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OF HEALTH SCIENCES
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Glossary of Terms*

***With permission from the Manual of Policies and Procedures for Radiation Protection, for the University of Minnesota, Department of Environmental Health and Safety, Radiation Protection Program, January 2000**

Absorbed Dose: When ionizing radiation passes through matter, some of its energy is imparted to the matter. The amount of energy imparted per unit mass of irradiated material is called the absorbed dose and is measured in rads.

Accelerator: A device for increasing the velocity and energy of charged elementary particles (such as electrons or protons) through application of electrical or magnetic forces. Accelerators have made particles move at velocities approaching the speed of light. Types of accelerators include betatrons, Cockcroft-Walton Accelerators, cyclotrons, linear accelerators, sychrocyclotrons, and Van de Graff generators.

Activity: The spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation.

Alpha Particles (Symbol α): Positively charged particle emitted by certain radioactive materials. It is composed of two neutrons and two protons bound together, hence is identical with the nucleus of a helium atom. It is the least penetrating of the three common types of radiation (alpha, beta and gamma) emitted by radioactive material. Alpha particles can be stopped by a sheet of paper. Alpha particles are not dangerous to plants, animals or people unless the alpha-emitting substance has entered the body.

Approved User: An individual who has obtained from the appropriate radioisotope license committee from the State of California, Department of Health Services, or directly from the Nuclear Regulatory Commission, a signed permit for possession and use of radioactive materials.

BETA PARTICLE (electron, positron) (Symbol β): An elementary particle emitted from the nucleus during radioactive decay, with a single electrical charge and a mass equal to 1/1837 that of a proton. A negative charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Beta radiation may cause skin burns, and beta emitters are harmful if they enter the body. A thin sheet of metal easily stops most beta particles.

BIOASSAY: Assay and measurement procedures used to determine the amount of radioactive material in a biological system.

BREMSSTRAHLUNG: Electromagnetic (x-ray) radiation associated with the deceleration of charged particles passing through matter. Usually associated with energetic beta-emitters such as ^{32}P.

COLLIMATOR: A device for focusing or confining a beam of particles or radiation, such as x-rays.

CONTAMINATION: The presence of radioactive material on materials or places where it is undesirable.

CURIE (Ci): Quantity of any radioactive material in which the number of disintegrations is 3.7×10^{10} per second. It is abbreviated Ci.

Millicurie: One-thousandth of a curie ($^1/_{1000}$ of a Ci)
3.7×10^7 disintegrations per second. It is abbreviated mCi.

Microcurie: One-millionth of a curie ($^1/_{1,000,000}$ of a Ci)
3.7 c 10^4 disintegrations per second. It is abbreviated μCi.

Picocurie: One- millionth of a microcurie ($^1/_{1,000,000}$ of a μCi)
3.7×10^{-2} disintegrations per second. It is abbreviated ρCi.

DOSE: Quantity of radiation or energy absorbed in a specified mass. For special purpose, it must be appropriately qualified, e.g. absorbed dose.

DOSE EQUIVALENT (DE): Quantity used in radiation protection expressing all radiation on a common scale for calculating the effective absorbed dose. The unit of dose equivalent is the rem, which is numerically equal to the absorbed dose in rads multiplied by certain modifying factors such as the quality factor and the distribution factor.

DOSE RATE: Radiation dose delivered per unit time and measured, for instance, in rems per hour.

ELECTROMAGNETIC RADIATION: Radiation consisting of associated and interacting electric and magnetic waves that travel at the speed of light. Examples include light, radio waves, gamma rays and x-rays. All can be transmitted through a vacuum.

ELECTRON: Negatively charged elementary particle, which is a constituent of every neutral atom. Its unit of negative electricity equals 4.8×10^{-10} coulombs. Its mass is 0.00549 atomic mass units.

EXTERNAL RADIATION HAZARD: Exposure to ionizing radiation emitted from a radiation source (radioactive material, x-ray machine, etc.) located outside the body; the ionizing radiation must penetrate through the skin to deeper body tissue to cause biological effects.

FILM BADGE: Packet of photographic film worn by personnel, which provides an approximate measure of radiation exposure for personnel monitoring, purposes. The badge may contain two or more films of different sensitivities, and it may contain filters that shield parts of the film from certain types of radiation.

FILTER, PRIMARY: A sheet of material, usually metal, placed in a beam of radiation to remove, as far as possible, the less penetrating components of the beam.

FILTER, SECONDARY: A sheet of material of lower atomic number, relative to that of the primary filter, placed in the filtered beam of radiation to remove characteristic radiation produced by the primary beam.

FLUOROSCOPE: An instrument with a fluorescent screen suitably mounted with respect to an x-ray tube, used most commonly for immediate indirect viewing of internal organs of the body, by means of x-rays. A fluorescent image, a kind of x-ray shadow picture, is produced.

GAMMA RAY (Symbol Υ): High-energy, short-wavelength electromagnetic radiation. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best-stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are essentially similar to x-rays but are usually more energetic and are nuclear in origin.

G-M COUNTER (Geiger-Muller): A radiation detection and measuring instrument. It consists of a gas-filled (Geiger-Muller) tube containing electrodes, between which there is an electrical voltage but no current flowing. When ionizing radiation passes through the tube, a short, intense pulse of current passes from the negative electrode to the positive electrode and is measured or counted. The number of pulses per second measures the intensity of radiation. It is known as a Geiger counter; it was named for Hans Geiger and W. Muller who invented it in the 1920s.

GENETIC EFFECTS (radiation): Radiation effects that can be transferred from parent to offspring. Any radiation-caused changes in the genetic material of sex cells.

HALF-LIFE, BIOLOGICAL (T_b); Time required for the body to eliminate one-half of an administered dose of any substance by the regular processes of elimination. This time is approximately the same for both stable and radioactive isotopes of a particular element.

HALF-LIFE, EFFECTIVE (T_{eff}): Time required for a radioactive nuclide in a system to be diminished 50% as a result of the combined action of radioactive decay and biological elimination.

$$T_{eff} = \frac{T_b \times T_r}{T_b + T_r}$$

HALF-LIFE, PHYSICAL (radiological) (T_r): Time required for a radioactive substance to lose 50% of its activity by decay. Each radionuclide has a unique half-life.

HALF-VALUE LAYER: The thickness of any specified material necessary to reduce the intensity of an x-ray or gamma ray beam to one-half its original value.

HEALTH PHYSICS: Branch of radiological science dealing with the protection of personnel from the harmful effect of ionizing radiation.

HIGH RADIATION AREA: Any area, accessible to personnel, in which there exists ionizing radiation at such levels that a major portion of the body could receive, in an hour, a dose in excess of 100 mrem.

INTERLOCK: Device (usually electronic) which precludes access to high radiation areas by automatically terminating or reducing radiation exposure rates upon entry by personnel.

INTERNAL RADIATION HAZARD: Exposure to ionizing radiation emitted from a radioisotope source located or incorporated within the body as a result of deposition of radioisotopes in body tissues (i.e., ^{131}I in the thyroid).

INVERSE SQUARE LAW: The intensity of radiation at any distance from a point source varies inversely as the square of that distance. For example, if the radiation exposure is 100 R/hr at 1 inch from the source the exposure will be 0.01 R/hr at 100 inches.

IONIZATION: Process of adding one or more electrons to, or removing one or more electrons from atoms or molecules, thereby creating ions. High temperatures, electrical discharges, or nuclear radiations can cause ionization.

IONIZATION CHAMBER: An instrument designed to measure the quantity of ionizing radiation in terms of the charge of electricity associated with ions produced within a defined volume.

KEV (keV): Energy acquired by a particle of one electronic charge in passing through a potential difference of one thousand volts (kV).

LINEAR ACCELERATOR: A long straight tube (or series of tubes) in which charged particles (ordinarily electrons or protons) gain in energy by the action of oscillating electromagnetic fields.

LINEAR ENERGY TRANSFER (LET): Measure of the ability of biological material to absorb ionizing radiation; radiation energy lost per unit length of a path through a biological material. In general, the higher the LET value, the greater the relative biological effectiveness of the radiation in that material.

MAXIMUM PERMISSIBLE DOSE EQUIVALENT (MPD): The maximum dose equivalent that a person, or specified parts of a person's body, shall be allowed to receive in a specified period of time (quarter or year).

MAXIMUM PERMISSIBLE CONCENTRATION (MPC): That amount of a particular radioactive material in the air, water, or food that might be expected to result in the MPD to the person consuming that material at the standard rate of intake (based on a standard person).

MEV (MeV): Energy acquired by a particle of one electronic charge in passing through a potential difference of one million volts (MV).

NEUTRON (SYMBOL n): An uncharged elementary particle, with a mass slightly greater than that of a proton, that is found in the nucleus of every atom heavier than hydrogen. A free neutron is unstable and decays with a half-life of about 13 minutes into an electron, proton and a neutrino. Neutrons sustain the fission chain reaction in a nuclear reactor.

NUCLEAR REGULATORY COMMISSION (NRC): Federal agency responsible for licensing, inspection, and enforcement of regulations pertaining to the use of sources of ionizing radiation.

PERSONNEL MONITORING DEVICES: These devices are used to determine by either physical or biological measurements, the amount of ionizing radiation to which an individual has been exposed. The most common monitoring method is the use of a film badge.

QUALITY FACTOR (QF): The factor by which the absorbed dose is multiplied to obtain a quantity that expresses on a common scale, for all ionizing radiation, the radiation dose received by exposed persons.

RAD: The unit of absorbed radiation dose equal to 100 ergs per gram of absorbing material.

RADIATION AREA: An area, accessible to personnel, in which there exits ionizing radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 mrem, or in any five consecutive days a dose in excess of 100 mrem.

RADIATION PROTECTION INSTRUMENT: A device that detects and records the characteristics of ionizing radiation.

RADIATION PROTECTION OFFICER (RPO): A person trained in radiological science who is responsible for the protection of persons from the harmful effects of ionizing radiation. Also referred to as health physicist or radiation safety officer.

RADIATION PROTECTION SURVEY: Evaluation of the radiation hazards incident to the production, use or existence of radioactive materials or other sources of ionizing radiation. Such evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes using or affecting these materials. With this information, it is possible to predict hazards resulting from expected or possible changes to materials or equipment.

RADIOACTIVE DECAY (DISINTEGRATION): The spontaneous transformation of one nuclide into a different nuclide or into a different energy state of the same nuclide. The process results in a decrease, with time, of the number of the original radioactive atoms in a sample. It involves the emission from the nucleus of alpha particles, beta particles (or electrons), or gamma rays; or the nuclear capture or ejection of orbiting electrons; or fission. Also called radioactive disintegration.

RADIOACTIVITY: The spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation. (Often shortened to "activity".)

RADIOISOTOPE (RADIOACTIVE MATERIAL): A radioactive isotope. An unstable isotope of an element decays or disintegrates spontaneously, emitting radiation. More than 1300 natural or artificial radioisotopes have been identified.

RADIOTOXICITY: A term referring to the potential of an isotope to cause damage to living tissue by absorption of energy from the disintegration of the radioactive material introduced into the body.

REM: The special unit of dose equivalence (rem = rads x QF). Also, one millirem (mrem) is equal to $^{1}/_{1000}$ rem.

RESTRICTED AREA (CONTROLLED AREA): Any area to which access is controlled for the purpose of protecting individuals from exposure to sources of ionizing radiating radiation.

ROENTGEN (R): A unit of exposure to ionizing radiation. It is the amount of gamma or x-rays required to produce ions carrying one electromagnetic unit of electrical charge (either positive or negative) in one cubic centimeter of dry air under standard conditions. Named after Wilhelm Roentgen, a German scientist who discovered x-rays in 1895. Also, one milliroentgen (mR) is equal to $^{1}/_{1000}$ R.

SMEAR SURVEY (WIPE TEST): A procedure in which a swab, such as a circle of filter paper, is rubbed on a surface and its radioactivity measured to determine if the surface is contaminated with a removable radioactive material.

THERMOLUMINESCENT DOSIMETER (TLD): A dosimeter made of a certain crystalline material capable of storing a fraction of absorbed ionizing radiation and releasing this energy in the form of visible photons when heated. The amount of light released can be used as a measure of radiation exposure to these crystals.

UNRESTRICTED AREA (NON-CONTROLLED AREA): An area to which access is not controlled for the purpose of protection of individuals from the exposures to sources of ionizing radiation.

VAN DE GRAFF ACCELERATOR: An electrostatic machine in which electrically charged particles are sprayed on a moving belt and carried by it to build up a high potential on the insulated terminal. Charged particles are then accelerated along a discharge path through a vacuum tube by the potential difference between the insulated terminal and the opposite end of the machine. A Van de Graff accelerator is often used t inject particles into larger accelerators. Named after R.S.Van de Graff, who invented the device in 1931.

WASTE (RADIOACTIVE): Equipment or materials (from nuclear operations) that are radioactive and that are no longer being used. Radioactive waste classification is based on the radioisotope, content, the specific activity, the chemical and physical form, and the stability of the radioisotope material.

X-RAY: Penetrating electromagnetic radiations having wave lengths shorter than those of visible light. Bombarding a metallic target with fast electrons in a vacuum usually produces X-rays. In nuclear reactions, it is customary to refer to photons originating in the nucleus as gamma rays, and those originating outside the nucleus as x-rays. Sometimes called roentgen rays, after their discoverer, W.C. Roentgen.