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RADIOACTIVE WASTE MANAGEMENT GLOSSARY

Second Edition

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FOREWORD

The IAEA Waste Management Glossary was first published in 1982 as TECDOC-264. At that time it was seen that a single glossary of terms for use in IAEA documents dealing with radioactive waste management would be useful. The intervening 5 years have shown this indeed to be the case. TECDOC-264 has provided a consistent reference for terms in IAEA reports in areas of waste processing and disposal, facility decontamination and decommissioning, and risk assessment. During this time these fields have also seen great progress and their terminology has evolved along with their technology.

This second edition of the Waste Management Glossary is intended to update and replace TECDOC-264. It maintains, however, the same purpose and philosophy, namely to provide a central, authoritative source of terms that have unique definitions in the field of radioactive waste management. Common words whose meaning in the waste management literature is unchanged from that found in a standard dictionary are generally omitted. This is also true for technical terms whose meaning is unchanged from that of a specific discipline, such as engineering or geology. Some of these words that are used very frequently in waste management are included here as a convenience to the user.

This glossary should be considered as a living document that can continue to be improved upon and grow as it is used. Suggestions for modifications, additions or other changes will be welcomed. Please address comments to the Waste Management Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.

ACKNOWLEDGEMENT

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MAJOR SOURCES OF DEFINITIONS

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RADIOACTIVE WASTE MANAGEMENT GLOSSARY

A

absorption

Incorporation within the physical or molecular structure. (See: sorption.)

accelerated test method

A procedure, preferrably one for which a standard protocol has been developed, that is used in a laboratory to produce in a reasonably short time (days or months) effects that would otherwise be observed only over much longer times (decades to millenia). Generally this requires adjusting parameters such as temperature (and pressure), radioactive dose rate, etc., that affect the kinetics of a chemical reaction.

acceptable limit

Limit acceptable to the regulatory body. (See: authorized limit.)

accessible environment

Those portions of the environment directly in contact with or readily available for use by human beings. Includes the Earth's atmosphere, the land surface, aquifers, surface waters, and the oceans. (See: human environment.)

acid digestion

In treating radioactive waste, the use of acid to chemically decompose a material into its simpler constituents (usually soluble) thereby releasing the radionuclides for subsequent processing. For example, organic material (resins, paper, gloves, etc.) contaminated with alpha-emitting nuclides may be acid digested for subsequent concentration of the nuclides.

actinide

An element with an atomic number from 89 to 103, inclusive. All are radioactive.

activation product, neutron

An element made radioactive by bombardment with neutrons.

activity

For an amount of radioactive nuclide in a particular energy state at a given time, the quotient of dN by dt is the expectation value of the number of spontaneous nuclear transitions from that energy state in the time interval dt. The special name for the SI unit of activity is becquerel (Bq); the curie (Ci) may be used temporarily.

adsorbent

A material that has the property of adsorbing radionuclides (see adsorption). Adsorbents may be used, for example, in treating gaseous or liquid waste, or in decontamination procedures.

adsorption

Adhesion of ions or molecules or particles to the surface of solid bodies with which they come in contact. (See: sorption.)

age of waste

(i) In terms of spent fuel or reprocessing waste, the time after the end of irradiation.

(ii) For waste whose activity arises from contact with radioactive materials, the time after separation from those materials.

airborne waste

Radioactively contaminated matter, generally small solid particles or liquid droplets, that has become suspended by the air (see: aerosols). Frequently including dust, smoke, or powders, it can lead to uncontrolled spread of contamination or to uptake by unprotected workers.

ALARA

An acronym for "as low as reasonably achievable", a concept meaning that the design and use of sources, and the practices associated therewith, should be such as to ensure that exposures are kept as low as is reasonably practicable, economic and social factors being taken into account.

alpha-bearing waste

Waste containing one or more alpha-emitting radionuclides, usually actinides, in quantities above acceptable limits for uncontrolled release. The limits are established by the national regulatory body.

aluminosilicate glass

A durable type of glass in which some of the silicon atoms that normally form the amorphous, polymeric structures that are characteristic of glasses (networks) are replaced by aluminum atoms. Aluminosilicate glasses are candidate matrices for solidifying some kinds of radioactive waste.

annual dose equivalent limit

The value of the annual dose equivalent that must not be exceeded, according to the ICRP system of dose limitation. It is regarded as the lower boundary of an unacceptable dose region.

annual limit on intake (ALI)

The smaller value of intake of a given radionuclide in a year by reference man which would result in either a committed dose equivalent of 50 mSv or a committed dose equivalent in any organ or tissue established by the national authority.

anoxic conditions

A chemical condition, often existing in underground waste repositories, in which the partial pressure of oxygen in the groundwater is very low. This affects the oxidation state of chemical species in the groundwater as well as bacteriological processes that can occur.

aquifer

A water-bearing formation below the surface of the earth that can furnish an appreciable supply of water for a well or spring.

area survey

The first stage of siting a waste repository, during which a broad area is examined to eliminate obviously unsuitable regions and to identify other regions which may contain suitable sites.

argillaceous

Applied to all rocks and substances composed of clay or having a notable proportion of clay in their composition.

arid sites

A term often applied to a shallow land waste disposal site located in an area that receives very little annual precipitation, typically less than 25 cm/year. In these sites there is little potential for radionuclide transport by rainwater moving downward through the soil.

arisings, waste

See: waste arisings.

atmospheric pathway

A vector through the air that radionuclides can potentially follow (see: airborne waste). This pathway can contribute to spread of contamination or to radionuclide uptake by man.

authorized limit

Limit set for a given radionuclide or source or for a given environment by a national or international environmental authority. (See: acceptable limit.)

B

back end of the fuel cycle

The part of the fuel cycle that includes spent fuel storage, fuel reprocessing, mixed oxide fuel fabrication and waste management, including spent fuel disposal.

backfill

The material used to refill the excavated portions of a repository or of a borehole after waste has been emplaced.

barrier (natural or engineered)

A feature which delays or prevents material migration to or from storage components. Facilities may include multiple barriers.

basalt

A dark-coloured igneous rock, commonly extrusive, composed primarily of calcic plagioclase and pyroxene; the fine-grained equivalent of gabbro. Basalt is considered to be a possible host medium for high-level waste repositories.

becquerel (Bq)

The SI unit of radioactivity, equivalent to 1 disintegration per second (approx. 2.7×10^{-11} Ci).

bedded salt

A salt formation in which the salt is roughly horizontal, laterally extensive and relatively thin in the vertical direction (approx. 200 metres).

bentonite

A soft plastic light-coloured clay formed by chemical alteration of volcanic ash. It is composed essentially of montmorillonite and related minerals of the smectite group. The properties of bentonite depend largely on its ion-exchange characteristics. Bentonite is ideally suited for use as a buffer material for surrounding waste packages in a deep repository.

biointrusion barriers

An engineered barrier designed to prevent plant roots or burrowing animals from coming into contact with buried waste, and thereby prevent transport of radionuclides by these vectors.

biosphere

That portion of the Earth's environment inhabited by any living organisms. It comprises parts of the atmosphere, the hydrosphere (ocean, seas, inland waters and subterranean waters) and the lithosphere. The biosphere includes the human habitat or environment in the widest sense of these terms. (See: accessible environment and human environment.)

bitumen

A general name for various solid and semi-solid hydrocarbons that are fusible and are soluble in carbon bisulfide. Petroleums, asphalts,

natural mineral waxes, and asphaltites are all considered bitumens. Bitumen is known to be very stable in the terrestrial environment and is sometimes used as a matrix for immobilizing low- and intermediate-level waste.

bituminization

The process of incorporating wastes into a bitumen matrix as a means of immobilization.

borehole

A cylindrical excavation, made by a rotary drilling device. Wastes are disposed of in the excavations.
For disposal at relatively shallow depth, boreholes can be drilled from the surface; for deep disposals they can be drilled from an access shaft in a mine.

borehole plug

An engineered barrier, usually a cementitious material, used to close a filled borehole in order to prevent intrusion by water, animals, or roots.

borosilicate glass

(i) A supercooled liquid based on a random lattice of silica tetrahedra, modified with boron and other cations.

(ii) A glass composition used as an immobilization matrix for a radioactive waste. (See: glass).

brine

An aqueous solution containing a high concentration of dissolved salts. Any water in a repository in a salt formation, for example, would certainly be brine, and its ability to corrode waste forms would be expected to differ considerably from ordinary groundwater.

buffer material

Any substance, frequently a natural clay, placed around a waste container in a repository. Often a primary purpose of such material is to serve as an additional barrier to prevent water from contacting the waste container and, by adsorption, to reduce the rate that radionuclides can migrate from the waste into the respository.

buffer zone

A controlled area surrounding a nuclear installation (e.g. a waste repository) established to ensure an adequate distance between the installation and places used by or accessible to the public.

burial ground

An area of land that has been dedicated for the shallow disposal of low or medium level waste. Access by the public as well as future use of the land will probably be restricted.

C

calcine

To heat a substance to a temperature below its melting point, in air, to bring about a loss of moisture and volatile products and to transform the constituents of interest into stable oxides. Such oxides or mixture of oxides are termed 'calcine'.

calciner

High-temperature process equipment used to convert waste solutions into a solid mixture of oxides (calcine).

can

See: canister.

canister (can)

A closed or sealed container for nuclear fuel or other radioactive material, which isolates and contains the contents; and may rely on other containers (e.g. a cask) for shielding.

cask

A massive container to transport and/or store irradiated nuclear fuel and other radioactive materials. It provides chemical, nuclear and radiological protection and dissipates heat from the fuel.

cement

A standard material used by the construction industry that has many uses in waste management because of its low cost and ease of

handling. Properties of cement mixtures and of the final solid product can be modified considerably by the use of additives. The mixture or final product is referred to as "concrete" if it contains aggregate (usually small stones) or without aggregate, a "grout".

cementation

The process of incorporating wastes into a concrete matrix as a means of immobilization.

ceramic materials

Solid materials, usually containing SiO_2 and metal oxides, that generally requires fabrication at an elevated temperature (typically $800^{o}C$) and often elevated pressure. Their microscopic structure is crystalline which distinguishes them from amorphous glasses. They are very stable and have been considered as good candidates for solidifying high level waste.

ceramic melter

A furnace used for melting together mixtures of wastes and glass-forming additives in order to vitrify the waste, i.e. to convert it to a stable glass. The inside of the melter is lined with a refractory ceramic that can resist corrosion by the molten glass. The melter is heated electrically.

chemical digestion

A chemical process for softening or solubilizing a material with heat and moisture.

chemisorption

An adsorption process in which the adsorbed material is chemically bound to the adsorber. This is in contrast to physical adsorption in which the adsorbed molecules might only be trapped, for example. Chemisorption occurs in some off-gas systems and in many ion exchange processes.

cladding (material)

An external layer of material (usually of Zircaloy, stainless steel, magnesium), directly surrounding nuclear fuel or other substance that seals and protects it from the environment and protects the

environment from radioactive material produced during irradiation. For HTR fuel particles, the multi-layer protective claddings are known as coatings.

cladding waste

Radioactive waste comprised of cladding hulls and assembly grid spacers for nuclear fuel elements. It is generated during reprocessing when spent fuel assemblies are disassembled and the fuel is dissolved. (See: hulls and spacers.)

clay

Minerals that are essentially hydrous aluminium silicates or occasionally hydrous magnesium silicates, with sodium, calcium, potassium and magnesium cations. Also denotes a natural material with plastic properties which is essentially a composition of fine to very fine clay particles. Clays differ greatly mineralogically and chemically and consequently in their physical properties; especially because of their large surface areas, most of them have good sorption characteristics.

cold testing

Testing of method, process, apparatus or instrumentation with the highly radioactive materials replaced by non-radioactive materials or materials which may contain radioactive tracers.

compaction

The reduction in bulk volume of a material, hence an increase in its density (weight per unit volume), by application of external pressure. Often it is an economical way to aid in the safe handling of low level solid wastes. Compaction of soil materials covering a repository is used to reduce its permeability.

compartment

Any part of the environment which may conveniently be considered as a single entity. (Used for environmental modelling.)

competent authority

An authority designated or otherwise recognized by a government for specific purposes in connection with radiation protection and/or nuclear safety.

complexation

A chemical term that refers to complex formation, in which a central metal ion is chemically bonded to atoms surrounding it. Depending on the circumstances, complexation can be used to remove radionuclides from solution, or by the formation of a neutral molecule, it may greatly enhance the mobility of a radionuclide in the environment.

compressive strength

The load per unit of area under which a solid block fails by shear or splitting.

computer code

See: computer model

computer model

A mathematical description of a facility or sequence of events which is evaluated via a computer. Computer models are usually indispensable for performing a safety analysis of a waste facility. In particular, models are used extensively to evaluate long-term events associated with a waste repository that cannot be tested directly, and to predict the resulting radiation dose to man.

concrete

The product that results from mixing cement, water, and aggregate (see cement). As a standard construction material it finds many uses in engineered waste facilities. It may also be a major component of decomissioning waste.

conditioning of waste

Those operations that transform waste into a form suitable for transport and/or storage and/or disposal. The operations may include converting the waste to another form, enclosing the waste in containers, and providing additional packaging.

conductivity, hydraulic

See: hydraulic conductivity.

confinement (or isolation) of waste

The segregation of radionuclides from the human environment and the

prevention of their release into that environment in unacceptable quantities or concentrations.

consequence analysis, biosphere

A safety analysis that estimates potential individual and collective radiation doses to humans, based on radionuclide releases and transport from a nuclear facility (e.g. a waste storage or disposal site) to the human environment as defined by hypothetical release and transport scenarios.

construction

Excavation of the underground facility and erection of any ancillary surface facilities in preparation for waste emplacement.

container, waste

The vessel into which waste is placed for final disposal; conversely the final barrier protecting the waste from external intrusions. For example, molten HLW glass would be poured into a container where it would cool and solidify. In a multibarrier system the sealed container would then become the final barrier protecting the glass against intrusion by water.

containment

A term signifying either:

1. The confinement of radioactive material in such a way that it is prevented from being dispersed into the environment or is only released at a specified rate, or
2. the device used to effect such confinement.

contamination, radioactive

The presence of a radioactive substance or substances in or on a material or in a place where they are undesirable or could be harmful.

controlled area

An area where workers might receive doses in excess of three-tenths of the occupational dose equivalent limits during the anticipated working period and where appropriate controls (such as restricted access, individual assessment of dose and special health supervision) are accordingly applied.

corrosion

A chemical attack on the surface of a material, thereby destroying the surface. Continual corrosion may penetrate or consume the material. In waste management the term is often applied to glasses and ceramic waste forms as well as to metals.

cost-benefit analysis

A systematic examination of the positive effects (benefits) and negative effects (costs) of undertaking an action. For example, cost-benefit analysis may be used for optimization studies in radiation protection practice.

creep

The deformation of a material at a very slow rate due to external forces and/or its own mass.

criteria

Principles or standards on which a decision or judgement can be based. They may be qualitative or quantitative. Acceptability criteria are set by a regulatory authority. (Some Member States use terms such as 'protection goals' instead of 'acceptability criteria'.)

critical group

For a given radiation source, the members of the public whose exposure is reasonably homogeneous and is typical of individuals receiving the highest effective dose equivalent or dose equivalent (whichever is relevant) from the source.

critical pathway

The dominant environmental pathway through which a given radionuclide reaches the critical group.

crystalline rock

1. A rock consisting of minerals in an obviously crystalline state.
2. An inexact general term for igneous and metamorphic rocks as opposed to sedimentary. (See: granite, basalt).

cumulative fraction released (or cumulative penetration)

a term for expressing leach rates of radionuclides from solidified

waste forms based upon depletion of the radionuclide to a certain sample depth.

curie (Ci)

A unit of activity equal to 3.7×10^{10} becquerels.

D

darcy

A measure of the permeability of a rock. One darcy equals a permeability such that one millilitre of fluid, having a viscosity of one centipoise, flows in one second under a pressure differential of one atmosphere through a porous material having a cross-sectional area of one square centimetre and a length of one centimetre.

decommissioning

The work required for the planned permanent retirement of a nuclear facility from active service. Different regulations will apply thereafter. (In some Member States a facility is not regarded as decommissioned until it is suitable for unrestricted use).

decontamination

The removal of radioactive contaminants with the objective of reducing the residual radioactivity level in or on materials, persons or the environment.

decontamination factor

The ratio of the initial level of contaminating radioactive material to the residual level achieved through a decontamination process.

deep geologic repository

A repository constructed, usually in consolidated rock, at a depth of several hundred meters or more in a continental formation.

deep-well injection

The discharge of liquid wastes via deep wells into permeable but confined geological formations deep underground as a means of isolating the wastes from the human environment.

de minimis

Part of the maxim "de minimis non jurat lex" (the law does not concern itself with trifles), sometimes used with reference to sources of radiation which a competent authority may decide to exempt from defined regulatory requirements because individual and collective effective dose equivalents received from them are both so low that they may be ignored.

denitration

Conversion of the nitrate ion (NO_3^-) to another chemical entity, normally a volatile nitrogen oxide. This may be done by thermal, chemical or electrolytic methods. Because nuclear fuel reprocessing is usually done in a nitric acid medium, denitration can be an important step in waste processing.

derived air concentration (DAC)

A concentration of a given radionuclide in air, obtained by means of a stylized model for the constantly maintained activity concentration ($Bq.m^{-3}$) of that radionuclide in air, which if breathed by the reference man for a working year of 2000 hours under conditions of light physical activity (breathing rate 1.2 m^3/h) would result in an inhalation of one ALI (annual limit air intake). Also the concentration which for 2000 hours of air immersion would lead to the irradiation of any organ or tissue to the appropriate limit.

deterministic analysis

A classical technique for studying a system behaviour mathematically using the laws of science and engineering provided that all system parameters, events and features are deterministically (as opposed to probabilistically) defined.

detriment

The mathematical expectation of the harm (damage to health and other effects) incurred from the exposure of individuals or groups of persons in a human population to a radiation source, taking into account not only the probabilities but also the severity of each type of deleterious effect.

devitrification

The spontaneous change of a glass, in which the atoms display no long range order in their locations, to a crystalline material in which atoms display a high degree of ordering. A glass is usually less stable than an assembly of crystals having the same composition, hence devitrification can occur at elevated temperatures or over long times. The ability of a devitrified material to resist leaching, for example, may be greatly different than for the parent glass.

dispersion

The summed effect of those processes of transport, diffusion and mixing which tend to distribute materials from wastes or effluents through an increasing volume of water or air. The ultimate effect appears as a dilution of the materials.

disposal

The emplacement of waste in a repository, or at a given location, without the intention of retrieval. Disposal also covers the approved direct discharge of wastes into the environment, with subsequent dispersion.

disruptive event

An event (e.g. earthquake, meteorite impact) that disrupts a waste repository.

distribution coefficient

A quantitative measure of how a given chemical species partitions itself between two phases at equilibrium. In waste processing this parameter is used to predict the effectiveness of separation methods such as solvent extraction, ion exchange, or gas scrubbing. In environmental studies the quantity is sometimes used to predict how soils or backfill materials can retard radionuclide movement.

documentation

Written, recorded or pictorial information describing, defining, specifying, reporting or certifying activities, requirements, procedures or results.

domal (or dome) salt

A local geologic formation of salt in which the salt thickness is greater vertically than laterally. The top of the formation may bear resemblance to a dome or to a mushroom.

dose

A term used in radiation protection with two meanings:

1. as a measure of the "quantity of radiation" present in, or "given" by, a radiation field - a concept now known as exposure; and
2. as a measure of the radiation "received" or "absorbed" by a target.

dose assessment

An estimate of the radiation exposure of an individual or a population group usually by means of predictive modeling techniques, sometimes supplemented by the results of measurements.

drum

A type of waste container similar in appearance to an oil drum which may be sealed by a fitted lid. It can be encased in concrete for intermediate-level wastes requiring some shielding. A typical volume for drums is 200 litres.

dynamic leach test

A laboratory test that simulates a situation in which flowing water enters a repository and contacts the waste form. The waste form to be tested will then be subjected to flowing water (and perhaps heat, pressure or other expected conditions) and its rate of dissolution measured.

E

effluent, radioactive

Airborne or liquid radioactive materials which are discharged into the environment.

electropolishing

An electrochemical process used to produce a smooth polished surface

on metal objects. In this process the object to be polished serves as the anode of an electrochemical cell. When used as a decontamination method, radioactive contaminants trapped in the surface layer are removed along with this layer of metal by anodic dissolution.

emanation

Radioactive gas formed by decay of a radioactive solid. The emanation may or may not be retained within the pore space of the solid phase.

embedding

A process of putting solid or liquid waste into a matrix to form a heterogeneous waste form.

emplacement

Placing the waste in its location for storage or disposal.

emplacement density

Amount of waste emplaced per unit area or volume of a storage or disposal site (e.g. canisters per hectare).

engineered barrier

See: barrier

engineered storage

The storage of radioactive wastes, usually in suitably sealed containers, in any of a variety of structures especially designed to protect them and to help keep them from leakage to the biosphere by accident or sabotage. They may also provide for extracting heat of radioactive decay from the waste.

entombment decommissioning

Placement of radioactive wastes and structural materials within an entombment structure (often comprising a portion of the existing production structure) for permanent disposal. Only those materials with hazardous lifetimes, as determined by radiological assessments, less than or equal to the expected lifetime of the entombment structure are intended to be so placed. Other radioactive materials are removed from the site for disposal.

environment

(i) The surroundings of an installation. (The immediate surroundings are termed the environs.)

(ii) The sum total of all the conditions and influences that surround an organism, human or otherwise, that affect its life, survival and development.

environmental compartment

Any part of an environment which is convenient to consider as a single entity in modelling studies.

environmental transfer models

Mathematical techniques for representing the transfer (of radionuclides or other pollutants or tracers) through the environment (usually to man).

evapotranspiration

The sum total of water lost from the land by evaporation and plant transpiration.

exclusion area

A term used in some countries to designate a zone which may be established around a nuclear facility or other radiation source, to which access is permitted under controlled conditions and in which residence is normally prohibited.

exposure

Irradiation of persons or materials. Exposure of persons to ionizing radiation may be either:

1. external exposure, irradiation by sources outside the body, or
2. internal exposure, irradiation by sources inside the body.

The term occupational exposure refers to exposure of a worker received or committed during a period of work.

exposure rate

The quotient of dX by dt, where dX is the increment of exposure in the time interval dt.

F

far-field

Rock formations outside of the repository, including the surrounding strata, at a distance from the waste disposal site such that, for modelling purposes, the site may be considered as a single entity, and the effects of individual waste packages are indistinguishable in the effects of the whole.

field experiment

A test conducted under ambient conditions outdoors, usually with regard to a shallow land burial site or to migration in the environment. The test may be contained in such a way that radionuclides cannot leave the area.

filtration

The process of separating solids from liquids or gases moving through the interstices of a solid medium.

fission gas

A fission product in gaseous form at ambient temperature (e.g. ^{85}Kr, $^{3}H_{2}$).

fission product

A nuclide produced either by fission or by the radioactive decay of nuclides formed by fission.

fissure

An extensive crack, break or fracture in the rock.

fixation (of radionuclides)

The practice of immobilizing radionuclides so that they are not easily dispersed. The term often refers to the application of paint or a similar material to a contaminated surface in order to prevent the radionuclides from becoming airborne or transferred by casual contact.

flocculation

A process of removing finely divided solid particles, frequently colloids, from a waste slurry by neutralizing their electrical

charges and allowing the neutralized particles to agglomerate and settle out. The neutralization is usually effected by chemical means through introducing charges of an opposite sign by the addition of either an electrolyte or another colloid.

fluidized bed technology

Technology to suspend solid particles in a loose bed of material by a rapidly moving upward stream of gas for enhancing chemical or physical reaction.

food-chain (or web)

A figure of speech for the dependence for food of organisms upon others in a series, beginning with plants or scavenging organisms and ending with the largest carnivores. A web is a network or series of food-chains.

fracture

A crack, joint, fault, or other break in rock. In underground repositories, fractures are of concern as possible paths for water flow and radionuclide migration.

front end of the fuel cycle

Mining, milling, enrichment and fabrication of nuclear fuel; sometimes reactors are included.

fuel cycle

See: nuclear fuel cycle.

fuel reprocessing plant (FRP)

Plant where spent fuel elements are dissolved, waste materials removed, and reusable materials are segregated.

G

gaseous waste

Process off-gases or airstreams which contain controlled levels of radioactivity, aerosols or chemical constituents. Typically, the gas or airstream would be considered a gaseous waste at the point at which it is released to the environment.

geohydrology (or groundwater hydrology)

A science that is concerned with the properties, distribution and movement of water below the surface of the land (i.e. in the soil and underlying rocks).

geologic barrier

In the context of deep underground disposal according to the multi-barrier approach, this is the barrier provided by the stable formation in which the repository itself is constructed.

geologic repository

A final disposal facility located deep underground in a stable formation such as salt, granite, etc. Usually such a repository would be provided for alpha-bearing or high-level waste.

glass

A solid material whose molecular structure has no long range order (analogous to the normal liquid state of the material). Glasses proposed as matrices for solidifying waste are generally based on a silicon-oxygen network. Radioactive atoms are chemically bound within the glass network.

glass-ceramic

The product resulting after a glass has been transformed into a crystalline material by a controlled process such as heating. The product may retain the desirable properties of both a glass and a ceramic (see: ceramic materials).

glass corrosion

A chemical attack, frequently by groundwater, on the surface of vitrified waste that can alter the surface and potentially release the radionuclides. (See: corrosion).

glass leaching

The transfer of radionuclides on or near the surface of vitrified waste into an ambient solution. The process occurs coincidentally with corrosion.

granite

Broadly applied, any holocrystalline quartz-bearing plutonic rock. Granite formations are being considered as possible hosts for high-level waste repositiories deep undergound.

gray (Gy)

The SI unit of absorbed dose equal, for ionizing radiation, to 1 joule of radiant energy absorbed in 1 kilogram of the material of interest. (1 Gy = 100 rad.)

groundwater

Water which permeates the (rock) strata of the Earth, filling their pores, fissures and cavities. (It excludes water of hydration.)

groundwater transport

The principal means by which radionuclides can be mobilized from an underground repository and moved into the biosphere. Avoiding such transport is the basis for selecting and designing repository systems.

grout

A relatively low-viscosity slurry of water, cement and other fine solids (see cement). Liquid radioactive wastes or waste slurries can be used to make grouts and hence solidify the waste. Grouts can be pumped or injected into geological formations.

H

half-life

In physics, the time required for the transformation of one-half of the atoms in a given radioactive decay process, following the exponential law (physical half-life).

By analogy, in biology this term is used in connection with the clearance of a substance from a tissue, an organ or the whole body (when the kinetics of such a phenomenon roughly follow an exponential dependence) to mean the time for one-half of this substance to be eliminated (biological half-life).

The time necessary for a radioactive material in a living organism to be reduced to one-half of its initial value by a combination of biological elimination and radioactive decay is termed effective half-life.

heat generating waste

Waste which is sufficiently radioactive that the energy of its decay significantly increases the temperature of its surroundings. Spent fuel elements require active cooling, for example in a water-filled basin, for several years after discharge from the reactor. The heat-generating period of HLW in a repository may last several hundred years.

HEPA filter (High-Efficiency Particulate Air) filter

Filter used for removing sub-micrometre and larger particles from a gaseous stream.

high-level waste

(i) The highly radioactive liquid, containing mainly fission products, as well as some actinides, which is separated during chemical reprocessing of irradiated fuel (aqueous) waste from the first solvent extraction cycle and those waste streams combined with it.

(ii) Spent reactor fuel, if it is declared a waste.

(iii) Any other waste with a radioactivity level comparable to (i) or (ii).

high-level waste tank

A tank intended for storage of liquid high-level waste. Such tanks likely will be double-walled, contain provisions for cooling the waste, and be well shielded. They will be subjected to strict quality assurance measures.

host rock (or host medium)

A geological formation in which a repository is located.

hulls and spacers

Radioactive waste, comprised of cladding hulls and assembly grid spacers, generated during reprocessing when spent fuel assemblies are disassembled and the fuel is dissolved.

human environment

Those portions of the Earth that are inhabited by humans or are readily accessible to them. (See: accessible environment.)

humid sites

A near surface repository located in an area at which annual precipitation exceeds water loss by evaporation, hence there is a significant downward flux of moisture through the soil which could transport radionuclides. Uptake of radionuclides by plant roots may also be significant in a humid site.

hydration

The chemical combination of water with another substance.

hydraulic conductivity

Ratio of flow velocity to driving force for viscous flow under saturated conditions of a specified liquid in a porous medium.

hydrofracture process

A process for permanent disposal of medium level liquid waste in which wastes in the form of a slurry containing hydraulic binders (grouts) are injected to induce fracturing in a deep underground formation (such as a nearly impermeable shale formation) considered to be isolated from the surface. The slurry solidifies in-situ, ensuring fixation of the waste.

hydrogeology

The study of the geological factors relating to the Earth's water.

hydrologic modeling

The construction of mathematical models, usually for use on a computer, that describe water flow through and around a specific underground repository. The model is intended to predict possible transport, via water, of radionuclides from the repository.

hydrology

The study of all waters in and upon the Earth. It includes underground water, surface water and rainfall, and embraces the concept of the hydrological cycle.

I

ICRP limit

A primary dose equivalent limit recommended by the ICRP. Dosimetric models may be used to derive the annual limit on intake (ALI) and derived air concentration (DAC).

immobilization of waste

Conversion of a waste to a solid form that reduces the potential for migration or dispersion of radionuclides by natural processes during storage, transport and disposal.

incineration

The process of burning a combustible material to reduce its volume and yield an ash residue.

incinerator ash

The non-combustible residue remaining after burning waste in a specially designed unit. The volume of radioactive ash will be much less than that of the original waste, and the ash will usually be incorporated into a solid matrix for disposal.

ingest

Take into the body by way of the digestive tract.

in-situ testing

Tests conducted within a geologic environment that is essentially equivalent to the environment of a potential repository. A special underground laboratory may be built for in-situ testing or tests may be done in an actual repository excavation. Only in such a facility can the full range of repository properties and waste-repository interactions be measured.

institutional control

Control by an authority or institution designated under the laws of a country or state. This control may be active (monitoring, surveillance, remedial work) or passive (land use control).

interim storage (storage)

Storage of radioactive materials such that:

(a) isolation, monitoring, environmental protection and human control are provided; and

(b) subsequent action involving treatment, transport, and disposal or reprocessing is expected.

intermediate-level waste (or medium-level waste)

Waste of a lower activity level and heat output than high-level waste, but which still requires shielding during handling and transportation. The term is used generally to refer to all wastes not defined as either high-level or low-level. (See: alpha-bearing waste and long-lived waste for other possible limitations).

intrusive rock

A body of igneous rock which has forced itself into an existing rock formation.

ion exchange

A usually reversible exchange of one ion with another, either in a liquid, or on a solid surface, or within a crystalline lattice.

ion exchange resin

An organic polymer that exhibits technically useful ion-exchange characteristics.

isolation of waste

See: confinement of waste.

J

joule melters

An electrically powered glass-making furnace in which the molten glass itself carries the electric current and is thereby heated. Such a design is considered to be well suited for vitrifying radioactive waste.

L

leachability

The susceptibility of a solid material to having its soluble, sorbed and/or suspendable constituents removed by the dissolving or erosive action of water or other fluids.

leachate

A solution, typically groundwater, that has been in contact with radioactive waste and as a result may contain radionuclides.

leaching

(i) Extraction of a soluble substance from a solid by a solvent with which the solid is in contact.

(ii) The term is often used in waste management to describe the gradual dissolution/erosion of emplaced solid waste or chemicals therefrom, or the removal of sorbed material from the surface of a solid or porous bed.

leach rate

The rate of dissolution or erosion of material from a solid. The term may be used to describe the rate of gradual dissolution/erosion of emplaced solid waste or the removal of sorbed material from the surface of a solid or porous bed.

leach test

A laboratory test conducted to determine the rate radionuclides are released from a waste form that is in contact with water. These tests are considered to be essential for judging and comparing waste forms. Many different test parameters have been used, and a number of protocols have been published.

lithostatic pressure

Pressure underground due to the weight of overlying rock and/or soil and/or water.

long-lived nuclide

For waste management purposes, a radioactive isotope with a half-life greater than about 30 years.

long-lived waste

Waste that will not decay to an acceptable activity level in a period of time during which administrative controls can be expected to last. (See: short-lived waste.)

long-term

In waste management, refers to periods of time which exceed the time during which administrative controls can be expected to last.

low-level waste

Waste which, because of its low radionuclide content, does not require shielding during normal handling and transportation. (See: alpha-bearing waste and long-lived waste for other possible limitations.)

lysimeter

A device that provides containment for conducting migration experiments under ambient outdoor conditions. A typical lysimeter could be a large diameter (2m or more) pipe emplaced vertically in the ground, with its open end a several cm above the surface and its lower end sealed. Rain water percolating through a mixture of waste and soil would reach the closed end where it would be pumped back to the surface for analysis.

M

matrix

In waste management, a non-radioactive material used to immobilize radioactive waste in a monolithic structure. Examples of matrices are bitumen, cement, various polymers, etc.

membrane filtration

Passing of aqueous solutions through solid filters with small pores to remove impurities or to separate chemical constituents.

migration

The movement of materials through a rock medium or some other solid substance, e.g. radionuclide migration.

milling

Operation of processing ore to obtain uranium or thorium for conversion into reactor fuel.

mill tailings (tailings)

Finely ground residues resulting from the processing of ore for recovery of uranium and thorium. Uranium mill tailings consist of two major fractions:

1. Slimes - the lighter, finer particles in the tailings (including particles in the micron and sub-micron range) made up of the clays and other very fine particles;
2. Sands - the heavier, coarser range of particles.

mixed waste

Radioactive waste that also contains chemicals that could cause undesirable effects in the environment. Such wastes present a number of technical and regulatory problems for processing and disposal.

model

In applied mathematics, an analytical or mathematical representation or quantification of a real system and the ways that phenomena occur within that system. Individual or sub-system models can be combined to give system models. Deterministic and probabilistic models are two types of mathematical models.

molecular sieve

A material with a rigid, uniform pore structure which completely excludes molecules larger than the structure pore openings and can sorb certain classes of small molecules from a fluid in contact with the material.

monitoring

The methodology and practice of measuring levels of radioactivity either in environmental samples or en route to the environment. Examples include ground water monitoring, gaseous effluent (stack) monitoring, and personnel monitoring.

MPC

The maximum permissible concentration. This refers to maximum levels of radioactivity in drinking water or in air as established by national authorities. (See also: annual limit on intake; derived air concentration).

multibarrier

A system using two or more independent barriers to isolate the waste from the human environment. These can include the waste form, the container (canister), other engineered barriers and the emplacement medium and its environment. (See: barrier.)

N

natural analogues

Radioactive minerals or mineral deposits whose migration history over very long times can be determined and used to forecast the possible behaviour of chemically similar waste radionuclides.

near-field region

The excavated repository including the waste package, filling or sealing materials, and those parts of the host medium whose characteristics have been or could be altered by the repository or its content.

non-high-level waste

Intermediate- or low-level waste.

nuclear fuel cycle

Processes connected with nuclear power production, including obtaining, using, storing, reprocessing and disposing of nuclear materials used in the operation of nuclear reactors.

nuclear waste

Unwanted radioactive by-products from the nuclear fuel cycle. (See: radioactive waste).

O

off-gas

The gas streams which arise from a process. Typical processes in radioactive waste management facilities such as dissolution, evaporation, incineration, vitrification, bituminization, and cementation, will generate process off-gases which contain water vapor, acid vapors, aerosols, radioactive constituents and gaseous chemical constituents.

off-gas treatment

The removal of radioactive components or chemical pollutants from gases prior to their release under controlled conditions into the atmosphere.

operating records

A set of documents, such as instrument charts, certificates, log books, computer print-outs and magnetic tapes, kept at each nuclear facility and organized in such a way that they provide a complete and objective history of the operation of the facility.

operational period

The period during which a nuclear facility is being used for its intended purpose until it is shut down and decommissioned.

operations, waste management

Broad classification of waste management activities in terms of their basic function (e.g. waste storage, treatment, transportation or disposal).

operator

Any person, government or other entity that conducts or carries on operations at a nuclear facility.

osmosis

The passage of solvent through a semi-permeable membrane from a dilute solution into a more concentrated one. (A semi-permeable membrane allows passage to the molecules of the solvent but not to the molecules of the solute.)

overpack

Secondary (or additional) external containment for packaged radioactive waste.

P

package, waste

See: waste package.

particulates

Solid aerosols or particles carried in process off-gases or airstreams or suspended in the air. Virtually all facilities which handle radioactive waste use high-efficiency particulate air (HEPA) filters to remove particulates from the process off-gases.

pathways model

A mathematical description, usually in the form of a computer algorithm, that determines the relative significance of possible radionuclide transport vectors, e.g. air, ground water, surface water, intrusive roots, animals, etc.

percolating groundwater

Groundwater that seeps via saturated flow conditions through soil or rock strata (see saturated zone).

performance allocation

Assignment of an expected or design level of performance for each barrier of a repository such that all barriers together will achieve the required level of safety.

performance assessment

Analysis to predict the performance of the system or subsystem, followed by comparison of the results of such analysis with appropriate standards or criteria. When the system under consideration is the overall waste disposal system and the performance measure is radiological impact or some other global measure of impact safety, performance assessment becomes the same as safety assessment.

performance confirmation

Tests carried out at a repository, usually after waste emplacement but prior to license termination, to confirm that the repository is performing as anticipated when emplacement of wastes was authorized.

permeability (of rock)

The capacity of a porous or pervious rock for transmitting a fluid. (See: darcy.)

physical separation

(i) Separation by geometry (distance, orientation, etc.).

(ii) Separation by appropriate barriers.

(iii) Separation by a combination of both concepts (i) and (ii).

physisorption

A type of adsorption in which the sorbed species is retained by the adsorber by physical means (as opposed to chemical bonding). Such an adsorption method can be used in off-gas treatment systems, for example.

plasma arc

A metal cutting technique in which an electrical discharge supplies heat for burning through the metal. This is a standard technique that is well suited to use in a contained, radioactive facility because no combustible gases are required.

plasticity

The property of a material, e.g. rock salt, that enables it to undergo permanent deformation without appreciable volume change or elastic rebound, and without rupture.

polymer modified cement

A cement to which substances made from long-chain organic molecules (polymers) have been added to modify either its mixing or handling characteristics, or characteristics of the final product.

porosity

The ratio of the aggregate volume of interstices in a rock or soil to its total volume.

porous media

Material that contains pores or cracks through which water or gas can flow. Often the term is applied to the geological formations around a waste repository and could denote an undesirable situation.

post-sealing period

The period after a waste repository has been shut down and sealed.

precipitation

1. A standard chemical method that can be used in treatment of liquid radioactive wastes. Radionuclides are removed from the liquid by either forming or being carried by the insoluble product of a chemical reaction made to occur within the liquid.
2. A meteorological term that refers to the total amount of water (rain, snow, etc.) that falls on a site.

preliminary site selection

The second stage of siting a waste repository during which a manageable number of potentially suitable sites is examined, using existing information or information from limited explorations, to determine whether one or more regions contain sites suitable for additional site confirmation studies.

pre-treatment of waste

Any step carried out prior to operations which have been defined as treatment, conditioning, off-site transport or disposal.

Pre-treatment techniques and practices include:

- collection and segregation
- size reduction
- chemical adjustment

primary waste

As-generated form and quantity of a waste.

pyrolysis

A chemical decomposition of a substance by heat.

Q

quality assurance

Planned and systematic actions aimed at providing adequate confidence that an item of a facility will perform satisfactorily in service.

quality control

Actions which provide a means to control and measure the characteristics of an item, process, facility or person in accordance with quality assurance requirements.

R

rad

A unit of absorbed dose of ionizing radiation equal to one hundredth of a gray (1 cGy).

radiation damage

Deleterious changes in the physical or chemical properties of a material resulting from exposure to ionizing radiation. This term does not apply to biological systems.

radiation protection or radiological protection

(i) All measures associated with the limitation of the harmful effects of ionizing radiation on people, such as limitation of external exposure to such radiation, limitation of bodily incorporation of radionuclides as well as the prophylactic limitation of bodily injury resulting from either of these.

(ii) All measures designed to limit radiation-induced chemical and physical damage in materials.

radiation stability

Capability of a material to withstand the action of ionizing radiation without changing its essential characteristics.

radioactive material

A material of which one or more constituents exhibit radioactivity.

radioactive source term

An expression used to denote information about the actual or potential release of radioactive material from a given source, which may include a specification of the composition, the amount, the rate and the mode of the release.

radioactive waste

Any material that contains or is contaminated with radionuclides at concentrations or radioactivity levels greater than the 'exempt quantities' established by the competent authorities and for which no use is foreseen.

radioactive waste management

All activities, administrative and operational, that are involved in the handling, treatment, conditioning, transportation, storage and disposal of waste.

radiodecay heat

Heat generated by the absorption of energy released by the decay of radionuclides.

radiolysis

Chemical decomposition by the action of ionizing radiation.

radiolytic effect

An effect caused by radiolysis, e.g. radiation-induced degradation of chemical compounds.

radionuclide migration

The movement of radionuclides through various media due to fluid flow and/or by diffusion.

radionuclide transport

The action of a particular vector that results in movement of radionuclides in the environment, e.g. radionuclide transport by groundwater. This specific term does not refer to the intentional transportation of radioactive materials by man: transportation of nuclear wastes in transport casks, etc.

radwaste

See: radioactive waste.

reactor waste

Waste arising from the routine operation of a nuclear reactor.

release scenario

See: scenario analysis.

rem

A unit of dose equivalent equal to one hundredth of a sievert (1 cSv).

remedial action

Corrective measures imposed at a near surface repository to prevent a previously unforeseen circumstance from causing unacceptable releases of radionuclides.

repository

A facility or designated site for storage or disposal of radioactive wastes.

repository system

A repository and all its supporting facilities.

reprocessing, fuel

Recovery of fissile and fertile material from irradiated nuclear fuel by chemical separation from fission products and other radionuclides (e.g. activation products, actinides); selected fission products may also be recovered.

resuspension

A vector for the environmental transport of radionuclides in which contaminated particles are picked up and carried by the wind.

retardation

A reduction in the velocity of radionuclide movement through the environment due to reversible adsorption on an immobile matrix. Soils often retard movement of waterborne nuclides, and the degree of retardation can be quantified.

retrievability

The capability to remove waste from where it has been stored.

reverse osmosis

Movement of a solvent out of a solution under pressure through a semi-permeable membrane into pure solvent or a less concentrated solution at lower pressure. (See: osmosis.) This process can be used to extract essentially pure (fresh) water from polluted or salt water.

risk

For the purposes of radiation protection, the probability that a given individual will incur any given deleterious stochastic effect as a result of radiation exposure.

risk analysis

An analysis of the risks associated with a technology wherein the possible events and their probabilities of occurrence are considered together with their potential consequences, the distribution of these consequences within the affected population(s), the time factor and the uncertainties of these estimates.

rock

To the geologist any mass of mineral matter, whether consolidated or not, which forms part of the Earth's crust is a rock. Rocks may consist of only one mineral species, in which case they are called monomineralic, but they more usually consist of an aggregate of mineral species.

routine discharges

Planned and controlled release of radionuclides to the environment. Such releases will meet all restrictions imposed by appropriate regulatory authorities.

S

safety

Protection of all persons from undue radiological hazard.

safety analysis

The analysis and calculation of the hazards (risks) associated with the implementation of a proposed activity.

safety assessment

A comparison of the results of safety analyses with acceptability criteria, its evaluation, and the resultant judgements made on the acceptability of the system assessed.

salt

A geological formation containing mainly halite (NaCl) with smaller inclusions of other minerals, usually the chloride or sulfate derivatives of the alkali or alkaline earth elements. Salt formations occur as bedded or domal deposits. These dry, stable formations are considered to be good hosts for deep underground waste repositories.

salt dome

A dome-like salt structure resulting from the upward movement of a salt mine.

saturated zone

A subsurface zone in which all the interstices are filled with water under pressure grater than that of the atmosphere. This zone is separated from the unsaturated zone, i.e. zone of aeration, by the water table.

scenario analysis

Part of a safety analysis that identifies and quantitatively defines phenomena, their probabilities and their interactions, which could initiate and/or influence the release and transport of radionuclides from a source to humans. A release scenario defines the phenomena relevant to release of radionuclides from a radioactive (e.g. waste) source; a transport scenario defines the phenomena relevant to transport of the released radionuclides through the geosphere and biosphere to humans.

scrubbing system

A system which contacts process off-gases and ventilation airstreams with water, chemical solutions or non-aqueous solvents. A typical scrubber design is a column with baffles or packing material through which the liquid flows countercurrent to the gas or airstream. Typical uses for scrubbing systems include humidifying and cooling of ventilation air, recovery of aerosols and chemical constituents from process off-gas and cooling process off-gas.

secondary waste

A form and quantity of waste that results as a by-product of the process from applying a waste treatment technology to a primary waste.

seepage basin

A pond into which very slightly contaminated water is discharged. In principle the pond provides a holding point for decay of some radionuclides and controlled release of others, either through seepage or evaporation out of the pond.

segregation

A pretreatment step for solid waste in which the wastes are sorted according to some property (e.g. combustibility) which will facilitate later waste treatments.

sensitivity analysis

An analysis of the variation of the solution of a problem with changes in the values of the variables involved. Two types of sensitivity analysis can be recognised. In simple parameter variation, the sensitivity of the solution is investigated for changes in one or more input parameters within a reasonable range about selected reference or mean values. In perturbation analysis, the sensitivities of the solution with respect to changes in all input parameters can be obtained by applying differential and/or integral analysis.

shaft

An access passage from the surface to the subsurface facilities for men and materials, ventilation, or nuclear waste.

shallow-ground disposal (e.g. shallow-ground burial)

Disposal of radioactive waste, with or without engineered barriers, above or below the ground surface, where the final protective covering is of the order of a few metres thick. Some Member States consider 'shallow-ground disposal' to be a mode of storage rather than a mode of disposal.

shield, radiation

A material interposed between a source of radiation and persons, or equipment or other objects, in order to attenuate the radiation.

shipping cask (transport cask)

A heavy protective container which shields and contains radioactive materials, dissipates heat, and prevents criticality during transport and handling.

short-lived nuclide

For waste management purposes, a radioactive isotope with a half-life shorter than about 30 years, e.g. ^{137}Cs, ^{90}Sr, ^{85}Kr, ^{3}H.

short-lived waste

Waste which will decay to a level which is considered to be insignificant from a radiological viewpoint, in a time period during which administrative controls can be expected to last. Such waste can be determined by radiological assessment of the storage or disposal system chosen. (See: long-lived waste.)

shutdown

Actions taken at a repository after disposal operations have ceased in order to prepare the facility for abandonment. This includes decommissioning of ancillary facilities and sealing the repository. Shutdown may occur immediately or after a period of surveillance following the final emplacement of waste.

sievert, Sv

The special name of the unit of dose equivalent.

$$1\ Sv = 1\ J.kg^{-1}.$$

site

The area containing a nuclear installation, (e.g. a waste repository) that is defined by a boundary and which is under effective control of the implementing organization.

site confirmation

Actions involved in establishing the suitability of an intended repository site. Extensive on-site investigations will be made to assure its capability for achieving all performance criteria, especially radiation protection requirements. The type of waste to be emplaced and the proposed repository design are of importance in this assessment.

siting

The process of selecting a suitable site for an installation, including appropriate assessment and definition of the related design bases.

slurry feeding

The practice of feeding a liquid waste slurry directly onto the surface of molten glass in a ceramic melter, without an intermediate step of drying or calcining the waste.

solidification

Conversion of liquid or liquid-like materials into a solid.

solidified waste, radioactive

Liquid waste or otherwise mobile waste materials (ion exchange resins, etc.) that have been immobilized by incorporation (either physical or chemical) into a solid matrix by some specific treatment.

solid waste, radioactive

Untreated waste that posesses physical properties commonly associated with the solid state. Animal carcasses are usually considered to be in this category.

sorption

A broad term referring to reactions taking place within pores or on the surfaces of a solid. Its use avoids the problem of technical distinction between absorption and adsorption reactions. Absorption is generally used to refer to reactions taking place largely within the pores of solids, in which case the capacity of the solid to absorb is proportional to its volume. Adsorption refers to reactions taking place on solid surfaces, so that the capacity of a solid is proportional to its effective surface area. An example of the latter process is ion exchange, whereby ions occupying charged sites on the surface of the solid are displaced by ions from solution.

source term

See: radioactive source term.

speciation

A term that refers to the chemical form(s) and properties of a radionuclide under a particular set of environmental conditions (pH, eH, ligands present, etc.). Speciation study is valuable because the environmental behaviour of a nuclide is largely determined by its chemical form.

specific activity

(i) The activity per unit mass of a pure radionuclide.

(ii) The activity of a radioisotope per unit mass of that element present in the material.

(iii) The activity per unit mass or volume of any sample of radioactive material.

spent fuel

Irradiated fuel units not intended for further reactor service.

spent fuel container

A vessel for storing used fuel rods from a reactor. After an initial period of cooling in a water-filled basin, spent fuel rods might be placed into a specially designed container for longer-term storage. Among other considerations, the container will provide passive cooling and be designed to prevent accidental criticality.

static leach test

A type of leach test in which the leachant does not flow past the waste form (see: leach test). Leachant solutions may be sampled or changed according to a specified routine.

storage

See: interim storage.

subsequent control

Any long-term safety measures, such as land-use restrictions, imposed to assist in achieving repository safety after shut-down and sealing has been completed and after the operating license for the repository has been cancelled.

subsidence

Sinking or caving in of the ground surface. This results from the inability of the upper layers of the Earth's crust to support their own mass, or that mass with additional surface load, over an area containing poorly compacted material and/or voids. Such voids can be man-made, as in the case of mines.

surface water

Water which fails to penetrate into the sub-soil and flows along the surface of the ground, eventually entering a lake, a river or the sea.

surveillance

All planned activities performed to ensure that conditions at a nuclear installation remain within the prescribed limits. For a waste repository, surveillance continues well past the periods of operation and closure.

synroc

The name given to a group of specially formulated zirconium-based ceramics that were originally developed by Australian scientists for immobilizing high-level waste.

T

tailings

See: mill tailings.

tailored ceramic

A ceramic material whose composition has been specially formulated to optimize the incorporation of a particular set of radionuclides into the crystalline matrix. The composition of the waste form is thus tailored to fit a particular waste stream (see: ceramic materials; synroc).

thermal gradient

A quantitatively measurable change in sensible heat as a function of distance. In a deep geological repository the thermal gradient produced by radioactive decay heat can potentially alter the host rock and water flow paths.

thermal loading

The quantity of heat-generating materials placed in a given area or volume; units are power per area or per volume, respectively.

thin film evaporator

A device designed to de-water liquid waste by evaporation, the liquid being spread on a thin film over the heat-transfer surface.

topography

(i) The configuration of (a portion of) the Earth's surface, including its relief and relative positions of its natural and man-made features.

(ii) The practice of graphical representation of the same.

transmissivity, hydraulic

Rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient. It is expressed as the product of the hydraulic conductivity and the thickness of the saturated portion of the aquifer.

transuranic (TRU) waste

Waste containing quantities of nuclides having atomic numbers above 92 above agreed limits. The limits are established by national regulatory bodies. (See: alpha-bearing waste.)

treatment of waste

Operations intended to benefit safety or economy by changing the characteristics of the waste. Three basic treatment concepts are:

(a) volume reduction;
(b) removal of radionuclides from the waste;
(c) change of composition. (See: conditioning of waste.)

tuff

One of a series of pyroclastic rocks composed of consolidated ash from fragmental volcanic material blown into the atmosphere by volcanic activity. Tuff has been considered as a potential host medium for high-level waste disposal.

U

underground disposal

Disposal of waste at an appropriate depth below the ground surface.

unsaturated flow

The flow of water in undersaturated soil by capillary action and gravity.

unsaturated zone

A subsurface zone in which at least some interstices contain air or water vapor, rather than liquid water. Also referred to as "zone of aeration". (See: saturated zone).

uptake

Amount of radioactive material absorbed into the extra cellular fluids. Also used to denote the process.

V

validation

Validation is a process carried out by comparison of model predictions with independent field observations and experimental measurements. A model cannot be considered validated until sufficient testing has been performed to ensure an acceptable level of predictive accuracy. (Note that the acceptable level of accuracy is judgmental and will vary depending on the specific problem or question to be addressed by the model).

vault

An above- or below-ground reinforced concrete structure containing an array of storage cavities, each of which could hold one or more spent fuel unit or waste package. Shielding is provided by the exterior of the structure. Heat removal is principally by forced or natural movement of gases over the exterior of the cavities. Heat rejection to the atmosphere is either direct or via a secondary cooling system.

verification

A mathematical model, or the corresponding computer code, is verified when it is shown that the code behaves as intended, i.e. that it is a proper mathematical representation of the conceptual model and that the equations are correctly encoded and solved.

vermiculite

A group of micaceous clay minerals closely related to chlorite and montmorillonite and having the general formula $(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2.4H_2O$. Because of its sorptive properties, vermiculite is often used in packaging small quantities of liquid waste.

vitrification

Any process of converting materials into a glass or glass-like form.

vitrified

(i) Transformed into a glass or glass-like material.

(ii) Of waste, immobilized in a glass or glass-like matrix.

volume reduction

A treatment that decreases the physical volume of a waste. Volume reduction is used to facilitate subsequent handling, storage, transportation or disposal of the waste. Typical treatments are mechanical compaction, incineration, or evaporation. Volume reduction results in a corresponding increase in radionuclide concentration.

volume reduction factor (VRF)

The ratio of the volumes of radioactive waste prior to and following treatment. In concentration processes the VRF is greater than one; in dilution systems, the VRF is less than one.

W

waste arisings

Radioactive wastes generated by any stage in the nuclear fuel cycle.

waste disposal

See: disposal.

waste form

The physical and chemical form of the waste materials (e.g. liquid, in concrete, in glass, etc.) without its packaging.

waste glass

The vitreous product that results from incorporating waste into a glass matrix.

waste management

See: radioactive waste management.

waste package

The waste form and any container(s) as prepared for handling, transport, treatment, conditioning, storage and disposal of waste.

waste retention system

A system for storage or disposal of liquid and/or solid wastes generated by the uranium or thorium mining and milling process.

water table

(i) The upper surface of the groundwater;

(ii) The upper surface of a zone of groundwater saturation.

'worst-case' scenario

The scenario for release and transport of radionuclides from a nuclear installation or facility (e.g. a waste storage or disposal site) to the biosphere that represents the most severe accident situation conceivable on the basis of pessimistic assumptions. Agreement on a 'worst-case' scenario may be difficult. Thus, the terminology "'conservative, but realistic' scenarios" is frequently used to define a set of scenarios that can be used in sensitivity and uncertainty analyses for safety assessment purposes.

Z

zeolite

A generic term for a group of hydrated alumino-silicates of Na, Ca, Ba, Sr, and K, characterized by their easy and reversible loss of water of hydration. Many are also characterized by a significant capacity for ion exchange.

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A group of micaceous clay minerals closely related to chlorite and montmorillonite and having the general formula $(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2.4H_2O$. Because of its sorptive properties, vermiculite is often used in packaging small quantities of liquid waste.

vitrification

Any process of converting materials into a glass or glass-like form.

vitrified

(i) Transformed into a glass or glass-like material.

(ii) Of waste, immobilized in a glass or glass-like matrix.

volume reduction

A treatment that decreases the physical volume of a waste. Volume reduction is used to facilitate subsequent handling, storage, transportation or disposal of the waste. Typical treatments are mechanical compaction, incineration, or evaporation. Volume reduction results in a corresponding increase in radionuclide concentration.

volume reduction factor (VRF)

The ratio of the volumes of radioactive waste prior to and following treatment. In concentration processes the VRF is greater than one; in dilution systems, the VRF is less than one.

W

waste arisings

Radioactive wastes generated by any stage in the nuclear fuel cycle.

waste disposal

See: disposal.

waste form

The physical and chemical form of the waste materials (e.g. liquid, in concrete, in glass, etc.) without its packaging.

waste glass

The vitreous product that results from incorporating waste into a glass matrix.

waste management

See: radioactive waste management.

waste package

The waste form and any container(s) as prepared for handling, transport, treatment, conditioning, storage and disposal of waste.

waste retention system

A system for storage or disposal of liquid and/or solid wastes generated by the uranium or thorium mining and milling process.

water table

(i) The upper surface of the groundwater;

(ii) The upper surface of a zone of groundwater saturation.

'worst-case' scenario

The scenario for release and transport of radionuclides from a nuclear installation or facility (e.g. a waste storage or disposal site) to the biosphere that represents the most severe accident situation conceivable on the basis of pessimistic assumptions. Agreement on a 'worst-case' scenario may be difficult. Thus, the terminology "'conservative, but realistic' scenarios" is frequently used to define a set of scenarios that can be used in sensitivity and uncertainty analyses for safety assessment purposes.

Z

zeolite

A generic term for a group of hydrated alumino-silicates of Na, Ca, Ba, Sr, and K, characterized by their easy and reversible loss of water of hydration. Many are also characterized by a significant capacity for ion exchange.