WHAT IS RADIATION?

Put simply, radiation is energy moving through space. There is natural background radiation all around us: in the ground, the food we eat, the air we breathe and cosmic rays from space. This natural background radiation gives us a ‘dose’ of about 2 or 3 millisieverts per year (mSv/yr).

‘Man-made’ radiation is also part of our everyday life. It is used in x-rays, organ scans, smoke detectors, industrial gauges and in the sterilisation of medical equipment and certain food stuffs.

The common types of radiation are:

- alpha particles (α), which can't penetrate the skin, but can be hazardous if inhaled in high concentrations
- beta particles (β), which can penetrate a centimetre or so into the body, but are blocked by a thin sheet of metal
- gamma rays (γ), which can go right through the body and require thicker materials to stop them, but aren't harmful at low levels.

MORE ABOUT RADIATION

BACKGROUND RADIATION OCCURS ALL AROUND US AND IS EASILY MEASURED AND CONTROLLED. IN FACT, RADIATION RISKS TO THOSE WORKING AND LIVING NEAR A MINE ARE VERY LOW.
WHAT ARE THORIUM & URANIUM?
Thorium and uranium are elements that are naturally occurring and radioactive. They are present in low concentrations nearly everywhere in nature. This includes in rocks, soils, water, plants, and animals, as well as humans. The average amount of thorium in rocks and soils is 11 ppm.

Uranium is in ordinary soil at about 3 ppm, up to 50 ppm in some granites and generally above 1,000 ppm in uranium ores. These amounts vary depending on the geology of the region. In some places the levels are much higher.

RADIATION DOSE LIMITS
Radiation dose limits are set at an international level and adopted by countries around the world. The limits are for doses from the workplace and do not include medical doses, or natural background radiation.

Public Limit
Worker Limit
1 mSv/yr
20 mSv/yr

DOSE COMPARISONS
Workers
Australasian uranium, rare earth & mineral sands miners 1 to 5 mSv/yr
Other radiation workers (e.g. radiographers, commercial flight crews) 1 to 5 mSv/yr
Medical doses
CAT-scan
Heart stress test
Other nuclear medicine scans
10 to 20 mSv
12 mSv
5 mSv

HOW IS RADIATION MEASURED?
Radiation is easy to measure. Different types of equipment are used to measure the different types of radiation. For example, to measure gamma radiation, you use a Geiger counter.

For people, the amount of radiation that interacts with your body is called exposure. The impact that radiation has on you is called a dose. Radiation doses are measured in sieverts (Sv) and one thousand of a sievert is known as a millisievert (mSv). Radiation workers usually get doses of several thousandths of a sievert in a year.

HOW DO YOU GET A DOSE?
There are three pathways to get a dose:

1. Gamma radiation ‘shine’
2. Breathing in radioactive dust
3. Eating radioactive dust

HOW DO YOU CONTROL RADIATION DOSES?

GAMMA SHINE
This depends on:
- size of source
- distance from source
- concentration (ore grade)

It can be controlled by:
- time - reducing the time spent near the source
- distance - increasing the distance from the source
- shielding - shielding the source (if needed)

BREATHING IN DUST
This is controlled by preventing or minimising the production of dust (by using methods such as water sprays), and by wearing dust masks as a precautionary measure.

EATING DUST
This is controlled by:
- personal cleanliness - washing your hands and face before meals
- workplace cleanliness - regularly cleaning work areas and crib rooms.

SAFETY
At a mine site, radiation is just one of many industrial hazards that must be managed. The main workplace risks are ordinary industrial accidents, such as slips, trips and falls, vehicle accidents and chemical incidents, or industrial hearing loss.

Chronic (ongoing, long duration) high doses of radiation well above those expected at Nolans are known to result in an increased chance of cancer, so Arafura will continue to manage, monitor and minimise all workplace risks including the radiation risk. The radiation management issues at Nolans will be very similar to those of mineral sand mines, which have operated safely in Australia since the 1930s.

Arafura takes radiation management very seriously. The company has monitored and recorded the levels of radiation experienced by workers during all major exploration campaigns at Nolans for the past 15 years. This has allowed Arafura to develop specific radiation safety rules based on real measurements.

Arafura has flown aerial surveys to determine zones of higher radioactivity and continues to monitor the general area around Nolans.

Arafura’s radiation measurements confirm its workers’ doses are well below the regulatory limit and in line with other radiation workers.

WHAT ABOUT RADON GAS?
Radon is a naturally-occurring radioactive gas present in the air that comes from uranium and thorium. It does not require active control except in enclosed spaces, such as in underground mines, where it can build up.

The concentration of radon outdoors depends on a couple of factors:
- rock properties (for example uranium and thorium content, porosity and moisture content), which affect the release of radon from the material
- weather conditions (for example wind and temperature), which affect how fast radon disperses into the atmosphere.

Radon concentration outdoors normally follows a daily pattern, peaking early in the morning when weather conditions tend to be cooler and colder, then dropping during the afternoon when air mixing increases because of the hotter air and wind. These concentrations vary naturally by factors of 10 to 100. The additional radon resulting from a mining process is very small compared with the natural daily variations.

Measurements at other mines have found the level of extra radon as a result of operations is not much above natural background levels.

As you can see in the graph below, radon added by mining is a fraction of the natural daily variation.

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WHAT ABOUT TAILINGS?

The chemical processes used by Arafura to recover the rare earths at Nolans will separate the uranium and thorium, removing it from the rare earth and phosphoric acid products, before its final disposal in tailings storage facilities. The amount of uranium and thorium in tailings will be similar to that in the Nolans orebody.

During the life of the operation, tailings will be managed to minimise dust and exposure to radiation. The way in which tailings are managed at mine sites is pretty standard. They are pumped to storage dams so they are typically about 60% water and 40% solids. Because they are fine-grained material, the tailings stay moist for a long time which limits the chance of dust blowing off the surface.

When the mine closes, the tailings will be covered with a layer of rock, which will prevent erosion and provide a barrier to shield against the low levels of radiation.

HOW IS RADIATION REGULATED?

Because there is uranium and thorium in the orebody, radiation must be monitored and controlled at Nolans. Arafura is bound by the same standards that apply to uranium mines (and other radiation workplaces) in Australia, and throughout the world.

In the Northern Territory, radiation in mining is regulated by the Department of Industry, Tourism and Trade, the Department of Health, and NT WorkSafe. Companies must submit and have approved by the regulator a Radiation Management Plan to the regulator before starting exploration, mining or processing operations, showing how radiation will be managed and controlled.

MORE INFO

These issues and others have been addressed in greater detail in the Nolans Environmental Impact Statement, which demonstrates that Arafura understands and can manage all potential impacts and risks.

We are happy to come and talk to community groups in Central Australia and there are some useful references below.

Nolans Environmental Impact Statement
www.arultd.com/projects/nolans/eis.html

Minerals Council of Australia
www.minerals.org.au or go to www.minerals.org.au/minerals/uranium for information on the uranium industry in Australia

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

Australian Nuclear Science and Technology Organisation (ANSTO)
www.ansto.gov.au

U.S. Environmental Protection Agency
www.epa.gov/radiation