Nuclear energy - Terminology, definitions units, and symbols

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"Nuclear energy – Vocabulary – Part 2: Radiological protection"
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FOLLOW UP

This document is the second working draft including the technical, terminological and editorial comments on the first working draft.
ISO/TC85/WG1 Experts are asked to comment this document, **before 21 October 2011**

COMMENTARIES

Comments are expected mainly on aspects as follows:
- The grouping of terms
- Bibliographical sources
- Selection and writing of definitions

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO TC/85 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/WD1 12749-2 was prepared by Technical Committee ISO/TC85, *Nuclear Energy.*

- Part 1: Nuclear energy: General terminology

- Part 2: Radiological protection

- Part 3: Nuclear fuels

- Part 4: Dosimetry for radiation processes

Introduction

This document will provide terms and definitions for general nuclear energy concepts dealing with radiological protection and other related concepts such as means of protection both human health and environment, measurement methods and instruments, the prevision or direct determination of the effect of ionizing radiations on the body. Terminological data are taken from ISO standards developed by the SC2 and other technically validated documents such as the IAEA Glossary, ICRP, ICRU 60, ICRU 51, VIM, GUM and BSS.

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 the radiological protection specialists. This market also includes nuclear reactors, nuclear fuel cycle, instruments to monitor both personnel and facilities and sites. In view of the foregoing, a large number of people are involved having different levels of scientific and technical knowledge, thus it can be widely divergent understandings and assumptions about concepts. The result is 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 sub domain 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.

Nuclear energy – Vocabulary – Part 2: Radiological protection

1 Scope

This International Standard lists unambiguous terms and definitions related to radiation protection concepts in the subject field of nuclear energy. It is intended to facilitate communication and promote common understanding.

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 IS0 10241-1:2011, Terminological entries in standards -- Part 1: General requirements and examples of presentation

All the terms included in this standard 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.

3 Terms and definitions

3.1 General terms related to radiological protection

3.1
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: Adapted from IAEA Glossary, June 2007, modified by adding “and the environment”]

3.1.1
radioactivity
stochastic process whereby nuclei undergo spontaneous random disintegration, usually accompanied by the emission of subatomic particles, or photons

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.1.1.1
radioactive material
material of which one or more constituents exhibit radioactivity

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

[SOURCE: ISO 921:1997]

3.1.1.1.1
radiation source
anything (apparatus, substance, installation) that may cause radiation exposure, such as by emitting ionizing radiation or releasing radioactive substances or materials

[SOURCE: ISO 14152:2001]

3.1.1.1.1.1
exposure
quotient of d*Q* by d*m*, where dQ is the absolute value of the total charge of the ions of one sign produced in air when all the electrons and positrons liberated or created by photons in air of mass dm are completely stopped in air, thus

$$X = \frac{\mathrm{d}Q}{\mathrm{d}m}.$$

Unit: $\mathrm{C\,kg^{-1}}$

SOURCE: [ICRU 60 (4.1.3)]

3.1.1.1.1.2
surface contamination
radioactive material which has been deposited on surfaces such as floors, tools, benches, etc..

NOTE
It may be loosely deposited, much like ordinary dust, or it may be fixed quite firmly by some chemical or physical means such as chemical bonding, adsorption, adhesion, and so on. This distinction is important, and surface contamination is classified on the basis of how easily it can be removed

[SOURCE: Noel Giffin , Wed Feb 7 16:09:39 PST 1996]

3.1.1.1.1.3
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: Adapted from IAEA Glossary, June 2007]

3.1.2
Dose
measure of the energy deposited by radiation in a target

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.1.2.1
dose coefficient
synonym for dose per unit intake of a radioactive substance, but sometimes also used to describe other coefficients linking quantities or concentrations of activity to doses or dose rates, such a 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: ICRU 103]

3.1.2.2
absorbed dose
D
*q*uotient 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 The unit of absorbed dose is Jkg^{-1}. The special name for the unit of absorbed dose is (Gy).

[SOURCE: ICRU 60 (4.2.5)]

3.1.3
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: IAEA Safety Standards, Draft 5.0, March 2011]

3.1.4
optimization of protection (and safety)
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: Adapted from ICRP 103, modified by adding “as low as reasonably achievable, economic and societal factors being taken into account” at the end]

3.1.5
limitation of dose
limit on equivalent dose 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: Adapted from National Council on Radiation Protection and Measurements USA, Glossary, modified by changing “radiation dose” by “equivalent dose”]

3.1.5.1
dose limit
value of the effective dose or the equivalent dose to individuals from planned situations that shall not be exceeded

[SOURCE: ICRP]

3.1.6
dose constraint
prospective and source related value of individual dose (dose constraint) or risk (risk constraint) that is used in planned exposure situations as a parameter for the optimization of protection and safety for the source, and that serves as a boundary in defining the range of options in optimization

[IAEA Safety Standards, Draft 5.0, March 2011]

3.1.7
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 Glossary, June 2007]

3.1.8
annual limit on intake
ALI
intake 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 equal to the relevant dose limit

NOTE 1
The annual limit on intake is expressed in units of activity.

NOTE 2
Some concepts and quantities are defined in term “reference man”, an idealized adult Caucasian male.

[SOURCE: Adapted from IAEA Glossary, June 2007,modified by changing “reference man” by “reference individual” and adding note 2]

3.1.8.1
derived air concentration (DAC)
derived limit on the activity concentration in air of a specified radionuclide, calculated such that reference individual , 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

NOTE
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.

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by replacing “Reference Man” with “reference individual”]

3.1.8.1.1
reference level
in an emergency exposure situation or an existing exposure situation, the level of dose, risk or activity concentration above which it is not appropriate to plan to allow exposures to occur and below which optimization of protection and safety would continue to be implemented

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.1.8.1.1.1
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

SOURCE: [IAEA Glossary, June 2007]

3.1.8.1.1.2
investigation level
value of a quantity such as effective dose, intake or contamination per unit area or volume at or above which investigation would be conducted

NOTE
Investigation levels are established by national authorities.

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.1.8.1.1.3
action level
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

NOTE
An action level can also be expressed in terms of any other measurable quantity as a level above which intervention should be undertaken.

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by splitting the definition into a definition and a note]

3.2 Terms related to biological effect

3.2.1
threshold dose
level of dose above which a deterministic effect occurs

[SOURCE:Lic. Inés Gómez Parada, Autoridad Regulatoria Nuclear, Buenos Aires, Argentina]

3.2.1.1
deterministic effect
biological effect of radiation for which a threshold dose exists above which the severity of the effect is greater for a higher dose

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by deleting “limit of” and the notes]

3.2.1.1.1
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: Adapted from ISO 21243:2008]

3.2.2
linear–no threshold (LNT) hypothesis
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

[SOURCE: Eng. Elías Palacios, Autoridad Regulatoria Nuclear, Buenos Aires, Argentina]

3.2.2.1
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

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

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.2.2.1.1
somatic effect
radiation induced health effect that occurs in the exposed person

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

NOTE 2
Deterministic effects are normally also somatic effects.

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by splitting the note in two and by deleting "stochastic effects may be somatic effects or hereditary effects" in the second one]

3.2.2.1.2
hereditary effect
radiation induced health effect that occurs in a descendant of the exposed person

NOTE
The less precise term 'genetic effect' is also used, but hereditary effect is preferred.
Hereditary effects are usually stochastic effects.

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.3 Terms related to radiological exposure

3.3.1
internal exposure
exposure to radiation from a source outside the body

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.3.1.1
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]

3.3.1.1.1
human alimentary tract model (HATM)
model that describes the processes that are involved when a radioactive material is incorporated by human ingestion

NOTE
HATM provides age-dependent parameter for the tract region, and associated transit times for the movement of materials through this region.

[SOURCE: Adapted from ICRP 66, modified by changing "ingestion by children and adults" to "human ingestion"]

3.3.1.1.2
human respiratory tract model (HRTM)

model that describes the processes that are involved when a radioactive material is incorporated by human inhalation

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

3.3.1.1.3
reference Individual
idealized male or female with characteristics defined by the Commission for the purpose of radiological protection, and with the anatomical and physiological characteristics defined in the report of the ICRP Task Group on Reference Man (ICRP, 2002)

[SOURCE: ICRP 103]

3.3.1.1.4
specific absorbed fraction (SAF)
fraction of energy emitted as a specified radiation type in a specified source region that is absorbed in a specified target tissue by unit mass of the target tissue.

[SOURCE: IAEA Glossary2007, June 2007]

3.3.1.1.5
clearance
removal of regulatory control by the regulatory body from radioactive material or radioactive objects within notified or authorized practices.

NOTE
Removal of control in this context refers to control applied for radiation protection purposes.

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.3.1.1.5.1
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

[SOURCE: Lic. Inés Gómez Parada, Autoridad Regulatoria Nuclear, Buenos Aires, Argentina]

3.3.1.1.6
retention function
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: ISO 20553:2006]

3.3.1.1.7
excretion function
the fraction of an intake excreted per day after a given time has elapsed since the intake occurred

[SOURCE: ISO 20553:2006]

3.3.1.1.8
organ dose
mean absorbed dose D_T in a specified tissue or organ T of the human body, given by:

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

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.

[SOURCE: IAEA Glossary, 2007]

3.3.1.1.9
radiation weighting factor
***w*R**
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.

[SOURCE: IAEA Glossary, June 2007]

3.3.1.1.10
dose equivalent
H
the product of *D* and *Q* at a point in tissue, where *D* is the absorbed dose and *Q* is the quality factor for the specific radiation at this point, thus:

$H=DQ$

NOTE The unit of dose equivalent is joule per kilogram (J kg^{-1}), and its special name is sievert (Sv).

[SOURCE: ICRP 103]

3.3.1.1.11
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.

[SOURCE: IAEA Glossary, June 2007]

3.3.1.1.12
effective dose
result of the summation of the equivalent doses in tissues or organs, each multiplied by the appropriate tissue weighting factor

NOTE 1
The effective dose is given by the expression
$E = \Sigma\, w_T\, H_T$
where H_T is the equivalent dose in tissue or organ, *T*, each multiplied by the appropriate tissue weighting factor for tissue *T*

NOTE 2
The effective dose is expressed in units of joules per kilogram (special name: sievert, Sv).

[SOURCE: Adapted from IAEA Safety Standards, Draft 5.0, March 2011 and ISO 20553:2006 by shortening the definition and adding two notes]

3.3.1.1.12.1
total dose
sum of effective dose from external radiation and committed effective dose from internal radiation

[ISO 20553:2006]

3.3.1.1.12.2
partial-body dose

equivalent dose to tissue, organs or parts of the body identified by the name of the part of the particular tissue, organ or body, e.g. bone narrow dose, skin dose, hand dose, testes dose or dose to the lens of the eyes

NOTE
The unit of equivalent dose is Jkg^{-1}, with the special name sievert (Sv).

[SOURCE: Adapted from ISO 15382:2002, modified by deleting the example in the definition and note 1]

3.3.2
external exposure
exposure to radiation from a source within the body

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.3.2.1
kerma
K
quotient of dE_{tr} by dm, where dE_{tr} is the sum of the initial kinetic energies of all the charged particles liberated by uncharged particles in a mass dm of material, thus

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

NOTE The unit of kerma is J kg^{-1}. The special name for the unit of kerma is gray (Gy).

[SOURCE:ICRU 60 (4.1.1)]

3.3.2.1.1
phantom
object constructed to simulate the scattering and attenuation properties of the human body

[SOURCE: Adapted from ISO 6980-2:2004, modified by deleting the note]

3.3.2.1.1.1
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

NOTE
ICRU sphere is used as a reference phantom in defining dose equivalent quantities.

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.3.2.1.1.2
reference phantom
computational phantom for the human body (male and female voxel phantoms based on medical imaging data) with the anatomical and physiological characteristics defined in the report of the ICRP Task Group on Reference Man (ICRP 2002)

[SOURCE: ICRP 2007, Vol 39 Nº2]

3.3.2.1.1.3
quality factor
Q
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*

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by deleting the two notes]

3.3.2.1.1.3.1
personal dose equivalent
*H*p *(d)*
dose equivalent in soft tissue (commonly interpreted as the 'ICRU sphere' ICRU tissue) at an appropriate depth, d, below a specified point on the human body.

NOTE1:The unit of personal dose equivalent is joule per kilogram ($J\ kg^{-1}$) and its special name is sievert (Sv).

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

[SOURCE: ICRP 103]

3.3.2.1.1.3.2
directional dose equivalent
H´(d,Ω)
dose equivalent at a point in a radiation field, that would be produced by the corresponding expanded field, in the ICRU sphere at a depth, *d*, on a radius in a specified directional, Ω

NOTE : Unit $J\ kg^{-1}$ .The special name for the unit of directional dose equivalent is sievert (Sv).

[SOURCE: ICRU 51]

3.3.2.1.1.4
conversion coefficient for neutrons
$h_{p\phi}(10;E,\alpha)$

quotient of the personal dose equivalent, $H_{p(10)}$, 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 at 10 mm depth in the ICRU tissue slab phantom, where E is the energy of the incident neutrons impinging on the phantom at an angle α

NOTE The SI unit of the conversion coefficient is $Sv \cdot m^2$. A commonly used unit of the conversion coefficient is $pSv \cdot cm^2$.

[SOURCE: ISO 21909:2005]

3.3.2.1.1.5
ICRU tissue
soft tissue
material with a density of 1 g cm^{-3} and a mass composition of 76,2 % oxygen, 10,1 % hydrogen, 11,1 % carbon, and 2,6 % nitrogen

[SOURCE: ICRU 39:1985, *Determination of Dose Equivalents Resulting from External Radiation Sources* and ISO 6980-1:2006]

3.3.2.1.1.5.1
tissue equivalence
property of a material that approximates the radiation attenuation and scattering properties of human tissue

[SOURCE: ISO 6980-1:2006]

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

[SOURCE: Adapted from ISO 6980-1:2006, modified by changing "the radiation attenuation" for "the absorption" and deleting the note]

3.3.3.1
existing exposure situation

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

NOTE
Examples: exposure to natural background radiation and exposure to residual radioactive material from a nuclear or radiological emergency after the emergency exposure situation has been declared ended

[SOURCE: Adapted from IAEA.org: Radiation Protection]

3.3.3.2
planned exposure situation

situation arising from the planned operation of a source or from a planned activity that results in an exposure from a source

[SOURCE: Adapted from IAEA.org: Radiation Protection]

3.3.3.3
emergency exposure situation
emergency exposure
situation of exposure where exposure at an elevated level is inevitable due to unexpected events or needs of important action

NOTE
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.

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by adding “where exposure at an elevated level is inevitable due to unexpected events or needs of important action”]

3.3.3.4
public exposure
exposure incurred by members of the public due to sources in planned exposure situations amd existing exposure situations, excluding any occupational or medical exposure

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.3.3.4.1
occupancy factor (T)
level of human occupancy of an area adjacent to a source of radiation

NOTE
The occupancy factor is used to determine the amount of shielding required in the walls. T is rated as full, for an office or laboratory next to an x-ray facility; partial, for corridors and restrooms; or occasional, for stairways, elevators, closets, and outside areas.

[SOURCE: Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier]

3.3.3.5
potential exposure
exposure that is not expected to be delivered with certainty but that may result from an accident at a source or an event or sequence of events of a probabilistic nature, including equipment failures and operating errors

[SOURCE: ICRP 103]

3.3.3.6
medical exposure
exposure incurred by patients for the purposes of medical or dental diagnosis or treatment; by carers and comforters; and by volunteers subject to exposure as part of a programme of biomedical research

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.3.3.7
occupational exposure
exposure of workers incurred in the course of their work

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.3.3.8
emergency planning zone (EPZ)
area to facilitate a preplanned strategy for actions ***t***o avoid and reduce the public exposure during an emergency around each nuclear installation

[SOURCE: Adapted from Nuclear Regulatory Commission USA, modified by changing “zone” by “area”, deleting “protective”, adding “to avoid and reduce the public exposure” and replacing “power plant” by “installation”]

3.3.3.8.1
ingestion exposure planning zone (IEPZ)
ingestion exposure pathway zone (IEPZ)
radius of about 50 miles from the reactor site

NOTE
Predetermined protective action plans are in place for this EPZ and are designed to avoid or reduce dose from potential ingestion of radioactive materials. These actions include a ban of contaminated food and water

[SOURCE: Adapted from USNRC: US Nuclear Regulatory Commission]

Proposed definition:

zone of a radius from a nuclear installation dependant of the nature of the installation and past experience at which the ingestion of any radioactive fallout from any accident will not have a significant consequence

3.4 Terms related to radiological monitoring

3.4.1
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 Glossary, June 2007]

3.4.1.1
radiological monitoring
radiation 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: Adapted from ISO 22188:2004 and ISO 20553:2006]

3.4.1.1.1
routine monitoring
monitoring carried out at regular intervals during normal operations

[SOURCE: SO 12790-1:2001]

3.4.1.1.2
special monitoring
monitoring carried out to quantify significant exposures following actual or suspected conditions

[SOURCE: Adapted from ISO 12790-1:2001, modified by adding “to quantify significant exposures following”]

3.4.1.1.3
operational monitoring
monitoring related to certain operations

[SOURCE: ISO 12790-1:2001]

3.4.1.1.4
environmental monitoring
measurement of external dose rates due to sources in the environment or of radionuclide concentrations in environmental media

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.4.1.1.5
workplace monitoring
monitoring using measurements made in the working environment

[SOURCE: ISO 20553:2006]

3.4.1.1.6
individual monitoring
personal monitoring
monitoring using measurements by equipment worn by individual workers, or measurements of quantities of radioactive material in or on their bodies.

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by deleting the note]

3.4.1.1.7
area monitoring
form of workplace monitoring in which an area is monitored by taking measurements at different points in the area

[SOURCE: IAEA Glossary, June 2007]

3.5 Terms related to measurement

3.5.1
bias
measurement bias
estimate of a systematic measurement error

[SOURCE: VIM (2.18)]

3.5.2
measurand
quantity intended to be measured

NOTE 1 The specification of a measurand requires knowledge of the kind of quantity, description of the state of the phenomenon, body or substance carrying the quantity, including any relevant component, and the chemical entities involved.

NOTE 2 In the second edition of the VIM and in IEC 60050-300:2001, the measurand is defined as the “quantity subject to measurement”.

[SOURCE: Adapted from VIM]

3.5.2.1
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 II error) while accepting a probability α of a erroneously deciding that a positive (non-zero) quantity of measurand is present in an appropriate blank sample (Type I error)

[SOURCE: ISO 12790-1:2001]

3.5.2.2
minimum detection level
MDL
smallest measurable amount (e.g. frequency or dose) that will be detected with a probability β of non-detection (Type II error) while accepting a probability α of erroneously deciding that a positive (non-zero) quantity present in an appropriate background sample (Type I error)

[SOURCE: ISO 19238:2004]

3.5.3
calibration
operation that, under specified conditions, establishes a relation between conventionally true value of quantity provided by standards and indication by measuring system

NOTE
It is important not to confuse calibration with adjustment of a measuring system., often mistakenly called "self-calibration", or with verification of calibration.

[SOURCE: Adapted from VIM 2008 (2.39), modified by shortening the definition, deleting the three notes and replacing them by only one]

3.5.3.1
reference conditions
set of influence quantities for which the calibration factor is valid without any correction

NOTE 1 Ideally, calibrations should be carried out under reference conditions. As this is not always achievable (e.g. for ambient air pressure) or convenient (e.g. for ambient temperature), a (small) interval around the reference values may be used. The deviations of the calibration factor from its value under reference conditions caused by these deviations should in principle be corrected for. In practice, the uncertainty aimed at serves as a criterion as to which influence quantity has to be taken into account by an explicit correction or whether its effect may be incorporated into the uncertainty. During type tests, all values of influence quantities which are not the subject of the test are fixed within the interval of the standard test conditions. The standard test conditions together with the reference conditions applicable to this part of ISO 4037 are given in Tables A.1 and A.2 of annex A.

NOTE 2 The value for the quantity to be measured may be chosen freely in agreement with the properties of the instrument to be calibrated. The quantity to be measured is not an influence quantity.

[SOURCE: ISO 4037-3:1999]

3.5.4
repeatability
closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement

[SOURCE: ISO 12790-1:2001]

3.5.5
reproducibility
closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement

[SOURCE: ISO 12790-1:2001]

3.5.6

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 Glossary2007, June 2007]

3.5.6.1
***in vitro* measurement**
measurements to determine the presence of or to estimate the amount of radioactive material in the excreta or in other biological materials removed from the body

[SOURCE: Adapted from ISO 12790-1:2001]

3.5.6.1.1
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.

[SOURCE: Adapted from DOE G4411-1B 3-1-2007, modified by deleting "(typically within one foot)"]

3.5.6.2
***in vivo* measurement**
measurement to determine the presence of or to estimate the amount of radioactive material in a living organism

[SOURCE: Adapted from ISO 12790-1:2001]

3.5.6.2.1
whole body counter (WBC)
facility where the determination of the whole body burden activity can be performed

[SOURCE: Lic. Inés Gómez Parada, Autoridad Regulatoria Nuclear, Buenos Aires, Argentina]

3.5.6.2.2
lung counter
equipment for the determination of the lung burden activity

[SOURCE: Lic. Inés Gómez Parada, Autoridad Regulatoria Nuclear, Buenos Aires, Argentina]

3.5.6.2.3
thyroid monitor
equipment for the determination of the thyroid burden activity

[SOURCE: Lic. Inés Gómez Parada, Autoridad Regulatoria Nuclear, Buenos Aires, Argentina]

3.5.7
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.

NOTE — For example:
- pulse ionization chamber,
- integration ionization chamber,
- current ionization chamber.

[SOURCE: IEC 394-05-02 MOD]

3.5.7.1
extrapolation ionization chamber
ionization chamber in which one of its characteristics can be varied, normally the spacing between electrodes, in order to extrapolate the chamber response to zero sensitive mass.

[IEC 394-05-21]

3.5.8
dosemeter
dosimeter
instrument used for measuring or evaluating the absorbed dose

[SOURCE: ISO 921:1997]

3.5.8.1
etched track detector
material, usually plastic in nature, etched and inspected microscopically to count nuclear tracks produced by incoming ionizing radiation

[SOURCE: Adapted from ISO 21909:2005, modified by changing "carefully manufactured under controlled conditions for the purpose of radiation measurements" for "etched and inspected microscopically to count nuclear tracks produced by incoming ionizing radiation"]

3.5.8.2
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]

3.5.8.3
optically stimulated luminescence (OSL) dosimeter
radiation dosimeter based on the emission of light when certain solids are warm

NOTE 1 The key elements of the dosimeter, thermoluminescent phosphors with deep traps, can store some of the energy absorbed from the radiations for very long periods at normal temperatures and release it as luminescence on demand when appropriately heated.

NOTE 2 The brightness (or light sum) of the luminescence is a measure of the original radiation dose.

[SOURCE: http://www.answers.com/topic/thermoluminescence#ixzz1VOBInLQ7]

3.5.9
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_T is the radiation weighting factor for radiation type R. When the radiation field is composed **of** different radiation types with different values of w_T the equivalent dose is:

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

NOTE

The unit of effective dose is Jkg^{-1}, with the special name sievert (Sv).

[SOURCE: Adapted from IAEA Glossary, June 2007, modified by deleting the last part of the note1 and notes 2 and 3]

3.5.10
biological dosimetry
measurement of the degree of a biological response to radiation, that is then used indirectly as measure of the absorbed dose received by tissue

[SOURCE: ICRU 30]

3.5.11
fading
loss of information during a period of time of an irradiated dosemeter

[SOURCE: ISO 21909:2005]

3.6 Terms related to technical aspects

3.6.1
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: Adapted from Thomas Jefferson National Accelerator Facility USA: Jefferson Lab Glossary, modified by changing “beam” to “area”]

3.6.2
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]

3.6.2.1
shielded enclosure
containment enclosed by an additional shielding wall intended to provide complementary shielding against penetrating radiation

NOTE 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.

[SOURCE: ISO 15080:2001]

3.6.2.2
build-up factor
in the passage of radiation through a medium, the 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 Glossary2009 (Draft)]

3.6.3
sealed radioactive source
radioactive source sealed in a capsule or having a bonded cover, the capsule or cover being strong enough to prevent contact with and dispersion of the radioactive material under the conditions of use and wear for which it was designed

[SOURCE: ISO 3999-1:2004]

3.6.4
high-efficiency particulate air filter
HEPA filter
high-efficiency filter used for removing aerosol particles from an air stream

NOTE 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.

[SOURCE: ISO 2889:2010]

3.6.5
protection factor
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: Adapted from ISO 8194:1987, modified by adding “under test conditions” and deleting the note]

3.6.6
naturally occurring radioactive material (NORM)
radioactive material containing no significant amounts of radionuclides other than naturally occurring radionuclides

NOTE
The exact definition of “significant amount” would be a regulatory decision.

[SOURCE: IAEA Glossary, June 2007]]

3.6.7
use factor
(in shielding design) the fraction of time that an x-ray beam is pointing in any given direction

[SOURCE: Adapted from Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier, modified by deleting “x-rays”]

3.6.8
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
The iodine prophylaxis is an urgent protective action.

NOTE 2
The term ‘thyroid blocking’ is sometimes used.

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.6.9
Computer Tomography Dose Index (CTDI)
the integrated dose profile (in the z-direction) for a single slice, normalized to the nominal slice thickness

NOTE
It can be measured either in air or in a phantom using either a pencil ion chamber or a row of TLDs. In essence the CTDI gives a measure of the “raw” output of a scanner

[SOURCE: Adapted from IAEA-TECDOC-1423]

3.6.10
high level waste (HLW).
high level radioactive waste (HLRW)
radioactive material containing most of the fission products and actinides present in spent fuel

NOTE 1:High level waste 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.

NOTE 2:Typical characteristics of high level waste are thermal power above about 2 kW/m^3 and long lived radionuclide concentrations exceeding limitations for short lived waste.

[SOURCE: Adapted from IAEA Safety Glossary, Version 2.0, September 2006, modified by splitting the definition in a definition and Note 1]

3.6.11
low level radioactive waste(LLRW)
radioactive waste with radiological characteristics between those of exempt waste and high level waste (LILW-LL). This may be long lived waste or short lived waste (LILW-SL)

NOTE
Low and intermediate level waste have activity levels above clearance levels and thermal power about 2 kW/m^2

[SOURCE: Adapted from IAEA Glossary 2007]

3.6.12
diagnostic reference level (DRL)
dose level in medical radiodiagnostic practices

NOTE 1
In radiophamaceuticals, DRL is level of activity for typical examinations for groups of standardized patients or standard phantom for broadly defined types of equipment.

NOTE 2
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: Adapted from Optimization of the Radiological Protection of Patients Undergoing Radiography, Fluoroscopy and Computed Tomography, IAEA TECDOC, Series N° 1423]

3.7Terms related to regulation

3.7.1
source-related assessment
assessment concerned with the exposures resulting from a single source

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

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

3.7.2
individual-related assessment
assessment concerned with the exposure of a single individual from many sources

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

3.7.3
risk coefficient,

lifetime risk or radiation detriment assumed to result from exposure to unit equivalent dose or effective dose

[SOURCE: IAEA Glossary June 2007]

3.7.4
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 Glossary, June 2007]

3.7.5
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
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 in which the activity concentrations of natural radio nuclides are below the relevant values given in IAEA safety standards.

NOTE 2
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: Adapted from IAEA Glossary, June 2007]

3.7.6
derived release limit
upper limits of release of radionuclides into atmosphere

[SOURCE: Health Physics 2005, 88 nº4]

3.7.7
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
Often used in a more general sense combining all processes (including molecular diffusion) that result in the spreading of a plume.

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

[SOURCE: Adapted from IAEA Glossary, June 2007]

3.7.8
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 Glossary, June 2007]

3.7.9
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 extend of potential exposures

[SOURCE: IAEA Glossary, June 2007]

3.7.10
access control
process of granting or denying specific requests

NOTE
The specific requests can be: 1) for 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: Adapted from Committee on National Security Systems (CNSS) Instruction No. 4009; 26 April 2010]

3.7.11
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 Glossary, June 2007]

3.7.12
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]

3.7.12.1
equilibrium factor
ratio of the equilibrium equivalent concentration of radon to the actual radon concentration.

[SOURCE: IAEA Glossary, June 2007]

3.7.13
committed dose
lifetime dose expected to result from an intake.

[SOURCE: IAEA Glossary, June 2007]

3.7.14
annual dose
committed effective dose resulting from all intakes and radiation due to external sources occurring during a calendar year

[SOURCE: Adapted from ISO 20553:2006, modified by adding “and radiation due to external sources]

3.7.15
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 Glossary, June 2007]

3.7.16
projected dose
dose that would be expected to be received if planned protective actions were not taken

[SOURCE: IAEA Safety Standards, Draft 5.0, March 2011]

3.7.16.1
protective action guide (PAG)
a value against which to compare the projected dose to an individual from a release of radioactive material at which a specific protective action to reduce or avoid that dose is warranted

[SOURCE: EPA Protective Action Guides , September 2007]

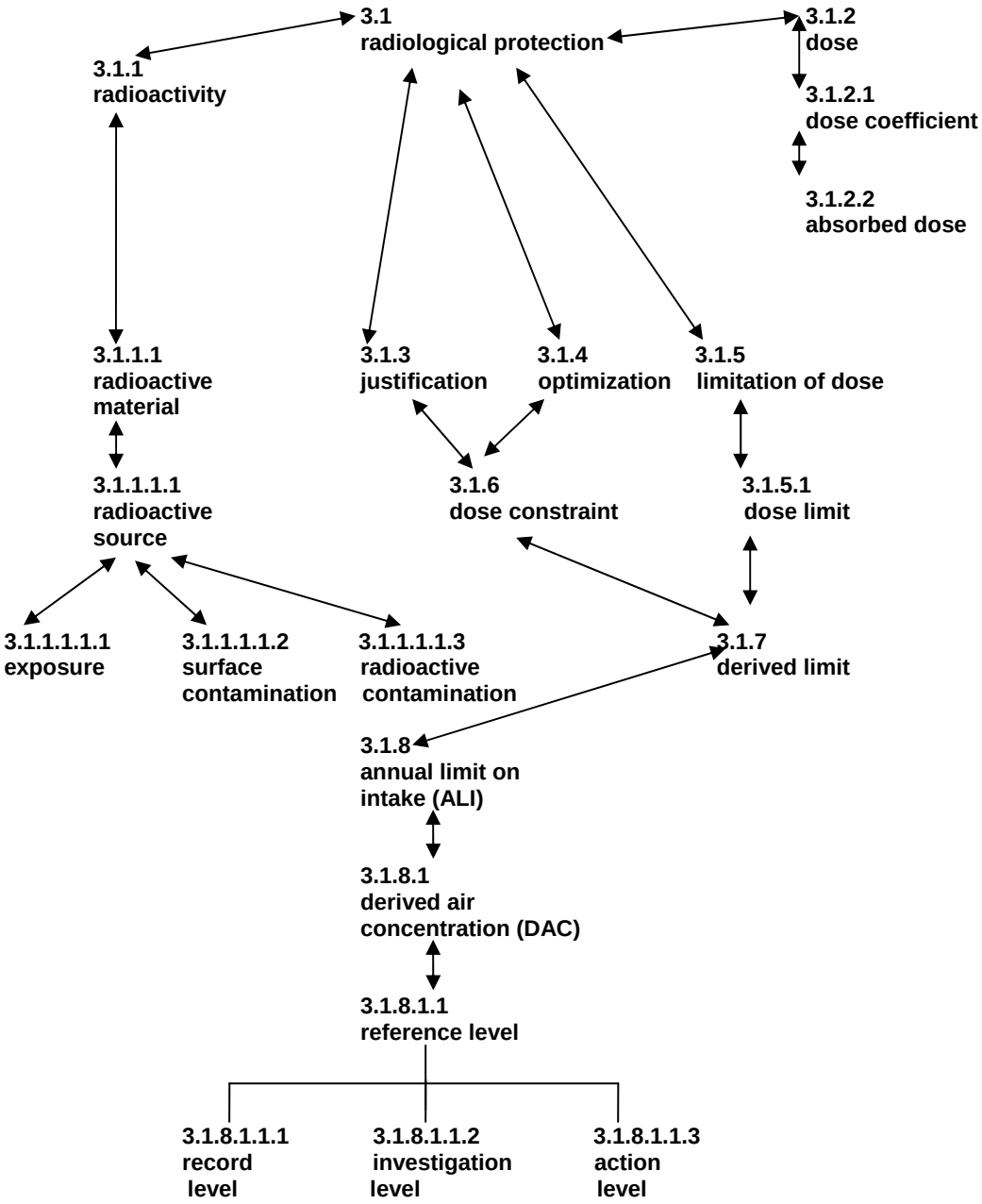
Annex A
(informative)

Concept diagrams

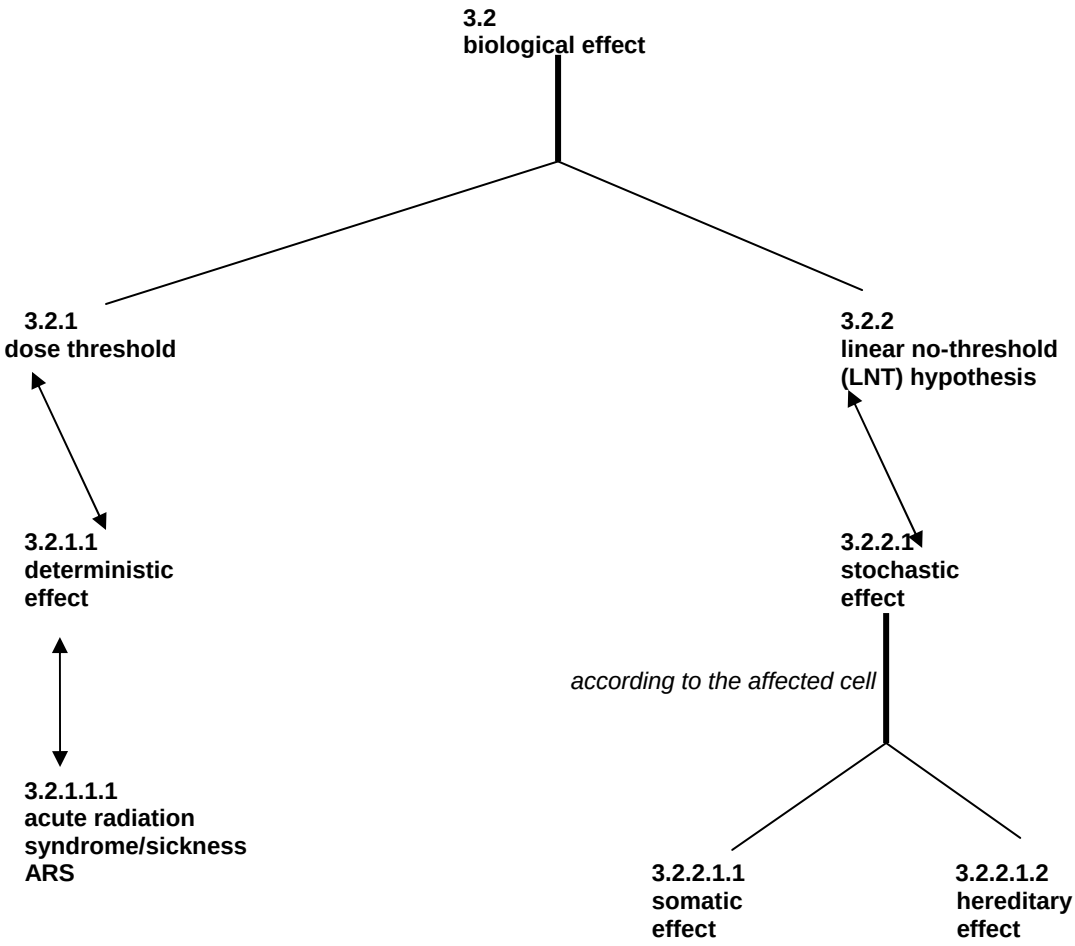
Notations in following diagrams show the position of each concept according to generic, partitive and associative relationship.

It has to be taken into account that following concept diagrams are only preliminary attempts to locate defined radiological protection concepts. Technical experts are required to check them and if necessary, to redesign them.

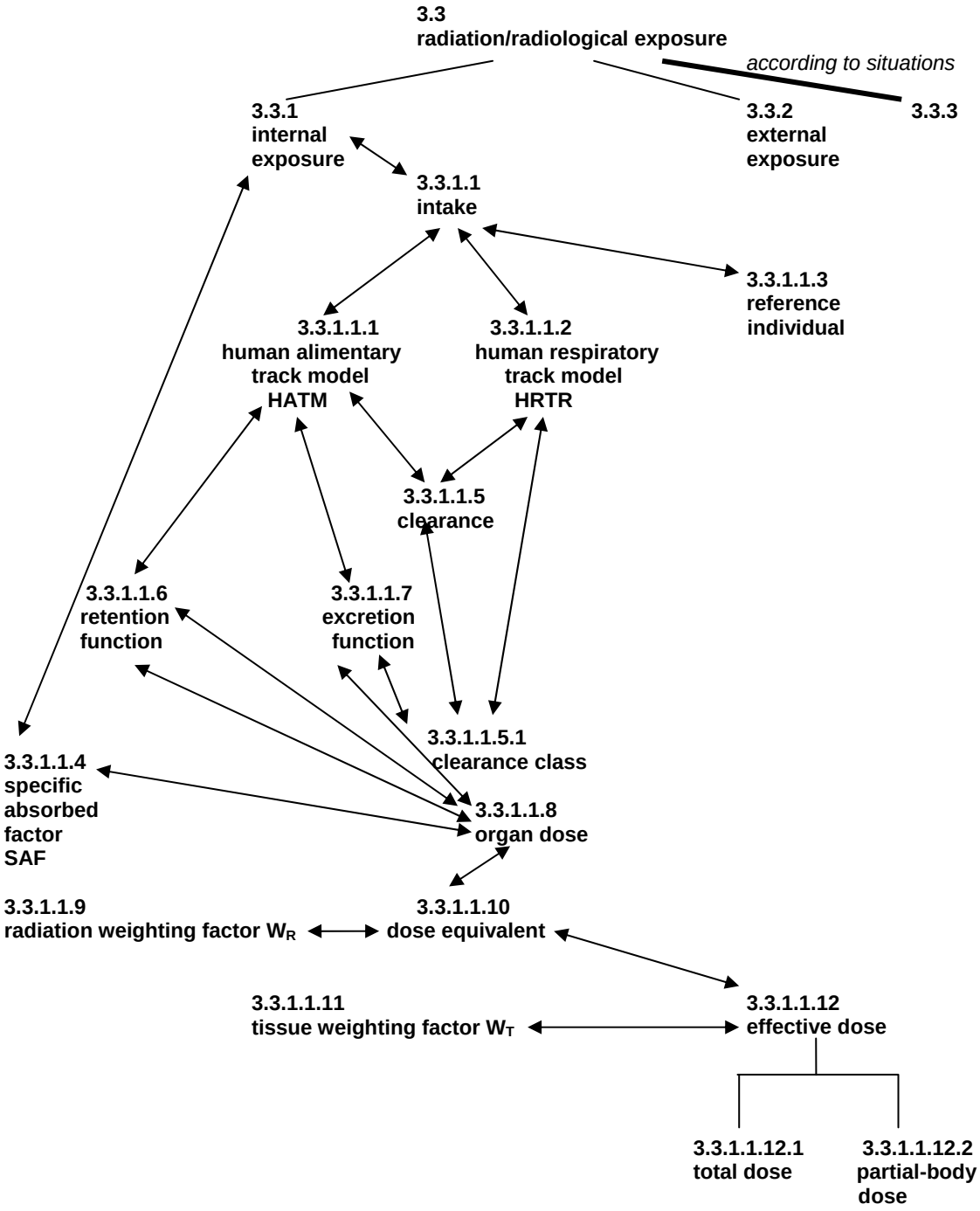
A.1 General terms related to radiological protection



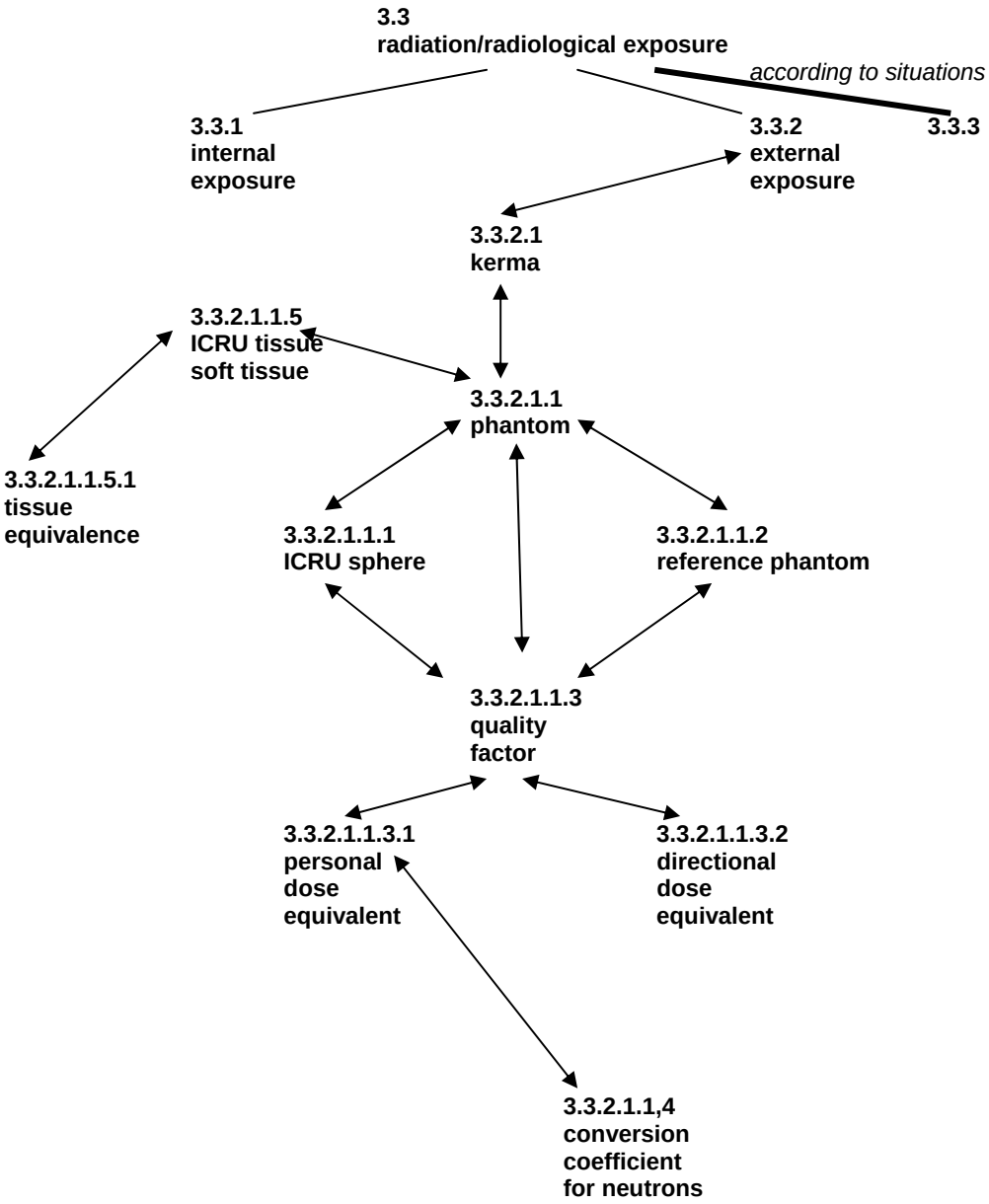
A.2 Terms related to biological effects



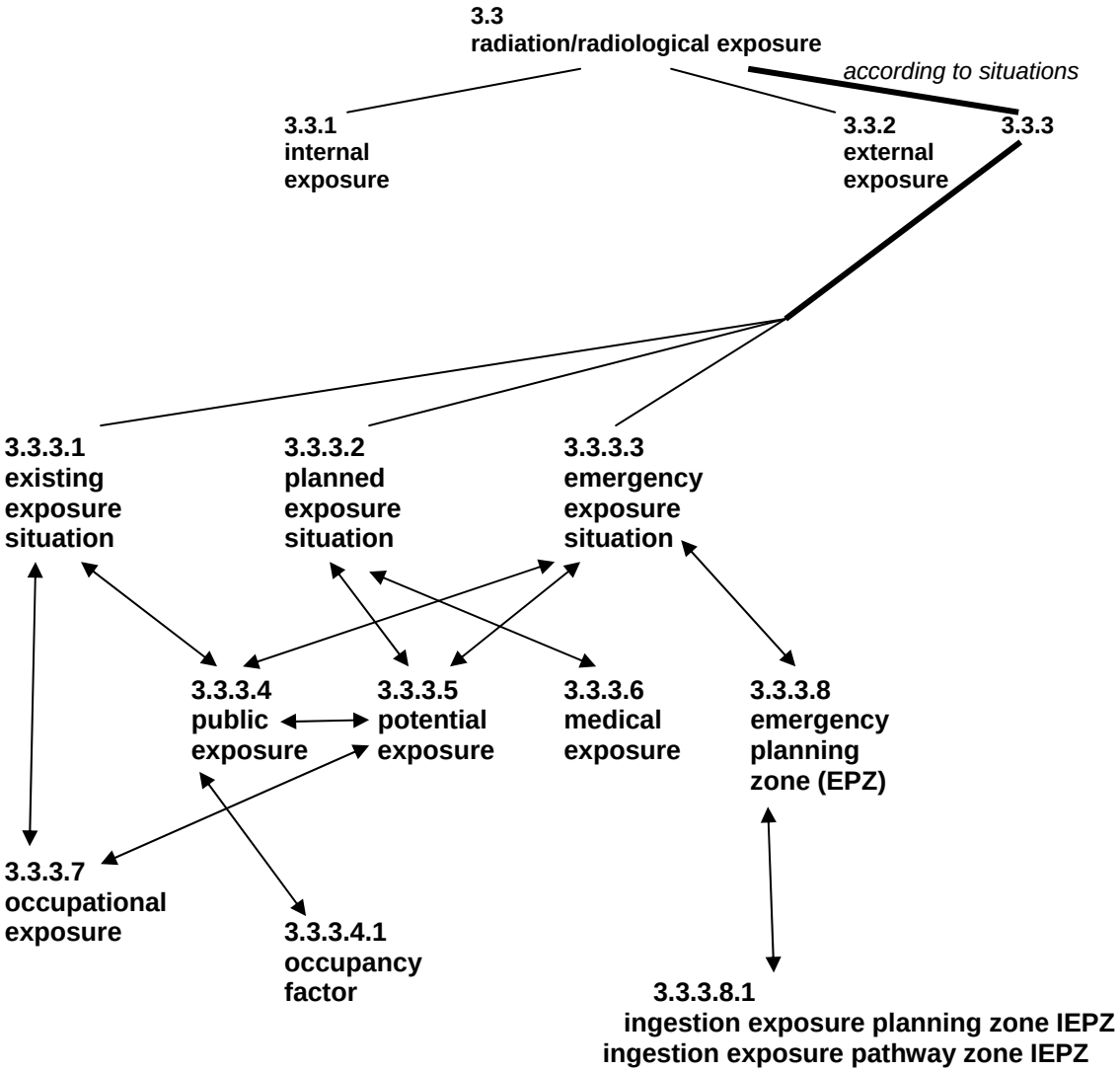
A.3 Terms related to radiological exposure



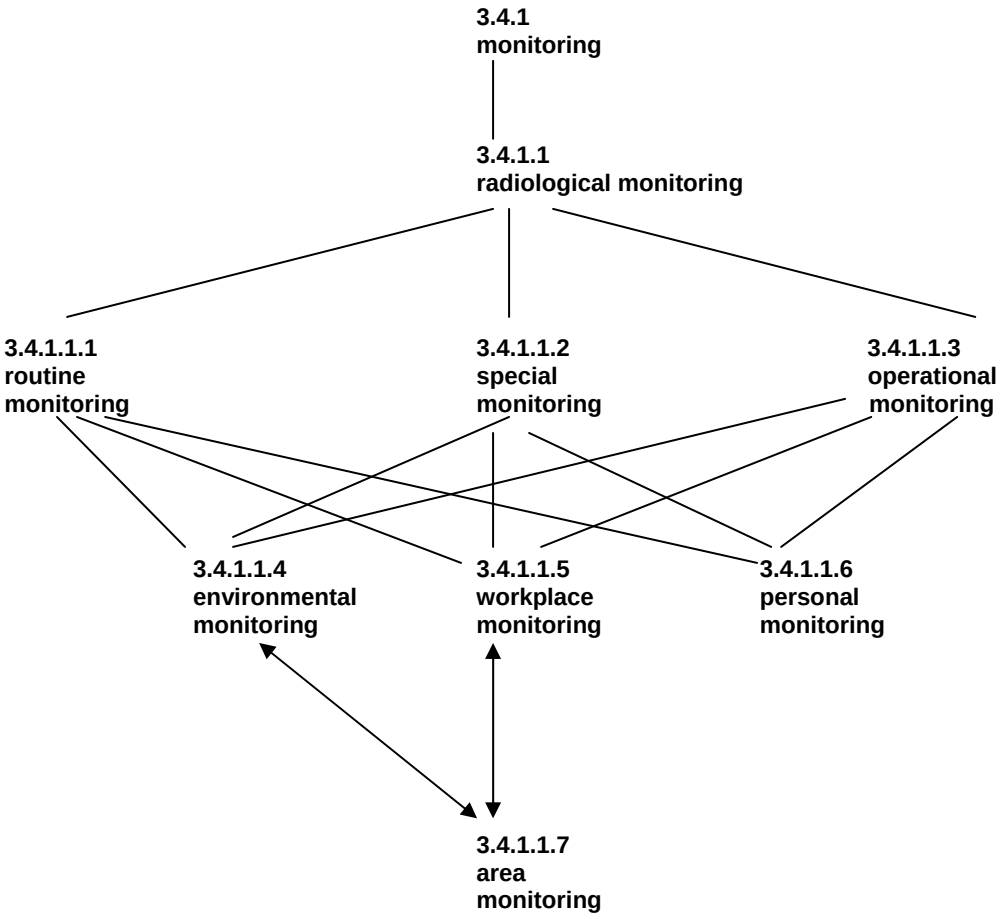
A.3 Terms related to radiological exposure *(Cont.)*



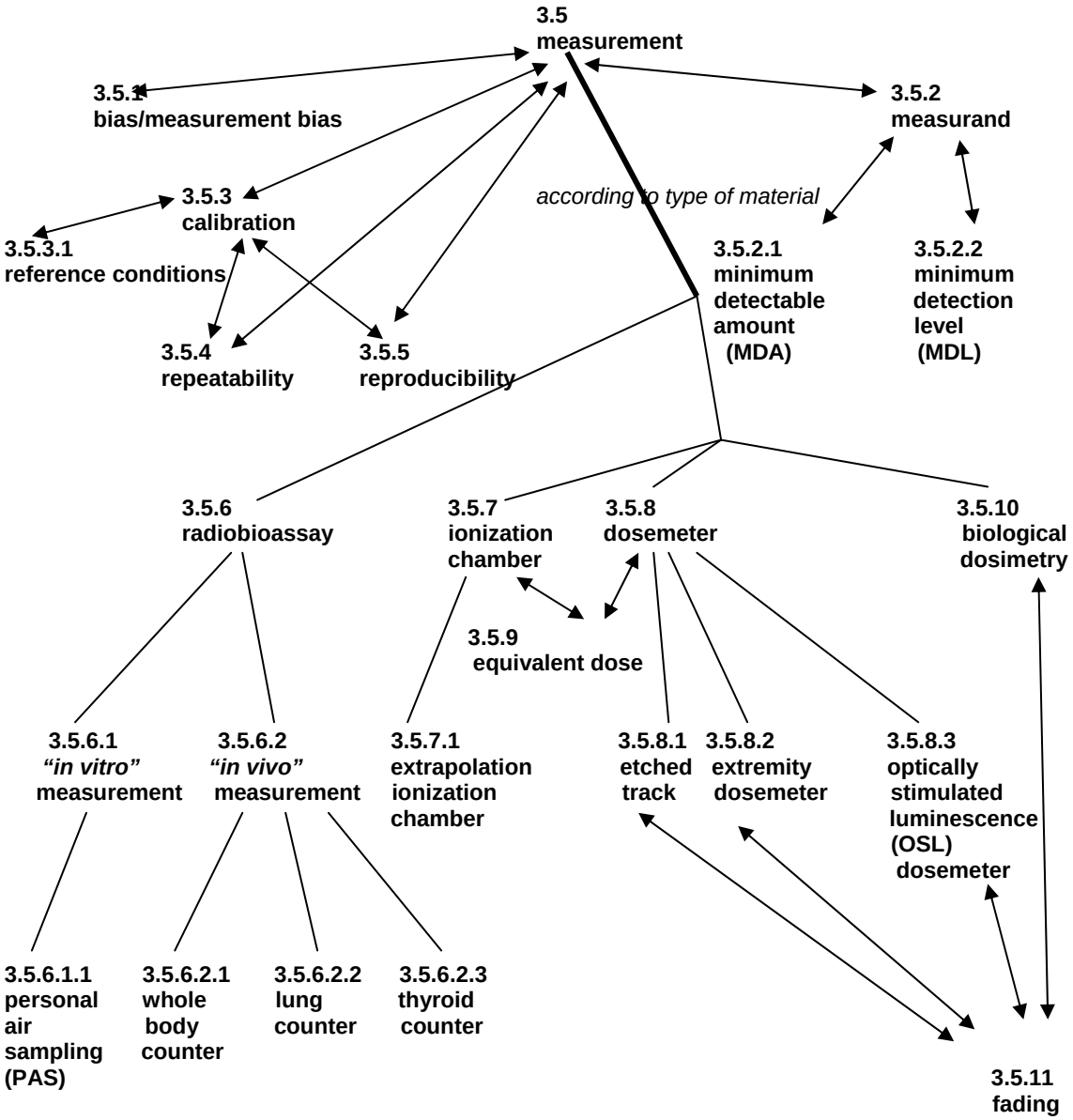
A.3 Terms related to radiological exposure *(Cont.)*



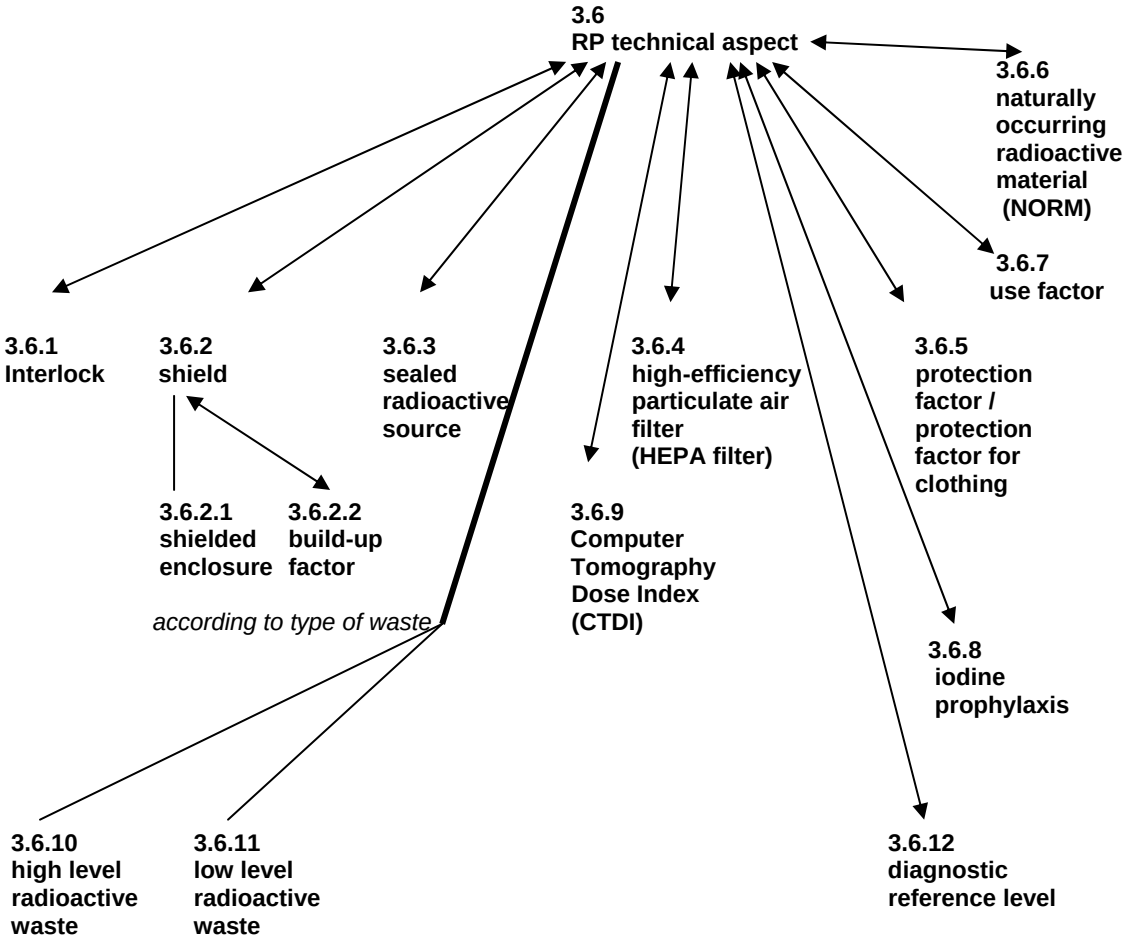
A.4 Terms related to radiological monitoring



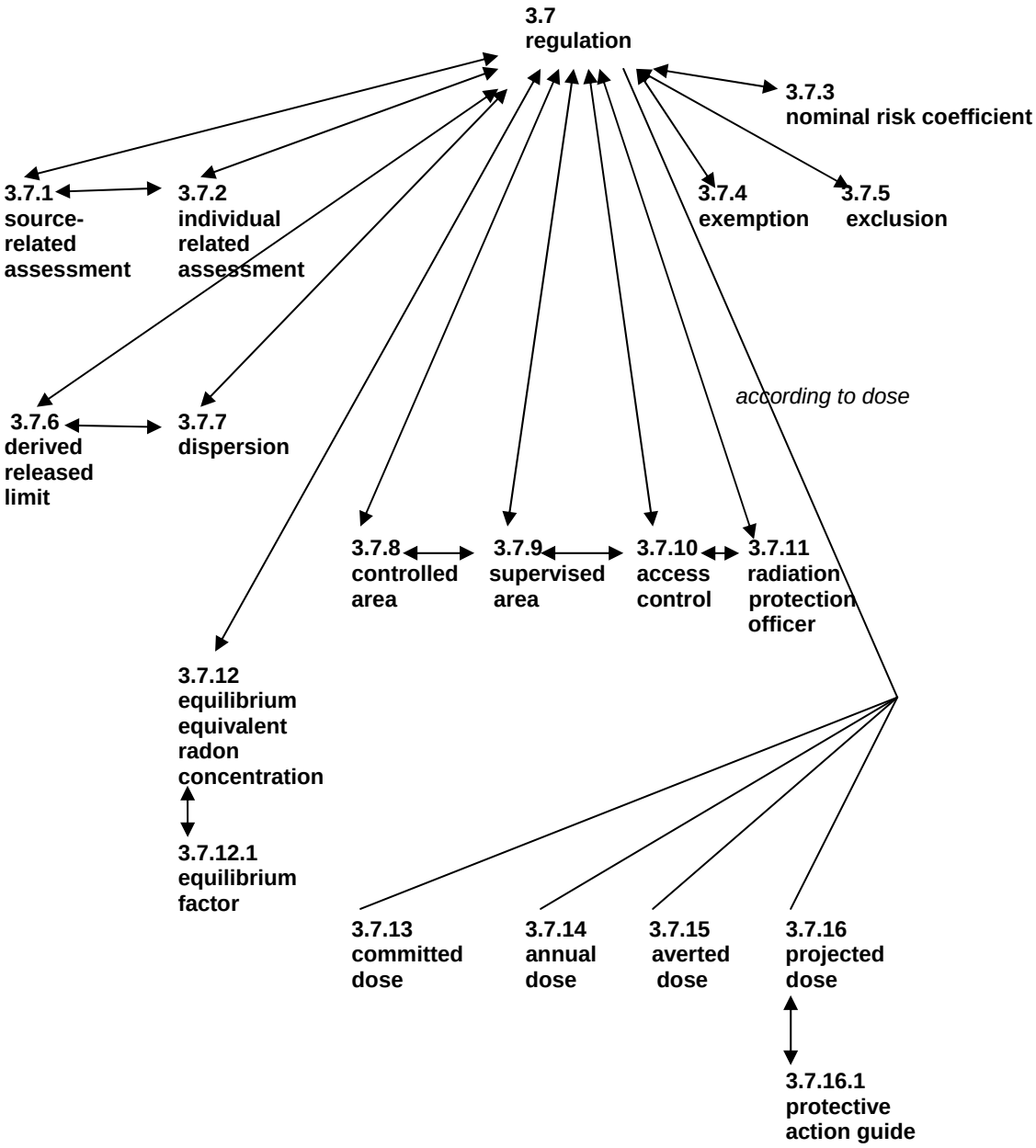
A.5 Terms related to measurement



A.6 Terms related to technical aspects



A.7 Terms related to regulation



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