Australian Government
Australian Radiation Protection and Nuclear Safety Agency

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Occupational exposure: Mineral sand mining and processing workers

Summary

Workers involved in the mining and processing of mineral sands contain radioactive minerals are occupationally exposed to ionising radiation. Current industry exposures are low; regulations, controls and exposure monitoring are required to keep exposures low.

What do I need to know?

Mineral sand ores contain titanium bearing minerals of ilmenite, rutile and leucoxene as well as the mineral zircon. They also contain trace quantities of the radioactive elements of uranium and thorium particularly monazite which is a mineral with reasonable thorium concentration (5-7%). Due to the radioactive nature of the ore ionising radiation exposure in the mining and processing of mineral sands comes externally from gamma radiation emitted or internally from the inhalation of ore and process dusts.

Dry plant separation processes and the processing, handling and storage of monazite carries the highest exposure risk, predominantly from the inhalation of dust exposure pathway.

What is the possible exposure?

Occupational exposures in the mining and milling of mineral sands in Australia are low. Data from the Australian mineral sands industry (2000 – 2008) shows average exposures for workers in dry separation plants to range 1.3 – 3.1 mSv (milliseiverts) per year during that period. Exposure to mining operators is much lower (<0.1 mSv per year) due to vehicle shielding, cabin ventilation and lower concentrations of radionuclides in the ore compared with processed materials.

In comparison average background radiation exposure in Australia is 1.5 mSv per year from natural sources and currently Australians are exposed to an average of 1.7 mSv per year from medical exposures.

What are the possible health effects?

Dose range (millisieverts)	**Description**	**Possible health effects**
Up to 10	Very low dose	None observed or expected (typical background range)
10–100	Low dose	Plausible health effects but not observed
100–1000	Moderate dose	Increase risk of cancer Acute effects at higher end of range (above 500 mSv)
Above 1000	High dose	Acute effects (burns, vomiting) Death possible at very high doses (above 5000 mSv)

No health effects have been observed or are expected to be observed at the very low doses normally received in this occupation.

Ionising radiation has been proven to cause harmful short term effects at moderate and high doses received in short periods of time, above 500 mSv, with an increased risk of cancer shown to occur for long term exposures of above 100 mSv.

Without appropriate controls low dose exposure (a few tens of millisieverts per year) can occur in mineral sands mining and processing.

At current exposures the risks are very low and comparable with the risks of exposure from background and medical radiation exposure.

Who is responsible for your safety?

In Australia the use of irradiating apparatus and radiation sources is regulated. Each state and territory is responsible for enforcing their respective radiation safety act and regulations in their jurisdictions. The Australian government is responsible of enforcing the radiation safety act and regulations of commonwealth entities only.

Organisations/employers are responsible for:

- devising, implementing, and regularly reviewing their radiation management plan
- regulatory compliance
- induction and ongoing training of workers, including contractors.

Workers are responsible for:

- following radiation protection practices specified in the radiation management plan
- complying with legitimate instructions of the employer or designated radiation safety officer
- participate in radiation protection training.

What is a radiation management plan?

Operators of each mineral sand mine and mill are required to have an approved Radiation Management Plan that complies with the requirements of the Code of Practice and Safety Guide for radiation protection and radioactive waste management in mining and mineral processing. All relevant controls for radiation protection must be included in this plan and the plan must be adhered to.

Controls must adhere to the hierarchy of control. Minimising time, increasing distance and shielding can be used to reduce gamma radiation exposure while ventilation is critical to reduce exposure from the inhalation pathway, when required respiratory protection may be needed as an additional control.

What are dose limits?

All Australian jurisdictions have uniform annual limits for public and occupational exposure to ionising radiation: 1 mSv for the public and 20 mSv for workers who are occupationally exposed. Despite this, there are different definitions of who is

'occupationally exposed' and who should wear personal dosimeters. You can further discuss occupational radiation exposure with your facility's Radiation Safety Officer or the relevant jurisdictional regulator.

For a pregnant radiation worker, the dose to the unborn child is restricted to the same as a member of the public – 1mSv. (See Management of Pregnant Workers Exposed to Ionising Radiation factsheet (/understanding-radiation/sources-radiation/occupational-exposure/occupational-exposure-management))

Further information

- Radiation Protection and NORM Residue Management in the Zircon and Zirconia Industries
- *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (/regulation-and-licensing/regulatory-publications/radiation-protection-series/codes-and-standards/rps9)*
- Australian National Radiation Dose Register (/our-services/monitoring/australian-national-radiation-dose-register)

ARPANSA respectfully acknowledges the Traditional Owners and Custodians of Country throughout Australia and their continuing connection to land, waters and community. We pay our respect to Aboriginal and Torres Strait Islander Peoples, their cultures, and to Elders past, present and emerging.

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