भारतीय मानक

Indian Standard

IS 16902 (Part 5) : 2023
ISO 12749-5 : 2018

परमाणु ऊर्जा, परमाणु तकनीकियाँ एवं रेडियोलॉजिकल संरक्षण — शब्दावली

भाग 5 परमाणु रिएक्टर

Nuclear Energy, Nuclear Technologies and Radiological Protection — Vocabulary

Part 5 Nuclear Reactors

ICS 01.040.13; 13.280

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

July 2023 **Price Group 15**

Nuclear Energy for Peaceful Applications Sectional Committee, CHD 30

NATIONAL FOREWORD

This Indian Standard (Part 5) which is identical with ISO 12749-5 : 2018 'Nuclear energy, nuclear technologies and radiological protection — Vocabulary — Part 5: Nuclear reactors' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Nuclear Energy for Peaceful Applications Sectional Committee and approval of the Chemical Division Council.

This part of IS 16902 provides terms and definitions for main concepts in the whole area of nuclear reactor science, technology, engineering, projects and operations, excluding quantitative data.

This Indian Standard is published in several parts. The other parts in this series are:

Part 1	General terminology
Part 2	Radiological protection
Part 3	Nuclear fuel cycle
Part 4	Dosimetry for radiation processing
Part 6	Nuclear medicine

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions and terminologies are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words `International Standard' appear referring to this standard, they should be read as `Indian Standard'; and
b) Comma (,) has been used as a decimal marker in the International Standard, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Contents

Page

Introduction

This document provides terms and definitions for main concepts in the whole area of nuclear reactor science, technology, engineering, projects and operations, excluding quantitative data. Terminological data are taken from ISO standards developed by TC 85/SC 6, from other technically validated documents issued by international organizations, especially IAEA and IEC, while a number of definitions have been drafted by WG 1 experts on the basis of their experience and after detailed discussions on concept characteristics, the best wording for their designations and definitions, as well as the most important links between concepts.

In most cases, international consensus exists among the communities of nuclear reactor specialists world-wide, on the most relevant concepts in the nuclear reactor area. Nevertheless, clear and unambiguous terms for these concepts are also needed.

The foregoing needs also to be considered together with the fact that a large number of people are involved in the broad nuclear reactor area, having different scopes and levels of scientific and technical knowledge and frequently having very specific activities within that broad field. Thus, there can be different understandings and assumptions about concepts. Hence, the result could be a poor communication that might lead into unexpected, different risky situations or consequences, if a conceptual difference is behind.

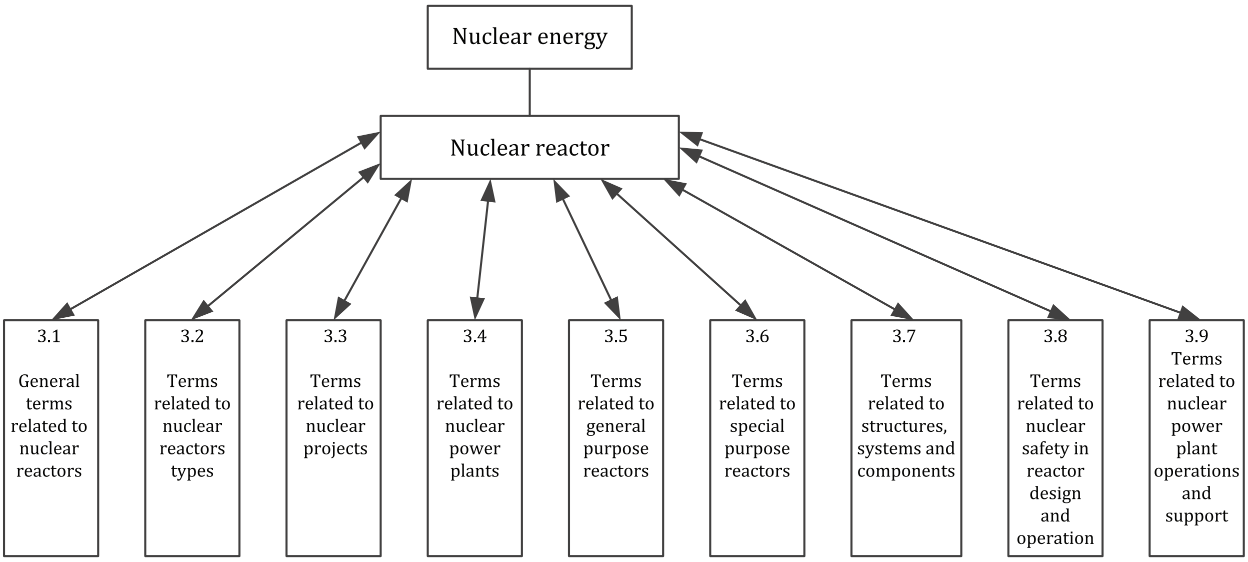
Conceptual arrangement of terms and definitions is based on concepts systems that show corresponding relationships among nuclear reactors concepts. Such arrangement provides users with a structured view of the nuclear energy sector and will facilitate common understanding of all related concepts. Besides, 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.

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 at the end of the standard. The structure of each entry is in accordance with ISO 10241-1. See also Annex A for the methodology used in the development of the vocabulary.

All the terms included in this document deal exclusively with nuclear reactor technology. 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. According to the title, the vocabulary deals with concepts belonging to the general ***nuclear energy*** field within which concepts in the **nuclear reactors** sub-field are taken into account.

Looking for an easier presentation of the required large number of defined concepts, the content of this document has been split into nine headings as shown below, which makes easier any search of terms or relationships between concepts.


Nuclear energy
Nuclear reactor
3.1 General terms related to nuclear reactors
3.2 Terms related to nuclear reactors types
3.3 Terms related to nuclear projects
3.4 Terms related to nuclear power plants
3.5 Terms related to general purpose reactors
3.6 Terms related to special purpose reactors
3.7 Terms related to structures, systems and components
3.8 Terms related to nuclear safety in reactor design and operation
3.9 Terms related to nuclear power plant operations and support

Indian Standard

NUCLEAR ENERGY, NUCLEAR TECHNOLOGIES AND RADIOLOGICAL PROTECTION — VOCABULARY

PART 5 NUCLEAR REACTORS

1 Scope

This document encompasses the collection of terms, definitions, notes and examples corresponding to nuclear reactors, excluding quantitative data. It provides the minimum essential information for each nuclear reactor concept represented by a single term. Full understanding of concepts requires background knowledge of the nuclear field. It is intended to facilitate communication and promote common understanding.

The scope of this document covers the whole field of nuclear reactors at a broad surface level.

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 https://www.iso.org/obp

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

3.1 General terms related to nuclear reactors

3.1.1
nuclear fission
process by which a nucleus undergoes a partition in two, infrequently in three, main fission fragments, releasing energy

Note 1 to entry: There are two types of nuclear fission: “spontaneous” and “induced” ones.

Note 2 to entry: The nucleus usually has a high mass number A, together with an intermediate or low average-binding-energy-per-nucleon; hence, an inherent instability exists, and the fission fragments are usually highly unstable.

Note 3 to entry: According to their capability for undergoing fission, a nucleus and its associated nuclide can be qualified as fissionable or eventually fissile.

3.1.1.1
induced nuclear fission
nuclear fission (3.1.1) initiated by a nucleus when an external colliding particle is absorbed

Note 1 to entry: The absorption of the external colliding particle, usually a neutron, generates a strong increase in the compound nucleus internal energy and, hence, increases the compound nucleus instability, favouring a large energy release by means of a nucleus partition.

3.1.1.2
spontaneous nuclear fission
nuclear fission (3.1.1) produced in a nucleus, having an inherent instability, that develops itself in a purely stochastic way and without intervention of any external colliding particle

3.1.2
fissionable nuclide
nuclide capable of undergoing fission by interaction with a neutron of some energy

Note 1 to entry: The definition may be restricted to significant capability, e.g. to a nuclide that is capable of supporting a self-sustaining *nuclear chain reaction* (3.1.9).

3.1.3
prompt fission neutron
neutron released out from a fission fragment in a stochastic way, with high kinetic-energy just following initiation of a *nuclear fission* (3.1.1) process

Note 1 to entry: The number of prompt neutrons released per fission, is stochastic as indicated, with an average value in the range 2,5 to 3 for most of concerned nuclides.

Note 2 to entry: Prompt fission neutron kinetic-energies form a continuum, between 0 and around 10 MeV, for a population of prompt fission neutrons released, with an average value usually close to 2 MeV.

3.1.4
prompt fission radiation
gamma and/or beta radiations released in a stochastic way, out from each decaying fission fragment just following initiation of a *nuclear fission* (3.1.1)

Note 1 to entry: These gamma and beta radiations are released in cascades, reflecting the high internal energy level of most of fission fragments just after fission initiation.

3.1.5
fission product
nuclide produced from *nuclear fission* (3.1.1) or from subsequent radioactive decay of such a nuclide

[SOURCE: ISO 12749-3:2015, 3.1.5]

3.1.5.1
fast neutron
neutron with kinetic energy greater than its surroundings when released during fission

3.1.5.1.1
delayed fission neutron
neutron emitted in few particular *fission product* (3.1.5) decays, typically with half-lives roughly in the range 0,1 s to 1 min, following initiation of a *nuclear fission* (3.1.1)

Note 1 to entry: Such decay occurs between two energy levels of a fission product-namely precursor-favouring a neutron release, hence, the emitted neutron will have a quite defined kinetic-energy at its release, typically below 1 MeV.

Note 2 to entry: In a fission neutron population, since delayed neutrons have kinetic evolutions dictated by those rather long periods, as compared to the extremely fast evolutions of prompt neutrons, the first ones provide an important contribution to the kinetic control of that neutron population.

3.1.5.1.1.1
thermal neutron
neutron that has, by collision with other particles, reached an energy state equal to that of its surroundings

Note 1 to entry: on the order of 0,025 eV (electron volts).

[SOURCE: United States Nuclear Regulatory Commission Glossary (Retrieved: 8 August 2017) https://www.nrc.gov/reading-rm/basic-ref/glossary.html], modified.

3.1.5.2
delayed fission radiation
gamma and/or beta, in certain cases also alpha radiations released in a stochastic way, from a radioactive *fission product* (3.1.5)

Note 1 to entry: Every possible fission product decay has extremely diverse half-lives, covering the range around 0.1 s up to more than a billion years.

Note 2 to entry: These "delayed" released gamma, beta and alpha radiations, after interactions with neighbouring atoms, are mainly absorbed by the surrounding materials and then finally converted into heat: they are the source of what is designated as decay-power or decay-heat or residual-heat.

3.1.6
fissile nuclide
nuclide capable of undergoing fission by interaction with neutrons

[SOURCE: ISO 12749-3:2015, 3.1.2]

3.1.7
fertile nuclide
nuclide that after absorbing a neutron becomes a *fissile nuclide* (3.1.6)

Note 1 to entry: In practice, the main fertile nuclides are: ^{238}U (producing the fissile ^{239}Pu), ^{240}Pu (producing the fissile ^{241}Pu) and ^{232}Th (producing the fissile ^{233}U), in all cases after the absorption of one neutron and the fast emission of some gamma photons.

3.1.8
fission energy
energy released in the fission process, which is primarily in the form of the kinetic energy of the fission fragments

3.1.9
nuclear chain reaction
<nuclear reactors> successive generations of *induced nuclear fissions* (3.1.1.1) by neutrons, these mainly released, in turn, in previous fissions in *fissionable nuclides* (3.1.2)

Note 1 to entry: The free neutron population in a system is multiplied by fissions releasing several neutrons per fission, compensating partially or totally, or exceeding the total neutron losses by capture and leakage from the system.

Note 2 to entry: A nuclear chain reaction can be initiated by a pre-existent small neutron population (like that resulting from photo-neutrons in particular materials for this purpose), or by neutrons released by spontaneous fissions, or by a specific "neutron source" emitting neutrons.

3.1.9.1
controlled nuclear chain reaction
chain reaction for which there are adequate and reliable physical means or systems to safely govern the value of the *effective neutron multiplication factor* (3.1.11) at any time, and under all possible circumstances

Note 1 to entry: The just mentioned physical means and/or systems form the available *reactivity* (3.1.12) control elements, which are usually parts of the *reactor regulation system* (3.7.2.1.2). Other systems and elements can assist this one for safety aspects.

Note 2 to entry: A *nuclear chain reaction* (3.1.9) is controlled by taking advantage of the delayed fraction of fission neutrons. This fraction depends on the properties of the *fissionable nuclides* (3.1.2) in the system. An uncontrolled chain reaction may be non-destructive due to negative contributions from the initial energy increase. The delayed neutrons allow more time for such negative feedback.

3.1.10
neutron multiplicative configuration
geometrical disposition of materials, one or more containing *fissionable nuclides* (3.1.2), the whole configuration being capable of maintaining a multiplicative chain reaction of neutron-*induced nuclear fissions* (3.1.1.1)

3.1.11
effective neutron multiplication factor
k_{eff}
<nuclear reactors> ratio between current to previous generation of neutron population in multiplicative medium

Note 1 to entry: The total number of produced neutrons per unit time includes all prompt and delayed neutrons released in fissions; while, the total number of lost neutrons are the sum of all absorbed neutrons (in fission and capture reactions), plus all leaking neutrons escaping.

Note 2 to entry: There are three possible circumstances:

a) $k_{eff} > 1$: fission power increases in time;

b) $k_{eff} = 1$: fission power remains constant in time;

c) $k_{eff} < 1$: fission power decreases in time.

When $k_{eff} > 1$, system is called supercritical; when $k_{eff} = 1$, system is called critical; and finally when $k_{eff} < 1$, then system is called subcritical.

3.1.12
reactivity
ρ
measure of the deviation from criticality of a nuclear chain reacting medium:

$$\rho = 1 - 1/k_{eff}$$

where k_{eff} is the ratio between the number of fissions in two succeeding generations (later to earlier) of the chain reaction

Note 1 to entry: A measure of the reactivity is typically defined such that a positive value corresponds to a supercritical state and a negative value corresponds to a subcritical state.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf[11], modified — Addition at the beginning of the definition of the wording stated in one comment.]

3.1.13
poison
substance used to reduce *reactivity* (3.1.12), typically in a *reactor core* (3.1.23.1), by virtue of its high neutron absorption cross-section

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.1.14
nuclear reactor kinetics
time evolution of the neutron population in a *reactor core* (3.1.23.1)

3.1.15
nuclear criticality
state of a nuclear chain reacting system when the chain reaction is just self-sustaining

[SOURCE: ISO 12749-3:2015, 3.1.1.4]

3.1.16
nuclear chain reaction extinction
action that terminates a *nuclear chain reaction* (3.1.9)

Note 1 to entry: Termination is caused by an operator-decided and manually executed action, or by automatic signal trips, normally provoking in both cases a significant insertion of neutron absorbers inside the *reactor core* (3.1.23.1).

3.1.17
nuclear reactor installation
set of a *nuclear reactor* (3.1.22), its authorities, *operation* (3.9.1)-*maintenance* (3.9.12), administrative-support staff, associated and dedicated plants, buildings, systems and all surrounding infra-structure and services, up to the installation perimeter fences

Note 1 to entry: Frequently, the concept is oriented to provide some specific products, like electric energy, radioactive isotopes, irradiation services, infra-structure for research and development.

Note 2 to entry: Usually, reactor systems, dedicated plants and associated infra-structure are very specially designed according to the reactor purposes.

Note 3 to entry: The most important buildings in a nuclear reactor installation are: the *containment* (3.7.5) building, that houses the *nuclear reactor* (3.1.22) and the *primary coolant* (3.1.23.4) system equipment, the turbine building (only present in *nuclear power plants* (3.2.5) or nuclear reactors coupled to a turbine-generator) that houses the *turbine generator* (3.4.4), the auxiliary building that houses support equipment and sometimes emergency equipment, the diesel generator building, that houses the diesel generator and the fuel building, where the spent fuel is stored.

3.1.18
radiation protection organization
installation staff sector that has radiation protection functions and duties both regarding site personnel, visitors and the public

Note 1 to entry: The radiation protection organization performs its duties with the aid of a number of check-stations, a large and well distributed gamma or other radiation detector network for radiation surveillance, appropriate radiation protection laboratory, personal dose management system, and implements the process of optimization of protection for plant personnel.

3.1.19
controlled area
defined area in which specific protection measures and safety provisions are or could be required for controlling exposures or preventing the spread of contamination in normal working conditions, and preventing or limiting the extent of potential exposures

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 28 November, 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.1.20
radiation shield
material interposed between a source of radiation and persons, or equipment or other objects, in order to attenuate the radiation

Note 1 to entry: The radiation shield is designed either as fixed or movable installation *structures* (3.7.1) or elements, and placed between large plant radioactive inventories and the authorized personnel working in a *controlled area* (3.1.19), or the off-site public and the environment, or some sensitive equipment.

3.1.21
radiation monitoring
<nuclear reactors> measurement and surveillance of the main radiation types, neutrons, gamma and beta, and their amounts

Note 1 to entry: The main radiation types are neutrons, gamma and beta rays; sometimes also their energy distribution is monitored.

Note 2 to entry: The radiation monitoring is performed around and near the *nuclear reactor* (3.1.22) (especially neutrons), as well as in all *controlled areas* (3.1.19) and other locations inside and even beyond plant borders (by means of an extended detector network).

3.1.22
nuclear reactor
special device having an inventory of nuclear fuel material containing *fissionable nuclides* (3.1.2) and often neutron moderating, neutron absorbing and cooling materials, all of them geometrically arranged in a particular *neutron multiplicative configuration* (3.1.10) designed and built for having the capability of initiating, maintaining and extinguishing a controlled, self-sustaining *nuclear fission* (3.1.1) chain reaction, under adequate safety conditions

3.1.23
nuclear island
part of the *nuclear power plant* (3.2.5) that consists of the *containment* (3.7.5), auxiliary and fuel building

[SOURCE: IAEA NUCLEAR ENERGY SERIES, No. NP-T-2.5. Construction technology for nuclear power plants – Vienna: International Atomic Energy Agency, 2011]

3.1.23.1
reactor core
part of a *nuclear reactor* (3.1.22), where the *fissionable nuclides* (3.1.2) sustaining the fission chain are located

Note 1 to entry: In most cases, *moderator* (3.1.23.1.2) and coolant are also included in the *reactor core* (3.1.23.1).

3.1.23.1.1
core reflector
material placed around the *reactor core* (3.1.23.1), totally or partially enveloping it, in order to scatter most of leaking neutrons back into the core, improving neutron economy

Note 1 to entry: Since most of *nuclear reactors* (3.1.22), have a preferred vertical cylinder geometry, they have 3 different reflectors: upper axial, lower axial and radial.

Note 2 to entry: The most used materials as reflectors in front of:

a) slow-or *thermal-neutrons* (3.1.5.1.1.1), are: H_2O (light or ordinary water), D_2O (heavy water), Be (beryllium), C (carbon, graphite);

b) *fast-neutrons* (3.1.5.1), are: SS (stainless steel).

3.1.23.1.2
moderator
material capable of slowing down *fast neutrons* (3.1.5.1) and, in this process, absorbing a relatively low amount of neutrons

EXAMPLE The most preferred moderators have been up to now:

— ^{1}H (A = 1, or ordinary H);

— ^{2}H (A = 2, or deuterium);

— ^{12}C (A = 12, or graphite).

The two first are respectively employed as:

a) “ordinary or light water”, using the symbols “LW or H_2O”;

b) “heavy water”, using the symbols “HW or D_2O”.

3.1.23.2
reactor internals
any of the different structural parts inside the *nuclear reactor* (3.1.22), covering various functions, either as part of the nuclear reactor itself or as part of reactor-associated systems

Note 1 to entry: Some of these functions are:

a) to support and provide adequate alignment to fuel assemblies (FAs), the *reactor core* (3.1.23.1) as a whole and one or more *core reflectors* (3.1.23.1.1);

b) to direct inlet and outlet *primary coolant* (3.1.23.4) flow and its distribution among all reactor heat sources, similar *structures* (3.7.1) for other fluids inside the reactor (like liquid *moderator* (3.1.23.1.2) and/or reflectors);

c) to provide in-core locations and protection for *in-core instrumentation* (3.7.6.1.1) and for elements and *components* (3.7.3) related to *reactivity* (3.1.12)/power control and *safety systems* (3.7.2.7) for *fast reactor* (3.2.3.1) extinction.

3.1.23.3
reactor vessel
enveloping *structure* (3.7.1) for harboring all elements of a *nuclear reactor* (3.1.22)

Note 1 to entry: Main elements usually allocated inside the reactor vessel, are as follows:

a) the *reactor core* (3.1.23.1) and its reflectors;

b) all *structures* (3.7.1) and tubes of *reactor internals* (3.1.23.2).

Note 2 to entry: The reactor vessel additionally serves as confining structure for the *primary coolant* (3.1.23.4). Moreover, in most cases this vessel is also part of a high-pressure boundary for the primary coolant, mainly encompassing the *reactor core* (3.1.23.1) and the *primary heat transport system* (3.7.2.5); in these cases, it is called “reactor pressure vessel or RPV”.

3.1.23.4
primary coolant
fluid circulating through the *reactor core* (3.1.23.1), in order to cool all fuel assemblies, receiving all their fission power

Note 1 to entry: The primary coolant normally removes instantaneous fission and decay powers generated in the *reactor core* (3.1.23.1) and is able for removing abnormal excessive heat. It circulates within the *primary heat transport system* (3.7.2.5), and transfers all reactor thermal power to a final heat sink. Such thermal power transfer can be either “direct”, or more usually “indirect”, by means of chained circuits circulating appropriate fluids, between the *nuclear reactor* (3.1.22) and that final heat sink.

Note 2 to entry: The primary or main coolant is always a fluid and then it can be, either: a liquid in single phase, or a boiling two-phase fluid, or a gas. The most widely employed are:

a) liquid-state ordinary or light water (H_2O) at atmospheric or high pressure;

b) liquid-state heavy water (D_2O) at atmospheric or high pressure;

c) boiling H_2O at high pressure;

d) CO_2 or He gases.

Note 3 to entry: The final heat sink usually can be either: the atmosphere, a river, a lake, a sea or an ocean. In a *nuclear power plant* (3.2.5) one of such sinks shares its function with a *turbine-generator* (3.4.4) set, where part of the total thermal power is converted to kinetic power and immediately to electric power.

3.2 Terms related to nuclear reactors types

3.2.1
nuclear reactor
(See 3.1.22)

3.2.1.1
power reactor
nuclear reactor (3.1.22) conceived to produce electrical power

3.2.1.2
multiple-purpose reactor
nuclear reactor (3.1.22) conceived for fulfilling several main purposes together, providing different services, except electric energy supply

EXAMPLE Reactors that produce radioisotopes, provide irradiation boxes and positions, irradiated material studies, neutron beams for research and development work, personnel training, etc.

3.2.1.3
special-purpose reactor
nuclear reactor (3.1.22) conceived with a particular target

EXAMPLE *Prototype reactors* (3.6.1.3), *demonstration reactors* (3.6.1.2), naval propulsion reactors, *desalination reactors* (3.6.1.5), *material testing reactors* (3.5.1.5), hydrogen *production reactors* (3.5.1.3).

3.2.2.1
breeder reactor
nuclear reactor (3.1.22) conceived for producing more *fissile nuclides* (3.1.6) than it uses, being the conversion ratio greater than one

3.2.2.2
converter reactor
nuclear reactor (3.1.22) conceived for producing less *fissile nuclides* (3.1.6) than it uses, being the conversion ratio smaller than one

3.2.2.3
transmutation reactor
nuclear reactor (3.1.22) conceived for the purpose of eliminating partially the radioactive wastes contained in other reactors spent nuclear fuel

3.2.3.1
fast reactor
nuclear reactor (3.1.22) designed and operated mainly using a predominantly *fast neutron* (3.1.5.1) energy spectrum

Note 1 to entry: The main contribution to fission power typically from neutrons with energies above 100 keV.

3.2.3.2
thermal reactor
nuclear reactor (3.1.22) designed and operated mainly using a predominantly *thermal neutron* (3.1.5.1.1.1) energy spectrumNote 1 to entry: The main contribution to fission power typically from neutrons with energies below 1 eV.

3.2.4.1
gas-cooled reactor
GCR
nuclear reactor (3.1.22) that uses gas as *primary coolant* (3.1.23.4)

Note 1 to entry: A gas cooled reactor can be either a thermal gas-cooled reactor or a gas cooled *fast reactor* (3.2.3.1).

Note 2 to entry: The gas is usually helium (He) or carbon dioxide (CO_2).

3.2.4.2
light water reactor
LWR
thermal *nuclear reactor* (3.1.22) cooled and moderated by light water

3.2.4.2.1
boiling water reactor
BWR
nuclear reactor (3.1.22) with water as a coolant and as a *moderator* (3.1.23.1.2), boiling in the core

Note 1 to entry: In a boiling water reactor the generated heat is removed from the core by evaporation.

[SOURCE: Koelzer, Winfried. “Glossary of Nuclear Terms”. Karlsruher Institut für Technologie, Karlsruhe, 2013. ISBN 3-923704-32-1. (Retrieved: 26 aug 2016). p. 180, http://www.euronuclear.org/info/encyclopedia/pdf/Nuclear_Glossary-%202013-02-13.pdf and GOST 23082-1978, modified.]

3.2.4.2.2
pressurized water reactor
PWR
power *nuclear reactor* (3.1.22) in which the heat is dissipated from the core using highly pressurized water

[SOURCE: Koelzer, Winfried. “Glossary of Nuclear Terms”. Karlsruher Institut für Technologie, Karlsruhe, 2013. ISBN 3-923704-32-1. (Retrieved: 26 aug 2016). 180p. http://www.euronuclear.org/info/encyclopedia/pdf/Nuclear_Glossary-202013-02-13.pdf]

Note 1 to entry: The coolant in form of pressurized water serves also a *moderator* (3.1.23.1.2).

3.2.4.3
heavy water reactor
nuclear reactor (3.1.22) cooled and/or moderated with heavy water (D_2O)

[SOURCE: Koelzer, Winfried. “Glossary of Nuclear Terms”. Karlsruher Institut für Technologie, Karlsruhe, 2013. ISBN 3-923704-32-1. (Retrieved: 26 aug 2016). 180p. http://www.euronuclear.org/info/encyclopedia/pdf/Nuclear_Glossary-202013-02-13.pdf]

3.2.4.3.1
pressurized heavy water reactor
PHWR
thermal *nuclear reactor* (3.1.22) cooled and moderated by heavy water (D_2O), having a pressurized D_2O coolant to be kept permanently in the liquid state

3.2.4.4
liquid metal reactor
liquid metal fast reactor
LMFR
fast *nuclear reactor* (3.1.22) using as coolant a liquid metal, like sodium, lead, or some alloy

3.2.4.4.1
sodium fast reactor
fast *nuclear reactor* (3.1.22) cooled by liquid sodium

Note 1 to entry: For the fact that sodium becomes active in the presence of a neutron field, these reactors may possess an intermediate heat transport system.

Note 2 to entry: The reactor is commonly fueled with mixed plutonium-uranium oxides (MOX), with an enrichment in the fissile isotope of the order of 15 %; although ^{232}Th-^{233}U based fuels have also been used.

3.2.4.4.2
lead fast reactor
fast *nuclear reactor* (3.1.22) cooled by liquid lead

3.2.4.5
molten salt reactor
nuclear reactor (3.1.22) where the fuel is a molten salt mixed with a carrier molten salt that acts as *primary coolant* (3.1.23.4)

Note 1 to entry: Molten salt is typically uranium, plutonium and thorium fluorides. Carrier molten salt is typically lithium fluorides.

3.2.5
nuclear power plant
NPP
nuclear reactor installation (3.1.17) that produces electrical and/or heat energy

Note 1 to entry: Nuclear power plant is a *nuclear reactor* (3.1.22) or reactors together with all *structures* (3.7.1), systems and *components* (3.7.3) necessary for safety and for the production of power, i.e. heat or electricity.

3.2.6
nuclear power plant technology generation
NPP technology generation
each of the main waves of new conceptual designs within historic *nuclear power plant* (3.2.5) technology evolution, since *generation I* (3.2.6.1) up to *generation IV* (3.2.6.5)

3.2.6.1
generation I
gen I
commercial *power reactor* (3.2.1.1) that started civilian nuclear power programs and was constructed during the 1950 and 1960 decades

Note 1 to entry: Almost all these reactors have already been closed down.

3.2.6.2
generation II
gen II
commercial *power reactors* (3.2.1.1) mostly designed and constructed during the 1970 and 1980 decades, to be reliable from a safety point of view and economically attractive for a typical operational lifetime of 30 years to 40 years

Note 1 to entry: Many of these reactors have implemented life extension programs and received approval from their *nuclear regulator* (3.3.9) to extend their *operating lifetimes* (3.9.8) beyond the original *license* (3.3.13) limits.

3.2.6.3
generation III
gen III
generation II (3.2.6.2) reactor including evolutionary, state-of-the-art design improvements

Note 1 to entry: These improvements are manifested in the areas of fuel technology, thermal efficiency, modularized construction, *safety systems* (3.7.2.7) and standardized design. Improvements in Gen III reactor technology have aimed at a longer operational life, typically 60 years of *operation* (3.9.1) and thus at being economically more competitive.

3.2.6.4
generation III+
gen III+
either an evolutionary development of *generation III* (3.2.6.3) reactors or an innovative one, offering improvements mainly in the field of safety over Gen III reactor designs

Note 1 to entry: Safety improvements comprise: *containment* (3.7.5) improvements, radioactive inventory release minimization, emphasis on passive systems (use of gravity potential energy rather than electrical energy, very high pressure differences, springs, natural convection).

3.2.6.5
generation IV
gen IV
novel design concepts of reactors that are expected to be built after year 2030 and to outpace the performance of the *Gen III* (3.2.6.3) and *Gen III+* (3.2.6.4) reactor

3.3 Terms related to nuclear projects

3.3.1
nuclear project
unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources related to *nuclear reactor installations* (3.1.17)

[SOURCE: ISO 9000:2015, 3.4.2, modified — The wording "related to nuclear reactor installations" has been added.]

3.3.2
project stage
each part in which the execution of a whole *nuclear project* (3.3.1) can be divided

3.3.3
engineering stage
each of the relevant parts in the engineering development for a system or civil work, or for a set of systems or civil *structures* (3.7.1) or buildings, or for the whole plant

3.3.4
project management area
activity space that constitutes the project management

Note 1 to entry: Such constituents usually are licensing, administration, commercial and contracts, legal, financing, project command and follow-up, quality management, design and engineering, procurement, construction, erection and plant commissioning.

3.3.5
design basis
DB
range of conditions and *events* (3.8.2) taken explicitly into account in the design of *structures* (3.7.1), systems and *components* (3.7.3) and equipment of a facility, according to established criteria, such that the facility can withstand them without exceeding authorized limits

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.3.6
equipment specification
technical document prepared by a high-level *contractor* (3.3.17) to specify technical and quality assurance requirements to the subcontractors

[SOURCE: ISO 18229:2018, 3.6, modified — Notes were deleted and the terminology slightly modified.]

3.3.7
design life
period of time during which a facility or *component* (3.7.3) is expected to perform according to the technical specifications to which it was produced

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.3.8
plant lifetime limiting factor
specific physical or chemical process producing a degradation or modification on some *component* (3.7.3) per second or equipment of the *nuclear reactor installation* (3.1.17)

3.3.9
nuclear regulator
nuclear regulatory body
body or system of bodies designated by the government as having legal authority for conducting the regulatory process and thereby regulating the safety of *nuclear reactor installations* (3.1.17) by establishing safety requirements and conducting oversight regarding implementation

3.3.10
responsible entity
formal entity acting at any moment in front of the *nuclear regulator* (3.3.9), as representative of a *nuclear project* (3.3.1) under execution, or of an existing *nuclear reactor installation* (3.1.17)

Note 1 to entry: In the first case, a *nuclear project* (3.3.1), the responsible entity is normally the project management. In the second case, an existing *nuclear reactor installation* (3.1.17), the responsible entity is normally the *operation* (3.9.1) organization.

3.3.11
licensee
holder of a current authorization granted by the *nuclear regulator* (3.3.9) to an organization that has the responsibility for the siting, design, construction, commissioning, *operation* (3.9.1) or decommissioning of a nuclear installation

3.3.12
licensing basis
set of regulatory requirements applicable to a nuclear installation

Note 1 to entry: The licensing basis, in addition to a set of regulatory requirements, may also include agreements and commitments made between the *nuclear regulator* (3.3.9) and the *licensee* (3.3.11).

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf.]

3.3.13
license
legal document issued by the *nuclear regulator* (3.3.9) granting authorization to perform specified *activities* relating to a facility *or activity*

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.3.14
mandatory documentation
set of all most relevant technical documentation associated to the installation, established by the *nuclear regulator* (3.3.9), to be fulfilled by the *responsible entity* (3.3.10), covering the whole area of *nuclear safety* (3.8.1), in order to obtain a nuclear *license* (3.3.13)

3.3.15
third-party inspection body
organization, company or body, that performs inspections on any granted-by-contract service or supplies required by standards and being independent of the *manufacturer* (3.3.18), contracting party, owner or user

[SOURCE: ISO 18229:2018, 3.19, modified — Wording slightly changed.]

3.3.16
prime contractor
legal entity that receives a major contract from the owner or project management for providing all main *components* (3.7.3) or a full provision of either the *nuclear island* (3.1.23) or the *balance of plant* (3.4.1.3)

[SOURCE: ISO 18229:2018, 3.11, modified — Wording slightly changed.]

3.3.17
contractor
supplier in a contractual situation

[SOURCE: ISO 10795:2011, 1.61]

3.3.17.1
subcontractor
any *contractor* (3.3.17), except for a *prime contractor* (3.3.16), providing supplies and/or services through a contract passed with other project contractor or eventually with the project management for specific items

[SOURCE: ISO 18229:2018, 3.15, modified — Note 1 to entry deleted.]

3.3.18
manufacturer
<nuclear reactor> legal entity responsible for the final design, manufacturing, engineering and the construction of any *component* (3.7.3) of the *nuclear reactor installation* (3.1.17)

[SOURCE: ISO 18229:2018, 3.9, modified — The field was added and "nuclear reactor" was replaced by "nuclear reactor installation".]

3.4 Terms related to nuclear power plants

3.4.1
nuclear power plant
NPP
(See 3.2.5)

3.4.1.1
single-unit nuclear power plant
single-unit NPP
nuclear power plant (3.2.5) having a single electric production line

3.4.1.2
multiple-unit nuclear power plant
multiple-unit NPP
nuclear power plant (3.2.5) having on a common site, two or more electric production lines

Note 1 to entry: The *nuclear reactors* (3.1.22) and the electric production lines can be either almost identical or different between them, though usually sharing various support or auxiliary installations, systems and/or supplies.

3.4.1.3
balance of plant
BOP
part of the *nuclear power plant* (3.2.5) that consists of a set of a main *turbine generator* (3.4.4) unit and all associated systems, *structures* (3.7.1) and *components* (3.7.3) necessary to produce electric power

3.4.1.3.1
gas turbine balance of plant
gas turbine BOP
balance of plant (3.4.1.3) type that produces electric energy associated to a *nuclear high temperature gas supply system* (3.4.6)

3.4.1.3.2
steam turbine balance of plant
steam turbine BOP
balance of plant (3.4.1.3) type that produces electric energy associated to a *nuclear steam supply system* (3.4.5)

3.4.1.4
nuclear island
(See 3.1.23)

3.4.1.5
turbine island
part of the *nuclear power plant* (3.2.5)that consists of the turbine building

[SOURCE: IAEA NUCLEAR ENERGY SERIES, No. NP-T-2.5. *Construction technology for nuclear power plants* – Vienna: International Atomic Energy Agency, 2011]

3.4.2
reference unit power
maximum (electrical) power that could be maintained continuously throughout a prolonged period of *operation* (3.9.1) under reference ambient conditions

Note 1 to entry: The power value is measured at the unit outlet terminals, i.e. after deducting the power taken by unit auxiliaries and the losses in the transformers that are considered integral parts of the unit.

Note 2 to entry: The reference unit power is expected to remain constant unless following design changes, or a new permanent authorization, it is decided to amend its original value.

Note 3 to entry: The power value is expressed in units of megawatt (electrical).

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "Glossary of terms in PRIS reports – PRIS: Power reactor information system". (Retrieved: 28 November, 2016). https://www.iaea.org/PRIS/Glossary.aspx], modified.

3.4.2.1
energy availability factor
ratio of the energy that the available *capacity* (3.9.5) could have produced during this period, to the energy that the *reference unit power* (3.4.2) could have produced during the same period

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "Glossary of terms in PRIS reports – PRIS: Power reactor information system". (Retrieved: 30 August, 2016). https://www.iaea.org/PRIS/Glossary.aspx]

3.4.3
NPP unit
part of the *NPP* (3.2.5) implementing NPP´s functions with the scope specified in the NPP´s *design basis* (3.3.5)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "*Construction technologies for nuclear power plants*". IAEA Nuclear Energy Series No. NP-T-2.5. IAEA, Vienna, 2011. p. 190]

Note 1 to entry: The NPP unit includes the *nuclear reactor* (3.1.22) plus all its associated systems and buildings not shared by other nuclear reactor.

3.4.4
turbine generator
equipment that produces electrical energy and which type is defined by the turbine-driving fluid

3.4.4.1
steam turbine generator
equipment in a BOP that produces electrical energy, where the generator is driven by a steam turbine supplied by a *NSSS* (3.4.5)

3.4.4.2
gas turbine generator
equipment in a BOP that produces electrical energy, where the generator is driven by a gas turbine supplied by a *NHTGSS* (3.4.6)

3.4.5
nuclear steam supply system
NSSS
nuclear reactor (3.1.22) and all its associated systems, *structures* (3.7.1) and *components* (3.7.3), necessary to reliably and safely produce steam at a suitable pressure to drive a *steam turbine generator* (3.4.4.1) unit

Note 1 to entry: The nuclear steam supply system can have different thermal power sources, such as PWR, PHWR, BWR, GCR and LMFR.

3.4.6
nuclear high temperature gas supply system
NHTGSS
nuclear reactor (3.1.22) and all its associated systems, *structures* (3.7.1) and *components* (3.7.3), necessary to reliably and safely produce gas at high temperature and pressure to drive a *gas turbine generator* (3.4.4.2) unit

Note 1 to entry: The nuclear high temperature gas supply system can have different thermal power sources, such as GCR, LMFR and GCFR.

3.4.7
steam condenser
equipment in a *steam turbine BOP* (3.4.1.3), aimed at receiving the exhausting low-pressure turbine steam, bringing this fluid into the liquid state by massive cooling

3.4.8
gas cooler
equipment in a *gas turbine BOP* (3.4.1.3.1), aimed at strongly lowering the gas temperature

Note 1 to entry: In a *gas turbine BOP* (3.4.1.3.1) the *NHTGSS* (3.4.6) feeds a *gas turbine generator* (3.4.4.2) that produces electrical power. To make this possible, the heat that is not converted to electrical or mechanical power, is transferred to the secondary cooling fluid.

3.5 Terms related to multiple-purpose reactors

3.5.1
multiple-purpose reactor
(See 3.2.1.2)

3.5.1.1
training and education reactor
type of *nuclear reactor* (3.1.22) dedicated to training students to operate, maintain, regulate, and improve nuclear reactors and other facilities, aimed from training in very specific reactor concepts up to broad education in the nuclear reactor field observing the *nuclear fission* (3.1.1) process and the interaction of radiation with matter

3.5.1.2
research reactor
type of *nuclear reactor* (3.1.22) engineered to use its neutron flux and ionizing radiation for scientific research in different fields

Note 1 to entry: The application fields can be medical, biological, electronic, engineering, industrial as well as related to specific reactor concepts or nuclear fuel cycle strategies services, technological developments and/or industrial production purposes. It includes the *reactor core* (3.1.23.1), the facilities/devices exposed to the neutron field within and around the core, and *structures* (3.7.1), systems and *components* (3.7.3) related to the safe *operation* (3.9.1) of the reactor.

Note 2 to entry: For most of research reactors the heat production from fission power of the nuclear reaction is essentially useless, therefore the denomination “research reactor” becomes a complement regarding *“power reactor”* (3.2.1.1), for which heat is recovered for further use while the neutron flux and ionizing radiation are not.

3.5.1.3
production reactor
nuclear reactor (3.1.22) designed and operated for using its neutron flux and/or ionizing radiation for the production of one or a few types of goods, including special nuclear material, or for the provision of services

Note 1 to entry: Some types of goods are medical and industrial radioisotopes and some services provision are material irradiations, district heating, *boron neutron capture therapy* (3.5.4) and industrial sterilization.

3.5.1.4
radioisotope production reactor
nuclear reactor (3.1.22) aimed at producing radioisotopes for medical and industrial applications, by neutron capture or fission reactions

Note 1 to entry: Usually, the “*neutron transmutation doping*” (3.5.3) is an application included in radioisotope *production reactors* (3.5.1.3).

3.5.1.5
material testing reactor
nuclear reactor (3.1.22) aimed at irradiating materials, with the purpose of testing and qualifying the behaviour of the irradiated materials

Note 1 to entry: The materials tested usually include nuclear fuels.

Note 2 to entry: “Material testing reactor” (MTR) is a generic name given to those reactors that use MTR-type fuel.

Note 3 to entry: “MTR fuel” is a generic name given to nuclear fuel composed by an assembly of uranium plates.

3.5.1.6
open pool reactor
nuclear reactor (3.1.22) where the core is placed at the bottom of an open pool

3.5.2
radioisotope production
technique that consists in the production of radioactive nuclides from neutron reactions occurring in the material contained in a target that is being exposed to a neutron radiation field

3.5.3
neutron transmutation doping
technique that consists in the irradiation of a target material with a neutron flux, mostly thermal, in order to produce dispersed impurities in the target material

Note 1 to entry: Main application is on silicon target, where the impurities produced are the dopants of the semiconductor.

Note 2 to entry: Special care shall be taken regarding the uniformity of the distribution of the introduced dopants.

3.5.4
boron neutron capture therapy
BNCT
technique for radiation therapy based on ^{10}B (n, alpha) reaction in cancer tissue or cell which, before the neutron radiation, has absorbed a chemical compound containing ^{10}B isotope

Note 1 to entry: Non-radioactive boron is added to pharmaceutical agents that are selective to be located in specific tissues (tumour localizing drugs). Boron -more precisely the ^{10}B isotope- has high cross section (that means high probability) to absorb neutrons; therefore, a nuclear reaction is produced due to neutron capture by boron with its resulting rupture into a lithium ion and an alpha particle. Both resulting particles have high energy and produce ionization very close to the reaction point, destroying the tissue cells.

3.5.5
neutron activation analysis
technique of elemental analysis based on the identification and measurement of intrinsic radiation of nuclide formed in sample material by neutron bombarding

3.5.5.1
prompt neutron activation analysis
technique of elemental analysis based on the identification and measurement of intrinsic radiation emitting from sample material by neutron continuously bombarding

Note 1 to entry: As a consequence of absorbing neutrons, a gamma ray is emitted by the sample in a very short time (in comparison with the times for the gamma rays obtained in the *neutron activation analysis* (3.5.5). The energy and intensity of the measured peaks lead to determination of the isotopic composition.

Note 2 to entry: This is a technique useful for trace elements that may not be well detected by neutron activation analysis.

3.5.6
neutron diffraction technique
technique by which the study of the scattering of neutrons upon a target reveals information about the structure of the target material

Note 1 to entry: In order that it is possible to study materials structure, the energy of the neutrons shall be in an energy range so that their wavelength be comparable to the typical dimensions of the materials being studied. The cold sources serve this purpose of taking the neutrons to some desired energy range for a variety of materials of interest.

Note 2 to entry: This technique is also available not only in *research reactors* (3.5.1.2) but in ad hoc research facilities like neutron spallation sources.

Note 3 to entry: The technique has a variety of fields of application like, material science, molecular biology, archaeology, etc.

3.5.7
solid fuel materials
ceramic fuels other than oxides

EXAMPLE Uranium nitride and uranium carbide.

3.5.8
homogeneous fuel solution
fissile nuclide (3.1.6) in soluble salt

EXAMPLE Uranium sulfate and uranium nitrate.

3.5.9
plated type fuel
MTR fuel
fuel assembly (3.5.11) that consists of several thin plates containing a fuel material cladded with aluminium, including lateral non-fuelled frames

Note 1 to entry: It is the fuel specifically used in *material testing reactors* (3.5.1.5).

3.5.10
rod type fuel
pin type fuel
rod of nuclear fuel, its cylindrical cladding and any associated *components* (3.7.3) necessary to form a structural unit

3.5.11
fuel assembly
fuel bundle
set of fuel elements and associated *components* (3.7.3) which are loaded into and subsequently removed from a *reactor core* (3.1.23.1) as a single unit

[SOURCE: ISO 12749-3:2015, 3.3.6.1]

3.5.11.1
annular fuel assembly
fuel assembly (3.5.11) that consists of annular fuel rods, which are cladded in their inner and outer surfaces, and associated *components* (3.7.3) necessary to form a structural unit

3.6 Terms related to special-purpose reactors

3.6.1
special-purpose reactor
(See 3.2.1.3)

3.6.1.1
zero-power reactor
special-purpose reactor (3.2.1.3) with a negligible thermal power, behaving as an almost identical copy, in its neutron parameters, of some reference *reactor core* (3.1.23.1) design

Note 1 to entry: "Critical facility", "critical mock-up" and "neutronic maquet" are all possible alternative designations of the same concept.

Note 2 to entry: Generally built to assess a novel core design for a *power reactor* (3.2.1.1), adequately reproducing the materials and geometry of the designed core.

3.6.1.2
demonstration reactor
special-purpose reactor (3.2.1.3) aimed at characterizing a novel *nuclear reactor* (3.1.22) design, reproducing its most relevant and distinctive features and its main nuclear, process and *safety systems* (3.7.2.7)

Note 1 to entry: Demonstration reactors should be able to operate in a range of parameters allowing the validation of the design in the novel features. Usually, their reactor power is scaled down to a fraction of the foreseen power output, optimising the investment needs.

Note 2 to entry: The design to be assessed by a demonstration reactor is generally an innovative *power reactor* (3.2.1.1) design that is planned for future commercial deployment.

3.6.1.3
prototype reactor
special-purpose reactor (3.2.1.3) aimed at characterizing and qualifying a novel *nuclear power plant* (3.2.5) design, reproducing the design of a future series of nuclear power plants, though usually with additional capabilities, margins and instrumentation and control devices

Note 1 to entry: The design to be qualified by a prototype reactor is generally an innovative *power reactor* (3.2.1.1) design that is planned for commercial deployment.

Note 2 to entry: Additional instrumentation allows performing engineering and qualification tests both during a commissioning extended in scope, and during *operation* (3.9.1) stage.

Note 3 to entry: Prototype reactors can be scaled to a fraction of the foreseen power output through a detailed similarity analysis, and may lack auxiliary systems that are not related to reactor performance.

Note 4 to entry: Engineering tests are related to the benchmarking of design calculation, while qualification tests point to prove the compliance with specific performance goals. Tests could be on individual systems or on the integrated plant.

3.6.1.4
first-of-a kind reactor
special-purpose reactor (3.2.1.3) aimed at being a reference model for a series of nearly identical *power reactors* (3.2.1.1) planned for commercial deployment

Note 1 to entry: First-of-a kind reactors are full-scale and full-scope plants that may have additional instrumentation on the reactor and main systems in order to facilitate characterization.

Note 2 to entry: The safety relevant systems, *structures* (3.7.1) and *components* (3.7.3) of a first-of-a kind reactor should feature adequate qualification from a previous *project stage* (3.3.2).

3.6.1.5
desalination reactor
special-purpose reactor (3.2.1.3) aimed at producing demineralized or drinkable water involving three different technologies: nuclear, desalination and their coupling system

Note 1 to entry: Nuclear desalination is generally a co-generation application, although it is technically viable to design a single-purpose plant for desalination.

Note 2 to entry: Nuclear desalination is generally assumed to use sea-water in the intake, but specific designs may be applied for brackish groundwater.

3.6.1.6
single-purpose reactor
special-purpose reactor (3.2.1.3) yielding a single product, be it electricity or any non-electrical application, like desalination, district heating, industrial process steam, naval propulsion, etc

Note 1 to entry: The term is generally applied for non-electrical applications, while a single-purpose reactor for electricity production is named "*nuclear power plant*" (3.2.5).

Note 2 to entry: Non-electrical applications are generally deployed in a co-generation scheme because this allows a more efficient use of the reactor energy.

3.6.1.7
co-generation reactor
special-purpose reactor (3.2.1.3) yielding two or more products, one of them being electricity

Note 1 to entry: Some non-electrical applications can be desalination, district heating and industrial process steam.

Note 2 to entry: Co-generation generally improves the overall thermal-cycle efficiency combining production processes which use steam at different energy levels. This implies the existence of a thermal coupling.

3.7 Terms related to structures, systems and components

3.7.1
structure
passive element of a facility that contributes to protection and safety, except human factors

EXAMPLE Buildings, vessels and shielding.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). 219 p. http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf, modified. The wording has been taken from the definition of "structures, systems and components".]

3.7.2
plant system
set of *components* (3.7.3) linked to each other so that they can perform one or more functions

Note 1 to entry: The different functions within a system may use dedicated or shared resources.

Note 2 to entry: The most common Plant System Classification is derived:

a) from their most relevant attributes:

1) predominant engineering branch involved in its design or Element-Component Type.

EXAMPLE Process, Mechanical, Electronic, Electrical and Civil Work Systems.

2) By function.

EXAMPLE Main system/Auxiliary systems.

b) considering their Second Level Features:

1) Relation with Radioactive Inventories (RIs).

EXAMPLE Nuclear system/Conventional systems (Related to/Not-related to radioactive inventory).

2) Role of main function with regard to *operation* (3.9.1).

EXAMPLE On-power *operation* (3.9.1) system/*shutdown state system* (3.8.16.1).

3) Role of main function with regard to *nuclear safety* (3.8.1)

EXAMPLE *Safety related system* (3.8.13)/not safety related system.

A particular system can appear in more than one of the preceding categories.

3.7.2.1
instrumentation and control system
plant system (3.7.2) based on electrical and electronic and programmable electronic technology covering four main functions: instrumentation, logic processing, man-machine interface and actuation

Note 1 to entry: The I&C system includes elements such as sensors, detectors and other input devices, data highways and other communication paths, interfaces to actuators and other output devices.

Note 2 to entry: The elements included in a specific I&C system are defined in the specification of the boundaries of the system.

Note 3 to entry: According to their typical functionality, IAEA distinguishes between automation/control systems, HMI systems, interlock systems and *protection systems* (3.7.2.1.1).

[SOURCE: IEC 61513:2011, modified.]

3.7.2.1.1
reactor protection system
protection system
RPS
system that monitors the *operation* (3.9.1) of a reactor and which, on sensing an abnormal condition, automatically initiates actions to prevent an unsafe or potentially unsafe condition

Note 1 to entry: This use of the term protection refers to protection of the plant; the system in this case encompasses all electrical and mechanical devices and circuitry, from sensors to actuation device input terminals.

Note 2 to entry: The reactor protection system (RPS) provides protection against abnormal conditions such as reactor over-power, too *fast neutron* (3.1.5.1) flux increase, high reactor inlet temperature, *primary heat transport system* (3.7.2.5) over-pressure, etc.

Note 3 to entry: The reactor protection system (RPS) imposes actions on several systems, especially, the *reactor regulation system* (3.7.2.1.2) (RRS), the *reactor shutdown system* (3.8.16.1) (SDS) and the *emergency core cooling system* (3.8.16.2) (ECCS).

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. “IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition”. IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.7.2.1.2
reactor regulation system
RRS
part of the overall *plant instrumentation* (3.7.6) and *instrumentation and control system* (3.7.2.1) aimed at providing adequate regulation of reactor *reactivity* (3.1.12) and total-power, as well as the 3-D core power density distribution, under normal conditions and under *design-basis* (3.3.5) abnormal *events* (3.8.2)

Note 1 to entry: The reactor regulation system also:

a) ensures adequate monitoring of reactor sub-criticality in all reactor *shutdown states* (3.9.2.1.2), and

b) ensures enough sub-criticality margins to keep indefinitely a safe and guarantied shutdown condition under normal conditions.

3.7.2.2
mechanical system
plant system (3.7.2) designed for ensuring a variety of functions requiring rigid elements

Note 1 to entry: The elements of a mechanical system can be either fixed or moving ones, like reactor control rods or large mechanical *structures* (3.7.1), like a metallic *containment* (3.7.5) or a heavy-metal gamma shield.

3.7.2.3
electrical system
plant system (3.7.2) designed for ensuring a specific electric supply generated by specific electric sources to one or more electric loads

Note 1 to entry: Depending on the system purpose and supply, the electrical system design can be dictated by *nuclear safety* (3.8.1) requirements, or by reliability targets e.g. *normal operation* (3.9.2.1) system, its design could also take into account the different reactor or plant conditions e.g. on-power, shutdown, perturbed, *accident* (3.8.2.2).

Note 2 to entry: An electrical system mainly consists of a set of electric cables, bus-bars and linking equipment.

3.7.2.4
process system
plant system (3.7.2) designed to perform thermal, hydraulic, transport, cooling, physical-chemical or chemical processes involving the circulated fluids

Note 1 to entry: The process system is composed by a closed or an open circuit and eventually including several redundant trains, allowing the circulation of one or more fluids.

3.7.2.5
primary heat transport system
PHTS
plant system (3.7.2) designed to cool all fuel assemblies removing all core fission power and transferring this amount of heat to some heat sink

Note 1 to entry: This is achieved by means of a *primary coolant* (3.1.23.4) fluid circulating within a closed circuit, using pumps or gas circulators depending on the fluid. When the coolant is a liquid metal or a molten salt, it is kept at nearly atmospheric pressure, when it is water or a gas it is pressurized.

3.7.2.6
reactor shield cooling system
SCS
plant system (3.7.2) designed to cool the main parts of the reactor shield in order to maintain reasonable values of temperature in all the main shield parts, especially under normal on-power conditions

3.7.2.7
safety system
plant system (3.7.2) provided to ensure the safe shutdown of the reactor or the residual heat removal from the *reactor core* (3.1.23.1), or to limit the consequences of *anticipated operational occurrences* (3.9.2.2) and *design basis accidents* (3.8.2.2.2)

3.7.2.8
support system
plant system (3.7.2) designed to provide a specific fluid supply required either by a *normal operation* (3.9.2.1) system or by a *safety system* (3.7.2.7)

Note 1 to entry: In both cases, the support system shall provide the fluid with all associated requirements in order to cover functions like system or *component* (3.7.3) cooling, fire-fighting coverage, local ambient conditions, compressed-air supply for pneumatic valves and other equipment and instruments, inert-gas supply for isolated piping and vessels.

3.7.3
component
<nuclear reactors> each of the most elementary parts of a *plant system* (3.7.2)

Note 1 to entry: A component mainly act as a single item, either for manufacturing, purchasing, mounting and testing during plant construction.

Note 2 to entry: A component usually performs at least one very specific or low level function within the system, consequently, it has its own particular technical name and identification code.

EXAMPLE

a) mechanical: vessel, pump, heat exchanger, pressurizer, elbow, valve, piping segment, mechanical *structure* (3.7.1), *containment* (3.7.5), penetration, mechanical support, strainer, irradiation device/box, cold neutron source;

b) process: filter, cleaning resin, liquid-*poison* (3.1.13) removal unit, HVAC damper;

c) electrical: diesel electro-generator, AC-power cable, electrical breaker;

d) electronic: I&C panel, computer, logic module, alarm, visualization device, switch;

e) instrumentation: fission chamber, process instrument, *accident* (3.8.2.2) instrument, pre-amplifier, amplifier;

f) special type: *fuel assembly* (3.5.11), ^{60}Co production element, *reactor core* (3.1.23.1) (only in some particular case).

3.7.3.1
active component
component (3.7.3) whose functioning depends on an external input such as actuation, mechanical movement or supply of power, and which responds with relative movement of parts or with a configuration change

3.7.3.2
passive component
component (3.7.3) whose functioning does not depend on an external input such as actuation, mechanical movement or supply of power, and lacks moving parts or parts subject to a configuration change

3.7.4
redundancy
provision of alternative, identical or diverse, *structures* (3.7.1), systems and *components* (3.7.3), so that any single structure, system or component can perform the required function regardless of the state of *operation* (3.9.1) or failure of any other

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. “IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition”. IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.7.5
containment
method or physical *structure* (3.7.1) designed to prevent or control the release and the dispersion of radioactive substances

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 1 December, 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.7.6
plant instrumentation
equipment that is used to measure the physical parameters from which the plant state can be inferred

Note 1 to entry: The plant instrumentation can be divided into two types: *nuclear instrumentation* (3.7.6.1) and *conventional instrumentation* (3.7.6.2).

3.7.6.1
nuclear instrumentation
plant instrumentation (3.7.6) that is used for the detection and measurement of the main radiation types present in a *nuclear reactor* (3.1.22)

Note 1 to entry: These radiation types are: neutron, gamma and beta.

Note 2 to entry: Nuclear instrumentation serves to fulfill the following functions:

a) monitoring of the power distribution and of the total reactor power;

b) monitoring of radiation-exposure within and beyond the installation border;

c) monitoring of the on-site radioactive inventories and radioactive releases;

d) providing input signals for the actuation of the *reactor regulation system* (3.7.2.1.2), the *reactor protection system* (3.7.2.1.1) and some *safety systems* (3.7.2.7).

3.7.6.1.1
in-core instrumentation
nuclear instrumentation (3.7.6.1) that is placed inside the *reactor core* (3.1.23.1), for the measurement of the neutron flux and the power distribution

Note 1 to entry: In-core instrumentation especially uses neutron detectors in large numbers distributed over the core volume and is required mainly during high-power *operation* (3.9.1).

3.7.6.1.2
ex-core instrumentation
nuclear instrumentation (3.7.6.1) that is placed outside the *reactor core* (3.1.23.1), for the measurement of the total reactor power

Note 1 to entry: Ex-core instrumentation is required during start up, intermediate and *low-power operation* (3.9.2.1.1.3), and can be placed inside or outside the *reactor vessel* (3.1.23.3).

3.7.6.2
conventional instrumentation
plant instrumentation (3.7.6) for measuring other physical parameters than nuclear radiations

Note 1 to entry: Conventional instrumentation is used, for example, for measuring temperature, pressure, flow rate.

Note 2 to entry: The conventional instrumentation used in a *nuclear reactor installation* (3.1.17) shall be able to withstand the radiation environment.

3.8 Terms related to nuclear safety in reactor design and operation

3.8.1
nuclear safety
achievement of proper operating conditions, prevention of *accidents* (3.8.2.2) and mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation risks

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.2
event
occurrence unintended by the operator, including operating error, equipment failure or other mishap, and deliberate action on the part of others, the consequences or potential consequences of which are not negligible from the point of view of protection and safety

Note 1 to entry: See event and International Nuclear and Radiological Event Scale (INES). There remains a fundamental mismatch between the terminology used in safety standards and that used in *INES*. In short, events that would be considered *accidents* (3.8.2.2) according to the safety standards definition may be accidents or '*incidents*' (3.8.2.1)(i.e. not accidents) in *INES* terminology. See *INES* for a more extensive discussion.

Note 2 to entry: As with *INES*, the terminology related to the reporting and analysis of events is not always consistent with the terminology used in safety standards, and great care should be taken to avoid confusion. In particular, the definition of event given above is identical in essence to the safety standards definition of accident. This difference derives from the fact that event reporting and analysis is concerned directly with the question of whether an event that could develop into an accident with significant consequences actually does so; terms such as accident are used only to describe the end result, and therefore other terms are needed to describe the earlier stages.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.2.1
incident
unintended *event* (3.8.2), including operating errors, equipment failures, initiating events, *accident* (3.8.2.2) precursors, near misses or other mishaps, or unauthorized act, malicious or non-malicious, the consequences or potential consequences of which are not negligible from the point of view of protection and safety

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.2.2
accident
unintended *event* (3.8.2), including operating errors, equipment failures and other mishaps, the consequences or potential consequences of which are not negligible from the point of view of protection and safety

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.2.2.1
severe accident
accident (3.8.2.2) more severe than a *design basis accident* (3.8.2.2.2) and involving significant core degradation

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.2.2.2
design basis accident
postulated *accident* (3.8.2.2) leading to accident conditions for which a facility is designed in accordance with established design criteria and conservative methodology, and for which releases of radioactive material are kept within acceptable limits

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.2.2.3
beyond design basis accident
postulated *accident* (3.8.2.2) with accident conditions more severe than those of a *design basis accident* (3.8.2.2.2)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.3
accident management
the taking of a set of actions during the evolution of a *beyond design basis accident* (3.8.2.2.3):

a) to prevent the escalation of the *event* (3.8.2) into a *severe accident* (3.8.2.2.1);

b) to mitigate the consequences of a severe *accident* (3.8.2.2);

c) to achieve a long term safe stable state

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.4
design extension conditions
postulated *accident* (3.8.2.2) conditions that are not considered for *design basis accident* (3.8.2.2.2), but are considered in the design process for the facility in accordance with best estimate methodology, and for which releases of radioactive material are kept within acceptable limits

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.5
common cause failure
failure of two or more *structures* (3.7.1), systems and *components* (3.7.3) due to a single specific *event* (3.8.2) or cause

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.6
common mode failure
failure of two or more *structures* (3.7.1), systems and *components* (3.7.3) in the same manner or mode due to a single specific *event* (3.8.2) or cause

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.7
defense in depth
hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of *anticipated operational occurrences* (3.9.2.2) or *events* (3.8.2)

Note 1 to entry: The objectives of defence in depth are:

a) to compensate for potential human and *component* (3.7.3) failures or malicious acts;

b) to maintain the effectiveness of the barriers by averting damage to the facility and to the barriers themselves;

c) to protect workers, members of the public and the environment from harm in accident conditions in the *event* (3.8.2) that these barriers are not fully effective.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf, modified — The wording of the definition has been shorten.]

3.8.8
safety culture
assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 1 December 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.9
safety analysis
evaluation of the potential hazards associated with the *operation* (3.9.1) of a facility or the conduct of an activity

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 1 December 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.10
safety limits
limits on operational parameters within which an authorized facility has been shown to be safe

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 1 December 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.11
safety limits and conditions
set of rules, setting forth parameter limits functional capability and performance levels of equipment and personnel approved by the *nuclear regulator* (3.3.9) for safe *operation* (3.9.1) of an authorized facility

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 1 December 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.12
safety function
top-level function related to *nuclear safety* (3.8.1), and their specific requirements according to the *nuclear reactor* (3.1.22) type, to be ensured and preserved at any time and under any plant condition, in every *nuclear reactor installation* (3.1.17)

3.8.13
safety related system
system important to safety that is not part of a *safety system* (3.7.2.7)

EXAMPLE A safety related *instrumentation and control system* (3.7.2.1) is important to safety but is not part of a safety system.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf, modified — The definition has been split in a definition and an example.]

3.8.14
safety system support feature
collection of equipment that provides services such as cooling, lubrication and energy supply required by the *protection system* (3.7.2.1.1) and the *safety actuation system* (3.8.16.4)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.15
contamination prevention safety feature
design feature preventing the possibility of contamination reaching the public, in all operational conditions and accidental scenarios

Note 1 to entry: In the case of nuclear desalination or district heating, the possibility of contaminating the product-water should be prevented by safety features implemented through *nuclear safety* (3.8.1) graded SSCs, and assessed through a nuclear *safety analysis* (3.8.9) technique.

3.8.16
safety system
(See 3.7.2.7)

3.8.16.1
reactor shutdown system
reactor SDS
safety system (3.7.2.7) having as central function to ensure the automatic initiation of a fast *nuclear reactor* (3.1.22) extinction, through the rapid insertion of a large quantity of neutron absorbers in the core

Note 1 to entry: In most of currently operating reactors there is only one SDS, but in present HWRs and in new designs (G-III+) are frequently 2 SDSs, with strong diversity.

3.8.16.1.1
scram
rapid shutdown of a *nuclear reactor* (3.1.22) in an emergency

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.8.16.2
emergency core cooling system
ECCS
safety system (3.7.2.7) having as central function to ensure the automatic initiation of a number of actions ensuring adequate core cooling and *primary coolant* (3.1.23.4) inventory losses compensation, following a loss of coolant accident (LOCA)

Note 1 to entry: The overall conception of ECCS is largely dependent on the reactor type, its design and on its primary coolant.

Note 2 to entry: The fast, pressure drop following the pipe break, imposes a sub-division of the ECCS response in more than one pressure stages, with a minimum of 2 stages.

Note 3 to entry: ECCS in HWR-*NPPs* (3.2.5) produces a degradation of the D_2O by mixing it with H_2O.

3.8.16.3
shutdown cooling system
SDCS
safety system (3.7.2.7), of the *process system* (3.7.2.4) type, having as central functions to ensure core decay-power removal and its transport to a final heat sink, both, under normal shutdown conditions and under a postulated LOCA *accident* (3.8.2.2), for intact loops in case of a *nuclear power plant* (3.2.5) with a multiple-loop *PHTS* (3.7.2.5).

3.8.16.4
safety actuation system
collection of equipment required to accomplish the necessary safety actions when initiated by the *protection system* (3.7.2.1.1)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9 Terms related to nuclear power plant operation and support

3.9.1
operation
all activities performed to achieve the purpose for which an authorized facility was constructed

Note 1 to entry: For a *nuclear power plant* (3.2.5), the operation includes *maintenance* (3.9.12), refuelling, in-service inspection and other associated activities.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.2
operational states
states defined under *normal operation* (3.9.2.1) and *anticipated operational occurrences* (3.9.2.2)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.2.1
normal operation
operation (3.9.1) within specified operational limits and conditions

Note 1 to entry: For a *nuclear power plant* (3.2.5), this includes start up, power operation, shutting down, shutdown, *maintenance* (3.9.12), testing and refuelling.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. “IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition”. IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.2.1.1
on power operation state
operational state (3.9.2) with a plant configuration authorized by design for on-power *operation* (3.9.1)

Note 1 to entry: In general, it is considered on-power operation state the operation at a power between 15 % to 100 %.

3.9.2.1.1.1
full-power operation
operational state (3.9.2) with a plant configuration authorized by design for on-power *operation* (3.9.1) at the maximum allowed nominal power, namely, operating at 100 % of its power *capacity* (3.9.5), both for *thermal reactor* (3.2.3.2) power and for main *turbine generator* (3.4.4) generated electric power

3.9.2.1.1.2
partial-load operation
operational state (3.9.2) with a plant configuration authorized by design for reactor on-power *operation* (3.9.1) at different allowed nominal power values, namely, operating at reactor-power levels below 100 % of its nominal power *capacity* (3.9.5), while main generator output could be from the same fraction down to even 0 % (no electric generation)

3.9.2.1.1.3
low-power operation
operational state (3.9.2) having few changes in the plant configuration with regard to that for *partial-load operation* (3.9.2.1.1.2), with a reactor power usually in the range between 1 % and 3 % (plant start-up range), but eventually extended up to 30 % (electric low-power range)

3.9.2.1.2
shutdown state
decrease in the fission rate and the consequent decrease in heat production, normally by the insertion of control rods in the *reactor core* (3.1.23.1)

3.9.2.1.2.1
hot shutdown
hot standby
operational state (3.9.2) with a complete plant configuration authorized by design for *low-power operation* (3.9.2.1.1.3), except for the *nuclear reactor* (3.1.22), which is kept in a guaranteed sub-critical state, at “zero fission-power”, not generating electrical power, but with the complete installation ready to turn to “on-power operation”

Note 1 to entry: The term hot standby is used within the verbiage of *pressurized water reactors* (3.2.4.2.2) while the term hot shutdown is used in the verbiage of *boiling water reactors* (3.2.4.2.1).

3.9.2.1.2.2
primary heat transport system pressurized cold shutdown
PHTS-pressurized cold shutdown
operational state (3.9.2) primarily applicable to *light water reactors* (3.2.4.2) witha) a plant configuration authorized by design,b) the *nuclear reactor* (3.1.22) in a guaranteed sub-critical state, generating “zero fission-power”, andc) the reactor coolant system at atmospheric pressure and below the coolant boiling temperature following a cooldown of the reactor

3.9.2.1.2.3
primary heat transport system depressurized-filled cold shutdown
PHTS-depressurized-filled cold shutdown
operational state (3.9.2) with a plant configuration authorized by design, with the *nuclear reactor* (3.1.22) in a guaranteed sub-critical state, generating "zero fission-power" (only very low decay-power), and the PHTS and its primary coolant (3.1.23.4) pressure values set at, or very near atmospheric value, while keeping filled the *PHTS* (3.7.2.5)

3.9.2.1.2.4
primary heat transport system drained cold shutdown
PHTS-drained cold shutdown
operational state (3.9.2) with a plant configuration authorized by design, with the *nuclear reactor* (3.1.22) in a guaranteed sub-critical state, generating "zero fission-power" (only very low decay-power), while the PHTS *primary coolant* (3.1.23.4) inventory is reduced to a minimum allowing the drainage of the primary pumps and other large *components* (3.7.3) for *maintenance* (3.9.12)

3.9.2.1.3
operational transient
each of the authorized-by-design plant configurations for safe transitions between allowed operational plant states, both at shutdown or on-power *operation* (3.9.1)

3.9.2.2
anticipated operational occurrence
deviation of an operational *process* from *normal operation* (3.9.2.1) that is expected to occur at least once during the *operating lifetime* (3.9.8) of a facility but which, in view of appropriate provisions, does not cause any significant damage to items important to safety or lead to *accident* (3.8.2.2) conditions

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.3
operations area
geographical area that contains an authorized facility

Note 1 to entry: The *operations* (3.9.1) area is enclosed by a physical barrier (the operations boundary) to prevent unauthorized access, by means of which the management of the authorized facility can exercise direct authority.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.4
operational bypass
bypass of certain protective actions when they are not necessary in a particular mode of plant *operation* (3.9.1)

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

Note 2 to entry: An operational bypass may be used when the protective action prevents, or might prevent, reliable *operation* (3.9.1) in the required mode.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.5
capacity
load for which a generating unit, generating station, or other electrical apparatus is rated either by the user or by the *manufacturer* (3.3.18)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "*Economic performance indicators for nuclear power plants*". IAEA Technical Reports Series No. 437. IAEA, Vienna, 2006. p. 158]

3.9.6
capacity factor
net electrical energy produced during the reference period versus the net electrical energy which would have been generated at maximum net *capacity* (3.9.5) under continuous *operation* (3.9.1) during the entire reference period, expressed in per cent

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "*Guidance for optimizing nuclear power plant maintenance programmes*". IAEA/TECDOC 1383. IAEA, Vienna, 2003. p. 140]

3.9.7
condition monitoring
continuous or periodic tests, inspections, measurement or trending of the performance or physical characteristics of *structures* (3.7.1), systems and *components* (3.7.3) to indicate current or future performance and the potential for failure

Note 1 to entry: Condition monitoring is usually conducted on a non-intrusive basis.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.8
operating lifetime
period during which an authorized facility is used for its intended purpose, until decommissioning or closure

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.9
service life
period from initial *operation* (3.9.1) to final withdrawal from service of a *structure* (3.7.1), system or *component* (3.7.3)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.10
configuration management
process of identifying and documenting the characteristics of a facility's *structures* (3.7.1), systems and *components* (3.7.3), including computer systems and software, and of ensuring that changes to these characteristics are properly developed, assessed, approved, issued, implemented, verified, recorded and incorporated into the facility documentation

Note 1 to entry: Configuration is used in the sense of the physical, functional and operational characteristics of the *structures* (3.7.1), systems and *components* (3.7.3) and parts of a facility.

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.11
ageing management
engineering, *operations* (3.9.1) and *maintenance* (3.9.12) actions to control within acceptable limits the ageing degradation of *structures* (3.7.1), systems and *components* (3.7.3)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 28 November 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.11.1
lifetime management
integration of *ageing management* (3.9.11) with economic planning

Note 1 to entry: Lifetime management is carried out: (1) to optimize the *operation* (3.9.1), *maintenance* (3.9.12) and service life of *structures* (3.7.1), systems *and components* (3.7.3); (2) to maintain an acceptable level of safety and performance; and (3) to improve economic performance over the *service life* (3.9.9) of the facility

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 28 November 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf, modified.]

3.9.11.2
life cycle management
lifetime management (3.9.11.1) in which due recognition is given to the fact that at all stages in the lifetime there may be effects that need to be taken into consideration

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.12
maintenance
organized activity, both administrative and technical, of keeping *structures* (3.7.1), systems and *components* (3.7.3) in good operating condition, including both preventive and corrective or repair aspects

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.12.1
planned maintenance
form of *preventive maintenance* (3.9.12.4) consisting of refurbishment or replacement that is scheduled and performed prior to unacceptable degradation of a *structure* (3.7.1), system or *component* (3.7.3)

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.12.2
periodic maintenance
time based maintenance
form of *preventive maintenance* (3.9.12.4) consisting of servicing, parts replacement, surveillance or testing at predetermined intervals of calendar time, operating time or number of cycles

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

3.9.12.3
predictive maintenance
condition based maintenance
form of *preventive maintenance* (3.9.12.4) performed continuously or at intervals governed by observed condition to monitor, diagnose or trend a *structure* (3.7.1), system or *component's* (3.7.3) condition indicators

Note 1 to entry: The results of the predictive maintenance indicate present and future functional ability or the nature of and schedule for *planned maintenance* (3.9.12.1).

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf, modified. The definition has been split in a definition and a note 1 to entry.]

3.9.12.4
preventive maintenance
actions that detect, preclude or mitigate degradation of a functional *structure* (3.7.1), system or *component* (3.7.3) to sustain or extend its useful life by controlling degradation and failures to an acceptable level

Note 1 to entry: Preventive maintenance may be *periodic maintenance* (3.9.12.2), *planned maintenance* (3.9.12.1) or *predictive maintenance* (3.9.12.3). Contrasted with corrective *maintenance* (3.9.12).

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf, modified — The definition has been split in a definition and a note 1 to entry.]

3.9.13
maintenance bypass
bypass of *safety system* (3.7.2.7) equipment during *maintenance* (3.9.12), testing or repair

[SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY. "IAEA Safety Glossary: Terminology used in nuclear safety and radiation protection. 2016 Edition". IAEA, Vienna, 2016. (Retrieved: 11 August 2016). p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf]

Annex A
(informative)

Methodology used in the development of the vocabulary

A.1 General

The specific character of the reactors concepts contained in this standard requires the use of:

— clear technical descriptions;

— 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 relationships between concepts within the field of nuclear reactors 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 International Standard. 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), and 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).

Example from ISO 704:2009, 5.5.2.2.1:

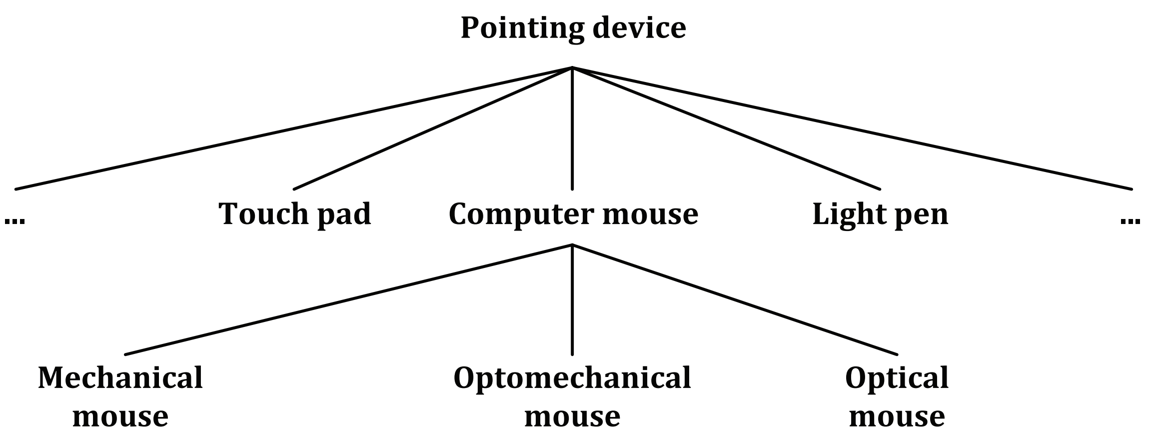


Figure A.1 — Graphical representation of a generic relation

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.

Example from ISO 704:2009, 5.5.2.3.1:

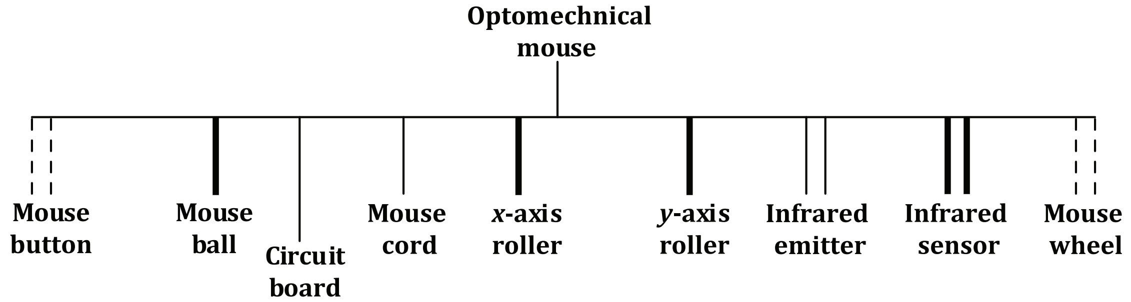


Figure A.2 — Graphical representation of a partitive relation

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, material and product. Besides, associative relations are the most commonly encountered in terminology practical work, as they correspond to the concepts relations established in the real world.

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

Example from ISO 704:2009, 5.6.2:

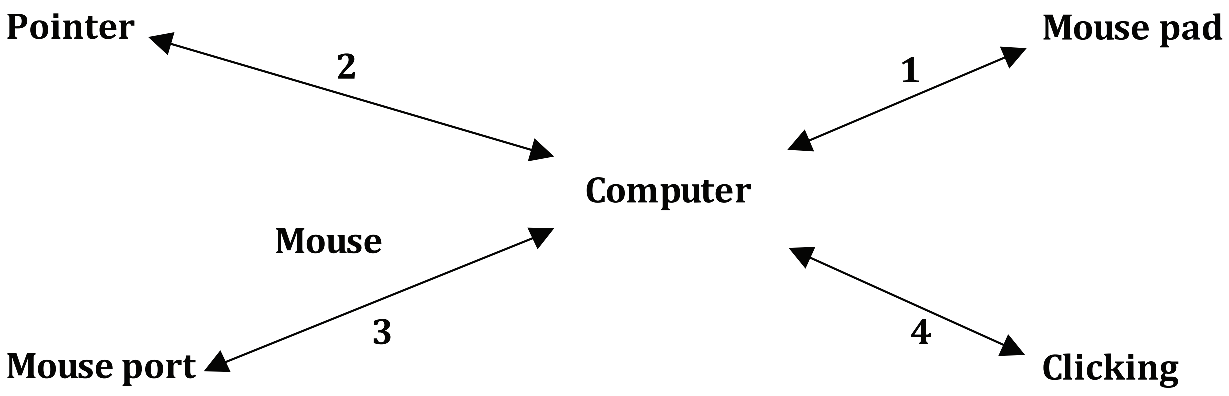


Figure A.3 — Graphical representation of an associative relation

A.3 Concept diagrams

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

Concept diagrams

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

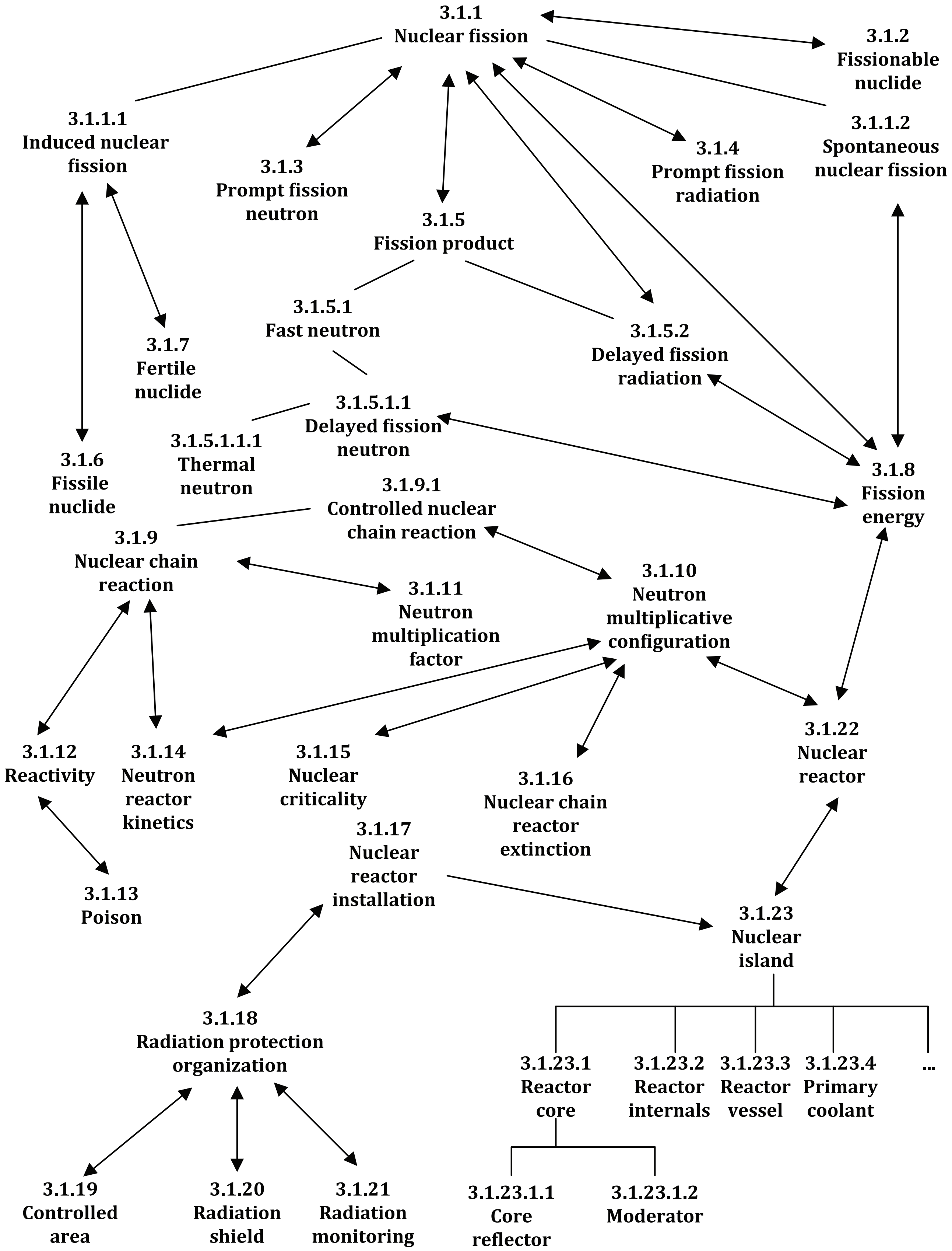


Figure A.4 — 3.1 General terms related to nuclear reactors

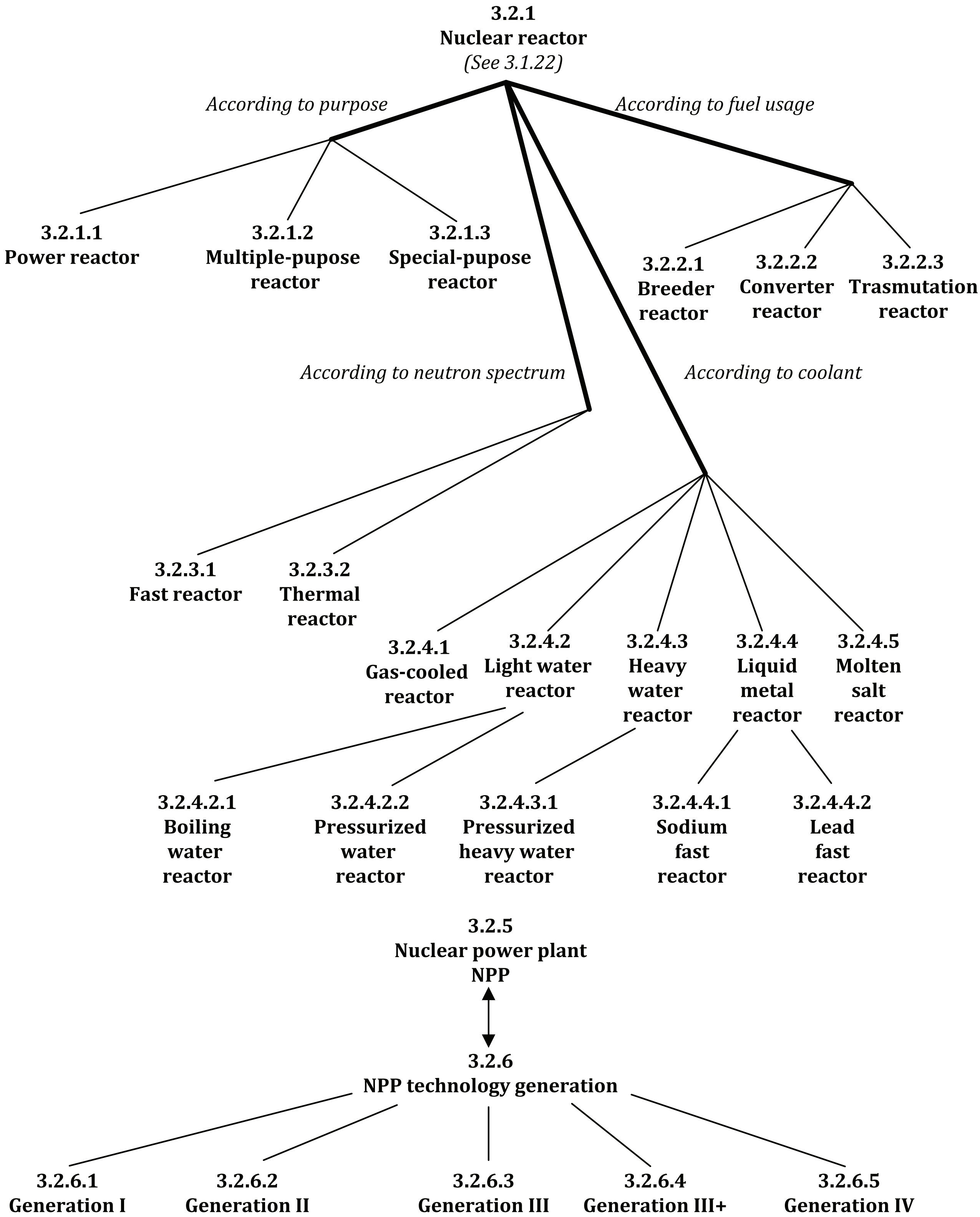


Figure A.5 — 3.2 Terms related to nuclear reactors types

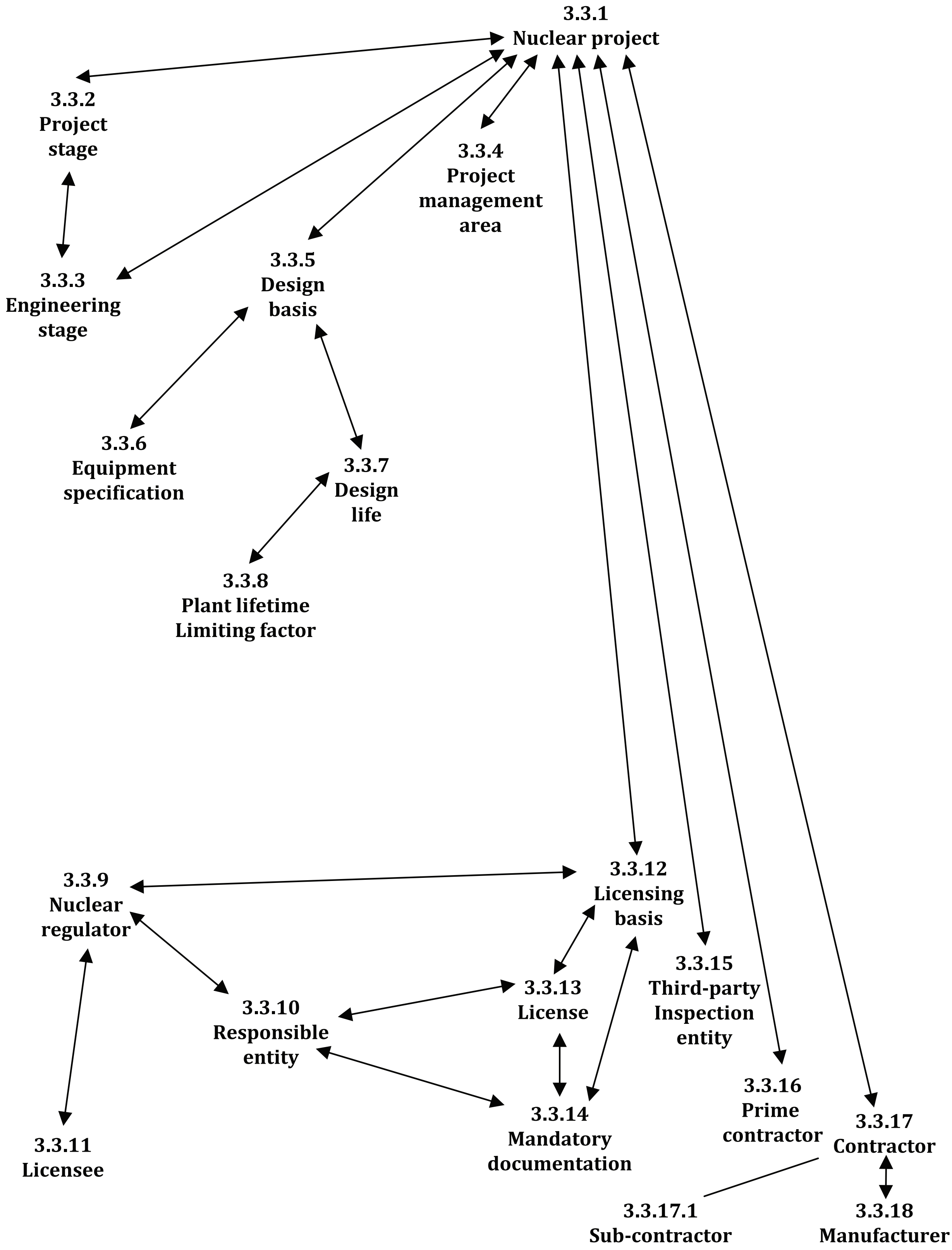


Figure A.6 — 3.3 Terms related to nuclear projects

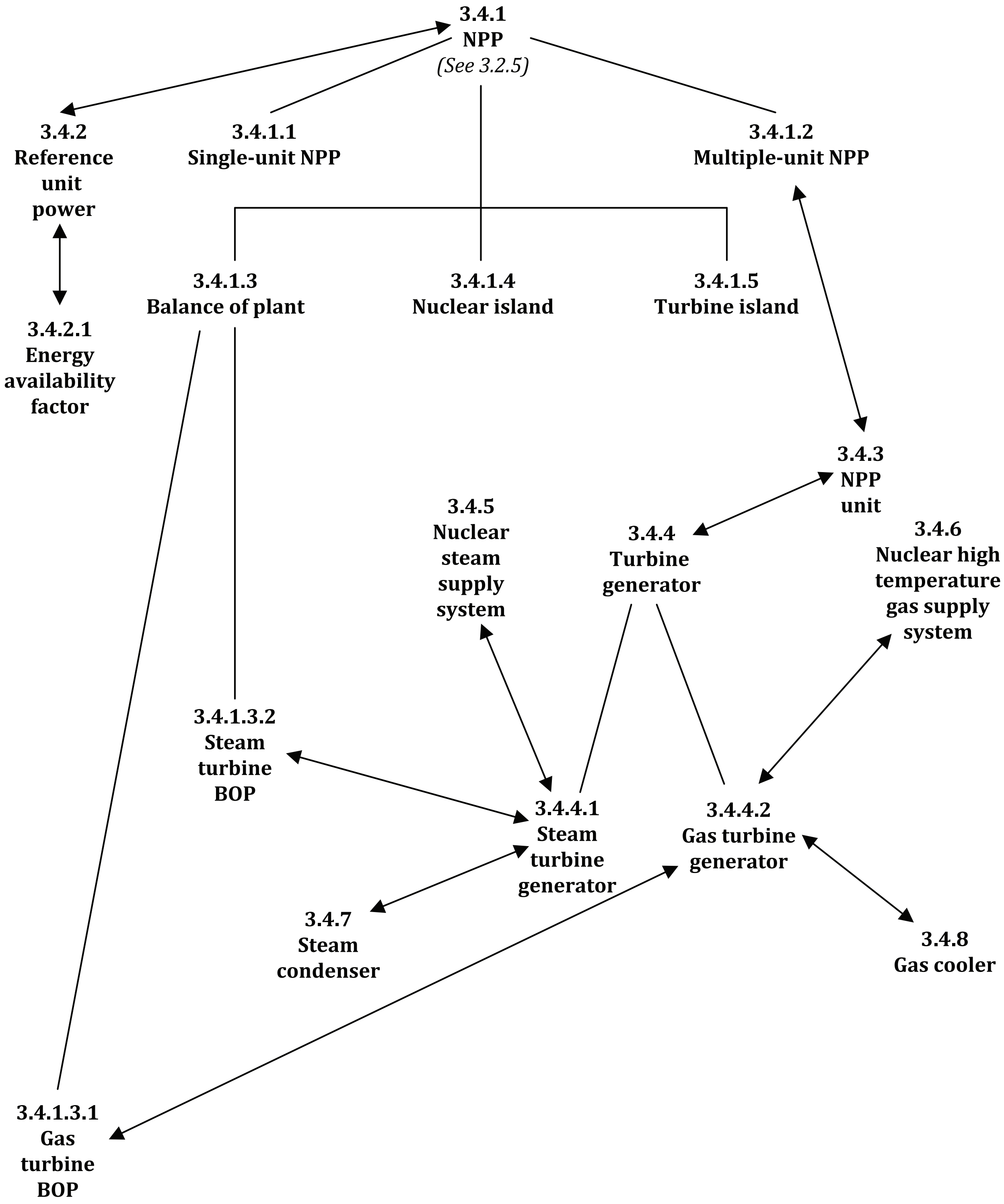


Figure A.7 — 3.4 Terms related to nuclear power plants

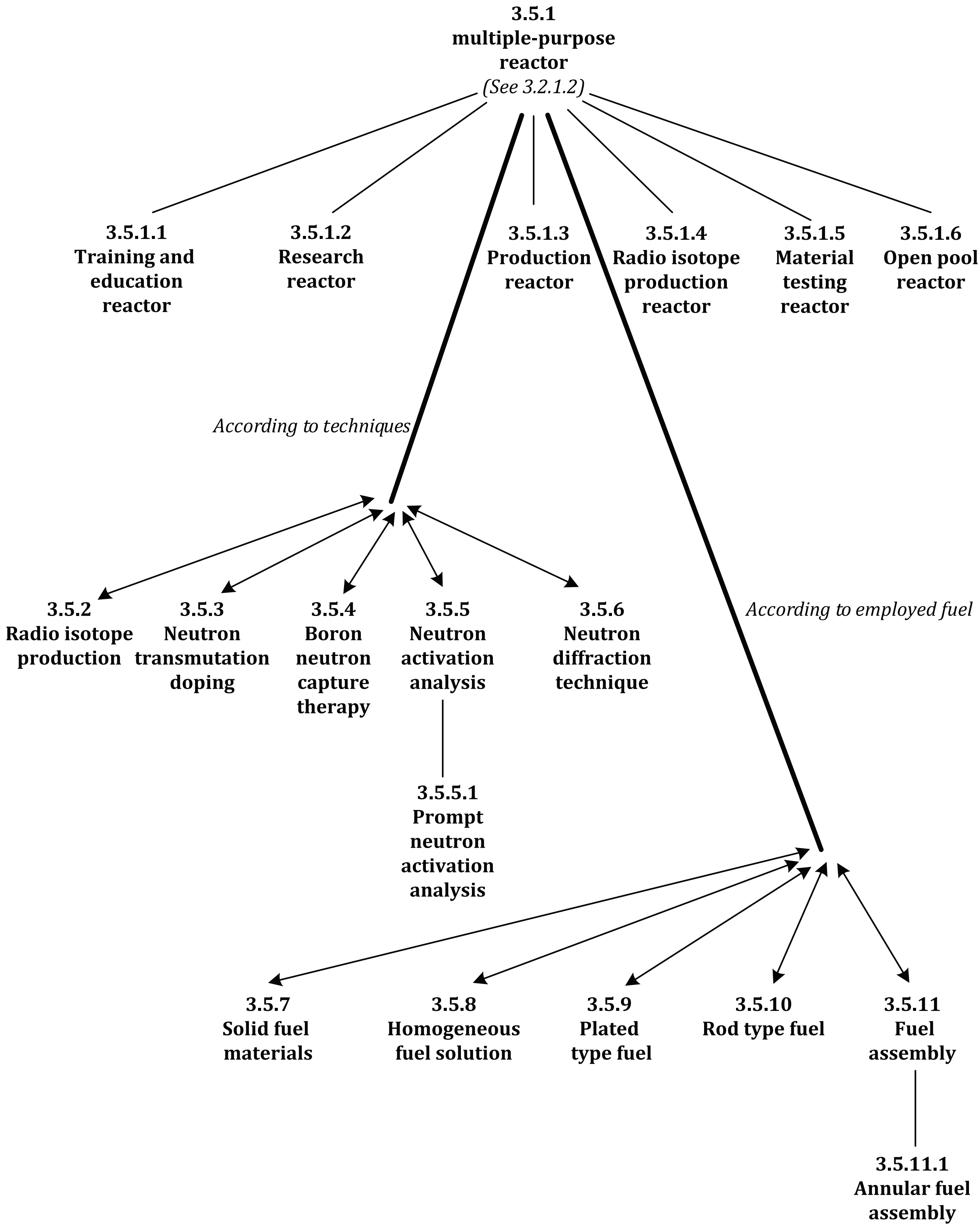


Figure A.8 — 3.5 Terms related to general purpose reactors

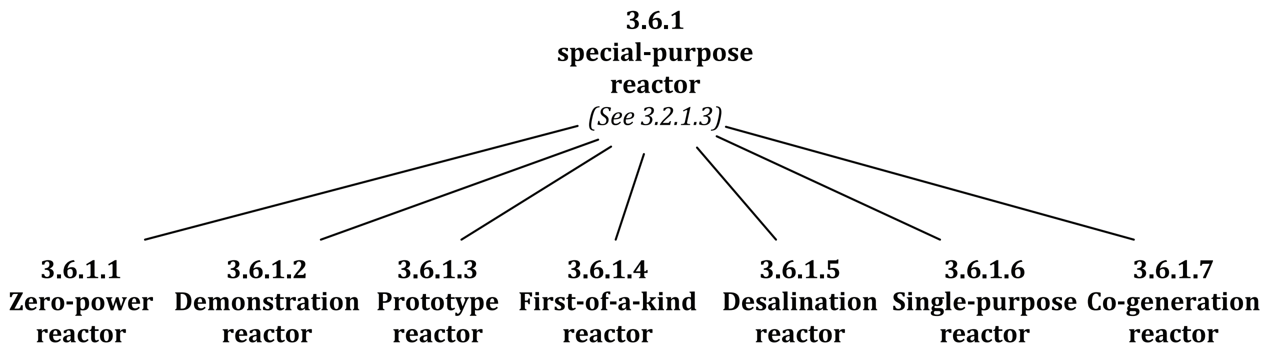


Figure A.9 — 3.6 Terms related to special purpose reactors

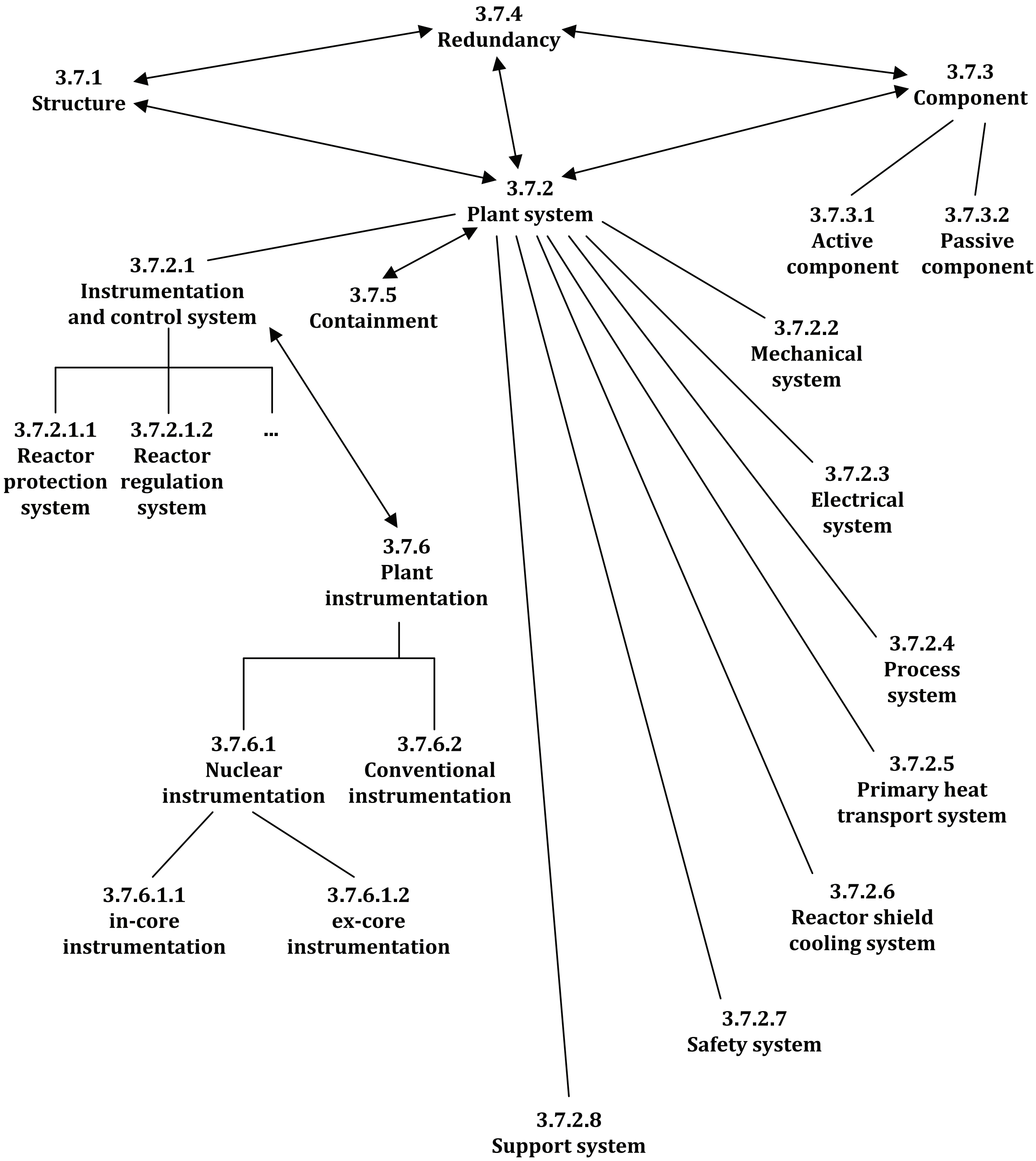


Figure A.10 — 3.7 Terms related to structures, systems and components

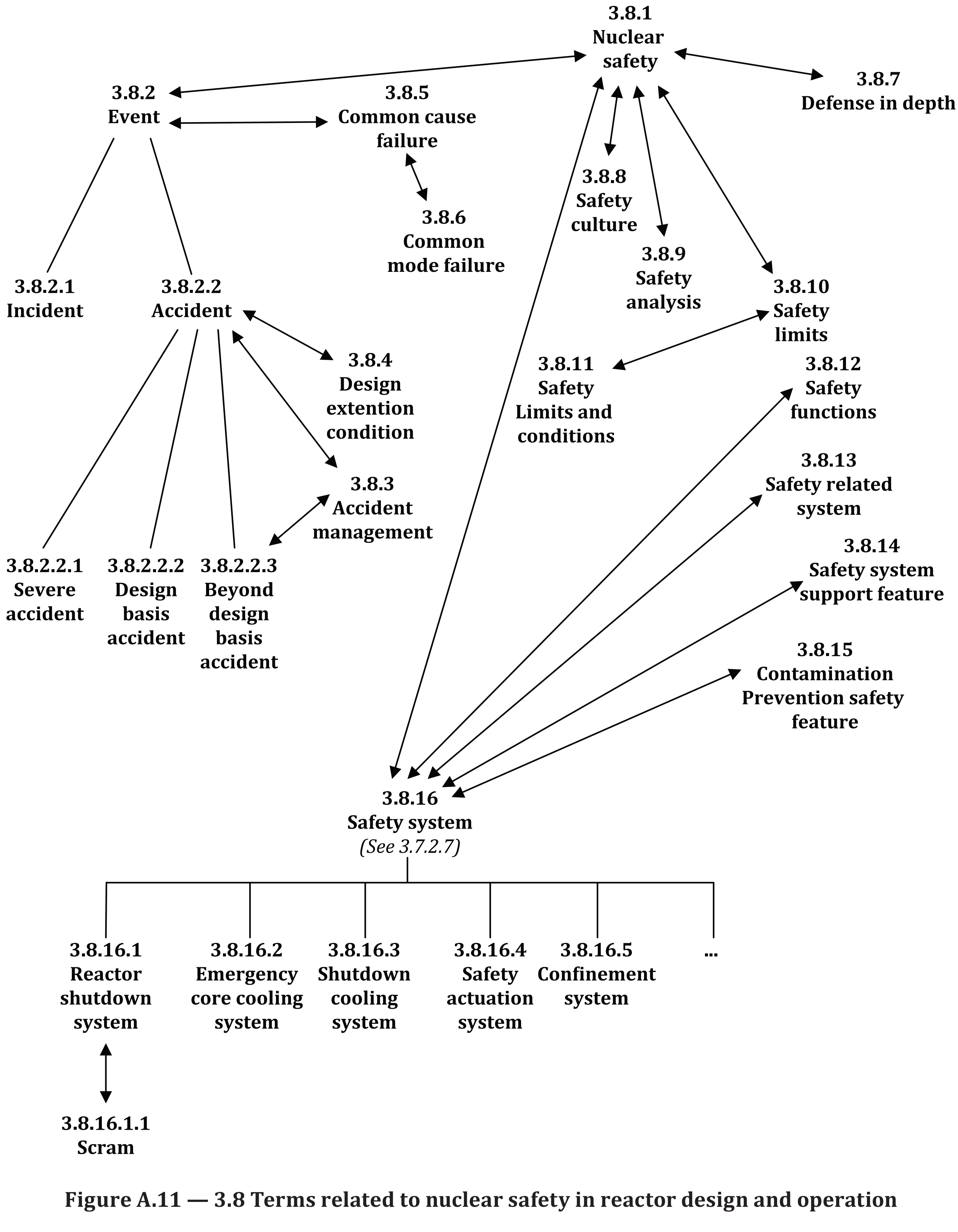
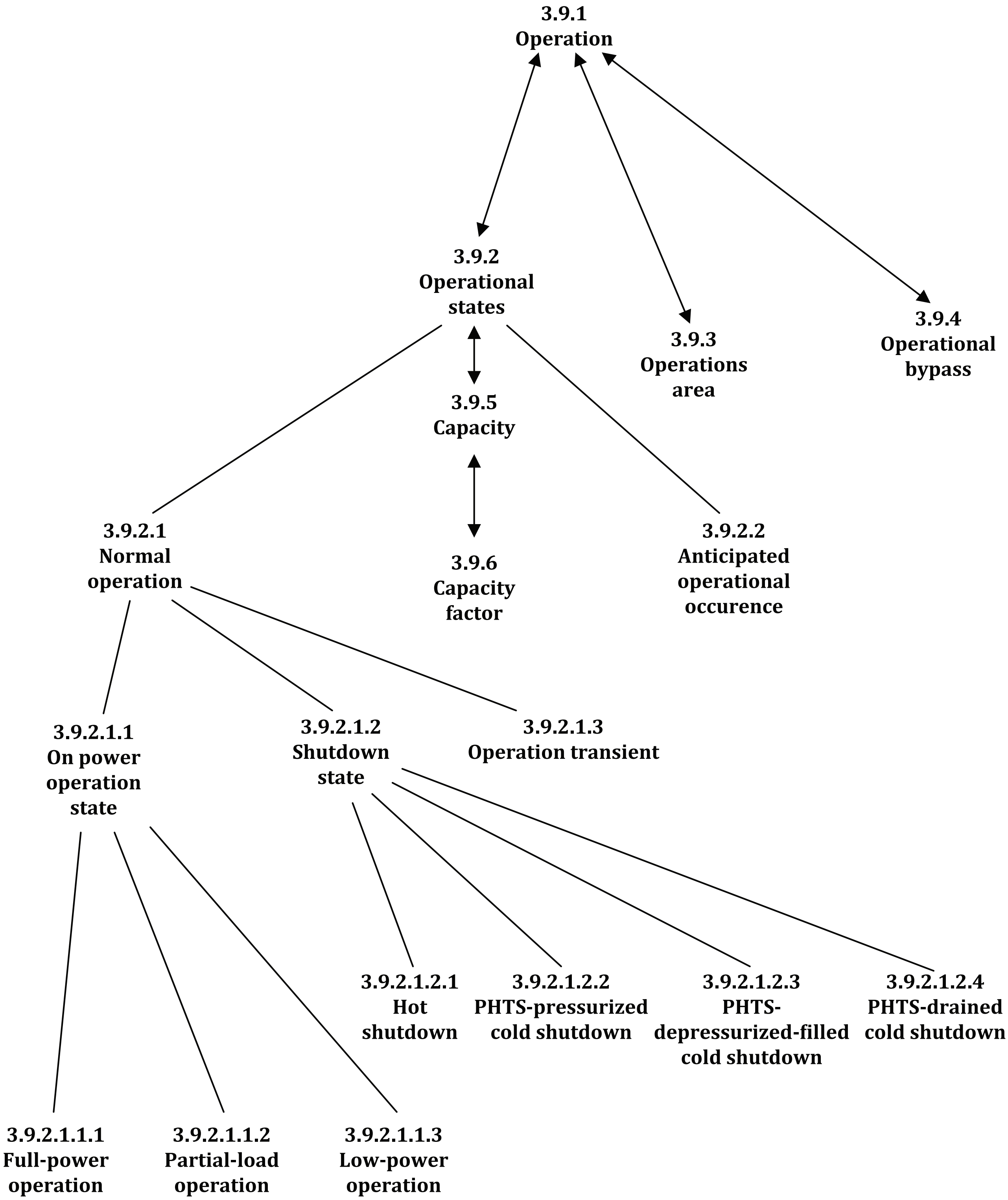
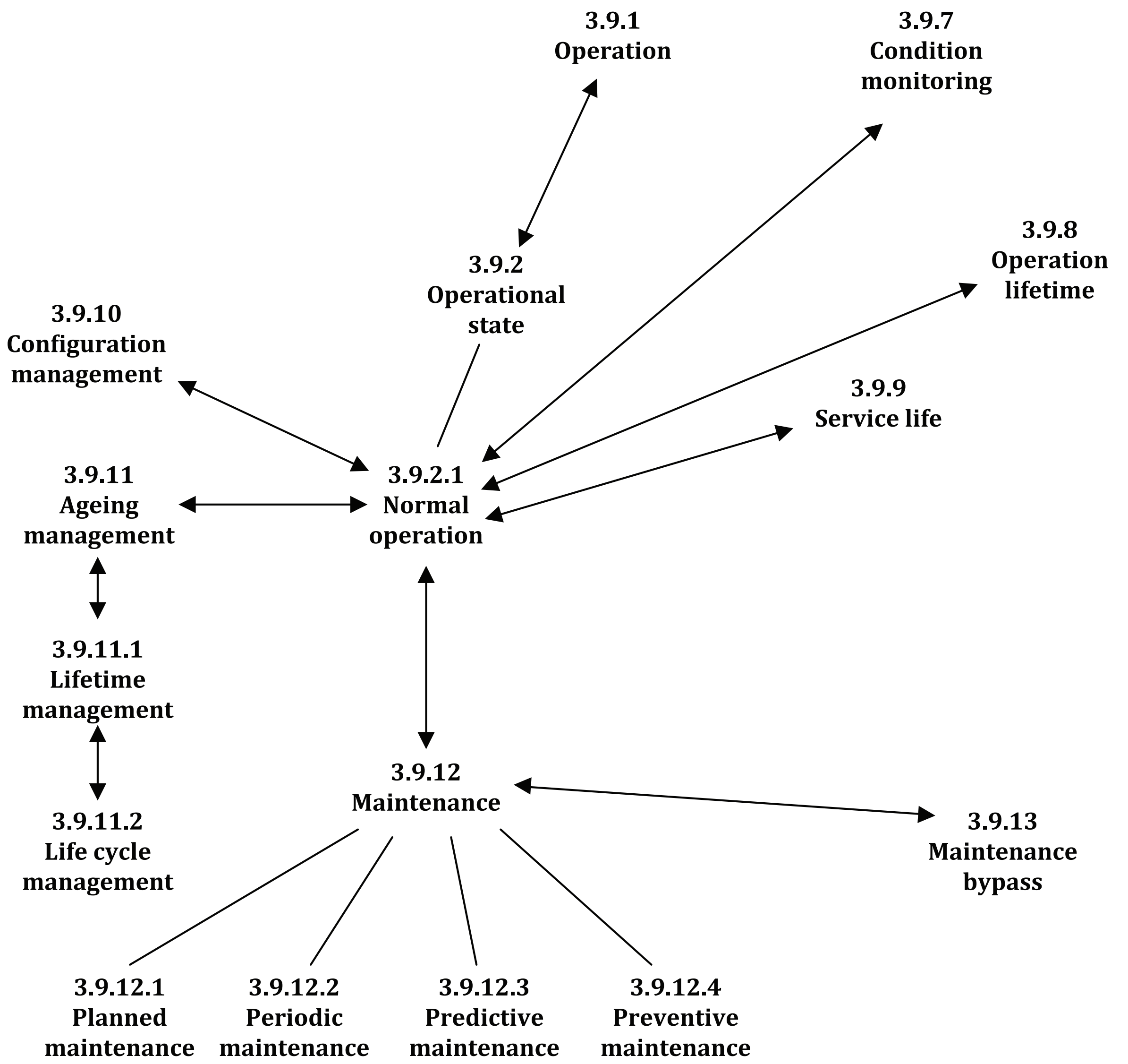


Figure A.11 — 3.8 Terms related to nuclear safety in reactor design and operation


3.9.1
Operation
3.9.2
Operational
states
3.9.3
Operations
area
3.9.4
Operational
bypass
3.9.5
Capacity
3.9.6
Capacity
factor
3.9.2.1
Normal
operation
3.9.2.2
Anticipated
operational
occurence
3.9.2.1.1
On power
operation
state
3.9.2.1.2
Shutdown
state
3.9.2.1.3
Operation transient
3.9.2.1.2.1
Hot
shutdown
3.9.2.1.2.2
PHTS-pressurized
cold shutdown
3.9.2.1.2.3
PHTS-
depressurized-filled
cold shutdown
3.9.2.1.2.4
PHTS-drained
cold shutdown
3.9.2.1.1.1
Full-power
operation
3.9.2.1.1.2
Partial-load
operation
3.9.2.1.1.3
Low-power
operation

a) Option 1



b) Option 2

Figure A.12 — 3.9 Terms related to nuclear power plant operations and support

Bibliography

[1] ISO 704:2009, *Terminology work — Principles and methods*

[2] ISO 1087-1:2000, *Terminology work — Vocabulary — Part 1: Theory and application*

[3] ISO 10241-1:2011, *Terminological entries in standards — Part 1: General requirements and examples of presentation*

[4] ISO 9000:2015, *Quality management systems — Fundamentals and vocabulary*

[5] ISO 10795:2011, *Space systems — Programme management and quality — Vocabulary*

[6] ISO 12749-3:2015, *Nuclear energy, nuclear technologies, and radiological protection — Vocabulary — Part 3: Nuclear fuel cycle*

[7] ISO 18229:2018, *Essential technical requirements for mechanical components and metallic structures foreseen for Generation IV nuclear reactors*

[8] IEC 61513:2011, *Nuclear power plants — Instrumentation and control for systems important to safety — General requirements for systems*

[9] GOST 23082-1978, *Nuclear reactors — Terms and definitions*

[10] INTERNATIONAL ATOMIC ENERGY AGENCY. *Construction technologies for nuclear power plants*. IAEA Nuclear Energy Series No. NP-T-2.5. IAEA, Vienna, 2011. p 190

[11] INTERNATIONAL ATOMIC ENERGY AGENCY. IAEA Safety Glossary: *Terminology used in nuclear safety and radiation protection*. 2016 Edition. IAEA, Vienna, 2016. (Retrieved: 11 August 2016]. p. 219, http://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf

[12] Koelzer, Winfried. Glossary of nuclear Terms. Karlsruher Institut für Technologie, Karlsruhe, 2013. ISBN 3-923704-32-1. [Retrieved: 26 aug 2016]. p. 180, http://www.euronuclear.org/info/encyclopedia/pdf/Nuclear_Glossary-202013-02-13.pdf

[13] INTERNATIONAL ATOMIC ENERGY AGENCY. *Radioactive waste management glossary*. 2003 Edition. IAEA, Vienna, Austria, 2003. p. 61

[14] INTERNATIONAL ATOMIC ENERGY AGENCY. *Glossary of terms in PRIS reports* – PRIS: Power reactor information system. [Retrieved: 30 aug 2016]. https://www.iaea.org/PRIS/Glossary.aspx

[15] INTERNATIONAL ATOMIC ENERGY AGENCY. "Glossary of terms in PRIS reports – PRIS: Power reactor information system". (Retrieved: 28 November, 2016). https://www.iaea.org/PRIS/Glossary.aspx

[16] INTERNATIONAL ATOMIC ENERGY AGENCY. "*Safety of nuclear power plants: design*". IAEA Safety Standards Series No. SSR-2/1 (Rev. 1). IAEA, Vienna, 2016. 99 p.

[17] INTERNATIONAL ATOMIC ENERGY AGENCY. *Economic performance indicators for nuclear power plants*. IAEA Technical Reports Series No. 437. IAEA, Vienna, 2006. p. 158

[18] INTERNATIONAL ATOMIC ENERGY AGENCY. *Guidance for optimizing nuclear power plant maintenance programmes*. IAEA-TECDOC-1383. IAEA, Vienna, 2003. p. 140

[19] United States Nuclear Regulatory Commission Glossary (Retrieved: 8 August 2017), https://www.nrc.gov/reading-rm/basic-ref/glossary.html]

Alphabetical index

R

S

T

This Indian Standard has been developed from Doc No.: CHD 30 (21928).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi