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Nuclear energy — Vocabulary —

Part 1: General terminology

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Partie 1: Terminologie générale

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Foreword

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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*.

A list of all parts in the ISO 12749 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides terms and definitions for basic concepts of nuclear energy, nuclear technologies, and radiological protection. Terminological data are taken from ISO standards developed by ISO/TC 85 and other technically validated documents, including the IAEA Glossary and vocabularies issued by different organizations Organization for Economic Co-operation and Development, Nuclear Energy Agency, Joint Committee for Guides in Metrology.

Unambiguous communication of nuclear energy and radiological 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 these activities. In line with the international demand for harmonization of terminology regarding nuclear and radiological activities, this standard will contribute to provide general, cross-cutting terms and definitions to meet users´ requirements. It will also improve promotion, knowledge and use of international standards dealing with nuclear energy, nuclear technologies and radiological protection and will help experts developing technical standards to avoid overlapping and contradiction.

Arrangement of terms and definitions is based on concepts systems that show corresponding relationships among nuclear and radiological concepts. Such arrangement provides users with a structured view of the nuclear energy, nuclear technologies, and radiological protection sectors and will facilitate common understanding of all related concepts, see also Annex A. 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 in fields like basic and applied sciences, technology, industry, health, safety, security and human resources training.

Nuclear energy — Vocabulary —

Part 1: General terminology

1 Scope

This document contains the terms, definitions, notes to entry and examples corresponding to the basic concepts of the nuclear energy, nuclear technologies, and radiological protection subject fields.

It provides the minimum essential information for each cross-cutting concept represented by a single term.

NOTE A full understanding of concepts goes with a background knowledge of nuclear energy, nuclear technologies, and radiological protection. It is intended to facilitate communication and promote common understanding.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Basic terms related to nuclear energy, nuclear technologies, and radiological protection

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

[SOURCE: IAEA Safety Glossary, 2018 Revision, June 2019, modified by adding “stochastic natural” at the beginning of the sentence, by replacing “atoms” with “nuclei”, by deleting “usually” and by replacing “radiation” with “subatomic particles, and/or photons”.]

3.1.2
activity
A
quotient of $-\mathrm{d}N$ by $\mathrm{d}t$, where $\mathrm{d}N$ is the change in the number of radioactive nuclei, at a particular energy state and at a given time, due to spontaneous nuclear transformations in the time interval $\mathrm{d}t$

[SOURCE: ICRU 85, 6.2, October 2011, modified by changing the order of the phrases, by deleting the word “mean”, by adding the word “radioactive”.]

Note 1 to entry: It is expressed as $A = -\mathrm{d}N / \mathrm{d}t$. Activity can be calculated as $A = \lambda N$, where λ is the *decay constant* (3.1.11) and N is the number of present radioactive nuclei.

Note 2 to entry: The special name for the unit of activity in the International System of Units is Becquerel (Bq), where 1 Bq = 1 s^{-1}. The use of the former unit Curie (1 Ci = 3,7 × 10^{10} Bq), is also accepted in many countries and in BIPM.

3.1.3
radiation
emission or transmission of energy in the form of waves or particles through space or through a material medium

Note 1 to entry: The term also applies to the radiated energy itself. Radiation includes electromagnetic, acoustic and particle radiation, as well as all forms of ionizing radiation.

[SOURCE: science.wolfram.com retrieved 5 December 2017, modified.]

3.1.4
ionizing radiation
radiation (3.1.3) capable of displacing electrons from atoms or molecules, thereby producing ions

Note 1 to entry: Ionizing radiation includes alpha radiation, beta radiation, neutron radiation, gamma or x rays, and cosmic rays.

[SOURCE: NCRP Composite Glossary
https://ncrponline.org/wp-content/themes/ncrp/PDFs/NCRP-Composite-Glossary.pdf]

3.1.5
radiation source
apparatus, substance or installation, that may cause radiation exposure, by emitting *ionizing radiation* (3.1.4) or releasing radioactive substances or materials

[SOURCE: ISO 12749-2:2013, 1.1.1 modified — by deleting the word “anything” and parenthesis to fulfil terminological requirement with regard to drafting of definitions.]

3.1.6
radiation processing
intentional irradiation of products or materials to preserve, modify or improve their characteristics

[SOURCE: ISO/ASTM 52628:2013, 3.1.12]

3.1.7
radiation shield
shielding
material interposed between a source of *radiation* (3.1.3) and persons, equipment or other objects, in order to attenuate the radiation

[SOURCE: ISO 12749-5:2018, 3.1.20, modified — by changing the verb “attenuate” by “reduce”.]

3.1.8
radionuclide
nuclide which is in an unstable state due to excess of internal energy and which will attain a stable state by emitting *radiation* (3.1.3)

Note 1 to entry: Radionuclides are either naturally occurring, such as ^{40}K, ^{235}U, ^{238}U, ^{232}Th and their radioactive *decay* (3.1.10) products, or produced by activation or other artificial means.

3.1.9
half-life
$T_{1/2}$
mean time taken for the activity of an amount of *radionuclide* (3.1.8) to become half its initial value

Note 1 to entry: $T_{1/2} = \ln 2/\lambda$, where λ is the *decay constant* (3.1.11).

3.1.10
decay
<radioactive> spontaneous nuclear transformation of one nuclide into a different nuclide or into a different energy state of the same nuclide

[SOURCE: NCRP Composite Glossary
https://ncrponline.org/wp-content/themes/ncrp/PDFs/NCRP-Composite-Glossary.pdf]

3.1.11
decay constant
λ
quotient of dP by dt, for a radionuclide in a particular energy state, where dP is the likelihood of a single nucleus undergoing a spontaneous nuclear transition from that energy state in the time interval dt

$$\lambda = \frac{dP}{dt} = -\frac{1}{N}\frac{dN}{dt}$$

where N is the number of nuclei of concern existing at time t and A is the *activity* (3.1.2)

Note 1 to entry: The decay constant is related to the radioactive *half-life* (3.1.9), $T_{1/2}$, of the radionuclide by the expression: $\lambda = \frac{\ln 2}{T_{1/2}}$

[SOURCE: IAEA Safety Glossary, 2018 Revision, June 2019, modified — by changing the position of the phrase between commas to fulfil terminological requirement with regard to drafting of definitions.]

3.2 Terms related to nuclear energy

3.2.1
nuclear energy
energy released by *nuclear fission* (3.2.2) or fusion

3.2.2
nuclear fission

splitting of a nucleus into fission fragments, either spontaneously or as a result of the impact of a particle, usually with an associated release of energy

Note 1 to entry: The nucleus usually has a high mass number, together with an intermediate or low average-binding-energy-per-nucleon; hence, an inherent instability exists, and the fission fragments are usually highly unstable.

[SOURCE: ISO 12749-5:2018, 3.1.1]

3.2.3
nuclear fusion
reaction in which two atomic nuclei combine to form a heavier atomic nucleus with the release of energy

[SOURCE: “Collins Dictionary”. 2019 (Retrieved: November 06, 2019)]

Note 1 to entry: Nuclear fusion occurs with very light element nuclei, like ^{2}H, ^{3}He, etc.

3.2.4
chain reaction
self-sustaining reaction in which the fission of nuclei of one generation of nuclei produces particles that cause the fission of at least an equal number of nuclei of the succeeding generation

3.2.5
nuclear fuel
fissionable nuclear material in the form of fabricated elements for loading into the reactor core of a civil nuclear power plant or research reactor

[SOURCE: IAEA Safety Glossary, 2018 Revision, June 2019]

3.2.6
nuclear fuel cycle
operations associated with the production of *nuclear energy* (3.2.1)

Note 1 to entry: The nuclear fuel cycle includes the following stages:

a) mining and processing of uranium or thorium ores;

b) conversion;

c) enrichment of uranium;

d) manufacture of *nuclear fuel* (3.2.5);

e) uses of the nuclear fuel;

f) reprocessing and recycling of spent fuel;

g) temporary radioactive material storage of spent fuel and *radioactive waste* (3.5.2) from fuel fabrication (and reprocessing and disposal of spent nuclear fuel [open fuel cycle] or high-level waste (closed fuel cycle*);*

h) any related research and development activities;

i) transport of radioactive material;

j) all waste management activities [including *decommissioning* (3.5.8) relating to operations associated with the production of nuclear energy].

[SOURCE: ISO 12749-3, 3.1.1.1]

Note 2 to entry: Reactor operation and other activities at a reactor site are not addressed in this part of ISO 12749, but are addressed in ISO 12749-5.

3.2.7
nuclear reactor
special device having an inventory of *nuclear fuel* (3.2.5) material containing fissionable nuclides and often neutron moderating, neutron absorbing and cooling materials, all of them geometrically arranged in a particular neutron multiplicative configuration designed and built for having the capability of initiating, maintaining and extinguishing a controlled, self-sustaining *nuclear fission* (3.2.2) *chain reaction* (3.2.4), under adequate safety conditions

3.3 Terms related to safety

3.3.1
radiation safety
recognition, evaluation and control of risks due to radiation exposure

Note 1 to entry: Control of the sources of *radiation* (3.1.3) and the exposure to radiation to protect people and the environment from unnecessary exposure and the deleterious effects of exposure to radiation.

[SOURCE: NCRP Composite Glossary, modified — by deleting “concerned with”.]