



UK Health
Security
Agency

UK National Radon Action Plan

Second edition

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Authors

T D Gooding¹, N Agada⁸, J Astbury¹, R Broughton⁸, J Carlton², D Cromie¹⁰, Z Daraktchieva¹, T Erinle², J Hulme⁸, J Hunt³, N Hutt¹, K James¹¹, R Jones⁹, E Kouroukla¹, P Iype⁶, T Lennon¹², G McKenna¹⁰, N McMahon⁵, G McMeekan⁷, A Mills⁸, L Murphy⁹, O Ogunbadejo², J Taylor⁸, G Wasson⁴

1. UK Health Security Agency, RCE, Chilton, Didcot, Oxfordshire OX11 0RQ
2. Department for Energy Security and Net Zero, 3 Whitehall Place, London SW1A 2AW
3. Department for the Environment, Food and Rural Affairs / Drinking Water Inspectorate, Area South West Quarter (D), Ground Floor Seacole Building, 2 Marsham Street, London SW1P 4DF
4. Department of Agriculture, Environment and Rural Affairs (Northern Ireland Environment Agency), Klondyke Building, Gasworks Business Park, Belfast BT7 2JA
5. Department of Health, Northern Ireland, Castle Buildings, Stormont, Belfast BT4 3SQ
6. Department of Health and Social Care, 39 Victoria St, London SW1H 0EU
7. Environment Agency, Horizon House, Deanery Road, Bristol BS1 5AH
8. Health and Safety Executive, Redgrave Court, Merton Road, Bootle, Merseyside L20 7HS
9. Health and Safety Executive Northern Ireland, 83 Ladas Drive, Belfast BT6 9FR
10. Public Health Agency, Northern Ireland, 12 to 22 Linenhall St, Belfast BT2 8BS
11. Public Health Wales, 2 Capital Quarter, Tyndall Street, Cardiff CF10 4BZ
12. Scottish Government, Building Standards Division, Denholm House, Livingston EH54 6GA

Executive summary

Radon is a colourless, odourless radioactive gas that is formed by the radioactive decay of uranium and thorium that occur naturally in rocks and soils, and may also be found in certain building materials and water. Radon is the single largest source of radiation exposure to the UK population in both homes and workplaces, is present in all air indoors and outdoor locations, and is a leading cause of lung cancer after tobacco smoking.

The United Kingdom has more than 4 decades of experience in characterising and controlling radon in homes and workplaces. Using this scientific understanding, which is informed by evidence, research, guidance and practical experience from within the UK and international bodies, the range of exposure situations of the UK population to radon has been established. In addition, effective and durable ways of reducing and preventing radon exposures have been developed.

This report presents, in a single document, the existing elements of radon control that make up the national radon strategy and the national radon action plan. It fulfils the radon-related requirements of the [Ionising Radiations \(Basic Safety Standards\) \(Miscellaneous Provisions\) Regulations 2018](#) (SI 2018/482) and replaces the first [UK National Radon Action Plan](#), published in 2018.

The report describes: the properties and health risks of radon; its distribution within the UK and routes of exposure; how radon exposure is assessed and managed in homes, workplaces, new buildings, water supplies and building materials; and the approaches to communicating on radon with groups of people affected. The report reviews the forward plan for action of the [first National Radon Action Plan](#) and identifies new topics for consideration.

This report was prepared by UK representatives of government departments and agencies and with input from stakeholders. The report is subject to open consultation.

The UK National Radon Action Plan will be updated at intervals of no more than 5 years.

1. Introduction

Radon is the single largest source of radiation exposure to the UK population in both homes and workplaces. The UK has more than 4 decades of experience in characterising and controlling radon in homes and workplaces. Using this scientific understanding, which is informed by evidence, research, guidance and practical experience from within the UK and international bodies, the range of exposure situations of the UK population to radon has been established. In addition, effective and durable ways of reducing and preventing radon exposures have been developed.

Once again this report presents, in a single document, the existing elements of radon control that make up the national radon strategy and the national radon action plan (NRAP). It fulfils the radon-related requirements of the Ionising Radiations (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018 (SI 2018/482) (1) and replaces the first UK NRAP published in 2018 (2). In compiling this report, the first NRAP has been reviewed and the existing UK action on radon updated. The forward plan has been assessed including the progress of the new topics previously identified for consideration. Additional topics have been identified for this NRAP.

This report was prepared by representatives of the government departments and agencies shown in Table 1 and with input from stakeholders. The report was subject to open consultation.

Government departments and agencies contributing to the UK National Radon Action Plan

Department of Agriculture, Environment and Rural Affairs (Northern Ireland Environment Agency)

Department for the Environment, Food and Rural Affairs / Drinking Water Inspectorate

Department for Energy Security and Net Zero

Department of Health and Social Care

Department of Health, Northern Ireland

Environment Agency

Health and Safety Executive

Health and Safety Executive Northern Ireland

Public Health Agency, Northern Ireland

Public Health Wales

Scottish Government

UK Health Security Agency

1.1 Properties of radon

1.1.1 Physical properties

Radon is a colourless, odourless radioactive gas that is undetectable by the human senses. As such, the level of radon can only be identified by measurement. It is formed by the radioactive decay of the small amounts of primordial uranium and thorium that occur in most rocks and soils and is present in all air, both indoors and outdoors. Radon has a number of radioactive isotopes, which have the same chemical properties but different nuclear properties. There are 3 naturally occurring isotopes of radon of which 2, radon-222 and radon-220, occur in significant amounts and decay by alpha emission.

Radon-222 is part of the uranium-238 radioactive decay chain. It is the immediate decay product of radium-226, which in turn is the radioactive decay product of primordial uranium-238 (half-life 4.5 billion years). Radon-222 has a half-life of 3.825 days and has a number of short-lived chemically reactive decay products that decay by alpha and beta emission. Radon-222 is commonly known as radon.

Radon-220, commonly known as thoron, is part of the primordial thorium-232 (half-life 14 billion years) decay chain. Thoron has a half-life of 55.6 seconds and has a number of short-lived decay products.

Radon 219, which is also known as actinon, is part of the primordial uranium-235 (half-life 0.7 billion years) decay chain. Radon-219 has a half-life of 4 seconds, which limits its capacity for exhalation from porous materials and contributes negligible human exposure.

Uranium (and radium) in near-surface rocks and soils is the main source of radon. In order for radon to be a source of radiation exposure, the surrounding rocks or soils must be sufficiently porous or permeable to allow radon to migrate with soil gas and enter overlying buildings. Activity concentrations of radon in the ground range from below 2,000 becquerels per cubic metre (Bq m^{-3}) to more than 100,000 Bq m^{-3} of soil gas (3). Where radon is released to open ground, concentrations in air are low: the UK average is 4 Bq m^{-3} (4).

1.1.2 Health risks

Most radiation exposure from radon arises from inhaling its short-lived solid radioactive decay products including isotopes of bismuth, lead and polonium, rather than radon itself. The decay products of radon, when created in indoor air, tend to adhere to airborne particulates, which then can be inhaled.

Radon is recognised by the International Agency for Research into Cancer (IARC) as a Class 1 carcinogen (5). Evidence has been obtained from pooled large scale epidemiological studies (6) that there is a linear relationship between long term radon exposure and excess relative lifetime lung cancer risk. This increases an individual's baseline lung cancer risk by 16% for each 100

Bq m⁻³ to which they are exposed over the long term. The risk relationship has also been demonstrated (6) at concentrations below the UK radon action level for homes (200 Bq m⁻³). The baseline lung cancer risk is much higher in smokers than in lifelong non-smokers, so the additional risk caused by radon is much larger in smokers than in non-smokers (7). In the UK, exposure to indoor radon is estimated to be responsible for more than 1,100 lung cancer deaths each year, with smokers and ex-smokers at the greatest individual risk.

There is currently no strong evidence to link radon exposure to cancers other than lung cancer or to other disease (7). Calculations of radiation doses to organs other than the lung suggest a small theoretical risk of cancer to other organs but these would be much smaller than the doses, and risks, to the lung. The UK Advisory Group on Ionising Radiation (AGIR) concluded that any effects on organs other than the lung are “so weak as to be generally undetectable in the published epidemiological studies”.

1.1.2 International advice

Radon is recognised as a health risk by the World Health Organization (WHO) (8) and IARC (5). Other international bodies that have provided advice on radon include the International Atomic Energy Agency (IAEA) (9), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) (10) and the International Commission on Radiological Protection (ICRP) (11, 12). UK organisations work collaboratively with many international organisations on radon and contribute as members of their committees and working groups.

1.2 Radon exposure in the UK

1.2.1 National radon survey and measurement database

The UK completed a radon survey in the 1980s to establish the population weighted average and distribution of radon exposure (4). Radon measurements were undertaken in more than 2,000 homes selected on a population-weighted basis, and estimated that the UK arithmetic mean radon concentration was about 20 Bq m⁻³.

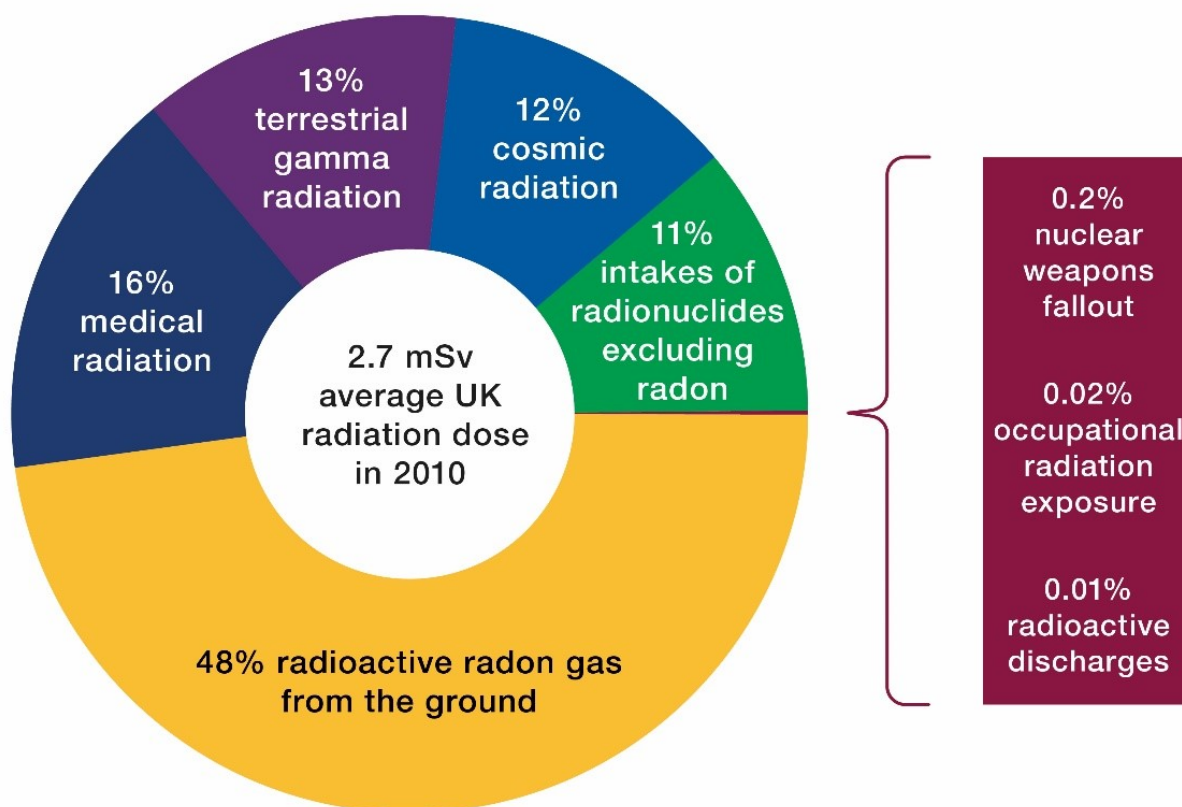
The results of 4 decades of measurements in homes and workplaces are stored in a national radon measurement database. The database currently holds the results from measurements made in around 600,000 homes and 40,000 other premises throughout the UK. The results from homes are used to produce the radon potential maps, however, individual results are not published to maintain their privacy. Workplace results do not contribute to the maps due to their inhomogeneity and the great availability of results in homes. Although the majority of homes measured are in areas of higher radon potential (radon-affected areas, see section 2.1.2), the database includes over 170,000 homes outside radon-affected areas. [Statistical summaries of measurements made in dwellings](#) are published at intervals online.

1.2.2 Radon in buildings

Radon can be drawn into a building from the ground below. A variety of processes, including the indoor-outdoor temperature differential, heating (the buoyancy of warm air), ventilation and the effect of wind, each influence the slightly lower indoor air pressure that in turn drives radon ingress.

Some building materials contain small amounts of radium and thorium, which can emit radon and thoron into room air. Private water supplies may also be a source of indoor radon. Indoor exposure to radon is the single largest source of ionising radiation exposure for people in the UK, representing around half of the total average individual exposure, as shown in Figure 1. In some areas of the country high radon levels produce significantly higher exposures (13) as indoor radon concentrations in air range from less than 10 to over 20,000 Bq m⁻³.

Figure 1. Sources of radiation exposure in the UK. Radon gas represents 48% of the 2.7 mSv average UK dose (2010 data)



Breakdown of the average UK radiation dose in 2010 by source of exposure

Text version of Figure 1

2.7 mSv average UK dose

48% radioactive radon gas from the ground

16% medical radiation

13% terrestrial gamma radiation

12% cosmic radiation

11% intakes of radionuclides (excluding radon)

0.2% nuclear weapons fallout

0.02% occupational radiation exposure

0.01% radioactive discharges

1.2.3 Radon and thoron from building materials

The radon emitted from building materials generally leads to low exposures. Radon concentrations in buildings from this source alone have not been observed above the UK action level (4).

Building materials with a high thorium content may exhale thoron into the buildings in which they are incorporated. This depends on the source concentration of thorium together with the physical matrix of the building material and the surface characteristics. In the UK, thoron contributes about 4% of the annual average radiation exposure (4).

1.2.4 Radon in water

Water derived from underground sources with elevated uranium or radium concentrations may have high levels of dissolved radon. Water from the public drinking water supply networks generally has radon at very low levels. In some private domestic ground-water derived drinking water supplies, the water may have elevated radon concentrations at the point of entry into the consumer's home. The consumer may be exposed both through the inhalation of radon in indoor air caused by de-gassing when water is drawn from taps, showers and so on and, to a lesser extent, from the ingestion of radon in water. The inhalation pathway gives rise to the great majority of radiation exposure from radon present in drinking water.

Industrial premises using large volumes of water from private supplies should consider this source during their risk assessments as it can produce radon concentrations in air high enough to be subject to regulatory control.

1.2.5 Radon from uses of radium and thorium

Radon can be generated from human activities involving radium and thorium. Radium-226 (half-life 1,600 years) is the radioactive parent of radon and has been used in the past for research, in luminised instruments and in other devices, for example, to eliminate static electricity. A small

number of premises, including factories and laboratories, have been found to have high radon levels from this source. Thorium-232 is the source of thoron and has also been used in research and past manufacturing, for example, as a component in gas-mantles. The use of radioactive materials is covered by the radioactive substances regulations ([14](#), [15](#)) and the Ionising Radiations Regulations 2017 (IRR17) and equivalent Northern Ireland legislation ([16](#), [17](#)). Several former factory sites have been discovered with ground contamination from radium and thorium, which have required radon mitigation of subsequent buildings.

1.2.6 Radon and related issues

Radon does not exist as an isolated problem independent of other factors in society. It is well established that the risk of radon exposure is amplified in those who are smokers or ex-smokers ([7](#)) and this is reflected in the UK approach to radon that provides enhanced advice for these groups in relation to radon at home.

It has been shown that some physical aspects of a building (that affect ventilation), such as the presence of primary or secondary double glazing as well as insulation, can adversely affect the indoor radon level. Such observations inform emerging areas of investigation, for instance the interaction between radon concentrations and energy efficiency measures. Changes to building regulations or practices that affect the radon transport processes need to be considered. There is regular communication and collaborative working between organisations working on radon and those engaged in related problems such as air quality and other environmental hazards.

2. Existing UK action on radon

Radon has been recognised for many years as the largest single source of radiation exposure in UK homes and workplaces. The major elements that implement the UK radon strategy are described below. A strategy summary is provided as [Appendix B](#). This report does not include exhaustive references to specific legislation, guidance and scientific evidence on the topics listed below.

2.1 Exposure to radon in homes

2.1.1 Radon reference level for homes

The setting of a reference level for radon in dwellings is a requirement of UK legislation ([1](#)). The radon action level of 200 Bq m⁻³ (annual average activity concentration) provides the primary reference level for informing decisions about reducing indoor radon concentrations in homes ([18](#)). The current action level has been in place since 1990 ([19](#)) and was reviewed and retained in 2010 ([18](#)).

This action level is within the ranges established by international standards and guidance published by the WHO ([8](#)), the IAEA ([9](#)), ICRP ([11](#)) and the European Union ([20](#)), each of which stipulates that indoor radon concentrations should not exceed an annual average of 300 Bq m⁻³. A supporting target level of 100 Bq m⁻³ was introduced in 2010 ([18](#)). It is both a supplementary reference level for current and ex-smokers (who are at higher individual lung cancer risk); and a level below which remediation should aim to reach. The target level also corresponds to the lower value of radon reference level recommended by the WHO ([8](#)).

2.1.2 Radon maps to support decision making

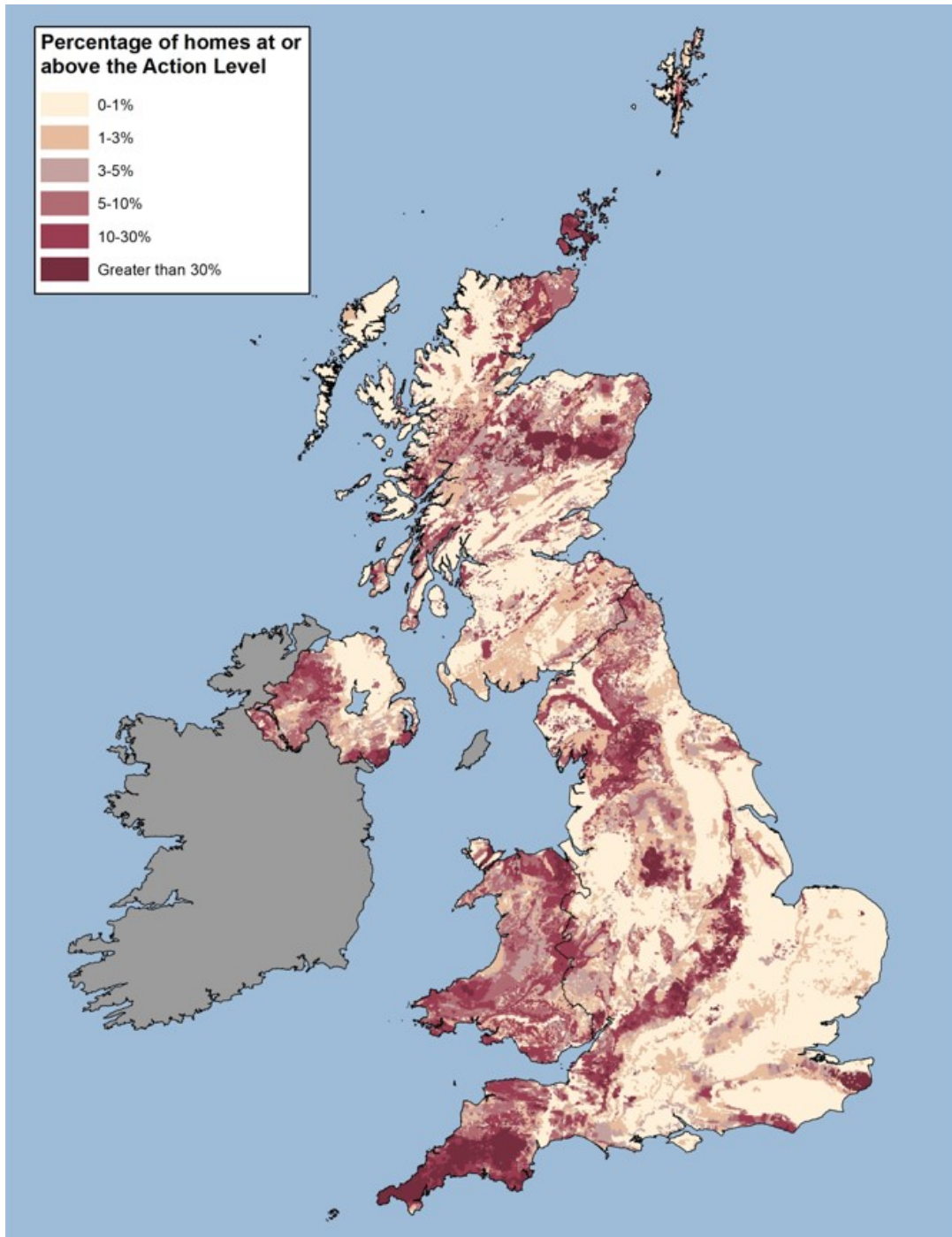
Radon is present in all buildings. High indoor radon levels occur in a small percentage of UK buildings and depend on a number of factors, including the geology of the ground underneath the building. Other factors, such as the construction details and the living styles of the occupants, are responsible for a very wide variation of indoor radon concentrations found in homes built on ground with the same radon potential. The geographical distribution of radon levels corresponds approximately to a lognormal distribution. In order to identify whether a particular building has high radon levels, it is necessary to measure the radon level in the building.

Maps (Figure 2) are produced that identify radon-affected areas ([21](#), [22](#)), where at least 1% of current or future homes are expected to be above the radon action level of 200 Bq m⁻³. The National Database of radon measurements is combined statistically with a detailed geological data set to prepare these maps. The current advice is that all homes in affected areas should be tested for radon.

The maps of [radon-affected areas](#) are accessible in indicative form (one km resolution, worst case radon potential) as an online interactive resource. Online and other services provide

definitive guidance for specific postal addresses and land areas. Radon measurements should be made in regularly occupied basements of properties, and in other underground facilities, irrespective of their geographical location (18).

Figure 2. Indicative UK radon map – areas with higher radon potential are widely distributed throughout the UK



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UKHSA and the British Geological Survey have an ongoing programme to review and update the UK radon potential maps to reflect significant new information, such as improved geological mapping, additional radon measurements, and improvements to the statistical methodology. The identification of areas where the radon concentration in a significant number of buildings is expected to exceed the reference level is a requirement of UK legislation (1).

2.1.3 Measuring radon in homes

Services are available from a number of organisations to undertake measurements of radon in homes. The established standard for measurements is using 2 detectors, one placed in the main living room and one in an occupied bedroom for a period of at least 3 months, to smooth out short term fluctuations. The results are combined (slightly weighted towards the bedroom) and a seasonal correction factor is applied to estimate the annual average concentration. This is compared to the action level and target level, as appropriate. Although usually a postal service, individual detector placement services are also offered by some providers, such as for social landlords.

Shorter duration measurements using passive detectors are also available from some providers, as are measurements using electronic (active) monitors. These measurements can be used to provide an indication of radon levels, however, their short duration means that there is much greater uncertainty in estimating the annual average. Short duration measurements are useful in giving a rapid assessment of whether mitigation systems are working (see section 2.1.4).

In exceptional situations, such as for very large or complicated structures or where the property has a private water supply, it may be appropriate to make additional measurements in the home, for example, in the kitchen or bathrooms.

A Validation Scheme for organisations offering radon measurements in homes has been run by UKHSA for many years and was updated in 2018 (23). This ensures that householders can obtain a reliable radon measurement that can be compared with the action level and hence make a properly informed decision about the need for mitigation. In addition, regular international intercomparison exercises are available (24) that allow those offering radon measurement services to check the technical performance of their measurement capability.

2.1.4 Reducing indoor radon levels in homes

Where high radon levels are identified, practical mitigation methods and supporting technical guidance are available to reduce radon concentrations, including from the [Building Research Establishment](#). Householders are advised to reduce radon levels that are above the action level and/or target level, as appropriate. Specific guidance for individual properties, such as the design and location of mitigation systems, is available from specialist companies in the radon sector, informed by research and operational experience. If the source of high radon levels was identified as being from the private water supply, remediation must be focused accordingly.

Mitigation methods should start being effective immediately. However, to assess their performance it is necessary to repeat the radon measurements. Long term post-mitigation measurements are the most reliable way of comparing radon concentrations with the action level, but short-term screening measurements have a role in giving rapid feedback on whether the work has been successful. A number of companies undertake radon measurement and mitigation work, some of whom are members of industry groupings including the [Radon Council](#) and the [UK Radon Association](#), who publish lists of services provided by their members.

Those with responsibility for a building with radon mitigation systems installed are advised to follow the installer's maintenance instructions and to re-test the building periodically to ensure that protection is maintained. Reasons for system failure include mechanical fans wearing out and building movement breaking seals in pipework.

2.1.5 Radon in housing standards

Each part of the UK has regulations, guidance and other supporting material that aim to ensure that homes are of an adequate standard. Provision for and consideration of radon varies across the UK. Some parts (England and Wales) use the Housing Health and Safety Rating System (HHSRS), which identifies radon as a potential health hazard (25). In Scotland, a review of the housing quality standards included radon as a topic that might be included in future updates; in Northern Ireland, a consultation included adoption of HHSRS (and hence explicit consideration of radon) as an option, with reports that it is already being used informally.

2.1.6 Promoting action on radon and encouraging mitigation in homes

Numerous public health programmes, generally funded by central and local government, to identify and encourage the remediation of homes with high radon levels have been completed. These have been conducted in partnership with local authorities (which has been shown to increase public engagement), in areas with significant numbers of homes in the higher bands of radon potential. However, it is internationally acknowledged by WHO (8) and others that engaging the public in effective radon activities remains a challenge, even when there is effective collaboration between radon stakeholders.

At the time of writing, UKHSA (and predecessor organisations) had undertaken more than 20 programmes of this nature. Advice on action to remediate high radon levels is provided in the form of letters, leaflets, signposting to online resources and, in many cases, press advertisements and invitations to local 'drop-in' sessions to obtain individual face-to-face advice about radon risks and mitigation. A number of similar programmes have been undertaken as local initiatives, generally by, or in collaboration with, local authorities. UKHSA maintains this ongoing programme of work, and evaluates the effectiveness of programmes through a process of continual improvement.

Social and private landlords are targeted by UKHSA and other radon stakeholders attending trade shows and other events that cover environmental and building matters. This reaches an audience that might not otherwise consider radon to be within their remit.

Targeted activities are also carried out by the radon industry, for example, through letter drops in areas of high radon potential and provision of online information to raise awareness regarding measurement and mitigation (see section 2.6), the instigation of 'Radon Awareness Week' and the annual UKRA Radon Symposium.

Where homes with exceptionally high radon levels are found, UKHSA provides additional individual practical support to the householders that can include individual advice on remediating and periodic radon monitoring.

Building Regulations specify that buildings in certain areas should be constructed with protective measures that aim to prevent radon ingress (see section 2.3). Work by the radon industry and others in this area has also shown that radon levels can still be elevated in homes built with protection, reinforcing the importance of testing these properties by the new occupiers. During the house buying and selling process, radon is included in the conveyancing process through the local authority search (CON 29 document) and property information form completed by the seller (TA6 in England and Wales). UKHSA continues to update and improve information for solicitors and purchasers.

2.2 Radon in the workplace

2.2.1 Regulations

Under the Health and Safety at Work etc Act 1974 ([26](#), [44](#)) and equivalent Northern Ireland legislation, employers must, as far as is reasonably practicable, ensure the health and safety of employees and others who have access to their work environment.

The Management of Health and Safety at Work Regulations 1999 ([27](#), [28](#)) and equivalent Northern Ireland legislation require a suitable and sufficient assessment of health and safety risks.

Where work in a radon atmosphere (which is not necessarily a registered workplace) exceeds the relevant reference level (300 Bq m⁻³ as an annual average), the Ionising Radiations Regulations 2017 ([16](#), [17](#)) and equivalent Northern Ireland legislation apply to work with radiation and the employer is required to take certain actions including those to control exposures (see section 2.2.4).

2.2.2 Radon maps to support decision making by employers

The radon-affected area maps that have been produced from radon measurements in homes can be used to indicate whether radon is likely to be a hazard in most workplaces and can be used to inform the risk assessment and need for radon measurements.

The identification of areas where the radon concentration in a significant number of buildings is expected to exceed the reference level is covered by UK legislation ([1](#)).

However, in occupied workplaces below ground, which includes the basement areas of buildings and mines and caves, the risk assessment should include radon measurements irrespective of the radon-affected area status ([29](#)).

2.2.3 Measuring radon in workplaces

Radon measurement in workplaces forms part of the risk assessment process and informs decisions about whether radon exposures should be controlled through mitigation or other means. The services available for radon measurements in homes are often suitable for indoor workplaces (see section 2.1.3). Most occupational radon measurements are made with passive monitors that are in place for 3 months. The number required in each building depends upon its internal area and the layout; for instance cellular or open plan offices may require different measurement densities. Protocols have been published to assist employers in determining the appropriate number of monitors for a suitable and sufficient test, starting at one monitor for every 100 square metres of floor area, on the ground floor and in any basement areas occupied for more than 50 hours per year.

Where reference levels have been exceeded, additional measurements are often required in workplaces after the initial test to determine the rooms with the highest radon concentrations, to assist with the design of mitigation work (section 2.2.4) and comply with regulations (section 2.2.1).

The location of radon monitors in mines and caves is typically within the main working areas and transit routes. The mining industry has a culture of using active monitors for routine air quality tests and electronic (active) monitors are used to complement the passive measurements.

In 2018, a revised Validation Scheme (section 2.1.3) was published ([23](#)) that applies to radon measurements in dwellings and, for the first time, indoor workplaces. This scheme takes into account the differences in the occupancy, physical size and layout of buildings, applies to long term measurements (3 months), updates protocols and performance standards, and includes a major review of seasonal correction factors. Laboratories being validated under this scheme from 2019 can choose whether to provide radon measurement services for dwellings, workplaces, or both.

2.2.4 Controlling radon exposure in workplaces

The first choice is usually to reduce the radon concentration. The same techniques for radon mitigation in homes are usually applicable to workplace buildings, sometimes with adaptations depending upon the size and layout of the building, radon levels, and any ventilation systems. Specialist contractors may also be needed where premises have undergone multiple extensions or changes of use. Post-mitigation radon measurements are required to determine whether the work has been successful, with regular maintenance checks thereafter to show that it remains effective. Contingency plans are required to address any system failures. The aim is to reduce radon levels as low as reasonably practicable (given social and economic considerations) and to below the threshold of the IRR17 and equivalent Northern Ireland legislation ([16](#), [17](#)).

In mines and caves, radon levels are generally controlled by air handling techniques, which may be informed by specialist advice on optimising ventilation routes, timing and fan speeds. Controlling the presence and movement of water may also be a significant factor.

In some workplaces, radon exposures may be controlled by managing local occupancy, for instance by limiting the access duration and frequency to a high radon area. This could be a temporary arrangement prior to mitigation or appropriate for a room with low occupancy, for example, a basement archive, or where mitigation would be prohibitively expensive.

In a small minority of workplaces, where elevated concentrations are difficult to reduce in practice, some workers have their radon exposures assessed individually using personal radon dosimeters.

Where radon levels remain above 300 Bq m⁻³ the IRR17 and equivalent Northern Ireland legislation ([16](#), [17](#)) continue to apply. The employer must consult a suitably qualified and experienced Radiation Protection Adviser for advice on compliance and optimisation, including where occupancy controls are to be in place to limit exposures.

In all workplaces where equipment is used to reduce radon concentrations, the systems should be included in standard maintenance schedules as defined by the manufacturer's instructions. The Provision and Use of Work Equipment Regulations 1998 and equivalent Northern Ireland legislation ([30](#), [31](#)) requires that mitigation systems be fit for purpose and in efficient working order. A system failure resulting in radon levels exceeding 300 Bq m⁻³ would mean that the IRR17 and equivalent Northern Ireland legislation ([16](#), [17](#)) would immediately apply, and that the exposure of occupants to radon remains significant, hence the need for contingency plans to identify and to rectify any faults.

2.3 Protecting new buildings against radon

Building regulations, supporting documents and guidance provide a tiered approach to the limitation of radon ingress in new buildings and extensions. In areas of lowest radon risk, no specific measures are expected. In areas of elevated radon risk, new buildings and extensions

should include a membrane that limits radon ingress from the ground ('basic protection'). In areas of highest radon risk, the membrane should be augmented by provision for additional measures that can be completed and activated if a radon measurement shows that the building has high levels in spite of the protection afforded by the membrane ('full protection'). Therefore, testing is recommended within the first year of occupation in all new buildings with radon prevention measures to ensure that radon concentrations are below the levels that require action (32).

The geographical areas that are subject to each level of protection are identified in relation to the UK radon potential map (Figure 2). Specific criteria for and descriptions of the expected measures are established by the individual nations within the UK (32). For instance in Scotland, the building standards require that "every building must be designed and constructed in such a way that there will not be a threat to the health of people in or around the building due to the emission or containment of radon gas". Throughout the UK, full protection is required where 10% or more of homes are expected to exceed the action level. In England and Wales, basic protection is required at the 3% level and in Northern Ireland and Scotland at the 1% level. The provision of appropriate measures to prevent radon ingress in new dwellings is covered by UK legislation (1).

2.4 Radon in water

In most UK drinking water supplies radon is present at very low levels. The potential presence of radon in public and private drinking water supplies is subject to regulation within each of the UK nations through a complicated system of national legislation. Recent water quality regulations for public supplies include:

- the Water Supply (Water Quality) Regulations 2016 (with 2018 amendments consolidated) (33)
- the Water Supply (Water Quality) Regulations (Wales) 2018 SI No 647 (34)
- the Water Supply (Water Quality) Regulations (Northern Ireland) 2017 (Statutory Rules of Northern Ireland 2017 No. 212) (35)
- the Public Water Supplies (Scotland) Regulations 2014 (Scottish Statutory Instrument No 364) (36)

Private water supplies are covered by:

- the Private Water Supplies Regulations 2016 (SI No 618) (37) which have some UK provision
- the Private Water Supplies (Wales) (Amendment) Regulations 2017 (SI No 1041, W270) (38)
- the Private Water Supplies (England) (Amendment) Regulations 2018 (SI No 707) (39)

- the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (Scottish Statutory Instrument 2017 No 282) (40)
- the Private Water Supplies Regulations (Northern Ireland) 2017 (Northern Ireland Statutory Rules 2017 No. 211) (41)

The requirement for testing can be different according to whether the supply is for commercial or public use, or for a single dwelling. Guidance is available from the Drinking Water Inspectorate (DWI) about techniques to reduce high radon levels in water supplies which covers:

- decay storage (a volume of water is stored for several weeks to allow the radon to radioactively decay)
- granular activated carbon (GAC) which adsorbs radon and also removes taste, colour, odour and synthetic organic chemicals
- aeration – the preferred method (42)

2.5 Radon exhalation from building materials

The EU Construction Products Regulation 2011 (43) provides uniformity in assessing the performance of construction products through harmonised product standards and technical assessments, which include radiation. Although a survey of radon emitted from building materials showed that this generally leads to low indoor exposures (4), additional research to date has not identified any building materials available on the current or recent UK market with sufficient radon exhalation to produce indoor radon levels over the action level for homes. The proposal to introduce legislation that would require construction products to provide consumer information covering ‘the emission of dangerous radiation’ has been paused following an initial consultation.

2.6 Communicating on radon

In most cases, the level of indoor radon does not relate to work or domestic activities in the building. The person responsible for a building or facility may remain unaware of the presence and potential significance of radon unless it is brought to their attention and they are made aware, through appropriate communications, of what actions they should take. The requirement to publish information on radon exposure and health risks, the importance of radon measurements, and technical means of mitigation are covered by legislation (1).

The individual circumstances will determine the need for particular radon information and guidance. This is available and communicated to relevant groups and individuals through a range of processes.

2.6.1 Online information resources

Information and guidance about radon are published in a number of online locations to support radon awareness and action. The major resources are listed below:

- [British Geological Survey](#) – access to BGS technical guidance and services
- [BRE Group](#) – access to BRE technical guidance and services
- [Drinking Water Inspectorate](#) – guidance on treatment of radon in water supplies
- [GOV.UK](#) – links to key government information on radon
- [Health and Safety Executive](#) – guidance on radon in the workplace
- [Radon information leaflet](#) – guidance on radon in the Northern Ireland workplaces
- [Radon Association](#) – an industry association
- [Radon Council](#) – an industry association
- [UKradon](#) – a dedicated radon website managed by UKHSA
- [NHS Wales: Radon](#) – information on radon from PHW

Many local authorities have information about radon on their websites relevant to their areas. Some individual companies provide radon information on their websites.

2.6.2 Media communications

Specific programmes, publications and events provide opportunities to promote radon awareness, including both national events such as ‘Radon Awareness Week’ and the promotion of other European radon events. A range of media channels is used including print and broadcast news media and social networking sites. In general, the specific activity provides a context, often either sectoral or geographical, in which radon information and guidance is provided.

2.6.3 Targeted communications

In some contexts, communications are more closely targeted to those who may need to take action on radon, including those with statutory duties. The actions being promoted are generally related to the processes of risk assessment and intervention as outlined in the strategy. Examples of targeted communications include: postal invites to participate in government-funded radon surveys; invitations to householders with high domestic radon levels to attend local ‘drop-in’ events focused on mitigation; information to bodies managing schools to remind them of their existing responsibilities and offering support to assess their school property portfolio; and information about radon for buyers of new and existing properties.

UKHSA maintains a programme of work, in partnership with stakeholders, to identify and address relevant sectors and groups, covering exposures in homes and workplaces that have a low awareness of radon. This includes exhibiting at conferences and events aimed at key groups (including social landlords and employers) to increase awareness and action in this sector.

2.6.4 Training for professionals

A number of organisations offer short duration or online training courses in radon measurement and mitigation and radon protection / prevention aimed at professionals in the building sector. Practical training in mitigation techniques is provided by industry professionals, along with mentoring. Radon is also included in the training of Environmental Health Officers and provided as part of the Continuing Professional Development on indoor air quality by the Chartered Institution of Building Services Engineers (CIBSE).

2.6.5 Stakeholder engagement

A range of activities is undertaken to provide engagement between the various stakeholders with a role in delivering UK's radon strategy. In many cases, radon is dealt with as part of a wider engagement process between relevant parties. In other cases, radon is the central theme of interaction.

While far from being an exhaustive list of all relevant interactions, UKHSA's engagements on radon serve to illustrate this. UKHSA undertakes the following regular radon stakeholder interactions:

- attend meetings, by invitation, of the 2 UK radon industry bodies: the Radon Council and the UK Radon Association
- hold the annual UK Radon Forum, which is attended by a wide range of stakeholders, including local government and the radon industry

Update and seek views on radon activities with parts of government including:

- devolved administrations (Northern Ireland, Scotland and Wales)
- the Drinking Water Inspectorate (through the UKHSA/DWI Water Advisory Group)
- Committee on the Medical Aspects of Radiation in the Environment (COMARE)
- the UKHSA Environmental Public Health Protection Network

2.7 Radon in UK overseas territories and crown dependencies

There are 14 British Overseas Territories and 3 crown dependencies. Responsibility for managing radon in each of the territories lies with the local territorial government. UK departments and agencies provide appropriate support to the territorial governments, including a recent online seminar on radon as part of a larger environmental information programme.

2.8 Maintaining and developing the evidence base on radon

For many years, the UK has made a significant contribution to the understanding of radon and the effectiveness of various aspects of a radon strategy. Evidence and findings are generally published in the open literature, at relevant conferences or through [GOV.UK](https://www.gov.uk).

Under consultation

3. Forward plan for action on radon

The radon strategy presented in [Appendix B](#) is implemented through the elements described in [Section 2](#).

The source of radon cannot be removed. It is therefore important that all the established arrangements and provisions for addressing radon are maintained so that, over time, more people in the UK are aware of radon, take appropriate action and are protected from high radon exposure.

The first NRAP identified actions intended to maintain and enhance the UK's position on managing radon in an effective, evidence-based manner. The actions and subsequent activities are reviewed below, recognising the national disruption for more than half the 5-year period that was caused by the SARS-CoV-2 (COVID-19) pandemic.

3.1 Maintain and review the existing processes that address radon exposure

The established UK infrastructure and provisions that support the assessment of and protection against radon exposure, outlined in section 2, will be maintained and reviewed in light of relevant evidence and experience. The main provisions are summarised as:

- a suite of radon advice including reference levels for radon exposure and the definition of radon-affected areas
- the capability to develop and the provision of resources, including radon potential maps that can be used by householders, landlords, employers and others to identify premises for which radon measurements are advised
- methods for increasing public engagement with and action on radon
- the capability for and provision of radon measurement services to support the assessment and management of indoor radon levels
- the provision of information, guidance and services relating to the measurement and reduction of indoor radon levels
- the capability for and delivery of activities to promote householder and landlord awareness and action on radon in homes including testing and mitigation, involving local and national stakeholders
- legislation and guidance concerning radon exposures in the workplace
- consideration of radon in health and safety arrangements for buildings, including new build, extensions and refurbishments
- the evidence base for radon exposure and associated risks, including the national radon database and the publication of area statistics

NRAP 2 comment: These actions will be maintained.

3.2 Review of new topics for consideration from previous NRAP

A review of Annexe XVIII of the EU-BSS (20) originally identified a small number of topics that the national plan should consider but which were either not in place in the UK at that time or were appropriate for review. These are outlined below, with the original text of their specific proposals for future action (including references to the now abolished Public Health England (PHE)), and a summary of their current status. The roles and responsibilities for radiation (and radon) were transferred to UKHSA in 2021.

3.2.1 Consider updating the national radon survey

“The original UK national radon survey was undertaken in the mid 1980s (4) and established the population weighted average and distribution of indoor radon concentrations in homes. This provides the baseline of evidence of the magnitude of radon exposure in UK homes. Since then, a number of influences may have led to changes in these parameters, including: better insulation of some existing and new homes; changes in the population size and distribution; changes to the national housing stock; changes in lifestyle; changes in house construction; and the inclusion of radon prevention measures in new properties in areas of elevated radon risk.

Action: PHE to consider whether an updated national survey is needed and if so what form this should take.”

NRAP 2 comment: As part of a wider programme to enhance national resilience, a national survey of background radiation levels is being planned. This will include radon measurements indoors, selected on a population-weighted basis, with long-term radon measurements outdoors selected on a geographical basis.

3.2.2 Consider developing an accreditation scheme for remediators

“The UK has at least 2 industry groups that provide services that fulfil some of the characteristics that might be expected of an accreditation scheme for remediation services. There may be merit in considering, potentially as an industry-led initiative, whether a national accreditation scheme would add value and how it would relate to existing arrangements.

Action: PHE to engage with stakeholders to consider benefit, options and practicality of establishing an accreditation system for radon remediation.”

NRAP 2 comment: UKHSA engagement continues with the radon industry groups to balance the merits of an accreditation scheme with the costs to establish and run a radon-specific scheme, or to take part in another scheme that is already recognised nationally.

3.2.3 Consider developing radon exhalation standards for building materials

“Government is carrying out research to identify building materials of concern from a radiation protection point of view. Further action will depend on the results of this research. However, it is expected that test methods being developed for European Product Standards will form the basis of future British Standards and enable regulations to be made, should this be deemed necessary.

Action: PHE to support government and stakeholders on relevant standards including research on radon exhalation from building materials, as required.”

NRAP 2 comment: The Office for Product Safety and Standards (with the Department for Business and Trade) is responsible for bringing the general safety requirements applying to consumer products into operation. This work is currently paused following an initial consultation.

3.2.4 Development of resources to aid local action on radon

“PHE provides information on health related issues as part of its ‘Fingertips’ tool and has developed specific packages of information for use by local authorities and others who are responsible for public health in their areas and regions. Currently, there is no information related to radon exposures within these items.

Action: PHE will lead a programme to prepare and provide material to support local radon activities, including a radon-specific public health indicator and locally-oriented digital information and resource packs, aimed primarily at local authorities.”

NRAP 2 comment: In 2019, the 2nd Atlas of variation in risk factors and healthcare for respiratory disease was published. Radon is covered under ‘Risk factors’, the section on lung cancer shows [local incidence maps and information on Fingertips](#). UKHSA continues to produce information to support local action on demand.

3.2.5 Review of special treatment for homes with very high radon concentrations

“The special treatment of homes with very high radon levels is noted in the EU-BSSD Annex XVIII given in [Appendix A](#). Household holders who live in homes with very high radon levels, with annual average radon concentrations in excess of 10,000 Bq m⁻³, are given additional advice

and support to reduce their levels. Currently, fewer than 20 homes have been identified for special action.

Action: PHE will review the process for providing advice and support to householders with very high radon levels. The review will include the advice, actions, ongoing support and the level of radon which would trigger this special action.”

NRAP 2 comment: UKHSA will keep the treatment of homes with very high radon levels under review, depending on the expert resources available.

3.2.6 Updating the UK National Radon Action Plan

“An update of the UK National Radon Action Plan, involving input from those with relevant responsibilities, should be undertaken periodically to provide a focus for ensuring and providing feedback on action and to ensure that an up to date picture is maintained on the national position on radon. Such a process is covered by UK legislation (1) and would meet the requirement of EU-BSS Article 103.1 (20) to update the plan on a regular basis and the need to consider schedules for its regular review. In between formal reviews, other methods such as existing forums and online blogs could provide useful channels for providing informal updates.

Action: Department of Health and Social Care, supported by PHE, to initiate a review and update of the subject and contents of the National Radon Action Plan initially within 5 years of its first publication and on a similar frequency thereafter.”

NRAP 2 comment: The Ionising Radiation (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018 (1) require the review of the first NRAP within 5 years. The second NRAP document was produced to fulfil this requirement.

3.3. Additional topics for consideration

3.3.1 Promote radon in programmes on climate change

There are numerous programmes on mitigating the effects of climate change. Many of these involve changes to building heating and ventilation, which potentially have unintended effects on the indoor radon levels.

Action: UKHSA and other stakeholders to seek out and become increasingly involved in programmes on climate change to raise awareness of the health risks from radon and avoid changes to building regulations or other standards that increase radon levels.

3.3.2 Increase radon visibility within indoor air quality (IAQ) stakeholders

Many programmes on IAQ are focused on pollution, either from materials (such as asbestos or VOCs) or sources outdoors. As radon is an established carcinogen, awareness needs to be raised within IAQ stakeholders' groups and relevant programmes.

Action: UKHSA and other stakeholders to promote radon awareness among IAQ groups.

3.3.3 Raise awareness of radon exposure when working from home (WFH)

Homeworking and hybrid working have become more widespread and established following the SARS-CoV-2 (COVID-19) pandemic. However, many employers are unaware of the ubiquity of radon exposure or believe that the IRR17 and equivalent Northern Ireland legislation ([16](#), [17](#)) only apply to registered workplaces. The exposure of many employees is continuing unassessed.

Action: HSE, HSENI, local authorities and employers' groups to raise awareness of regulations applying to radon at work.

3.3.4 Emphasise and increase international influence and collaboration

The UK is a leading and involved partner in radon work with influential international organisations, including regulatory bodies. This includes IAEA, HERCA, EURADOS, ISO, IEC, UNSCEAR and WHO. Following the UK leaving the European Union, the membership of many relevant organisations remains open, including those with a worldwide remit for radon.

Action: UKHSA and other stakeholders to seek new opportunities to influence radon standards and practices at an international level.

3.3.5 Keep previous NRAP topics for consideration under review

The topics for consideration under the first NRAP should be kept under review for relevance, progress or set aside.

Action: UKHSA and other stakeholders to review and assess original topics for consideration.

4. Acknowledgements

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Under consultation

5. Glossary

Terms and expressions

Term	Meaning
Becquerel (symbol Bq)	The unit of the amount or activity of a radionuclide. Describes the rate at which transformations occur. 1 Bq = 1 transformation per second.
Becquerel per cubic metre of air (symbol Bq m ⁻³)	The amount of a radionuclide in each cubic metre of air. Often referred to as the activity concentration.
Mitigation	The reduction in the radon level by mechanical or other means. Mitigation does not imply the complete removal of radon.
Radon	The radionuclide Radon-222 and its progeny, as appropriate.
Radon action level	The reference level for the activity concentration of radon in UK homes. Its value, expressed as the annual average radon gas concentration in the home, is 200 Bq m ⁻³ .
Radon-affected areas	Parts of the country with a 1% or more probability of present or future homes being above the action level.
Reference level	The level of activity concentration above which it is judged inappropriate to allow exposures to occur as a result of that exposure situation, even though it is not a limit that may not be exceeded.
Remediation	The removal of a source. Also see 'mitigation'.
Thoron	The radionuclide Radon-220 and its progeny, as appropriate.

Acronyms and organisations

Acronym	Organisation
AGIR	Advisory Group on Ionising Radiation
BEIS	Department for Business, Energy and Industrial Strategy
CIBSE	Chartered Institution of Building Services Engineers
DAERA	Department of Agriculture, Environment and Rural Affairs (NI)
DEFRA	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DoH NI	Department of Health Northern Ireland
DHSC	Department of Health and Social Care

Acronym	Organisation
DWI	Drinking Water Inspectorate
EA	Environment Agency
EU-BSS	European Union Basic Safety Standards, Council Directive 2013/59/EURATOM
EURADOS	European Radiation Dosimetry Group
HERCA	Heads of European Radiation Competent Authorities
HHSRS	Housing Health and Safety Rating System
HSC	Public Health Agency Northern Ireland
HSE	Health and Safety Executive
HSENI	Health and Safety Executive Northern Ireland
IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
ICRP	International Commission on Radiological Protection
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
MHCLG	Ministry of Housing, Communities and Local Government
PHE	Public Health England
PHW	Public Health Wales
SG	Scottish Government
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WHO	World Health Organization

6. References

1. [The Ionising Radiation \(Basic Safety Standards\) \(Miscellaneous Provisions\) Regulations 2018](#). SI 2018/482
2. McColl NP, Bradley EJ, Gooding TD, Ashby C, Astbury J, Atkinson J, Harrall R, Howard T, Hunt J, Kernohan D, James K, Jones R, Laverty J, McMahon N, McNicholas C, Moss L, Murphy L, T Netherwood T, Rankin P, Stewart M, Taylor J, V Tink V, Waldron G, Wasson G. [UK National Radon Action Plan](#). PHE-CRCE-043
3. Varley NR and Flowers AG. 'Indoor radon prediction from soil gas measurements.' Health Physics 1998: volume 74, issue 6, pages 714 to 718
4. Wrixon AD, Green BMR, Lomas PR, Miles JCH, Cliff KD, Francis EA, Driscoll CMH, James AC and O'Riordan MC (1988). 'Natural radiation exposure in UK dwellings.' NRPB-R190
5. International Agency for Research on Cancer. [IARC monographs on the evaluation of carcinogenic risks to humans volume 100D. A review of human carcinogens. Part D: Radiation](#) / IARC Working Group on the Evaluation of Carcinogenic Risks to Humans
6. Darby S, Hill D, Auvinen A, Barros-Dios JM, Baysson H, Bochicchio F, Deo H, Falk R, Forastiere F, Hakama M, Heid I, Kreienbrock L, Kreuzer M, Lagarde F, Mäkeläinen I, Muirhead C, Oberaigner W, Pershagen G, Ruano-Ravina A, Ruosteenoja E, Schaffrath Rosario AS, Tirmarche M, Tomásek L, Whitley E, Wichmann H-E, Doll R (2005). [Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies](#) British Medical Journal 2005: volume 330
7. [Radon and Public Health](#). Report of the Independent Advisory Group on Ionising Radiation. Documents of the Health Protection Agency. Radiation, Chemical and Environmental Hazards, RCE-11, June 2009. ISBN 978-0-85951-644-0
8. [WHO Handbook on Indoor Radon: A Public Health Perspective](#). WHO Press, Geneva, 2009
9. [Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. General Safety Requirements Part 3](#)
10. United Nations Scientific Committee on the Effects of Atomic Radiation (2009). [Effects of exposure to radon gas](#)
11. [Lung cancer risk from radon and progeny and statement on radon](#). ICRP Publication 115. Ann ICRP 2010: volume 40, issue 1
12. [Summary of ICRP Recommendations on Radon](#) (2018)
13. Oatway WB, Jones AL, Holmes S, Watson S and Cabianna T (2016). [Ionising radiation exposure of the UK population: 2010 Review](#). PHE-CRCE-026
14. [Environmental Permitting \(England and Wales\) Regulations 2016](#). SI1154/2016
15. [Environmental Authorisations \(Scotland\) Regulations 2018](#). SSI219/2018
16. [The Ionising Radiations Regulations 2017](#). SI1075/2017
17. [The Ionising Radiations Regulations \(Northern Ireland\) 2017](#). SR No 229
18. McColl NP, Miles JCH, Green BMR, Dixon DW, Fey R, Meara JR, Harrison JD and Cooper JR. [Limitation of human exposure to radon](#). HPA-RCE-15

19. Board Statement on Radon in Homes. Documents of the NRPB Docs 1 number 1
20. Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, Official Journal of the European Union L13/1
21. [UKradon](#) (accessed 22 August 2023)
22. Daraktchieva Z, Appleton JD, Rees DM, Adlam KAM, Myers AH, Hodgson SA, McColl NP, Wasson GR and Peake LJ (2015). [Indicative atlas of radon in Northern Ireland](#). PHE-CRCE-017
23. Daraktchieva Z, Howarth CB, Gooding TD, Bradley EJ and Hutt N. [Validation scheme for organisations making measurements of radon in UK buildings: 2018 revision](#). PHE-CRCE-040
24. Miller, CA and Howarth, CB. [Results of the 2021 intercomparison of passive radon detectors](#). UKHSA RCE-002
25. [Housing Act 2004. Chapter 34](#)
26. [Health and Safety at Work etc Act, 1974](#)
27. [The Management of Health and Safety at Work Regulations 1999 SI 3242/1999](#)
28. HSENI (2000). [The Management of Health and Safety at Work Regulations \(Northern Ireland\) 2000](#)
29. [Radon in the workplace](#) (accessed 28 September 2023)
30. [The Provision and Use of Work Equipment Regulations 1998 SI 2306/1998](#)
31. [The Provision and Use of Work Equipment Regulations \(Northern Ireland\) 1999](#)
32. [Radon. Guidance on protective measures for new buildings. BRE-211](#). Building Research Establishment. ISBN 978-1-84806-486-7
33. [The Water Supply \(Water Quality\) Regulations 2016 \(with 2018 amendments consolidated\)](#)
34. [The Water Supply \(Water Quality\) Regulations \(Wales\) 2018 \(SI No 647\)](#)
35. [The Water Supply \(Water Quality\) Regulations \(Northern Ireland\) 2017 \(Statutory Rules of Northern Ireland 2017 number 212\)](#)
36. [The Public Water Supplies \(Scotland\) Regulations 2014 \(Scottish Statutory Instrument No 364\)](#)
37. [Private Water Supplies Regulations 2016 \(SI No 618\)](#)
38. [Private Water Supplies \(Wales\) \(Amendment\) Regulations 2017 \(SI No 1041 \(W270\)\)](#)
39. [Private Water Supplies \(England\)\(Amendment\) Regulations 2018 \(SI No 707\)](#)
40. [The Water Intended for Human Consumption \(Private Supplies\)\(Scotland\) Regulations 2017 \(Scottish Statutory Instrument 2017 No 282\)](#)
41. [The Private Water Supplies Regulations \(Northern Ireland\) 2017 \(Northern Ireland Statutory Rules 2017 No. 211\)](#)
42. [Treatment for radon and uranium](#) (accessed 1 August 2023)
43. [EU Construction Products Regulation 2011](#). SI305/2011
44. HSAW(NI)O (1978). [Health and Safety at Work \(Northern Ireland\) Order 1978](#)

Appendix A. EU Basic Safety Standards: Annexe XVIII

List of items to be considered in preparing the national action plan to address long-term risks from radon exposures as referred to in Articles 54, 74 and 103 .

1. Strategy for conducting surveys of indoor radon concentrations or soil gas concentrations for the purpose of estimating the distribution of indoor radon concentrations, for the management of measurement data and for the establishment of other relevant parameters (such as soil and rock types, permeability and radium-226 content of rock or soil).
2. Approach, data and criteria used for the delineation of areas or for the definition of other parameters that can be used as specific indicators of situations with potentially high exposure to radon.
3. Identification of types of workplaces and buildings with public access, such as schools, underground workplaces, and those in certain areas, where measurements are required, on the basis of a risk assessment, considering for instance, occupancy hours.
4. The basis for the establishment of reference levels for dwellings and workplaces. If applicable, the basis for the establishment of different reference levels for different uses of buildings (dwellings, buildings with public access, workplaces) as well as for existing and for new buildings.
5. Assignment of responsibilities (governmental and non-governmental), coordination mechanisms and available resources for implementation of the action plan.
6. Strategy for reducing radon exposure in dwellings and for giving priority to addressing the situations identified under point 2.
7. Strategies for facilitating post construction remedial action.
8. Strategy, including methods and tools, for preventing radon ingress in new buildings, including identification of building materials with significant radon exhalation.
9. Schedules for reviews of the action plan.
10. Strategy for communication to increase public awareness and inform local decision makers, employers and employees of the risks of radon, including in relation to smoking.
11. Guidance on methods and tools for measurements and remedial measures. Criteria for the accreditation of measurement and remediation services shall also be considered.
12. Where appropriate, provision of financial support for radon surveys and for remedial measures, in particular for private dwellings with very high radon concentrations.
13. Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non-smokers).
14. Where appropriate, consideration of other related issues and corresponding programmes such as programmes on energy saving and indoor air quality.

Appendix B. UK Radon Strategy

Recognising that radon is the largest source of radiation exposure to the UK population, the UK Radon Strategy (UKRS) aims to: identify and reduce high individual radon exposures and the overall level of radon exposure to the population at home, work or elsewhere, with a consequent reduction in the risk of lung cancer.

The UKRS meets the radon requirements of the European Union Basic Safety Standards Directive (B1), including those transposed through the Ionising Radiation (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018 (B2) and other regulations.

The UKRS is built on the scientific evidence and understanding of radon and its presence across the UK, continued research and collaborations at a national and international level, combined with legislation and practical implementation.

The national radiation survey in the 1980s provided the population-weighted annual average radon concentration of 20 Bq m⁻³. This also identified radon from the ground as the dominant UK source, with no significant contribution from building materials. Private water supplies could also be a source; further research is ongoing to understand the implication of the EC's proposals relating to radon in drinking water for the UK (B3). Subsequent measurement campaigns (with Government support) enabled a detailed national radon map to be produced. The radon potential maps for all 4 UK countries have been updated several times, combining the radon measurement results of around 600,000 homes with detailed geology. Hazard maps for drinking water sources have been produced and are currently under review.

The action level for homes was set in 1990 at 200 Bq m⁻³ (annual average radon concentration), with the target level of 100 Bq m⁻³ added in 2010 (B4) for those with a history of tobacco smoking and as a target for building mitigation work. The regulatory threshold for work in a radon atmosphere is 300 Bq m⁻³ (annual average radon concentration) from the Ionising Radiations Regulations 2017 (B5, B6) and equivalent Northern Ireland legislation. Geographical areas where at least 1% of current or future homes are estimated to exceed the action level are defined as radon-affected areas, with associated advice and standards for householders, employers, building regulations (to prevent radon ingress) and property sales. All basements, cellars and underground workings should be considered at increased risk from high radon levels.

Measurement protocols for homes and workplaces have been established, backed up with a Validation Scheme for quality control. Householders, landlords and employers are able to purchase and install radon detectors with confidence, and are advised to do so in the affected areas. Employers need to include radon in their risk assessments, which will include below ground areas occupied for more than 50 hours per year.

Radon mitigation is provided by private contractors, many of which have organised themselves into 2 self-regulating bodies (The Radon Council and UK Radon Association) with the aim of raising standards across the industry. Employers and landlords have legal obligations to control or reduce radon exposures, usually by building mitigation. Financial help may be available from local government for private householders on the lowest incomes with high radon levels.

The UKRS includes the provision of information and advice through national and local government routes (for example, [UKradon](#) and [Radon in the workplace](#)) and through other professional or industry bodies. Radon is also part of a wider public health strategy that includes smoking cessation. Collaborative programmes are also in place to link radon with indoor air quality and the health effects of climate change, so that unintended effects on radon levels from interventions can be avoided.

Regulations require that the NRAP be updated at intervals no greater than 5 years.

References

(B1) [Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation](#). Official Journal of the European Union L13/1

(B2) [The Ionising Radiation \(Basic Safety Standards\) \(Miscellaneous Provisions\) Regulations 2018](#). SI 2018/482

(B3) [Understanding the implication of the EC's proposals relating to radon in drinking water for the UK](#)

(B4) McColl NP, Miles JCH, Green BMR, Dixon DW, Fey R, Meara JR, Harrison JD and Cooper JR. [Limitation of Human Exposure to Radon](#). HPA-RCE-15

(B5) [The Ionising Radiations Regulations 2017 SI1075/2017](#)

(B6) [The Ionising Radiations Regulations \(Northern Ireland\) 2017 SR No 229](#)

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UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation health secure.

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