

Appendix B. Definitions.

ABSORBED DOSE - The amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material. (See Rad)

ABSORPTION - The phenomenon by which radiation imparts some or all of its energy to any material through which it passes.

ACTIVITY - The number of nuclear disintegrations occurring in a given quantity of material per unit time. (See curie)

ALPHA PARTICLE - A strongly ionizing particle emitted from the nucleus during radioactive decay having a mass and charge equal in magnitude to a helium nucleus, consisting of 2 protons and 2 neutrons with a double positive charge.

ALPHA RAY - A stream of fast-moving helium nuclei (alpha particles), a strongly ionizing and weakly penetrating radiation.

ANNIHILATION (Electron) - An interaction between a positive and negative electron; their energy, including rest energy, being converted into electromagnetic radiation (annihilation radiation).

ANNUAL LIMIT OF INTAKE (ALI) - Means the derived limit for the

amount of radioactive material taken into the body of an adult worker by inhalation or ingestion a year.

ATOM - Smallest particle of an element which is capable of entering into a chemical reaction.

BACKGROUND RADIATION - Ionizing radiation arising from radioactive material other than the one directly under consideration. Background radiation due to cosmic rays and natural radioactivity is always present. There may also be background radiation due to the presence of radioactive substances in other parts of the building, in the building material itself, etc.

BETA PARTICLE - Charged particle emitted from the nucleus of an atom, having a mass and charge equal in magnitude to that of the electron.

BETA RAY - A stream of high speed electrons or positrons of nuclear origin more penetrating but less ionizing than alpha rays.

BREMSSTRAHLUNG - Electromagnetic (x-ray) radiation associated with the deceleration of charged particles passing through matter. Usually associated with energetic beta emitters (for example, phosphorus-32).

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CALIBRATION - Determination of variation from standard, or accuracy, of a measuring instrument to ascertain necessary correction factors.

COMMITTED DOSE EQUIVALENT (CDE) - ($H_{T,50}$) Means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50 year period following the intake.

COMMITTED EFFECTIVE DOSE EQUIVALENT (CEDE) - ($H_{g,50}$) Is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the Committed Dose Equivalent to these organs or tissues.

CONTAMINATION, RADIOACTIVE - Deposition of radioactive material in any place where it is not desired, and particularly in any place where the presence may be harmful.

COUNT (Radiation Measurements) - The external indication of a device designed to enumerate ionizing events. It may refer to a single detected event or to the total registered in a given period of time. The term is often erroneously used to designate a disintegration, ionizing event, or voltage pulse.

CRITICAL ORGAN - That organ or tissue, the irradiation of

which will result in the greatest hazard to the health of the individual or his or her descendants.

CURIE - The quantity of any radioactive material in which the number of disintegrations is 3.700×10^{10} per second. Abbreviated Ci.

Millicurie - One-thousandth of a curie (3.7×10^7 disintegrations per second). Abbreviated mCi.

Microcurie - One-millionth of a curie (3.7×10^4 disintegrations per second). Abbreviated μ Ci.

Picocurie - One-millionth of a microcurie (3.7×10^{-2} disintegrations per second or 2.22 disintegrations per minute). Abbreviated pCi.

DECAY, RADIOACTIVE - Disintegration of the nucleus of an unstable nuclide by the spontaneous emission of charged particles and/or photons.

DECLARED PREGNANT WORKER - Means a women who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

DEEP DOSE EQUIVALENT (DDE) - (H_d) Which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

DERIVED AIR CONCENTRATIONS (DAC) - Means the concentration

of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 m³/hr), results in an intake of one ALI.

DETERMINISTIC (NON-STOCHASTIC EFFECTS) - Means health effects, the severity of which varies with dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a deterministic effect (also called a non-stochastic effect).

DOSE - A general term denoting the quantity of radiation or energy absorbed in a specified mass. For special purposes, it must be appropriately qualified (for example, absorbed dose).

DOSE, 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 (or prefixed forms of the unit such as millirad); which is 100 ergs/gram. The SI unit for the rad is the gray. 1 gray = 100 rads.

DOSE, EQUIVALENT - A 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, the distribution factor, etc.

EFFECTIVE DOSE EQUIVALENT (EDE) - (H_E) Is the sum of the products of the dose equivalent to organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated.

EFFICIENCY, INTRINSIC - A measure of the probability that a count will be recorded when radiation is incident on a detector. Usage varies considerably so it is well to make sure which factors (window, transmission, sensitive volume, energy dependence, etc.) are included in a given case.

EFFICIENCY, ABSOLUTE - A measure of the probability that a count will be recorded when radiation is emitted by the source. Absolute efficiency includes intrinsic efficiency, but also includes geometric factors.

ELECTRON - Negatively charged elementary particle which is a constituent of every neutral atom. Its unit of negative electricity equals 4.8×10^{-19} coulombs. Its mass is 0.00549 atomic mass units.

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ELECTRON CAPTURE - A mode of radioactive decay involving the capture of an orbital electron by its nucleus. Capture from the particular electron shell is designated as "K-electron capture," "L-electron capture," etc.

ELECTRON VOLT - A unit of energy equivalent to the amount of energy gained by an electron in passing through a potential difference of 1 volt. Abbreviated eV. Larger multiple units of the electron volt frequently used are: keV for thousand or kiloelectron volts, MeV for million electron volts and BeV for billion electron volts.

EXPOSURE - A measure of the ionization produced in air by x or gamma radiation. It is the sum of the electrical charges on all ions of one sign produced in air when all electrons liberated by photons in volume element of air are completely stopped in air, divided by the mass of air in the volume element. The special unit of exposure is the roentgen.

EXTREMITY - Means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

EYE DOSE EQUIVALENT (LDE) - 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 centimeter (300 mg/cm²).

FILM BADGE - A packet of photographic film used for the approximate measurement of radiation exposure for personnel monitoring purposes. The badge may contain two or more films of differing sensitivity, and it may contain filters which shield parts of the film from certain types of radiation.

GAMMA RAY - Very penetrating electromagnetic radiation of nuclear origin. Except for origin, identical to x-ray.

GEIGER-MUELLER (G-M) COUNTER - Highly sensitive gas-filled detector and associated circuitry used for radiation detection and measurement.

GENETIC EFFECT OF RADIATION - Inheritable changes, chiefly mutations, produced by the absorption of ionizing radiation. On the basis of present knowledge these effects are purely additive, and there is no recovery.

HALF-LIFE, BIOLOGICAL - ($B_{1/2}$) The 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 radionuclides of a particular element.

HALF-LIFE, EFFECTIVE - ($E_{1/2}$)
Time required for a radioactive nuclide in a system to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

$$E_{1/2} = (B_{1/2} \times T_{1/2}) / (B_{1/2} + T_{1/2})$$

HALF-LIFE, RADIOACTIVE - ($T_{1/2}$)
Time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has a unique half-life.

HALF VALUE LAYER (Half thickness) - 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 - The science concerned with recognition, evaluation and control of health hazards from ionizing and non-ionizing radiation.

HIGH RADIATION AREA - Means an area accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

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 a source, the exposure will be 0.01 R/hr at 100 inches.

ION - Atomic particle, atom, or chemical radical bearing an electrical charge, either negative or positive.

IONIZATION - The process by which a neutral atom or molecule acquires either a positive or a negative charge.

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.

IONIZATION, SPECIFIC - The number of ion pairs per unit length of path of ionizing radiation in a medium (for example, per centimeter of air or per micron of tissue).

IONIZING RADIATION - Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

ISOTOPES - Nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist

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between isotopes of a particular element.

MILLIROENTGEN (mR) - A submultiple of the roentgen equal to one one-thousandth (1/1000th) of a roentgen.

MONITORING, RADIOLOGICAL - Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region as a safety measure for purposes of health protection. For example, Area Monitoring: Routine monitoring of the level of radiation or of radioactive contamination of any particular area, building, room or equipment. Personnel Monitoring: Monitoring any part of an individual, or any part of his clothing (See Radiological Survey).

NEUTRON - Elementary particle with a mass approximately the same as that of a hydrogen atom and electrically neutral. It has a half-life in minutes and decays in a free state into a proton and an electron.

NUCLIDE - A species of atom characterized by its mass number, atomic number, and energy state of its nucleus, provided that the atom is capable of existing for a measurable time.

OCCUPATIONAL EXPOSURE: The exposure received by an

individual in a restricted area or in the course of employment in which the individual's assigned duties involve exposure to ionizing radiation or radioactive material from licensed or unlicensed sources of radiation, whether in the possession of the licensee or another person. Occupational exposure does not include exposure to background radiation, as a patient in medical practices, from voluntary application in medical programs, or as a member of the general public.

PLANNED SPECIAL EXPOSURE (PSE) - Means an infrequent exposure to radiation, separate from and in addition to the annual NRC (Tier 1) dose limit.

PROTECTIVE BARRIERS - Barriers of radiation absorbing material, such as lead, concrete, plaster, and plastic, that are used to reduce radiation exposure. Protective Barriers, Primary: Barriers sufficient to attenuate the useful beam to the required degree. Protective Barriers, Secondary: Barriers sufficient to attenuate stray or scattered radiation to the required degree.

RADIATION - 1. The emission and propagation of energy through space or through a material medium in the form of waves; for instance, the emission and

propagation of electromagnetic waves, or of sound and elastic waves. 2. The energy propagated through a material medium as waves; for example, energy in the form of electromagnetic waves or of elastic waves. The term "radiation" or "radiant energy," when unqualified, usually refers to electromagnetic radiation. Such radiation commonly is classified according to frequency as Hertzian, infrared, visible (light), ultraviolet, x-ray, and gamma ray. 3. By extension, corpuscular emissions, such as alpha and beta radiation, or rays of mixed or unknown type, as cosmic radiation.

RADIATION AREA - Means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters.

RADIATION SURVEY - Evaluation of the radiation hazards incident to the production, use or existence of radioactive materials or other sources of radiation under a specific set of conditions. 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 to predict hazards resulting from expected or possible changes in materials or equipment.

RADIONUCLIDE - A nuclide with an unstable ratio of neutrons to protons placing the nucleus in a state of stress. In an attempt to reorganize to a more stable state, it may undergo various types of rearrangement that involve the release of radiation.

RADIOTOXICITY - 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.

RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) - For a particular living organism or part of an organism, the ratio of the absorbed dose of a reference radiation that produces a specified biological effect to the absorbed dose of the radiation of interest that produces the same biological effect.

REM - The special unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, distribution factor, and any other necessary modifying factors.

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ROENTGEN (R) - The amount of X or gamma radiation below 3 MeV in energy which produces 2.58×10^{-4} coulombs per kilogram (C/kg) of dry air. The roentgen is the special unit of exposure.

SCINTILLATION COUNTER - A counter in which light flashes produced in a scintillator by ionizing radiation are converted into electrical pulses by a photomultiplier tube.

SHALLOW DOSE EQUIVALENT (SDE) - (H_s) Which applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeters (7 mg/cm^2) averaged over an area of 1 square centimeter. Shallow Dose Equivalent, Whole Body (WB) means for purposes of external exposure, head, trunk (including male gonads), arms above the elbow or legs above the knee. Shallow Dose Equivalent, Maximum Extremity (ME) means for purposes of external exposure, arms below the elbow or legs below the knee.

SHIELDING MATERIAL - Any material which is used to absorb radiation and thus effectively reduce the intensity of radiation, and in some cases eliminate it. Lead, concrete, aluminum, water, and plastic are examples of commonly used shielding material.

SIEVERT - The SI unit of dose equivalent, 1 sievert (Sv) equals 100 rem.

SMEAR (Smear or Swipe Test) - A procedure in which a swab, for example,, a circle of filter paper, is rubbed on a surface and its radioactivity measured to determine if the surface is contaminated with loose radioactive material.

SPECIFIC ACTIVITY - Total radioactivity of a given nuclide per gram of a compound, element or radioactive nuclide.

STOCHASTIC EFFECT - Means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE) - Means the sum of the Deep Dose Equivalent (for external exposures) and the Committed Effective Dose Equivalent (for internal exposures).

TOTAL ORGAN DOSE EQUIVALENT (TODE) - Means the sum of the Deep Dose Equivalent (H_d) and the Committed Dose Equivalent ($H_{T,50}$) to any individual organ or tissue, other than the lens of the eye, being equal to 50 rems (0.5 Sv).

THERMOLUMINESCENT DOSIMETER - A dosimeter made of certain crystalline material which is capable of both 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.

VERY HIGH RADIATION AREA - Means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at a meter from a radiation source or from any surface that the radiation penetrates.

WEIGHTING FACTORS (W_T) - For an organ or tissue (T) is the proportion or the risk of

stochastic effect resulting from irradiation of that organ or tissue of the total risk of stochastic effect when the whole body is irradiated uniformly.

X-RAYS - Penetrating electromagnetic radiations having wave lengths shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extranuclear part of the atom as x-rays. These rays are sometimes called roentgen rays after their discoverer, W.C. Roentgen.