

GLOSSARY

- A** **Absorbed dose:** the amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material, in which the absorbed dose is expressed in units of rad or gray (1 rad = 0.01 gray)
- Accuracy:** the closeness of the result of a measurement to the true value of the quantity measured
- Action level:** defined by regulatory agencies, the level of pollutants which, if exceeded, requires regulatory action
- Aerosol:** a gaseous suspension of very small particles of liquid or solid
- Ag:** silver
- Alameda County Flood Control and Water Conservation District:** also known as Zone 7, the water management agency for the Livermore-Amador Valley with responsibility for water treatment and distribution, and responsible for management of agricultural and surface water and the ground water basin
- Alluvium:** sediment deposited by flowing water
- Alpha particle:** a positively charged particle emitted from the nucleus of an atom, having mass and charge equal to those of a helium nucleus (two protons and two neutrons)
- Ambient air:** the surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures; not considered in monitoring purposes when immediately adjacent to emission sources
- Analysis of variance (ANOVA):** a test of whether two or more sample means are statistically different
- Analyte:** the specific component measured in a chemical analysis
- Anion:** a negatively charged ion, such as Cl⁻
- Aquifer:** a saturated layer of rock or soil below the ground surface that can supply usable quantities of ground water to wells and springs, and be a source of water for domestic, agricultural, and industrial uses
- Aquitard:** low-permeability geologic formation that bounds an aquifer
- As:** arsenic
- Atom:** the smallest particle of an element capable of entering into a chemical reaction
- Atomic absorption (AA) spectroscopy:** a method used to determine the elemental composition of a sample, where the sample is vaporized and its light absorbance measured

- B Barcad:** device that samples water in a well in which water, collected in a discrete water-bearing zone, is forced to the surface by pressurized nitrogen
- Bay Area Air Quality Management District (BAAQMD):** the local agency responsible for regulating stationary air emission sources (including the LLNL Livermore site) in the San Francisco Bay Area
- Becquerel (Bq):** the SI unit of activity of a radionuclide, equal to the activity of a radionuclide having one spontaneous nuclear transition per second
- Beta particle:** a negatively charged particle emitted from the nucleus of an atom, having charge, mass, and other properties of an electron
- Biochemical (biological) oxygen demand (BOD):** a measure of the amount of dissolved oxygen that microorganisms need to break down organic matter in water, used as an indicator of water quality
- Blowdown:** water discharged from cooling towers in order to control total dissolved solids concentrations by allowing make-up water to replenish cooling apparatuses
- C CaCO₃:** calcium carbonate
- California Code of Regulations (CCR):** codification of regulations promulgated by the State of California
- California Environmental Quality Act of 1970 (CEQA):** statute that requires that all California state, local, and regional agencies document, consider, and disclose to the public the environmental implications of their actions
- CAP88-PC:** computer code required by the EPA for modeling air emissions of radionuclides
- Categorical discharge:** discharge from a process regulated by EPA rules for specific industrial categories
- Cd:** cadmium
- Chain-of-custody:** a method for documenting the history and possession of a sample from the time of its collection, through its analysis and data reporting, to its final disposition
- Chemistry and Materials Science Environmental Services (CES):** an LLNL laboratory that analyzes environmental samples
- Chlorofluorocarbon (CFC):** a compound that has fluorine and chlorine atoms on a carbon backbone, such as Freons
- Chlorocarbon:** a compound of carbon and chlorine, or carbon, hydrogen, and chlorine, such as carbon tetrachloride, chloroform, and tetrachloroethene
- Code of Federal Regulations (CFR):** a codification of all regulations promulgated by federal government agencies
- Collective dose equivalent and collective effective dose equivalent:** the sums of the dose equivalents or effective dose equivalents to all individuals in an exposed population within 80 km (50 miles) of the radiation source. These are evaluated by multiplying the dose received by an individual at each location by the number of individuals receiving that dose, and summing over all such products for locations within 80 km of the source. They are expressed in units of person-rem or person-sievert. The collective EDE is also referred to as the “population dose.”

Committed dose equivalent: the predicted total dose equivalent to a tissue or organ over a 50-year period after an intake of a radionuclide into the body. It does not include contributions from external dose. Committed dose equivalent is expressed in units of rem (or sievert; 100 rem equals one sievert).

Committed effective dose equivalent: the sum of the committed dose equivalents to various tissues in the body, each multiplied by an appropriate weighting factor representing the relative vulnerability of different parts of the body to radiation. Committed effective dose equivalent is expressed in units of rem or sievert.

Comprehensive Environmental Response, Compensation and Liability Act of 1980

(CERCLA): administered by EPA, this program, also known as Superfund, requires private parties to notify the EPA after the release of hazardous substances or conditions that threaten to release hazardous substances, and undertake short-term removal and long-term remediation.

Cosmic radiation: radiation with very high energies originating outside the earth's atmosphere; it is one source contributing to natural background radiation

Cr: chromium

Cu: copper

Curie (Ci): a unit of measurement of radioactivity, defined as the amount of radioactive material in which the decay rate is 3.7×10^{10} disintegrations per second or 2.22×10^{12} disintegrations per minute; one Ci is approximately equal to the decay rate of one gram of pure radium

D Daughter nuclide: a nuclide formed by the radioactive decay of another nuclide, which is called the parent

De minimis: shortened form of "de minimis non curat lex," which means, "The law does not care for, or take notice of, very small or trifling matters," meaning a level that is so inconsequential that it cannot be cause for concern

Depleted uranium: uranium having a lower proportion of the isotope ^{235}U than is found in naturally occurring uranium. The masses of the three uranium isotopes with atomic weights 238, 235, and 234 occur in depleted uranium in the weight-percentages 99.8, 0.2, and 5×10^{-4} , respectively. Depleted uranium is sometimes referred to as D-38.

Derived Concentration Guide (DCG): concentrations of radionuclides in water and air that could be continuously consumed or inhaled for one year and not exceed the DOE primary radiation standard to the public (100 mrem/y EDE)

Dose: the energy imparted to matter by ionizing radiation; the unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium

Dose commitment: the dose that an organ or tissue would receive during a specified period of time (e.g., 50 or 70 years) as a result of one year's intake of one or more radionuclides

Dose equivalent: the product of absorbed dose in rad (or gray) in tissue and a quality factor representing the relative damage caused to living tissue by different kinds of radiation, and perhaps other modifying factors representing the distribution of radiation, etc. expressed in units of rem or sievert (1 rem = 0.01 sievert)

Dosimeter: a portable detection device for measuring the total accumulated exposure to ionizing radiation

Dosimetry: the theory and application of the principles and techniques of measuring and recording radiation doses

Downgradient: in the direction of groundwater flow from a designated area; analogous to downstream

Drainage Retention Basin (DRB): man-made, lined pond used to capture storm water runoff and treated water at the LLNL Livermore site

E Effective dose equivalent (EDE): an estimate of the total risk of potential effects from radiation exposure, it is the summation of the products of the dose equivalent and weighting factor for each tissue. The weighting factor is the decimal fraction of the risk arising from irradiation of a selected tissue to the total risk when the whole body is irradiated uniformly to the same dose equivalent. These factors permit dose equivalents from nonuniform exposure of the body to be expressed in terms of an effective dose equivalent that is numerically equal to the dose from a uniform exposure of the whole body that entails the same risk as the internal exposure (ICRP 1980). The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent caused by penetrating radiation from sources external to the body, and is expressed in units of rem (or sievert).

Effluent: a liquid or gaseous waste discharged to the environment

Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA): act that requires facilities that produce, use, or store hazardous substances to report releases of reportable quantities or hazardous substances to the environment

Environmental impact report (EIR): a detailed report prepared pursuant to CEQA on the environmental impacts from any action carried out, approved, or funded by a California state, regional, or local agency

Environmental impact statement (EIS): a detailed report, required by the National Environmental Policy Act, on the environmental impacts from a federally approved or funded project. An EIS must be prepared by a federal agency when a “major” federal action that will have “significant” environmental impacts is planned.

Evapotranspiration: a process by which water is transferred from the soil to the air by plants that take the water up through their roots and release it through their leaves and other aboveground tissue

F Federal facility: a facility that is owned or operated by the federal government, subject to the same requirements as other responsible parties when placed on the Superfund National Priorities List

Federal facility agreement (FFA): a negotiated agreement that specifies required actions at a federal facility as agreed upon by various agencies (e.g., EPA, RWQCB, and DOE).

Federal Register: a document published daily by the federal government containing notification of government agency actions, including notification of EPA and DOE decisions concerning permit applications and rule-making

Freon 11: trichlorofluoromethane

Freon 113: 1,1,2-trichloro-1,2,2-trifluoroethane; also known as CFC 113

G Gamma ray: high-energy, short-wavelength, electromagnetic radiation emitted from the nucleus of an atom, frequently accompanying the emission of alpha or beta particles

Gram (g): the standard metric measure of weight approximately equal to 0.035 ounce

Gray (Gy): the SI unit of measure for absorbed dose; the quantity of energy imparted by ionizing radiation to a unit mass of matter, such as tissue. One gray equals 100 rads, or 1 joule per kilogram.

Groundwater: all subsurface water

H Half-life (radiological): the time required for one-half the radioactive atoms in a given amount of material to decay; for example, after one half-life, half of the atoms will have decayed; after two half-lives, three-fourths; after three half-lives, seven-eighths; and so on, exponentially

Hazardous waste: hazardous wastes exhibit any of the following characteristics: ignitability, corrosivity, reactivity, or EP-toxicity (yielding toxic constituents in a leaching test), but other wastes that do not necessarily exhibit these characteristics have been determined to be hazardous by EPA. Although the legal definition of hazardous waste is complex, according to EPA the term generally refers to any waste that, if managed improperly, could pose a threat to human health and the environment.

(California) Hazardous Waste Control Act (HWCA): legislation specifying requirements for hazardous waste management in California

Hg: mercury

High-efficiency particulate air filter (HEPA): a throwaway, extended-media, dry type filter used to capture particulates in an air stream; HEPA collection efficiencies are at least 99.97% for 0.3 micrometer diameter particles

Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX): a high-explosive compound

High explosives (HE): materials that release large amounts of chemical energy when detonated

Hydraulic gradient: in an aquifer, the rate of change of total head (water-level elevation) per unit distance of flow at a given point and in a given direction

Hydrology: the science dealing with the properties, distribution, and circulation of natural water systems

I Inorganic compounds: compounds that either do not contain carbon or do not contain hydrogen along with carbon, including metals, salts, and various carbon oxides (e.g., carbon monoxide and carbon dioxide).

In situ: refers to the treatment of contaminated areas in place without excavation or removal, as in the in situ treatment of on-site soils through biodegradation of contaminants

Interim status: a legal classification allowing hazardous waste incinerators or other hazardous waste management facilities to operate while EPA considers their permit applications, provided that they were under construction or in operation by November 19, 1980 and can meet other interim status requirements

International Commission on Radiological Protection (ICRP): an international organization that studies radiation, including its measurement and effects

Interquartile range (IQR): the distance between the top of the lower quartile and the bottom of the upper quartile, which provides a measure of the spread of data

Isotopes: forms of an element having the same number of protons in their nuclei, but differing numbers of neutrons

- L** **Less than detection limits:** a phrase indicating that a chemical constituent was either not present in a sample, or is present in such a small concentration that it cannot be measured by a laboratory's analytical procedure, and therefore is not identified or not quantified at the lowest level of sensitivity.
- Liter (L):** the SI measure of capacity approximately equal to 1.057 quart
- Livermore Water Reclamation Plant (LWRP):** the City of Livermore's municipal wastewater treatment plant, which accepts discharges from the LLNL Livermore site
- Low-level waste:** waste defined by DOE Order 5820.2A, which contains transuranic nuclide concentrations less than 100 nCi/g
- Lower limit of detection:** the smallest concentration or amount of analyte that can be detected in a sample at a 95% confidence level
- Lysimeter:** an instrument for measuring the water percolating through soils and determining the dissolved materials
- M** **Maximally exposed individual (MEI):** a hypothetical member of the public at a fixed location who, over an entire year, receives the maximum effective dose equivalent (summed over all pathways) from a given source of radionuclide releases to air. Generally, the MEI is different for each source at a site.
- Multiple completion:** a borehole with water surveillance monitoring devices (Barcads) placed at various levels and separated by impermeable layers of material such as grout. Usually referred to as a well, the uppermost "completion" is accessible from the surface, making physical sample-taking possible (as opposed to Barcads).
- Mixed waste:** waste that has the properties of both hazardous and radioactive waste
- N** **National Emission Standards for Hazardous Air Pollutants (NESHAPs):** standards found in the Clean Air Act that set limits for hazardous air pollutants
- National Environmental Policy Act (NEPA):** federal legislation enacted in 1969 that requires all federal agencies to document and consider environmental impacts for federally funded or approved projects and the legislation under which DOE is responsible for NEPA compliance at LLNL
- National Institute for Standards and Technology (NIST):** the federal agency, formerly known as the National Bureau of Standards, responsible for reference materials against which laboratory materials are calibrated
- National Pollutant Discharge Elimination System (NPDES):** federal regulation under the Clean Water Act that requires permits for discharges into surface waterways
- NEWTRIT:** model used to calculate doses from environmental measurements
- Ni:** nickel
- Nonpoint source:** any nonconfined area from which pollutants are discharged into a body of water (e.g., agricultural runoff, construction runoff, and parking lot drainage), or into air (e.g., a pile of uranium tailings)
- Nuclear Regulatory Commission (NRC):** the federal agency charged with oversight of nuclear power and nuclear machinery and applications not regulated by DOE or the Department of Defense

Nuclide: a species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons, number of neutrons, and energy content; or, alternatively, by the atomic number, mass number, and atomic mass. To be regarded as a distinct nuclide, the atom must be capable of existing for a measurable length of time.

O Off-site: outside the boundaries of the LLNL Livermore site and Site 300 properties

On-site: within the boundaries of the LLNL Livermore site or Site 300 properties

P Part B permit: the second, narrative section submitted by generators in the RCRA permitting process that covers in detail the procedures followed at a facility to protect human health and the environment

Parts per billion (ppb): a unit of measure for the concentration of a substance in its surrounding medium; for example, one billion grams of water containing one gram of salt has a salt concentration of one part per billion

Parts per million (ppm): a unit of measure for the concentration of a substance in its surrounding medium; for example, one million grams of water containing one gram of salt has a salt concentration of one part per million

Pb: lead

Perched aquifer: aquifer that is separated from another water-bearing stratum by an impermeable layer

Performance standards (incinerators): specific regulatory requirements established by EPA limiting the concentrations of designated organic compounds, particulate matter, and hydrogen chloride in incinerator emissions

pH: a measure of hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0 to 6; basic solutions have a pH greater than 7; and neutral solutions have a pH of 7.

Piezometer: instrument for measuring fluid pressure used to measure the elevation of the water table in a small, nonpumping well

Pliocene: geological epoch of the Tertiary period, starting about 12 million years ago

PM-10: fine particulate matter with an aerodynamic diameter equal to or less than 10 microns

Point source: any confined and discrete conveyance (e.g., pipe, ditch, well, or stack)

Pretreatment: any process used to reduce a pollutant load before it enters the sewer system

Pretreatment regulations: national wastewater pretreatment regulations, adopted by EPA in compliance with the 1977 amendments to the Clean Water Act, which required that EPA establish pretreatment standards for existing and new industrial sources

Priority pollutants: a set of organic and inorganic chemicals identified by EPA as indicators of environmental contamination

Q Quality assurance (QA): a system of activities whose purpose is to provide the assurance that standards of quality are attained with a stated level of confidence

Quality control (QC): procedures used to verify that prescribed standards of performance are attained

Quality factor: the factor by which the absorbed dose (rad) is multiplied to obtain a quantity that expresses (on a common scale for all ionizing radiation) the biological damage to exposed persons, usually used because some types of radiation, such as alpha particles, are biologically more damaging than others. Quality factors for alpha, beta, and gamma radiation are in the ratio 20:1:1.

Quaternary: the geologic era encompassing the last 2–3 million years

R Rad: the unit of absorbed dose and the quantity of energy imparted by ionizing radiation to a unit mass of matter such as tissue, and equal to 0.01 joule per kilogram, or 0.01 gray.

Radioactive decay: the spontaneous transformation of one radionuclide into a different nuclide (which may or may not be radioactive), or de-excitation to a lower energy state of the nucleus by emission of nuclear radiation, primarily alpha or beta particles, or gamma rays (photons)

Radioactivity: the spontaneous emission of nuclear radiation, generally alpha or beta particles, or gamma rays, from the nucleus of an unstable isotope

Radionuclide: an unstable nuclide. See nuclide and radioactivity.

Regional Water Quality Control Board (RWQCB): the California regional agency responsible for water quality standards and the enforcement of state water quality laws within its jurisdiction. California is divided into a number of RWQCBs; the Livermore site is regulated by the San Francisco Bay Region, and Site 300 is regulated by the Central Valley Region.

Rem: a unit of radiation dose equivalent and effective dose equivalent describing the effectiveness of a type of radiation to produce biological effects; coined from the phrase “roentgen equivalent man,” and the product of the absorbed dose (rad), a quality factor (Q), a distribution factor, and other necessary modifying factors. One rem equals 0.01-sievert.

Resource Conservation and Recovery Act of 1976 (RCRA): a program of federal laws and regulations that govern the management of hazardous wastes, and applicable to all entities that manage hazardous wastes

Risk assessment: the use of established methods to measure the risks posed by an activity or exposure by evaluating the relationship between exposure to radioactive substances and the subsequent occurrence of health effects and the likelihood for that exposure to occur

Roentgen (R): a unit of measurement used to express radiation exposure in terms of the amount of ionization produced in a volume of air

S Sampling and Analysis Plan: a detailed document that describes the procedures used to collect, handle, and analyze groundwater samples, and details quality control measures that are implemented to ensure that sample-collection, analysis, and data-presentation activities meet the prescribed requirements

San Francisco Bay Regional Water Quality Control Board (SFBRWCB): the local agency responsible for regulating stationary air emission sources (including the Livermore site) in the San Francisco Bay Area

San Joaquin County Health District (SJCHD): the local agency that enforces underground-tank regulations in San Joaquin County, including Site 300

San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD): the local agency responsible for regulating stationary air emission sources (including Site 300) in San Joaquin County

Sanitary waste: most simply, waste generated by routine operations that is not regulated as hazardous or radioactive by state or federal agencies

Saturated zone: a subsurface zone below which all rock pore-space is filled with water; also called the phreatic zone

Sensitivity: the capability of methodology or instrumentation to discriminate between samples having differing concentrations or containing varying amounts of analyte

Sewerage: the system of sewers

Sievert (Sv): the SI unit of radiation dose equivalent and effective dose equivalent, that is the product of the absorbed dose (gray), quality factor (Q), distribution factor, and other necessary modifying factors. 1 Sv equals 100 rem.

Sitewide Maximally Exposed Individual (SW-MEI): a hypothetical person who receives, at the location of a given publicly accessible facility (such as a church, school, business, or residence), the greatest LLNL-induced effective dose equivalent (summed over all pathways) from all sources of radionuclide releases to air at a site. Doses at this receptor location caused by each emission source are summed, and yield a larger value than for the location of any other similar public facility. This individual is assumed to continuously reside at this location 24 hours per day, 365 days per year.

Specific conductance: measure of the ability of a material to conduct electricity; also called conductivity

Superfund: the common name used for the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). California has also established a "State Superfund" under provisions of the California Hazardous Waste Control Act.

Superfund Amendments and Reauthorization Act (SARA): act enacted in 1986, which amended and reauthorized CERCLA for five years at a total funding level of \$8.5 billion

Surface impoundment: a facility or part of a facility that is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials, although it may be lined with man-made materials. The impoundment is designed to hold an accumulation of liquid wastes, or wastes containing free liquids, and is not an injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons.

Système International d'Unités (SI): an international system of physical units which include meter (length), kilogram (mass), kelvin (temperature), becquerel (radioactivity), gray (radioactive dose), and sievert (dose equivalent)

T Thermoluminescent dosimeter (TLD): a device used to measure external beta or gamma radiation levels, and which contains a material that, after exposure to beta or gamma radiation, emits light when processed and heated

Total dissolved solids (TDS): the portion of solid material in a waste stream that is dissolved and passed through a filter

Total organic carbon (TOC): the sum of the organic material present in a sample

Total organic halides (TOX): the sum of the organic halides present in a sample

Total suspended solids (TSS): the total mass of particulate matter per unit volume suspended in water and wastewater discharges that is large enough to be collected by a 0.45 micron filter

Tritium: the radioactive isotope of hydrogen, containing one proton and two neutrons in its nucleus, which decays at a half-life of 12.3 years by emitting a low-energy beta particle

Transuranic waste (TRU): material contaminated with alpha-emitting transuranium nuclides, which have an atomic number greater than 92 (e.g. ^{239}Pu), half-lives longer than 20 years, and are present in concentrations greater than 100 nCi/g of waste

U Unsaturated zone: that portion of the subsurface in which the pores are only partially filled with water and the direction of water flow is vertical; is also referred to as the vadose zone.

U.S. Department of Energy (DOE): the federal agency responsible for conducting energy research and regulating nuclear materials used for weapons production

U.S. Environmental Protection Agency (EPA): the federal agency responsible for enforcing federal environmental laws. Although some of this responsibility may be delegated to state and local regulatory agencies, EPA retains oversight authority to ensure protection of human health and the environment.

V Vadose zone: the partially saturated or unsaturated region above the water table that does not yield water to wells

Volatile organic compound (VOC): liquid or solid organic compounds that have a high vapor pressure at normal pressures and temperatures and thus tend to spontaneously pass into the vapor state

W Waste accumulation area (WAA): an officially designated area that meets current environmental standards and guidelines for temporary (less than 90 days) storage of hazardous waste before pickup by the Hazardous Waste Management Division for off-site disposal

Wastewater treatment system: a collection of treatment processes and facilities designed and built to reduce the amount of suspended solids, bacteria, oxygen-demanding materials, and chemical constituents in wastewater

Water table: the water-level surface below the ground at which the unsaturated zone ends and the saturated zone begins, and the level to which a well that is screened in the unconfined aquifer would fill with water

Weighting factor: a tissue-specific value used to calculate dose equivalents which represents the fraction of the total health risk resulting from uniform, whole-body irradiation that could be contributed to that particular tissue. The weighting factors used in this report are recommended by the International Commission on Radiological Protection (ICRP 1980).

Wind rose: a diagram that shows the frequency and intensity of wind from different directions at a specific location

Z Zn: zinc

Zone 7: the common name for the Alameda County Flood Control and Water Conservation District