
Glossary

Absolute risk model: Assumes that the radiation-induced cancer risk is independent of spontaneous rate but only a direct function of the radiation dose.

Absorbed dose: Quantity of energy deposited from incident radiation per unit mass of absorber. The SI unit is the Gray, symbol Gy. $1 \text{ Gy} = 1 \text{ joule per kg}$.

Actinides: Series of 15 elements in Group IIIA of the Periodic Table with atomic numbers 89 (actinium) to 103 (lawrencium) and including uranium and the transuranics.

Activation: Induction of radioactivity in a stable element by irradiation, usually by neutrons.

Activation product: Radionuclide generated by the irradiation of a stable nuclide.

Activity: The intensity or strength of a radioactive source: the number of atoms disintegrating per unit time and emitting detectable radiation, regardless of source mass. The SI unit is the Becquerel, symbol Bq

$$1 \text{ Bq} = 1 \text{ disintegration per second}$$

The earlier unit was the Curie, symbol Ci

$$1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$$

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.

Adsorption: Uptake of a substance by physical or chemical reaction on the accessible surface of a solid or at a liquid interface.

Aerosol: Solid or liquid particles suspended in a gas.

Alpha particle: Doubly positively-charged particle, an ^4He nucleus comprising two protons plus two neutrons, emitted during the decay of some radionuclides.

Atom: The smallest unit of an element, comprising a positive nucleus with orbiting electrons.

Atomic mass: The mass of an atom in multiples of a unit defined as one twelfth of the mass of the nucleus of an isotope of carbon, ^{12}C . The mass of a single proton or neutron thus approximates to this unit. Hence the atomic mass of an isotope of any element is approximately equal to the total number of protons and neutrons in the nucleus, symbol A.

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

Becquerel: The SI unit of radioactivity, symbol Bq.

1 Bq = 1 disintegration per second on average

For multiple units see Table in appendix.

Beta particle: An elementary charged particle emitted during the decay of many radioisotopes. When the isotope is on the neutron-rich side of the line of stability, the particle is the negative electron. If on the proton-rich side, the particle is of identical mass and charge but positive, known as the positron.

Biological cycling: General term covering biologically-mediated transformations and pathways.

Biological half-life: The time in which a biological system eliminates by natural processes half the amount of a foreign substance that has entered. This does not include the spontaneous decay of the foreign substance, such as a radionuclide, for which see under "Effective half-life".

Biota: The flora and fauna of a given region.

Case-control study: A method of epidemiological study comparing the background and life-styles of confirmed cases with those of closely-comparable control subjects not having the given health problem.

Cluster: The elevated numerical incidence of a given morbidity within a defined geographical area.

Coefficient of variation: The standard deviation divided by the value of the parameter considered.

Cohort: A group of subjects of the same relevant category (age sector, gender, specific background, etc., as required) studied progressively over time.

Cohort study: Epidemiological study comparing exposures in a given cohort with morbidity incidence.

Collective dose: The product of the average individual dose in a population group and of the size of that population group.

Collective dose commitment: The integral over infinite time of the collective dose rates delivered to the world's population as a result of a specific practice (in this case, the nuclear weapons tests). The actual radiation exposures may occur over many years after the explosions have taken place and may be received by individuals not yet born at the time of the explosions.

Collective effective dose: Product of the mean effective dose to a group or population from a given source and the number of individuals in the group. The unit is the person-sievert. (Definition in agreement with UNSCEAR, 1993.)

Committed equivalent dose: Integral or equivalent dose-rate in a given tissue or organ over time following an intake of radioactive material. Definition in agreement with European Union.

Concentration factor: Ratio of element or nuclide in a specific organ or tissue of the consumer to that in what was consumed, or to that in the environmental medium.

Critical group: Sub-group of the public most affected by a given release of radioactivity.

Curie: The earlier non-SI unit of radioactivity, symbol Ci.

1 Ci = 3.7×10^{10} disintegrations per second.

Daughter: Stable or radioactive nuclide resulting from the decay of a parent radionuclide, sometimes down a chain of radioactivity daughters.

Decay: The transformation of a radionuclide, usually by the emission of radiation, into a more stable nuclide, sometimes via less-stable intermediate daughters.

Decay constant: That fraction of a given initial number of atoms of a radioactive nuclide which decays in unit time.

Decay-corrected fallout: Measured contamination corrected for radioactive decay to give activities at time of initial fallout.

Decay product: A nuclide, radioactive or stable, resulting from the decay of a radionuclide. See under "Daughter".

Decontamination: The removal or 'clean-up' of radioactivity.

Deposition velocity: The ratio of the activity deposited per unit surface area per second to the activity per unit volume of air in contact.

Deterministic health effect: Non-stochastic effects. Human health consequences whose occurrence and severity are a direct function of radiation dose, sometimes above a threshold.

Disintegration: See 'Decay'.

DNA: Deoxyribonucleic acid, macromolecules in the cell nucleus carrying all genetic information.

Dose: A general term denoting the quantity of radiation or energy absorbed per unit of mass. For special purposes, it must be appropriately qualified. If unqualified, it refers to absorbed dose. The unit of absorbed dose used in the traditional system of units is the rad (1 rad = 100 erg g⁻¹). In the SI system of units, the unit of absorbed dose is the gray (Gy). One Gy = 100 rad = 1 J kg⁻¹.

Dose commitment: The integral over infinite time of the effective doses delivered to the world's population by specific events or practices (UNSCEAR, 1993).

Dose rate: Absorbed dose per unit time.

Ecosystem: An environmental unit, including all relevant physical features and all living organisms which function within it.

Effective dose: The sum of the equivalent doses in all tissues and organs of the body, weighted by their radiosensitivity defined by a Quality Factor. The unit is the Sievert, symbol Sv, which since the Quality Factor is dimensionless, can be defined in SI units: 1 Sievert = 1 Joule per kilogram.

Effective half-life: The time in which a radionuclide within a biological system is reduced to half its activity by the combined action of radioactive decay and biological elimination.

Electron: An elementary particle with a unit negative electrical charge and a mass 1/1837 that of the proton. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

Electron-volt: A unit of energy equal to the energy gained by an electron accelerating through a potential difference of one volt, Symbol eV. $1 \text{ eV} = 1.6 \times 10^{-12} \text{ erg}$. For multiple units see appendix.

Element: Substance comprising only atoms of the same atomic number.

Enrichment: The process of increasing the proportion of a chosen isotope of an element.

Epilation: Loss of hair.

Equivalent dose: The product of the absorbed dose in the tissue considered and of the radiation weighting factor of the radiation that causes the absorbed dose. Because the radiation weighting factor is dimensionless, the unit for equivalent dose is the same as that for absorbed dose, J kg^{-1} . However, the unit for equivalent dose has a special name: the sievert (Sv). Since the radiations that are considered in this report are the beta and gamma radiation, for which the radiation weighting factors are taken to be equal to one, the numerical value of the equivalent doses estimated in this report, expressed in sieverts, are the same as those of the absorbed doses, expressed in grays.

Exposure: A measure of the ionisation generated by gamma or X-radiation. The SI unit of exposure is the coulomb per kilogram, C kg^{-1} . The earlier unit, used in places in this report, is the Roentgen, symbol R, defined as 1 e.s.u. of ions of each sign generated per cm^3 of air at ntp.

$$1 \text{ R} = 83.8 \text{ ergs absorbed per gram of air at ntp.}$$

$$\text{Hence } 1 \text{ R} = 2.58 \times 10^{-4} \text{ coulombs per kilogram.}$$

$$\text{and } 1 \text{ R} = 8.73 \times 10^{-3} \text{ Gray}$$

$$1 \text{ Gray} = \text{approximately } 115 \text{ Roentgen.}$$

Exposure route: The pathway by which a radionuclide irradiates a biological system. The main human external exposure routes are radiation from a cloud or a ground deposit. The main internal exposure routes are by inhalation, ingestion, absorption through skin or entry through cut or wound.

External dose: Dose from sources of ionizing radiation located outside the body.

Fallout: The radioactive debris from a nuclear detonation deposited on the ground from an airborne cloud. Can be local, regional or global.

Fission: The exoenergetic break-up of the nucleus of an atom into two or more smaller nuclei. It may be spontaneous or follow the absorption of an energetic particle, usually a neutron, e.g.:



Fission yield: The percentage of fissions leading to a particular nuclide by direct formation or by decay of precursors.

Fission product: Nuclides (radioactive or stable) resulting from fission, directly or by the subsequent decay of primary fission fragments.

Fusion: The forming of a single atomic nucleus from two light nuclei, with the release of energy e.g.:



Gamma radiation: Photon of high-energy electromagnetic radiation (wavelength of less than 0.01 nm) emitted in some radioactive decay processes and causing ionisation.

Genetic effects: Viable mutants of genomes that can be transmitted from parent to offspring.

Gray: The unit of absorbed dose in the SI system, symbol Gy. 1 Gy = 1 Joule per kg.

Half-life: Time in which half the nuclei of a given radioisotope disintegrate.

Health detriment: An estimate of the reduction of length and quality of life after exposure to ionising radiation.

Health registry: A data base for morbidity and mortality rates in cohorts or populations.

Hot particles: Radioactive fallout particles of a few microns or less in dimensions but with activities up to several orders of magnitude higher than the generality of fallout.

Incidence: Frequency of events, e.g. the development of cancer in a population.

Internal dose: Dose to internal organs and tissues from radioactivity inside the body.

Ionisation: The adding or removing of electron(s) from a neutral atom or molecule to form an ion.

Irradiation: Exposure of matter to ionising radiation.

Isotope: Nuclide of a given chemical element which while having the same number of protons, Z , in its nucleus has a different number of neutrons, N , and hence a different atomic mass, A .

Lanthanides: A series of 15 elements in Group IIIA of the Periodic Table with atomic numbers 57 (lanthanum) to 71 (lutetium). Also known as the 'rare earths'.

Leaching: Removal of the soluble component of a porous solid by the permeation of water.

Mass number: Total number of protons plus neutrons in the nucleus of a given atom. Symbol A .

Molecule: The smallest particle of a compound capable of independent existence while retaining its chemical properties.

Natural radiation: Ionising radiation in the environment from naturally-occurring radioactive elements and cosmic rays. In the non-ionising context, infra-red, ultra-violet, solar, etc.

Neutron: Uncharged elementary particle of approximately unit atomic mass.

Nucleus: The positively-charged core of an atom, composed to protons and neutrons.

Nuclide: The isotopes of all elements, each characterized by its number of protons, Z , and the sum of its protons and neutrons, A . (Sometimes, in addition, by the energy state of the nucleus.) A distinct nuclide, even if an unstable isomer, must be capable of existing for a measureable time.

Parent radionuclide: A radionuclide which yields a daughter nuclide on disintegration.

Person-sievert: A unit of collective dose obtained by multiplying the average effective equivalent dose by the number of people exposed.

Plowshare: Name given to nuclear tests carried out in the USA that were intended for civilian purposes.

Plutonium: A transuranic chemical element of the actinide series in Group IIIA of the Periodic Table, atomic number 94.

Proton: Positively-charged elementary particle of approximately unit atomic mass.

Quality factor: Factor to take account of the different degrees of damage to tissues and organs by different types and energies of radiation.

Rad: Earlier non-SI unit of absorbed dose. $1 \text{ rad} = 100 \text{ erg g}^{-1} = 0.01 \text{ J kg}^{-1} = 0.01 \text{ Gray}$.

Radioactive decay: Spontaneous disintegration of the nucleus of a radionuclide.

Radioactive equilibrium: The establishment of a radionuclide parent-daughter equilibrium in which the activity of the daughter is exactly equal to that of the parent.

Radioactivity: Emission of particles or electromagnetic radiation from the nuclei of unstable atoms in their attempts to attain stability.

Radiobiology: The study of the involvement, use or consequences of radioactivity in biological systems.

Radionuclide: An unstable nuclide which emits energy (gamma rays) or electric charge (beta rays) or matter (alpha particles) in order to attain greater stability, sometimes via a chain of less-stable daughters.

Rainout: The removal of aerosols from the atmosphere by rain.

Relative risk: Assumes that radiation-induced cancer risk is proportional to spontaneous rate, i.e. increasing considerably with age; fits risk for solid tumours in the survivors of Hiroshima/Nagasaki quite well.

Rem: Earlier non-SI unit of equivalent radiation dose. The product of the absorbed dose in rads and the Quality Factor of the radiation. $1 \text{ rem} = 0.01 \text{ sievert}$.

Resuspension factor: The ratio of the concentration factor of a radionuclide in air to the ground surface contamination from which the airborne activity arises.

Risk coefficient: The statistical probability that a particular stochastic effect will occur per unit dose; depending on a wide range of factors.

Roentgen: The earlier unit of ionisation by X-rays or gamma, used in places in this report. Symbol R. Defined as the X-ray or gamma beam which will generate one electrostatic unit of ions of each sign per cm^3 of air at ntp. The unit relies on the uncertain determination of air ionisation energies and for this reason the Roentgen is now generally replaced by an SI unit of absorbed radiation dose, the coulomb per kilogram.

$1 \text{ R} = 83.8 \text{ ergs absorbed per gram of air at ntp}$.

Hence $1 \text{ R} = 2.58 \times 10^{-4} \text{ coulombs per kilogram}$.

and $1 \text{ R} = 8.73 \times 10^{-3} \text{ Gray}$

$1 \text{ Gray} = \text{approximately } 115 \text{ Roentgen}$.

Sievert: The unit of equivalent radiation dose, symbol Sv. The product of the absorbed dose in Grays and the Quality Factor of the radiation. Although strictly not an SI unit,

the Sievert can be defined in SI units since the Quality Factor is dimensionless: 1 Sv = 1 joule per kilogram.

SI units: Système Internationale. The agreed system of scientific units based primarily on the kilogram, metre, second, ampere, kelvin, mole and candela.

Skin burns: Acute skin reaction to ionizing radiation, may lead to local destruction of epidermis and dermis and finally scars.

Somatic change: Change occurring in biological tissue other than the germ cells.

Sorption: A general term for the processes of adsorption, absorption and persorption.

Spent fuel: Nuclear reactor fuel in which neutron-absorbing fission products have accumulated sufficiently to inhibit the chain reaction.

Stochastic: Pertaining to random variables.

Stochastic health effect: Effects whose probability of occurrence in an exposed population is a direct function of dose. These effects are commonly regarded as having no threshold. Hereditary effects and some somatic effects, especially carcinogenesis, are regarded as being stochastic (see also 7.2.2).

Teratogenic: Inducing defects in a developing embryo or foetus.

Transuranic: Chemical elements with atomic numbers above uranium, ^{92}U .

Tritium: A hydrogen isotope, ^3H , with a nucleus of one proton and two neutrons. Radioactive, with half-life of 12.4 years.

Tritium ratio, TR: A unit tritium concentration of one ^3H atom in 10^{18} atoms of ^1H , giving an activity of 0.118 Bq per kg of water.

Uncertainty: The range of values within which the true value is estimated to lie. It is a best assessment of the range of possible inaccuracies from both random and systematic error.

X-radiation: Electromagnetic radiation of a wavelength from 10nm ("soft" X-rays) down to 0.01 nm ("hard" X-rays), emitted in the radioactive decay of some nuclei. (See also Gamma radiation, which continues the electromagnetic spectrum downwards below 0.01 nm.)

Yield (energy yield): The total energy released in a nuclear explosion. Usually expressed as the tonnage of TNT which would generate the same energy. 1 kiloton of TNT is taken to release 10^{12} calories, corresponding to the complete fission of approximately 57 g of ^{235}U or 58 g of ^{239}Pu .

Radiation Units

(After: Warner, F. E. and Harrison, R. M. (1993) *Radioecology after Chernobyl*, John Wiley & Sons Ltd, Chichester.)

Quantity	SI unit	Symbol	Non-SI unit	Symbol	Conversion
Activity	becquerel	Bq	curie	Ci	1 Bq = 2.7×10^{-11} Ci
Absorbed dose	gray	Gy	rad	rad	1 Gy = 100 rad
Dose equivalent	sievert	Sv	rem	rem	1 Sv = 100 rem

Metric Multiples and Sub-multiples

In the metric system of weights and measures, designations of multiples and sub-divisions of any unit may be arrived at by combining with the name of the unit the following prefixes:

E (exa),	meaning 10^{18}	m (milli),	meaning 10^{-3}
P (peta),	meaning 10^{15}	μ (micro),	meaning 10^{-6}
T (tera),	meaning 10^{12}	n (nano),	meaning 10^{-9}
G (giga),	meaning 10^9	p (pico),	meaning 10^{-12}
M (mega),	meaning 10^6	f (femto),	meaning 10^{-15}
k (kilo),	meaning 10^3	a (atto),	meaning 10^{-18}