

Glossary

A

Absorbed Dose: The energy imparted to a unit mass of matter by ionizing radiation. The unit of absorbed dose is the rad or gray. One rad equals 100 ergs per gram and one gray is one Joule/Kg.

Acceptable Daily Intake: An estimate of the daily exposure dose that is likely to be without deleterious effect even if continued exposure occurs over a lifetime.

Accuracy: The degree of agreement between a measured value and the true value; usually expressed as +/- percent of full scale.

Action Levels: Regulatory levels recommended by EPA for remedial action. For example, 148 Bqm-3 or 4 pCiL-1 is the action level for radon in homes.

Activity: The number of nuclear transitions occurring in a given quantity of radioactive material per unit of time. For example one disintegration/second is a becquerel (Bq), which has replaced curie (Ci) as the standard unit of activity.

Acute: Exposure, diseases, or responses with a short time course.

Acute Exposure: A single exposure to a toxic substance. Acute exposures are usually characterized as lasting no longer than a day, as compared to longer, continuing or chronic exposures.

Acute Toxicity: Any poisonous effect produced within a short period of time following exposure, usually 24 to 96 hours, resulting in biological harm and often death.

Adaptive Response: The ability of cells to respond to low doses of radiation with the induction of a series of genes and to reduce the level of radiation-induced damage when challenged with a subsequent high dose of radiation.

Added Risk: The difference between the cancer incidence under the exposure condition and the background incidence in the absence of exposure.

Additive Effect: Equal to the sum of effects from two agents when acting alone.

AEC: Atomic Energy Commission, 1947-1974. Broken up in 1974 into the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC). ERDA later became the Department of Energy (DOE).

Aerobic: Life or processes that require, or are not destroyed by, the presence of oxygen.

Airborne Particulates: Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets.

ALARA: Acronym for "As Low As Reasonably Achievable," means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, taking into account the state of technology and the economics of improvements in relation the benefits to public health and safety, other societal and socioeconomic considerations, and utilization of nuclear energy (see 10 CFR 20.1003).

Algorithm: A formula or set of steps for solving a problem.

Allele: Two genes for the same trait, for example at a locus for eye color, different alleles might result in blue or brown eyes.

Alpha Decay: The emission of a nucleus of a helium atom from the nucleus of an element, generally of a heavy element, in the process of its radioactive decay.

Alpha Particle: The nuclei of a helium atom (with two neutrons and two protons each) that are discharged by radioactive decay of many heavy elements, such as uranium-238 and plutonium-239.

Alpha Irradiation: Radiation with alpha particles.

Anaerobic: A life or process that occurs in, or is not destroyed by, the absence of oxygen.

Annual Limit on Intake (ALI): 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 (mannequin used to determine dose) that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue (see 10 CFR 20.1003).

Antagonism: Interference or inhibition of the effect of one physical or chemical agent by the action of another.

Anthropogenic: Of human origin.

Apoptosis: Programmed cell death that plays an important role in both development and cancer induction.

Atom: The smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a central core of protons and neutrons called the nucleus. Electrons revolve in orbits in the region surrounding the nucleus.

Atomic Energy: Energy released in nuclear reactions. Of particular interest is the energy released when a neutron initiates the breaking up or fissioning of an atom's nucleus into smaller pieces (fission), or when two nuclei are joined together under millions of degrees of heat (fusion). It is more correctly called nuclear energy.

Atomic Number (symbolized Z): The number of protons in a nucleus. It determines the chemical properties of an element.

Atomic Weight: The nominal atomic weight of an isotope is given by the sum of the number of neutrons and protons in each nucleus. The exact atomic weight differs fractionally from that whole number, because neutrons are slightly heavier than protons and the mass of the nucleus is also affected by the binding energy.

Attributable Risk: The rate of a disease in exposed individuals that can be attributed to exposure. This measure is derived by subtracting the rate (usually incidence or mortality) of the disease among nonexposed persons from the corresponding rate among exposed individuals.

Autosome: All the chromosomes but the sex chromosome.

B

Background Radiation: 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. The typically quoted average individual exposure from background radiation is 360 millirems or 3.6 millisieverts per year.

Base Pair: Two nitrogenous bases (adenine and thymine) or (guanine and cytosine) held together in DNA by weak bonds forming a double helix.

Base Sequence: The order of nucleotide bases in a DNA molecule that is responsible for the genetic code.

Becquerel: The SI unit of activity equal to one disintegration per second. [37 billion (3.7×10^{10}) becquerels = 1 curie (Ci)].

BEIR: Several committees of the National Academy of Sciences-National Research Council on Biological Effects of Ionizing Radiation and their Reports. For example, BEIR VI defined the health effects of radon.

Benign: Usually referring to nonmalignant tumors.

Beta Decay: The emission of electrons or positrons (particles identical to electrons, but with a positive electrical charge) from the nucleus of an element in the process of radioactive decay of the element.

Beta Particle: A charged particle emitted from a nucleus during radioactive decay, with a mass equal to $1/1837$ that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Thin sheets of metal or plastic may stop beta particles.

Beta Radiation: Radiation consisting of beta particles.

Bias: Any difference between the true value and that actually obtained due to all causes other than sampling variability.

Binding Energy: The energy required to separate the nucleons in a nucleus into separate, free particles.

Biodosimetry: The use of biological changes to detect past radiation exposure. Chromosome aberrations have been used widely in biological dosimetry.

Biological Half-life: The time required for a biological system (such as a human or animal) to eliminate, by natural processes, half the amount of a substance (such as a radioactive material) that has been absorbed into that system.

Biotechnology: The use by industry of recombinant DNA, cell fusion, and new bioprocessing techniques.

Body Burden: The total amount of a specific substance in an organism, including the amount stored, the amount that is mobile, and the amount absorbed.

Bone Seeker: A radioisotope that tends to accumulate in the bones when it is introduced into the body. An example is strontium-90, which behaves chemically like calcium.

Breeder Reactor: A reactor designed to produce more fissile material than it consumes; also sometimes called "fast reactor" since most breeder reactors use fast neutrons for sustaining the nuclear chain reaction.

BTU: British thermal unit. The amount of energy gained by a pound of water when its temperature is increased by one degree Fahrenheit.

Bystander Effects: The response of cells that are not directly traversed by radiation but respond with gene induction and production of potential genetic and carcinogenic changes.

C

Cancer: A malignant tumor of potentially unlimited growth capable of invading other tissue and of metastasis.

Carcinogen: A substance or agent that increases the frequency of cancer in a population.

Carcinogenesis: The process involved in cancer production.

Carcinogenic: Cancer-causing physical or chemical insult.

Carcinogenic Potency: The slope of the dose-response curve for a carcinogen.

Carcinoma: Malignant new growth made up of epithelial cells tending to infiltrate the surrounding tissues; may give rise to metastasis.

Cell: The basic structural unit of the body.

Centimorgan (cM): A unit of measure of recombination frequency; one cM is equal to a 1% chance that a marker at a genetic locus will be separated from a marker for the second locus as the result of crossing over in a single generation. In humans, one cM is equivalent, on average, to one million base pairs.

Centromere: The region of the chromosome where spindle fibers attach during cell division.

Chromosome: The self-replicating genetic structure of cells, which carry the nuclear DNA and genes.

Chronic: Exposure that is protracted in time, or a disease that is long-term in nature.

Chronic Effect: An adverse effect on a human or animal in which symptoms develop slowly over a long period of time or at a long time after an exposure.

Chronic Exposure: Exposures that occur over an extended period of time or a significant fraction of the animal's or person's lifetime. These may be continuous or given in multiple small fractions.

Cleanup: Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans and the environment. The term "cleanup" is sometimes used interchangeably with the terms environmental isolation, remedial action, removal action, response action, or corrective action.

Clone: A group of cells derived from a single ancestor.

Cohort Study: An epidemiological study that observes subjects in differently exposed groups and compares the incidence of disease. Although ordinarily prospective in nature, such a study is sometimes carried out retrospectively, using historical data.

Collective Dose: The sum of individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Committed Dose Equivalent: Dose to a specific organ or tissue that is received from an intake of radioactive material by an individual during the 50-year period following the intake (see 10 CFR 20.1003).

Committed Effective Dose Equivalent: The committed dose equivalent for a given organ multiplied by a weighting factor (see 10 CFR 20.1003).

Comparative Risk: An expression of the risks associated with two (or more) actions leading to the same goal; may be expressed quantitatively (a ratio of 1.5) or qualitatively (one risk greater than another risk). Any comparison among the risks of two or more hazards with respect to a common scale.

Complementary DNA (cDNA): DNA that is synthesized from a messenger RNA template; the single-stranded form is often used as a probe in physical mapping of the genome.

Concentration Ratio: Ratio of a compound's or radionuclide's concentration in an organism or its tissues to that in the surrounding media under equilibrium or steady-state conditions.

Confidence Interval: A range of values ($a_1 < a < a_2$) determined from a sample of definite rules so chosen that, in repeated random samples from the hypothesized population, an arbitrarily fixed proportion of that range will include the true value, x , of an estimated parameter. The limits, a_1 and a_2 , are called confidence limits; the relative frequency with which these limits include a is called the confidence coefficient, and the complementary probability is called the confidence level.

Contamination: The deposition of radioactive material on the surfaces of structures, areas, objects, or people. The material also may be airborne, external, or internal (inside components or people).

Critical Organ: The part of the body most susceptible to radiation damage under specific exposure conditions.

Criticality: A term used in reactor physics to describe the state when the number of neutrons released by fission is exactly balanced by the neutrons being absorbed (by fuel and poisons) and escaping the reactor core. A reactor is said to be "critical" when it achieves a self-sustaining nuclear chain reaction, as when the reactor is operating.

Cumulative Dose: The total dose resulting from repeated exposures of ionizing radiation to the same portion of the body or to the whole body, over a period of time (see 10 CFR 20.1003). Often refers to an occupationally exposed worker.

Curie (Ci): The unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion (3.7×10^{10}) disintegrations per second, which is approximately the activity of 1 gram of radium. The Becquerel (Bq) has replaced the Ci in the SI system. The Becquerel (Bq) is 1 disintegration per second.

D

Daughter Products: Isotopes that are formed by the radioactive decay of some other isotope.

Decay: The decrease in the amount of any radioactive material with the passage of time due to spontaneous emission from the atomic nuclei of either alpha or beta particles, often accompanied by gamma radiation. Every radionuclide has a definite half-life.

De Minimis Risk: From the legal maxim "de minimis non curat lex" or "the law is not concerned with trifles." A risk below regulatory concern.

Department of Energy (DOE): This federal agency's mission is to achieve efficiency in energy use, diversity in energy sources, a more productive and competitive economy, improved environmental quality, and a secure national defense. DOE was created on October 1, 1977, from the Energy and Research and Development Agency and incorporates various aspects of non-nuclear federal energy programs and policy. DOE is funding the Low Dose Radiation Research Program described on this Web site.

Depleted Uranium: Uranium having a percentage of uranium-235 smaller than the 0.7 percent found in natural uranium. It is obtained from spent (used) fuel elements or as byproduct tails, or residues, from uranium isotope separation.

Deterministic Effect: Health effect for which severity varies with the dose and a threshold is believed to exist. Radiation-induced cataract formation and birth defects are examples of a deterministic effect (also called a non-stochastic effect) (see 10 CFR 20.1003).

Diploid: A full set of genetic material consisting of paired chromosomes, one chromosome from each parental set.

DNA: Nuclear material that contains genes and is responsible for the genetic code.

DNA Replication: The use of existing DNA as a template for the synthesis of new DNA strands.

DNA Repair: The cell's ability to repair DNA damage and restore the original base sequences. This process can restore DNA damage produced by normal physiological processes, ionizing radiation, or chemicals. There are many forms of DNA repair, and many genes responsible for and involved in DNA repair have been identified.

DNA Sequence: The relative order of base pairs, whether in a fragment of DNA, a gene, a chromosome, or an entire genome.

Dose: The absorbed dose, given in rads (or in SI units, (Gy) grays), that represents the energy in ergs or Joules absorbed from the radiation per unit mass of tissue. Furthermore, the biologically effective dose or dose equivalent, given in rem or sieverts, is a measure of the biological damage to living tissue from radiation exposure.

Dose Equivalent (H): A quantity used for radiation protection purposes that expresses on a common scale for all radiation types. The product of the absorbed dose from ionizing radiation and the quality factor (Q). The quality factors are specified by the International Commission on Radiological Units and Measurements (ICRU) for different types of radiation and organ exposures.

Dose Rate: The quantity of absorbed dose delivered per unit time.

Dose Rate Effectiveness Factor (DREF): A factor by which the effect caused by a specific type of radiation changes at low as compared to high dose rate.

Dose Response: Correlation between a quantified exposure (dose) and the proportion of a population demonstrating a specific effect (response).

Dose-Response Assessment: The process of characterizing the relationship between the dose of an agent administered or received and the incidence of an adverse health effect in exposed populations and estimating the incidence of the effect as a function of human exposure to the agent.

Dosimetric Models: A method for estimating risk. Based on the use of physical models for doses to target cells combined with data from epidemiological studies of human exposures from other types of radiation; used to predict risk from radiation types for which no human data is available.

Dosimetry: The theory and application of the principles and techniques involved in the measurement and recording of ionizing radiation doses.

E

Ecological Fallacy: The inference that a correlation between variables derived from data grouped in social or other aggregates (ecological units) will hold between persons (individual units).

Effect: A biological change caused by an exposure.

Effective Dose Equivalent (HE): The sum over specified tissues of the products of the dose equivalent in a tissue and the weighting factor for that tissue.

Effective Half-Life: The time required for a radionuclide contained in a biological system, such as a human or an animal, to reduce its activity by one-half as a combined result of radioactive decay and biological elimination.

ELCR (Excess Lifetime Cancer Risk): Potential carcinogenic effects characterized by estimating the probability of cancer incidence in a population of individuals for a specific lifetime.

Projected from intakes (and exposures) and chemical-specific dose-response data (i.e., slope factors). By multiplying the intake by the slope factor, the ELCR result is a probability.

Electromagnetic Radiation: A traveling wave motion resulting from changing electric or magnetic fields. Familiar electromagnetic radiation ranges from X rays (and gamma rays) of short wavelength through the ultraviolet, visible, and infrared regions to radar and radio waves of relatively long wavelength.

Electron: An elementary particle carrying 1 unit of negative electric charge. Its mass is $1/1837$ that of a proton.

Element: One of the 103 known chemical substances that cannot be broken down farther without changing its chemical properties.

Endonuclease: An enzyme that cleaves the nucleic acid substrate at defined nucleotide sequences at internal DNA sites; makes it possible to isolate desired DNA fragments.

Environmental Impact Statement: A document required by the National Environmental Policy Act for major projects or legislative proposals of federal agencies.

Environmental Protection Agency (EPA): Created in 1970, the EPA is responsible for working with state and local governments to set standards that help control and prevent pollution and minimize the potential health effects of solid and hazardous waste and toxic and radioactive substances.

Enzyme: A protein that acts as a catalyst to speed the rate of a biochemical reaction but does not alter the reaction's direction or nature.

Epidemiology: The study of the distribution and dynamics of diseases and injuries in human populations. The two main types of epidemiological studies of chronic disease are cohort (follow-up) studies and case-control (retrospective) studies.

Eukaryote: Organisms with membrane-bound nucleus and chromosomes. Higher plants and animals are eukaryotes.

Exon: Gene sequence that codes for proteins.

Exonuclease: Enzyme that cleaves nucleotides sequentially from free ends of a linear nucleic acid substrate.

Exposure: Contact of an organism with a chemical, radiological, or physical agent.

Exposure Assessment: The process of measuring or estimating the intensity, frequency, and duration of human exposures to an agent currently present in the environment or of estimating hypothetical exposures that might arise.

Exposure Level: The amount or concentration of a chemical or field strength of a radiation field.

External Radiation Dose: The dose from sources of radiation located outside the body, most often from gamma rays. Beta rays can contribute to dose in the skin and other relatively superficial tissues.

F

False Negative Results: Results falsely showing no effect.

False Positive Results: Results falsely showing an effect.

Fertile Material: Material not in itself fissile (fissionable by thermal neutrons) that can be converted into a fissile material by irradiation in a reactor.

FISH (Fluorescence In Situ Hybridization): The use of fluorescent DNA probes to locate, mark, or map DNA sequences, genes, regions or complete chromosomes.

Fissile Material: Material consisting of atoms whose nuclei can be split when irradiated with low energy (ideally, zero energy) neutrons.

Fission Product: Any atom created by the fission of a heavy element. Fission products are usually radioactive.

Flow Cytometry: The analysis of biological material by detection of properties of cells or subcellular fractions using a combination of fluorescence and a laser beam. This makes it possible to sort cells or subcellular fractions for further analysis.

Frank-Effect Level (FEL): Exposure level that produces unmistakable adverse effects, such as irreversible functional impairment or mortality, at a statistically or biologically significant increase in frequency or severity between an exposed population and its appropriate control.

Free Radical: An unstable and highly reactive molecule, bearing an atom with an unpaired electron, that nonspecifically reacts with a variety of organic structures such as DNA. The interaction of ionizing radiation with water can generate free radicals in the form of hydroxyl and hydroperoxyl groups that are potent oxidizing agents.

Fusion: Combining of two nuclei to form a heavier one. Fusing the isotopes of light elements such as hydrogen or lithium results in a large release of energy.

G

Gamete: Mature male or female reproductive cells with a haploid set of chromosomes.

Gamma Multihit Model: A generalization of the one-hit dose-response model that provides a better description of dose-response data.

Gamma Radiation: High-energy, short wavelength electromagnetic radiation emitted from the nucleus of an atom. Gamma rays are very penetrating and are shielded by dense materials such as lead. Gamma rays are similar to X rays.

Gene: The fundamental physical and functional unit of genetics. Genes code for specific functional products.

Gene Chip Technology: Development of chips that have microarrays of cDNA from a large number of genes on them. By hybridization it is possible to monitor and measure changes in gene expression for each gene on the chip. This technology is valuable in determine which genes change gene expression in response to radiation or chemical insults.

Gene Expression: The process by which a gene's coded information is converted into proteins. Expressed genes include those that are transcribed into messenger RNA and translated into proteins as well as those that are transcribed into RNA but not into proteins.

Gene Mapping: Determination of relative positions of genes on a DNA molecule and distances between them.

Genetic Code: The sequence of nucleotides coded in triplet (codons) along the mRNA that determines the sequence of amino acids during protein synthesis.

Genetic Informatics: Development of methods to search databases quickly, analyze DNA sequence information, and predict protein sequence and structure from DNA sequence data.

Genome: All the genetic material in the chromosomes of a defined organism.

Genomic Instability: The loss of genetic stability induced by radiation or chemicals. Expressed as genetic damage many cell divisions after the insult is administered.

Genotype: The genetic constitution of an organism, as distinguished from its physical appearance (its phenotype).

Gray (Gy): The new international system (SI) unit of absorbed radiation dose expressed in terms of energy per unit mass of tissue. 1 gray = 1 Joule/kilogram and also equals 100 rad.

H

Half-Life: The time in which half the atoms of a radioactive substance will have disintegrated, leaving half the original amount. Half the residue will disintegrate in another equal period of time.

Haploid: A single set of chromosomes, half the genetic material's full set, present in egg and sperm cells.

Hazard Analysis: Procedures used to (1) identify potential sources of release of hazardous materials from fixed facilities or transportation accidents, (2) determine a geographical area's vulnerability to a release of hazardous materials, and (3) compare hazards to determine which present greater or lesser risks to a community.

Hazard Identification: The process of determining whether exposure to an agent can cause an increase in the incidence of a health condition.

Hazard Ranking System (HRS): Principal screening tool used by EPA to evaluate public-health and environmental risks associated with abandoned or uncontrolled hazardous waste sites. HRS calculates a score based on the potential of hazardous substances to spread from the site through the air, surface water, and groundwater and on such other factors as the human population's

density and proximity. This score is the primary factor in deciding whether the site should be on the National Priorities List and, if so, its ranking compared to other sites on the list.

Health Effect: Deviation in the human body's normal function that results in an increased incidence of disease.

Health Effect Assessment: The component of risk assessment that determines the probability of a health effect, given a particular level or range of exposure to a hazard.

Health Physics: The science concerned with the recognition, evaluation, and control of health hazards that may arise from accidents or applications that result in exposure to ionizing radiation.

Heterozygosity: The presence of different alleles on homologous chromosomes.

High-to-Low Dose Extrapolation: The process of predicting human risks from low radiation exposures using either human or animal data on risks derived from high levels of exposure.

Homeostasis: An ability of the body to maintain stability.

Hormesis: The theory that small doses of radiation can induce beneficial biological processes and are healthful.

Human Equivalent Dose: A dose which, when administered to humans, produces an effect equal to the same effect produced by a dose in animals.

Human Exposure Evaluation: Describes the nature and size of the population exposed to a substance and the magnitude and duration of their exposure. The evaluation could concern past, current, or anticipated exposures.

Human Genome Initiative: Early name for what later became the Human Genome Project (see Human Genome Project Information web site).

Human Health Risk: The likelihood that a given exposure or series of exposures may have damaged or will damage the health of individuals.

I

ICRP: International Commission on Radiological Protection: International body charged with providing an overview of radiation standards and regulations and information to help standardize these regulations.

ICRU: International Commission on Radiation Units and Measurements: The international organization charged with standardizing radiation units and measures.

Incidence: The number of new cases of a disease in a population over a period of time.

Individual Risk: The risk to an individual based on the average risk to a population with similar exposures.

Induced Radioactivity: Radioactivity produced in any material as a result of nuclear reactions, especially by absorption of neutrons.

In Situ Hybridization: The use of DNA or RNA probes to detect the presence of the complementary DNA sequences.

Internal Radiation Dose: The dose to organs of the body from radioactive materials deposited and retained inside the body. It may consist of any combination of alpha, beta, and gamma radiation.

Interphase: The period in the cell cycle when the DNA is replicated in the nucleus, followed by cell division and mitosis.

Intron: DNA base sequence that interrupts the gene's protein-coding sequences.

Inverse Dose Rate Effect: An effect in which, for a given exposure, the probability of effect increases as the dose rate is decreased.

In Vitro: Studies carried out in cell or culture systems outside the whole organism.

In Vivo: Studies carried out in whole organisms.

Ion: (1) An atom that has too many or too few electrons, causing it to have an electrical charge, and therefore, to be chemically active. (2) An electron that is not associated (in orbit) with a nucleus.

Ionization: The process of adding to or removing one or more electrons from atoms or molecules, thereby creating ions and free radicals. High temperatures, metabolic processes, electrical discharges, and radiation can cause ionization.

Ionize: To split off one or more electrons from an atom, thus leaving it with a positive electric charge. The electrons usually attach to other atoms or molecules, giving them a negative charge.

Ionizing Radiation: Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, X rays, neutrons, and ultraviolet light.

Irradiation: Exposure to radiation.

Isotope: Atoms of the same element that have an equal number of protons (and hence the same chemical properties) but a different number of neutrons and, therefore, different atomic weights. Although chemical properties are the same, radioactive and nuclear (radioactive decay) properties may be quite different for each isotope of an element.

J

Joule: Measure of energy. Deposition of one Joule/Kg is equal to 1 Gy or 100 rads.

K

Karyotype: A system for arranging chromosomes according to their size, centromere location, and shape. Used to determine chromosome changes induced by radiation or during disease processes.

Kerma: The sum of the initial kinetic energies of all the charged ionizing particles liberated by uncharged particles per unit of mass of a specific material. SI unit of kerma is joule per kilogram and is the same as Gy.

L

Latency Period: The average period of time between exposure to an agent and the onset of a health effect.

LD50: Lethal dose fifty. A calculated dose of radiation or a chemical substance that is expected to kill 50% of a population.

Lethal Dose (Lethal Dose 50/30): The dose of radiation expected to cause the death of 50 percent of the exposed population within 30 days. For single whole-body acute radiation exposure, the LD 50/30 is in the range from 400 to 500 rem (4 to 5 sieverts).

Lifetime Exposure: Total calculated exposure to radiation or a chemical that a human would receive in a lifetime (usually assumed to be 70 years).

Linear Energy Transfer (LET): The amount of energy deposited per unit of distance that the radiation travels in tissue. Alpha particles are examples of high LET radiation.

Linkage: The proximity of two or more markers on a chromosome.

LNTH: The linear no-threshold model stating that any amount of radiation dose, no matter how small, results in increased radiation risk. For every unit of dose, there is an increase in risk.

Locus (Loci): The position on a chromosome of a gene or other chromosome marker.

Logit Model: A dose-response model which, like the probit model, leads to an S-shaped dose-response curve, symmetrical around the 50% response point. The logit model leads to lower "very safe doses" than the probit model, even when both models are equally descriptive of the data in the observable range.

Log-Probit Model: A dose-response model that assumes that each animal has its own threshold dose below which no response occurs and above which a tumor (or other effect) is produced by exposure to a chemical.

Lowest-Observed-Adverse-Effect-Level (LOAEL): In an experiment, the lowest dose that produced an observable adverse effect.

M

Macrorestriction map: Map depicting the order of and distance between sites at which restriction enzymes cleave chromosomes.

Malignant: A cancer that tends to become progressively worse and to result in death if not treated; having the properties of anaplasia, invasiveness, and metastasis.

Mapping: See gene mapping, linkage map, physical map.

Marker: An identifiable physical location on a chromosome (e.g., restriction enzyme cutting site, gene) whose inheritance can be monitored. Markers can be expressed DNA regions (genes) or DNA segments with no known coding function but with a determinable pattern of inheritance. See restriction fragment length polymorphism.

Mass Number (symbolized A): The number of nucleons (neutrons and protons) in the nucleus of an atom. Also known as the atomic weight of an atom.

MDL (Minimum Detectable Level): The threshold of detection for a biological response, substance, or device in question.

Megabase (Mb): Unit of length for DNA fragments, equal to 1 million nucleotides and roughly equal to 1 cM.

Meiosis: The process of two consecutive cell divisions in the diploid progenitors of sex cells. Meiosis results in four rather than two daughter cells, each with a haploid set of chromosomes.

Messenger RNA (mRNA): RNA that serves as a template for protein synthesis. See genetic code.

Metaphase: A stage in mitosis or meiosis during which the chromosomes are aligned along the equatorial plate of the cell. The stage of the cell cycle that is used to evaluate chromosome aberrations and mark gene location.

Metastasis: The spread of cancer from one organ or part to another not directly connected with it.

Microbeam: A machine capable of delivering defined radiation doses or particle numbers to known cellular locations. Microbeams can deliver a known number of alpha particles to known cellular organelles. Used to measure bystander effects.

Micronuclei: Chromosome fragments or lagging chromosomes that are not incorporated into the nucleus at cell division. Used in biological dosimetry and detection of genomic instability.

Mitosis: The process of nuclear division in cells that produces daughter cells genetically identical to each other and to the parent cell.

Morbidity: A departure from a state of physical or mental well-being, resulting from disease or injury. Frequently used only if the affected individual is aware of the condition.

Mortality: Death; the death rate; ratio of number of deaths to a given population.

Mortality Rate: The number of deaths that occur in a given population during a given time interval, usually deaths per 103 or 105 people per year. Can be age, sex, race, and cause specific.

Multistage Model: A carcinogenesis dose-response model in which cancer is assumed to originate as a "malignant" cell initiated by a series of somatic-like mutations occurring in a finite number of steps. It is also assumed that each mutational stage can be depicted as a Poisson process in which the transition rate is approximately linear in dose rate.

Mutagen/Mutagenicity: An agent that causes a permanent genetic change in a cell in addition to that occurring during normal genetic recombination. Mutagenicity is the capacity of a chemical or physical agent to cause such permanent genetic alterations.

Mutation: Any heritable change in DNA sequence. Can be induced by changes at the chromosome, gene, or DNA level.

N

NAS/NRC (National Academy of Science/National Research Council): The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars involved in scientific and engineering research. As part of NAS, the National Research Council is designed to associate the broad community of science and technology with the needs of the government. The NRC is the operating agency for NAS.

NCRP (National Council on Radiation Protection and Measurements): A nonprofit corporation chartered by Congress to provide information that protects the public against radiation and provides recommendations on radiation measurements, quantities and units.

Neoplasm: An aberrant new growth of abnormal cells or tissue in which the growth is uncontrollable and progressive.

Neutron: An elementary particle slightly heavier than a proton, with no electric charge.

NIOSH: National Institute for Occupational Safety and Health of the Public Health Service, U.S. Department of Health and Human Services (DHHS). A federal agency that, among other activities, tests and certifies respiratory protective devices and air sampling detector tubes, recommends occupational exposure limits for various substances, and assists in occupational safety and health investigations and research.

Nonstochastic Effects: The severity of radiation-induced effects increases in affected individuals as the dose increases. A threshold usually exists for nonstochastic effects.

No Observable Adverse Effect Level (NOAEL): From long-term toxicological studies, the levels that indicate a safe, lifetime exposure level for a given chemical. Used to establish tolerance levels for human diets. Also written, NOEL.

Nuclear Regulatory Commission (NRC): NRC is an independent agency created from the Atomic Energy Commission in 1975 to regulate civilian uses of nuclear material. Specifically, NRC is responsible for ensuring that activities associated with the operation of nuclear power and fuel cycle plants and the use of radioactive materials in medical, industrial, and research applications are carried out with adequate protection of public health and safety, the environment, and national security.

Nucleic Acid: A large molecule composed of nucleotide subunits.

Nucleon: Common name for a constituent particle of the atomic nucleus. At present, applied to protons and neutrons, but may include any other particles found to exist in the nucleus.

Nucleotide: A subunit of DNA or RNA consisting of a nitrogenous base (adenine, guanine, thymine, or cytosine in DNA; adenine, guanine, uracil, or cytosine in RNA), a phosphate molecule, and a sugar molecule (deoxyribose in DNA and ribose in RNA). Thousands of nucleotides are linked to form a DNA or RNA molecule. See DNA, base pair, RNA.

Nucleus: (1) The nucleus of an atom is the central core that comprises almost all the weight of the atom. All atomic nuclei (except H-1, which has a single proton) contain both protons and neutrons. (2) The cellular organelle that contains the chromosomes and genetic material.

O

Occupational Exposure: Radiation exposure attributable to people's occupations.

Oncogene: Genes that encode the potential for cancer and, when activated, can induce cancer.

Oncogenic: A substance that causes tumors, whether benign or malignant.

One-Hit Model: The basic dose-response model based on the concept that a tumor can be induced by a single receptor that has been exposed to a single quantum or effective dose unit of a chemical.

Organ-Weighting Factor (WT): Factor indicating the ratio of stochastic-effects risk attributable to a given organ's or tissue's irradiation to the total risk when the whole body is uniformly irradiated.

Organelle: Any complex biological structure that forms a component of cells and performs a characteristic function. Examples of organelles are centrioles, the endoplasmic reticulum, kinetosomes, lysosomes, proteosomes, mitochondria, and ribosomes.

OSHA: Occupational Safety and Health Administration of the U.S. Department of Labor. Federal agency with safety and health regulatory and enforcement authorities for most U.S. industry and business.

P

Particle: A tiny mass of material. Airborne particles that exist in the atmosphere as a solid or liquid can be natural, caused by stirring of soil dusts, or anthropogenic. They vary in size from coarse (diameter $>3 \mu\text{m}$) to fine ($<3 \mu\text{m}$). Sometimes "inhalable" or "respirable" is used to describe particles ($<2 \mu\text{m}$) that can be inhaled through the nose and enter the lungs.

Particulates: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in the air or emissions.

PCC: Premature chromosome condensation, a method of studying chromosomes that are in the interphase stage of the cell cycle. PCC is used in many chromosome-repair studies.

PCR: Polymerase Chain Reaction, a method to amplify the amount of DNA from a given region of a gene or chromosome to rapidly produce a highly specific amplification of the desired sequence. PCR also can be used to detect the existence of the defined sequence in a DNA sample. This method has enabled major advances in molecular biology by providing adequate amounts of known DNA for study.

Person-Gray: The unit of population exposure obtained by summing dose equivalent values for all people in the exposed population. Thus, one person-gray can result from one person being exposed to 1 Gy or to 100,000 people each exposed to 10Gy.

Person-Year: The sum of the number of years each person in a study population is at risk; a metric used to aggregate the total population at risk, assuming that 10 people at risk for one year is equivalent to 1 person at risk for 10 years.

pH: A measure of the acidity or alkalinity of a material, liquid or solid (pH is represented on a scale of 0 to 14 with 7 representing a neutral state, 0 representing the most acid, and 14 the most alkaline).

Photon: The indivisible unit or quantum of electromagnetic radiation. The photons' energy determines the radiation's nature from radio waves at the lowest energy levels through infrared, visible, and ultraviolet light to X or gamma rays, which have energy high enough to ionize atoms.

Picocurie: One trillionth (10^{-12}) of a curie.

Point Source: A single isolated stationary source of pollution.

Polygenic Disorder: Genetic disorder (e.g., heart disease, diabetes, and some cancers) resulting from the combined action of alleles of more than one gene. Although such disorders are inherited, they depend on the simultaneous presence of several alleles; thus the hereditary patterns are usually more complex than those of single-gene disorders.

Polymerase, DNA or RNA: Enzymes that catalyze the synthesis of nucleic acids on pre-existing nucleic acid templates, assembling RNA from ribonucleotides or DNA from deoxyribonucleotides.

Polymorphism: Difference in DNA sequence among individuals. Genetic variations occurring in more than 1% of a population would be considered useful polymorphisms for genetic linkage analysis.

Population Dose (population exposure): The summation of individual radiation doses received by all those exposed to the source or event being considered.

Positron: An elementary particle with a positive electric charge but in other respects identical to an electron.

Primer: Short preexisting polynucleotide chain to which DNA polymerase can add new deoxyribonucleotides.

Probe: Single-stranded DNA or RNA molecules of specific base sequence, labeled either radioactively or immunologically, that are used to detect the complementary base sequence by hybridization.

Prokaryote: Cell or organism lacking a membrane-bound, structurally discrete nucleus and other subcellular compartments. Bacteria are prokaryotes. Compare eukaryote.

Probability: The chance that a particular event will occur, given the population of all possible events. See definition for risk.

Probit Analysis: A statistical transformation that will make the cumulative normal distribution linear. In analysis of dose-response, when the data on response rate as a function of dose are given as probits, the linear regression line of these data yields the best estimate of the dose-response curve. The probit unit is $y = 5 + Z(p)$, where p = the prevalence of response at each dose level and $Z(p)$ = the corresponding value of the standard cumulative normal distribution.

Promoter: (1) DNA site to which RNA polymerase will bind and initiate transcription. (2) Agent that is not carcinogenic by itself but capable of amplifying a true carcinogen's effect by increasing the probability of late-stage cellular changes needed to complete the carcinogenic process. Promoters usually require protracted application to be effective in increasing cancer incidence.

Prospective Study: An inquiry in which groups of individuals are selected according to their exposure to certain factors and followed over time to determine differences in disease rates in relation to their factor exposure. Also called cohort study.

Proton: An elementary particle with a positive electric charge and a mass that is given the value 1 on the scale of atomic weights.

Q

Quality Assurance/Quality Control: (QA/QC) A system of procedures, checks, audits, and corrective actions to ensure that research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

Quality Factor (Q): A factor used for radiation protection purposes that accounts for differences in biological effectiveness between different types of radiation. Derived from the linear portions of the dose-response relationships for the different radiation types.

R

Rad: A unit of absorbed dose of radiation defined as deposition of 100 ergs of energy per gram of tissue. It amounts to approximately one ionization per cubic micron. This has been replaced in the SI system with the gray, which is equal to 100 rads.

Radiation (Ionizing): Emission of particles (i.e., alpha, beta, or gamma particles) or rays (i.e., alpha, beta, gamma, or X rays) by the nucleus of an atom.

Radiation Shielding: Reduction of radiation by interposing a shield of absorbing material between any radioactive source and a person, work area, or radiation-sensitive device.

Radiation Sickness (Syndrome): The complex of symptoms characterizing the disease known as radiation injury, resulting from excessive exposure (greater than 200 rads or 2 gray) of the whole body (or large part) to ionizing radiation. The earliest of these symptoms are nausea, fatigue, vomiting, and diarrhea, which may be followed by loss of hair (epilation), hemorrhage, inflammation of the mouth and throat, and general loss of energy. In severe cases, where the radiation exposure has been around 1000 rad (10 gray) or more, death may occur within 2 to 4 weeks. Those who survive 6 weeks after the receipt of a single large dose of radiation to the whole body may generally be expected to recover.

Radiation Units: Units listed for easy conversion.

Units Conversion Factors

Becquerel (SI) 1 disintegration/s = 2.7×10^{-11} Ci

Curie 3.7×10^{10} disintegrations/s = 3.7×10^{10} Bq

Gray (SI) 1 J/kg = 100 rad

Rad 100 ergs/g = 0.01 Gy

Rem 0.01 Sievert

Sievert (SI) 100 Rem

Radioactive (Decay): Property of undergoing spontaneous nuclear transformation in which nuclear particles or electromagnetic energy are emitted.

Radioactivity: The spontaneous discharge of radiation from atomic nuclei. This is usually in the form of beta or alpha radiation, together with gamma radiation. Beta or alpha emission results in transformation of the atom into a different element, changing the atomic number by +1 or -2 respectively.

Radioisotope: A radioactive isotope. An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. More than 1300 natural and artificial radioisotopes have been identified.

Radionuclides: Radioactive elements. These may be subdivided into natural radionuclides such as radium or uranium, which are normally present in the earth; and artificial radionuclides, which are not normally present (or normally present in very small amounts) and are produced by nuclear fission.

Radium (Ra): A radioactive metallic element with atomic number 88. As found in nature, the most common isotope has a mass number of 226. It occurs in minute quantities associated with uranium in pitchblende, camotite, and other minerals.

Radon (Rn): A radioactive element that is one of the heaviest gases known. Its atomic number is 86. It is a daughter of radium.

Recombinant DNA Molecules: A combination of DNA molecules of different origin, joined using recombinant DNA technologies.

Recombinant DNA Technology: Procedure used to join together DNA segments in a cell-free system (an environment outside a cell or organism). Under appropriate conditions, a recombinant DNA molecule can enter a cell and replicate there, either autonomously or after it has become integrated into a cellular chromosome.

Reference Dose: Toxicity value for evaluating noncarcinogenic (systemic) effects of daily exposure to contaminant levels without appreciable deleterious effects during a lifetime.

Relative Biological Effectiveness (RBE): The amount of radiation required to produce the same level of biological change as would be produced by a reference radiation, with all other physical and biological variables held as constant as possible. RBE depends on the ionization's density along the tracks of the ionizing particles.

Relative Risk: Ratio of the disease rate (usually incidence or mortality) among those exposed to the rate among those not exposed.

Rem: A unit of equivalent absorbed dose of radiation, taking account of the relative biological effectiveness of the particular radiation. The dose in rems is the dose in rads multiplied by the

quality factor Q derived from the RBE. Rem has been replaced in the SI system with sievert. One sievert equals 100 rem.

Repository: A permanent resting place for radioactive wastes that will finally decay to natural radioactivity levels.

Reprocessing: Chemical treatment of spent fuel from a nuclear reactor to separate unused uranium and plutonium from radioactive fission product wastes. This allows recycle of valuable fuel material and minimizes the volume of high-level waste materials.

Restriction Enzyme, Endonuclease: A protein that recognizes specific short nucleotide sequences and cuts DNA at those sites. Bacteria contain over 400 such enzymes that recognize and cut over 100 different DNA sequences.

Restriction Enzyme Cutting Site: A specific nucleotide sequence of DNA at which a particular restriction enzyme cuts the DNA.

Restriction Fragment Length Polymorphism (RFLP): Variation between individuals in DNA fragment sizes cut by specific restriction enzymes; polymorphic sequences that result in RFLPs are used as markers on both physical maps and genetic linkage maps. RFLPs are usually caused by mutation at a cutting site.

Ribonucleic Acid (RNA): A chemical found in the nucleus and cytoplasm of cells; it plays an important role in protein synthesis and other chemical activities of the cell. The structure of RNA is similar to that of DNA. There are several classes of RNA molecules, including messenger RNA, transfer RNA, ribosomal RNA, and other small RNAs, each serving a different purpose.

Ribosomes: Small cellular components composed of specialized ribosomal RNA and protein; site of protein synthesis.

Risk: The product of severity (consequence) impact and likelihood (probability) impact. Specifically for carcinogenic effects, risk is estimated as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to a potential carcinogen. For noncarcinogenic (systemic) effects, risk is not expressed as a probability but rather is evaluated by comparing an exposure level over a period of time to a reference dose for a similar exposure period.

Risk Analysis: A detailed examination including risk assessment, risk evaluation, and risk management alternatives; performed to understand the nature of unwanted negative consequences to human life, health, property, or the environment; an analytical process to provide information regarding undesirable events; the process of quantifying the probabilities and expected consequences of identified risks.

Risk Assessment: The process of establishing information regarding acceptable levels of risk for individuals, groups, society, or the environment.

Risk Characterization: The last step in risk assessment. This process characterizes the potential for adverse health effects and evaluates the uncertainty involved.

Risk Communication: The exchange of information about health or environmental risks among all the stakeholders i.e., risk assessors and managers, the general public, news media, interest groups, etc.

Risk Estimate: Description of the probability that organisms exposed to a specific dose of a chemical or other pollutant will develop an adverse response (e.g., cancer).

Risk Estimation: The scientific determination of risk characteristics, usually in as quantitative a way as possible. These include the magnitude, spatial scale, duration, and intensity of adverse consequences and their associated probabilities as well as a description of the cause and effect links.

Risk Evaluation: A component of risk assessment in which judgments are made about the significance and acceptability of risk.

Risk Factor: Characteristic (e.g., race, sex, age, obesity) or variable (e.g., smoking, occupational exposure level) associated with increased probability of a toxic effect.

Risk Identification: Recognizing that a hazard exists and trying to define its characteristics. Often risks exist and are even measured for some time before their adverse consequences are recognized. In other cases, risk identification is a deliberate procedure to review, and it is hoped, anticipate possible hazards.

Risk Management: The process of evaluating and selecting alternative regulatory and nonregulatory responses to risk. The selection process necessarily requires the consideration of legal, economic, and behavioral factors.

Risk-Specific Dose: The dose associated with a specified risk level.

Roentgen: A unit of gamma radiation measured by the amount of ionization per unit volume in air. In non-bony biological tissue 1 roentgen delivers a dose approximately equal to 1 rad.

S

Sequencing: Determining the order of nucleotides (base sequences) in a DNA or RNA molecule or the order of amino acids in a protein.

Sex Chromosome: The human X or Y chromosome that determines an individual's sex. Females have two X chromosomes in diploid cells; males have an X and a Y chromosome.

Sievert: The SI unit of equivalent absorbed dose equal to 1 Joule/Kilogram or 100 rems.

SI units: The international system of units as defined by the general conference on weights and measures in 1960. These units are generally based on meter/kilogram/second units, with special quantities for radiation including the becquerel, gray, sievert.

Slope Factor: Toxicity value for evaluating the probability of an individual's developing cancer from exposure to contaminant levels over a lifetime.

Somatic Cell: Any cell in the body except gametes and their precursors.

Somatic Effects of Radiation: Effects of radiation limited to the somatic cells of the exposed individual, as distinguished from genetic effects. Generally refers to the induction of cancer.

Southern Blotting: Transfer by absorption of DNA fragments separated in electrophoretic gels to membrane filters for detection of specific base sequences by radiolabeled complementary probes.

Specific Activity: A measure of the amount of radioactivity in a unit weight (generally one gram) of material.

Standard Deviation: A measure of dispersion or variation, usually taken as the square root of the variance.

Standard Geometric Deviation: Measure of value dispersion about a geometric mean; the frequency-distribution portion that is one standard geometric deviation to either side of the geometric mean; accounts for 68% of total samples.

Standard Normal Deviation: Measure of value dispersion about a mean; positive square root of the average of squares of individual deviations from the mean.

Statistical Significance: The statistical significance determined by using appropriate standard techniques of statistical analysis with results interpreted at the stated confidence level and based on data relating species present in sufficient numbers at control areas to permit a valid statistical comparison with the areas being tested.

Stochastic Effects: Effects that occur by chance, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose. In the context of radiation protection, the main stochastic effects are cancer and genetic effects.

Suppressor Gene: A gene that can suppress the action of another gene such as an oncogene.

Synergism: Interaction between two substances that results in a greater effect than the sum of both substances acting independently.

Synergistic: Working together; agent that works synergistically with one or more others, such as the interaction of cigarette smoke and radon to increase the lung-cancer level above that predicted by an additive model from either agent given alone.

T

Tandem Repeat Sequences: Multiple copies of the same base sequence on a chromosome; used as a marker in physical mapping.

Target Cells: Tissue cells determined to be the key cells in which changes produce an end point such as cancer.

Telomere: The end of a chromosome. This specialized structure is involved in the replication and stability of chromosomes and linear DNA molecules.

Teratogenic: Substances suspected of causing malformations or serious deviations from normal; cannot be inherited in or on animal embryos or fetuses.

Thermonuclear Weapon: A nuclear weapon that gets a large part of its explosive power from fusion reactions.

Threshold: A pollutant concentration (or dose) below which no deleterious effect occurs.

Threshold Dose: The minimum application of a given substance required to produce an observable effect.

Threshold Limit Value (TLV): Refers to airborne concentrations of substances. Represents conditions under which nearly all workers are believed to be protected while repeatedly exposed for an 8-hr. day, 5 days a week [expressed as parts per million (ppm) for gases and vapors and as milligrams per cubic meter (mg/m³) for fumes, mists, and dusts].

Toxicity: Degree of danger a substance poses to animal or plant life.

Toxicity Assessment: Characterization of the toxicological properties and effects of radiation or chemical, with special emphasis on establishment of dose-response characteristics.

Toxicity Profile: An examination, summary, and interpretation of a hazardous substance to determine levels of exposure and associated health effects.

Toxicology: The study of the adverse effects of chemicals and radionuclides on living organisms.

Trace: A very small amount of a material. Usually used in reference to concentrations on the order of or less than 1 to 10 parts per million.

Transcription: The synthesis of an RNA copy from a sequence of DNA (a gene); the first step in gene expression.

Transfection: The introduction of DNA into a host cell.

Transformation: (1) Process by which an individual cell's genetic material is altered by incorporation of exogenous DNA into its genome. (2) Step that changes a "normal" cell into a "cancer" cell.

Translation: The process in which the genetic code carried by mRNA directs the synthesis of proteins from amino acids.

TRU (transuranic waste): Waste that contains more than 100 nCi/g of alpha emitting isotopes with atomic numbers greater than 92 and half-lives greater than 20 years. Such wastes result primarily from fuel reprocessing and from the fabrication of plutonium weapons and plutonium-bearing reactor fuel.

Tumor: Any abnormal mass of cells resulting from excessive cellular multiplication or lack of differentiation.

U

Uncertainty Analysis: A detailed examination of the systematic and random errors of a measurement or estimate; an analytical process to provide information regarding the uncertainty.

Unit Risk: The unit risk factors (URFs) provide estimates of risks due to a unit inventory of contaminant (i.e., risk/gram or risk/curie). URFs can be calculated for water, soil, air, and radiation.

UNSCEAR (United Nations Scientific Committee on the Effect of Atomic Radiation): International body that publishes periodic reports on sources and effects of ionizing radiation.

V

Virus: A noncellular biological entity that can reproduce only within a host cell. Viruses consist of nucleic acid covered by protein; some animal viruses are also surrounded by membrane. Inside the infected cell, the virus uses the synthetic capability of the host to produce progeny virus.

W

Waste Characterization: Identification of radiation, chemical and microbiological constituents of a waste material.

Waste Isolation Pilot Plant (WIPP): WIPP, which is under development by the Department of Energy, is a potential geologic disposal facility for transuranic (TRU) radioactive waste generated as by-products from DOE's nuclear weapons production. WIPP is located underground in excavated natural salt formations near Carlsbad, New Mexico.

Whole Body Dose Equivalent (Hwb): The dose equivalent associated with uniform irradiation of the whole body.

Working Level (WL): A unit of air concentration of potential alpha energy released from radon and its daughters. One working level is the concentration of radon daughters that has a potential energy release of 1.3×10^5 MeV per liter of air or SI units of 2.08×10^{-5} J/m³.

Working Level Month (WLM): Exposure of one working level from radon and its daughters for 170 hours. (3.5×10^{-3} Jh/m³).

X

X Ray: Penetrating electromagnetic radiation (photon) having a wavelength that is much shorter than that of visible light. These rays are usually produced by excitation of the electron field around certain nuclei.

Y

Yeast Artificial Chromosome (YAC): A vector used to clone DNA fragments (up to 400 kb); it is constructed from the telomeric, centromeric, and replication origin sequences needed for replication in yeast cells.

Yield: The energy released by a nuclear explosion.

Yucca Mountain: Located in Nevada, Yucca Mountain is being characterized as a potential geologic repository for High Level Waste, Spent Nuclear Fuel, and possibly for waste that is defined as Greater-than-Class-C (GTCC). A key element of permanent disposal is that it must be able to isolate highly radioactive waste for thousands of years because its radioactivity can harm people and the environment.

Z

Zero Order Analysis: The simplest approach to quantification of a risk with a limited treatment of each risk component (e.g. source terms, transport, health effects, etc.).