BS ISO 12749-2:2013

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Nuclear energy, nuclear technologies, and radiological protection — Vocabulary

Part 2: Radiological protection

National foreword

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Partie 2: Protection radiologique

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Foreword

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The committee responsible for this document is ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection.*

ISO 12749 consists of the following parts, under the general title *Nuclear energy, nuclear technologies, and radiological protection — Vocabulary*.

— *Part 2: Radiological protection*

The following parts are under preparation:

— *Part 3: Nuclear fuel cycle*

0. Introduction

0.1 General

This part of ISO 12749 provides terms and definitions for general nuclear energy concepts dealing with radiological protection and other related concepts, such as means of protection for human health and environment, measurement methods and instruments, and the prevision or direct determination of the effect of ionizing radiations on the body. Terminological data are taken from International Standards developed by the SC 2 and other technically validated documents such as the IAEA Glossary, IAEA BSS, ICRP, ICRU 60, ICRU 51, VIM, and BIPM.

Unambiguous communication of radiological protection concepts is crucial, taking into account the relevant implications that may arise from misunderstandings with regard to equipment and materials involved in the standards dealing with this subject. The market of radiological protection is a heterogeneous one because it comprises equipment designed, built, and operated along the safe practices defined by radiological protection specialists. This market also includes nuclear reactors, nuclear fuel cycle, and instruments to monitor both personnel and facilities and sites. In view of the foregoing, a large number of people having different levels of scientific and technical knowledge are involved; thus, there can be widely divergent understandings and assumptions about concepts. The results are poor communication, high risk of accidents, and duplication of effort as different groups are going to define concepts according to their perspectives.

Conceptual arrangement of terms and definitions is based on concepts systems that show corresponding relationships among radiological protection concepts. Such arrangement provides users with a structured view of this special subdomain within the nuclear energy sector and will facilitate common understanding of radiological protection concepts. Besides, concepts systems and conceptual arrangement of terminological data will be helpful to any kind of user because it will promote clear, accurate, and useful communication. At the end of this part of ISO 12749, an alphabetical index shows the terms followed by their corresponding notation.

0.2 Structure of the vocabulary

The terminology entries are presented in the conceptual order of the English preferred terms. Both a systematic index and an alphabetical index are included. The structure of each entry is in accordance with ISO 10241-1:2011.

All the terms included in this part of ISO 12749 deal exclusively with radiation protection. When selecting terms and definitions, special care has been taken to include the terms that need to be defined, that is to say, either because the definitions are essential to the correct understanding of the corresponding concepts or because some specific ambiguities need to be addressed.

The notes appended to certain definitions offer clarification or examples to facilitate understanding of the concepts described. In certain cases, miscellaneous information is also included, for example, the units in which a quantity is normally measured, recommended parameter values, references, etc.

According to the title, the vocabulary deals with concepts belonging to the general ***nuclear energy*** subject field within which concepts in the **radiological protection** sub-subject field are taken into account.

INTERNATIONAL STANDARD ISO 12749-2:2013(E)

Nuclear energy, nuclear technologies, and radiological protection — Vocabulary —

Part 2: Radiological protection

Scope

This part of ISO 12749 lists unambiguous terms and definitions related to radiological protection concepts in the subject field of nuclear energy. It is intended to facilitate communication and promote common understanding.

1 General terms related to radiological protection

1.1
radiological protection
radiation protection
protection of people and the environment from the harmful effects of exposure to ionizing radiation and the means for achieving such protection

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By adding "and the environment".]

1.1.1
radiation source
anything (apparatus, substance, installation) that may cause radiation exposure, such as by emitting ionization radiation or releasing radioactive substances or materials

[SOURCE: ISO 14152:2001]

1.1.1.1
radioactivity
stochastic process whereby nuclei undergo spontaneous disintegration, usually accompanied by the emission of subatomic particles, or photons

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By deleting "random" between "spontaneous" and "disintegration".]

1.1.1.1.1
radioactive material
material of which one or more constituents exhibit *radioactivity* (1.1.1.1)

Note 1 to entry: For special purposes such as regulation, this term may be restricted to *radioactive material* (1.1.1.1.1) with an activity or a specific activity greater than a specified value.

[SOURCE: ISO 921:1997]

1.1.1.1.1.1
radioactive contamination
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

1.1.1.1.1.1.1
surface contamination
radioactive material (1.1.1.1.1) deposited on surfaces of facilities (floor surface, work bench tops, machines, etc.), equipment, or personnel

1.1.2
equilibrium equivalent radon concentration
concentration of radon in air, in equilibrium with its short-lived decay products, which would have the same potential alpha energy concentration as the existing non-equilibrium mixture

[SOURCE: UNSCEAR 2006, Appendix E]

1.1.2.1
equilibrium factor
ratio of the equilibrium equivalent concentration of radon to the actual radon concentration

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

1.1.3
justification
process of determining for a planned exposure situation whether a practice is, overall, beneficial or for an emergency exposure situation or an existing exposure situation whether a proposed protective action or remedial action is likely, overall, to be beneficial

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

1.1.4
optimization of protection
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 societal factors being taken into account

[SOURCE: ICRP 103, modified — By adding "as low as reasonably achievable, economic and societal factors being taken into account" at the end.]

1.1.5
dose
measure of the energy deposited by radiation in a target

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

Note 1 to entry: Abbreviation for any of the existing dose quantities such as absorbed dose, effective dose, or equivalent dose.

Note 2 to entry: If unqualified, the dose quantity should be indicated by the context.

1.1.6
dose limit
limit on *equivalent dose* (3.3.2) and/or on *effective dose* (3.3.4) that is applied for exposure to individuals in order to prevent the occurrence of radiation-induced deterministic effects or to limit the probability of radiation-related stochastic effects to an acceptable level

[SOURCE: National Council on Radiation Protection and Measurements USA, Glossary, modified — By changing "radiation dose" to "equivalent dose" and adding "and/or on effective dose".]

1.1.6.1
partial-body dose
equivalent dose (3.3.2) to tissue, organs, or parts of the body

Note 1 to entry: Identified by the name of the part of the particular tissue, organ, or body, e.g. bone marrow dose, skin dose, hand dose, testes dose, or dose to the lens of the eyes.

Note 2 to entry: The unit of *equivalent dose* (3.3.2) is joule per kilogram ($J \cdot kg^{-1}$) and its special name is sievert (Sv).

[SOURCE: ISO 15382:2002, modified — By stating the examples in Note 1 and adding Note 2.]

1.1.6.2
annual dose
dose from *external exposure* (3.2) in a year plus the *committed dose* (3.1.2) from intakes of radionuclides in that year

[SOURCE: IAEA Basic Safety Standards, March 2011]

1.1.6.3
total dose
dose from *external exposure* (3.2) in a given period plus the *committed dose* (3.1.2) from intakes of radionuclides in that same period

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

1.1.7
dose constraint
prospective and source-related value of individual dose or risk that is used in *planned exposure situations* (3.4.1) as a parameter for the *optimization of protection* (1.1.4) and safety for the source, and that serves as a boundary in defining the range of options in optimization

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

1.1.8
derived limit
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

1.1.9
derived air concentration
DAC
derived limit (1.1.8) on the activity concentration in air of a specified radionuclide, calculated such that reference individual, breathing air with constant contamination at the concentration while performing light physical activity for a working year, would receive an intake corresponding to the *annual limit on intake* (1.1.9.1) for the radionuclide in question

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By replacing “Reference Man” with “reference individual”.]

Note 1 to entry: 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 2 000 h.

1.1.9.1
annual limit on intake
ALI
intake (3.1.1) by inhalation or ingestion or through the skin of a given radionuclide in a year by reference individual which would result in a *committed dose* (3.1.2) equal to the relevant *dose limit* (1.1.6)

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By changing "reference man" to "reference individual".]

Note 1 to entry: The annual limit on intake is expressed in units of activity.

2 Terms related to biological effect

2.1
threshold dose
level of *dose* (1.1.5) above which a deterministic effect occurs

2.1.1
deterministic effect
tissue reaction
biological effect of radiation for which a *threshold dose* (2.1) exists above which the severity of the effect is greater for a higher dose
[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By deleting "limit of" and the notes.]

[SOURCE: ICRP 103:2007]

2.1.1.1
acute radiation syndrome or sickness
ARS
acute illness caused by irradiation of the entire body (or most of the body) by a high dose of penetrating radiation in a very short period of time (usually a matter of minutes)

[SOURCE: ISO 21243:2008]

2.2
linear non-threshold model
LNT model
dose-response model which is based on the assumption that, in the low dose range, radiation doses greater than zero will increase the risk of excess cancer and/or heritable disease in a simple proportionate manner

[SOURCE: ICRP 103:2007]

2.2.1
stochastic effect
radiation-induced health effect, whose probability of occurrence is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By changing "the probability of occurrence of which" to "whose probability of occurrence".]

Note 1 to entry: Stochastic effects may be somatic effects or hereditary effects and generally occur without a threshold level of dose. Examples include solid cancers and leukaemia.

2.2.1.1
somatic effect
radiation-induced health effect that occurs in the exposed person

Note 1 to entry: Somatic effect includes effects occurring after birth that are attributable to exposure in uterus.

Note 2 to entry: Deterministic effects are normally also somatic effects.

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By splitting the note in two and by deleting "stochastic effects may be somatic effects or hereditary effects" in Note 2.]

2.2.1.2
hereditary effect
radiation-induced health effect that occurs in a descendant of the exposed person

Note 1 to entry: The less precise term 'genetic effect' is also used, but hereditary effect is preferred.

Note 2 to entry: Hereditary effects are usually stochastic effects.

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By omitting Note 3.]

2.2.2
risk coefficient
lifetime risk or radiation detriment assumed to result from exposure to unit *equivalent dose* (3.3.2) or *effective dose* (3.3.4)

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

3 Terms related to radiological exposure

3.1
internal exposure
exposure to radiation from a source inside the body

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

3.1.1
intake
activity of a radionuclide taken into the body in a given time period or as a result of a given event

[SOURCE: ISO 20553:2006]

3.1.1.1
dose coefficient
dose per unit intake of a radioactive substance

Note 1 to entry: Sometimes, it is 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.

[SOURCE: ICRP 103, modified — By splitting the wording into a definition and a note.]

3.1.1.2
human alimentary tract model
HATM
model that describes the processes that are involved when a *radioactive material* (1.1.1.1.1) is incorporated by human ingestion

[SOURCE: ICRP 66, modified — By changing "ingestion by children and adults" to "human ingestion".]

Note 1 to entry: HATM provides age-dependent parameter for the tract region, and associated transit times for the movement of materials through this region.

3.1.1.3
human respiratory tract model
HRTM
model that describes the processes that are involved when a *radioactive material* (1.1.1.1.1) is incorporated by human inhalation

[SOURCE: ICRP 66, modified to be consistent with the definition of human alimentary tract model]

3.1.1.4
retention fraction
fraction of an intake present in the body or in a tissue, organ, or region of the body after a given time has elapsed since the intake occurred

[SOURCE: ICRP 68]

3.1.1.5
excretion fraction
fraction of an intake excreted per day after a given time has elapsed since the intake occurred

[SOURCE: ICRP 68]

3.1.1.6
specific absorbed fraction
fraction of energy that is emitted as a specified radiation type in a source region, *S*, that is absorbed in 1 kg of a target tissue, *T*

[SOURCE: ICRP 103:2007]

3.1.1.7
clearance class
lung absorption class
classification used to distinguish between the different rates at which the inhaled radionuclides are transferred from the respiratory tract to the blood

3.1.2
committed dose
lifetime dose expected to result from an *intake* (3.3.1)

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

3.2
external exposure
exposure to radiation from a source outside the body

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

3.3
organ dose
mean *absorbed dose* (4.1.6.7) D_T in a specified tissue or organ, *T*, of the human body, given by:

$$D_T = = \frac{1}{m_T} \int_{m_T} D\, dm = \frac{\varepsilon_T}{m_T}$$

where m_T is the mass of the tissue or organ, *D* is the *absorbed dose* (4.1.6.7) in the mass element *dm*, and ε_T is the total energy imparted

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

3.3.1
radiation weighting factor
W_R
number by which the *absorbed dose* (4.1.6.7) in a tissue or organ is multiplied to reflect the relative biological effectiveness of the radiation in inducing *stochastic effects* (2.2.1) at low doses, the result being the *equivalent dose* (3.3.2)

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

3.3.2
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* (4.1.6.7) 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:

$$H_T = \sum_R w_R D_{T,R}$$

Note 1 to entry: The unit of equivalent dose is joule per kilogram ($J \cdot kg^{-1}$) and its special name is sievert (Sv).

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By deleting the last part of Note 1 and Notes 2 and 3.]

3.3.3
tissue weighting factor
W_T
multiplier of the *equivalent dose* (3.3.2) 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* (2.2.1) of radiation

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

3.3.4
effective dose
E
sum of the *equivalent dose* (3.3.2) in tissue or organ, W_T, multiplied by the appropriate tissue weighting factor, T, given by the expression $E = \sum w_T H_T$ where H_T is the *equivalent dose* (3.3.2) in tissue or organ, T, each multiplied by the appropriate tissue weighting factor for tissue, T

[SOURCE: ICRP 103:2007, modified — By rewording “result of the summation of the equivalent doses in tissues or organs, each multiplied by the appropriate tissue weighting factor”.]

Note 1 to entry: The unit of *effective dose* is joule per kilogram ($J \cdot kg^{-1}$) and its special name is sievert (Sv).

3.4.1
planned exposure situation
situation arising from the planned operation of a source radiation or from a planned action that results in an exposure from a source radiation

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011, modified — By changing “activity” to “action” and adding “radiation” after “source”.]

3.4.1.1
use factor
fraction of the workload during which the useful beam is pointed toward the area in question

[SOURCE: IEC IEV 50 Radiology and radiological physics/Radiation protection: methods and monitoring]

3.4.1.2
occupancy factor
T
factor by which the workload should be multiplied in order to correct for the degree or type of occupancy of the area in question

[SOURCE: IEC IEV 50 Radiology and radiological physics/Radiation protection: methods and monitoring]

3.4.1.3
occupational exposure
exposure of workers incurred in the course of their work

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

3.4.1.4
medical exposure
exposure incurred by patients for the purposes of medical or dental diagnosis or treatment; by careers and comforters; and by volunteers subject to exposure as part of a programme of biomedical research

3.4.1.5
public exposure
exposure incurred by members of the public due to sources in *planned exposure situations* (3.4.1) and existing exposure situations, excluding any occupational or medical exposure and the normal local natural background radiations

[SOURCE: ICRP 103:2007]

3.4.2
existing exposure situation
situation of exposure which already exists when a decision on the need for control needs to be taken

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

Note 1 to entry: Examples are exposure to background radiation and exposure to residual *radioactive material* (1.1.1.1.1) from a nuclear or radiological emergency after the *emergency exposure situation* (3.4.3) has been declared ended.

3.4.2.1
potential exposure
exposure that is not expected to be delivered with certainty but that may result from an accident at a source, an event, or sequence of events of a probabilistic nature, including equipment failures and operating errors

[SOURCE: ICRP 103:2007]

3.4.3
emergency exposure situation
situation of exposure where exposure at an elevated level is inevitable due to unexpected events or needs of important action

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By adding "where exposure at an elevated level is inevitable due to unexpected events or needs of important action".]

Note 1 to entry: This may include unplanned exposures resulting directly from the emergency and planned exposures to persons undertaking actions to mitigate the consequences of the emergency.

Note 2 to entry: Emergency exposure may be occupational exposure or public exposure.

3.4.3.1
reference level
in an *emergency exposure situation* (3.4.3) or an *existing exposure situation* (3.4.2), level of *dose* (1.1.5), risk, or activity concentration above which it is not appropriate to plan to allow exposures to occur and below which *optimization of protection* (1.1.4) and safety would continue to be implemented

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

3.4.4
averted dose
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

4 Terms related to radiological monitoring

4.1
radiological monitoring
radiation monitoring
monitoring
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

4.1.1
routine monitoring
monitoring carried out at regular intervals during normal operations

[SOURCE: ISO 12790-1:2001]

4.1.2
special monitoring
monitoring carried out to quantify significant exposures following actual or suspected conditions

[SOURCE: ISO 12790-1:2001, modified — By adding "to quantify significant exposures following".]

4.1.3
operational monitoring
monitoring related to certain operations

[SOURCE: ISO 12790-1:2001]

4.1.4
environmental monitoring
measurement of external dose rates due to sources in the environment or of radionuclide concentrations in environmental media

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

4.1.5
workplace monitoring
monitoring using measurements made in the working environment

[SOURCE: ISO 20553:2006]

4.1.6
individual monitoring
personal monitoring
monitoring using measurements by equipment worn by individual workers, or measurements of quantities of *radioactive material* (1.1.1.1.1) in or on the bodies of individual workers, or measurement of radioactive material excreted by individual workers

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

4.1.6.1
phantom
object constructed to simulate the scattering and absorption properties of the human body for a given ionizing radiation

[SOURCE: ISO 6980-2:2004, modified — By adding "for a given ionizing radiation" at the end of the definition and deleting the note.]

4.1.6.2
reference phantom
computational *phantom* (4.1.6.1) for the human body (male and female voxel phantoms based on medical imaging data) with the anatomical and physiological characteristics

[SOURCE: Annals of the ICRP, Volume 39, Issue 2, April 2009, Pages 3–5]

Note 1 to entry: The characteristics are defined in the report of ICRP Task Group on Reference Man (ICRP 2002).

4.1.6.3
ICRU tissue
material with a density of 1 $g \cdot cm^{-3}$ and a mass composition of 76,2 % oxygen, 10,1 % hydrogen, 11,1 % carbon, and 2,6 % nitrogen

[SOURCE: ICRU 39:1985 and ISO 6980-1:2006]

4.1.6.4
ICRU sphere
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

Note 1 to entry: ICRU sphere is used as a reference phantom in defining *dose equivalent* (4.1.6.8) quantities.

4.1.6.5
tissue equivalence
property of a material that approximates the absorption and scattering properties of biological tissue for a given radiation

4.1.6.6
quality factor
Q
number by which the *absorbed dose* (4.1.6.7) (D) is multiplied to reflect the relative biological effectiveness of the radiation, the result being the *dose equivalent* (4.1.6.8)

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By deleting "in a tissue or organ" and the two notes.]

4.1.6.7
absorbed dose
D
quotient of $d\bar{\varepsilon}$ by dm, where $d\bar{\varepsilon}$ is the mean energy imparted to matter of mass dm thus

$$D = \frac{d\bar{\varepsilon}}{dm}$$

Note 1 to entry: The unit of absorbed dose is joule per kilogram ($J \cdot kg^{-1}$). The special name for the unit of absorbed dose is gray (Gy).

[SOURCE: ICRU 60, 4.2.5]

4.1.6.8
dose equivalent
H
product of *D* and *Q* at a point in tissue, where *D* is the *absorbed dose* (4.1.6.7) and *Q* is the *quality factor* (4.1.6.6) for the specific radiation at this point, thus:

$$H = DQ$$

Note 1 to entry: The unit of dose equivalent is joule per kilogram ($J \cdot kg^{-1}$), and its special name is sievert (Sv).

[SOURCE: ICRP 103:2007]

4.1.6.8.1
ambient dose equivalent
dose equivalent (4.1.6.8) that would be produced by the corresponding aligned and expanded field in the *ICRU sphere* (4.1.6.4) at a depth, *d*, on the radius opposing the direction of the aligned field

[SOURCE: IAEA – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

4.1.6.8.2
directional dose equivalent
H′ (d, Ω)
dose equivalent (4.1.6.8) at a point in a radiation field, that would be produced by the corresponding expanded field, in the *ICRU sphere* (4.1.6.4) at a depth, *d*, on a radius in a specified direction, *Ω*

[SOURCE: ICRU 51]

Note 1 to entry: The unit of directional dose equivalent is joule per kilogram ($J \cdot kg^{-1}$) and its special name is sievert (Sv).

4.1.6.8.3
personal dose equivalent
$H_p(d)$
dose equivalent (4.1.6.8) in soft tissue at an appropriate depth, *d*, below a specified point on the human body

[SOURCE: ICRP 103:2007]

Note 1 to entry: The unit of *personal dose equivalent* is joule per kilogram ($J \cdot kg^{-1}$) and its special name is sievert (Sv).

Note 2 to entry: The specified point is usually given by the position where the individual's dosimeter is worn.

4.1.6.9
conversion coefficient for neutrons
$h_{p\Phi}(10;E,\alpha)$
quotient of the *personal dose equivalent* (4.1.6.8.3), $h_p(10)$, and the neutron fluence, φ_n, at a point in the radiation field and used to convert from neutron fluence into the *personal dose equivalent* (4.1.6.8.3) at 10 mm depth in the *ICRU tissue* (4.1.6.3) slab phantom, where E is the energy of the incident neutrons impinging on the *phantom* (4.1.6.1) at an angle, α

[SOURCE: ISO 21909:2005]

Note 1 to entry: The SI unit of the conversion coefficient is sievert per square metre (Sv/m^2). A commonly used unit of the conversion coefficient is picosievert per square centimetre (pSv/cm^2).

4.1.7
area monitoring
form of *workplace monitoring* (4.1.5) in which an area is monitored by taking measurements at different points in the area

5 Terms related to measurement

5.1
minimum detectable amount
MDA
smallest amount (activity or mass) of a measurand in a sample that will be detected with a probability β of non-detection (Type B error) while accepting a probability α of erroneously deciding that a positive (non-zero) quantity of measurand is present in an appropriate blank sample (Type A error)

[SOURCE: ISO 12790-1:2001 and BIPM/JCGM 100:2008]

5.2
minimum detection level
MDL
smallest measurable amount (e.g. counting rate or dose) that will be detected with a probability β of non-detection (Type B error) while accepting a probability α of erroneously deciding that a positive (non-zero) quantity present in an appropriate background sample (Type A error)

[SOURCE: ISO 19238:2004, modified — By changing "frequency" to "counting rate".]

5.3
bioassay
radiobioassay
procedure used to determine the nature, activity, location, or retention of radionuclides in the body by *in vivo* measurement or by *in vitro* analysis of material excreted or otherwise removed from the body

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

5.3.1
***in vitro* measurement**
measurements to determine the presence of or to estimate the amount of *radioactive material* (1.1.1.1.1) in the excreta or in other biological materials removed from the body

[SOURCE: ISO 28218:2010, modified.]

5.3.1.1
personal air sampling
PAS
sampling of air in the immediate vicinity of an individual's nose and mouth, usually by a portable sampling pump and collection tube (e.g. a lapel sampler) worn on the body

5.3.2
***in vivo* measurement**
measurement to determine the presence of or to estimate the amount of *radioactive material* (1.1.1.1.1) in a living organism

[SOURCE: ISO 28218:2010, modified — By rewording the definition.]

5.3.2.1
whole body counter
WBC
equipment for the determination of the whole body burden activity

5.3.2.2
lung counter
equipment for the determination of the lung burden activity

5.3.2.3
thyroid counter
equipment for the determination of the thyroid burden activity

5.4
ionization chamber
ionization detector filled with a suitable gas, or gaseous mixture, in which an electric field, insufficient to induce gas multiplication, is provided for the total collection at the electrodes of charges associated with the ions and the electrons produced in the sensitive volume of the detector by the ionizing radiation

[SOURCE: IEC 394-25-02]

Note 1 to entry: Examples are pulse ionization chamber, integration ionization chamber, and current ionization chamber.

5.4.1
extrapolation ionization chamber
ionization chamber (5.4) in which one of its characteristics can be varied, normally the spacing between electrodes, in order to extrapolate the chamber response to 0,07 mm depth

[SOURCE: IEC 394-25-21, modified — By changing "zero sensitive mass" with "0,07 mm depth".]

5.5
dosemeter
dosimeter
device having a reproducible, measurable response to radiation that can be used to measure the *absorbed dose* (4.1.6.7) or *dose equivalent* (4.1.6.8) quantities in a given system

5.5.1
etched track detector
material, usually plastic in nature, etched and inspected microscopically to count nuclear tracks produced by incoming ionizing radiation to measure the *absorbed dose* (4.1.6.7) or *dose equivalent* (4.1.6.8) in a given system

[SOURCE: ISO 21909:2005, modified — By changing "carefully manufactured under controlled conditions for the purpose of radiation measurements" to "etched and inspected microscopically to count nuclear tracks produced by incoming ionizing radiation" and adding at the end "to measure the absorbed dose or dose equivalent in a given system".]

5.5.2
extremity dosemeter
dosemeter intended to be worn on the finger or limb [hands, feet, forearms (including the elbow), and lower leg (including the patella)]

[SOURCE: ISO 12794:2000]

5.5.3
optically stimulated luminescence dosimeter
OSL dosimeter
solid detector that uses the luminescence emitted from an irradiated material during exposure to light

Note 1 to entry: The magnitude of the luminescence is a function of the energy stored in the material during its exposure to ionizing radiation.

5.6
biological dosimetry
measurement of the degree of a biological response to radiation, that is then used indirectly as measure of the *absorbed dose* (4.1.6.7) received by tissue

[SOURCE: ICRU 30]

5.7
fading
loss of information during a period of time of an irradiated dosemeter

[SOURCE: ISO 21909:2005]

6 Terms related to technical aspects

6.1
interlock
automatic sensing device that causes a radiation-producing device to shut off or prevents access to the hazardous radiation area while it is present

[SOURCE: Thomas Jefferson National Accelerator Facility USA: Jefferson Lab Glossary, modified — By changing "beam" to "area".]

6.2
shield
material interposed between a source of radiation and persons, or equipment or other objects, in order to attenuate the radiation

[SOURCE: IAEA Safety Series No. 76:1996]

6.2.1
shielded enclosure
containment enclosed by an additional shielding wall intended to provide complementary shielding against penetrating radiation

[SOURCE: ISO 15080:2001]

Note 1 to entry: This additional shielding wall can be integral with, mounted on, or independent of the containment enclosure wall. The choice and thickness of the protection material depend on the type of radiation (beta, gamma, or neutron) and the type of handling required.

6.2.2
build-up factor
in the passage of radiation through a medium, ratio of the total value of a specified radiation quantity at any point to the contribution to that value from radiation reaching the point without having undergone a collision

[SOURCE: American National Standard Glossary, 2009]

6.3
sealed radioactive source
radioactive material (1.1.1.1.1) sealed in a capsule or associated with a material to which it is closely bonded, this capsule or bonding material being strong enough to maintain leak tightness of the sealed source under the conditions of use and wear for which it was designed

[SOURCE: ISO 2919:2012]

6.4
high-efficiency particulate air filter
HEPA filter
high-efficiency filter used for removing aerosol particles from an air stream

[SOURCE: ISO 2889:2010]

Note 1 to entry: A HEPA filter usually collects aerosol particles at the most penetrating particle size (between 0,1 µm and 0,3 µm diameter) with a high efficiency and is designed to collect greater fractions of aerosol articles with diameters either larger or smaller. The minimum efficiency of a HEPA filter is not defined in an International Standard.

6.5
protection factor for clothing
ratio of the average concentrations of pollutant measured under test conditions in the ambient atmosphere and inside the helmet of the suit at the point where the wearer draws breath

[SOURCE: ISO 8194:1987, modified — By adding "under test conditions" and deleting the note.]

6.6
computer tomography dose index
CTDI
integrated dose profile (in the *z*-direction) for a single slice, normalized to the nominal slice thickness

[SOURCE: Optimization of the Radiological Protection of Patients Undergoing Radiography, Fluoroscopy and Computed Tomography, IAEA TECDOC, Series N° 1423]

Note 1 to entry: It can be measured either in air or in a phantom using either a pencil-type ion chamber or a row of TLDs. In essence, the CTDI gives a measure of the "raw" output of a scanner.

6.7
iodine prophylaxis
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

Note 1 to entry: The iodine prophylaxis is an urgent protective action.

Note 2 to entry: The term "thyroid blocking" is sometimes used.

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By rearranging the wording in Note 1.]

6.8
diagnostic reference level
DRL
level used in medical imaging to indicate whether, in routine conditions, the *dose* (3.1.1.2) to the patient or the amount of radiopharmaceuticals administered in a specified radiological procedure is unusually high or unusually low for that procedure

Note 1 to entry: In radio pharmaceuticals, DRL is a level of activity for typical examinations for groups of standardized patients or standard phantom for broadly defined types of equipment.

Note 2 to entry: These levels are indicative of good practice, when not exceeded, for standard procedures when good and normal practice regarding diagnostic and technical performance is applied.

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

[SOURCE: Adapted from Optimization of the Radiological Protection of Patients Undergoing Radiography, Fluoroscopy and Computed Tomography, IAEA TECDOC, Series N° 1423]

7 Terms related to regulation

7.1
individual-related assessment
assessment concerned with the exposure of a single individual from many radiation sources

[SOURCE: Annals of the ICRP, 21(1-3), Pergamon Press, Oxford]

7.2
source-related assessment
assessment concerned with the exposures resulting from a single *radiation source* (1.1.1)

[SOURCE: Annals of the ICRP, 21(1-3), Pergamon Press, Oxford]

Note 1 to entry: In source-related assessments, the individual doses have to be supplemented by information on the number of people exposed.

7.3
naturally occurring radioactive material
radioactive material (1.1.1.1.1) containing no significant amounts of radionuclides other than naturally occurring radionuclides

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

Note 1 to entry: The exact definition of "significant amount" would be a regulatory decision.

7.4
exemption
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

7.5
exclusion
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

Note 1 to entry: This kind of 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* (1.1.1.1.1) in which the activity concentrations of natural radionuclides are below the relevant values given in IAEA safety standards.

Note 2 to entry: The concept is related to those of clearance (which is normally used in relation to materials) and exemption (which relates to practices or sources).

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By rewording the definition and splitting additional information in two notes.]

7.6
clearance
removal of *radioactive materials* (1.1.1.1.1) or radioactive objects within notified or authorized practices from any further regulatory control by the regulatory body

[SOURCE: IAEA Safety Standards Series, Safety Guide, No RS-G-1.7]

7.7
derived release limit
upper limits of release of radionuclides into atmosphere

[SOURCE: Health Physics 2005, 88 Issue 4]

7.8
dispersion
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

Note 1 to entry: Dispersion is often used in a more general sense combining all processes (including molecular diffusion) that result in the spreading of a plume.

Note 2 to entry: The terms atmospheric dispersion and hydrodynamic dispersion are used in this more general sense for plumes in air and water, respectively.

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition, modified — By redrafting the definition and stating additional information in the two notes.]

7.9
recording level
level of *dose* (1.1.5), exposure, or *intake* (3.1.1) 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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

7.10
investigation level
value of a quantity such as *effective dose* (3.3.4), intake, or contamination per unit area or volume at or above which investigation would be conducted

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

Note 1 to entry: Investigation levels are established by national authorities.

7.11
controlled area
area in which individual exposure of personnel to radiation is controlled and which is under the supervision of a person who has knowledge of the appropriate radiation protection regulations and responsibility for applying them

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

7.12
supervised area
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

7.13
access control
process of granting or denying specific requests for obtaining and using information or for entrance to specific physical facilities

Note 1 to entry: The specific requests can be: 1) to obtain and use information and related information processing services and 2) to enter specific physical facilities (e.g. Federal buildings, military establishments, and border crossing entrances).

[SOURCE: Committee on National Security Systems (CNSS) Instruction No. 4009; 26 April 2010, modified — By adding at the end "for obtaining and using information or for entrance to specific physical facilities".]

7.14
radiation protection officer
radiation safety officer
RSO
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

[SOURCE: IAEA Safety Glossary Terminology Used in Nuclear Safety and Radiation Protection – 2007 Edition]

7.15
projected dose
dose (1.1.5) that would be expected to be received if planned protective actions were not taken

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - Interim Edition IAEA Safety Standards Series GSR Part 3, 2011]

7.15.1
protective action guide
PAG
value against which to compare the *projected dose* (7.15) to an individual from a release of *radioactive material* (1.1.1.1.1) at which a specific protective action to reduce or avoid that dose is warranted

[SOURCE: EPA Protective Action Guides, September 2007]

7.16
emergency planning zone
EPZ
area for which planning is needed to ensure that prompt and effective actions can be taken to avoid and reduce the *public exposure* (3.4.1.5)

7.17
ingestion exposure planning zone
ingestion exposure pathway zone
IEPZ
area surrounding a nuclear installation where action could be necessary to protect the public from the ingestion of contaminated water and foods

Note 1 to entry: Predetermined protective action plans are in place for this EPZ and are designed to avoid or reduce dose from potential ingestion of *radioactive materials* (1.1.1.1). These actions include a ban of contaminated food and water.

[SOURCE: ANSI/ANS:1987, 3.3.1, modified — By changing "an area of approximately 50 miles radius" to "area", and "nuclear power plant" to "nuclear installation".]

7.18
high level waste
HLW
high level radioactive waste
HLRW
waste with levels of activity concentration high enough to generate significant quantities of heat by the radioactive decay process or waste with large amounts of long-lived radionuclides that need to be considered in the design of a disposal facility for such waste

[SOURCE: IAEA Safety Guide, No. GSG1]

7.19
intermediate level waste
ILW
waste that, because of its content, particularly of long-lived radionuclides, requires a greater degree of containment and isolation than that provided by near surface disposal

[SOURCE: IAEA Safety Guide, No. GSG1]

7.20
low level waste
LLW
waste that is above clearance levels, but with limited amounts of long-lived radionuclides

Note 1 to entry: Such waste requires robust isolation and containment for periods of up to a few hundred years and is suitable for disposal in engineered near-surface facilities.

[SOURCE: IAEA Safety Guide, No. GSG1, modified — By splitting in a definition and a note.]

Annex A
(informative)

Methodology used in the development of the vocabulary

A.1 General

Taking into account that radiological protection concepts are found in a large number of technical standards used by a great number of stakeholders from different countries with the objective of sharing best practices to improve efficiency, radiation safety in radiotherapy, diagnostic, interventional radiology, and nuclear medicine, only to mention some of them, it is necessary to use

— clear technical descriptions, and

— a coherent and harmonized vocabulary that is easily understandable by all potential users.

Concepts are not independent of one another, and an analysis of the relations between concepts within the field of radiological protection and the arrangement of them into concept systems is a prerequisite of a coherent vocabulary. Such an analysis was used in the development of the vocabulary specified in this part of ISO 12749. Since the concept diagrams employed during the development process may be helpful in an informative sense, they are reproduced in A.3.

A.2 Concept relationships and their graphical representation

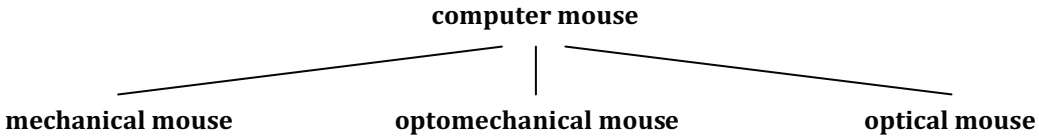
A.2.1 General

In terminology work, the relationships between concepts are based on the three primary forms of concept relationships indicated in this annex: the hierarchical generic (A.2.2), the partitive (A.2.3), and the non-hierarchical associative (A.2.4).

A.2.2 Generic relation

Subordinate concepts within the hierarchy inherit all the characteristics of the superordinate concept and contain descriptions of these characteristics which distinguish them from the superordinate (parent) and coordinate (sibling) concepts, e.g. the relation of mechanical mouse, optomechanical mouse, and optical mouse to computer mouse.

Generic relations are depicted by a fan or tree diagram without arrows (see Figure A.1).



NOTE This example is adapted from ISO 704:2009, 5.5.2.2.1.

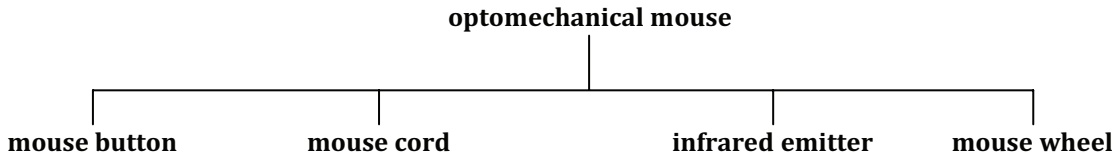
Figure A.1 — Graphical representation of a generic relation

A.2.3 Partitive relation

Subordinate concepts within the hierarchy form constituent parts of the superordinate concept, e.g. mouse button, mouse cord, infrared emitter, and mouse wheel may be defined as parts of the concept

optomechanical mouse. In comparison, it is inappropriate to define red cord (one possible characteristic of mouse cord) as part of an optomechanical mouse.

Partitive relations are depicted by a rake without arrows (see Figure A.2). Singular parts are depicted by one line, multiple parts by double lines.



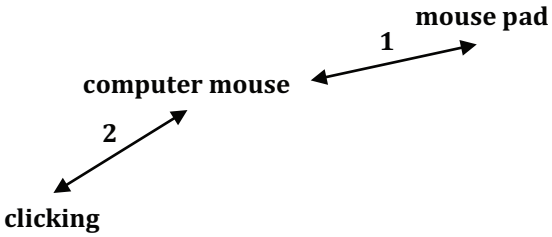
NOTE This example is adapted from ISO 704:2009, 5.5.2.3.1.

Figure A.2 — Graphical representation of a partitive relation

A.2.4 Associative relation

Associative relations cannot provide the economies in description that are present in generic and partitive relations but are helpful in identifying the nature of the relationship between one concept and another within a concept system, e.g. cause and effect, activity and location, activity and result, tool and function, and material and product. Besides, associative relations are the most commonly encountered in terminology practical work, as they correspond to the concept relations established in the real world.

Associative relations are depicted by a line with arrowheads at each end (see Figure A.3).



NOTE This example is adapted from ISO 704:2009, 5.6.2.

Figure A.3 — Graphical representation of an associative relation

A.3 Concept diagrams

Figures A.4 to A.12 show the concept diagrams on which the thematic groups of the radiological protection vocabulary are based.

Notations in the following diagrams show the position of each concept according to generic, partitive, and associative relationships.

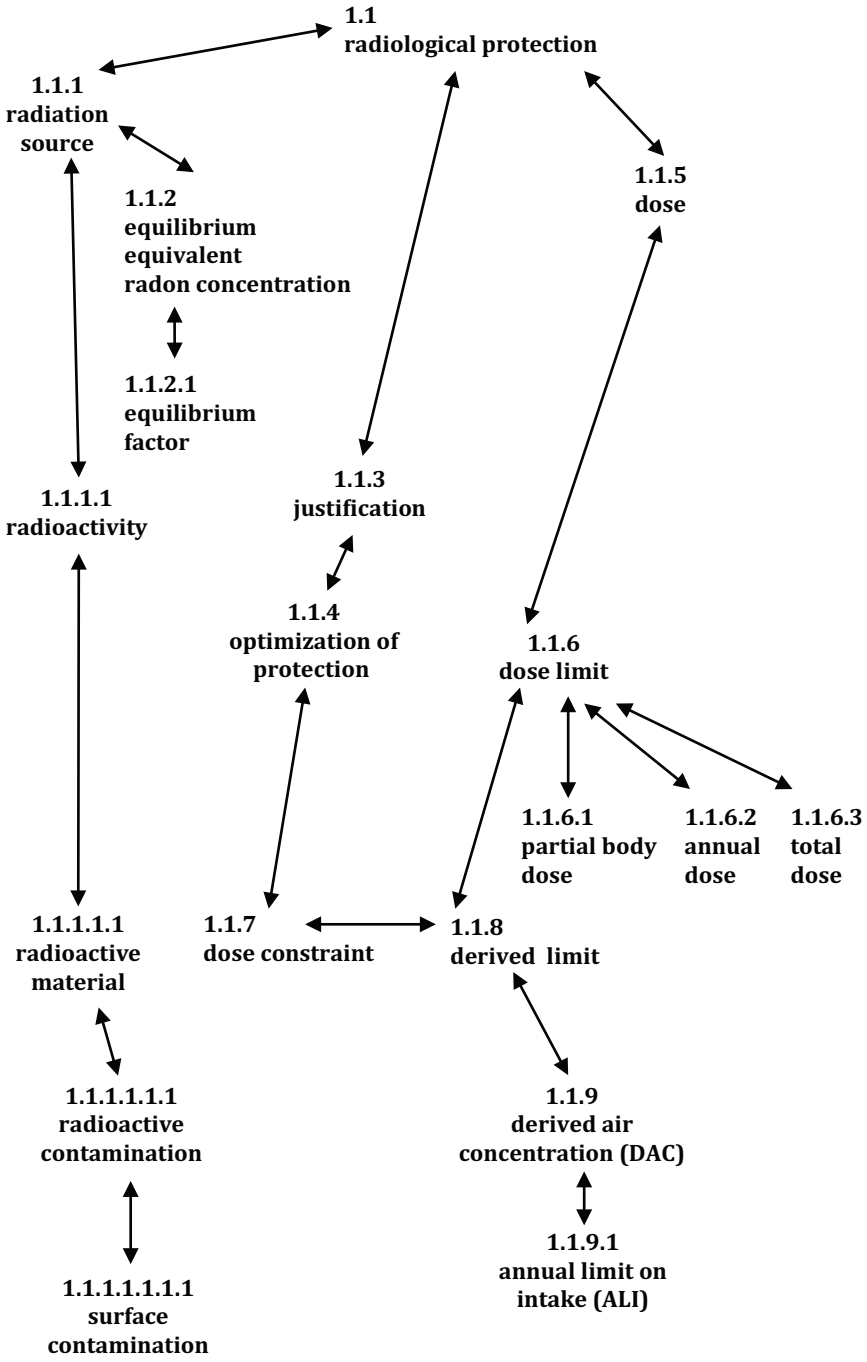


Figure A.4 — Clause 1: General terms related to radiological protection

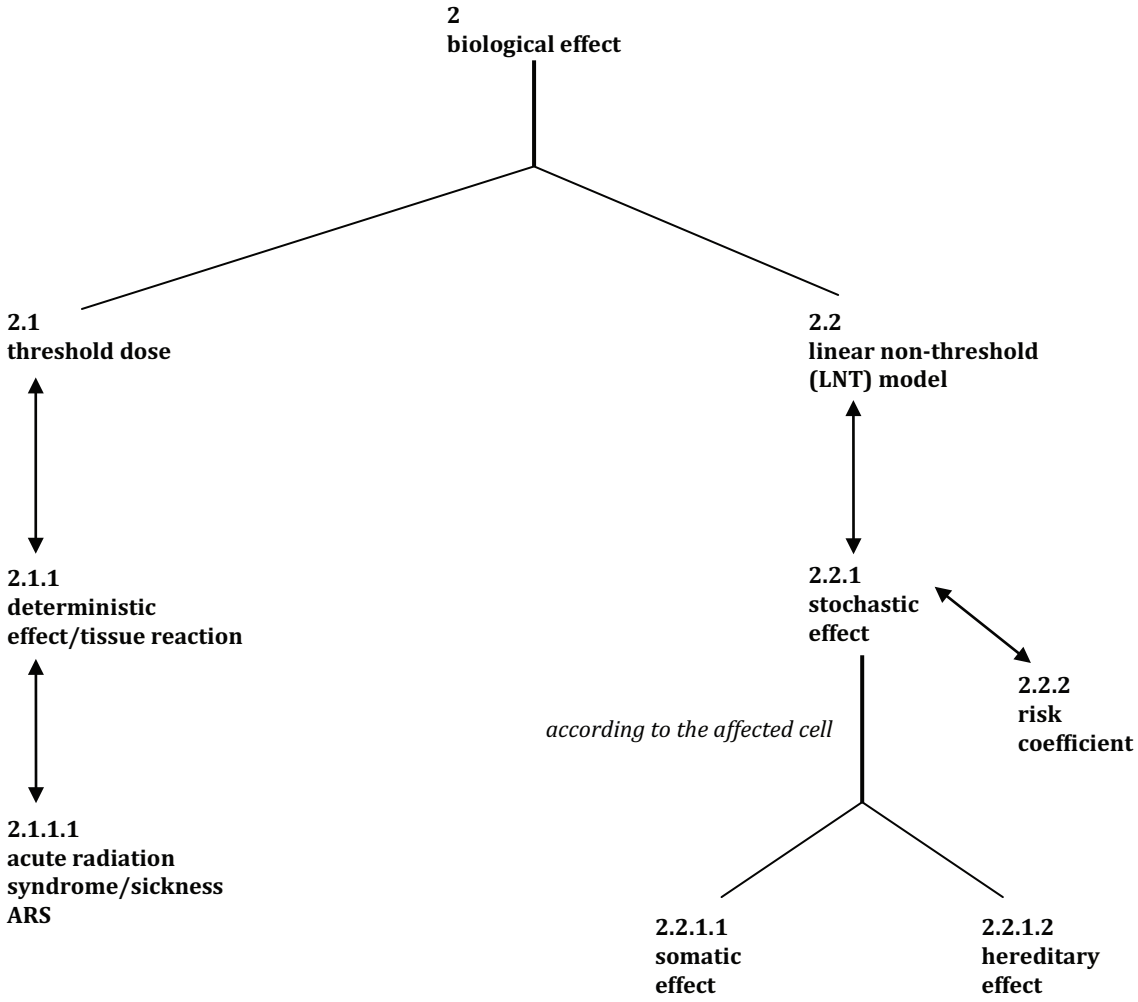


Figure A.5 — Clause 2: Terms related to biological effects

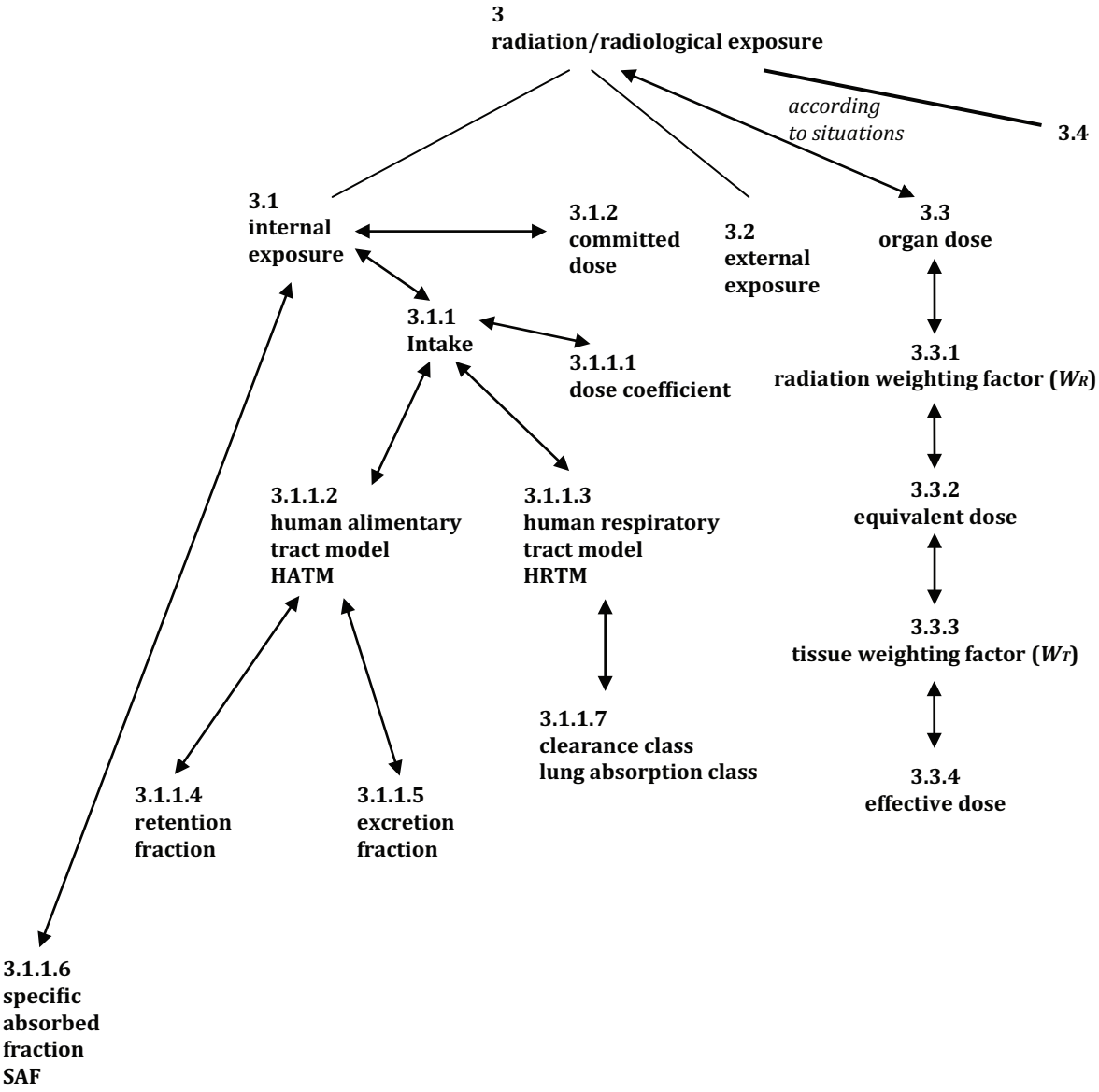


Figure A.6 — Clause 3: Terms related to radiological exposure (1 of 2)

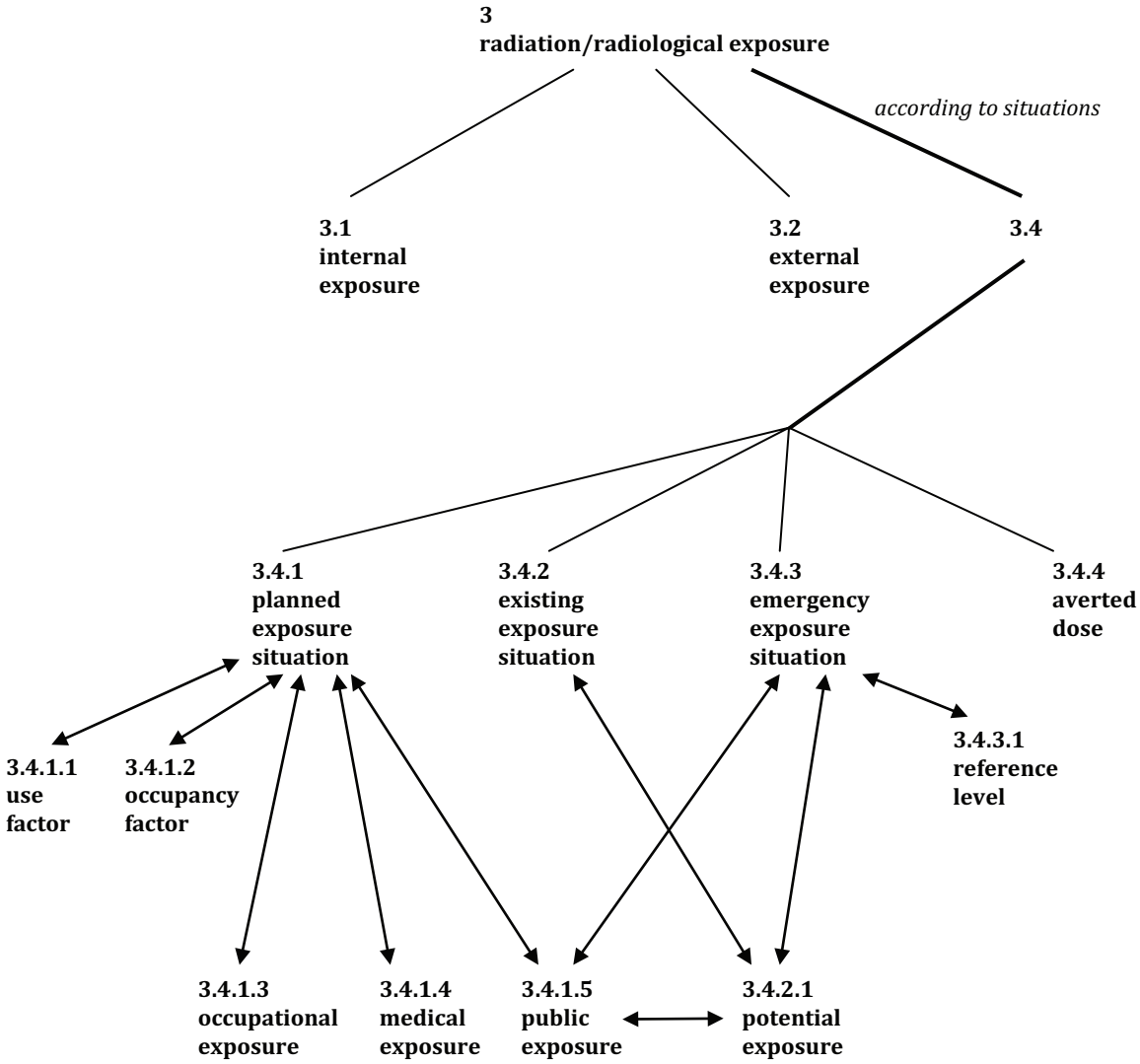


Figure A.6 — Clause 3: Terms related to radiological exposure (2 of 2)

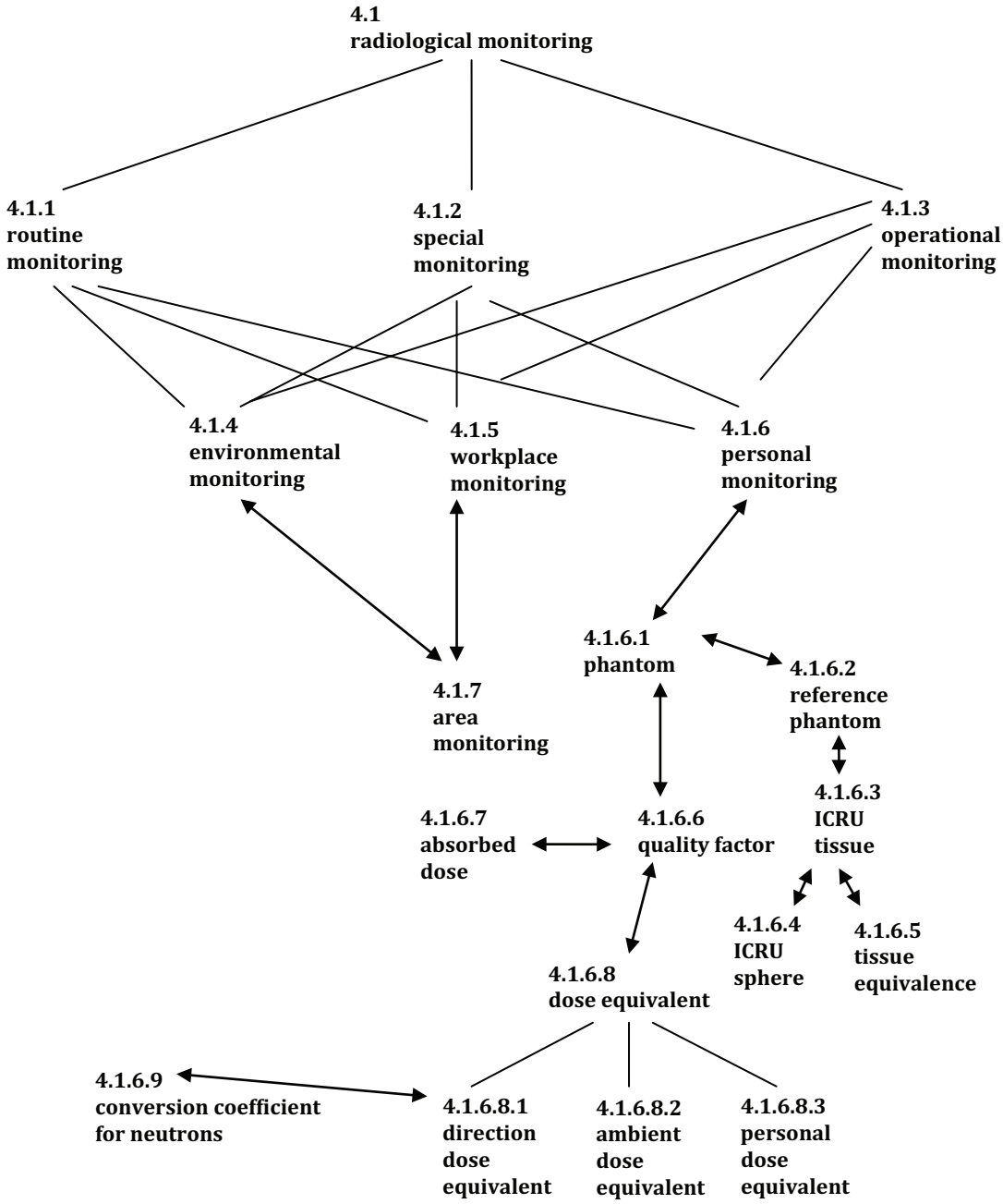


Figure A.7 — Clause 4: Terms related to radiological monitoring

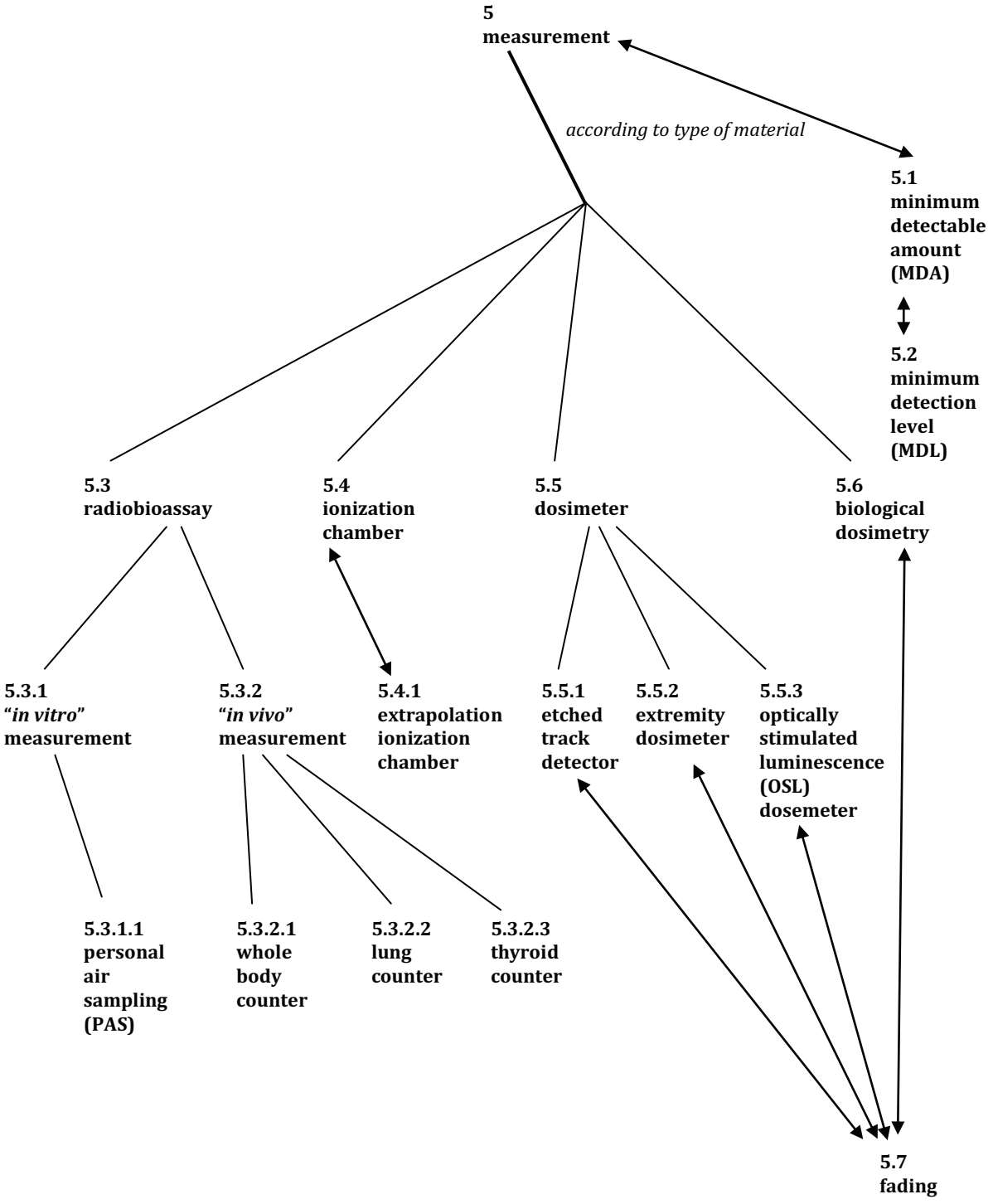


Figure A.8 — Clause 5: Terms related to measurement

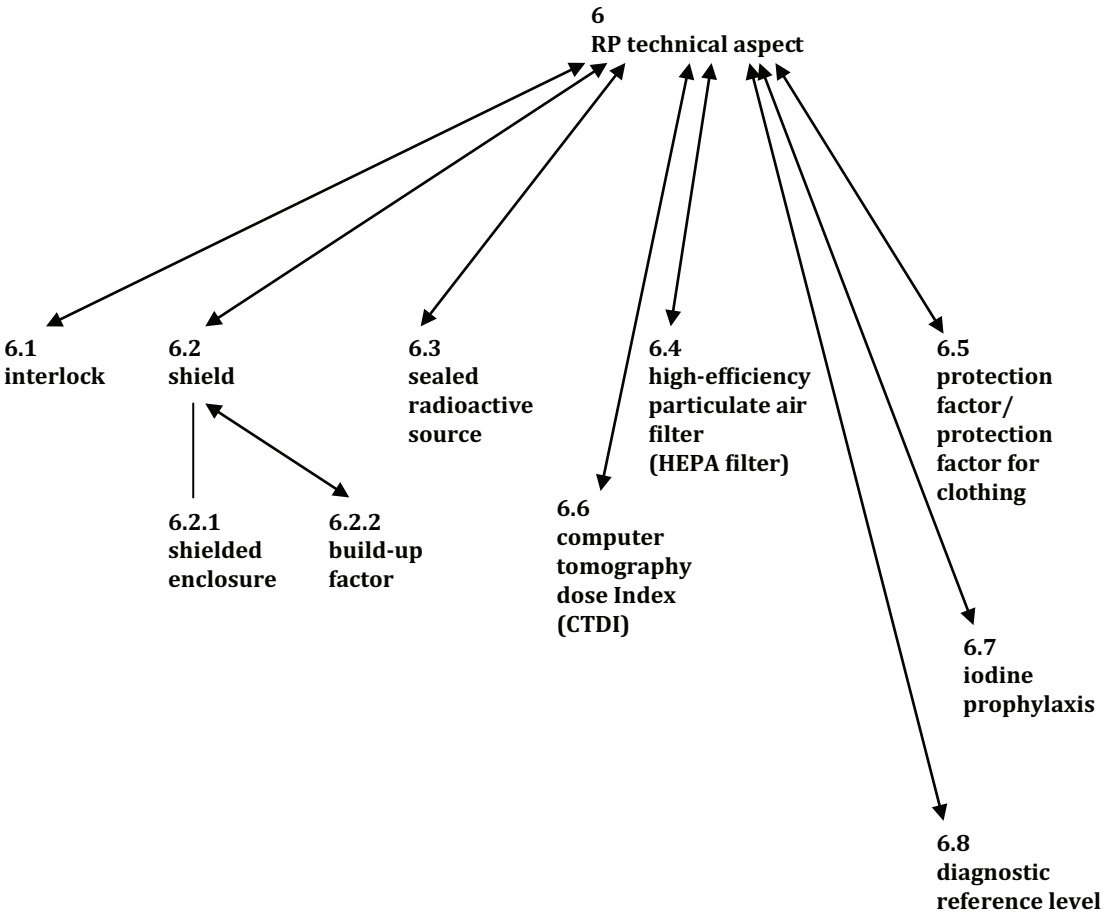


Figure A.9 — Clause 6: Terms related to technical aspects

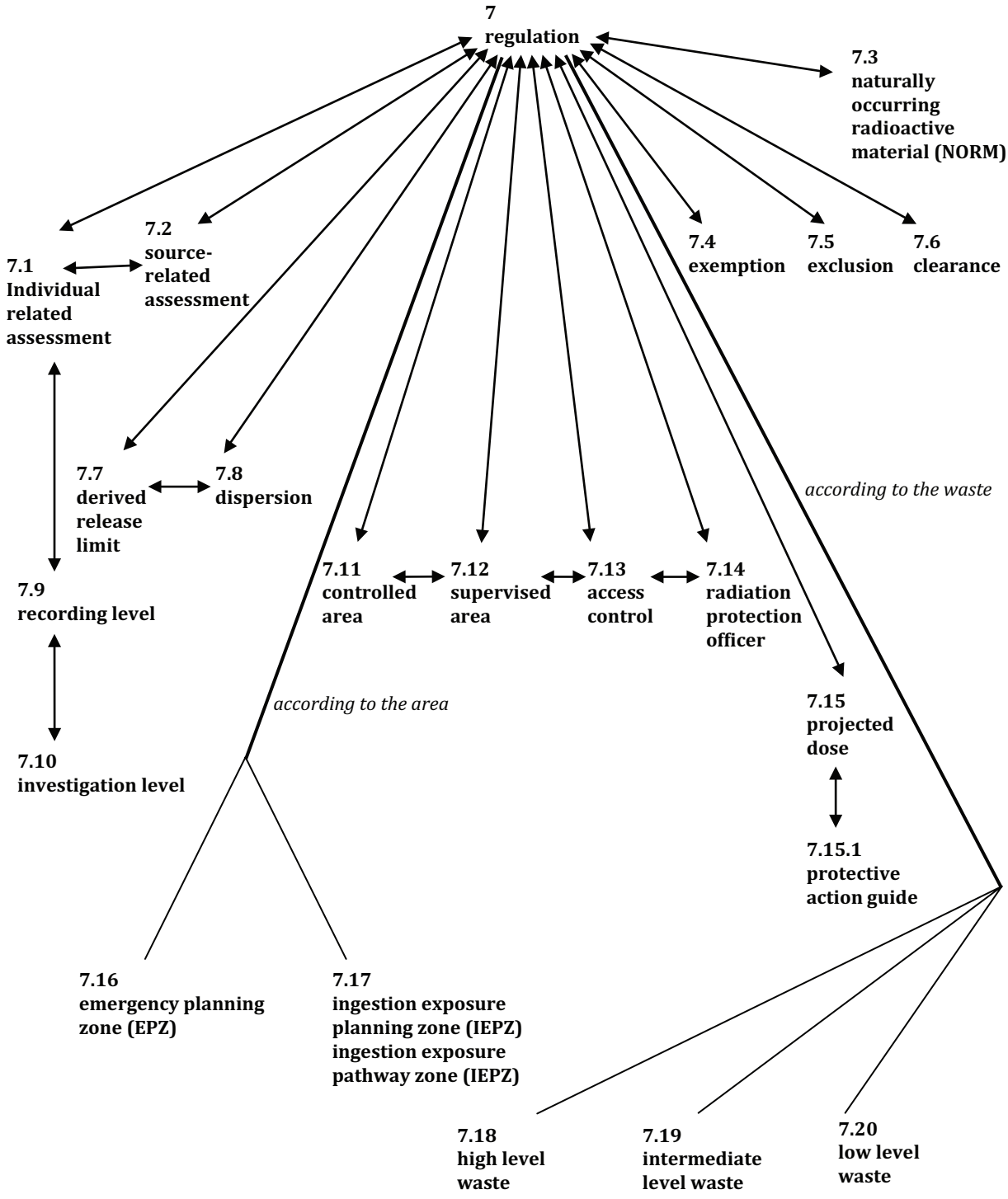


Figure A.10 — Clause 7: Terms related to regulation

Annex B
(informative)

Alphabetical index

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