

GLOSSARY

1:100 year flood: a large magnitude flood which has a statistical recurrence frequency of once in every 100 years.

Acid: substance with a pH of less than 7.

Alkali: substance with a pH of more than 7.

Alluvium: mud, sand and gravel and other materials moved by streams and rivers and deposited by them.

Alpha particle: a particle consisting of two protons plus two neutrons. Emitted by a radio-nuclide.

Ambient: background or natural condition.

Anion: a negatively charged ion e.g. chloride (Cl⁻), sulphate (SO₄²⁻), phosphate (PO₄³⁻), nitrate (NO₃⁻), carbonate (CO₃²⁻) and bicarbonate (HCO₃⁻) etc.

Annual limit of exposure (ALE): is a special secondary limit used for radon gas and is defined as follows: the exposure to an airborne radio-nuclide, expressed as the time integral of concentration, which would result in the ICRP's reference man inhaling the **annual limit of intake** for that radio-nuclide.

Atmospheric stability: stability is a function of barometric pressure, temperature through the air column and wind.

Berg winds: very strong, hot winds which usually blow during the winter months from the east and north-east.

Beta particle: a particle, emitted by a radio-nuclide, with a mass and charge equal in magnitude to an electron. The electric charge may be positive, in which case, the beta particle is called a positron.

Bioaccumulation: the accumulation of toxic substances eg heavy metals, in plant and animal tissues.

Buffering capacity: the ability of soil or rock to resist an induced change in pH.

Bund: a wall built to contain spills and prevent them from entering the environment.

Calcareous: containing calcium carbonate.

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Calcine: the residue of iron oxide left after roasting of the pyrite (FeS_2) in the acid plant.

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Calcite: calcium carbonate, CaCO_3 .

Calcrete: calcareous hardpan, usually occurring near the surface, underlying very shallow soils.

Cation: a positively charged ion e.g. calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), aluminium (Al^{3+}), ammonia (NH_4^+) etc.

Conductivity, electrical: a measure of the ability of a material to conduct electricity. It is expressed in Siemens per metre and $1 \text{ mS/m} = 0.001 \text{ S/m} = 0.01 \text{ mmho/cm}$.

Contamination: pollution.

Corrosive: a substance that can corrode, or gradually destroy through chemical reaction, another substance.

Cut-off trench: a deep trench excavated through the alluvium in the gorges down to bedrock to intercept seepage and/or ground water flow. Some trenches are equipped with pumps.

Derived air concentration (DAC): the DAC for a given radionuclide is a **derived limit** and is the activity concentration of that **radionuclide** in air (Bq/m^3) which, if inhaled by reference man for a working year of 2 000 hours under conditions of light physical activity (breathing rate of $1.2 \text{ m}^3/\text{h}$), would result in an inhalation of one **ALI**, or the concentration which for 2 000 hours of air immersion would lead to the irradiation of any organ or tissue to the appropriate limit.”

Derived limits: are related to primary limits by a defined model such that if the derived limits are observed, it is likely that the primary limits would be observed. A commonly used derived limit is the **derived air concentration (DAC)**.

Desiccant: a substance that removes moisture from the air.

Dewatering well: a borehole drilled into bedrock and equipped with a pump to pump out seepage water on a continual basis.

Diurnal: daytime.

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Dose equivalent limits (DELs) or primary limits: apply to an occupationally exposed individual and a critical group of exposed members of the public. A dose equivalent is a measure of the total quantity of radiation to which the whole body of a person is exposed. The ICRP's DELs apply to the sum of the relevant doses from external exposure in a specified period and the 50-year committed dose from intakes in the same period. Both external and internal exposures must be considered when assessing compliance with DELs.

Emanation co-efficient: expresses the fraction of the radon atoms which emanate from radio-active materials.

Exothermic reaction: a chemical reaction which gives off heat e.g. oxidation of pyrite.

Fracture zone: a rock mass with numerous cracks caused by deformation and stress.

Fugitive dust: emissions of those air pollutants that enter the atmosphere without first passing through a stack or duct designed to control their flow.

Fumigation: a very high concentration of fumes and gases near ground level under extreme temperature inversion conditions.

Gamma ray: a discrete quantity of energy, without mass or charge, that is propagated by a wave. Emitted as a radio-nuclide.

Gneiss: a foliated metamorphic rock of coarse grain with a banded appearance.

Grit blasting: the use of coarse silica (grit) under very high pressure to clean out the interior of pipes etc.

Ground water: water flowing under the ground surface. At Rössing, the term is used to describe naturally occurring ground water (as opposed to Seepage, see below).

Gypsum: calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), (often builds up as a scale inside pipes).

Heavy metal: metals with a high specific gravity e.g. lead, copper, nickel, zinc etc., which are soluble in water at a pH of less than 5.0.

Hydraulic conductivity: a measure of the ability of a material to conduct ground water.

Igneous rocks: rocks which are usually crystalline or glassy that have solidified from magma (molten rock).

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Impervious: prevents the passage of liquid or any other substance.

Ionisation: the process by which a neutral atom or molecule acquires an electric charge. The production of ions.

Ionising radiation: radiation that produces ionisation in matter. Examples are alpha particles, beta particles, gamma rays, X-rays and neutrons.

Isotope: nuclides with the same number of protons, but different numbers of neutrons.

Jarosite: a radio-active form of gypsum (see Gypsum).

Leachate: a liquid, resulting from percolation of rainfall through a landfill site combined with the products of in situ decomposition, which seeps from a landfill site.

Leaching: the process of dissolving out uranium from the ore using sulphuric acid.

Lithostratigraphy: rock sequence.

Marble: a metamorphosed limestone. The calcium carbonate of the limestone is recrystallised as calcite.

Membrane: a liner, usually made of plastic, which is used to prevent liquids from penetrating the ground.

Metamorphic rocks: sedimentary or igneous rocks which have undergone changes brought about by heat or pressure.

Monitoring borehole: borehole used to collect water samples and record water levels to monitor changes in chemistry and hydraulic characteristics.

Muckpile: loose pile of rock which forms at the base of the bench after blasting.

Neutron: an elementary particle with unit atomic mass approximately and no electrical charge.

Non-point source: a diffuse source of pollution, usually uncontrolled eg a gravel road or the tailings dam.

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Nuisance dust: also known as fall-out dust. This dust is visible to the naked eye and has a size range of >20 to <200 μm .

Occupational health exposure: an exposure occurs when a person is exposed to liquids, solids and gases as part of their normal job function.

Paddy: a small, basin-shaped disposal area on the tailings impoundment (see **Tailings impoundment**) which is built up in incremental lifts. Water from the tailings slurry accumulates in the centre of the paddy from where it is returned to the plant.

Particulate dust: dust derived from controlled or point sources, such as stack emissions.

Particulates: airborne particles (dust).

Penstock: the conduit which drains water from the paddy pools.

Permeability: refers to the ease with which gases and liquids penetrate and pass through unconsolidated (soils, alluvium) and consolidated (rock) materials.

Phreatic surface: water table

Piezometer: an instrument that measures the magnitude and direction of water pressure in a borehole.

Piezometric head: interstitial water pressure e.g. in a tailings impoundment.

Plant Spillage Sump: a large, partially lined pit situated below the thickeners and leach tanks, which collects all spills and runoff from the plant area up gradient of it (also referred to as a "snake pit").

Point source: a single, often controlled point of emission eg a stack or fan outlet.

Pollution: the introduction into the environment of any substance which has, or results in, harmful or undesirable effects to man and the environment.

Primary aquifer: a water bearing zone in which all the interstitial pores are hydraulically connected i.e. saturated. At Rössing, the primary aquifers are found in the alluvial silty sands and gravels which have accumulated on the valley floors.

Proton: an elementary particle with unit atomic mass approximately and unit positive electrical charge.

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Pyrite: iron sulphide, FeS_2 , which is used at Rössing to manufacture sulphuric acid in the acid plant.

Pyrite: iron sulphide, FeS_2 , which was used historically at Rössing to manufacture sulphuric acid in the acid plant.

Quartz: a hard, glass-like mineral made from silica, SiO_2 .

Quartzite: a quartz sandstone with a quartz cement.

Radiation: the process of emitting energy as waves or particles (refers to **ionising radiation** in the text).

Radio-active decay: the spontaneous transformation of a radio-nuclide. The decrease in activity of a radio-active substance.

Radio-activity: the property of radio-nuclides of spontaneously emitting ionising radiation (see **ionising radiation**).

Radio-nuclide: an unstable nuclide that emits ionising radiation (see **ionising radiation**).

Radon daughters: the radon daughters of major importance are polonium⁻²¹⁸, lead⁻²¹⁴, bismuth⁻²¹⁴ and polonium⁻²¹⁴.

Radon: radon⁻²²² is an inert, radio-active gas formed by the radio-active decay of radium⁻²²⁶, a long-lived member of the uranium⁻²³⁸ decay series.

Raw water: fresh water sold to Rössing in bulk by the Dept of Water Affairs.

Respirable dust: dust with a particle size less than 10 μg , which can be inhaled.

Risk assessment: a systematic, quantitative evaluation of the health and environmental risk of exposure to chemical or physical agents.

Risk management: the process of evaluating alternative options and strategies for reducing risks and selecting the best option.

Schist: a foliated metamorphic rock of medium to coarse grain.

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Secondary aquifer: water bearing strata in which the water is contained in fractures and fissures in the rock.

Secondary limits: are used when primary dose limits cannot be applied directly. They have been developed for external and internal exposures as follows:

external exposure - limits expressed in terms of dose equivalent indices;

internal exposure - limits expressed in terms of annual limits of intake (ALI).

Seepage: the term "seepage" is used at Rössing to describe the effluents from various mining activities which have seeped into the ground.

Self-confinement factor: gives that fraction of radon atoms that is released into the atmosphere. The factor is a function of the thickness of the radio-active material and the effective relaxation length.

Silicosis: lung fibrosis caused by inhalation of dust containing silica.

Slimes: very fine grained particles (silt and clay) in a water slurry.

Spring: a naturally occurring phenomenon where ground water daylights on the surface of the earth. Springs occur where the water table meets the ground surface or where water under pressure reaches the surface.

Suspended inhalable dust: also known as PM2.5 because it is less than 2.5 μm .

Syncline: a fold in rocks shaped like the letter U.

Tailings impoundment: the area, comprising a series of paddies (see Paddy), in which tailings are disposed.

Tailings impoundment: the area, comprising a series of paddies (see **Paddy**), in which tailings are disposed.

Tailings: the coarse sand and silt which remains after the uranium has been leached out i.e. the waste product of the reduction process.

Thoron: thoron is an isotope of radon⁻²²⁰ and is the product of the radio-active decay series of natural thorium⁻²³².

Tillite: a hard boulder clay, left after the melting of an ice sheet.

Toxic: poisonous.

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Toxicity: the ability of a substance to cause damage to living tissue, impairment of the central nervous system, severe illness or, in extreme cases, death when ingested, inhaled or absorbed by the skin. The toxic hazard of a material may depend on its physical state and on its solubility in water and acids. The hazard also depends on the quantities received.

Transmissivity: the ability of an aquifer to transmit water.

Trigger value: a value, determined by means of a risk assessment which indicates that pollution may be occurring.

WABCO tyres: tyres from the very large haulage trucks used on the mine to carry ore from the pit.

Water table: the upper surface of the ground water.

Working level (WL): is any combination of radon⁻²²² and its daughters resulting in the emission of 1.5×10^5 MeV alpha activity per cubic decimetre of air, or 3.7 Bq/dm^3 radon⁻²²² in equilibrium with its daughter elements.

Yellow cake: ammonium diuranate.