*

deterministic effect if it is fatal or life threatening or results in a permanent injury that reduces quality of life.

- The level of the threshold *dose* is characteristic of the particular *health effect* but may also depend, to a limited extent, on the exposed individual. Examples of *deterministic effects* include erythema and acute *radiation* syndrome (*radiation* sickness).
- The term ***non-stochastic effect*** is used in some older publications, but is now superseded.
- Contrasting term: *stochastic effect*.

early effect. A *radiation* induced *health effect* that occurs within months of the *exposure* that caused it.

- All *early effects* are *deterministic effects*; most, but not all, *deterministic effects* are *early effects.*

hereditary effect. A *radiation* induced *health effect* that occurs in a descendant of the exposed person.

- The less precise term 'genetic effect' is also used, but *hereditary effect* is preferred.
- *Hereditary effects* are usually *stochastic effects.*
- Contrasting term: *somatic effect*.

late effect. A *radiation* induced *health effect* that occurs years after the *exposure* that caused it.

- The most common *late effects* are *stochastic effects*, such as leukaemia and solid cancers, but some *deterministic effects* (e.g. cataract formation) can also be *late effects.*

[*non-stochastic effect*]. See *health effects (of radiation): deterministic effect*.

severe deterministic effect. A *deterministic effect* that is fatal or life threatening or results in a permanent injury that reduces quality of life. See *health effects (of radiation): deterministic effect.*

somatic effect. A *radiation* induced *health effect* that occurs in the exposed person.

- This includes effects occurring after birth that are attributable to *exposure* in utero.
- *Deterministic effects* are normally also *somatic effects*; *stochastic effects* may be *somatic effects* or *hereditary effects.*
- Contrasting term: *hereditary effect*.

stochastic effect. A *radiation* induced *health effect*, the probability of occurrence of which is greater for a higher *radiation dose* and the severity of which (if it occurs) is independent of *dose*.

ⓘ *Stochastic effects* may be *somatic effects* or *hereditary effects*, and generally occur without a threshold level of *dose*. Examples include solid cancers and leukaemia.

ⓘ Contrasting term: *deterministic effect*.

health professional

An individual who has been accredited through appropriate national *procedures* to practise a profession related to health (e.g. medicine, dentistry, chiropractic, podiatry, nursing, medical physics, *radiation* and nuclear medical technology, radiopharmacy, occupational health). (From Ref. [1].)

ⓘ Used in the BSS to distinguish from a *medical practitioner*, who satisfies additional criteria.

health surveillance

Medical supervision intended to ensure the initial and continuing fitness of *workers* for their intended tasks. (From Ref. [1].)

[heat generating waste (HGW)]

See *waste classes*.

hereditary effect

See *health effects (of radiation)*.

high energy radiotherapy equipment

X ray equipment and other types of *radiation* generators capable of operating at generating potentials above 300 kV, and radionuclide teletherapy equipment.

high linear energy transfer (LET) radiation

See *radiation*.

high level waste (HLW)

See *waste classes.*

high enriched uranium (HEU)

See *uranium*.

human factors engineering

Engineering in which factors that could influence human performance are taken into account.

hydrodynamic dispersion

See *dispersion*.

hypothetical critical group

See *critical group.*

I

IAEA publication

An IAEA copyrighted hard copy or electronic product issued with unlimited distribution and bearing the IAEA emblem (logo) on the front.

ⓘ A document is a non-copyrighted hard copy or electronic product issued with limited distribution and bearing the IAEA emblem on the front. It may or may not be fully edited and typeset (usually not). A manuscript is an unissued copy of a draft publication or document.

ICRU sphere

A sphere of 30 cm diameter made of *tissue equivalent material* with a density of 1 g/cm^3 and a mass composition of 76.2% oxygen, 11.1% carbon, 10.1% hydrogen and 2.6% nitrogen.

ⓘ Used as a reference phantom in defining *dose equivalent quantities.*

ⓘ See Ref. [24].

illicit trafficking (in nuclear or radioactive material)

ⓘ The term is in use but there is no agreed definition. The vague phrase is used in different contexts to mean different things.

ⓘ The term ***nuclear trafficking*** is vaguer still and more open to (mis)interpretation, and is better avoided where clear communication is necessary.

immobilization

See *waste management, radioactive* (1).

in-service inspection

See *inspection*.

incident

Any unintended *event*, including operating errors, equipment *failures*, *initiating events*, *accident precursors*, *near misses* or other mishaps, or unauthorized act, *malicious* or non-malicious, the consequences or potential consequences of which are not negligible from the point of view of *protection* or *safety.*

See also *event* and *INES*.

! The word *incident* is often used, in *INES* and elsewhere, to describe *events* that are, in effect, minor *accidents*, i.e. that are distinguished from *accidents* only in terms of being less severe. This is a distinction with little basis in normal usage. An *incident* can be minor or major, just as an *accident* can, but unlike an *accident*, an *incident* can be caused intentionally.

ⓘ This definition of *incident* was derived on the basis of the entries for *accident* and *event* and the explanation of the term *incident* given in Ref. [22].

nuclear incident. [Any occurrence or series of occurrences having the same origin which causes *nuclear damage* or, but only with respect to *preventive measures*, creates a grave and imminent threat of causing such damage.] (From Ref. [25].)

! This usage is specific to the Convention on Supplementary Compensation for Nuclear Damage [25], for the purposes of the Convention, and should otherwise be avoided.

serious incident. See *INES*.

independent assessment

See *assessment* (2).

independent equipment

Equipment that possesses both of the following characteristics:

(a) The ability to perform its required function is unaffected by the *operation* or *failure* of other equipment;
(b) The ability to perform its function is unaffected by the occurrence of the effects resulting from the *postulated initiating event* for which it is required to function.

indicator

condition indicator. Characteristic of a *structure, system or component* that can be observed, measured or trended to infer or directly indicate the current and future ability of the *structure, system or component* to function within *acceptance criteria*.

functional indicator. *Condition indicator* that is a direct indication of the current ability of a *structure, system or component* to function within *acceptance criteria*.

performance indicator. Characteristic of a *process* that can be observed, measured or trended to infer or directly indicate the current and future performance of the *process*, with particular emphasis on satisfactory performance for *safety.*

individual dose

See *dose concepts.*

individual dose equivalent, penetrating

See *dose equivalent quantities: personal dose equivalent*.

individual dose equivalent, superficial

See *dose equivalent quantities: personal dose equivalent*.

individual monitoring

See *monitoring* (1).

industrial package

See *package.*

INES (International Nuclear Event Scale)

A simple scale, designed for promptly communicating to the public in consistent terms the *safety* significance of *events* at *nuclear facilities.*

- ! The scale should not be confused with *emergency classification* systems, and should not be used as a basis for *emergency response* actions.
- ! The *INES* terminology — particularly the use of the terms *incident* and *accident*— is different from that used in *safety standards*, and great care should be taken to avoid confusion between the two. Unless otherwise indicated, the terms *incident* and *accident* are used in this Safety Glossary with their *safety standards* meaning (see *incident* and *accident* (1) and under *event*).

Level 0 (***deviation***): An *event* with no *safety* significance.

Level 1 (***anomaly***): An *event* beyond the authorized operating regime, but not involving significant *failures* in *safety* provisions, significant spread of *contamination* or overexposure of *workers*.

Level 2 (***incident***): [An *event* involving significant *failure* in *safety* provisions, but with sufficient *defence in depth* remaining to cope with additional *failures* and/or resulting in a *dose* to a *worker* exceeding a statutory *dose limit* and/or leading to the presence of *activity* in *on-site* areas not expected by *design* and which require corrective action.]

Level 3 (***serious incident***): [A minor *accident*, where only the last layer of *defence in depth* remained operational and/or involving severe spread of *contamination on-site* or *deterministic effects* to a *worker* and/or a very small release of *radioactive material off-site* (i.e. a *critical group dose* of the order of tenths of a millisievert).]

Level 4 (***accident without significant off-site risk***): An *accident* involving significant damage to the installation (e.g. partial core melt) and/or overexposure of one or more *workers* resulting in a high probability of death and/or an *off-site* release such that the *critical group dose* is of the order of a few millisieverts.

Level 5 (***accident with off-site risk***): An *accident* resulting in severe damage to the installation and/or an *off-site* release of *radioactive material* radiologically equivalent to hundreds or thousands of TBq of ^{131}I, likely to result in partial implementation of *countermeasures* covered by *emergency plans*.

ⓘ E.g. the 1979 *accident* at Three Mile Island, USA (severe damage to the installation) or the 1957 *accident* at Windscale, UK (severe damage to the installation and significant *off-site* release).

Level 6 (***serious accident***): An *accident* involving a significant release of *radioactive material* and likely to require full implementation of planned *countermeasures*, but less severe than a *major accident*.

ⓘ E.g. the 1957 *accident* at Kyshtym, USSR (now in the Russian Federation).

Level 7 (***major accident***): An *accident* involving a major release of *radioactive material* with widespread health and environmental effects.

ⓘ E.g. the 1986 *accident* at Chernobyl, USSR (now in Ukraine).

incident. [An *event* classified as Level 1, 2 or 3, i.e. beyond the authorized operating regime, but not as serious as an *accident*.]

accident. [An *event* classified as Level 4, 5, 6 or 7, i.e. that involves a release of *radioactive material off-site* likely to cause *public exposure* at least of the order of *authorized limits* or requiring *countermeasures* to be taken, or causes significant damage to the installation, or results in *exposure* of *workers on-site* to such a degree that there is a high probability of early death.]

! There remains a fundamental mismatch between the terminology used in *safety standards* and that used in *INES*. In short, *events* that would be considered *accidents* according to the *safety standards* definition may be *accidents* or *incidents* (i.e. not *accidents*) in *INES* terminology. This is not a serious day to day technical problem because the two areas are quite separate. However, it is a potential problem for public communication.

infant

ⓘ In dosimetry, unless otherwise stated, an *infant* is assumed to be a one year old, and annual quantities (e.g. *annual dose*, annual *intake*) relating to an *infant* refer to the year starting at birth. See also *child* and *reference individual*.

[inhalation class]

See *lung absorption type.*

initial phase

See *emergency phase.*

initiating event

An identified *event* that leads to *anticipated operational occurrences* or *accident conditions.*

ⓘ This term (often shortened to ***initiator***) is used in relation to *event* reporting and *analysis*, i.e. when such *events* have occurred. For the consideration of hypothetical *events* considered at the *design* stage, the term *postulated initiating event* is used.

postulated initiating event (PIE). An *event* identified during *design* as capable of leading to *anticipated operational occurrences* or *accident conditions.*

ⓘ The primary causes of *postulated initiating events* may be credible equipment *failures* and *operator* errors (both within and external to the *facility*) or human induced or natural *events.*

initiator

See *initiating event*.

inspection

An examination, observation, measurement or test undertaken to assess *structures*, *systems and components* and materials, as well as operational *activities*, technical *processes*, organizational *processes*, *procedures* and personnel competence.

in-service inspection. *Inspection* of *structures, systems and components* undertaken over the *operating lifetime* by or on behalf of the *operating organization* for the purpose of identifying age related degradation or conditions that, if not addressed, might lead to the *failure* of *structures, systems or components.*

ⓘ *Inspection* of operational *activities*, *processes*, etc., by or on behalf of the *operating organization* would normally be described by terms such as *self-assessment* and *audit.*

regulatory inspection. *Inspection* undertaken by or on behalf of the *regulatory body.*

installation processing radioactive substances

Any *installation processing radioactive substances* for which the yearly throughput is higher than 10 000 times the *exemption activity* levels presented in Table I-I of the Basic Safety Standards. (From Ref. [1].)

ⓘ A general term designed to include *facilities* engaged in manufacturing *sources* or *consumer products*, or handling them in bulk as a commercial undertaking, but to exclude small scale users of such products.

institutional control

See *control* (1).

intake

1. The act or *process* of taking radionuclides into the body by inhalation or ingestion or through the skin. (From Ref. [1].)

2. The *activity* of a radionuclide taken into the body in a given time period or as a result of a given *event*.

acute intake. An *intake* occurring within a time period short enough that it can be treated as instantaneous for the purposes of assessing the resulting *committed dose*.

! The *exposure* that results from an *acute intake* is not necessarily *acute exposure*. For a long lived radionuclide that is retained in the body, an *acute intake* will result in *chronic exposure*.

chronic intake. An *intake* over an extended period of time, such that it cannot be treated as a single instantaneous *intake* for the purposes of assessing the resulting *committed dose*.

ⓘ *Chronic intake* may, however, be treated as a series of *acute intakes*.

integrated management system (for *facilities and activities*)

A single coherent *management system* in which all the component parts of an organization are integrated to enable the organization's objectives to be achieved.

ⓘ These component parts include the organizational structure, resources and organizational *processes*.

ⓘ Personnel, equipment and organizational culture, as well as the documented policies and *processes*, form parts of the *management system*.

ⓘ The organizational *processes* have to address the totality of the *requirements* on the organization, as established by or in, for example, *interested parties*, IAEA *safety standards* and other international codes and standards.

interacting event

An *event* or a sequence of associated *events* that, interacting with a *facility*, affect *site personnel* or *items important to safety* in a manner which could adversely influence *safety*.

[interim storage]

See *storage.*

intermediate bulk container (IBC)

A portable *packaging* that:

(a) Has a capacity of not more than 3 m^3;
(b) Is designed for mechanical handling;
(c) Is resistant to the stresses produced in handling and *transport*, as determined by performance tests;
(d) Is designed to conform to the standards in the chapter on Recommendations on Intermediate Bulk Containers (IBCs) of the United Nations Recommendations on the Transport of Dangerous Goods [26]. (From Ref. [2].)

[intermediate level waste (ILW)]

See *waste classes.*

internal exposure

See *exposure* (1).

international nuclear transport

See *transport* (1).

intervention

Any action intended to reduce or avert *exposure* or the likelihood of *exposure* to *sources* that are not part of a controlled *practice* or that are out of *control* as a consequence of an *accident*. (From Ref. [1].)

ⓘ This definition is somewhat more explicit than (though not necessarily inconsistent with) that of Ref. [16].

intervention level

See *level.*

operational intervention level (OIL). See *level: intervention level.*

intrusion barrier

See *barrier*.

investigation level

See *level*.

iodine prophylaxis

The administration of a compound of stable iodine (usually potassium iodide) to prevent or reduce the *uptake* of *radioactive* isotopes of iodine by the thyroid in the *event* of an *accident* involving *radioactive* iodine.

ⓘ An *urgent protective action*.

ⓘ The term 'thyroid blocking' is sometimes used.

ionizing radiation

See *radiation*.

irradiation installation

A *structure* or an installation that houses a particle accelerator, X ray apparatus or large *radioactive source* and that can produce high *radiation* fields. (From Ref. [1].)

ⓘ *Irradiation installations* include installations for external beam *radiation* therapy, installations for sterilization or preservation of commercial products and some installations for industrial radiography.

item important to safety

See *plant equipment*.

J

justification

1. The *process* of determining whether a *practice* is, overall, beneficial, as required by the International Commission on Radiological Protection's *System of Radiological Protection*, i.e. whether the benefits to individuals and to society from introducing or continuing the *practice* outweigh the harm (including *radiation detriment*) resulting from the *practice.*

2. The *process* of determining whether a proposed *intervention* is likely, overall, to be beneficial, as required by the International Commission on Radiological Protection's *System of Radiological Protection*, i.e. whether the benefits to individuals and to society (including the reduction in *radiation detriment*) from introducing or continuing the *intervention* outweigh the cost of the *intervention* and any harm or damage caused by the *intervention*.

K

kerma, *K*

The quantity K, defined as:

$$K = \frac{dE_{tr}}{dm}$$

where dE_{tr} is the sum of the initial kinetic energies of all charged ionizing particles liberated by uncharged ionizing particles in a material of mass dm. (From Ref. [1].)

- ⓘ Unit: *gray* (Gy).
- ⓘ Originally an acronym for kinetic energy released in matter, but now accepted as a word.

air kerma. The *kerma* value for air.

- ⓘ Under charged particle equilibrium conditions, the *air kerma* (in *gray*) is numerically approximately equal to the *absorbed dose* in air (in *gray*).

reference air kerma rate. The *kerma* rate to air, in air, at a reference distance of 1 m, corrected for air *attenuation* and scattering. (From Ref. [1].)

- ⓘ This quantity is expressed in μGy/h at 1 m.

kerma factor

The *kerma* per unit *particle fluence.*

knowledge management

An integrated, systematic approach to identifying, managing and sharing an organization's knowledge and enabling groups of people to create new knowledge collectively to help in achieving the organization's objectives.

- ⓘ In the context of *management systems*, *knowledge management* helps an organization to gain insight and understanding from its own experience. Specific *activities* in *knowledge management* help the organization to better acquire, record, store and utilize knowledge.
- — The term 'knowledge' is often used to refer to bodies of facts and principles accumulated by humankind over the course of time. Explicit knowledge is knowledge that is contained in, for example, documents, drawings, calculations, *designs*, databases, *procedures* and manuals. Tacit knowledge is

knowledge that is held in a person's mind and has typically not been captured or transferred in any form (if it were, it would then become explicit knowledge).

— Knowledge is distinct from information: data yield information and knowledge is gained by acquiring, understanding and interpreting information. Knowledge and information each consist of true statements, but knowledge serves a purpose: knowledge confers a capacity for effective action.

— Knowledge for an organization is the acquiring, understanding and interpreting of information. Knowledge may be applied for such purposes as: problem solving and learning; forming judgements and opinions; decision making, forecasting and strategic planning; generating feasible options for action and taking actions to achieve desired results. Knowledge also protects intellectual assets from decay, augments intelligence and provides increased flexibility.

L

large freight container

See *freight container*.

late effect

See *health effects (of radiation)*.

latent weakness

See *cause*.

legal person

Any organization, corporation, partnership, firm, association, trust, estate, public or private institution, group, political or administrative entity or other person designated in accordance with national legislation who or which has responsibility and authority for any action having implications for *protection and safety*.

ⓘ Contrasted in legal texts with natural person, meaning an individual.

ⓘ See also *applicant*, *licence* and *registration*.

level

action level. The level of *dose rate* or *activity concentration* above which *remedial actions* or *protective actions* should be carried out in *chronic exposure* or *emergency exposure* situations. An *action level* can also be expressed in terms of any other measurable quantity as a level above which *intervention* should be undertaken.

emergency action level (EAL). A specific, predetermined, observable criterion used to detect, recognize and determine the *emergency class*.

ⓘ An *emergency action level* could represent an instrument reading, the status of a piece of equipment or any observable *event*, such as a fire. In this sense, it is not strictly an *action level* as defined above, but has essentially the same function.

clearance level. A value, established by a *regulatory body* and expressed in terms of *activity concentration* and/or total *activity*, at or below which a *source* of *radiation* may be released from *regulatory control*.

ⓘ See also *clearance* (1).

exemption level. A value, established by a *regulatory body* and expressed in terms of *activity concentration*, total *activity*, *dose rate* or *radiation* energy, at or below which a *source* of *radiation* may be granted *exemption* from *regulatory control* without further consideration.

ⓘ A *regulatory body* may also grant *exemption* on a case by case basis, following *notification*. Although the term *exemption level* does not strictly apply in such a situation, a criterion for *exemption* may nevertheless be established by the *regulatory body*, expressed in similar terms or, alternatively, in terms of *annual dose* on the basis of an appropriate *dose assessment*. (See para. 5.12 of Ref. [10] and para. 2.26 of Ref. [27].)

ⓘ In the BSS [1], the term *exemption levels* is used, and values are specified in Table I-I of Schedule I, but neither *exemption* nor *exemption level* is defined in the BSS glossary.

guidance level. A level of a specified quantity above which appropriate actions should be considered. In some circumstances, actions may need to be considered when the specified quantity is substantially below the *guidance level*. (From Ref. [1].)

guidance level for medical exposure. A value of *dose*, *dose rate* or *activity* selected by professional bodies in consultation with the *regulatory body* to indicate a level above which there should be a review by *medical practitioners* in order to determine whether or not the value is excessive, taking into account the particular circumstances and applying sound clinical judgement. (From Ref. [1].)

intervention level. The level of *avertable dose* at which a specific *protective action* is taken in an *emergency* or a situation of *chronic exposure*.

operational intervention level (OIL). A calculated level, measured by instruments or determined by laboratory analysis, that corresponds to an *intervention level* or *action level*.

ⓘ *Operational intervention levels* are typically expressed in terms of *dose rates* or of *activity* of *radioactive material* released, time integrated air concentrations, ground or surface concentrations, or *activity concentrations* of radionuclides in environmental, food or water samples. An *operational intervention level* is a type of *action level* that is used immediately and directly (without further *assessment*) to determine the appropriate *protective actions* on the basis of an environmental measurement.

investigation level. The value of a quantity such as *effective dose*, *intake* or *contamination* per unit area or volume at or above which an investigation should be conducted. (From Ref. [1].)

level of defence in depth. See *defence in depth*.

recording level. A level of *dose*, *exposure* or *intake* specified by the *regulatory body* at or above which values of *dose*, *exposure* or *intake* received by *workers* are to be entered in their individual *exposure* records. (From Ref. [1].)

reference level. An *action level*, *intervention level*, *investigation level* or *recording level*. (From Ref. [1].)

licence

1. A legal document issued by the *regulatory body* granting *authorization* to perform specified *activities* related to a *facility or activity.*

ⓘ The holder of a current *licence* is termed a ***licensee.*** Other derivative terms should not be needed; a *licence* is a product of the *authorization process* (although the term ***licensing process*** is sometimes used), and a *practice* with a current *licence* is an authorized *practice.*

ⓘ *Authorization* may take other forms, such as *registration*.

ⓘ The *licensee* is the person or organization having overall responsibility for a *facility* or *activity* (the ***responsible legal person***).

2. [Any *authorization* granted by the *regulatory body* to the *applicant* to have the responsibility for the *siting*, *design*, *construction*, *commissioning*, *operation* or *decommissioning* of a *nuclear installation*.] (From Ref. [4].)

3. [Any *authorization*, permission or certification granted by a *regulatory body* to carry out any activity related to management of *spent fuel* or of *radioactive waste.*] (From Ref. [5].)

! The definitions (2) and (3) from the Conventions [4, 5] are somewhat more general in scope than the normal IAEA usage in definition (1). In IAEA usage, a *licence* is a particular type of *authorization*, normally representing the primary *authorization* for the *operation* of a whole *facility* or *activity.* The conditions attached to the *licence* may require that further, more specific, *authorization* or *approval* be obtained by the *licensee* before carrying out particular *activities.*

licensee

See *licence* (1).

licensing basis

A set of regulatory *requirements* applicable to a *nuclear installation*.

ⓘ The *licensing basis*, in addition to a set of regulatory *requirements*, may also include agreements and commitments made between the *regulatory body* and the *licensee* (e.g. in the form of letters exchanged or of statements made in technical meetings).

licensing process

See *licence* (1).

life/lifetime

design life. The period of time during which a *facility* or *component* is expected to perform according to the technical specifications to which it was produced.

operating life/lifetime. 1. The period during which an *authorized facility* is used for its intended purpose, until *decommissioning* or *closure*.

ⓘ The synonyms ***operating period*** and ***operational period*** are also used.

2. [The period during which a *spent fuel* or a *radioactive waste management facility* is used for its intended purpose. In the case of a *disposal facility*, the period begins when *spent fuel* or *radioactive waste* is first emplaced in the *facility* and ends upon *closure* of the *facility*.] (From Ref. [5].)

qualified life. Period for which a *structure, system or component* has been demonstrated, through testing, *analysis* or experience, to be capable of functioning within *acceptance criteria* during specific *operating conditions* while retaining the ability to perform its *safety functions* in a *design basis accident* or earthquake.

service life. The period from initial *operation* to final withdrawal from service of a *structure, system or component*.

life cycle management

Life management (or *lifetime management*) in which due recognition is given to the fact that at all stages in the lifetime there may be effects that need to be taken into consideration.

- ⓘ An example is the approach to products, *processes* and services in which it is recognized that at all stages in the lifetime of a product (extraction and processing of raw materials, manufacturing, *transport* and distribution, use and reuse, and recycling and *waste* management) there are environmental and economic impacts.
- ⓘ The term 'life cycle' (as opposed to lifetime) implies that the life is genuinely cyclical (as in the case of recycling or *reprocessing*).
- ⓘ See *cradle to grave approach*.
- ⓘ See *ageing management*.

life management (or lifetime management)

See *ageing management*.

lifetime dose

See *dose concepts*.

lifetime risk

See *risk* (3).

limit

The value of a quantity used in certain specified *activities* or circumstances that must not be exceeded. (From Ref. [1].)

- ! The term *limit* should only be used for a criterion that must not be exceeded, e.g. where exceeding the *limit* would cause some form of legal sanction to be invoked. Criteria used for other purposes — e.g. to indicate a need for closer investigation or a review of *procedures*, or as a threshold for reporting to a *regulatory body* — should be described using other terms, such as *reference level*.

acceptable limit. A *limit* acceptable to the *regulatory body*.

- ⓘ The term *acceptable limit* is usually used to refer to a *limit* on the predicted radiological consequences of an *accident* (or on *potential exposures* if they occur) that is acceptable to the relevant *regulatory body* when the probability of occurrence of the *accident* or *potential exposures* has been taken into

account (i.e. on the basis that it is unlikely to occur). The term *authorized limit* should be used to refer to *limits* on *doses* or *risks*, or on releases of radionuclides, which are acceptable to the *regulatory body* on the assumption that they are likely to occur.

annual limit on exposure (ALE). The *potential alpha energy exposure* in a year that would result in inhalation of the *annual limit on intake (ALI)*.

ⓘ Used for *exposure* to *radon progeny* and *thoron progeny.*

ⓘ In units of $J \cdot h/m^3$.

annual limit on intake (ALI). The *intake* by inhalation or ingestion or through the skin of a given radionuclide in a year by *Reference Man* which would result in a *committed dose* equal to the relevant *dose limit*. (From Ref. [1].)

ⓘ The *annual limit on intake* is expressed in units of *activity.*

ⓘ See Ref. [28].

authorized limit. A *limit* on a measurable quantity, established or formally accepted by a *regulatory body.*

! Wherever possible, *authorized limit* should be used in preference to *prescribed limit*.

ⓘ Equivalent in meaning to *prescribed limit*, *authorized limit* has been more commonly used in *radiation safety* and *waste safety*, particularly in the context of *limits* on *discharges.*

derived limit. A *limit* on a measurable quantity set, on the basis of a *model*, such that compliance with the *derived limit* may be assumed to ensure compliance with a *primary limit*.

dose limit. The value of the *effective dose* or the *equivalent dose* to individuals from controlled *practices* that shall not be exceeded. (From Ref. [1].)

operational limits and conditions. A set of rules setting forth parameter *limits*, the functional capability and the performance levels of equipment and personnel approved by the *regulatory body* for safe *operation* of an *authorized facility.*

[*prescribed limit*]. A *limit* established or accepted by the *regulatory body.*

ⓘ The term *authorized limit* is preferred.

primary limit. A *limit* on the *dose* or *risk* to an individual.

safety limits. *Limits* on operational parameters within which an *authorized facility* has been shown to be safe.

ⓘ *Safety limits* are *operational limits and conditions* beyond those for *normal operation*.

[*secondary limit*]. A *limit* on a measurable quantity that corresponds to a *primary limit*.

! Such a *limit* meets the definition of *derived limit*, and *derived limit* should be used.

ⓘ E.g. the *annual limit on intake*, a *secondary limit*, corresponds to the *primary limit* on *annual effective dose* for a *worker*.

linear energy transfer (LET), L_Δ

Defined generally as:

$$L_\Delta = \left(\frac{\mathrm{d}E}{\mathrm{d}\ell}\right)_\Delta$$

where $\mathrm{d}E$ is the energy lost in traversing distance $\mathrm{d}\ell$ and Δ is an upper bound on the energy transferred in any single collision.

ⓘ A measure of how, as a function of distance, energy is transferred from *radiation* to the exposed matter. A high value of *linear energy transfer* indicates that energy is deposited within a small distance.

ⓘ L_∞ (i.e. with $\Delta = \infty$) is termed the ***unrestricted linear energy transfer*** in defining the *quality factor*.

ⓘ L_Δ is also known as the ***restricted linear collision stopping power***.

linear–no threshold (LNT) hypothesis

The hypothesis that the *risk* of *stochastic effects* is directly proportional to the *dose* for all levels of *dose* and *dose rate* (below those at which *deterministic effects* occur).

ⓘ I.e. that any non-zero *dose* implies a non-zero *risk* of *stochastic effects*.

ⓘ This is the working hypothesis on which the IAEA's *safety standards* (and the International Commission on Radiological Protection's recommendations) are based. It is not proven — indeed it is probably not provable — for low *doses* and *dose rates*, but it is considered the most radiobiologically defensible assumption on which to base *safety standards*. Other hypotheses conjecture that the *risk* of *stochastic effects* at low *doses* and/or *dose rates* is:

(a) Greater than that implied by the *linear–no threshold hypothesis* (superlinear hypotheses);

(b) Less than that implied by the *linear–no threshold hypothesis* (sublinear hypotheses);
(c) Zero below some threshold value of *dose* or *dose rate* (threshold hypotheses); or
(d) Negative below some threshold value of *dose* or *dose rate*, i.e. that low *doses* and *dose rates* protect individuals against *stochastic effects* and/or other types of harm (hormesis hypotheses).

living probabilistic safety assessment (PSA)

See *probabilistic safety assessment (PSA)*.

logic

The generation of a required binary output signal from a number of binary input signals according to predetermined rules, or the equipment used for generating this signal.

long lived waste

See *waste classes.*

longer term protective action

See *protective action* (1).

low and intermediate level waste (LILW)

See *waste classes.*

low dispersible radioactive material

Either solid *radioactive material*, or solid *radioactive material* in a sealed capsule, that has limited dispersibility and is not in powder form. (From Ref. [2].)

low enriched uranium (LEU)

See *uranium.*

low linear energy transfer (LET) radiation

See *radiation*.

[low level waste (LLW)]

See *waste classes.*

low specific activity (LSA) material

! This usage is specific to the Transport Regulations, and should otherwise be avoided.

Radioactive material which by its nature has a limited *specific activity*, or *radioactive material* for which *limits* of estimated average *specific activity* apply. External shielding materials surrounding the *low specific activity material* shall not be considered in determining the estimated average *specific activity.*

Low specific activity material shall be [classified] in one of three groups:

(a) ***LSA-I***

1. Uranium and thorium ores and concentrates of such ores, and other ores containing *naturally occurring radionuclides* which are intended to be processed for the use of these radionuclides;
2. *Natural uranium*, *depleted uranium*, natural thorium or their compounds or mixtures, provided that they are unirradiated and in solid or liquid form;
3. *Radioactive material* for which the A_2 value is unlimited, excluding *fissile material* in quantities not excepted under para. 672 [of Ref. [2]]; or
4. Other *radioactive material* in which the *activity* is distributed throughout and the estimated average *specific activity* does not exceed 30 times the values for *activity concentration* specified in paras 401–406 [of Ref. [2]], excluding *fissile material* in quantities not excepted under para. 672 [of Ref. [2]].

(b) ***LSA-II***

1. Water with tritium concentration up to 0.8 TBq/L; or

2. Other material in which the *activity* is distributed throughout and the estimated average *specific activity* does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.

(c) ***LSA-III***

Solids (e.g. consolidated *waste*, activated material), excluding powders, in which:

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

low toxicity alpha emitters

Natural uranium; *depleted uranium*; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical and chemical concentrates; or alpha emitters with a *half-life* of less than 10 days. (From Ref. [2].)

lower limit of detection

See *minimum detectable activity (MDA)*.

lung absorption type

A classification used to distinguish between the different rates at which inhaled radionuclides are transferred from the respiratory tract to the blood.

ⓘ Reference [29] classifies materials into three *lung absorption types*:
(a) Type F (fast) are materials that are readily absorbed into the blood;
(b) Type M (moderate) are materials that have intermediate rates of absorption into the blood;
(c) Type S (slow) are materials that are relatively insoluble and are only slowly absorbed into the blood.

ⓘ The *lung absorption types* supersede the ***inhalation classes*** D (days), M (months) and Y (years) previously recommended in Ref. [15] (often referred

to informally as ‘lung classes’). There is an approximate correspondence between *lung absorption type* F and *inhalation class* D, between *lung absorption type* M and *inhalation class* M and between *lung absorption type* S and *inhalation class* Y.

ⓘ See also *gut transfer factor*, a similar concept for ingested radionuclides in the gastrointestinal tract.

M

main safety function

See *safety function*.

maintenance

The organized activity, both administrative and technical, of keeping *structures, systems and components* in good operating condition, including both preventive and corrective (or *repair*) aspects.

corrective maintenance. Actions that restore, by *repair*, overhaul or replacement, the capability of a failed *structure, system or component* to function within *acceptance criteria*.

ⓘ Contrasted with *preventive maintenance*.

periodic maintenance. Form of *preventive maintenance* consisting of servicing, parts replacement, surveillance or testing at predetermined intervals of calendar time, operating time or number of cycles.

ⓘ Also termed ***time based maintenance***.

planned maintenance. Form of *preventive maintenance* consisting of refurbishment or replacement that is scheduled and performed prior to unacceptable degradation of a *structure, system or component*.

predictive maintenance. Form of *preventive maintenance* performed continuously or at intervals governed by observed condition to monitor, diagnose or trend a *structure, system or component*'s *condition indicators*; results indicate present and future functional ability or the nature of and schedule for *planned maintenance*.

ⓘ Also termed ***condition based maintenance***.

preventive maintenance. Actions that detect, preclude or mitigate degradation of a functional *structure, system or component* to sustain or extend its useful life by controlling degradation and *failures* to an acceptable level.

ⓘ *Preventive maintenance* may be *periodic maintenance*, *planned maintenance* or *predictive maintenance*.

ⓘ Contrasted with *corrective maintenance*.

reliability centred maintenance (RCM). A *process* for specifying applicable *preventive maintenance* requirements for *safety related systems* and equipment in order to prevent potential *failures* or to control the *failure modes* optimally. *RCM* utilizes a decision *logic* tree to identify the *maintenance* requirements according to the *safety* consequences and operational consequences of each *failure* and the degradation mechanism responsible for the *failures*.

maintenance bypass

See *bypass* (1).

major accident

See *INES*.

malice

The intention to do evil.

ⓘ In law, wrongful intention, especially as increasing the guilt of certain offences. See also *malevolent*.

malice aforethought, malicious intent. In law, the intention to commit a crime.

malicious. Characterized by *malice*; intending or intended to do harm.

malevolence

An instance of wishing evil to others.

ⓘ See also *malice*. Often used interchangeably with *malice*. However, *malice* relates to acts or the intention to commit acts. Since the term *malice* has an established usage under the law, it should be preferred if this is what is meant.

malevolent. Characterized by *malevolence*; wishing evil to others.

management (of sealed radioactive sources)

[The administrative and operational *activities* that are involved in the manufacture, supply, receipt, possession, *storage*, use, transfer, import, export,

transport, *maintenance*, recycling or *disposal* of *radioactive sources.*] (From Ref. [11].)

ⓘ This usage is specific to the Code of Conduct on the Safety and Security of Radioactive Sources [11].

management self-assessment

See *assessment* (2).

management system

A set of interrelated or interacting elements (system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner.

ⓘ The component parts of the *management system* include the organizational structure, resources and organizational *processes.* Management is defined (in ISO 9000) as coordinated *activities* to direct and *control* an organization.

ⓘ The *management system* integrates all elements of an organization into one coherent system to enable all of the organization's objectives to be achieved. These elements include the organizational structure, resources and *processes.* Personnel, equipment and organizational culture as well as the documented policies and *processes* are parts of the *management system*. The organization's *processes* have to address the totality of the *requirements* on the organization as established in, for example, IAEA *safety standards* and other international codes and standards.

management system review

A regular and systematic evaluation by *senior management* of an organization of the suitability, adequacy, effectiveness and efficiency of its *management system* in executing the policies and achieving the goals and objectives of the organization.

ⓘ ***Senior management*** means the person who, or group of people which, directs, controls and assesses an organization at the highest level.

material ageing

See *ageing.*

mathematical model

See *model.*

maximum normal operating pressure

The maximum pressure above atmospheric pressure at mean sea level that would develop in the *containment system* in a period of one year under the conditions of temperature and solar *radiation* corresponding to environmental conditions in the absence of venting, external cooling by an ancillary *system* or operational *controls* during *transport*. (From Ref. [2].)

! This usage is specific to the Transport Regulations.

medical exposure

See *exposure, types of*.

medical practitioner

An individual who: (a) has been accredited through appropriate national *procedures* as a *health professional*; (b) fulfils the national *requirements* on training and experience for prescribing *procedures* involving *medical exposure*; and (c) is a *registrant* or a *licensee* or a *worker* who has been designated by a registered or licensed *employer* for the purpose of prescribing *procedures* involving *medical exposure*. (From Ref. [1].)

[medium level waste (MLW)]

See *waste classes*.

member of the public

In a general sense, any individual in the population except, for *protection and safety* purposes, when subject to *occupational* or *medical exposure*. For the purpose of verifying compliance with the *annual dose limit* for *public exposure*, the representative individual in the relevant *critical group*.

migration

The movement of radionuclides in the environment as a result of natural *processes*.

ⓘ Most commonly, movement of radionuclides in association with groundwater flow.

mill

See [*mine or mill processing radioactive ores*].

milling

See [*mining and milling*].

[mine or mill processing radioactive ores]

[Installation for mining, milling or processing ores containing *uranium series* or *thorium series* radionuclides. A mine processing *radioactive* ores is any mine that yields ores containing *uranium series* or *thorium series* radionuclides, either in sufficient quantities or concentrations to warrant exploitation or, when present in conjunction with other substances being mined, in quantities or concentrations that require *radiation protection* measures to be taken as determined by the *Regulatory Authority*. A mill processing *radioactive* ores is any *facility* for processing *radioactive* ores from a mine processing *radioactive* ores as here defined to produce a physical or chemical concentrate.] (From Ref. [1].)

- ⓘ This definition from the BSS included those mining and processing *operations* aimed at extracting *uranium series* or *thorium series* radionuclides and those aimed at the extraction of other substances from ore where this represents a significant radiological hazard.
- ⓘ Strictly speaking, a mill in the context of the processing of minerals is a *facility* for the processing of ore to reduce its particle size, especially by crushing or grinding. However, in the context of the BSS definition, the term *mill* is used in a broader sense to denote a *facility* in which additional (e.g. hydrometallurgical) processing may also be carried out. Owing to the possibility of confusion, the use of the word *mill* in this broader sense, in this expression or elsewhere, is discouraged.
- ⓘ This definition has been included for information only. Words are used with their normal dictionary definitions except for the term *radioactive*. See *radioactive* (2).

minimization, waste

The *process* of reducing the amount and *activity* of *radioactive waste* to a level as low as reasonably achievable, at all stages from the *design* of a *facility or activity* to *decommissioning*, by reducing *waste* generation and by means such as recycling and reuse, and *treatment*, with due consideration for secondary as well as primary *waste*.

- ⓘ Should not be confused with *volume reduction*.

minimum detectable activity (MDA)

The *radioactivity* which, if present in a sample, produces a counting rate that will be detected (i.e. considered to be above *background*) with a certain level of confidence.

- ⓘ The 'certain level of confidence' is normally set at 95%, i.e. a sample containing exactly the *minimum detectable activity* will, as a result of random fluctuations, be taken to be free of *radioactivity* 5% of the time.
- ⓘ The *minimum detectable activity* is sometimes referred to as the ***detection limit*** or ***lower limit of detection***. The counting rate from a sample containing the *minimum detectable activity* is termed the ***determination level***.

minimum significant activity (MSA)

The *radioactivity* which, if present in a sample, produces a counting rate that can be reliably distinguished from *background* with a certain level of confidence.

- ⓘ A sample containing exactly the *minimum significant activity* will, as a result of random fluctuations, be taken to be free of *radioactivity* 50% of the time, whereas a true *background* sample will be taken to be free of *radioactivity* 95% of the time.
- ⓘ The *minimum significant activity* is sometimes referred to as the ***decision limit***. The counting rate from a sample containing the *minimum significant activity* is termed the ***critical level***.

[mining and milling]

[Mining in a mine that yields *radioactive ore* containing *uranium series* or *thorium series* radionuclides either in amounts or concentrations sufficient to warrant exploitation or, when present in conjunction with other substances being mined, in amounts or concentrations that require *radiation protection* measures to be taken; and processing of *radioactive ores* from such mines to produce a chemical concentrate.]

- ⓘ This definition was restricted to those mining and processing operations aimed at extracting *uranium series* or *thorium series* radionuclides and those aimed at extracting other substances from ore that represent a significant radiological hazard. This definition has been included for information only. The terms *mining* and *milling* should be used with their normal dictionary definitions, qualified where necessary (e.g. by use of the term *radioactive*).
- ⓘ Strictly speaking, milling in the context of the processing of minerals is the processing of ore to reduce its particle size, especially by crushing or grinding. However, in the context of this definition, the term *milling* is used in a broader sense to include additional (e.g. hydrometallurgical) processing.

Owing to the possibility of confusion, the use of the word *milling* in this broader sense, in this expression or elsewhere, is discouraged.

! See *mine or mill processing radioactive ores.*

[mining and milling waste (MMW)]

See *waste.*

mitigatory action

See *protective action* (1).

mixed waste

See *waste.*

model

An analytical representation or quantification of a real system and the ways in which phenomena occur within that system, used to predict or assess the behaviour of the real system under specified (often hypothetical) conditions.

computational model. A calculational tool that implements a *mathematical model*.

conceptual model. A set of qualitative assumptions used to describe a system (or part thereof).

ⓘ These assumptions would normally cover, as a minimum, the geometry and dimensionality of the system, initial and boundary conditions, time dependence, and the nature of the relevant physical, chemical and biological *processes* and phenomena.

mathematical model. A set of mathematical equations designed to represent a *conceptual model*.

model calibration

See *calibration*.

model validation

See *validation* (1).

model verification

See *verification* (1).

monitoring

1. The measurement of *dose* or *contamination* for reasons related to the *assessment* or *control* of *exposure* to *radiation* or *radioactive substances*, and the interpretation of the results. (From Ref. [1].)

ⓘ 'Measurement' is used somewhat loosely here. The 'measurement' of *dose* often means the measurement of a *dose equivalent quantity* as a proxy (i.e. substitute) for a *dose quantity* that cannot be measured directly. Also, sampling may be involved as a preliminary step to measurement.

ⓘ *Monitoring* may be subdivided in two different ways: according to where the measurements are made, into *individual monitoring*, *workplace monitoring*, *source monitoring* and *environmental monitoring*; and, according to the purpose of the *monitoring*, into *routine monitoring*, *task related monitoring* and *special monitoring*.

area monitoring. A form of *workplace monitoring* in which an area is monitored by taking measurements at different points in that area.

ⓘ As opposed to measurements by a static monitor.

environmental monitoring. The measurement of *external dose* rates due to *sources* in the environment or of radionuclide concentrations in environmental media.

ⓘ Contrasted with *source monitoring*.

individual monitoring. *Monitoring* using measurements by equipment worn by individual *workers*, or measurements of quantities of *radioactive material* in or on their bodies.

ⓘ Also called *personal monitoring*. Usually contrasted with *workplace monitoring*.

[*personal monitoring*]. Synonymous with *individual monitoring*.

ⓘ This usage may be confusing and is discouraged in favour of *individual monitoring*.

[*personnel monitoring*]. A combination of *individual monitoring* and *workplace monitoring*.

ⓘ This usage may be confusing and is discouraged in favour of *individual monitoring* and/or *workplace monitoring*, as appropriate.

routine monitoring. *Monitoring* associated with continuing *operations* and intended: (1) to demonstrate that working conditions, including the levels of *individual dose*, remain satisfactory; and (2) to meet regulatory *requirements.*

ⓘ *Routine monitoring* can be *individual monitoring* or *workplace monitoring*.

ⓘ Contrasting terms: *task related monitoring* and *special monitoring.*

source monitoring. The measurement of *activity* in *radioactive material* being released to the environment or of *external dose* rates due to *sources* within a *facility or activity.*

ⓘ Contrasted with *environmental monitoring*.

special monitoring. *Monitoring* designed to investigate a specific situation in the workplace for which insufficient information is available to demonstrate adequate *control*, by providing detailed information to elucidate any problems and to define future *procedures.*

ⓘ *Special monitoring* would normally be undertaken at the *commissioning* stage of new *facilities*, following major modifications either to *facilities* or to *procedures*, or when *operations* are being carried out under abnormal circumstances, such as following an *accident*.

ⓘ *Special monitoring* can be *individual monitoring* or *workplace monitoring*.

ⓘ Contrasting terms: *routine monitoring* and *task related monitoring*.

task related monitoring. *Monitoring* in relation to a specific *operation*, to provide data to support immediate decisions on the management of the *operation*.

ⓘ *Task related monitoring* can be *individual monitoring* or *workplace monitoring*.

ⓘ Contrasting terms: *routine monitoring* and *special monitoring*.

workplace monitoring. *Monitoring* using measurements made in the working environment.

ⓘ Usually contrasted with *individual monitoring.*

2. Continuous or periodic measurement of radiological or other parameters or determination of the status of a *structure, system or component*. Sampling may be involved as a preliminary step to measurement.

ⓘ Although the concept is not fundamentally different from definition (1), this definition is more suited to the types of *monitoring* concerned primarily with *safety* (i.e. keeping *sources* under *control*) rather than with *protection* (i.e. controlling *exposure*). This definition is particularly relevant to *monitoring* the status of a *nuclear installation* by tracking plant variables, or *monitoring* the long term performance of a *waste repository* by tracking variables such as water fluxes. These examples differ from definition (1) in that the routine measurements are themselves of no particular interest; the *monitoring* is only intended to detect unexpected *deviations* if they occur.

condition monitoring. Continuous or periodic tests, *inspections*, measurement or trending of the performance or physical characteristics of *structures, systems and components* to indicate current or future performance and the potential for *failure*.

ⓘ *Condition monitoring* is usually conducted on a non-intrusive basis.

multilateral approval

See *approval*.

multiple barriers

See *barrier*.

multiplexing

Transmission and reception of two or more signals or messages over a single data *channel*, e.g. by the use of time division, frequency division or pulse code techniques.

multiplicative risk projection model

See *risk projection model*.

N

natural analogue

ⓘ A situation in nature that is used as a *model* for *processes* affecting human-made systems, allowing conclusions to be drawn that are relevant for making judgements about the *safety* of an existing or planned *nuclear facility*. In particular, mineral deposits containing radionuclides whose *migration* history over very long time periods can be analysed and the results used in modelling the potential behaviour of these or similar radionuclides in the *geosphere* over a long period of time.

natural background

See *background*.

natural source

See *source* (1).

natural uranium

See *uranium*.

naturally occurring radioactive material (NORM)

Radioactive material containing no significant amounts of radionuclides other than *naturally occurring radionuclides*.

ⓘ The exact definition of 'significant amounts' would be a regulatory decision.

ⓘ Material in which the *activity concentrations* of the *naturally occurring radionuclides* have been changed by a *process* is included in *naturally occurring radioactive material*.

ⓘ *Naturally occurring radioactive material* or *NORM* should be used in the singular unless reference is explicitly being made to various materials.

naturally occurring radionuclides

See *radionuclides of natural origin*.

near field

The excavated area of a *repository* near or in contact with the *waste packages*, including filling or sealing materials, and those parts of the host

medium/rock whose characteristics have been or could be altered by the *repository* or its contents.

ⓘ See also *far field*.

near miss

A potential significant *event* that could have occurred as the consequence of a sequence of actual occurrences but did not occur owing to the plant conditions prevailing at the time.

near surface disposal

See *disposal* (1).

near surface repository

See *repository.*

new fuel

See *nuclear fuel*.

non-fixed contamination

See *contamination* (2).

non-physical ageing

See *ageing*.

[non-stochastic effect]

See *health effects (of radiation): deterministic effect*.

NORM

See *naturally occurring radioactive material.*

NORM residue

Material that remains from a *process* and comprises or is contaminated by *naturally occurring radioactive material (NORM)*.

ⓘ A *NORM residue* may or may not be *waste*.

NORM waste

See *waste*.

normal exposure

See *exposure situations*.

normal operation

See *plant states*.

notification

1. A document submitted to the *regulatory body* by a *legal person* to notify an intention to carry out a *practice* or other use of a *source*.

ⓘ This includes the *notification* of appropriate *competent authorities* by a *consignor* that a *shipment* will pass through or into their countries, as *required* under paras 558–561 of the 2005 edition of the Transport Regulations [2].

2. A report submitted promptly to a national or international authority providing details of an *emergency* or a possible *emergency*; for example, as *required* by the Convention on Early Notification of a Nuclear Accident.

3. A set of actions taken upon detection of *emergency* conditions with the purpose of alerting all organizations with responsibility for *emergency response* in the event of such conditions.

notification point

A designated organization with which *arrangements* have been made to receive *notification* (3) and to initiate promptly the predetermined actions to activate a part of the *emergency response*.

notifying State

The State that is responsible for notifying (see *notification* (2)) potentially affected States and the IAEA of an *event* or situation of actual, potential or perceived radiological significance for other States. This includes:

(a) The State Party that has jurisdiction or *control* over the *facility* or *activity* (including space objects) in accordance with Article 1 of the Convention on Early Notification of a Nuclear Accident [6]; or
(b) The State that initially detects, or discovers evidence of, a *transnational emergency*, for example by: detecting significant increases in atmospheric *radiation levels* of unknown origin; detecting *contamination* in transboundary *shipments*; discovering a *dangerous source* that may have originated in another State; or diagnosing medical symptoms that may have resulted from *exposure* outside the State.

nuclear *(adjective)*

ⓘ Strictly: relating to a nucleus; relating to or using energy released in nuclear fission or fusion.
! The adjective 'nuclear' is used in many phrases to modify a noun that it cannot logically modify. It must be borne in mind that the meaning of such phrases may be unclear. These phrases may therefore be open to misunderstanding, misrepresentation or mistranslation, and their usage may need to be explained. Such phrases include: nuclear accident; nuclear community; nuclear emergency; nuclear facility; nuclear fuel; nuclear incident; nuclear installation; nuclear material; nuclear medicine; [a] nuclear power; nuclear sabotage; nuclear safety; nuclear security; nuclear terrorism; nuclear trafficking; nuclear watchdog; and nuclear weapon. For example, strictly speaking, 'nuclear material' primarily means the material of the atomic nucleus.

nuclear accident

See *accident* (1).

[nuclear damage]

[(i) Loss of life or personal injury;
(ii) loss of or damage to property;

and each of the following to the extent determined by the law of the competent court:

(iii) economic loss arising from loss or damage referred to in sub-paragraph (i) or (ii), insofar as not included in those sub-paragraphs, if incurred by a person entitled to claim in respect of such loss or damage;
(iv) the costs of measures of reinstatement of impaired environment, unless such impairment is insignificant, if such measures are actually taken or to be taken, and insofar as not included in sub-paragraph (ii);
(v) loss of income deriving from an economic interest in any use or enjoyment of the environment, incurred as a result of a significant impairment of that environment, and insofar as not included in sub-paragraph (ii);
(vi) the costs of *preventive measures*, and further loss or damage caused by such measures;
(vii) any other economic loss, other than any caused by the impairment of the environment, if permitted by the general law on civil liability of the competent court,

in the case of sub-paragraphs (i) to (v) and (vii) above, to the extent that the loss or damage arises out of or results from *ionizing radiation* emitted by any *source* of *radiation* inside a *nuclear installation*, or emitted from *nuclear fuel* or *radioactive* products or *waste* in, or of *nuclear material* coming from, originating in, or sent to, a *nuclear installation*, whether so arising from the *radioactive* properties of such matter, or from a combination of *radioactive* properties with toxic, explosive or other hazardous properties of such matter.] (From Ref. [25].)

ⓘ In this context, ***preventive measures*** are defined as any reasonable measures taken by any person after a *nuclear incident* has occurred to prevent or minimize damage referred to in sub-paragraphs (i) to (v) or (vii), subject to any *approval* of the competent authorities *required* by the law of the State where the measures were taken.

nuclear emergency

See *emergency*.

nuclear facility

1. A *facility* (including associated buildings and equipment) in which *nuclear material* is produced, processed, used, handled, stored or disposed of.

ⓘ See *facilities and activities* and *nuclear installation*.

2. [A *facility* (including associated buildings and equipment) in which *nuclear material* is produced, processed, used, handled, stored or disposed of, if damage to or interference with such *facility* could lead to the release of significant amounts of *radiation* or *radioactive material*.] (From Ref. [30].)

! This usage is specific to the revised Convention on the Physical Protection of Nuclear Material and Nuclear Facilities [30], for the purposes of the Convention, and should otherwise be avoided. (See http://www.iaea.org/NewsCenter/Features/PhysicalProtection/index.html)

3. [A civilian *facility* and its associated land, buildings and equipment in which *radioactive materials* are produced, processed, used, handled, stored or disposed of on such a scale that consideration of *safety* is *required*.] (From Ref. [5].)

! This usage is specific to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5], for the purposes of the Joint Convention, and should otherwise be avoided.

ⓘ Essentially synonymous with *authorized facility*, and hence more general than *nuclear installation*. Note that this differs from safeguards terminology, in which *installation* is more general than *facility*.

nuclear fuel

Fissionable nuclear material in the form of fabricated elements for loading into the reactor core of a civil nuclear power plant or *research reactor*.

fresh fuel. *New fuel* or *unirradiated fuel*, including *fuel* fabricated from *fissionable* material recovered by *reprocessing* previously irradiated *fuel*.

nuclear fuel cycle

All *operations* associated with the production of nuclear energy, including:

(a) Mining and processing of uranium or thorium ores;
(b) Enrichment of uranium;
(c) Manufacture of *nuclear fuel*;
(d) *Operation* of nuclear reactors (including *research reactors*);
(e) *Reprocessing* of *spent fuel*;
(f) All *waste management activities* (including *decommissioning*) relating to *operations* associated with the production of nuclear energy;
(g) Any related research and development *activities*.

nuclear incident

See *incident*.

nuclear installation

1. A *nuclear fuel* fabrication plant, *research reactor* (including subcritical and *critical assemblies*), nuclear power plant, *spent fuel storage facility*, enrichment plant or *reprocessing facility*. (From Ref. [1].)

ⓘ This is essentially any *authorized facilities* that are part of the *nuclear fuel cycle* except *facilities* for the mining or processing of uranium or thorium ores and *radioactive waste management facilities*.

2. [For each Contracting Party, any land based civil nuclear power plant under its jurisdiction, including such *storage*, handling and *treatment facilities* for *radioactive materials* as are on the same site and are directly related to the *operation* of the nuclear power plant. Such a plant ceases to be a *nuclear installation* when all *nuclear fuel elements* have been removed permanently from the reactor core and have been stored safely in accordance with approved *procedures*, and a *decommissioning* programme has been agreed to by the *regulatory body*.] (From Ref. [4].)

nuclear material

Plutonium except that with isotopic concentration exceeding 80% in plutonium-238; uranium-233; *uranium enriched in the isotope 235 or 233*; uranium containing the mixture of isotopes as occurring in nature other than in the form of ore or ore residue; any material containing one or more of the foregoing. (From Ref. [30].)

ⓘ *Nuclear material* is necessary for the production of nuclear weapons or other nuclear explosive devices. Under comprehensive *safeguards agreements*, the IAEA verifies that all *nuclear material* subject to safeguards has been declared and placed under safeguards. Certain non-nuclear materials are essential for the use or production of *nuclear material* and may also be subject to IAEA safeguards under certain agreements.

ⓘ The Statute of the IAEA [31] uses the term ***special fissionable material***, with the meaning essentially of *nuclear material* as defined here, but explicitly excluding *source material*.

ⓘ For the purposes of IAEA *safeguards agreements*, *nuclear material* is defined as "any *source material* or *special fissionable material* as defined in Article XX of the Statute of the IAEA". The meaning is essentially the same as that of *nuclear material* as defined here. See Ref. [32].

ⓘ The Paris Convention on Third Party Liability in the Field of Nuclear Energy [33] uses the term 'nuclear substances', which means *nuclear fuel* (other than *natural uranium* and *depleted uranium*) and *radioactive* products or *radioactive waste*.

nuclear or radiological emergency

See *emergency*.

[nuclear sabotage]

See *sabotage*.

(nuclear) safety

The achievement of proper *operating conditions*, prevention of *accidents* or mitigation of *accident* consequences, resulting in *protection* of *workers*, the public and the environment from undue *radiation* hazards.

ⓘ Often abbreviated to *safety* in *IAEA publications* on *nuclear safety*. *Safety* means *nuclear safety* unless otherwise stated, in particular when other types of *safety* (e.g. fire *safety*, conventional industrial *safety*) are also being discussed.

ⓘ See *protection and safety* for a discussion of the relationship between *nuclear safety* and *radiation protection*.

(nuclear) security

The prevention and detection of, and response to, theft, *sabotage*, unauthorized access, illegal transfer or other *malicious* acts involving *nuclear material*, other *radioactive substances* or their associated *facilities*.

ⓘ See IAEA GOV/2005/50.

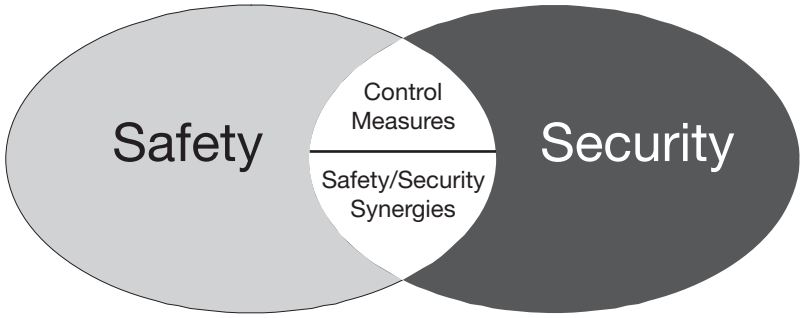
ⓘ This includes, but is not limited to, the prevention and detection of, and response to, the theft of *nuclear material* or other *radioactive material* (with or without knowledge of the nature of the material), *sabotage*, and other *malicious* acts, *illicit trafficking* and unauthorized transfer.

ⓘ The response element of the definition refers to those actions aimed at 'reversing' the immediate consequences of unauthorized access or actions (e.g. recovering material). Response to the radiological consequences that might ensue is considered part of *safety*.

ⓘ Often abbreviated to *security* in *IAEA publications* on *nuclear security*.

ⓘ There is not an exact distinction between the general terms *safety* and *security*. In general, *security* is concerned with *malicious* or negligent actions by humans that could cause or threaten harm to other humans; *safety* is concerned with the broader issue of harm to humans (or the environment)

from *radiation*, whatever the cause. The precise interaction between *security* and *safety* depends on the context. *Security* of *nuclear material* for reasons relating to non-proliferation is outside the scope of the Safety Glossary.



ⓘ *Safety* and *security synergies* concern, for example: the regulatory infrastructure; engineering provisions in the *design* and *construction* of *nuclear installations* and other *facilities*; *controls* on access to *nuclear installations* and other *facilities*; the categorization of *radioactive sources*; *source design*; the *security* of the management of *radioactive sources* and *radioactive material*; the recovery of *orphan sources*; *emergency response* plans; and *radioactive waste management*. *Safety* matters are intrinsic to *activities*, and transparent and probabilistic *safety analysis* is used. *Security* matters concern *malicious* actions and are confidential, and threat based judgement is used.

[nuclear terrorism]

See *terrorism*.

[nuclear terrorist]

See *terrorism*.

[nuclear trafficking]

See *illicit trafficking*.

O

observed cause

See *cause*.

occupational exposure

See *exposure, types of*.

off-site

Outside the *site area*.

on-site

Within the *site area*.

operating conditions

See *plant states: operational states*.

operating lifetime

See *life*.

operating organization

1. An organization applying for *authorization* or *authorized* to operate an *authorized facility* and responsible for its *safety*.

! Note that such an organization may become the *operating organization* before *operation* starts.

ⓘ In practice, for an *authorized facility*, the *operating organization* is normally also the *licensee* or *registrant*. However, the separate terms are retained to refer to the two different capacities.

ⓘ See also *operator*.

2. The organization (and its contractors) which undertakes the *siting*, *design*, *construction*, *commissioning* and/or *operation* of a *nuclear facility*.

ⓘ This usage is peculiar to *waste safety* documentation, with the corresponding understanding of *siting* as a multistage *process*. This difference is partly a reflection of the particularly crucial role of *siting* in the *safety* of *repositories*.

operating period

See *life: operating life/lifetime* (1).

operating personnel

Individual *workers* engaged in the *operation* of an *authorized facility*.

! This may be shortened to *operator(s)*, but only if there is no danger of confusion with *operator* in the sense of *operating organization*.

operation[7]

All *activities* performed to achieve the purpose for which an *authorized facility* was constructed.

ⓘ For a nuclear power plant, this includes *maintenance*, refuelling, *in-service inspection* and other associated *activities*.

abnormal operation. See *plant states: anticipated operational occurrence*.

assisted operation. See *assisted (by the IAEA) operation*.

ⓘ The term 'operation' is used here in its normal sense.

normal operation. See *plant states*.

operational bypass

See *bypass* (1).

operational intervention level (OIL)

See *level: intervention level*.

operational limits and conditions

See *limit*.

operational period

See *life: operating life/lifetime* (1).

operational states

See *plant states.*

operations area

See *area*.

operations boundary

See *operations area*.

operator

Any organization or person applying for *authorization* or authorized and/or responsible for *nuclear*, *radiation*, *radioactive waste* or *transport safety* when undertaking *activities* or in relation to any *nuclear facilities* or *sources* of *ionizing radiation*. This includes, inter alia, private individuals, governmental bodies, *consignors* or *carriers*, *licensees*, hospitals, self-employed persons, etc.

! *Operator* is sometimes used to refer to *operating personnel*. If used in this way, particular care should be taken to ensure that there is no possibility of confusion.

ⓘ *Operator* includes either those who are directly in *control* of a *facility* or an *activity* during use of a *source* (such as radiographers or carriers) or, in the case of a *source* not under *control* (such as a lost or illicitly removed *source* or a re-entering satellite), those who were responsible for the *source* before *control* over it was lost.

ⓘ Synonymous with *operating organization*.

optimization of protection (and safety)

The *process* of determining what level of *protection and safety* makes *exposures*, and the probability and magnitude of *potential exposures*, "as low as reasonably achievable, economic and social factors being taken into account" (***ALARA***), as required by the International Commission on Radiological Protection *System of Radiological Protection*.

! This is not the same as optimization of the *process* or *practice* concerned. An explicit term such as *optimization of protection (and safety)* should be used.

! The term *ALARA* should not be used to mean *optimization of protection (and safety)*.

organ dose

See *dose quantities.*

orphan source

See *source* (2).

overall emergency plan

See *emergency plan* (1).

overpack

1. See *waste management, radioactive* (1).

2. An enclosure such as a box or bag which is used by a single *consignor* to facilitate as a handling unit a *consignment* of one or more *packages* for convenience of handling, stowage and carriage. (From Ref. [2].)

P

package

The *packaging* with its *radioactive contents* as presented for *transport*. The types of *packages* covered by [the Transport] Regulations [2], which are subject to the *activity limits* and material restrictions of Section IV [of the Transport Regulations [2]] and meet the corresponding *requirements*, are:

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

Packages containing *fissile material* or uranium hexafluoride are subject to additional *requirements.* (From Ref. [2].)

ⓘ The detailed specifications and *requirements* for these *package* types are specified in Ref. [2], and are too complex to attempt to summarize here.

package, waste

The product of *conditioning* that includes the *waste form* and any *container(s)* and internal *barriers* (e.g. absorbing materials and liner), as prepared in accordance with *requirements* for handling, *transport*, *storage* and/or *disposal*.

packaging

1. The assembly of *components* necessary to enclose the *radioactive contents* completely. It may, in particular, consist of one or more receptacles, absorbent materials, spacing *structures*, *radiation* shielding and service equipment for filling, emptying, venting and pressure relief; devices for cooling, absorbing mechanical shocks, handling and tie-down, and thermal insulation; and service devices integral to the *package.* The *packaging* may be a box, drum or similar receptacle, or may also be a *freight container*, *tank* or *intermediate bulk container*. (From Ref. [2].)

2. See *waste management, radioactive* (1).

particle fluence

See *fluence.*

passenger aircraft

See *aircraft*.

passive component

A *component* whose functioning does not depend on an external input such as actuation, mechanical movement or supply of power.

ⓘ A *passive component* has no moving part, and, for example, only experiences a change in pressure, in temperature or in fluid flow in performing its functions. In addition, certain *components* that function with very high *reliability* based on irreversible action or change may be assigned to this category.

ⓘ Examples of *passive components* are heat exchangers, pipes, vessels, electrical cables and *structures.* It is emphasized that this definition is necessarily general in nature, as is the corresponding definition of *active component*. Certain *components*, such as rupture discs, check valves, *safety* valves, injectors and some solid state electronic devices, have characteristics which require special consideration before designation as an *active* or *passive component*.

ⓘ Any *component* that is not a *passive component* is an *active component*.

peer review

An examination or review of commercial, professional or academic efficiency, competence, etc., by others in the same occupation.

ⓘ Also: The evaluation, by experts in the relevant field, of a scientific research project for which a grant is sought; the *process* by which a learned journal passes a paper received for publication to outside experts for their comments on its suitability and worth; refereeing.

performance assessment

See *assessment* (1).

performance indicator

See *indicator*.

periodic maintenance

See *maintenance*.

periodic safety review

A systematic reassessment of the *safety* of an existing *facility (or activity)* carried out at regular intervals to deal with the cumulative effects of *ageing*, modifications, operating experience, technical developments and *siting* aspects, and aimed at ensuring a high level of *safety* throughout the *service life* of the *facility (or activity)*.

permanent relocation

See *relocation*.

personal dose equivalent

See *dose equivalent quantities*.

[personal monitoring]

See *monitoring* (1).

[personnel monitoring]

See *monitoring* (1).

physical ageing

See *ageing*.

physical diversity

See *diversity*.

physical half-life

See *half-life* (2): *radioactive half-life.*

physical protection

See *protection* (3).

physical separation

Separation by geometry (distance, orientation, etc.), by appropriate *barriers*, or by a combination thereof.

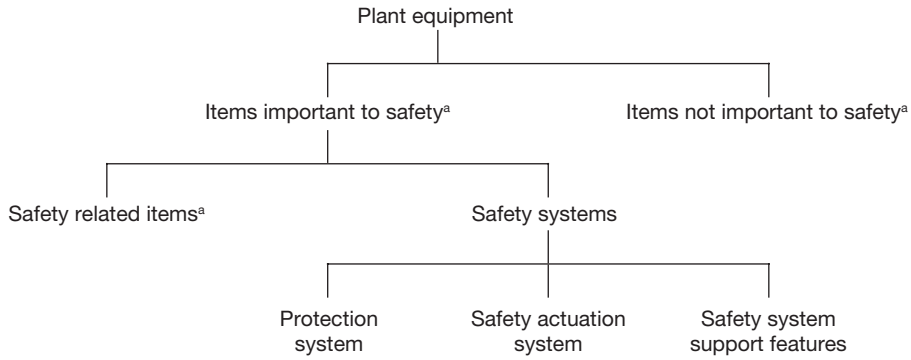
physisorption

See *sorption*.

planned maintenance

See *maintenance.*

plant equipment



[a] In this context, an 'item' is a *structure*, *system* or *component*.

item important to safety. An item that is part of a *safety group* and/or whose malfunction or *failure* could lead to *radiation exposure* of the *site personnel* or *members of the public.*

ⓘ *Items important to safety* include:

— Those *structures, systems and components* whose malfunction or *failure* could lead to undue *radiation exposure* of *site personnel* or *members of the public*;
— Those *structures, systems and components* that prevent *anticipated operational occurrences* from leading to *accident conditions*;
— Those features that are provided to mitigate the consequences of malfunction or *failure* of *structures, systems and components.*

protection system. *System* that monitors the *operation* of a reactor and which, on sensing an abnormal condition, automatically initiates actions to prevent an unsafe or potentially unsafe condition.

! This use of the term *protection* refers to *protection* of the plant (*protection* (2)).

ⓘ The *system* in this case encompasses all electrical and mechanical devices and circuitry, from sensors to *actuation device* input terminals.

safety actuation system. The collection of equipment required to accomplish the necessary *safety actions* when initiated by the *protection system*.

safety related item. An *item important to safety* that is not part of a *safety system*.

safety related system. A *system* important to *safety* that is not part of a *safety system*.

ⓘ A *safety* related instrumentation and *control system*, for example, is an instrumentation and *control system* that is important to *safety* but which is not part of a *safety system*.

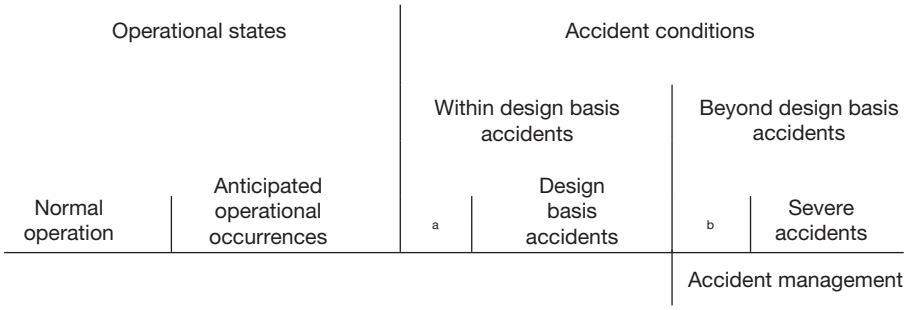
safety system. A *system* important to *safety*, provided to ensure the safe shutdown of the reactor or the *residual heat* removal from the core, or to limit the consequences of *anticipated operational occurrences* and *design basis accidents.*

ⓘ *Safety systems* consist of the *protection system*, the *safety actuation systems* and the *safety system support features. Components* of *safety systems* may be provided solely to perform *safety functions*, or may perform *safety functions* in some plant *operational states* and non-safety functions in other *operational states.*

safety system support features. The collection of equipment that provides services such as cooling, lubrication and energy supply required by the *protection system* and the *safety actuation systems.*

! After a *postulated initiating event*, some required *safety system support features* may be initiated by the *protection system* and others may be initiated by the *safety actuation systems* they serve; other required *safety system support features* may not need to be initiated if they are in *operation* at the time of the *postulated initiating event*.

plant states



[a] *Accident conditions* that are not *design basis accidents* as explicitly considered but which are encompassed by them.
[b] *Beyond design basis accidents* without significant core degradation.

ⓘ This figure differs from that in the 1988 versions of the Nuclear Safety Standards Codes, as follows:
(a) *Accident conditions* are now taken to include all non-operational states, rather than just *design basis accidents* and those conditions encompassed by them (marked a);
(b) The new category, marked b, of *beyond design basis accidents* that are not classified as *severe accidents* because there is no significant core degradation;
(c) The term *accident management* is applied only to *beyond design basis accidents*, rather than to all non-operational states.

accident conditions. *Deviations* from *normal operation* more severe than *anticipated operational occurrences*, including *design basis accidents* and *severe accidents.*

ⓘ Examples of such *deviations* include a major *fuel failure* or a loss of coolant accident (LOCA).
ⓘ See *accident*.

accident management. The taking of a set of actions during the evolution of a *beyond design basis accident*:

(a) To prevent the escalation of the *event* into a *severe accident*;
(b) To mitigate the consequences of a *severe accident*;
(c) To achieve a long term safe stable state.

ⓘ The second aspect of *accident management* (to mitigate the consequences of a *severe accident*) is also termed *severe accident management*.

anticipated operational occurrence. An operational *process* deviating from *normal operation* which is expected to occur at least once during the *operating lifetime* of a *facility* but which, in view of appropriate *design* provisions, does not cause any significant damage to *items important to safety* or lead to *accident conditions.*

ⓘ Examples of *anticipated operational occurrences* are loss of normal electrical power and faults such as a turbine trip, malfunction of individual items of a normally running plant, *failure* to function of individual items of *control* equipment, and loss of power to the main coolant pump.
ⓘ Some States and organizations use the term ***abnormal operation*** (for contrast with *normal operation*) for this concept.

beyond design basis accident. *Accident conditions* more severe than a *design basis accident*.

design basis accident. *Accident conditions* against which a *facility* is designed according to established *design* criteria, and for which the damage to the *fuel* and the release of *radioactive material* are kept within *authorized limits.*

normal operation. *Operation* within specified *operational limits and conditions.*

ⓘ For a nuclear power plant, this includes startup, power *operation*, shutting down, shutdown, *maintenance*, testing and refuelling.

operational states. States defined under *normal operation* and *anticipated operational occurrences.*

ⓘ Some States and organizations use the term ***operating conditions*** (in contrast to *accident conditions*) for this concept.

severe accident. *Accident conditions* more severe than a *design basis accident* and involving significant core degradation.

severe accident management. See *severe accident* and *accident management*.

ⓘ By extension, *accident management* for a *severe accident* includes the taking of a set of actions during the evolution of the *accident* to mitigate degradation of the core.

within design basis accident. *Accident conditions* not more severe than a *design basis accident*.

poison

A substance used to reduce *reactivity* in a reactor core, by virtue of its high neutron *absorption* cross-section.

[*burnable poison*]. A *poison* that becomes less effective as a result of absorbing neutrons.

! The term *burnable absorber* is preferred.

postulated initiating event (PIE)

See *initiating event*.

potential alpha energy

The total alpha energy ultimately emitted during the decay of *radon progeny* or of *thoron progeny* through the decay chain.

! Note that the definition of *radon progeny* includes the decay chain up to but not including lead-210.

potential alpha energy exposure

The time integral of the *potential alpha energy* concentration in air over the time period for which an individual is exposed to *radon progeny* or *thoron progeny*.

! This is not a form of *potential exposure*.

ⓘ Used in measuring *exposure* to *radon progeny* and *thoron progeny*, particularly for *occupational exposure*.

ⓘ Unit: $J \cdot h/m^3$.

potential exposure

See *exposure situations.*

practice

Any human activity that introduces additional *sources* of *exposure* or additional *exposure pathways*, or extends *exposure* to additional people, or 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. (From Ref. [1].)

! *Radioactive waste* is generated as a result of *practices* that involve some beneficial effect, such as the generation of electricity by nuclear means or the diagnostic application of radioisotopes. The management of this *waste* is therefore only one part of the overall *practice.*

ⓘ Contrasting term: *intervention*. See also *facilities and activities.*

ⓘ Terms such as 'authorized *practice*', 'controlled *practice*' and 'regulated *practice*' are used to distinguish those *practices* that are subject to *regulatory control* from other *activities* which meet the definition of a *practice* but do not need or are not amenable to *control.*

precautionary action zone (PAZ)

See *emergency zones.*

predictive maintenance

See *maintenance.*

predisposal

See *waste management, radioactive* (1).

[prescribed limit]

See *limit*.

pretreatment

See *waste management, radioactive* (1).

preventive maintenance

See *maintenance*.

preventive measures

See [*nuclear damage*].

primary limit

See *limit*.

prime mover

A *component* that converts energy into action when commanded by an *actuation device*.

ⓘ Such as a motor, solenoid operator or pneumatic operator.

probabilistic analysis

ⓘ Often taken to be synonymous with ***stochastic analysis***. Strictly, however, *stochastic* conveys directly the idea of randomness (or at least apparent randomness), whereas *probabilistic* is directly related to probabilities, and hence only indirectly concerned with randomness. Therefore, a natural *event* or *process* might more correctly be described as *stochastic* (as in *stochastic effect*), whereas *probabilistic* would be more appropriate for describing a mathematical *analysis* of *stochastic events* or *processes* and their consequences (such an *analysis* would, strictly, only be *stochastic* if the analytical method itself included an element of randomness, e.g. Monte Carlo *analysis*).

probabilistic safety assessment (PSA)

A comprehensive, structured approach to identifying *failure scenarios*, constituting a conceptual and mathematical tool for deriving numerical estimates of *risk*.

ⓘ Three levels of *probabilistic safety assessment* are generally recognized. Level 1 comprises the *assessment* of plant *failur*es leading to determination of the frequency of core damage. Level 2 includes the *assessment* of *containment* response, leading, together with Level 1 results, to the determination of frequencies of *failure* of the *containment* and release to the environment of a given percentage of the reactor core's inventory of radionuclides. Level 3 includes the *assessment* of *off-site* consequences, leading, together with the results of Level 2 *analysis*, to estimates of public *risks*. (See, for example, Ref. [34].)

living probabilistic safety assessment. A *probabilistic safety assessment* that is updated as necessary to reflect the current *design* and operational features, and is documented in such a way that each aspect of the *PSA model* can be directly related to existing plant information, plant documentation or the analysts' assumptions in the absence of such information.

procedure

A series of specified actions conducted in a certain order or manner.

ⓘ The set of actions to be taken to conduct an activity or to perform a *process* is typically specified in a set of instructions.

process

1. A course of action or proceeding, especially a series of progressive stages in the manufacture of a product or some other *operation*.

2. A set of interrelated or interacting *activities* that transforms inputs into outputs.

ⓘ A product is the result or output of a *process.*

processing (waste)

See *waste management, radioactive* (1).

projected dose

See *dose concepts.*

prolonged exposure

See *exposure situations: chronic exposure.*

protection

1. (against *radiation*):

radiation protection (also ***radiological protection***). The *protection* of people from the effects of *exposure* to *ionizing radiation*, and the means for achieving this.

- See also *protection and safety*.
- The International Commission on Radiological Protection and others use the term *radiological protection*, which is synonymous.
- The accepted understanding of the term *radiation protection* is restricted to *protection* of humans. Suggestions to extend the definition to include the *protection* of non-human species or the environment are controversial.

2. (of a nuclear reactor). See *plant equipment: protection system*.

3. (of *nuclear material*):

[***physical protection.*** Measures for the *protection* of *nuclear material* or *authorized facilities*, designed to prevent unauthorized access or removal of *fissile material* or *sabotage* with regard to safeguards, as, for example, in the Convention on the Physical Protection of Nuclear Material.] [30]

protection and safety

The *protection* of people against *exposure* to *ionizing radiation* or *radioactive materials* and the *safety* of *radiation sources*, including the means for achieving this, and the means for preventing *accidents* and for mitigating the consequences of *accidents* should they occur. (From Ref. [1].)

- *Safety* is primarily concerned with maintaining *control* over *sources*, whereas *(radiation) protection* is primarily concerned with controlling *exposure* to *radiation* and its effects. Clearly the two are closely connected: *radiation protection* (or *radiological protection*) is very much simpler if the *source* in question is under *control*, so *safety* necessarily contributes towards *protection*. *Sources* come in many different types, and hence *safety* may be termed *nuclear safety*, *radiation safety*, *radioactive waste safety* or *transport safety*, but *protection* (in this sense) is primarily concerned with protecting humans against *exposure*, whatever the *source*, and so is always *radiation protection*.

protection system

See *plant equipment*.

protective action

1. An *intervention* intended to avoid or reduce *doses* to *members of the public* in *emergencies* or situations of *chronic exposure*.

- See also *remedial action*.
- This is related to *radiation protection* (see definition (1) of *protection*, and *protection and safety*).

longer term protective action. A *protective action* that is not an *urgent protective action*.

ⓘ Such *protective actions* are likely to be prolonged over weeks, months or years.

ⓘ These include measures such as *relocation*, *agricultural countermeasures* and *remedial actions.*

mitigatory action. Immediate action by the *operator* or other party:

(1) To reduce the potential for conditions to develop that would result in *exposure* or a release of *radioactive material* requiring *emergency actions* on or off the site; or
(2) To mitigate *source* conditions that may result in *exposure* or a release of *radioactive material* requiring *emergency actions* on or off the site.

urgent protective action. A *protective action* in the event of an *emergency* which must be taken promptly (normally within hours) in order to be effective, and the effectiveness of which will be markedly reduced if it is delayed.

ⓘ The most commonly considered *urgent protective actions* in a *nuclear or radiological emergency* are *evacuation*, *decontamination* of individuals, *sheltering*, respiratory *protection*, *iodine prophylaxis* and restriction of the consumption of potentially contaminated foodstuffs.

2. A *protection system* action calling for the *operation* of a particular *safety actuation device.*

ⓘ This is related to definition (2) of *protection*.

protective task

The generation of at least those *protective actions* necessary to ensure that the *safety task* required by a given *postulated initiating event* is accomplished.

public exposure

See *exposure, types of.*

publication, IAEA

See *IAEA publication*.

Q

qualification

equipment qualification. Generation and *maintenance* of evidence to ensure that equipment will operate on demand, under specified *service conditions*, to meet *system* performance requirements.

ⓘ See Ref. [9].

ⓘ More specific terms are used for particular equipment or particular conditions; for example, ***seismic qualification*** is a form of *equipment qualification* that relates to conditions that could be encountered in the event of earthquakes.

qualified equipment

Equipment certified as having satisfied *equipment qualification* requirements for the conditions relevant to its *safety function(s)*.

qualified expert

An individual who, by virtue of certification by appropriate boards or societies, professional licences or academic qualifications and experience, is duly recognized as having expertise in a relevant field of specialization, e.g. medical physics, *radiation protection*, occupational health, fire safety, *quality assurance* or any relevant engineering or *safety* speciality. (From Ref. [1].)

ⓘ This should not normally need definition.

qualified life

See *life*.

quality assurance (QA)

1. The function of a *management system* that provides confidence that specified *requirements* will be fulfilled.

! The IAEA is revising the *requirements* and guidance in the subject area of *quality assurance* for new *safety standards* on *management systems* for the *safety* of nuclear *facilities and activities* involving the use of *ionizing radiation*. The term *management system* has been adopted in the revised standards instead of the terms *quality assurance* and '*quality assurance* programme'.

ⓘ Planned and systematic actions are necessary to provide adequate confidence that an item, *process* or service will satisfy given *requirements* for quality; for

example, those specified in the *licence*. This statement is slightly modified from that in ISO 921:1997 (Nuclear Energy: Vocabulary) [7] to say 'an item, *process* or service' instead of 'a product or service' and to add the example. A more general definition of *quality assurance* and definitions of related terms can be found in ISO 8402:1994 [35].

2. A systematic programme of *controls* and *inspections* applied by any organization or body involved in the *transport* of *radioactive material* which is aimed at providing adequate confidence that the standard of *safety* prescribed in [the Transport] Regulations is achieved in practice. (From Ref. [2].)

3. All those planned and systematic actions necessary to provide confidence that a *structure, system or component* will perform satisfactorily in service. (From Ref. [35].)

quality control (QC)

Part of *quality assurance* intended to verify that *structures, systems and components* correspond to predetermined requirements.

ⓘ This definition is taken from ISO 921:1997 (Nuclear Energy: Vocabulary) [7]. A more general definition of *quality control* and definitions of related terms can be found in ISO 8402:1994 [35].

quality factor, *Q*

A number by which the *absorbed dose* in a tissue or organ is multiplied to reflect the *relative biological effectiveness* of the *radiation*, the result being the *dose equivalent*.

ⓘ Superseded by *radiation weighting factor* in the definition of *equivalent dose* in Ref. [16], but still defined, as a function of *linear energy transfer*, for use in calculating the *dose equivalent quantities* used in *monitoring*. The BSS [1] also state that the mean *quality factor* $\overline{Q}$ at 10 mm depth in the *ICRU sphere* can be used as a value of *radiation weighting factor* for *radiation* types for which the BSS do not specify a value (see *radiation weighting factor*).

R

[rad]

Unit of *absorbed dose*, equal to 0.01 Gy.

ⓘ Superseded by the *gray (Gy)*.

ⓘ Abbreviation of *röntgen absorbed dose* or *radiation absorbed dose.*

radiation

! When used in *IAEA publications*, the term *radiation* normally refers only to *ionizing radiation*. The IAEA has no statutory responsibilities in relation to non-ionizing *radiation*.

ⓘ *Ionizing radiation* can be divided into *low linear energy transfer radiation* and *high linear energy transfer radiation* (as a guide to its *relative biological effectiveness*), or into *strongly penetrating radiation* and *weakly penetrating radiation* (as an indication of its ability to penetrate shielding or the human body).

high linear energy transfer radiation. *Radiation* with high *linear energy transfer*, normally assumed to comprise protons, neutrons and alpha particles (or other particles of similar or greater mass).

ⓘ These are the types of *radiation* for which the International Commission on Radiological Protection recommends a *radiation weighting factor* greater than 1.

ⓘ Contrasting term: *low linear energy transfer radiation*.

ionizing radiation. For the purposes of *radiation protection*, *radiation* capable of producing ion pairs in biological material(s). (From Ref. [1].)

low linear energy transfer radiation. *Radiation* with low *linear energy transfer*, normally assumed to comprise photons (including X rays and gamma *radiation*), electrons, positrons and muons.

ⓘ These are the types of *radiation* for which the International Commission on Radiological Protection recommends a *radiation weighting factor* of 1.

strongly penetrating radiation. *Radiation* for which *limits* on *effective dose* are normally more restrictive than *limits* on *equivalent dose* to any tissue or organ, i.e. the fraction of the relevant *dose limit* received will, for a given *exposure*, be higher for *effective dose* than for *equivalent dose* to any tissue or organ. If the reverse is true, the *radiation* is termed ***weakly penetrating radiation***.

ⓘ For most practical purposes, it may be assumed that *strongly penetrating radiation* includes photons of energy above about 20–30 keV, high energy electrons (more than about 1–2 MeV) and neutrons, and that *weakly penetrating radiation* includes photons of energy below about 20–30 keV, beta particles and other electrons of less than about 1–2 MeV, and massive charged particles such as protons.
ⓘ Contrasting term: *weakly penetrating radiation*.

weakly penetrating radiation. See *radiation: strongly penetrating radiation*.

[radiation area]

See *area: controlled area*.

radiation detriment

The total harm that would eventually be experienced by an exposed group and its descendants as a result of the group's *exposure* to *radiation* from a *source*. (From Ref. [1].)

ⓘ In its Publication 60 [16], the International Commission on Radiological Protection defines a measure of *radiation detriment* that has the dimensions of probability and that could therefore also be considered a measure of *risk*.

radiation emergency

See *emergency: nuclear or radiological emergency.*

radiation level

[The corresponding *dose rate* expressed in millisieverts per hour.] (From Ref. [2].)

! This usage is specific to the Transport Regulations, and should otherwise be avoided.

radiation protection

See *protection* (1).

radiation protection officer

A person technically competent in *radiation protection* matters relevant for a given type of *practice* who is designated by the *registrant* or *licensee* to oversee the application of relevant *requirements* established in international *safety standards.*

radiation protection programme

Systematic arrangements which are aimed at providing adequate consideration of *radiation protection* measures. (From Ref. [2].)

radiation risks

— Detrimental *health effects* of *exposure* to *radiation* (including the likelihood of such effects occurring).
— Any other *safety* related *risks* (including those to ecosystems in the environment) that might arise as a direct consequence of:
  - *Exposure* to *radiation*;
  - The presence of *radioactive material* (including *radioactive waste*) or its release to the environment;
  - A loss of *control* over a nuclear reactor core, nuclear chain reaction, *radioactive source* or any other *source* of *radiation*. (From Ref. [22].)

ⓘ For the purposes of the IAEA *safety standards*, it is assumed that there is no threshold level of *radiation dose* below which there are no associated *radiation risks.* Safety Requirements and Safety Guides specify the *radiation exposures* and other *risks* to which they refer.

radiation source

See *source* (1).

radiation specialist

A person trained in *radiation protection* and other areas of specialization necessary in order to be able to assess radiological conditions, to mitigate radiological consequences or to control *doses* to responders.

radiation weighting factor, w_R

A number by which the *absorbed dose* in a tissue or organ is multiplied to reflect the *relative biological effectiveness* of the *radiation* in inducing *stochastic effects* at low *doses*, the result being the *equivalent dose.*

ⓘ Values are selected by the International Commission on Radiological Protection to be representative of the relevant *relative biological effectiveness* and are broadly compatible with the values previously recommended for *quality factors* in the definition of *dose equivalent*. The *radiation weighting factor* values recommended by the International Commission on Radiological Protection [16] are:

Type of *radiation*	w_R
Photons, all energies	1
Electrons and muons, all energies[a]	1
Neutrons, energy:	
<10 keV	5
10 keV to 100 keV	10
>100 keV to 2 MeV	20
>2 MeV to 20 MeV	10
>20 MeV	5
Protons, other than recoil protons, energy >2 MeV	5
Alpha particles, *fission fragments*, heavy nuclei	20

[a] Excluding Auger electrons emitted from radionuclides bound to DNA, for which special microdosimetric considerations apply.

ⓘ If calculation of the *radiation weighting factor* for neutrons requires a continuous function, the following approximation can be used, where E is the neutron energy in MeV:

$$w_R = 5 + 17e^{-(\ln(2E))^2/6}$$

ⓘ For *radiation* types and energies not included in the table, w_R can be taken to be equal to $\bar{Q}$ at 10 mm depth in the *ICRU sphere* and can be obtained as follows:

$$\bar{Q} = \frac{1}{D}\int_0^\infty Q(L)D_L \mathrm{d}L$$

where D is the *absorbed dose*, $Q(L)$ is the *quality factor* in terms of the *unrestricted linear energy transfer* L in water, specified in Ref. [16], and D_L is the distribution of D in L.

$$Q(L) = \begin{cases} 1 & \text{for} \quad L \leq 10 \\ 0.32L - 2.2 & \text{for} \quad 10 < L < 100 \\ 300/\sqrt{L} & \text{for} \quad L \geq 100 \end{cases}$$

where L is expressed in keV/μm.

radioactive *(adjective)*

1. Exhibiting *radioactivity*; emitting or relating to the emission of *ionizing radiation* or particles.

ⓘ This is the 'scientific' definition, and should not be confused with the 'regulatory' definition (2).

2. Designated in national law or by a *regulatory body* as being subject to *regulatory control* because of its *radioactivity.*

radioactive contents

The *radioactive material* together with any contaminated or activated solids, liquids and gases within the *packaging*. (From Ref. [2].)

radioactive discharges

See *discharge* (1).

radioactive equilibrium

See *equilibrium, radioactive.*

radioactive half-life

See *half-life* (2).

radioactive material

1. Material designated in national law or by a *regulatory body* as being subject to *regulatory control* because of its *radioactivity.*

! *Radioactive material* should be used in the singular unless reference is expressly being made to the presence of various types of *radioactive material*.

ⓘ Some States use the term ***radioactive substance*** for this regulatory purpose. However, the term *radioactive substance* is also sometimes used to indicate that the scientific use of *radioactive* (see *radioactive* (1)) is intended, rather than the regulatory meaning of *radioactive* (see *radioactive* (2)) suggested by the term *radioactive material*. It is therefore essential that any such distinctions in meaning are clarified.

ⓘ In regulatory terminology in some States, *radioactive material* ceases to be *radioactive material* when it becomes *radioactive waste*; the term *radioactive substance* is used to cover both, i.e. *radioactive substance* includes *radioactive material* and *radioactive waste.*

2. Any material containing radionuclides where both the *activity concentration* and the total *activity* in the *consignment* exceed the values specified in paras 401–406 [of the Transport Regulations]. (From Ref. [2].)

! This usage is specific to the Transport Regulations, and should otherwise be avoided.

radioactive source

See *source* (2).

radioactive sources, safety of

See *safety of radioactive sources.*

radioactive sources, security of

See *security of radioactive sources.*

radioactive substance

See *radioactive material* (1).

radioactive waste

See *waste, radioactive.*

radioactive waste management

See *waste management, radioactive.*

radioactive waste management facility

See *waste management facility, radioactive.*

radioactivity

The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of *radiation*.

! In *IAEA publications*, *radioactivity* should be used only to refer to the phenomenon. To refer to the physical quantity or to an amount of a *radioactive substance*, use *activity.*

radiological assessor

A person who in the event of a *nuclear or radiological emergency* assists the *operator* of a *dangerous source* by performing *radiation surveys*, performing *dose assessments*, controlling *contamination*, ensuring the *radiation protection* of *emergency workers* and formulating recommendations on *protective actions.*

ⓘ The radiological assessor would generally be the *radiation protection officer.*

radiological emergency

See *emergency.*

[radiological material]

See *nuclear material* and *radioactive material.*

radiological protection

See *protection* (1).

radiological survey

See *survey.*

[radiological sabotage]

See *sabotage.*

[radiological terrorism]

See *terrorism*.

[radiological terrorist]

See *terrorism*.

[radionuclear]

! 'Radionuclear' is not a legitimate word. See *nuclear material* and *radioactive material*.

ⓘ *Radionuclear* has been used in nuclear medicine to mean 'involving the use of radionuclides'; thus '*radionuclear* tests' in nuclear medicine has been used to mean tests in which radiopharmaceuticals are administered. This usage should be avoided.

ⓘ *Radionuclear* has also been used as a journalese shorthand form for 'nuclear and/or radiological', as in the terms '*radionuclear* weapon' and '*radionuclear emergency*', or for 'nuclear and/or *radioactive*', as in the term '*radionuclear* material'. These and other such usages should be avoided.

radionuclides of natural origin

Radionuclides that occur naturally on Earth in significant quantities.

ⓘ The term is usually used to refer to the primordial radionuclides potassium-40, uranium-235, uranium-238, thorium-232 and their *radioactive* decay products.

ⓘ Contrasted with radionuclides of artificial origin, and also with artificial radionuclides, anthropogenic radionuclides and human-made radionuclides.

radon

1. Any combination of isotopes of the element *radon*.

2. Radon-222.

ⓘ When contrasted with *thoron* (radon-220).

radon progeny

The short lived *radioactive* decay products of radon-222.

ⓘ This includes the decay chain up to but not including lead-210, namely polonium-218 (sometimes called radium A), lead-214 (radium B),

bismuth-214 (radium C) and polonium-214 (radium C′), plus traces of astatine-218, thallium-210 (radium C″) and lead-209. Lead-210 (radium D), which has a *half-life* of 22.3 years, and its *radioactive* progeny — bismuth-210 (radium E) and polonium-210 (radium F), plus traces of mercury-206 and thallium-206 — are, strictly, progeny of radon-222, but they are not normally included in the meaning of the term *radon progeny*, because they will not normally be present in significant amounts in airborne form. The stable decay product lead-206 is sometimes known as radium G.

reactivity, ρ

For a nuclear chain reacting medium:

$$\rho = 1 - \frac{1}{K_{\text{eff}}}$$

where K_{eff} is the ratio between the number of fissions in two succeeding generations (later to earlier) of the chain reaction.

ⓘ A measure of the *deviation* from *criticality* of a nuclear chain reacting medium, such that positive values correspond to a supercritical state and negative values correspond to a subcritical state.

shutdown reactivity. The *reactivity* when all *control* devices are introducing their maximum negative *reactivity*.

ⓘ A reactor is shut down quickly by moving *control* devices rapidly into position to introduce their negative *reactivity* into the core.

recording level

See *level*.

redundancy

Provision of alternative (identical or diverse) *structures, systems and components*, so that any one can perform the required function regardless of the state of *operation* or *failure* of any other.

reference air kerma rate

See *kerma*.

reference individual

An idealized human with characteristics defined by the International Commission on Radiological Protection for *radiation protection* purposes.

ⓘ Reference values for eight *reference individuals* — a newborn; a one year old; a five year old; a ten year old; male and female 15 year olds; and male and female adults — are given in Ref. [36]. These reference values are based on data for western European and North American populations, but Ref. [36] also provides additional information on individual variation among grossly normal individuals resulting from differences in age, gender, race and other factors.

ⓘ This is a refinement of the *Reference Man* concept.

reference level

See *level*.

Reference Man

An idealized adult Caucasian human male defined by the International Commission on Radiological Protection for the purpose of *radiation protection assessment*. (From Ref. [1].)

ⓘ See Ref. [37]. Although this is now being superseded by the more general concept of the *reference individual* (see Ref. [36]), some concepts and quantities are still defined in terms of *Reference Man*.

registrant

See *registration*.

registration

A form of *authorization* for *practices* of low or moderate *risks* whereby the *legal person* responsible [i.e. ***responsible legal person***] 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. The requirements for *safety assessment* and the conditions or limitations applied to the *practice* should be less severe than those for licensing. (From Ref. [1].)

ⓘ Typical *practices* that are amenable to *registration* are those for which: (a) *safety* can largely be ensured by the *design* of the *facilities* and equipment; (b) the operating *procedures* are simple to follow; (c) the *safety* training

requirements are minimal; and (d) there is a history of few problems with *safety* in *operations*. *Registration* is best suited to those *practices* for which *operations* do not vary significantly.

ⓘ The holder of a current *registration* is termed a ***registrant***. Other derivative terms should not be needed; a *registration* is a product of the *authorization process*, and a *practice* with a current *registration* is an authorized *practice*.

[Regulatory Authority]

An authority or authorities designated or otherwise recognized by a government for regulatory purposes in connection with *protection and safety*. (From Ref. [1].)

! Superseded by the term *regulatory body*, which should generally be used. The term *Regulatory Authority* (with initial capitals) has been retained in publications where consistency with the BSS was necessary.

regulatory body

1. An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory *process*, including issuing *authorizations*, and thereby regulating *nuclear*, *radiation*, *radioactive waste* and *transport safety*.

ⓘ The national *competent authority* for the regulation of *radioactive material transport safety* (see Ref. [2]) is included in this description, as is the *Regulatory Authority* for *radiation protection and safety* (see Ref. [1]).

! Supersedes the term *Regulatory Authority* as used in the BSS. The term *Regulatory Authority* (with initial capitals) has been retained in publications where consistency with the BSS was necessary.

2. [For each Contracting Party any body or bodies given the legal authority by that Contracting Party to grant *licences* and to regulate the *siting*, *design*, *construction*, *commissioning*, *operation* or *decommissioning* of *nuclear installations*.] (From Ref. [4].)

3. [Any body or bodies given the legal authority by the Contracting Party to regulate any aspect of the *safety* of *spent fuel* or *radioactive waste management* including the granting of *licences*.] (From Ref. [5].)

4. [An entity or organization or a system of entities or organizations designated by the government of a State as having legal authority for exercising *regulatory control* with respect to *radioactive sources*, including issuing

authorizations, and thereby regulating one or more aspects of the *safety* or *security of radioactive sources*.] (From Ref. [11].)

regulatory control

See *control* (1).

regulatory inspection

See *inspection*.

rehabilitation

See *remediation*.

relative biological effectiveness (RBE)

A relative measure of the effectiveness of different *radiation* types at inducing a specified *health effect*, expressed as the inverse ratio of the *absorbed doses* of two different *radiation* types that would produce the same degree of a defined biological *end point*.

[relative dose]

[The ratio of the *dose coefficient* calculated using specific information for one or more parameter values, to the corresponding *dose coefficient* given in an International Commission on Radiological Protection report calculated using reference values for all parameters.] (From Ref. [21].)

! This is not a *dose*, and therefore the term is misleading.

relative risk

See *risk* (3).

reliability

The probability that a *system* or *component* will meet its minimum performance requirements when called upon to do so.

ⓘ See also *availability*.

reliability centred maintenance (RCM)

See *maintenance*.

relocation

The non-urgent removal or extended exclusion of people from a contaminated area to avoid *chronic exposure*.

- *Relocation* is a *longer term protective action*. It may be a continuation of the *urgent protective action* of *evacuation*.
- *Relocation* is considered to be ***permanent relocation*** (sometimes termed **[*resettlement*]**) if it continues for more than a year or two and return is not foreseeable; otherwise it is ***temporary relocation***.

[rem]

Unit of *dose equivalent* and *effective dose equivalent*, equal to 0.01 Sv.

- Superseded by the *sievert (Sv)*.
- Abbreviation of *röntgen* equivalent man.

remedial action

Action taken when a specified *action level* is exceeded, to reduce *radiation doses* that might otherwise be received, in an *intervention* situation involving *chronic exposure*. (From Ref. [1].)

- *Remedial actions* could also be termed *longer term protective actions*, but *longer term protective actions* are not necessarily *remedial actions*.
- See also *protective action* and *root cause*.

remediation

Any measures that may be carried out to reduce the *radiation exposure* from existing *contamination* of land areas through actions applied to the *contamination* itself (the *source*) or to the *exposure pathways* to humans.

- Complete removal of the *contamination* is not implied.
- The more informal term *cleanup* is also used. If used, it should be used with the same meaning as *remediation*, not to attempt to convey a different meaning.
- The terms *rehabilitation* and *restoration* may be taken to imply that the conditions that prevailed before the *contamination* can be achieved again, which is not normally the case (e.g. owing to the effects of the *remedial action* itself). Their use is discouraged.
- See *decontamination*.

remedy

See *cause*: *root cause.*

repair

Action on a non-conforming product to make it acceptable for its intended use (ISO 9000). See also *cause*: *direct cause.*

repository

A *nuclear facility* where *waste* is emplaced for *disposal.*

geological repository. A *facility* for *radioactive waste disposal* located underground (usually several hundred metres or more below the surface) in a stable geological formation to provide long term isolation of radionuclides from the *biosphere.*

near surface repository. A *facility* for *radioactive waste disposal* located at or within a few tens of metres of the Earth's surface.

reprocessing

A *process* or *operation*, the purpose of which is to extract *radioactive* isotopes from *spent fuel* for further use.

required, requirement

Required by (national or international) law or regulations, or by IAEA Safety Fundamentals or Safety Requirements.

! In *IAEA publications*, *required* (and other terms such as *requirement* derived from the verb 'require') should be used in this sense only. Care should be taken to avoid confusion. The more general sense of something that is necessary should be expressed using other words.

research reactor

[A nuclear reactor used mainly for the generation and utilization of neutron flux and *ionizing radiation* for research and other purposes, including experimental *facilities* associated with the reactor and *storage*, handling and *treatment facilities* for *radioactive materials* on the same site that are directly

related to safe *operation* of the *research reactor*. *Facilities* commonly known as *critical* assemblies are included.]

! This definition is particular to the Code of Conduct on the Safety of Research Reactors [38].

[resettlement]

See *relocation*.

residual dose

See *dose concepts.*

residual heat

The sum of the heat originating from *radioactive* decay and shutdown fission and the heat stored in reactor related *structures* and in heat *transport* media.

response organization

An organization designated or otherwise recognized by a State as being responsible for managing or implementing any aspect of an *emergency response.*

response time

The period of time necessary for a *component* to achieve a specified output state from the time that it receives a signal requiring it to assume that output state.

! Note that this is not related to *emergency response.*

responsible legal person

See *licence* and *registration*.

restoration

See *remediation*.

restricted linear collision stopping power

See *linear energy transfer (LET)*.

restricted use

See *use*.

risk

ⓘ Depending on the context, the term *risk* may be used to represent a quantitative measure (as, for example, in definitions (1) and (2)) or as a qualitative concept (as often for definition (3)).

1. A multiattribute quantity expressing hazard, danger or chance of harmful or injurious consequences associated with actual or *potential exposures*. It relates to quantities such as the probability that specific deleterious consequences may arise and the magnitude and character of such consequences. (From Ref. [1].)

ⓘ In mathematical terms, this can be expressed generally as a set of triplets, $R = \{\langle S_i | p_i | X_i \rangle\}$, where S_i is an identification or description of a *scenario* i, p_i is the probability of that *scenario* and X_i is a measure of the consequence of the *scenario*. The concept of *risk* is sometimes also considered to include uncertainty in the probabilities p_i of the *scenarios*.

2. The mathematical mean (expectation value) of an appropriate measure of a specified (usually unwelcome) consequence:

$$R = \sum_i p_i C_i$$

where p_i is the probability of occurrence of *scenario* or *event sequence* i and C_i is a measure of the consequence of that *scenario* or *event sequence*.

ⓘ Typical consequence measures C_i include core damage frequency, the estimated number or probability of *health effects*, etc.

ⓘ If the number of *scenarios* or *event sequences* is large, the summation is replaced by an integral.

ⓘ The summing of *risks* associated with *scenarios* or *event sequences* with widely differing values of C_i is controversial. In such cases the use of the term ‘expectation value’, although mathematically correct, is misleading and should be avoided if possible.

ⓘ Methods for treating uncertainty in the values of p_i and C_i, and in particular whether such uncertainty is represented as an element of *risk* itself or as uncertainty in estimates of *risk*, vary.

3. The probability of a specified *health effect* occurring in a person or group as a result of *exposure* to *radiation*.

ⓘ The *health effect(s)* in question must be stated — e.g. *risk* of fatal cancer, *risk* of serious *hereditary effects* or overall *radiation detriment* — as there is no generally accepted 'default'.

ⓘ Commonly expressed as the product of the probability that *exposure* will occur and the probability that the *exposure*, assuming that it occurs, will cause the specified *health effect*. The latter probability is sometimes termed the ***conditional risk***.

annual risk. The probability that a specified *health effect* will occur at some time in the future in an individual as a result of *radiation exposure* incurred or committed in a given year, taking account of the probability of *exposure* occurring in that year.

! This is not the probability of the *health effect* occurring in the year in question; it is the *lifetime risk* resulting from the *annual dose* for that year.

attributable risk. The *risk* of a specified *health effect* assumed to result from a specified *exposure.*

excess relative risk. The ratio of the *excess risk* of a specified *stochastic effect* to the probability of the same effect in the unexposed population, i.e. the *relative risk* minus one. In theory, this should be equal to the *attributable risk* from the *exposure* received by the exposed group, but *excess relative risk* is normally used in the context of observed numbers of effects, whereas *attributable risk* normally refers to a figure calculated on the basis of a known or estimated *exposure.*

excess risk. The difference between the incidence of a specified *stochastic effect* observed in an exposed group to that in an unexposed *control* group.

lifetime risk. The probability that a specified *health effect* will occur at some time in the future in an individual as a result of *radiation exposure.*

relative risk. The ratio between the incidence of a specified *stochastic effect* observed in an exposed group and that in an unexposed *control* group. (See *control* (2).)

risk assessment

See *assessment* (1).

risk coefficient, γ

The *lifetime risk* or *radiation detriment* assumed to result from *exposure* to unit *equivalent dose* or *effective dose.*

[risk factor]

ⓘ Sometimes used as a synonym for *risk coefficient*. However, this is different from the normal medical use of the term *risk factor* to indicate a factor that influences an individual's *risk*, and therefore should be avoided.

risk monitor

A plant specific real time *analysis* tool used to determine the instantaneous *risk* based on the actual status of the *systems* and *components.* At any given time, the *risk monitor* reflects the current plant configuration in terms of the known status of the various *systems* and/or *components*, e.g. whether there are any *components* out of service for *maintenance* or tests. The *model* used by the *risk monitor* is based on, and is consistent with, the *living probabilistic safety assessment* for the *facility.*

risk projection model

A *conceptual model* for estimating the *risk* from *radiation exposure* at low *doses* and *dose rates* on the basis of epidemiological evidence concerning the *risk* from high *doses* and/or *dose rates.*

additive risk projection model. A *risk projection model* in which *exposure* is assumed to lead to an *attributable risk* that is proportional to the *dose* but independent of the natural probability of the effect.

multiplicative risk projection model. A *risk projection model* in which *exposure* is assumed to lead to an *attributable risk* that is proportional to the *dose* and to the natural probability of the effect.

[röntgen (R)]

Unit of *exposure*, equal to 2.58×10^{-4} C/kg (exactly).
ⓘ Superseded by the SI unit C/kg.

root cause

See *cause*.

root uptake

See *uptake* (1).

routine monitoring

See *monitoring* (1).

S

sabotage

[Any deliberate act directed against a *nuclear facility* or *nuclear material* in use, *storage* or *transport* which could directly or indirectly endanger the health and *safety* of personnel, the public or the environment by *exposure* to *radiation* or release of *radioactive substances.*]

ⓘ From and particular to the Revised Convention on the Physical Protection of Nuclear Material and Nuclear Facilities [30].
See: http://www.iaea.org/NewsCenter/Features/PhysicalProtection/index.html

ⓘ Use this word with caution and avoid such journalese terms as *nuclear sabotage*, *radiological sabotage.*

safeguards agreement

An agreement between the IAEA and one or more Member States which contains an undertaking by one or more of those States not to use certain items in such a way as to further any military purpose and which gives the IAEA the right to observe compliance with such undertaking. Such an agreement may concern:

(a) An IAEA project;
(b) A bilateral or multilateral arrangement in the field of nuclear energy under which the IAEA may be asked to administer safeguards; or
(c) Any of a State's nuclear *activities* unilaterally submitted to IAEA safeguards.

safety

See *nuclear safety* and *protection and safety.*

ⓘ In the Fundamental Safety Principles (Safety Fundamentals), the generalized usage in this particular text of the term *safety* (i.e. to mean *protection and safety*) is explained as follows (Ref. [22], paras 3.1 and 3.2):

> "3.1. For the purposes of this publication, '*safety*' means the *protection* of people and the environment against *radiation risks*, and the *safety* of *facilities and activities* that give rise to *radiation risks.* '*Safety*' as used here and in the IAEA *safety standards* includes the *safety* of *nuclear installations*, radiation *safety*, the *safety* of *radioactive waste management* and *safety* in the *transport* of *radioactive material*; it does not include non-radiation-related aspects of *safety.*

3.2. "*Safety* is concerned with both *radiation risks* under normal circumstances and *radiation risks* as a consequence of *incidents*[4], as well as with other possible direct consequences of a loss of control over a nuclear reactor core, nuclear chain reaction, *radioactive source* or any other *source* of radiation. *Safety measures* include actions to prevent *incidents* and arrangements put in place to mitigate their consequences if they were to occur."

safety action

A single action taken by a *safety actuation system*.

ⓘ For example, insertion of a *control* rod, closing of *containment* valves or *operation* of the *safety* injection pumps.

safety actuation system

See *plant equipment*.

safety analysis

See *analysis*.

safety assessment

See *assessment* (1).

safety case

A collection of arguments and evidence in support of the *safety* of a *facility or activity*.

ⓘ This will normally include the findings of a *safety assessment* and a statement of confidence in these findings.

ⓘ For a *repository*, the *safety case* may relate to a given stage of development. In such cases, the *safety case* should acknowledge the existence of any unresolved issues and should provide guidance for work to resolve these issues in future development stages.

"[4] '*Incidents*' includes *initiating events*, *accident precursors*, *near misses*, *accidents* and unauthorized acts (including *malicious* and non-malicious acts)."

safety committee

A group of experts from the *operating organization* convened to advise on the *safety* of *operation* of an *authorized facility.*

safety culture

The assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, *protection and safety issues* receive the attention warranted by their significance.

ⓘ For a more detailed discussion, see Ref. [39].

safety function

A specific purpose that must be accomplished for *safety.*

ⓘ Reference [40] lists 19 *safety functions* to be fulfilled by the *design* of a nuclear power plant in order to meet three general *safety requirements*:

(a) The capability to safely shut down the reactor and maintain it in a safe shutdown condition during and after appropriate *operational states* and *accident conditions*;
(b) The capability to remove *residual heat* from the reactor core after shutdown, and during and after appropriate *operational states* and *accident conditions*;
(c) The capability to reduce the potential for the release of *radioactive material* and to ensure that any releases are within *prescribed limits* during and after *operational states* and within *acceptable limits* during and after *design basis accidents.*

ⓘ This guidance is commonly condensed into a succinct expression of three ***main safety functions*** for nuclear power plants:

(a) *Control* of *reactivity*;
(b) Cooling of *radioactive material*;
(c) *Confinement* of *radioactive material.*

In earlier *IAEA publications*, 'basic *safety function*' and 'fundamental *safety function*' were also used.

safety group

The assembly of equipment designated to perform all actions required for a particular *postulated initiating event* to ensure that the *limits* specified in the

design basis for *anticipated operational occurrences* and *design basis accidents* are not exceeded.

! The term 'group' is also used (with various qualifying adjectives, e.g. *maintenance* group, *commissioning* group) in the more obvious sense of a group of people involved in a particular area of work. Such terms may need to be defined if there is any chance of confusion with *safety group*.

safety indicator

A quantity used in *assessments* as a measure of the radiological impact of a *source* or *practice*, or of the performance of *protection and safety* provisions, other than a prediction of *dose* or *risk*.

ⓘ Such quantities are most commonly used in situations where predictions of *dose* or *risk* are unlikely to be reliable, e.g. long term *assessments* of *repositories*. They are normally either:

(a) Illustrative calculations of *dose* or *risk* quantities, used to give an indication of the possible magnitude of *doses* or *risks* for comparison with criteria; or
(b) Other quantities, such as radionuclide concentrations or fluxes, that are considered to give a more reliable indication of impact, and that can be compared with other relevant data.

safety issues

Deviations from current *safety standards* or *practices*, or weaknesses in *facility design* or *practices* identified by plant *events*, with a potential impact on *safety* because of their impact on *defence in depth*, *safety* margins or *safety culture*.

safety layers

Passive *systems*, automatically or manually initiated *safety systems*, or administrative *controls* that are provided to ensure that the *required safety functions* are achieved.

ⓘ Often expressed as:

(a) Hardware, i.e. passive and active *safety systems*;
(b) Software, including personnel and *procedures* as well as computer software;
(c) Management *control*, particularly preventing *defence in depth* degradation (through *quality assurance*, *preventive maintenance*, *surveillance testing*, etc.) and reacting appropriately to experience

feedback from degradations that do occur (e.g. determining *root causes* and taking corrective actions).

ⓘ See also *defence in depth*.

safety limits

See *limit*.

safety measure

Any action that might be taken, condition that might be applied or *procedure* that might be followed to fulfil the basic *requirements* of Safety Requirements (see footnote 2).

safety of radioactive sources

[Measures intended to minimize the likelihood of *accidents* involving *radioactive sources* and, should such an *accident* occur, to mitigate its consequences.] (From Ref. [11].)

safety related item

See *plant equipment.*

safety related system

See *plant equipment.*

safety standards

Standards of *safety* issued pursuant to Article III(A)(6)[10] of the Statute of the IAEA [31].

ⓘ *Safety standards* issued since 1997 in the IAEA Safety Standards Series are designated as Safety Fundamentals, Safety Requirements or Safety Guides.

[10] [The Agency is authorized…] 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 (including such standards for labour conditions)…"

Other *IAEA publications*, such as Safety Reports and TECDOCs (most of which are issued pursuant to Article VIII of the Statute), are not *safety standards*. Some *safety standards* issued prior to 1997 in the IAEA Safety Series were designated Safety Standards, Codes, Regulations or Rules. Furthermore, some publications issued in the Safety Series were not *safety standards*, notably those designated Safety Practices or Procedures and Data.

ⓘ *Requirements*, regulations, standards, rules, codes of practice or recommendations established to protect people and the environment against *ionizing radiation* and to minimize danger to life and property (see footnote 2).

safety system

See *plant equipment*.

safety system settings

The levels at which protective devices are automatically actuated in the event of *anticipated operational occurrences* or *accident conditions*, to prevent *safety limits* from being exceeded.

safety system support features

See *plant equipment*.

safety task

The sensing of one or more variables indicative of a specific *postulated initiating event*, the signal processing, the initiation and completion of the *safety actions required* to prevent the *limits* specified in the *design basis* from being exceeded, and the initiation and completion of certain services from the *safety system support features*.

scenario

A postulated or assumed set of conditions and/or *events*.

ⓘ Most commonly used in *analysis* or *assessment* to represent possible future conditions and/or *events* to be modelled, such as possible *accidents* at a *nuclear facility*, or the possible future evolution of a *repository* and its surroundings. A *scenario* may represent the conditions at a single point in time or a single *event*, or a time history of conditions and/or *events* (including *processes*).

ⓘ See *event*.

scram

A rapid *emergency* shutdown of a nuclear reactor.

ⓘ See *anticipated transient without scram (ATWS)*.

screening

A type of *analysis* aimed at eliminating from further consideration factors that are less significant for *protection* or *safety* in order to concentrate on the more significant factors. This is typically achieved by consideration of very pessimistic hypothetical *scenarios*.

ⓘ *Screening* is usually conducted at an early stage in order to narrow the range of factors needing detailed consideration in an *analysis* or *assessment*.

screening distance value (SDV)

The distance from a *facility* beyond which, for *screening* purposes, potential origins of a particular type of *external event* can be ignored.

ⓘ The definition in Ref. [41] had '*sources*' instead of 'origins'.

screening probability level (SPL)

A value of the annual probability of occurrence of a particular type of *event* below which, for *screening* purposes, such an *event* can be ignored.

seabed disposal

See *disposal* (3).

sealed source

See *source* (2).

[secondary limit]

See *limit*.

security

See (*nuclear*) *security*.

security culture

[Characteristics and attitudes in organizations and of individuals which establish that *security* issues receive the attention warranted by their significance.] (From Ref. [11].)

security of radioactive sources

[Measures to prevent unauthorized access or damage to, and loss, theft or unauthorized transfer of, *radioactive sources.*] (From Ref. [11].)

! This includes unauthorized access, theft and unauthorized transfer, irrespective of the intent or state of knowledge of the perpetrator.

segregation

See *waste management, radioactive* (1).

seismic qualification

See *equipment qualification*.

self-assessment

See *assessment* (2).

senior management

See *management system review.*

sensitivity analysis

See *analysis.*

serious accident

See *INES.*

serious incident

See *INES.*

service conditions

Actual physical states or influences during the *service life* of a *structure, system or component*, including *operating conditions* (normal and error induced), *design basis event* conditions and conditions following a *design basis event*.

service life

See *life*.

severe accident

See *plant states*.

severe accident management

See *plant states*.

severe deterministic effect

See *health effects (of radiation): severe deterministic effect*.

sheltering

The use of a *structure* for *protection* from an airborne plume and/or deposited radionuclides.

ⓘ An *urgent protective action*, used to provide shielding against *external exposure* and to reduce the *intake* of airborne radionuclides by inhalation.

shipment

The specific movement of a *consignment* from origin to destination. (From Ref. [2].)

short lived waste

See *waste classes*.

shutdown reactivity

See *reactivity.*

sievert (Sv)

The SI unit of *equivalent dose* and *effective dose*, equal to 1 J/kg.

significant transboundary release

A release of *radioactive material* to the environment that may result in *doses* or levels of *contamination* beyond national borders from the release which exceed international *intervention levels* or *action levels* for *protective actions*, including food restrictions and restrictions on commerce.

single failure

A *failure* which results in the loss of capability of a *system* or *component* to perform its intended *safety function(s)*, and any consequential *failure(s)* which result from it.

single failure criterion

A criterion (or requirement) applied to a *system* such that it must be capable of performing its task in the presence of any *single failure.*

ⓘ The ***double contingency principle*** is a principle applied, for example, in the *design* of *processes* for *fuel cycle facilities*, such that the *design* for a *process* must include sufficient *safety* factors that a *criticality accident* would not be possible unless at least two unlikely and independent changes in *process* conditions were to occur concurrently.

site area

See *area*.

site area emergency

See *emergency class.*

site boundary

See *area: site area*.

site characterization

See *characterization* (2).

site confirmation

The final stage of the *siting process* for a *repository*, based on detailed investigations on the preferred site which provide site specific information needed for *safety assessment*. This stage includes the finalization of the *repository design* and the preparation and submission of a *licence* application to the *regulatory body*.

ⓘ *Site confirmation* follows *site characterization*.

site evaluation

Analysis of those factors at a site that could affect the *safety* of a *facility or activity* on that site. This includes *site characterization*, consideration of factors that could affect *safety* features of the *facility* or *activity* so as to result in a release of *radioactive material* and/or could affect the *dispersion* of such material in the environment, as well as population and access issues relevant to *safety* (e.g. feasibility of *evacuation*, location of people and resources).

ⓘ The *analysis* for a site of the origins of *external events* that could give rise to hazards with potential consequences for the *safety* of a nuclear power plant constructed on that site. (The definition in Ref. [41] had '*sources*' instead of 'origins'.)

ⓘ For a nuclear power plant, *site evaluation* typically involves the following stages:

(a) *Site selection* stage. One or more preferred candidate sites are selected after the investigation of a large region, the rejection of unsuitable sites, and *screening* and comparison of the remaining sites.

(b) *Site characterization* stage. This stage is further subdivided into:
- *Site verification*, in which the suitability of the site to host a nuclear power plant is verified mainly according to predefined site *exclusion* criteria;
- *Site confirmation*, in which the characteristics of the site necessary for the purposes of *analysis* and detailed *design* are determined.

(c) Pre-operational stage. Studies and investigations begun in the previous stages are continued after the start of *construction* and before the start of *operation* of the plant, to complete and refine the *assessment* of site

characteristics. The site data obtained allow a final *assessment* of the simulation *models* used in the final *design*.

(d) Operational stage. Appropriate *safety* related *site evaluation activities* are carried out throughout the lifetime of the *facility*, mainly by means of *monitoring* and *periodic safety review*.

site personnel

All persons working in the *site area* of an *authorized facility*, either permanently or temporarily.

site selection

See *site evaluation*.

siting[7]

The *process* of selecting a suitable site for a *facility*, including appropriate *assessment* and definition of the related *design bases*.

ⓘ The *siting process* for a *nuclear installation* generally consists of site *survey* and *site selection*. Site *survey* is the *process* of identifying candidate sites for a *nuclear installation* after the investigation of a large region and the rejection of unsuitable sites. *Site selection* is the *process* of assessing the remaining sites by *screening* and comparing them on the basis of *safety* and other considerations to select one or more preferred candidate sites. See also *site evaluation*.

ⓘ The *siting process* for a *repository* is particularly crucial to its long term *safety*; it may therefore be a particularly extensive *process*, and is divided into the following stages:

— Concept and planning;
— *Area survey*;
— *Site characterization*;
— *Site confirmation*.

SL-1, SL-2

Levels of ground motion (representing the potential effects of earthquakes) considered in the *design basis* for a *facility*.

ⓘ *SL-1* corresponds to a less severe, more likely earthquake than *SL-2*. In some States, *SL-1* corresponds to a level with a probability of 10^{-2} per year of being exceeded, and *SL-2* corresponds to a level with a probability of 10^{-4} per year of being exceeded.

small freight container

See *freight container*.

somatic effect

See *health effects (of radiation)*.

sorption

The interaction of an atom, molecule or particle with the solid surface at a solid–solution or a solid–gas interface.

- ⓘ Used in the context of radionuclide *migration* to describe the interaction of radionuclides in pore- or groundwater with soil or host rock, and of radionuclides in surface water bodies with suspended and bed sediments.
- ⓘ A general term which includes ***absorption*** (interactions taking place largely within the pores of solids) and ***adsorption*** (interactions taking place on solid surfaces). The *processes* involved can also be divided into ***chemisorption*** (chemical bonding with the substrate) and ***physisorption*** (physical attraction, e.g. by weak electrostatic forces).
- ⓘ In practice, *sorption* may sometimes be difficult to distinguish from other factors affecting *migration*, such as filtration or *dispersion*.

source

1. Anything that may cause *radiation exposure* — such as by emitting *ionizing radiation* or by releasing *radioactive substances* or *material* — and can be treated as a single entity for *protection and safety* purposes.

- ⓘ For example, materials emitting *radon* are *sources* in the environment, a sterilization gamma irradiation unit is a *source* for the *practice* of *radiation* preservation of food, an X ray unit may be a *source* for the *practice* of radiodiagnosis; a nuclear power plant is part of the *practice* of generating electricity by nuclear fission, and may be regarded as a *source* (e.g. with respect to *discharges* to the environment) or as a collection of *sources* (e.g. for occupational *radiation protection* purposes). A complex or multiple installation situated at one location or site may, as appropriate, be considered a single *source* for the purposes of application of international *safety standards*.

natural source. A naturally occurring *source* of *radiation*, such as the sun and stars (*sources* of cosmic *radiation*) and rocks and soil (terrestrial *sources* of *radiation*).

ⓘ Examples of *natural sources* include *naturally occurring radioactive material (NORM)* associated with the processing of raw materials (i.e. feedstocks, intermediate products, final products, co-products and *waste*).

[***radiation source.*** A *radiation* generator, or a *radioactive source* or other *radioactive material* outside the *nuclear fuel cycles* of research and power reactors.] (Defined in the 2001 edition of the Code of Conduct on the Safety and Security of Radioactive Sources, but not included in the 2004 edition (see Ref. [11]).)

2. *Radioactive material* used as a *source* of *radiation*.

ⓘ Such as those sources used for medical applications or in industrial instruments. These are, of course, *sources* as defined in (1), but this usage is less general.

dangerous source. A *source* that could, if not under *control*, give rise to *exposure* sufficient to cause *severe deterministic effects.* This categorization is used for determining the need for *emergency response arrangements* and is not to be confused with categorizations of *sources* for other purposes.

disused source. A *radioactive source* that is no longer used, and is not intended to be used, for the *practice* for which an *authorization* has been granted. (From Ref. [11].)

ⓘ The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5] refers to "disused *sealed sources*", but does not define them. On the basis of this definition of *disused source* and the definition of *sealed source* (see below), a disused *sealed source* is a *radioactive source* comprising *radioactive material* that is permanently sealed in a capsule or closely bonded and in a solid form (excluding reactor *fuel elements*) that is no longer used, and is not intended to be used, for the *practice* for which an *authorization* has been granted.

! Note that a *disused source* may still represent a significant radiological hazard. It differs from a *spent source* in that it may still be capable of performing its function; it may be disused because it is no longer needed.

orphan source. A *radioactive source* which is not under *regulatory control*, either because it has never been under *regulatory control* or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper *authorization*. (From Ref. [11].)

radioactive source. [*Radioactive material* that is permanently sealed in a capsule or closely bonded and in a solid form and which is not exempt from *regulatory control*. This also includes any *radioactive material* released if the *radioactive source* is leaking or broken, but does not include material encapsulated for *disposal*, or *nuclear material* within the *nuclear fuel cycles* of research and power reactors.] (From Ref. [11].)

ⓘ This definition is particular to the Code of Conduct on the Safety and Security of Radioactive Sources [11].

sealed source. *Radioactive material* that is (a) permanently sealed in a capsule or (b) closely bonded and in a solid form.

ⓘ The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management definition [5] is identical, except that the words "excluding reactor *fuel elements*" are added. The BSS definition [1] is as above[11], but continues: "The capsule or material of a *sealed source* shall be strong enough to maintain leaktightness under the conditions of use and wear for which the *source* was designed, also under foreseeable mishaps."

ⓘ The term *special form radioactive material*, used in the context of *transport* of *radioactive material*, has essentially the same meaning.

ⓘ Disused *sealed source*: see *Source: disused source.*

spent source. A *source* that is no longer suitable for its intended purpose as a result of *radioactive* decay.

! Note that a *spent source* may still represent a radiological hazard.

unsealed source. A *source* that does not meet the definition of a *sealed source*.

vulnerable source. A *radioactive source* for which the *control* is inadequate to provide assurance of long term *safety* and *security*, such that it could relatively easily be acquired by unauthorized persons.

source material

Uranium containing the mixture of isotopes occurring in nature; uranium depleted in the isotope 235; thorium; any of the foregoing in the form of metal, alloy, chemical compound, or concentrate; any other material containing one or

[11] The definition in the BSS [1] included the word 'bounded' instead of 'bonded'. This appears to have been an error, not an intended change in meaning.

more of the foregoing in such concentration as the [IAEA] Board of Governors shall from time to time determine; and such other material as the [IAEA] Board of Governors shall from time to time determine. (From Ref. [31].)

source monitoring

See *monitoring* (1).

source region

A region within the body containing one or more radionuclides responsible for irradiating a *target tissue*.

ⓘ Used in internal dosimetry.

source term

The amount and isotopic composition of material released (or postulated to be released) from a *facility*.

ⓘ Used in modelling releases of radionuclides to the environment, particularly in the context of *accidents* at *nuclear installations* or releases from *radioactive waste* in *repositories*.

special arrangement

Those provisions, approved by the *competent authority*, under which *consignments* which do not satisfy all the applicable *requirements* of [the Transport] Regulations may be transported. (From Ref. [2].)

special facility

A facility for which predetermined facility specific actions need to be taken if *urgent protective actions* are ordered in its locality in the event of a *nuclear or radiological emergency*. Examples include chemical plants that cannot be evacuated until certain actions have been taken to prevent fire or explosions, and telecommunications centres that must be staffed in order to maintain telephone services.

ⓘ This is not necessarily a *facility* within the meaning of the term *facilities and activities*.

special fissionable material

See *nuclear material*.

special form radioactive material

Either an indispersible solid *radioactive material* or a sealed capsule containing *radioactive material*. (From Ref. [2].)

special monitoring

See *monitoring* (1).

special population groups

Members of the public for whom *special arrangements* are necessary in order for effective *protective actions* to be taken in the event of a *nuclear or radiological emergency*. Examples include disabled persons, hospital patients and prisoners.

specific activity

See *activity* (1).

spent fuel

1. *Nuclear fuel* removed from a reactor following irradiation that is no longer usable in its present form because of depletion of *fissile material*, *poison* buildup or *radiation* damage.

2. [*Nuclear fuel* that has been irradiated in and permanently removed from a reactor core.] (From Ref. [5].)

ⓘ The adjective 'spent' suggests that *spent fuel* cannot be used as *fuel* in its present form (e.g. as in *spent source*). In practice, however (as in (2) above), *spent fuel* is commonly used to refer to *fuel* which has been used as *fuel* but will no longer be used, whether or not it could be used (and which might more accurately be termed 'disused *fuel*').

spent fuel management

All *activities* that relate to the handling or *storage* of *spent fuel*, excluding *off-site transport*. It may also involve *discharges*. (From Ref. [5].)

spent fuel management facility

Any *facility* or installation the primary purpose of which is *spent fuel management*. (From Ref. [5].)

spent source

See *source* (2).

[stakeholder]

Interested party; concerned party.

ⓘ A person, company, etc., with a concern or (especially financial) interest in ensuring the success of an organization, business, system, etc.

! The term s*takeholder* has disputed usages and is misleading and too all-encompassing for clear use. In view of the potential for misunderstanding, use of the term is discouraged in favour of 'interested parties' or 'concerned parties', for example. Interested parties would need to be specified as relevant.

ⓘ *Stakeholder* means an interested party — whether a person or a company, etc. — with an interest or concern in ensuring the success of an organization, business, system, etc. To 'have a stake in' something, figuratively, means to have something to gain or lose by, or to have an interest in, the turn of events. The term s*takeholder* is used in a broad sense to mean a person or group having an interest in the performance of an organization. Those who can influence *events* may effectively become interested parties — whether their 'interest' is regarded as 'genuine' or not — in the sense that their views need to be considered. Interested parties have typically included the following: customers, owners, *operators*, employees, *suppliers*, partners, trade unions; the regulated industry or professionals; scientific bodies; governmental agencies or regulators (local, regional and national) whose responsibilities may cover nuclear energy; the media; the public (individuals, community groups and interest groups); and other States, especially neighbouring States that have entered into agreements providing for an exchange of information concerning possible transboundary impacts, or States involved in the export or import of certain technologies or materials.

ⓘ The Handbook on Nuclear Law [42] states that: "Owing to the differing views on who has a genuine interest in a particular nuclear related activity, no authoritative definition of *stakeholder* has yet been offered, and no definition is likely to be accepted by all parties. However, *stakeholders* have typically

included the following: the regulated industry or professionals; scientific bodies; governmental agencies (local, regional and national) whose responsibilities arguably cover nuclear energy; the media; the public (individuals, community groups and interest groups); and other States (especially neighbouring States that have entered into agreements providing for an exchange of information concerning possible transboundary impacts, or States involved in the export or import of certain technologies or material)."

State of destination

A State to which a *transboundary movement* is planned or takes place. (From Ref. [5].)

State of origin

A State from which a *transboundary movement* is planned to be initiated or is initiated. (From Ref. [5].)

State of transit

Any State, other than a *State of origin* or a *State of destination*, through whose territory a *transboundary movement* is planned or takes place. (From Ref. [5].)

stochastic analysis

See *probabilistic analysis.*

stochastic effect

See *health effects (of radiation)*.

storage

The holding of *radioactive sources*, *spent fuel* or *radioactive waste* in a *facility* that provides for their/its *containment*, with the intention of retrieval.

ⓘ Generalized from the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5], the Code of Conduct on the Safety and Security of Radioactive Sources [11] and Ref. [43].

! *Storage* is by definition an interim measure, and the term ***interim storage*** would therefore be appropriate only to refer to short term temporary *storage*

when contrasting this with the longer term fate of the *waste*. *Storage* as defined above should not be described as *interim storage*.

- ⓘ In many cases, the only element of this definition that is important is the distinction between *disposal* (with no intent to retrieve) and *storage* (with intent to retrieve). In such cases, a definition is not necessary; the distinction can be made in the form of a footnote at the first use of the term *disposal* or *storage* (e.g. "The use of the term *disposal* indicates that there is no intention to retrieve the *waste*. If retrieval of the *waste* at any time in the future is intended, the term *storage* is used.").
- ⓘ For *storage* in a combined *storage* and *disposal facility*, for which a decision may be made at the time of its *closure* whether to remove the *waste* stored during the *operation* of the *storage facility* or to dispose of it by encasing it in concrete, the question of intention of retrieval may be left open until the time of *closure* of the *facility*.
- ⓘ Contrasted with *disposal*.

dry storage. *Storage* in a gaseous environment, such as air or an inert gas.

- ⓘ *Dry storage facilities* include *facilities* for the *storage* of *spent fuel* in casks, silos or vaults.

wet storage. *Storage* in water or in another liquid.

- ⓘ The universal mode of *wet storage* consists in storing *spent fuel* assemblies or *spent fuel elements* in pools of water or other liquids, usually supported on racks or in baskets and/or in *canisters* that also contain liquid. The liquid in the pool surrounding the *fuel* provides for heat dissipation and *radiation* shielding, and the racks or other devices ensure a geometrical configuration that maintains subcriticality.

strongly penetrating radiation

See *radiation*.

structure

See, *structures, systems and components.*

structures, systems and components (SSCs)

A general term encompassing all of the elements (items) of a *facility* or *activity* which contribute to *protection and safety*, except *human factors.*

- ⓘ ***Structures*** are the passive elements: buildings, vessels, shielding, etc. A ***system*** comprises several *components*, assembled in such a way as to perform a specific (active) function. A ***component*** is a discrete element of a *system*.

Examples of components are wires, transistors, integrated circuits, motors, relays, solenoids, pipes, fittings, pumps, tanks and valves.

ⓘ See also *core components.*

sub-seabed disposal

See *disposal* (1).

supervised area

See *area*.

supplier

Any *legal person* to whom a *registrant* or *licensee* delegates duties, totally or partially, in relation to the *design*, manufacture, production or *construction* of a *source*. (An importer of a *source* is considered a *supplier* of the *source*.) (From Ref. [1].)

[surface contaminated object (SCO)]

! This usage is specific to the Transport Regulations, and should otherwise be avoided.

A solid object which is not itself *radioactive* but which has *radioactive material* distributed on its surfaces. *SCOs* shall be in one of two groups:

(a) ***SCO-I.*** A solid object on which:

(i) The *non-fixed contamination* on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 Bq/cm^2 for beta and gamma emitters and *low toxicity alpha emitters*, or 0.4 Bq/cm^2 for all other alpha emitters; and

(ii) The *fixed contamination* on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and gamma emitters and *low toxicity alpha emitters*, or 4×10^3 Bq/cm^2 for all other alpha emitters; and

(iii) The *non-fixed contamination* plus the *fixed contamination* on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and

gamma emitters and *low toxicity alpha emitters*, or 4×10^3 Bq/cm^2 for all other alpha emitters.

(b) ***SCO-II.*** A solid object on which either the *fixed* or *non-fixed contamination* on the surface exceeds the applicable *limits* specified for *SCO-I* in (a) above and on which:

(i) The *non-fixed contamination* on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 for beta and gamma emitters and *low toxicity alpha emitters*, or 40 Bq/cm^2 for all other alpha emitters; and
(ii) The *fixed contamination* on the accessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8×10^5 Bq/cm^2 for beta and gamma emitters and *low toxicity alpha emitters*, or 8×10^4 Bq/cm^2 for all other alpha emitters; and
(iii) The *non-fixed contamination* plus the *fixed contamination* on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8×10^5 Bq/cm^2 for beta and gamma emitters and *low toxicity alpha emitters*, or 8×10^4 Bq/cm^2 for all other alpha emitters. (From Ref. [2].)

surveillance testing

Periodic testing to verify that *structures, systems and components* continue to function or are capable of performing their functions when called upon to do so.

survey

area survey. An early stage of the *siting process* for a *repository*, during which a broad region is examined to eliminate unsuitable areas and to identify other areas which may contain suitable sites.

ⓘ *Area survey* is followed by *site characterization*.
ⓘ *Area survey* may also refer to the *siting process* for any other *authorized facility*. See also *site evaluation*, which includes *site characterization* and is not specific to a *repository* site.

habit survey. An evaluation of those aspects of the behaviour of *members of the public* that might influence their *exposure* — such as food *intake* rates or occupancy of different areas — usually aimed at characterizing *critical groups*.

radiological survey. An evaluation of the radiological conditions and potential hazards associated with the production, use, transfer, release, *disposal* or presence of *radioactive material* or other *sources* of *radiation*.

synergy

Combined, correlated or syzygistic action of a group of units or faculties that exceeds the sum of the individual effects; increased effectiveness, achievement, etc., produced as a result of combined action or cooperation.

ⓘ The term 'synergism' is also used. The antonym of 'synergic' (synergetic, synergistic) would be 'antergic' (antergetic, antergistic), meaning antagonistic, e.g. of an action in opposition to the action of another part.

ⓘ 'Syzygy' means a pair of connected or correlated things, such as *safety* and *security.*

system

See *structures, systems and components.*

system code

A computer *model* that is capable of simulating the transient performance of a complex system such as a nuclear power plant.

ⓘ A *system code* typically includes equations for thermohydraulics, neutronics and heat transfer, and must include special *models* for simulating the performance of *components* such as pumps and separators. The *system code* typically also simulates the *control logic* implemented in the plant and is able to predict the evolution of *accidents.*

system code validation

See *validation* (1).

system code verification

See *verification* (1).

System of Radiological Protection

The systems of *protection* for *practices* and for *intervention* recommended by the International Commission on Radiological Protection.

- *System of Radiological Protection* usually refers to both systems together (or, for historical reasons, to the *system* for *practices* only); individually they should be referred to as the 'system of *protection* for *practices*' and the 'system of *protection* for *intervention*'.
- See Ref. [16].

T

tailings

The residues resulting from the processing of ore to extract *uranium series* or *thorium series* radionuclides, or similar residues from processing ores for other purposes.

tank

A *tank* container, a portable *tank*, a road *tank vehicle*, a rail *tank* wagon or a receptacle with a capacity of not less than 450 L for containing liquids, powders, granules, slurries or solids which are loaded as gas or liquid and subsequently solidified, and of not less than 1000 L for containing gases. A *tank* container shall be capable of being carried on land or on sea and of being loaded and discharged without the need of removal of its structural equipment, shall possess stabilizing members and tie-down attachments external to the shell, and shall be capable of being lifted when full. (From Ref. [2].)

! This usage is specific to the Transport Regulations [2], and should otherwise be avoided.

target tissue/organ

The tissue or organ to which *radiation* is directed.

ⓘ Used in internal dosimetry, normally in relation to a *source region*.

task related monitoring

See *monitoring* (1).

technological obsolescence

See *ageing: non-physical ageing*.

temporary relocation

See *relocation*.

terrorism

ⓘ The use of organized intimidation; a policy intended to strike with terror those against whom it is adopted; the employment of methods of intimidation; the fact of terrorizing or condition of being terrorized.

ⓘ The United Nations High-level Panel on Threats, Challenges and Change (Ref. [44], p. 183) has stated the following:

"164. That definition of *terrorism* should include the following elements: (a) recognition, in the preamble, that State use of force against civilians is regulated by the Geneva Conventions and other instruments, and, if of sufficient scale, constitutes a war crime by the persons concerned or a crime against humanity; (b) restatement that acts under the 12 preceding anti-terrorism conventions are *terrorism*, and a declaration that they are a crime under international law; and restatement that *terrorism* in time of armed conflict is prohibited by the Geneva Conventions and Protocols; (c) reference to the definitions contained in the 1999 International Convention for the Suppression of the Financing of Terrorism and Security Council resolution 1566 (2004); (d) description of *terrorism* as "any action, in addition to actions already specified by the existing conventions on aspects of *terrorism*, the Geneva Conventions and Security Council resolution 1566 (2004), that is intended to cause death or serious bodily harm to civilians or non-combatants, when the purpose of such act, by its nature or context, is to intimidate a population, or to compel a Government or an international organization to do or to abstain from doing any act".
See http://www.un.org/secureworld/report2.pdf

[***nuclear terrorism.*** *Terrorism* involving *nuclear material*.] (See *nuclear*.)

[*nuclear terrorist*]

ⓘ Avoid these and similar journalese terms such as *nuclear sabotage* or *nuclear trafficking* in publications.

[***radiological terrorism.*** *Terrorism* involving *radioactive material*.]

[*radiological terrorist*]

ⓘ Avoid these and similar journalese terms such as *radiological sabotage* or radiological trafficking in publications.

[*terrorist*]

ⓘ Anyone who attempts to further his or her views by a system of coercive intimidation; a person who uses or favours violent and intimidating methods of coercing a government or community.
ⓘ The term now usually refers to a member of a clandestine or expatriate organization aiming to coerce an established government by acts of violence against it or its subjects.

terrorist

See *terrorism*.

therapeutic exposure

See *exposure, types of: medical exposure.*

thorium series

The decay chain of thorium-232.

ⓘ Namely, thorium-232, radium-228, actinium-228, thorium-228, radium-224, radon-220, polonium-216, lead-212, bismuth-212, polonium-212 (64%), thallium-208 (36%) and (stable) lead-208.

thoron

Radon-220.

thoron progeny

The (short lived) *radioactive* decay products of *thoron*.

ⓘ Namely, polonium-216 (sometimes called thorium A), lead-212 (thorium B), bismuth-212 (thorium C), polonium-212 (thorium C′, 64%) and thallium-208 (thorium C″, 36%). The stable decay product lead-208 is sometimes known as thorium D.

threat assessment

See *assessment* (1).

time based maintenance

See *maintenance: periodic maintenance.*

tissue equivalent material

Material designed to have, when irradiated, interaction properties similar to those of soft tissue.

ⓘ Used to make phantoms, such as the *ICRU sphere*.

ⓘ The *tissue equivalent material* used in the *ICRU sphere* has a density of 1 g/cm^3 and an elemental composition, by mass, of 76.2% oxygen, 11.1% carbon, 10.1% hydrogen and 2.6% nitrogen, but materials of various other compositions (e.g. water) are considered suitable for particular applications [17].
ⓘ The term ***tissue substitute*** is also used with the same meaning.

tissue substitute

See *tissue equivalent material*.

tissue weighting factor, w_T

Multiplier of the *equivalent dose* to an organ or tissue used for *radiation protection* purposes to account for the different sensitivities of different organs and tissues to the induction of *stochastic effects* of *radiation*. (From Ref. [1].)

ⓘ The *tissue weighting factors* recommended by the International Commission on Radiological Protection for calculating *effective dose* are:

Tissue or organ	w_T
Gonads	0.20
Bone marrow (red)	0.12
Colon[a]	0.12
Lung	0.12
Stomach	0.12
Bladder	0.05
Breast	0.05
Liver	0.05
Oesophagus	0.05
Thyroid	0.05
Skin	0.01
Bone surface	0.01
Remainder[b]	0.05

[a] The weighting factor for the colon is applied to the mass average of the *equivalent dose* in the walls of the upper and lower large intestine.

[b] For the purposes of calculation, the remainder is composed of adrenal glands, brain, extrathoracic region, small intestine, kidney, muscle, pancreas, spleen, thymus and uterus. In those exceptional cases in which the most exposed remainder tissue receives the highest *committed equivalent dose* of all organs, a weighting factor of 0.025 shall be applied to that tissue or organ and a weighting factor of 0.025 to the average *dose* in the rest of the remainder as defined here.

trafficking

See *illicit trafficking*.

trafficking, nuclear

See *illicit trafficking*.

transboundary exposure

Exposure of *members of the public* in one State due to *radioactive material* released via *accidents*, *discharges* or *waste disposal* in another State.

transboundary movement

1. Any movement of *radioactive material* from one State to or through another.

2. [Any *shipment* of *spent fuel* or of *radioactive waste* from a *State of origin* to a *State of destination*.] (From Ref. [5].)

transient population groups

Those *members of the public* who are residing for a short period of time (days to weeks) in a location (such as a camping ground) that can be identified in advance. This does not include *members of the public* who may be travelling through an area.

transitory exposure

See *exposure situations: chronic exposure*.

transnational emergency

See *emergency*.

transport

1. The deliberate physical movement of *radioactive material* (other than that forming part of the means of propulsion) from one place to another.

ⓘ The term ***transportation*** is also used, particularly in US English or where there is a need to distinguish this meaning of *transport* from meaning (2).

international nuclear transport. [The carriage of a *consignment* of *nuclear material* by any means of *transportation* intended to go beyond the territory of the State where the *shipment* originates, beginning with the departure from a *facility* of the shipper in that State and ending with the arrival at a *facility* of the receiver within the State of ultimate destination.]. (From Ref. [30].)

ⓘ More recent texts use the term *transboundary movement* for a similar concept.

2. The movement of something as a result of being carried by a medium.

ⓘ A general term used when a number of different *processes* are involved. The most common examples are heat *transport* — a combination of *advection*, convection, etc., in a cooling medium — and radionuclide *transport* in the environment — which could include *processes* such as *advection*, *diffusion*, *sorption* and *uptake.*

transport index (TI)

A number assigned to a *package*, *overpack* or *freight container*, or to unpackaged *LSA-I* or *SCO-I*, which is used to provide *control* over *radiation exposure.* (From Ref. [2].)

ⓘ The value of the *transport index* for a *package* or *overpack* is used (with the surface *dose rate*) in determining the category (I-WHITE, II-YELLOW or III-YELLOW) to which the *package* or *overpack* belongs, and hence which *requirements* are applicable to its *transport*. A *package* or *overpack* with a *transport index* greater than 10 can be transported only under *exclusive use.*

ⓘ The *procedure* for calculating a *transport index* is given in paras 526 and 527 of the 2005 edition of the Transport Regulations [2]. In essence, the *transport index* is the maximum *dose rate* 1 m from the outer surface of the load, expressed in mrem/h (or the value in mSv/h multiplied by 100), and in specified cases multiplied by a factor between 1 (for small sized loads) and 10 (for large sized loads). (See Ref. [2].)

transportation

See *transport* (1).

treatment

See *waste management, radioactive* (1).

Type A/B(U)/B(M)/C package

See *package.*

types of exposure

See *exposure, types of.*

U

ultimate heat sink

A medium into which the transferred *residual heat* can always be accepted, even if all other means of removing the heat have been lost or are insufficient.

ⓘ This medium is normally a body of water or the atmosphere.

ultimate heat transport system

The *systems* and *components* needed to transfer *residual heat* to the *ultimate heat sink* after shutdown.

unattached fraction

The fraction of *potential alpha energy* of *radon progeny* that arises from atoms that are not attached to ambient aerosol particles.

uncertainty analysis

See *analysis*.

unilateral approval

See *approval*.

unirradiated fuel

See *nuclear fuel*.

unirradiated thorium

Thorium containing not more than 10^{-7} g of uranium-233 per gram of thorium-232. (From Ref. [2].)

ⓘ Although the term *unirradiated thorium* is used, the issue is not really whether the thorium has been irradiated, but rather whether the content of uranium-233 (a *fissile material*) is significantly higher than the trace levels found in naturally occurring thorium.

unirradiated uranium

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

ⓘ Although the term *unirradiated uranium* is used, the issue is not really whether the uranium has been irradiated, but rather whether the content of plutonium (a *fissile material*) is significantly higher than the trace levels found in naturally occurring uranium.

unrestricted linear energy transfer, *L*

See *linear energy transfer (LET)*.

unrestricted use

See *use.*

unsealed source

See *source* (2).

uptake

1. A general term for the *processes* by which radionuclides enter one part of a biological system from another.

ⓘ Used for a range of situations, particularly for describing the overall effect when there are a number of contributing *processes*; e.g. ***root uptake***, the transfer of radionuclides from soil to plants through the plant roots.

2. The *processes* by which radionuclides enter the body fluids from the respiratory tract, gastrointestinal tract or through the skin, or the fraction of an *intake* that enters the body fluids by these *processes.*

uranium

depleted uranium. Uranium containing a lesser mass percentage of uranium-235 than in *natural uranium*. (From Ref. [2].)

enriched uranium. Uranium containing a greater mass percentage of uranium-235 than 0.72%. (From Ref. [2].)

high enriched uranium (HEU). Uranium containing 20% or more of the isotope ^{235}U. *HEU* is considered a *special fissionable material* and a direct use material. (From Ref. [32].)

low enriched uranium (LEU). *Enriched uranium* containing less than 20% of the isotope ^{235}U. *LEU* is considered a *special fissionable material* and an indirect use material. (From Ref. [32].)

natural uranium. Uranium (which may be chemically separated) containing the naturally occurring distribution of uranium isotopes (approximately 99.28% uranium-238 and 0.72% uranium-235 by mass). (From Ref. [2].)

ⓘ In all cases, a very small mass percentage of uranium-234 is present.

ⓘ The naturally occurring distribution of uranium isotopes including uranium-234 (approximately 99.285% uranium-238, 0.710% uranium-235 and 0.005% uranium-234 by mass) corresponds to approximately 48.9% uranium-234, 2.2% uranium-235 and 48.9% uranium-238 by *activity.*

uranium enriched in the isotope uranium-235 or uranium-233

Uranium containing the isotope uranium-235 or uranium-233 or both in an amount such that the abundance ratio of the sum of these isotopes to the isotope uranium-238 is greater than the ratio of the isotope uranium-235 to the isotope uranium-238 occurring in nature [30, 31].

uranium series

The decay chain of uranium-238.

ⓘ Namely, uranium-238, thorium-234, protactinium-234, uranium-234, thorium-230, radium-226, radon-222, polonium-218, lead-214, bismuth-214 and polonium-214, lead-210, bismuth-210, polonium-210 and (stable) lead-206, plus traces of astatine-218, thallium-210, lead-209, mercury-206 and thallium-206.

urgent protective action

See *protective action* (1).

urgent protective action planning zone (UPZ)

See *emergency zones.*

use

authorized use. Use of *radioactive material* or *radioactive* objects from an authorized *practice* in accordance with an *authorization*.

ⓘ Intended primarily for contrast with *clearance*, in that *clearance* implies no further *regulatory control* over the use, whereas the *authorization* for *authorized use* may prescribe or prohibit specific uses.

ⓘ A form of *restricted use.*

restricted use. The use of an area or of materials subject to restrictions imposed for reasons of *radiation protection and safety.*

ⓘ Restrictions would typically be expressed in the form of prohibition of particular *activities* (e.g. house building, growing or harvesting particular foods) or prescription of particular *procedures* (e.g. materials may only be recycled or reused within a *facility*).

unrestricted use. The use of an area or of material without any radiologically based restrictions.

! There may be other restrictions on the use of the area or material, such as planning restrictions on the use of an area of land or restrictions related to the chemical properties of a material. In some situations, these restrictions could, in addition to their primary intended effect, have an incidental effect on *radiation exposure*, but the use is classified as *unrestricted use* unless the primary reason for the restrictions is radiological.

ⓘ *Unrestricted use* is contrasted with *restricted use.*

V

validation

1. The *process* of determining whether a product or service is adequate to perform its intended function satisfactorily.

ⓘ *Validation* is broader in scope, and may involve a greater element of judgement, than *verification*.

computer system validation. The *process* of testing and evaluating the integrated computer *system* (hardware and software) to ensure compliance with the functional, performance and interface requirements.

model validation. The *process* of determining whether a *model* is an adequate representation of the real *system* being modelled, by comparing the predictions of the *model* with observations of the real *system*.

ⓘ Normally contrasted with *model verification*, although *verification* will often be a part of the broader *process* of *validation*.

ⓘ There is some controversy about the extent to which *model validation* can be achieved, particularly in relation to modelling the long term *migration* of radionuclides from *radioactive waste* in *repositories.*

system code validation. *Assessment* of the accuracy of values predicted by the *system code* against relevant experimental data for the important phenomena expected to occur.

2. Confirmation by means of objective evidence that the requirements for a specific intended purpose and use or application have been fulfilled. See *verification*.

ⓘ The corresponding status is termed ‘validated’.

ⓘ The conditions of use for *validation* purposes may be real or simulated.

vehicle

A road *vehicle* (including an articulated *vehicle*, i.e. a tractor and semi-trailer combination) or railroad car or railway wagon. Each trailer shall be considered a separate *vehicle.* (From Ref. [2].)

! This usage is specific to the Transport Regulations [2], and should otherwise be avoided.

vendor

A *design*, contracting or manufacturing organization supplying a service, *component* or *facility.*

verification

1. The *process* of determining whether the quality or performance of a product or service is as stated, as intended or as required.

ⓘ *Verification* is closely related to *quality assurance* and *quality control.*

computer system verification. The *process* of ensuring that a phase in the *system* life cycle meets the requirements imposed on it by the previous phase.

model verification. The *process* of determining whether a *computational model* correctly implements the intended *conceptual model* or *mathematical model*.

system code verification. Review of source coding in relation to its description in the *system code* documentation.

2. Confirmation by means of objective evidence that specified requirements have been fulfilled. See *validation.*

ⓘ The corresponding status is termed 'verified'.

ⓘ *Verification* may comprise *activities* such as: performing alternative calculations; comparing a new *design* specification with a similar proven *design* specification; undertaking tests and demonstrations; and reviewing documents prior to issue.

[very low level waste (VLLW)]

See *waste classes.*

vessel

Any seagoing *vessel* or inland waterway craft used for carrying cargo. (From Ref. [2].)

! This restricted use of the term *vessel* in relation to the *transport* of *radioactive material* does not apply in other areas of *safety*, e.g. a reactor pressure vessel is a vessel as normally understood.

volume reduction

See *waste management, radioactive* (1).

vulnerable source

See *source* (2).

W

warning point

A contact point that is staffed or able to be alerted at all times for promptly responding to, or initiating a response to, an incoming *notification* (definition (2)), warning message, request for assistance or request for *verification* of a message, as appropriate, from the IAEA.

waste

Material for which no further use is foreseen.

exempt waste. *Waste* that is released from *regulatory control* in accordance with *exemption* principles.

[***mining and milling waste (MMW).*** *Waste* from *mining and milling.*]

ⓘ This includes *tailings* from processing, residues from heap leaching, waste rock, sludges, filter cakes, scales and various effluents.

! See also [*mining and milling*].

mixed waste. *Radioactive waste* that also contains non-radioactive toxic or hazardous substances.

NORM waste. *Naturally occurring radioactive material* for which no further use is foreseen.

radioactive waste. See *waste, radioactive.*

waste, radioactive

1. For legal and regulatory purposes, *waste* that contains, or is contaminated with, radionuclides at concentrations or *activities* greater than *clearance levels* as established by the *regulatory body.*

! It should be recognized that this definition is purely for regulatory purposes, and that material with *activity concentrations* equal to or less than *clearance levels* is *radioactive* from a physical viewpoint, although the associated radiological hazards are considered negligible.

ⓘ *Waste* should be used in the singular unless reference is expressly being made to the presence of various types of *waste.*

2. [*Radioactive material* in gaseous, liquid or solid form for which no further use is foreseen by the Contracting Party or by a natural or *legal person* whose decision is accepted by the Contracting Party, and which is controlled as *radioactive waste* by a *regulatory body* under the legislative and regulatory framework of the Contracting Party.] (From Ref. [5].)

3. Material, whatever its physical form, remaining from *practices* or *interventions* and for which no further use is foreseen (i) that contains or is contaminated with *radioactive* substances and has an *activity* or *activity concentration* higher than the level for *clearance* from regulatory *requirements*, and (ii) *exposure* to which is not *excluded* from the [Basic Safety] Standards. (From Ref. [1].)

waste acceptance requirements

Quantitative or qualitative criteria specified by the *regulatory body*, or specified by an *operator* and *approved* by the *regulatory body*, for *radioactive waste* to be accepted by the *operator* of a *repository* for *disposal*, or by the *operator* of a *storage facility* for *storage*.

ⓘ *Waste acceptance requirements* might include, for example, restrictions on the *activity concentration* or total *activity* of particular radionuclides (or types of radionuclide) in the *waste*, or *requirements* concerning the *waste form* or *packaging* of the *waste*.

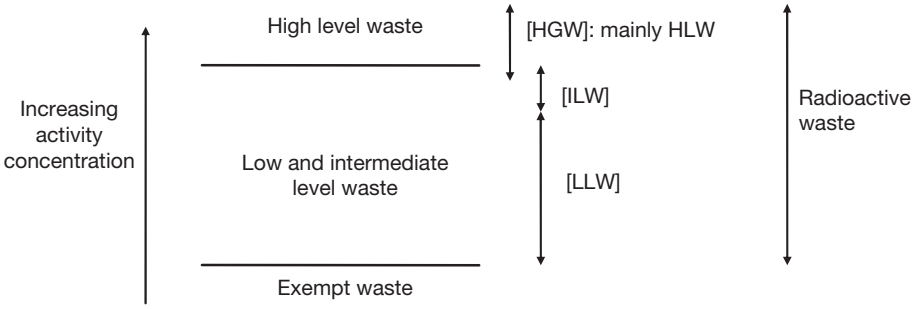
waste canister

See *container, waste*.

waste characterization

See *characterization* (2).

waste classes



ⓘ Classes not in square brackets are those recommended in Ref. [45]. This classification system is organized to take into account matters considered of prime importance for *disposal safety*. A number of issues related to *waste* classification are currently under review.

ⓘ The other classes listed below (in square brackets) are sometimes used, e.g. in national classification systems, and are mentioned here to indicate how they typically relate to the classes in Ref. [45].

ⓘ Other systems classify *waste* on other bases, such as according to its origin (e.g. reactor *operations waste*, *reprocessing waste*, *decommissioning waste* and defence *waste*).

exempt waste. See *waste*.

[*heat generating waste (HGW)*]. *Radioactive waste* that is sufficiently *radioactive* that the decay heat significantly increases its temperature and the temperature of its surroundings.

ⓘ In practice, *heat generating waste* is normally *high level waste*, although some types of *intermediate level waste* may qualify as *heat generating waste*.

high level waste (HLW). The *radioactive* liquid containing most of the *fission products* and actinides present in *spent fuel* — which forms the residue from the first solvent extraction cycle in *reprocessing* — and some of the associated *waste* streams; this material following solidification; *spent fuel* (if it is declared a *waste*); or any other *waste* with similar radiological characteristics.

ⓘ Typical characteristics of *high level waste* are thermal power above about 2 kW/m^3 and long lived radionuclide concentrations exceeding the limitations for *short lived waste* [45].

[*intermediate level waste (ILW)*]. See *low and intermediate level waste (LILW)*.

long lived waste. *Radioactive waste* that contains significant levels of radionuclides with a *half-life* greater than 30 years.

ⓘ Typical characteristics are long lived radionuclide concentrations exceeding the limitations for *short lived waste* [45].

low and intermediate level waste (LILW). *Radioactive waste* with radiological characteristics between those of *exempt waste* and *high level waste*. This may be *long lived waste* ***(LILW-LL)*** or *short lived waste* ***(LILW-SL)***.

ⓘ Typical characteristics of *low and intermediate level waste* are *activity* levels above *clearance levels* and thermal power below about 2 kW/m^3 [45].

ⓘ Many States subdivide this class in other ways, for example into ***low level waste (LLW)*** and ***intermediate level waste (ILW)*** or ***medium level waste (MLW)***, often on the basis of *waste acceptance requirements* for *near surface repositories*. These terms should not be used in *IAEA publications* unless explicit definitions are given for the purposes of the publication in question.

[*low level waste (LLW)*]. See *low and intermediate level waste (LILW)*.

[*medium level waste (MLW)*]. See *low and intermediate level waste (LILW)*.

short lived waste. *Radioactive waste* that does not contain significant levels of radionuclides with a *half-life* greater than 30 years.

ⓘ Typical characteristics are restricted long lived radionuclide concentrations (limitation of long lived radionuclides to 4000 Bq/g in individual *waste packages* and to an overall average of 400 Bq/g per *waste package*); see paras 324 and 325 of Ref. [45].

[*very low level waste (VLLW)*]. [*Radioactive waste* considered suitable by the *regulatory body* for *authorized disposal*, subject to specified conditions, with ordinary *waste* in *facilities* not specifically designed for *radioactive waste disposal*.]

ⓘ This is a category used in some Member States; in others there is no such category, as no *radioactive waste* at all may be disposed of in this way, however low level it is.

waste conditioning

See *waste management, radioactive* (1).

waste container

See *container, waste.*

waste disposal

See *disposal.*

waste form

Waste in its physical and chemical form after *treatment* and/or *conditioning* (resulting in a solid product) prior to *packaging*. The *waste form* is a *component* of the *waste package.*

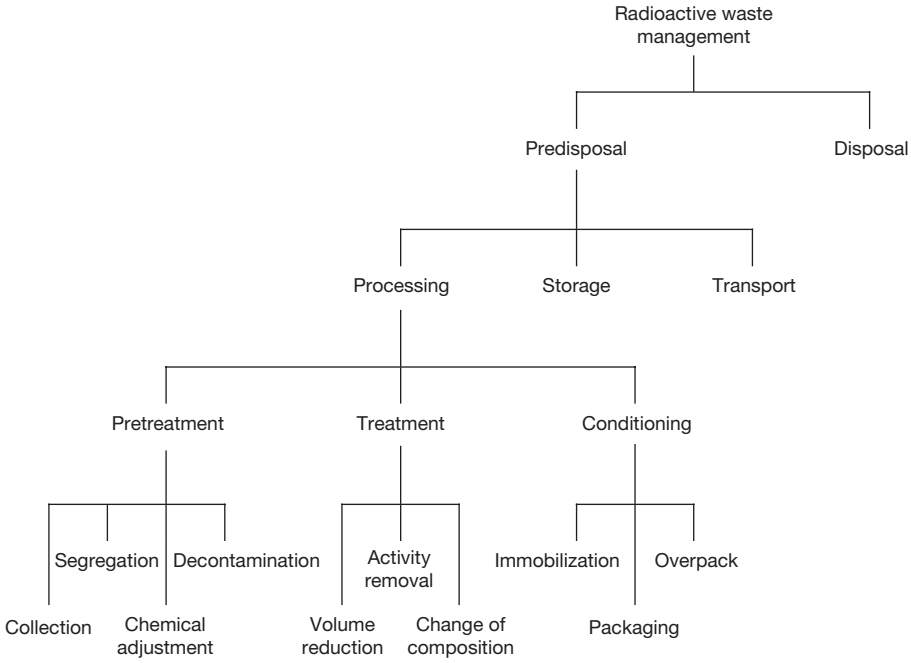
waste generator

The *operating organization* of a *facility or activity* that generates *waste.*

! For convenience, the scope of the term *waste generator* is sometimes extended to include whoever currently has the responsibilities of the *waste generator* (e.g. if the actual *waste generator* is unknown or no longer exists and a successor organization has assumed responsibility for the *waste*).

waste management, radioactive

1. All administrative and operational *activities* involved in the handling, *pretreatment*, *treatment*, *conditioning*, *transport*, *storage* and *disposal* of *radioactive waste.*



conditioning. Those *operations* that produce a *waste package* suitable for handling, *transport*, *storage* and/or *disposal*. *Conditioning* may include the conversion of the *waste* to a solid *waste form*, enclosure of the *waste* in containers and, if necessary, provision of an *overpack*.

immobilization. Conversion of *waste* into a *waste form* by solidification, embedding or encapsulation.

ⓘ *Immobilization* reduces the potential for *migration* or *dispersion* of radionuclides during handling, *transport*, *storage* and/or *disposal*.

overpack. A secondary (or additional) outer container for one or more *waste packages*, used for handling, *transport*, *storage* and/or *disposal*.

packaging. Preparation of *radioactive waste* for safe handling, *transport*, *storage* and/or *disposal* by means of enclosing it in a suitable *container*.

predisposal. Any *waste management* steps carried out prior to *disposal*, such as *pretreatment*, *treatment*, *conditioning*, *storage* and *transport activities.*

ⓘ *Predisposal* is used as a contraction of 'pre-disposal *radioactive waste management*', not a form of *disposal.*

pretreatment. Any or all of the *operations* prior to *waste treatment*, such as collection, *segregation*, chemical adjustment and *decontamination*.

processing. Any *operation* that changes the characteristics of *waste*, including *pretreatment*, *treatment* and *conditioning*.

segregation. An activity where types of *waste* or material (*radioactive* or *exempt*) are separated or are kept separate on the basis of radiological, chemical and/or physical properties, to facilitate *waste* handling and/or *processing*.

treatment. *Operations* intended to benefit *safety* and/or economy by changing the characteristics of the *waste.* Three basic *treatment* objectives are:

(a) *Volume reduction*;
(b) Removal of radionuclides from the *waste*;
(c) Change of composition.

Treatment may result in an appropriate *waste form*.

ⓘ If *treatment* does not result in an appropriate *waste form*, the *waste* may be immobilized.

volume reduction. A *treatment* method that decreases the physical volume of a *waste.*

ⓘ Typical *volume reduction* methods are mechanical compaction, incineration and evaporation.
ⓘ Should not be confused with *waste minimization*.

2. [All *activities*, including *decommissioning activities*, that relate to the handling, *pretreatment*, *treatment*, *conditioning*, *storage* or *disposal* of *radioactive waste*, excluding *off-site transportation*. It may also involve *discharges.*] (From Ref. [5].)

waste management facility, radioactive

1. *Facility* specifically designated to handle, treat, condition, temporarily store or permanently dispose of *radioactive waste*. (From Ref. [1].)

2. [Any *facility* or *installation* the primary purpose of which is *radioactive waste management*, including a *nuclear facility* in the *process* of being *decommissioned* only if it is designated by the Contracting Party as a *radioactive waste management facility*.] (From Ref. [5].)

waste minimization

See *minimization, waste*.

waste package

See *package, waste*.

weakly penetrating radiation

See *radiation: strongly penetrating radiation*.

wet storage

See *storage*.

within design basis accident

See *plant states*.

worker

Any person who works, whether full time, part time or temporarily, for an *employer* and who has recognized rights and duties in relation to occupational *radiation protection*. (A self-employed person is regarded as having the duties of both an *employer* and a *worker*.) (From Ref. [1].)

[working level (WL)]

A unit of *potential alpha energy* concentration (i.e. the *potential alpha energy* per unit volume of air) resulting from the presence of *radon progeny* or *thoron progeny*, equal to 1.3×10^8 MeV/m^3 (exactly).

! The term *working level* is now obsolete and its use is discouraged.

ⓘ In SI units, a *working level* is 2.1×10^{-5} J/m^3 (approximately).

[working level month (WLM)]

The *exposure* to *radon progeny* or *thoron progeny* which would be incurred during a working month (170 hours) in a constant *potential alpha energy* concentration of one *working level*.

! The term *working level month* is now obsolete and its use is discouraged.

ⓘ In SI units, a *working level month* is 3.54×10^{-3} J·h/m^3 (approximately).

workplace monitoring

See *monitoring* (1).

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Annex

SI UNITS AND PREFIXES

■ SI base units
▪ SI derived units and non-SI units accepted for use with SI
▫ Additional units accepted for use with SI for the time being

(See International Standard ISO 1000 and the several parts of ISO 31.)

Prefixes for SI (and metric units)

d	(deci)	10^{-1}	da	(deca)	10^{1}
c	(centi)	10^{-2}	h	(hecto)	10^{2}
m	(milli)	10^{-3}	k	(kilo)	10^{3}
µ	(micro)	10^{-6}	M	(mega)	10^{6}
n	(nano)	10^{-9}	G	(giga)	10^{9}
p	(pico)	10^{-12}	T	(tera)	10^{12}
f	(femto)	10^{-15}	P	(peta)	10^{15}
a	(atto)	10^{-18}	E	(exa)	10^{18}

Length

■	m	metre
▫	Å	ångström (10^{-10} m)

Area

▫	a	are (10^{2} m^2)
▫	ha	hectare (10^{4} m^2)
▫	b	barn (10^{-28} m^2)

Volume

▪	L	litre

Mass

■	kg	kilogram
▪	t	tonne (10^{3} kg)
▪	u	unified atomic mass unit

Time

■	s	second
▪	min	minute
▪	h	hour
▪	d	day

Temperature

■	K	kelvin
▪	°C	degree Celsius

Pressure (Indicate absolute (abs) or gauge (g) as required, e.g. 304 kPa (g))

▪	Pa	pascal (N/m^2)
▫	bar	bar (10^{5} Pa)

Radiation units

▪	Bq	becquerel (dimensions: s^{-1})
▪	Gy	gray (1 Gy = 1 J/kg)
▪	Sv	sievert
▫	Ci	curie (1 Ci = 37 GBq)
▫	R	röntgen (1 R = 258 µC/kg)
▫	rad	rad (100 rad = 1 Gy)
▫	rem	rem (100 rem = 1 Sv)

Electricity and magnetism

■	A	ampere
▪	C	coulomb
▪	eV	electronvolt
▪	F	farad
▪	H	henry
▪	Hz	hertz (cycles per second)
▪	Ω	ohm
▪	S	siemens (ohm^{-1})
▪	T	tesla
▪	V	volt
▪	W	watt
▪	Wb	weber

Others

■	cd	candela
■	mol	mole
▪	J	joule
▪	lm	lumen
▪	lx	lux
▪	N	newton
▪	rad	radian
▪	sr	steradian
▪	°	degree of angle
▪	′	minute of angle
▪	″	second of angle

The IAEA Safety Glossary clarifies and harmonizes terminology and usage in the IAEA safety standards. To this end, it defines and explains scientific and technical terms used in the IAEA safety standards and in other safety related publications, and provides information on their usage. The Safety Glossary provides guidance primarily for the drafters, reviewers and users of IAEA safety standards. However, it is also a source of information for drafters and users of other safety and security related IAEA publications and for other IAEA staff, and is of wider interest in Member States.

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