Radioactivity and Health

Factsheet:// 4

This factsheet introduces naturally-occurring and man-made radiation and some of the sources from which we are exposed. It goes on to explain how the risks posed by the radioactive materials from submarines will be carefully managed during and after the dismantling process.

Introduction

Everybody is exposed to natural radiation all the time and the vast majority receive their highest exposure, or radiation 'dose' from naturally occurring radiation sources. Doses from man-made radiation are usually much smaller than those from natural radiation but vary considerably.

Radiation Doses

Ionising radiation is produced from natural and man-made radioactive materials. Naturally occurring radiation is present in the environment from radioactive minerals remaining from the very early formation of the planet. This leads to exposure to gamma rays and radioactive radon gas from certain rocks and from radioactive material in our food and drink. We are also exposed to natural ionising radiation that comes from outer space and passes through the atmosphere of the planet - so-called cosmic radiation.

There are three main sources of man-made ionising radiation. Firstly, it is used for medical diagnostic purposes, such as X-rays and CT scans, and treatment of some diseases such as cancer. Secondly, radioactive materials are used in industry, primarily for producing electricity and for measurement purposes. Thirdly, it is present as fallout from previous nuclear weapon explosions and from accidents or incidents world-wide.

Ionising radiation has enough energy to cause damage to human cells, which can increase the risk of cancer later in life. However, these risks to health are relatively low. In general the health effects of ionising radiation are dependent on the dose received. While low doses increase the risk of cancer later in life, very high doses can be fatal in a shorter timeframe.

In the UK the Health Protection Agency (HPA) has calculated that on average people are exposed to about 2.7 millisieverts (mSv) of radiation a year. The chart overleaf shows the average annual radiation doses as a result of some everyday activities.

Sources of radiation dose

Medical - X-rays and radioactive materials are used to diagnose disease and medical radiation is the largest source of man-made exposure of the public.

Gamma rays – Gamma rays are emitted by natural radioactivity in the earth and building materials. People are exposed to gamma rays indoors as well as outdoors. The dose depends upon the local rocks and soils, and the nature of the building materials.

Radon – Radon gas comes from uranium that occurs naturally in the ground. We all breathe it in throughout our lives. Out of doors it disperses widely, and levels are low, but indoors levels can build up considerably.

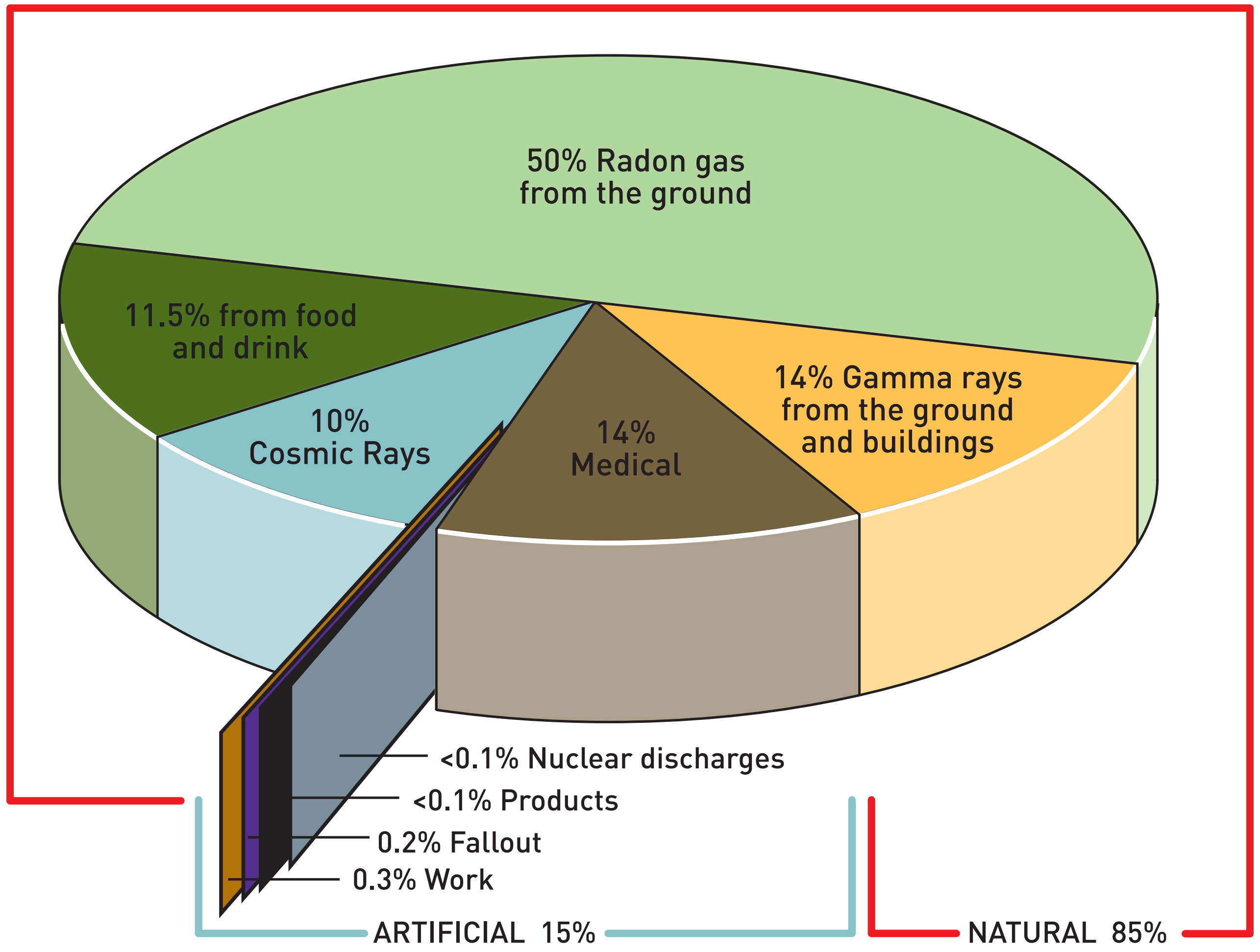
Food and drink – Radioactive materials occur at different levels in different foods. There is little possibility of reducing exposure from natural radioactivity in diet.

Cosmic rays – Radiation doses from cosmic rays increase with latitude and altitude. The rays readily penetrate the fuselage of aircraft and the fabric of buildings.

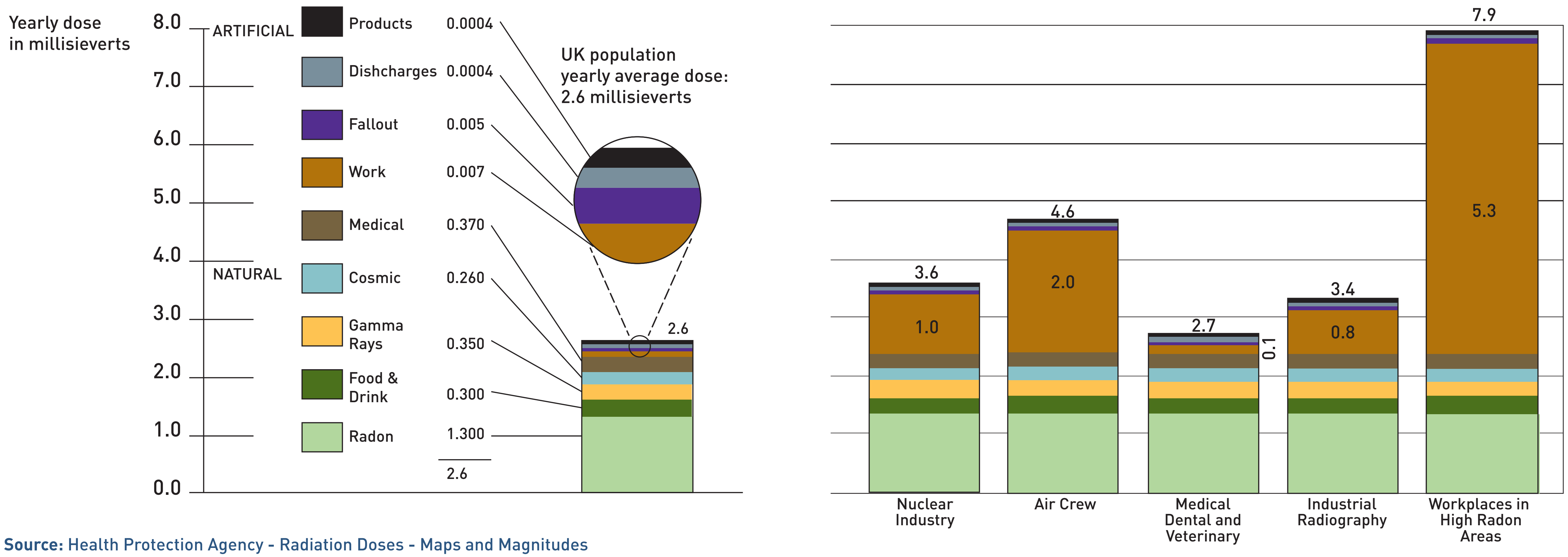
Environmental – Radioactive materials are discharged to the environment by the nuclear and other industries, by Universities and hospitals. These discharges are controlled and have been continually reduced.

Work - The overall doses received by groups of workers show that the most exposed are those who received their doses from natural sources. About 156,000 people in the UK are exposed to man-made radiation as a result of their work. Average annual radiation doses are: for the nuclear industry, 1 mSv; for general radiation workers, 0.5 mSv; for medical radiation workers, 0.1 mSv.

Source: Health Protection Agency - Radiation Doses - Maps and Magnitudes



This chart shows the yearly doses for different occupational groups compared with the UK average



Source: Health Protection Agency - Radiation Doses - Maps and Magnitudes

Submarine dismantling will involve radiation doses to workers that are well below the legal limits and discharges will be controlled and monitored to ensure there are no ill effects

Submarine dismantling and radioactive materials

In many ways, submarine dismantling will be similar to the dismantling of a large, conventionally powered ship but the important difference is that the initial dismantling activity will also require the safe management of radioactive materials.

The submarine nuclear reactor is designed to be compact and very well-shielded within the Reactor Compartment (RC) of the submarine. Almost all of its radioactivity is contained within the robust metal structure of the Reactor Pressure Vessel (RPV) and all the highly radioactive fuel is removed from the RPV shortly after the submarine leaves service. What remains for initial dismantling is the metal in the RPV that has become radioactive during operation, and the pipe work connected to the RPV that has been contaminated with small amounts of radioactive deposits. There may also be small amounts of radioactive contamination in other parts of the submarine, outside the Reactor Compartment.

What are the risks of accidents and leaks from the dismantling process and how will the risks be managed?

No industrial activity (nuclear or conventional) is risk free, and activities involving radiation can be harmful to both humans and the environment if not properly managed and controlled. For this reason, submarine dismantling activities will be carried out to stringent safety standards and will be closely regulated by independent bodies (for more information see the **factsheet on Regulation**).

Before any dismantling activities can begin, a Safety Case must be prepared. The Safety Case must prove to the regulators that every conceivable accident scenario has been assessed and that all reasonable measures have been put in place to prevent accidents from occurring and to minimise their impact if they do occur.

It is physically impossible for there to be a nuclear reactor accident during the dismantling process as all the nuclear fuel is removed from the submarine before it is dismantled. Also, as the vast majority of the radioactive material remaining in the submarine is fixed within the solid metal of the RPV, the risk of radioactive material escaping is extremely small.
The initial dismantling process will also carefully manage the much smaller amounts of radioactive contamination that may be found in the submarine outside the Reactor Compartment. All materials removed from the submarine will be fully monitored and controlled to ensure that all hazardous material, whether radioactive or non-radioactive, is properly managed in line with strict regulatory requirements.

Will there be radioactive discharges and how will the public and the environment be protected?

As with other similar industrial sites dealing with radioactive material, dockyards are permitted to discharge liquids containing very small quantities of radioactivity into waterways. Discharges are controlled within strict limits set by the Environment Agency or Scottish Environment Protection Agency and the local environment is monitored to be sure that there are no ill-effects from these discharges.

How will workers be protected from radiation?

Workers' exposure to radiation from submarine dismantling activities will be carefully managed to reduce any health risk to levels that are as low as reasonably practicable. The annual radiation dose received by workers will be well within the limits set by UK law.

A variety of methods can be used to protect both workers and the public from radiation including shielding (to block radiation), containment (to prevent radioactive materials escaping) and strict controls on access to areas where there are radiation hazards. The selection and use of suitable methods is part of the rigorous design process that supports the Safety Case that must be approved by regulators.

Comparison of doses from sources of exposure

Sources of Exposure	Dose (mSv)
Dental X-ray	0.005
Chest X-ray	0.02
Transatlantic flight	0.07
Nuclear power station worker average annual occupational exposure	0.2
UK annual average radon dose	1
CT scan of the head	1.4
UK average annual radiation dose	2.7
USA average annual radiation dose	6.2
CT scan of the chest	6.6
Average annual radon dose to people in Cornwall	7.8
Whole body CT scan	10
Annual exposure limit for nuclear industry employees	20
Acute radiation effects 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

Source: Health Protection Agency, www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation

Glossary

Atoms - The building-blocks of all matter. Miniscule in size, e.g. one human hair is one million carbon atoms wide. Consists of a nucleus of neutrons and protons, plus electrons which surround the nucleus.

Radioactivity - When an atom's nucleus is unstable and gives up excess energy or mass which is ejected from the atom – called disintegration, or radioactive decay. There are different types of radioactive decay, but all are called 'ionising radiation' because electrically-charged particles called 'ions' are produced in the material it strikes. When humans absorb radiation, it is commonly referred to as a dose.

Millisievert - A unit of radiation dose. 1 millisievert (1 mSv) is 50 times the radiation dose from a single film chest X-ray or less than half the average annual dose from natural radiation in the UK.

Dose Limits - The dose limits recommended by the International Commission on Radiological Protection (ICRP), and regulated in the UK by the Office for Nuclear Regulation, are used to regulate exposure:

- for occupational exposures, 20 mSv/y averaged over 5years, with no more than 50 mSv in any 1 year
- for the public, 1 mSv/y