



**White Paper**

**Radon - what are the risks?**

October 2023

## Radon - what are the risks?

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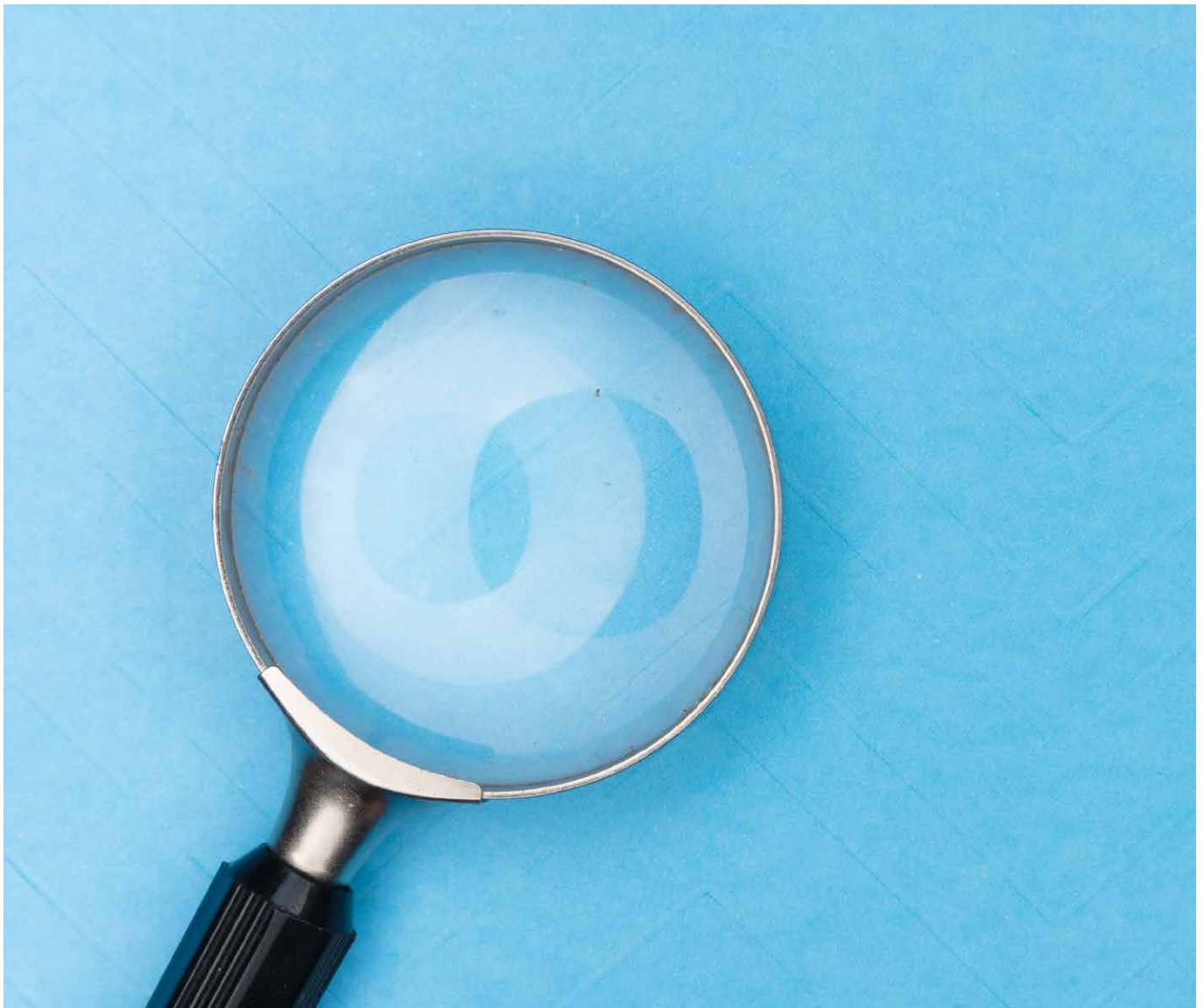
Over the Summer a high-profile prosecution of a school in Bath, has raised questions about radon from organisations wanting to know what they need to do.

Our October whitepaper is taking a closer look at radon and some of the issues around assessing your risk and managing it.

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## 1. What is radon?

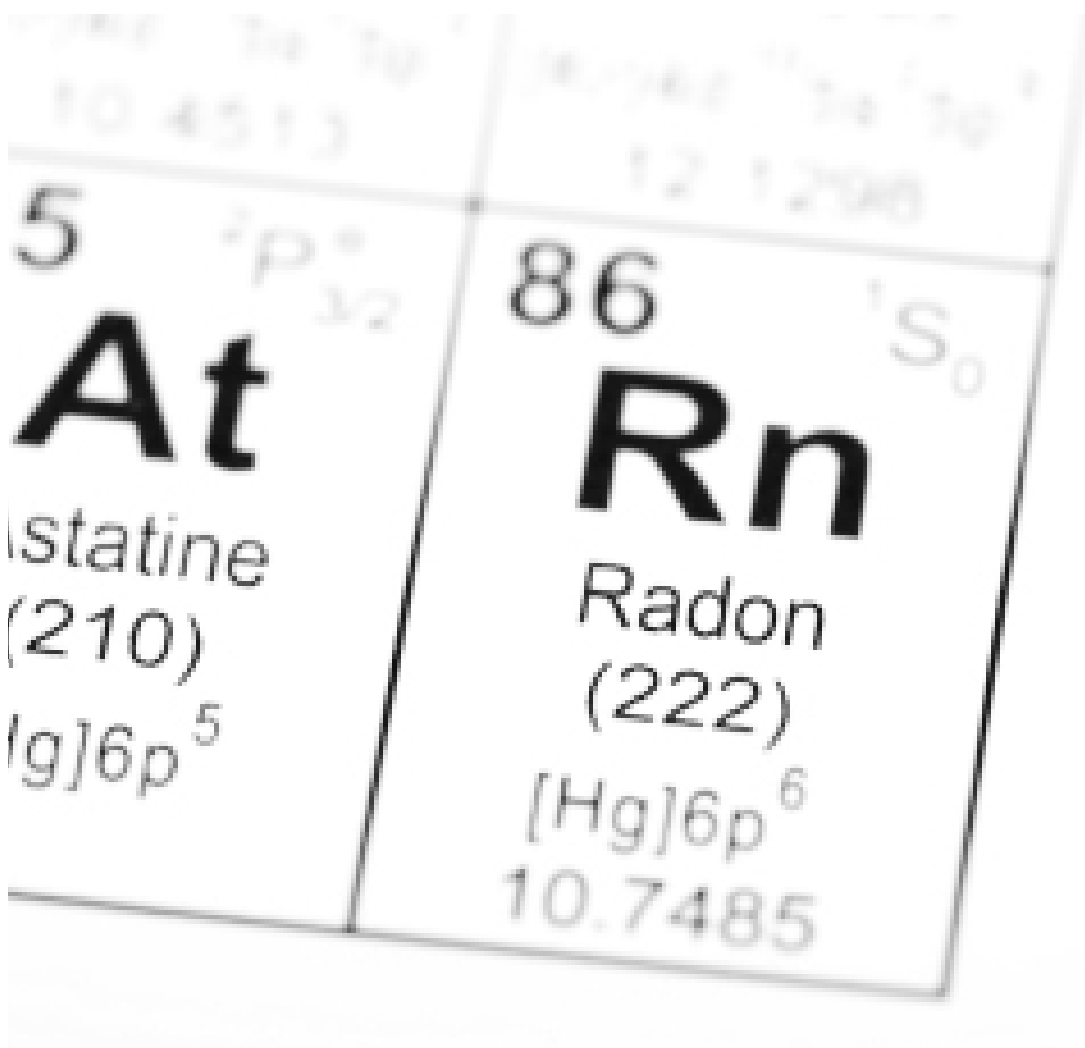
Radon is a colourless, odourless, radioactive, chemical element. It is one of the 6 noble gases, with an atomic number of 86 and the chemical symbol Rn. It is naturally occurring as a product of normal radioactive decay, being specifically an immediate decay product of radium.

Radon exists in three isotopes or slightly different chemical forms, these being radon-222, radon-220 and radon-219. Each of these can be found in rocks and soil, with the type and concentration usually dependent on the levels of Uranium and other radon sources (Thorium and Radium) that naturally occur in those materials. Radon can also be found in groundwater and surface water systems, natural gas and as a product of burning fossil fuels.

Radon is considered to be the single largest contributor to background radiation exposure (the levels of naturally occurring radioactivity in the environment) for most people. Although of course these background levels vary between locations due to local differences in geology.

In the UK, the UK Health Security Agency (UKHSA) publishes an "Affected Area" map for reference/use, identifying the "Maximum radon potential" as a percentage for all the Home Nations. The new radon map was launched on 01/12/22.

Here is a link to the UK radon map: [UKradon - UK maps of radon](#)



## 2. What are the health issues with radon?

Being a gas under standard conditions, radon can be inhaled and as it is radioactive, it can cause damage to our cells and DNA. According to the World Health Organisation (WHO), radon is a leading cause of lung cancer with between 3% and 14% of all lung cancers in the country estimated to be the result of radon exposure.

Of the three isotopes of radon, radon-222 is identified as the most dangerous, as it has a long decay rate, so can readily accumulate over time, whereas radon-219 is not considered dangerous.

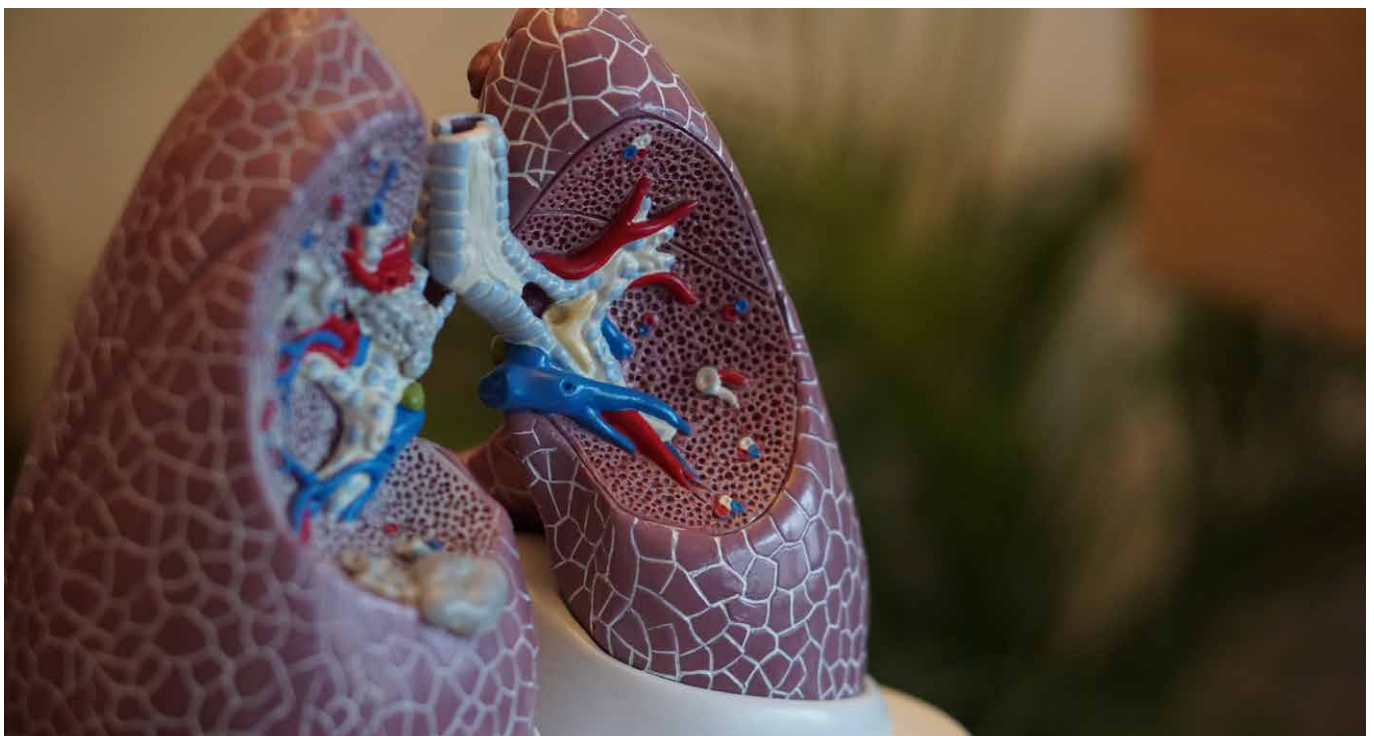
The WHO also highlight:

- In most countries, radon exposure is second only to smoking in terms of causing lung cancer, and there is strong evidence linking both smoking (current and well as historic smokers) and radon exposure to a greater risk too. For people who have never smoked, radon is the primary cause of lung cancer;
- Even low concentrations of radon can result in a small increase in the risk of lung cancer, and there is no known threshold concentration below which radon exposure presents no risk;
- Most radon-induced lung cancers are caused by low and moderate radon concentrations rather than by high radon concentrations, because in general less people are exposed to high indoor radon concentrations.

WHO also identify that "to date, epidemiological studies have not confirmed an association between consumption of drinking-water containing radon and an increased risk of stomach cancer."

The Health and Safety Executive estimate radon results "in over 1000 fatal cancers per year."

A link to WHO information on radon is: [Radon \(who.int\)](https://www.who.int)



### 3. What happened with the recent prosecution?

This year, Kingswood School in Bath, became the first employer in the UK to be prosecuted for a radon related failure; on the 19th July 2023, at Taunton Magistrates' Court the school Trustees Ltd pleaded guilty to breaching Section 2(1) and 3(1) of the Health and Safety at Work etc Act 1974, and were fined £50,000 with £19,222 costs.

High levels of radon in some school buildings had been identified in 2007 and remedial works had been carried out to reduce the concentrations of the radioactive gas. But then between 2010 and 2018 they failed to undertake further checks or monitoring, until the intervention by HSE. As a result, HSE reported that:

- Five pupils at the school were exposed to levels of radon almost 8 times the legal limit;
- Two other children, who were not pupils at the school, were exposed to levels of radon almost 14 times the legal limit; and
- Two employees at the school were also exposed to high levels of radon during the period in question.

Dr Maria Dugdale, the Chair of The UK Radon Association (UKRA) commenting on the case said, "We believe that this situation may be replicated up and down the country, not only in schools but across all industries as many employers remain unaware of their responsibilities regarding radon. Radon causes over 1100 deaths from lung cancer each year in the UK, yet these are avoidable."

Stewart Robertson, HSE Principal Specialist Inspector (Radiation), said, "We will not hesitate to take action against companies, including schools, who do not do all that they should to keep people safe. Every workplace needs to consider radon as a risk to its employees and others."

[Boarding school fined £50,000 after pupils overexposed to radon radioactive gas | HSE Media Centre](#)



#### 4. How much radiation are we normally exposed to in the UK and where does it come from?

Since 1974, there have been several published reviews into the levels of exposure of the UK population to sources of ionising radiation. The eighth review in 2010 (PHE-CRCE-026) estimated per caput dose to the UK population from exposure to all significant sources of ionising radiation, was about 2.7 millisieverts (mSv). This was broken down into:

- Radon and thoron - 48%
- Medical - 16%
- Terrestrial gamma radiation - 13%
- Cosmic radiation - 12%
- Intake of radionuclides (excluding Radon) - 11%
- Weapons fallout - 0.2%
- Occupational - 0.02%
- Discharges - 0.01%

The figure of about 2.7 mSv was the same as that identified in the previous review of 2003. As explained by GOV.UK (see link below) a "millisievert is a measure of radiation dose which accounts for the fact that ionising radiation can affect different parts of the body to differing degrees. The millisievert dose also allows for the different effects of different types of radiation, x rays, gamma rays, neutrons, alpha particles and beta particles."

In most external environments radon dissipates quickly, so the risks to health are low. Buildings will naturally contain radon, although the levels occurring are dependent on the location of the property and ability of the gas to penetrate it. Underground buildings, or those with cellars, basements, etc. should be considered as having an increased risk of higher radon levels.

Further information can be found at:

[PHE-CRCE-026 \(publishing.service.gov.uk\)](https://www.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/434826/phe-crce-026.pdf)

[Ionising radiation: dose comparisons - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/ionising-radiation-dose-comparisons)



## 5. What are the regulations covering radon and what do I need to do?

General duties for employers under the Health and Safety at Work etc. Act 1974, require them to ensure the health and safety of employees, and others who may be affected by their activities, so far as is reasonably practicable. This extends to the workplace and the working environment too.

Section 3.1 of The Management of Health and Safety at Work Regulations 1999, states:

“Every employer shall make a suitable and sufficient assessment of—  
(a) the risks to the health and safety of his employees to which they are exposed whilst they are at work; and  
(b) the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking.”

For radon, the HSE identify radon risk assessments should be carried out in the following circumstances:

**Above ground workplaces** - For the vast majority of above ground workplaces the risk assessment should include radon measurements in appropriate ground floor rooms where the building is located in a radon Affected Area. Employers may choose to take a conservative approach and undertake measurements in all premises located in a 1-km grid square that is shaded in the indicative atlas (i.e. measurements are not usually required in above ground workplaces located in the white areas of the indicative atlas). If employers wish to be more specific, they may choose to consult the definitive PHE radon dataset online (a small fee is charged) to identify the Affected Area status of a particular building or buildings.

**Below ground workplaces** - For occupied below-ground workplaces (for example those occupied greater than an average of an hour per week or approximately 50 hours per year), or those containing an open water source, the risk assessment should include radon measurements. This applies to all below ground workplaces in the UK (basements, cellars, mines, caves, tunnels, etc), irrespective of the above ground Affected Areas status.”

Where any measurements of radon are carried out as part of the risk assessment and these are found to be above 300 Bq/m<sup>3</sup> (as an annual average), The Ionising Radiations Regulations 2017 (IRR17) now apply. In these situations, the employer needs to take action to reduce and/or restrict exposure to radon. Any occupied areas in particular will need specific attention.



As radon enters building from the ground, depending on how much radon is present, a range of measures can be taken to reduce levels. These could include:

- Improving general ventilation or specifically increasing under-floor ventilation;
- Sealing floors and walls (including pipe and cable entries, cracks, etc.);
- Installing radon proof barriers/membranes
- Installing a radon sump system in the basement or under a solid floor.

HSE recommend a consultation with an experienced Radiation Protection Adviser (RPA) and/or a specialist radon removal (remediation) contractor for assistance in implementing the relevant measures to reduce the radon exposure, as needed.

For new buildings (and extensions in both dwellings and places of work) the various iterations of the Building Regulations across the UK identify the need for protective measures to be installed during construction. Testing in these environments is still a requirement for employers.





Radon risk assessments should be kept under review especially where changes to the fabric of a building or work processes occur. The risk assessment itself or your RPA, may also identify the need to re-measure radon levels. HSE suggests the following guidelines:

- Where radon levels were found to be significantly less than 300 Bq/m<sup>3</sup> at the initial measurement, the period of remeasurement might be of the order of once every 10 years;
- Where radon levels were just below 300 Bq/m<sup>3</sup> at the initial measurement, the suggested period for remeasurement will be less than 10 years; and
- Where radon levels were above 300 Becquerels per cubic metre (Bq/m<sup>3</sup>) at the initial measurement and measures have been taken to reduce radon exposures (such as engineered systems or occupancy restrictions), the remeasurement periods may need to be significantly more frequent in order to verify their continuing effectiveness.

HSE and UKHSA UKRadon websites provided more detailed information on testing and other requirements, such as domestic properties.

Enforcement of the regulations relating to radon is the responsibility of HSE and local authorities for the relevant premises under their jurisdictions.

The Control of Substances Hazardous to Health Regulations 2002, are NOT relevant to radon, as ionising radiation is outside the scope of these regulations.

Further information can be found at:

[Radon in the workplace \(hse.gov.uk\)](https://www.hse.gov.uk/radon/)  
[UKradon - Home](#)

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+44 (0)1403 269375



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[info@assurityconsulting.co.uk](mailto:info@assurityconsulting.co.uk)



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