Naturally occurring radioactive material (NORM)

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EPA 1107/17: This information sheet explains what naturally occurring radioactive material is and where it is found in the environment, home and industry.

Introduction

What is naturally occurring radioactive material?

Naturally occurring radioactive material, sometimes known as NORM, is the term used to describe any radioactive substance that exists naturally in the environment.

NORM is found everywhere in the environment including soil, rocks, water, air and vegetation. It is also present in the human body and all living tissues. It is typically found in very low concentrations, with potassium-40 being the most common radioactive element in the human body and in foodstuffs.

NORM primarily consists of uranium, thorium and potassium, which have been present since the formation of the earth approximately 4.5 billion years ago. These radioactive elements spontaneously decay to produce a range of other radioactive elements known as decay products such as radon and radium.

Uranium and thorium are typically contained within chemical compounds such as minerals. Geological processes such as weathering, erosion and the dissolution of rocks in groundwater cause these elements to be distributed across the natural environment. Consequently, uranium and thorium can be found in almost all soils.

Radiation from NORM

Everyone receives a background radiation dose of NORM, with the worldwide average being between 1 and 10 millisieverts (mSv) per year. A millisievert is the unit for measuring the dose of absorbed ionising radiation by the human body.

In Australia the average is about 1.5 mSv per year (ARPANSA 2017a) and is a combination of mostly radiation from NORM and cosmic radiation.

When radioactive atoms (radionuclides) decay, they release energy in the form of ionising radiation. There are three types of ionising radiation: alpha, beta and gamma.

Alpha and beta radiation consist of tiny particles that are much smaller than the radionuclide from which they were emitted. Exposure from alpha and beta radiation can arise from the inhalation of airborne radionuclides from sources such as dust and radon gas. Ingestion can occur through drinking groundwater or eating foods containing NORM.

Gamma radiation consists of high energy photons that have the ability to pass through the human body. It is part of the electromagnetic spectrum, like visible light, but with much higher energy. Exposure from gamma radiation from NORM occurs when people are close to a radioactive source, such as uranium bearing rocks, and from the background radiation that is always around us.

Is NORM safe?

Radiation from NORM presents very low risk to the public. It occurs in low concentrations and contributes to everyone's natural background radiation dose.

Natural background radiation levels about 100 times higher (IAEA 1991) than the levels found in Australia occur in several parts of the world and these levels have not been shown to cause any apparent harm to the local population (Ghiassi-nejad *et al* 2002). Locations with these higher background levels include Ramsar in Iran, Guarapari in Brazil, Kerala in India, Yangjiang in China and parts of the Flinders Ranges in South Australia. In Ramsar, a peak yearly dose of 260 mSv has been reported (Karam and Mortazavi 2005).

Figure 1 **Paralana Hot Springs, located at Arkaroola in the northern Flinders Rangers, South Australia. The spring contains elevated levels of radiation, due to a high concentration of uranium in the granite rock beneath. Groundwater flows through fractures in the granite and dissolves uranium and other radionuclides into the water. Energy, in the form of heat, is released when the radionuclides decay, which increases the temperature of the water.**

NORM in the home

Most people are likely to have low concentrations of NORM in their homes. For example, kitchen bench tops made of granite and the always present radioactive gas radon, which is produced from the decay of uranium bearing minerals. Radon is colourless, odourless and chemically inert so it can easily escape from the ground and into the air where it can be inhaled.

Radon is present in air at varying concentrations. However indoor levels are often slightly higher than outdoor due to buildings having the effect of accumulating radon. Places of elevated radon concentrations can include basements, cellars or other underground environments.

The average radon concentration in Australian homes is generally very low and poses minimal concern to health (ARPANSA 2017b).

NORM and industry

Industries are required to thoroughly identify all radiation hazards specific to their operations and implement appropriate control measures to ensure exposure to ionising radiation to workers and members of the public are below specified exposure limits.

The most obvious industry that handles NORM is the uranium industry. If the uranium concentration within an area is high enough such that it can be economically extracted, then mining and processing of that area to produce uranium concentrate is feasible. Even though the uranium oxide concentrate produced (the yellowcake that is shipped from uranium mines in drums) is technically still a NORM, it is generally managed and regulated in the same way as man-made radioactive substances.

Some mining operations encounter NORM as a byproduct. Heavy mineral sands mining, which produces titanium and zirconium for the production of paints and ceramics, often encounters elevated levels of uranium and thorium radionuclides once the valuable metals from the ore have been extracted.

Coal-fired power stations discharge NORM to the environment through air emissions from the burning of coal and the disposal of fly ash. This is because most of the coal mined from the earth naturally contains uranium and thorium radionuclides.

The oil and gas industry often encounters NORM during the extraction and processing stages. NORM can be released when the oil and gas is pumped from deep underground to the surface. It generally accumulates as scale on the inside walls of pipes, causing elevated levels of radiation.

Underground operations, such as mining and tunnel construction, can release NORM in the form of radon gas, particularly in areas with high concentrations of uranium. Radon will naturally emanate from the walls, floors and ceilings in underground areas. For people working in these conditions, adequate ventilation is required to reduce the risk of exposure via inhalation.

Sometimes NORM can exist at levels that require control, such as in uranium mining. Exposure is typically internal, due to the inhalation of radon and radioactive particles in dust.

However, most NORM encountered in industry is not regulated. Below a certain concentration, it is excluded from regulation as it presents low risk, for example radon in homes.

What is the EPA's role with respect to NORM in South Australia?

The EPA plays an important role in the regulation of radioactive material by administering the *Radiation Protection and Control Act 1982* and acting in an advisory capacity to other government agencies, industry and the public.

During the construction and operation of facilities that handle NORM at concentrations requiring regulation, the EPA acts directly as the regulator for the activities in regards to licensing the operators and ensuring they comply with the Act and the *Radiation Protection and Control (Ionising Radiation) Regulations 2015*.

References

ARPANSA 2017a, *Ionising radiation and health*, Australian Radiation Protection and Nuclear Safety Agency, viewed 13 December 2017, www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/ionising-radiation-and-health.

ARPANSA 2017b, Radon map of Australia, Australian Radiation Protection and Nuclear Safety Agency, viewed 13 December 2017, www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/radon-map.

IAEA Bulletin 1991, *High levels of natural radiation*, Report of an international conference in Ramsar, International Atomic Energy Agency, Vienna.

Ghiassi-nejad M, Mortazavi SMJ, Cameron JR, Niroomand-rad A and PA Karam 2002, 'Very high background radiation areas of Ramsar', *Health Physics*, Volume 82, Number 1.

Karam PA and , SMJ Mortazavi 2005, *Ramsar hot springs: how safe is to live in an environment with high level of natural radiation*, (JAERI-Conf--2005-001), Japan.

Further information

Legislation

Online legislation is freely available. Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet
Adelaide Service SA Centre
108 North Terrace
Adelaide SA 5000

Telephone: 13 23 24
Facsimile: (08) 8204 1909
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General information

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