Glossary

absorbed dose, radiation The energy absorbed per unit mass. The special name is the Gray (Gy = 1 joule per kilogram). The historical unit is the rad (100 ergs/gram). The conversion is 100 rad = 1 Gy.

absorption type (F (fast), M (moderate), and S (slow) clearance) A classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lungs to the blood. The practical transport rates to the gastrointestinal tract and lymph nodes are the same for all three of the absorption types.

activity The number of nuclear transformations occurring in a given quantity of material per unit time (see becquerel and curie).

activity median aerodynamic diameter (AMAD) The diameter of a unit-density sphere with the same terminal settling velocity in air as that of the aerosol particle whose activity is the median for the entire aerosol.

alpha particle A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus, but of nuclear origin. It comprizes two neutrons and two protons and has a mass number of 4 and an electrostatic charge of +2. On capturing two electrons it forms an atom of helium indistiguishable from any other helium atom.

anamnesis A patient's account of his or her medical history.

anthropogenic Man-made or derived from man's activities.

aquifer Underground body of water, hosted in permeable rocks such as sandstone or fractured igneous rocks or in unconsolidated sands and gravels.

atom The smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a central core called the *nucleus,* which contains *protons* and *neutrons* and one of more outer shells of *electrons.*

atomic mass (u) The mass of a neutral atom of a nuclide, usually expressed in terms of 'atomic mass units.' The 'atomic mass unit' is one-twelfth the mass of one neutral atom of carbon-12; equivalent to 1.6604×10^{-24} g.

atomic number The number of protons in the nucleus of a neutral atom of a nuclide (Symbol: Z).

atomic weight The weighted mean of the masses of the neutral atoms of an element expressed in atomic mass units.

background concentration The concentration (or level) of a substance characteristic of a particular medium (e.g. soil, water, rock etc.) in an area or region arising from both natural sources and non-natural diffuse sources such as atmospheric deposition. (after definition for background concentration soil, ISO 11074-1:1996)

background radiation The amount of radiation to which a member of the general population is exposed from natural sources, such as terrestrial radiation from naturally occurring radionuclides in the soil, cosmic radiation originating from outer space, and naturally occurring radionuclides deposited in the human body.

becquerel (Bq) The International System of Units unit of activity and equals that quantity of radioactive material in which one transformation (disintegration) occurs per second (1 Bq = 1 disintegration per second = 2.7×10^{-11} Ci or 27 pCi).

beta particle Charged particle emitted from the nucleus of an atom. A beta particle has a mass and charge equal in magnitude to that of the electron. The charge may be either +1 (for a positron; also generically called a beta particle) or –1 (for a negatron).

biological half-life The time required for a biological system, such as that of a human, to eliminate by natural process half of the amount of a substance (such as a chemical substance or radioactive material) that has entered it.

carcinogen A chemical or substance capable of inducing cancer.

carcinoma Malignant neoplasm composed of epithelial cells, regardless of their derivation.

charged particle An ion or an elementary particle carrying a positive or negative charge.

collective dose The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

committed effective dose E(t) Following an intake into the body of a radioactive material there is a period during which the material gives rise to an effective dose. The committed effective dose is the time interval of the effective dose rate. If the time interval is not specified it is implied that the value is 50 or 70 years, as defined by the regulator or assessor.

committed equivalent dose H_t(t) Following an intake into the body of a radioactive material, there is a period of time during which the material gives rise to an equivalent dose. The committed equivalent dose is the time integral of the equivalent dose rate, and is applied to the year the radioactive material entered the body. If the time interval is not specified it is implied that the value is 50 or 70 years as defined by the regulator or assessor.

complex / complexation A compound / process in which molecules or ions form coordinate bonds to a metal atom or ion.

cosmic rays High-energy particulate and electromagnetic radiation, which originate outside the Earth's atmosphere (e.g. protons, pions, muons, neutrinos etc.).

curie (Ci) A unit of radioactivity. One curie equals that quantity of radioactive material in which there are 3.7×10^{10} nuclear transformations per second (1 Ci = 3.7×10^{10} disintegrations per second = 3.7×10^{10} Bq). The activity of 1 gram of radium is approximately 1 Ci.

decay, radioactive Transformation of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons (see Disintegration).

decay chain or decay series A sequence of radioactive decays (transformations) beginning with one nucleus. The initial nucleus decays into a secondary nucleus 'or progeny nucleus' that differs from the first by whatever particles were emitted during the decay. If further decays take place, the subsequent nuclei are also usually called progeny.

decay product A new isotope formed as a result of radioactive decay. A nuclide resulting from the radioactive transformation of a radionuclide, formed either directly or as the result of successive transformations in a radioactive series. A decay product may be either radioactive or stable.

depleted uranium (DU) Uranium having a percentage of uranium-235 less than the naturally occurring distribution of U-235 found in natural uranium (less than 0.711 weight per cent U-235).

developmental toxicity The occurrence of adverse effects on the developing organism that may result from exposure to a chemical or radiation prior to conception (either parent), during prenatal development, or postnatally to the time of sexual maturation. Adverse developmental effects may be detected at any point in the life span of the organism.

disintegration constant The fraction of the number of atoms of a radioactive nuclide which decay in unit time; ? (Greek lambda; equal to 0.693/radioactive half-life) is the symbol for the decay constant in the equation $N = N_o e^{-\lambda t}$, where N_o is the initial number of atoms present, and N is the number of atoms present after some time (t) (see Decay Constant).

disintegration, nuclear A spontaneous nuclear transformation (radioactivity) characterized by the emission of energy and/or mass from the nucleus. When large numbers of nuclei are involved, the process is characterized by a definite half-life (see Transformation, Nuclear).

dose assessment An estimate of the radiation dose to an individual or a population group usually by means of predictive modeling techniques, sometimes supplemented by the results of measurement.

dose, effective The equivalent dose (H_t) multiplied by a tissue-weighting factor, w_t, with the special name sievert (Sv). The tissue-weighting factor represents the contribution of the organ or tissue to the total cancer detriment due to the effect resulting from uniform irradiation of the body. $E = (w_r)(w_t)(D)$, the sum of the weighted equivalent doses in all the tissues and organs in the body. It is given by $E = W_t H_t$ where W_t is the weighting factor for tissue T.

dose, equivalent (H_t) The absorbed dose D multiplied by a radiation-weighting factor W_r to account for the different qualities of radiation (alpha, beta, and gamma) in terms of potential effect. The special name is the sievert (Sv). The present weighting factors are as follows: alpha radiation is $w_r = 20$; beta and gamma radiation $w_r = 1$. The dose equivalent expresses all radiation on a common risk scale. (The unit of equivalent dose is the rem. In SI units, the equivalent dose is the sievert, which equals 100 rem.)

dose, pharmacological A general term denoting the quantity (mass) of a substance introduced into the body. For special purposes it must be appropriately qualified.

dose, radiation absorbed The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad. One rad equals 100 ergs per gram. In SI Units, the absorbed dose is the gray, which is 1 J/kg, so 100 rads = 1 Gray (see rad). Absorbed dose rate is the absorbed dose per unit time.

dose, radiation cumulative The total dose resulting from repeated or continuous exposures to radiation.

dose rate Absorbed dose delivered per unit time.

dosimetry Quantification of radiation doses to individuals or populations resulting from specified exposures.

electron volt A unit of energy equivalent to the energy gained by an electron in passing through a potential difference of one volt. Larger multiple units of the electron volt are frequently used: keV for thousand or kilo electron volts, MeV for million or mega electron volts.

embryotoxicity and fetotoxicity Any toxic effect on the conceptus as a result of prenatal exposure to a chemical or to radiation; the distinguishing feature between the two terms is the stage of development during which the insult occurred. The terms, as used here, include malformations and variations, altered growth, and in utero death.

enrichment, isotopic An isotopic separation process by which the relative abundance of the isotope element of interest is altered, thus producing a form of the element that has been enriched in one or more isotopes and depleted in others. In uranium enrichment, the percentage of uranium-235 in natural uranium may be increased from 0.7% to greater than 90% in a gaseous diffusion, thermal diffusion, centrifugation, mass spectrometric or laser separation process based on the different thermal velocities, mass differences or any other suitable property of the constituents of natural uranium (^{234}U, ^{235}U, ^{238}U).

equilibrium, radioactive In a radioactive series, the state that prevails when the ratios between the activities of two or more successive members of the series remains constant.

exposure (chemical) Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g. skin, lungs, gut) and is available for absorption.

exposure (radiation) Being exposed to ionizing radiation or to a radioactive material. Exposure is quantified as the amount of radioactive material available at the exchange boundaries of the organism (e.g. the gut, skin, lungs) and available for absorption, as well as exposure to penetrating radiation from outside the body.

gamma ray, penetrating Short-wavelength electromagnetic radiation of nuclear origin.

genetic effect of radiation or substance Inheritable change, chiefly mutations, produced by the absorption of ionizing radiation by germ cells.

half-life, radioactive Time required for a radioactive substance to lose 50% of its activity by decay. Each radionuclide has a unique half-life.

harm Harm to health of living organisms or other interfaces with ecological systems of which they form part. In the case of humans some definitions include harm to property. Note that harm is not just a matter of exceeding action or trigger levels, but is that determined by a structured source-pathway-receptor analysis and the effects on a given target (i.e. not just exposure)

immunologic toxicity The occurrence of adverse effects on the immune system that may result from exposure to environmental agents, such as chemicals.

in vitro Isolated from the living organism and artificially maintained, as in a test tube.

in vivo Occurring within the living organism.

ion Atomic particle, charged atom, or chemical radical bearing a net electrical charge, either negative or positive.

ionization The process by which a neutral atom or molecule acquires a positive or negative charge.

ionization path (Track)--The trail of ion pairs produced by ionizing radiation in its passage through matter.

ionizing radiation Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Examples: alpha, beta, gamma, X-rays, and neutrons.

isotopes Nuclides having the same number of protons in their nuclei, and hence the same atomic number, but differing in the number of neutrons and therefore in the mass number. Almost identical physical properties exist between isotopes of a particular element. The term should not be used as a synonym for nuclide.

land contamination **T**he presence of a substance or component that is not present naturally that does not necessarily cause harm (ISO 11074-1:1996)

mass numbers (A) The number of nucleons (protons and neutrons) in the nucleus of an atom.

natural background concentration The concentration or level of a substance that is derived solely from natural sources (i.e. of geological origin) after ISO 11074-1:1996.

neutron Elementary nuclear particle with no electric charge.

nuclide A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons (Z), number of neutrons (N), and energy content, or, alternatively, by the atomic number (Z), mass number A = (N+Z), and atomic mass. To be regarded as a distinct nuclide, the atom must be capable of existing for a measurable time.

power, stopping A measure of the ability of a material to absorb energy from an ionizing particle passing through it; the greater the stopping power, the greater the energy absorbing ability (see Linear Energy Transfer).

progeny The decay product or products resulting after a radioactive decay or a series of radioactive decays. The progeny can be stable but can also be radioactive, and the chain continues until a stable nuclide is formed.

proton Elementary nuclear particle with a positive electric charge

radiation The emission and propagation of energy through space or through a material medium in the form of waves (e.g. the emission and propagation of electromagnetic waves or of sound and elastic waves). The term radiation or radiant energy, when unqualified, usually refers to electromagnetic radiation. Such radiation is commonly classified according to frequency, as microwaves, infrared, visible (light), ultraviolet, X-rays and gamma rays (see Photon) and, by extension, corpuscular emission, such as alpha and beta radiation, neutrons, or rays of mixed or unknown type, such as cosmic radiation.

radiation, background See Background Radiation.

radiation, external Radiation from a source outside the body.

radiation, internal Radiation from a source within the body (as a result of deposition of radionuclides in body tissues).

radiation, ionizing Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter (see Radiation).

radioactivity Spontaneous nuclear transformations that result in the formation of new elements. These transformations are accomplished by emission of particles from the nucleus or by the capture of an orbital electron. Each of these reactions may or may not be accompanied by a gamma photon.

radioactive decay constant (λ**)** The fraction of the number of atoms of a radioactive nuclide that decay in unit time (see Disintegration Constant).

radioactivity, natural The property of radioactivity exhibited by more than 50 naturally occurring radionuclides.

radio-isotopes An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5000 natural and artificial radio-isotopes have been identified.

radionuclide A radio-isotope or radioactive nuclide characterized by the constitution of its nucleus.

rem (rem) A non-SI unit of equivalent dose. The equivalent dose in rem is numerically equal to the absorbed dose in rad multiplied by the quality factor (radiation-weighting factor) (1 rem = 0.01 sievert).

reproductive toxicity The occurrence of adverse effects on the reproductive system that may result from exposure to a chemical or to radiation. The toxicity may be directed to the reproductive organs and/or the related endocrine system. The

manifestation of such toxicity may be noted as alterations in sexual behavior, fertility, pregnancy outcomes, or modifications in other functions that are dependent on the integrity of this system.

secular equilibrium If the original radionuclide has a very much longer half-life than its progeny (so there is not appreciable change in its amount in the time interval required for later products to attain equilibrium) then, after equilibrium is reached, equal numbers of atoms of all members of the series disintegrate in unit time. This condition is never exactly attained but is essentially established in such a case as radium and its series to ^{210}Pb. The half-life of radium is about 1600 years, of radon, approximately 3.82 days, and of each of the subsequent members, a few minutes. After about a month, essentially the equilibrium amount of radon is present; then (and for a long time) all members of the series disintegrate the same number of atoms per unit time. At this time, the activity of the progeny equals the activity of the original radionuclide.

SI units The International System of Units as defined by the General Conference of Weights and Measures in 1960. These units are generally based on the meter/kilogram/second units, with special quantities for radiation including the becquerel, gray, and sievert.

sievert (Sv) The SI unit of any of the quantities expressed as equivalent or effective dose. The equivalent dose in sieverts is equal to the absorbed dose, in grays, multiplied by the radiation-weighting factor (1 Sv = 100 rem). The effective dose is the equivalent dose multiplied by the tissue-weighting factor.

soil The upper layer of the Earth's crust composed of mineral parts, organic substance, water, air and living matter (ISO 11074-1, 1996).

soil function Soil functions describe the significance of soils to man and the environment (ISO 11074-1, 1996). Important soil functions include: control of substance and energy cycles as compartment of ecosystems; basis for the life of plants, animals and man; carrier of genetic reservoir; basis for the stability of buildings; basis for the production of agricultural products; buffer inhibiting movement of water, contaminants or other agents into groundwater; reservoir of archaeological remains; reservoir of paleoecological remains.

soil pollutant A substance or agent present in the soil which due to its properties, amount or concentration causes adverse impacts on (i.e. harm to) soil functions or soil use (ISO 11074-1, 1996).

sorption Generic terms covering sorbing by physical or chemical processes or both. The term does not specifically differentiate between absorption or adsorption.

specific-activity Radioactivity per gramme of a radionuclide. It may be calculated from the formula ($N_A\lambda$/MW). Where N_A is the number of atoms in one mole of a material (Avogadro's constant, 6.023×10^{23}), 8 is the radioactive decay constant and MW is the atomic weight of a given isotope. The specific activity for a substance containing a mixture of isotopes may be obtained using the equation:

Specific activity of mixture = the sum of? $N_A \lambda_i$ / MW_i F_i
Where F_i is the fractional abundance (by weight) of the given isotope (i) in the mixture. Additionally, where an isotope has more than one decay mode the

specific activity for a given mode of decay may be obtained by multiplying the specific activity for all decay modes by the relative fractional abundance of a given decay mode, ?8 is the radioactive decay constant.

speciation A broad generic term describing the various chemical forms an element can take (e.g. the bicarbonate ion HCO_3^- is a species of carbon)

spontaneous fission A relatively rare radioactive process in which fission (splitting of the original radionuclide into two radionuclides of approximately equal mass) occurs spontaneously amongst heavy nuclides such as ^{238}U.

stable isotope A non-radioactive isotope of an element.

stochastic Calculated or modelled according to the laws of probability

teratogen Any chemical or radiation that causes birth defects.

threshold limit value (TLV) The maximum concentration of a substance to which most workers can be exposed without adverse effect. TLV is a term used exclusively by the American Conference of Governmental Industrial Hygienists (ACGIH). Other terms used to express the same concept are the MAC (maximum allowable concentration) and the OSHA equivalent PEL (permissible exposure limits).

tolerable intake An estimate of the daily intake of a substance which can occur over a lifetime without appreciable health risk**.**

transformation, nuclear The process by which a nuclide is transformed into a different nuclide by absorbing or emitting a particle.

X-rays Penetrating electromagnetic radiations whose wave lengths are very much shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. X-rays (called characteristic X-rays) are also produced when an orbital electron falls from a high energy level to a low energy level.

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