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

Part 2: Radiological protection

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Partie 2: Protection radiologique

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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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.

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
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”.]