

Appendix F: Definitions

DEFINITIONS

ABSORBED DOSE means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).

ACT means the Atomic Energy Act of 1954 (42 U.S.C. 20011 et seq.) as amended.

ACTIVITY is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

ADULT means an individual 18 or more years of age.

AIRBORNE RADIOACTIVE MATERIAL means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

AIRBORNE RADIOACTIVITY AREA means a room, enclosure, or area in which airborne radioactive materials composed wholly or partly of licensed material, exist in concentrations-

- i. In excess of the derived air concentrations (DACs) specified in appendix B, NAC 459, or
- ii. To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake [ALI] or 12 DAC-hours.

ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking 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, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

ANNUAL LIMIT ON INTAKE (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 SV) or a committed dose equivalent of 50 rems (0.5 SV) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2, of appendix B, NAC 459.

APPLICATION FOR USE OF RADIONUCLIDES: An application, which precedes the issuance of a Radiation Use Authorization (RUA). Separate applications are required for non-human research use and non-human classroom use (a Classroom Use Authorization CUA).

BACKGROUND RADIATION means radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

BECQUEREL (Bq): A Unit of radioactivity equal to one radioactive disintegration per second.

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

BYPRODUCT MATERIAL means- (1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material: and (2) The tailing or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

CLASS (or Lung class or inhalation class) means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D (Days) of less than 10 days, for Class W (Weeks) from 10 to 100 days, and for Class Y (Years) of greater than 100 days.

COLLECTIVE DOSE is 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.

COMMISSION means the Nuclear Regulatory Commission or its duly authorized representatives.

COMMITTED DOSE EQUIVALENT ($H_{T,50}$) 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 ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and committed dose equivalent to these organs or tissues ($H_{E,50} = \sum W_T H_{T,50}$).

CONTROLLED AREA means an area outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

URIE: The basic unit of radioactivity is the Curie (Ci). A sample has an activity of one curie if it decays at a rate of $3.7E10$ disintegrations per second (dps). Subunits of the Curie are:

millicurie (mCi) = $3.7E7$ dps
microcurie (uCi) = $3.7E4$ dps
picocurie (pCi) = $3.7E-2$ dps

The international unit for activity is the becquerel (Bq). One disintegration per second is equal to one becquerel.

DECLARED PREGNANT WOMAN means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

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

DEPARTMENT means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C.7101 et seq.) to the extent that the Department, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers, and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c), and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301 (a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat 565 at 577-578, 42 U.S.C, 7151).

DERIVED AIR CONCENTRATION (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 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of appendix B to "20.1001-20.2401.

DERIVED AIR CONCENTRATION-HOUR (DAC-hour) is the product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

DOSE OR RADIATION DOSE is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this section.

DOSE EQUIVALENT (H_T) means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

DOSIMETRY PROCESSOR means an individual or an organization that processes and evaluates individual monitoring equipment in order to determine the radiation dose delivered -- the equipment. ($H_{E.50} = \sum W_T H_{T.50}$).

EFFECTIVE DOSE EQUIVALENT (H_E) is the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighing factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum w_T H_T$).

EMBRYO/FETUS means the developing human organism from conception until the time of birth.

ENTRANCE OR ACCESS POINT means any location through which an individual could gain access to radiation areas or to radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

EXPOSURE means being exposed to ionizing radiation or to radioactive material.

EXTERNAL DOSE means that portion of the dose equivalent received from radiation sources outside the body.

EXTREMITY means hand, elbow, arm below the elbow, foot, knee or 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 centimeter (300 mg/cm^2).

GENERALLY APPLICABLE ENVIRONMENTAL RADIATION STANDARDS means standards issued by the Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

GOVERNMENT AGENCY means any executive department, commission, independent establishment, corporation wholly or partly owned by the United States of America, which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

GRAY (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rads).

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.

INDIVIDUAL means any human being.

INDIVIDUAL MONITORING means - (1) the assessment of dose equivalent by the use of devices designed to be worn by an individual: (2) The assessment of committed effective dose equivalent by bioassay (see *Bioassay*) or by determination of the time-weighted air concentrations to which an individual has been exposed, i.e. DAC-hours: or (3) The assessment of dose equivalent by the use of survey data.

INDIVIDUAL MONITORING DEVICES (INDIVIDUAL MONITORING EQUIPMENT) means devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal ("lapel") air sampling devices.

INTERNAL DOSE means that portion of the dose equivalent received from radioactive material taken into the body.

IONIZING RADIATION: Any electromagnetic or particulate radiation capable of producing ions directly or indirectly in its passage through matter. In general, it will refer to gamma rays and x-rays, alpha and beta particles, neutrons, protons, high speed electrons, and other nuclear particles; not sound or radio waves, or visible, infrared or ultra-violet light.

LICENSE means a license issued by the division in accordance with the provisions of NAC 459.010 to 459.950, inclusive, and Chapter 459 of NRS.

LICENSED RADIOACTIVE MATERIAL means any radioactive material that is possessed under a specific or general license issued by the division pursuant to this chapter.

LICENSEE means the holder of a license.

LIMITS (dose limits) means the permissible upper bounds of radiation doses.

LOST OR MISSING LICENSED MATERIAL means licensed material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

MEMBER OF THE PUBLIC means an individual in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

MINOR means an individual less than 18 years of age.

MONITORING (radiation monitoring, radiation protection monitoring) means the measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

NAC.459: Refers to the Nevada Administrative Code which contains regulations and requirements pertaining to the University license.

NONSTOCHASTIC EFFECT means health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

NRC means the Nuclear Regulatory Commission or its duly authorized representative.

OCCUPATIONAL DOSE means 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 from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the general public.

PERSON has the meaning ascribed to it in subsection 5 of NRS 459.010

PERSONNEL DOSIMETRY: Devices which measure the cumulative dose of radiation to an individual.

PLANNED SPECIAL EXPOSURE means an infrequent exposure to radiation, separate from and in addition to the annual dose limits.

PUBLIC DOSE means the dose received by a member of the public from exposure to radiation and to radioactive material released by a licensee, or to another source of radiation either within a licensee's controlled area or in unrestricted areas. It does not include occupational dose or doses received from background radiation, as a patient from medical practices, or from voluntary participation in medical research programs.

QUALITY FACTOR (Q) means the applicable modifying factor that is specified in NAC 459.3235.

QUARTER means a period of time equal to one-fourth of the year observed by the licensee (approximately 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 is the special unit of absorbed dose. One rad is equal to an absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

RADIATION (ionizing radiation) means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light.

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 from the radiation source or from any surface that the radiation penetrates.

RADIATION PRODUCING MACHINE: Any device capable of producing ionizing radiation when the associated control devices are operated, but excluding devices which produce radiation only by the use of radioactive materials.

RADIATION SOURCE: A radiation source is any radionuclide, x-ray machine, accelerator, or other device capable of emitting ionizing radiation and is subject to the provisions of this Manual. Ionizing radiation is any particulate or electromagnetic radiation capable of producing biological damage.

RADIATION USE AUTHORIZATION (RUA): An authorization issued by the Radiation Safety Committee to conduct specific research or education/training using specific radioisotopes.

RADIOACTIVE CONTAMINATION: Deposition of radioactive material where it is not desired.

RADIOACTIVE MATERIALS: Any material, solid, liquid, or gas which emits ionizing radiation spontaneously, including radioactive waste.

REFERENCE MAN means a hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base.

REM is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert).

RESPIRATORY PROTECTIVE DEVICE means an apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials.

RESTRICTED AREA means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

ROENTGEN: The quantity of X or gamma radiation (NOT alpha or beta radiation) that results in 1 electrostatic unit (esu) of ionization per 1 cubic centimeter (cc) of dry air, at Standard Temperature and Pressure (STP) at the point of measurement. One esu represents 2E9 ion pairs, or 2.58E-4 coulombs/kg air. This amount of radiation imparts an amount of energy equivalent to 5.4E7 MeV per gram of air, or 0.87 RAD to air. A Roentgen of X-radiation in the energy range of 0.1 to 3.0 MeV also produces 0.9 RAD in tissue. Thus, for most purposes, values of exposures in roentgens can be considered essentially equal to absorbed doses in RADS to tissue irradiated at the same point, or to dose equivalents in REM.

SANITARY SEWERAGE means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee.

SHALLOW-DOSE EQUIVALENT (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 centimeter (7 mg/cm²) averaged over an area of 1 square centimeter.

SIEVERT is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 SV=100 rems).

SITE BOUNDARY means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee.

SOURCE MATERIAL means - (1) Uranium or thorium or any combination of uranium and thorium in any physical or chemical form; or (2) Ores that contain, by weight, one-twentieth of 1 percent (0.05 percent), or more, of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

SPECIAL NUCLEAR MATERIAL means - (1) plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Commission, pursuant to the provisions of section 51 of the Act, determines to be special nuclear material, but does not include source material; or (2) Any material artificially enriched by any of the foregoing but does not include source material.

STOCHASTIC EFFECTS 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.

SURVEY means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

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).

UNRESTRICTED AREA means an area, access to which is neither limited nor controlled by the licensee.

URANIUM FUEL CYCLE means the operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel to the extent that these activities directly support the production of electrical power for public use. Uranium fuel cycle does not include mining operations, operations at waste disposal sites, transportation of radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and byproduct materials from the cycle.

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 1 meter from a radiation source or from any surface that the radiation penetrates. (Note: At very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts)).

WEEK means 7 consecutive days starting on Sunday.

WEIGHING FACTOR w_T , for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHING FACTORS	
Organ or tissue	w_T
Gonads	0.25
Breast	0.15
Redbone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	¹ 0.30
Whole Body	² 1.00

¹0.30 results from 0.06 for each of 5 "remainder" organs (excluding the skin and the lens of the eye) that receive the highest doses.

²For the purpose of Weighing the external whole body dose (for adding it to the internal dose), a single weighing factor $w_T=1.0$, has been specified. The use of other

weighing factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.

WHOLE BODY means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

WORKING LEVEL (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha particle energy.

WORKING LEVEL MONTH (WLM) means an exposure to 1 working level for 170 hours (2,000 working hours per year/12 months per year = approximately 170 hours per month).

YEAR means the period of time beginning in January used to determine compliance with the provisions of this part. The licensee may change the starting date of the year used to determine compliance by the licensee provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.