

## Appendix A. Glossary

**Absorbed dose** The energy imparted by ionizing radiation to a suitably small volume of matter divided by the mass of that volume. Unit gray, symbol Gy. 1 Gy = 1 joule per kilogram.

**Actinides** A group of 15 *elements* with *atomic number* from that of actinium (89) to lawrencium (103) inclusive. All are *radioactive*. Group includes uranium, plutonium, americium, and curium.

**Activity** The rate at which nuclear transformations occur in a *radioactive material*. Used as a measure of the amount of a *radionuclide* present. Unit becquerel, symbol Bq. 1 Bq = 1 transformation per second.

**Alpha particle** A particle consisting of two *protons* plus two *neutrons* (i.e. the *nucleus* of a helium *atom*) emitted by a *radionuclide*.

**Atom** Unit of matter consisting of a single nucleus surrounded by a number of *electrons* equal to the number of *protons* in the nucleus. The smallest portion of an *element* that can combine chemically with other atoms.

**Atomic mass** The mass of an *isotope* of an *element* expressed in atomic mass units, which are defined as one-twelfth of the mass of an *atom* of carbon-12. (An atomic mass of 1 is equivalent to about  $1.66 \times 10^{-27}$  kg.)

**Atomic number** The number of *protons* in the *nucleus* of an *atom*. Symbol Z.

**Becquerel** See *activity*.

**Beta particle** An *electron* or *positron* which has been emitted by an atomic *nucleus* or *neutron* in a nuclear transformation.

**Brachytherapy** The use of sealed radioactive sources in or on the body for treating certain types of cancer.

**Chromosomes** Rod-shaped bodies found in the *nuclei of cells* in the body. They contain the *genes*, or hereditary constituents. Human beings possess 23 pairs.

**Collective dose** The total *radiation dose* incurred by a population. Frequently used for *collective effective dose*.

**Collective effective dose** The quantity obtained by adding the *effective doses* received by all of the people in a defined population (often all of the people exposed to *radiation* from a particular source). Unit man sievert, symbol man Sv. Frequently abbreviated to collective dose.

**Consumer products** Devices such as smoke detectors, luminous dials, or ion generating tubes that contain a small amount of *radioactive* substances.

**Cosmic rays** High energy *ionizing radiation* from outer space. Have a complex composition at the surface of the Earth.

**Decay** The process of spontaneous transformation of a *radionuclide* or the decrease in the activity of a *radioactive* substance as a result of this process.

**Decay product** A *nuclide* or *radionuclide* produced by *decay*. It may be formed directly from decay of a *radionuclide* or as a result of a series of *decays* through several *radionuclides*. Sometimes referred to as progeny or daughters.

**Decommissioning** Administrative and technical actions taken to allow the removal of regulatory controls from a facility. *Decommissioning* typically includes dismantling the facility, but this need not be the case.

**Depleted uranium** Uranium containing a lesser mass percentage of uranium-235 than the 0.7 per cent found in *natural uranium*. A by-product from the production of *enriched uranium*.

**Diagnostic radiology** The use of radiation (e.g. *X rays*) or radioactive materials in medicine for identifying disease or injury in patients.

**Disposal** In relation to *radioactive waste*, emplacement in an appropriate *facility* without the intention of retrieval.

**DNA** Deoxyribonucleic acid. The compound that controls the structure and function of cells and is the material of inheritance.

**Dose** General term for a measure of the energy deposited by *radiation* in a target. See the more specific terms *absorbed dose*, *equivalent dose*, *effective dose* and *collective effective dose*. Frequently used for *effective dose*.

**Effective dose** A measure of *dose* designed to reflect the amount of *radiation detriment* likely to result from the *dose*. Obtained by multiplying the *equivalent dose* to each tissue or organ by an appropriate tissue weighting factor and summing the products. Unit sievert, symbol Sv. Tissue weighting factors are tabulated in Chapter 2.

**Electrical interaction** A force of repulsion acting between electric charges of like sign or a force of attraction acting between electric charges of unlike sign.

**Electromagnetic radiation** Radiation consisting of electrical and magnetic fields oscillating at right angles to each other. Ranges from very long wavelengths (low energy) such as radio waves, through intermediate wavelengths such as visible light to very short wavelengths (high energy) such as *gamma rays*.

**Electron** A stable elementary particle having a negative electric charge of  $1.6 \times 10^{-19}$  C and a mass of  $9.1 \times 10^{-31}$  kg.

**Electron volt** Unit of energy employed in radiation physics. Equal to the energy gained by an electron in passing through a potential difference of 1 volt. Symbol eV.  $1 \text{ eV} = 1.6 \times 10^{-19}$  joule approximately.

**Element** A substance with *atoms* all of the same *atomic number*.

**Enriched uranium** Uranium containing a greater mass percentage of uranium-235 than the 0.7 per cent found in *natural uranium*.

**Equivalent dose** A measure of the *dose* to a tissue or organ designed to reflect the amount of harm caused to the tissue or organ. Obtained by multiplying the *absorbed dose* by a radiation weighting factor to allow for the different effectiveness of the various types of *radiation* in causing harm to tissue. Unit sievert, symbol Sv. Radiation weighting factors are given in Chapter 2.

**Erythema** Reddening of the skin caused by dilation of blood vessels. Can occur as a result of high *radiation doses*.

**Excitation** A process by which *radiation* imparts energy to an *atom* or *molecule* without causing *ionization*. The energy may be absorbed by the *nucleus* or the *electrons*, and may be released in the form of *radiation* when the *atom* or *molecule* 'relaxes'.

**Fallout** Airborne radioactive material from the testing of nuclear weapons or nuclear accidents deposited on the Earth's surface.

**Fast neutrons** High energy (i.e. fast moving) *neutrons*, such as those produced by nuclear *fission*. In reactor physics, conventionally defined as neutrons with kinetic energies greater than 0.1 MeV. Corresponding velocity of about  $4 \times 10^6$  m/s

**Fast reactor** A *nuclear reactor* in which fission is induced predominantly by *fast neutrons*.

**Fission** Nuclear fission. The division of a heavy nucleus into two (or, rarely, more) parts with masses of equal order of magnitude, usually accompanied by the emission of *neutrons* and *gamma radiation*.

**Fission products** *Nuclides* produced by nuclear fission or by the subsequent *radioactive decay* of the *nuclides* thus formed.

**Free radical** An uncharged *atom* or group of atoms having one or more unpaired electrons which were part of a chemical bond. Generally very reactive in a chemical sense.

**Fusion** Thermonuclear fusion. The merging of two light *nuclei*, resulting in the production of at least one nuclear species heavier than either initial *nucleus*, together with excess energy.

**Gamma ray** Penetrating electromagnetic radiation emitted by an atomic nucleus during radioactive decay and having wavelengths much shorter than those of visible light.

**Geiger-Müller tube** A glass or metal envelope containing a gas at low pressure and two electrodes. *Ionizing radiation* causes discharges, which are registered as electric pulses in a counter. The number of pulses is related to *dose*.

**Genes** The biological units of heredity. They are arranged along the length of *chromosomes*.

**Gray** See *absorbed dose*.

**Half-life** For a *radionuclide*, the time required for the *activity* to decrease, by a radioactive decay process, by half. Symbol  $t_{1/2}$ .

**Ion** An *atom*, *molecule* or fragment of a *molecule* that has acquired an electric charge through the loss or capture of *electrons*.

**Ionization** The process by which an *atom* or *molecule* acquires or loses an electric charge. The production of *ions*.

**Ionizing radiation** For the purposes of *radiation protection*, *radiation* capable of producing ion pairs in biological material(s). Examples are *alpha particles*, *gamma rays*, *X rays* and *neutrons*.

**Irradiation** The act of being exposed to radiation. It can be intentional, for example through industrial irradiation to sterilize medical equipment, or accidental, for example through proximity to a source that emits radiation. Irradiation does not usually result in radioactive contamination, but damage can occur depending on the dose received.

**Isotopes** *Nuclides* with the same number of *protons* but different numbers of *neutrons*. Not a synonym for *nuclide*.

**Man sievert** See *collective effective dose*.

**Mass number** The number of *protons* plus *neutrons* in the *nucleus* of an *atom*. Symbol *A*.

**Moderator** A material used in *thermal reactors* to reduce the energy and speed of the *fast neutrons* produced as a result of *fission* to become *thermal neutrons* that can cause further *fission*.

**Molecule** A group of *atoms* bonded to each other chemically. The smallest portion of a substance that can exist by itself and retain the properties of the substance.

**Mutation** A chemical change in the *DNA* in the *nucleus of a cell*. Mutations in sperm or egg cells or their precursors may lead to inherited effects in children. Mutations in body cells may lead to effects in the individual.

**Neutron** An elementary particle having no electric charge, a mass of about  $1.67 \times 10^{-27}$  kg and a mean lifetime of about 1000 seconds

**Non-ionizing radiation** *Radiation* that is not *ionizing radiation*. Examples are *ultraviolet radiation*, *visible light*, *infrared radiation* and *radiofrequency radiation*.

**Nuclear fuel cycle** All operations associated with the production of nuclear energy, including: mining and milling, processing and enrichment of uranium; manufacture of nuclear fuel; operation of *nuclear reactors*; reprocessing of nuclear fuel; any related research and development; and all related *waste management* activities (including *decommissioning*).

**Nuclear medicine** The use of *radionuclides* for diagnosing or treating disease in patients.

**Nuclear reactor** A device in which a self-sustaining *nuclear fission* chain reaction can be maintained and controlled. (A reactor employing *fusion* reactions is a thermonuclear reactor.)

**Nucleus (of an atom)** The positively charged central portion of an *atom*. Contains the *protons* and *neutrons*.

**Nucleus (of a cell)** The centre of a human cell that controls its functioning. Contains the important genetic material: *DNA*.

**Nuclide** A species of *atom* characterized by the number of *protons* and *neutrons* and the energy state of the *nucleus*.

**Order of magnitude** A factor of ten or so, or an approximate value of a quantity, given to the nearest power of ten.

**Photon** A quantum of *electromagnetic radiation*.

**Positron** A stable elementary particle having a positive electric charge of  $1.6 \times 10^{-19}$  C and a mass of  $9.1 \times 10^{-31}$  kg (i.e. similar to an *electron*, but positively charged).

**Pressurized water reactor** A *thermal reactor* using water as both *moderator* and coolant. The water is maintained under pressure to prevent boiling.

**Probability** The mathematical chance that a given event will occur.

**Proton** A stable elementary particle having a positive electric charge of  $1.6 \times 10^{-19}$  C and a mass of  $1.67 \times 10^{-27}$  kg.

**PWR** *Pressurized water reactor.*

**Radiation** Energy, in the form of waves or particles, propagating through space. Frequently used for *ionizing radiation* in the text, except when it is necessary to avoid confusion with *non-ionizing radiation*.

**Radiation detriment** The total harm that would eventually be experienced by an exposed person or group and their descendants as a result of their *exposure to radiation*.

**Radioactive** Exhibiting *radioactivity*. For legal and regulatory purposes, the meaning of *radioactive* is often restricted to those materials designated in national law or by a *regulatory body* as being subject to regulatory control because of their *radioactivity*.

**Radioactive waste** For legal and regulatory purposes, material for which no further use is foreseen that contains or is contaminated with *radionuclides* at concentrations or *activities* greater than levels set by the *regulatory body*.

**Radioactivity** The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of *radiation*.

**Radiobiology** The study of the effects of *ionizing radiation* on living things.

**Radiation protection (or radiological protection)** The *protection* of people from the effects of *exposure to ionizing radiation*, and the means for achieving this.

**Radionuclide** A *radioactive nuclide*.

**Radiotherapy** The use of radiation beams for treating disease, usually cancer, in patients.

**Regulatory body** An organization designated by the government as having legal authority for regulating nuclear, radiation, radioactive waste and transport safety.

**Risk** The probability of a specified *health effect* occurring in a person or group as a result of *exposure to radiation*.

**Risk factor** The *lifetime risk* or *radiation detriment* assumed to result from *exposure* to unit *equivalent dose* or *effective dose*. Unit  $\text{Sv}^{-1}$ .

**Scintillation counter** A device containing material that emits light flashes when exposed to *ionizing radiation*. The flashes are converted to electric pulses which are counted. The number of pulses is related to *dose*.

**Sievert** See *effective dose* and *equivalent dose*.

**Silicon diode** A device made of a silicon compound in which current flows when exposed to *ionizing radiation*. The current is converted to electrical pulses which are counted. The number of pulses is related to *dose*.

**Thermal neutrons** *Neutrons* in thermal equilibrium with the medium in which they exist, i.e. they have the same average thermal energy as the surrounding *atoms* or *molecules*. The average energy of neutrons at ordinary temperatures is about 0.025 eV, corresponding to an average velocity of  $2.2 \times 10^3$  m/s.

**Thermal reactor** A *nuclear reactor* in which fission is induced predominantly by *thermal neutrons*.

**Thermoluminescent material** Material which, when heated, releases visible light in proportion to the amount of *radiation* to which it has been exposed.

**Waste management** All administrative and operational activities involved in the handling, *treatment, conditioning, transport, storage, and disposal* of *radioactive waste*.

**Wavelength** The distance between successive crests of an *electromagnetic wave* passing through a given material.

**X ray** Penetrating electromagnetic radiation emitted by an atom when electrons in the atom lose energy, and having wavelengths much shorter than those of visible light. Cf *gamma ray*.