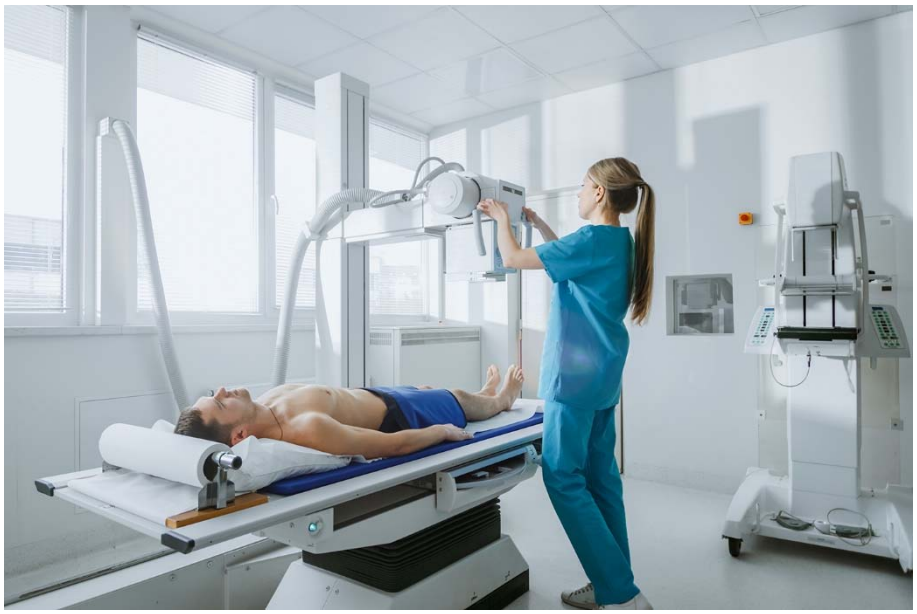
WIM RESOURCE
Think Ahead, Move Ahead



AVONBANK PROJECT
INFORMATION SHEET

RADIATION

FREQUENTLY ASKED QUESTIONS

What do we mean by radiation and radioactive?

A substance is radioactive if some of its atoms radiate or give off energy as particles or electromagnetic waves. Radiation is described as being either ionising or non-ionising.

Ionising radiation has enough energy to strip some electrons from the atoms it collides with, causing it to become charged (i.e., ionised). It can cause chemical reactions, and sometimes biological changes. It includes electromagnetic radiation such as x-rays and gamma rays, and particulate alpha and beta radiation. Naturally occurring radioactive material emit ionising radiation.

Non-ionising radiation is the term given to radiation which has insufficient energy to cause ionisation. It includes electric and magnetic fields, radio waves, microwaves, infrared, and visible radiation.

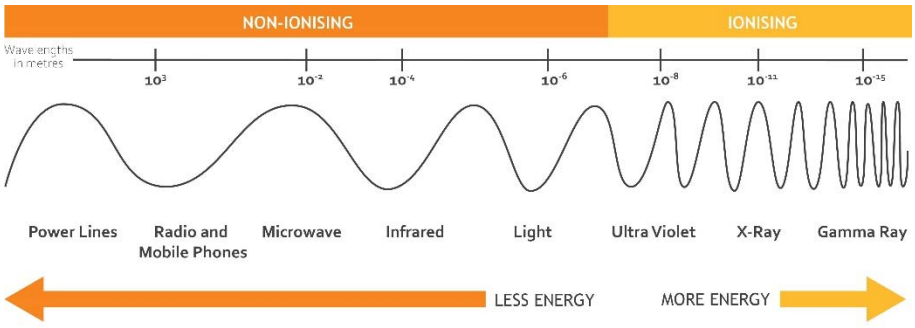


Figure 1: Non-ionising radiation has long wavelengths and uses less energy, while ionising wavelengths have shorter wavelengths and uses more energy.

GLOSSARY

Electromagnetic radiation (waves) – radiation that can be considered as a wave of electric and magnetic energy travelling through a vacuum or a material.

Ionisation – the process by which a neutral atom or molecule acquires or loses an electric charge.

NORMs – naturally occurring radioactive materials e.g., uranium.

Radiation – the process of emitting energy as waves or particles.

Radioactivity – the property of radionuclides of spontaneously emitting ionising radiation

Visible radiation (light) – the sensation of vision and found between ultraviolet and infrared radiations in the electromagnetic spectrum

Wavelength – The distance between successive crests of an electromagnetic wave passing through a given material. Unit: metre (m).

XRF – x-ray fluorescence spectroscopy

For more terms associated with radiation, please visit the Australian Radiation Protection and Nuclear Safety Agency https://www.arpansa.gov.au/understanding-radiation/what-is-radiation/radiation/glossary

Where does ionising radiation come from?

Ionising radiation is everywhere, it is a natural part of our environment and may be either from natural sources or human-made sources:

- 8% comes from cosmic radiation from the sun;
- 8% comes from naturally occurring radioactive materials (NORMs) found in the earth such as uranium, radium and thorium;
- 54% comes from radon (a naturally occurring radioactive gas) that comes from radium present in the soil;
- 11% comes from naturally occurring radioactive elements in food and water such as bananas (potassium-40);
- 15% comes from medical x-rays and nuclear medicine (radiation therapy for cancer);
- 3% comes from industrial uses such as industrial density gauges and power stations, and
- 1% comes from weapons testing.

Everyday environmental radiation is called background radiation.

Is the Avonbank ore radioactive?

Avonbank ore contains approximately 5% (by weight) of heavy minerals, including zircon, ilmenite, monazite and xenotime, and once separated using wet gravity separation a Heavy Mineral Concentrate (HMC) is produced.

Zircon, monazite and xenotime contain very low levels of NORM (principally uranium and thorium) within the mineral grain. While uranium and thorium are naturally present in soils everywhere, the levels are slightly higher in mineral sand deposits, granite, and phosphate rocks.

Will there be other sources of radiation at Avonbank?

At Avonbank, radiation sources that are not NORMs will include nuclear density gauges (for measuring the viscosity of ore slurry), an XRF machine (in the on-site laboratory to measure mineral content), and smoke detectors in offices (these alarms contain a tiny amount of decaying Americium that emits alpha radiation).

What state legislation governs radiation safety?

Radiation practices at Avonbank are governed by the Victorian Department of Health and Human Services as legislated by the Radiation Act 2005 and the Radiation Regulations 2017. The HMC will have radioactive concentrations above the prescribed levels specified in the Act.

As such a Management Licence will be issued to WIM Resources with strict conditions to maintain radiation safety in the workplace and to ensure protection of the environment from radiation.

What are the limits for radiation exposure?

Background radiation in Australia is on average 2.0mSv/year. The world average is around 2.5mSv/year. The highest background radiation occurs in Ramsar (Iran) at 260mSv/year from naturally occurring radium enriched soils and hot springs.

What are comparison exposures?

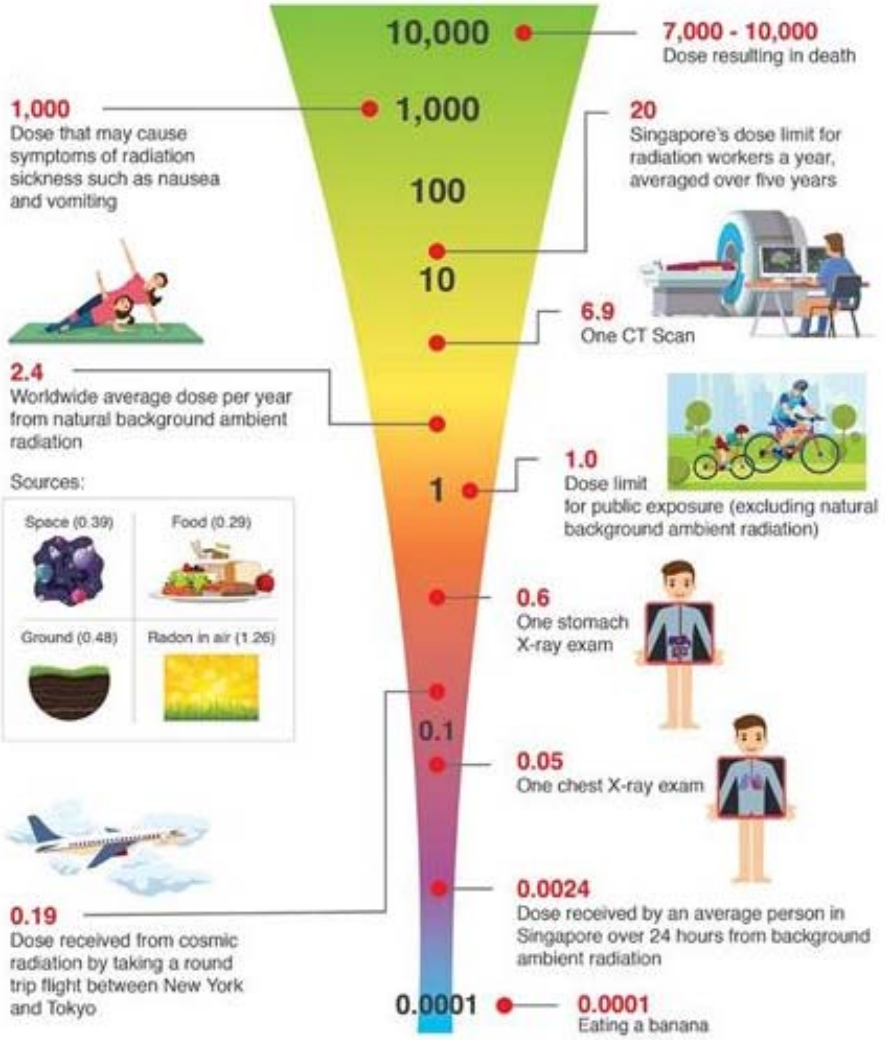


Figure 2: effective radiation dose in mSv . Source © 2021 National Environment Agency. Information made available under the terms of the Singapore Open Data Licence version 1.0

EFFECTIVE DOSE

Effective dose is measured in the international (SI) unit sievert (Sv). Normal radiation protection levels are measured using:

- microsievert (μSv) or 1/1,000,000 Sv
- millisievert (mSv) or 1/1,000 Sv

CONTACT

For more information on WIM's response to radiation, please contact free call 1800 959 298.

Information on the Avonbank Project may also be found on the website www.wimresource.com.au.

Information on radiation can be found at the following government authorities:

Department of Health and Human Services www.dhhs.vic.gov.au

Australian Radiation Protection and Nuclear Safety Agency www.arpansa.gov.au

What are the types of ionising radiation?

Ionising radiation associated with HMC comes in three forms: Alpha, Beta and Gamma.

Alpha radiation consists of heavy, positively charged particles (two protons and two neutrons) emitted by atoms of elements such as uranium and radium. Alpha radiation can be stopped completely by a sheet of paper or by the thin surface layer of our skin. However, if alpha-emitting materials (dusts) are taken into the body by breathing, eating, or drinking, they can expose internal tissues directly and may, therefore, cause biological damage.

Beta radiation are high-energy, high-speed electrons (or positrons) emitted by certain types of radioactive elements such as potassium-40. They are more penetrating than alpha particles and can pass through 1-2 centimetres of water. In general, a sheet of aluminium a few millimetres thick will stop beta radiation.

Gamma rays are electromagnetic radiation similar to X-rays, light, and radio waves. Gamma rays, are more penetrating than X-rays depending on their energy, can pass right through the human body, but can be stopped by thick walls of concrete or lead. Some gamma rays are produced by HMC and density gauges.

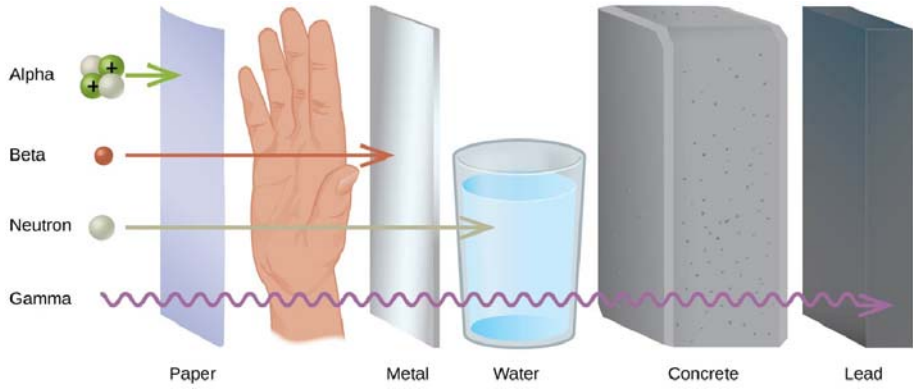


Figure 3: types of ionising radiation. Source: CC BY 4.0; General Chemistry at OpenStax CNX, Contributed by Paul Flowers, Klaus Theopold and Richard Langley et al.

How is radiation exposure managed?

A Radiation Management Plan will be prepared which identifies those areas where radiation exists and how to manage and monitor potential risks.

Our goal is to keep all radiation doses "as low as reasonably practicable" (ALARP principle). Managing exposure is achieved by:

- design (e.g., maintain distance from gauges and stockpiles of HMC);
- housekeeping (keeping dust levels low);
- personal hygiene (hand washing prior eating and smoking);
- procedures (identifying ways to reduce risk);
- permits (restricting access and time); and
- monitoring (wipe tests, dust filters, TLD badges).