



Radiation Glossary

Activity

The rate of disintegration (transformation) or decay of radioactive material. The units of activity are Curie (Ci) and the Becquerel (Bq).

Agreement State

Any state with which the U.S. Nuclear Regulatory Commission has entered into an effective agreement under subsection 274b. of the Atomic Energy Act of 1954, as amended. Under the agreement, the state regulates the use of by-product, source, and small quantities of special nuclear material within said state.

Airborne Radioactive Material

Radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

ALARA

Acronym for "As Low As Reasonably Achievable". Making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken. It takes into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, societal and socioeconomic considerations, and in relation to utilization of radioactive materials and licensed materials in the public interest.

Alpha Particle

A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus, with a mass number of 4 and a charge of +2.

Annual Limit on Intake (ALI)

Annual intake of a given radionuclide by "Reference Man" which would result in either a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to an organ or tissue.

Attenuation

The process by which radiation is reduced in intensity when passing through some material. It is the combination of absorption and scattering processes.

Background Radiation

Radiation from cosmic sources; naturally occurring radioactive materials, including radon and fallout from nuclear weapons tests.

Laboratory Safety

46 Blackstone Street, Cambridge, MA 02139 | T: 617.496.3797 | F: 617.496.5509

www.ehs.harvard.edu | email: lab_safety@harvard.edu

Beta (particle)

High speed electrons, which are emitted from the nuclei of radioactive atoms during radioactive decay, as a result of the transformation of a neutron into a proton. They can be stopped by a thin (thickness varies for different radionuclides) sheet of plastic or glass.

Becquerel

A unit, in the International System of Units (SI), of measurement of activity equal to one decay per second.

Bioassay

The determination of kinds, quantities, or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct counting (in vivo) or by analysis and evaluation of materials excreted or removed from the body.

Biological Half Life

The time that is required by an organism to eliminate half the amount of a substance that has entered it.

Bremstrahlung

X-rays produced when a charged particle loses energy in interactions with heavy nuclei when moving through matter.

Calibration

The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.

Charged Particle

An elementary particle or ion which carries a positive or negative electric charge.

Committed Effective Dose Equivalent

The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following intake.

Contamination

The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel. Can either be fixed or removable.

Counter

A general term used for a radiation detection instrument, survey meter, or a liquid scintillation counter (LSC) that detects and measures radiation. The signals (needle blip and audio beep) show ionization events called counts.

CPM (Counts Per Minute)

A commonly used measure of radioactivity from particle emitters; since a detection instrument cannot operate at 100% efficiency, the CPM found will be less than the actual DPM

Critical Organ

The organ receiving the highest dose or highest amount of a particular nuclide that results in the greatest damage to the body as a result of an intake.

Cumulative Dose

The total dose resulting from repeated exposures of radiation to the same region, or to the whole body, over a period of time.

Curie (Ci)

The basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium. Named for Marie and Pierre Curie, who discovered radium in 1898.

Decay, Radioactive

The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous emission from the atomic nuclei of either alpha, beta particles, or gamma rays.

Declared Pregnant Worker

A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

Decontamination

The reduction or removal of contaminating radioactive material from a structure, area, object, or person.

Deep Dose Equivalent

A term that applies to external whole-body exposure, and is the dose equivalent at a tissue depth of 1 cm.

Detector

A material or device that is sensitive to radiation and can produce a signal suitable for measurement or analysis. A radiation detection instrument.

Disintegration

See decay, radioactive.

Dose

A generic term referring to the amount of radiation received by a biological organism.

Dose Equivalent

The product of the absorbed dose in tissue, quality factor, and other modifying factors at the location of interest. The units are mrem.

Dose Rate

The ionizing radiation dose delivered per unit time, such as mrem/hour.

Dosimeter

A portable instrument for measuring the total accumulated exposure to ionizing radiation.

DPM (Disintegrations per Minute)

The number of radioactive disintegrations per unit time; there are $2.2E6$ disintegrations per minute in a microcurie.

Effective Dose Equivalent

The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

Effective Half-Life

The time required for the amount of a radioactive element deposited in a living organism to be reduced by 50% from the combined removal mechanisms of radioactive decay and biological elimination.

Embryo/Fetus

The developing human organism from conception until the time of birth. More specifically; embryo: 2 weeks (implantation) - 8 weeks; fetus : 8 weeks - term.

Exposure

- 1) A measure of the ionization produced in air by X or gamma radiation. The unit of exposure is the Roentgen (R).
- 2) Being exposed to ionizing radiation or to radioactive material.

Exposure Rate

The amount of ionization in air caused by x-ray or gamma ray radiation per unit time; unit of measurement is the Roentgen per unit time (R/hr)

External Dose

The portion of the dose equivalent received from radiation sources outside the body.

Extremity

Arm below the elbow and the leg below the knee.

Eye Dose Equivalent

Applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm.

Gamma Ray

Relatively short wavelength electromagnetic radiation released from the nucleus of an atom.

Geiger-Mueller Counter (GM)

A radiation detection instrument that can detect alpha, beta and gamma radiation; response is not energy dependent.

Half-life

The time in which half the atoms of a particular radioactive substance disintegrate to another nuclear form. Measured half lives vary from millionths of a second to billions of years. Also referred to as the physical half-life.

Half Value Layer

The thickness of any given absorber (shield) that will reduce the intensity of incident radiation to one half of its initial value.

Health Physics

The science concerned with recognition, evaluation, and control of health hazards from non-ionizing and ionizing radiation.

High Radiation Area

An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Intake

Quantity of material introduced into the body by inhalation, ingestion, or through the skin.

Internal Dose

That portion of the dose equivalent received from radioactive material taken into the body.

Ionization

The process of adding or removing one or more electrons from atoms or molecules. High temperatures, electrical discharges, or radiation can cause ionization.

Ionization Chamber

An instrument that detects and measures ionizing radiation by measuring the electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Ionizing Radiation

Any radiation capable of displacing electrons from atoms or molecules, producing ions. Examples: alpha, beta, gamma, X-rays, neutrons, and ultraviolet light. High doses may produce severe skin or tissue damage.

Irradiation

Exposure to radiation.

Isotope

One of two or more atoms with the same number of protons, but different number of neutrons, in their nuclei. Example: ^{12}C , ^{13}C , and ^{14}C are isotopes of the same element. Isotopes have very nearly the same chemical properties, but often different physical properties (^{12}C and ^{13}C are stable, while ^{14}C is radioactive).

Limits

The permissible upper bounds of radiation doses.

Liquid Scintillation Counting

A method of determining activity of a radioactive sample using a liquid Fluor and a means of detecting the scintillation resulting from the interaction of radiation with the Fluor.

NaI (Sodium Iodide) Detector

A detector which combines a scintillation crystal (produces light when struck by ionizing radiation), a photomultiplier tube, and associated electronic circuits for counting light emissions produced in the crystal (NaI) by ionizing radiation. A NaI scintillation probe with a ratemeter can be used for detection of gamma and x-rays.

Nuclide

A general term referring to all known isotopes, both stable (~279) and unstable (~5000), of the chemical elements.

Occupational Dose

The dose received by an individual in a restricted area or in the course of employment in which the individual's assigned duties involve exposure to radiation and to radioactive material. This does not include dose received from background radiation, as a patient from medical procedures, from voluntary participation in medical research programs, or as a member of the general public.

Personnel Monitoring

The determination of the degree of radioactive contamination on individuals using survey meters, or the determination of radiation dosage received by means of dosimetry devices.

Physical Half Life

The time required for a radioisotope to reduce activity by half.

Pig

A container (usually lead) used to ship or store radioactive materials. The thick walls protect the person handling the container from radiation. Large containers are usually called casks.

Proportional Counter

A radiation detection instrument in which an electronic system receives pulses that are proportional to the number of ions formed in a gas-filled tube/probe by ionizing radiation.

Quality Factor

The modifying factor that is used to derive dose equivalent from the absorbed dose. They vary for different radiation types and reflect the degree of biological effect.

Quarter

A period of time equal to one-fourth of the year observed by the licensee (approx. 13 consecutive weeks). Providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Rad

The special unit of absorbed dose. One rad is equivalent to 100 ergs/gram or 0.01 J/kg.

Radiation

Alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other charged particles capable of producing ions. Radiation, as used in this context, does not include non-ionizing radiation, such as radio waves, microwaves, or visible, infrared, or ultraviolet light.

Radiation Area

An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Radiation Detection Instrument

A device that detects and records the characteristics of ionizing radiation.

Radiation Machine

Any device capable of producing radiation except those which produce radiation only from radioactive material.

Radiation Shielding

Reduction of radiation by placing a shield of absorbing material between any radioactive source and a person, work area, or radiation sensitive device.

Radiation Source

Usually a manmade sealed source of radiation used in teletherapy, radiography, as a power source for batteries, calibration, or in various industrial gauges. Machines such as accelerators, radioisotope generators, and natural radionuclides may be considered sources.

Radiation Standards

Exposure standards, permissible concentrations, rules for safe handling, regulations for transportation, regulations for industrial control of radiation and control of radioactive material by legislative means.

Radiation Warning Symbol

An officially prescribed symbol (a magenta trefoil) on a yellow background that must be displayed where certain quantities of radioactive materials are present or where certain doses of radiation could be received.

Radioactive waste

A solid, liquid, or gaseous material from experiment/research operations that is radioactive and for which there is no further use.

Radioactivity

The spontaneous emission of radiation, generally alpha particles, beta particles, or gamma rays from the nucleus of an unstable isotope.

Radioisotope

An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.

Rem

The special unit for dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rads, multiplied by the quality factor.

Roentgen (R)

A unit of exposure to ionizing radiation. It is that amount of gamma or x-rays required to produce ions carrying 1 electrostatic unit of electrical charge in 1 cubic centimeter of dry air under standard conditions. Named after Wilhelm Roentgen, German scientist who discovered x-rays in 1895.

Restricted Area

An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation or radioactive materials. Restricted area does not include areas used as residential quarters, offices, etc.

Scintillation Detector

A radiation detection instrument comprised of a phosphor, photomultiplier tube(s), and associated electronic circuits for counting light emissions produced in the phosphor by ionizing radiation.

Sealed Source

Radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal under the most severe conditions which are likely to be encountered in normal use and handling.

Secondary Radiation

Radiation originating as the result of absorption of other radiation in matter. It may be either electromagnetic (e.g. Bremsstrahlung from ^{32}P betas passing through lead) or particulate in nature.

Shallow Dose Equivalent

Applies to the external exposure of the skin or an extremity. This is the dose equivalent at a tissue depth 0.007 cm averaged over an area of 1 square centimeter.

Shielding

Any material or obstruction that absorbs radiation and thus tends to protect personnel or materials from the effects of ionizing radiation.

Survey Meter

Any portable radiation detection instrument especially adapted for inspecting an area to establish the existence and amount of radioactive material or contamination present.

TLD (ThermoLuminescent Dosimeter)

A crystalline material which emits light when heated after radiation exposure; used in dosimetry.

Whole Body

Refers to the head, trunk (including gonads), arms above the elbow, and legs above the knee.

Wipe Sample

Wiping of 100 square centimeters of a surface with a filter paper or a cotton swab for the purpose of determining if removable contamination is present. The wipe is then analyzed with a radiation detection instrument, such as a survey meter or a LSC).

X-rays

Penetrating electromagnetic radiation (photon) having a wavelength that is much shorter than that of visible light. They can be produced by excitation of the electrons around certain nuclei (characteristic x-rays) or by the interaction of high speed electrons with the electric fields around nuclei.

Email radiation_protection@harvard.edu to send comments and suggestions to the Radiation Protection Office.