GDF

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The science files

Version 2 - 01/2022

What is radioactive waste?

Nuclear Waste Services

What is the challenge?

The UK has radioactive waste that needs to be managed safely. Radioactive waste emits high energy radiation, also called 'ionizing' radiation. If this gets into our bodies, it can damage them and can cause cancer or hereditary defects. The greater the dose of radiation received, the greater the chance of this happening.

All of us are continually exposed to naturally occurring low levels of ionizing radiation in our everyday lives. This comes from cosmic rays that enter our atmosphere, from the rocks beneath our feet and from eating, drinking and breathing substances that emit radiation. We have evolved to thrive with these natural background levels. We also use ionizing radiation to our benefit in food preservation, in the smoke detectors in our homes, and in certain medical applications, for example in diagnostic tests such as X-rays and CT scans. However, significantly increasing the amount of radiation that we are exposed to can cause harm.

Source of Exposure	Radiation Dose (mSv)*
Dental X-ray	0.005
100g of Brazil nuts	0.010
Chest X-ray	0.014
Transatlantic flight	0.08
Average annual occupation exposure for a nuclear power station worker (2010)	0.18
UK annual average dose from natural radiation gas	1.3
UK average annual radiation dose	2.7
CT scan of the chest	6.6
Average annual dose to people in Cornwall from natural radon gas	7.8
Annual exposure limit for nuclear industry employees	20
Level at which changes in blood cells can be readily observed	100
Acute radiation effects observed, including nausea and a reduction in white blood cell count	1000
Dose of radiation which would kill about half of those receiving it in a month	5000

Figure 1: Typical amounts of radiation received from everyday activities compared to those that can cause harm.
*A millisievert, or mSv, is a unit of measurement of radiation dose

Some radioactive wastes emit a lot of radiation, so are potentially dangerous if not handled properly. Three types of radiation can be given off. Alpha radiation travels only very short distances in air and a sheet of tissue is enough to block its passage. Beta radiation can be stopped by a few millimetres of aluminium. Gamma radiation requires several centimetres of lead or a metre or two of rock or concrete to stop it.

You can read more about the different types of radioactive waste in a separate note we have produced, called "What will go into a GDF?"

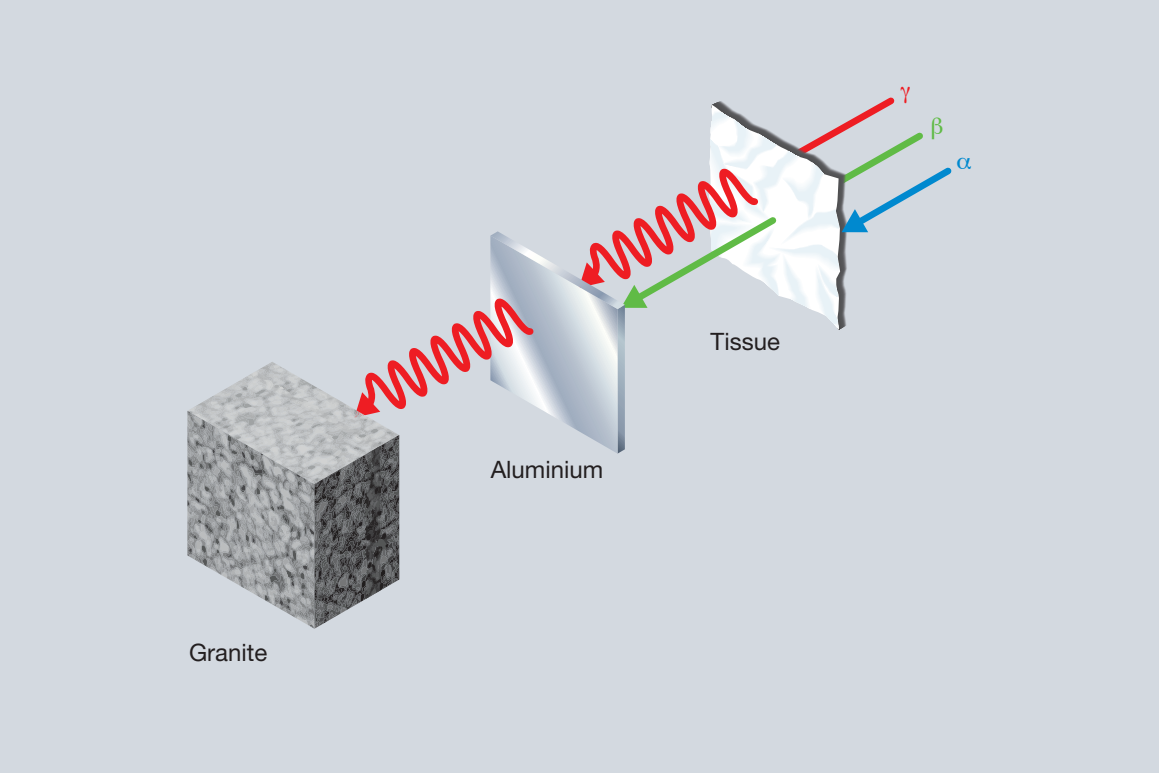

Figure 2: Ease of stopping different types of radiation.

Radioactive waste could cause harm if people were exposed to the radiation it emits in the following ways:

- By direct exposure to beta or gamma radiation (our skin provides an effective barrier against alpha radiation).
- If the radioactive materials in the waste were released into the environment in a form where they could enter our food or drinking water or be inhaled in the air we breathe.

We protect ourselves from radioactive waste by taking steps to stop the radioactive component from getting into our food or drinking water supplies, and by using appropriate shielding materials to prevent direct exposure.

Unlike other hazardous wastes, radioactive waste becomes less dangerous over time. This is because it undergoes radioactive 'decay', i.e. it gives off radiation and eventually becomes a stable (non-radioactive) material.

The time it takes for decay to occur depends on the 'half-life' of the radioactive material in question, which is the time taken for the amount of this material to halve. Half-lives of different radioactive materials vary between fractions of a second and millions of years. After the passage of 10 half-lives, less than one thousandth of the original material remains – after 20 half-lives, less than one millionth.

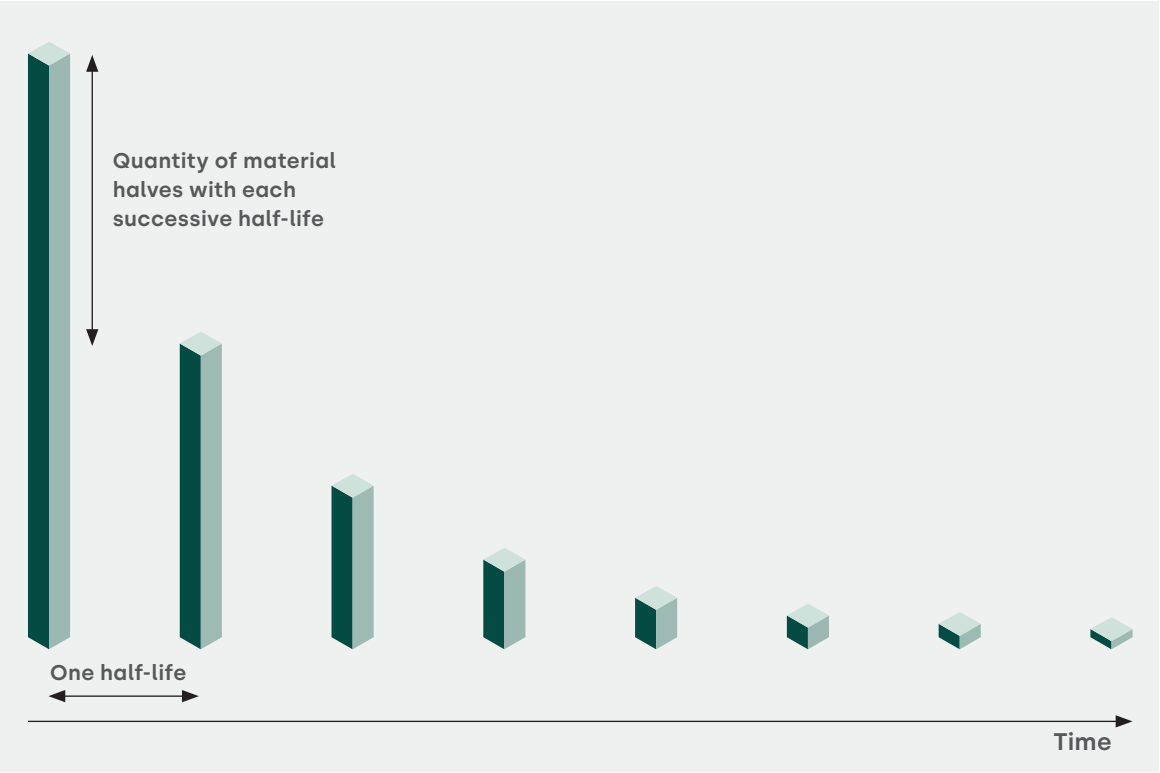

Figure 3: Representation of radioactive decay showing how the amount of material falls over time.

The half-life of a particular radioactive material is constant – it never changes. This means we can work out how long it will take for radioactive waste to become harmless, and plan accordingly.

Some radioactive wastes also contain toxic substances such as heavy metals or asbestos. These chemical hazards also need to be considered when planning how to dispose of radioactive waste safely.

It is internationally accepted that the safest and most secure option for managing the more dangerous forms of radioactive waste is through geological disposal – permanently putting the waste deep underground.

To find out more, go to part 2 of The science files: 'What will go into a GDF?'