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UK National Radon Action Plan

Draft for consultation

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UK National Radon Action Plan

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Abstract

Radon is a colourless, odourless radioactive gas that is formed by the radioactive decay of elements that occur naturally in rocks and soils. Radon is the single biggest source of radiation exposure to the UK population in both homes and workplaces. This report presents in a single document, the elements that make up the national radon strategy and the national radon action plan. It fulfils relevant requirements in the 2013 European Union Basic Safety Standards on protection against ionising radiation (EURATOM, 2013).

EURATOM (2013). 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.

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Executive Summary

Radon is a colourless, odourless radioactive gas that is formed by the radioactive decay of elements that occur naturally in rocks and soils, and may also be found in certain building materials and water. Radon is the single biggest source of radiation exposure to the UK population in both homes and workplaces, and is the second leading cause of lung cancer after tobacco smoking.

The United Kingdom has more than four 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 from 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.

Previously, reports covering the various aspects of radon measurement and control have been published that represent parts of a national strategy to reduce both high individual radon exposures and the overall level of radon exposure to the population. The fundamental aim is to reduce the individual and overall risks of lung cancer.

This report presents the UK strategy and action plan on radon. It was prepared to present, 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 radon-related requirements in the Ionising Radiations (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018 (SI 2018/482) (BEIS, 2018) that enact part of the 2013 European Union Basic Safety Standards on protection against ionising radiation (EURATOM, 2013).

An overview is presented that describes: the properties of radon and its distribution with the UK; the nature of human exposure to radon in homes and workplaces: regulations, standards and methods of mitigating high radon levels and preventing radon ingress in new construction; radon in water; radon in building materials; and the way in which information on radon controls is communicated to all the groups of people affected. The report also outlines new topics for consideration.

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

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

EURATOM (2013). 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.

The Ionising Radiation (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018. SI 2018/482

Contents

1 Introduction

Radon is the single biggest source of radiation exposure to the UK population in both homes and workplaces. This report presents the UK strategy and action plan on radon. It was prepared to present, 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 a number of radon-specific requirements in the 2013 European Union Basic Safety Standards (EU-BSS) on protection against ionising radiation (EURATOM, 2013).

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 and was approved for issue by the organisations listed.

Table 1 Government departments and agencies contributing to the UK National Radon Action Plan

Government departments and agencies contributing to the UK National Radon Action Plan and Strategy
Department of Agriculture, Environment and Rural Affairs (Northern Ireland Environment Agency)
Department for the Environment, Food and Rural Affairs / Drinking Water Inspectorate
Department of Health and Social Care
Department of Health, Northern Ireland
Environment Agency
Health and Safety Executive
Health and Safety Executive Northern Ireland
Ministry of Housing, Communities and Local Government
Public Health Agency, Northern Ireland
Public Health Wales
Public Health England
Scottish Government

1.1 Properties of radon

1.1.1 Physical properties

Radon is a colourless, odourless radioactive gas. It is formed by the radioactive decay of the small amounts of primordial elements that occur naturally in most rocks and soils. It has a number of radioactive isotopes which have the same chemical properties but different nuclear properties. There are three naturally-occurring isotopes of which two, radon-222 and radon-220, occur naturally 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 3.8 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 decay chain of a primordial radionuclide, thorium-232. Thoron has a half-life of 55.6 seconds and has a number of short-lived decay products.

Uranium (and radium) in near-surface rocks and soil is the main source of radon. In order for radon to be a source of radiation exposure, the surrounding soil or rocks must be sufficiently porous and permeable to allow radon to migrate with soil gas and enter overlying buildings. Activity concentrations of radon in the ground are often of the order of 100,000 becquerels per cubic metre (Bq m^{-3}) of soil gas. Where radon is released to open ground, concentrations in air are low: the UK average is 4 Bq m^{-3} (Wrixon *et al*, 1988).

1.1.2 Health risks

Most radiation exposure from radon arises from inhaling the 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 can then be inhaled.

Radon is recognised by the International Agency for Research into Cancer (IARC) as a Class 1 carcinogen (IARC, 2012). Evidence has been obtained from pooled large scale epidemiological studies (Darby *et al*, 2005) that there is a linear relationship between long term radon exposure and excess relative lifetime lung cancer risk. Overall, 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 been demonstrated (Darby *et al*, 2005) at concentrations at least as low the UK radon Action Level for homes (200 Bq m^{-3}) (NRPB, 1990, HPA, 2010). An individual's baseline lung cancer risk is strongly dependent on their smoking status. Current smokers have a risk of about 15% to age 75, compared with 0.4% for lifelong non-smoker. In the UK, exposure to indoor radon is responsible for an estimated 1,100 lung cancer deaths each year with smokers and ex-smokers at the greatest individual risk (AGIR, 2009).

There is currently no strong evidence to link radon exposure to cancers other than lung cancer or to other disease (AGIR, 2009). 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 concluded that any effects on organs other than the lung are "so weak as to be generally undetectable in the published epidemiological studies".

1.2 Radon exposure in the UK

1.2.1 National radon survey and measurement database

The UK has completed a radon survey to establish the population weighted average and distribution of radon exposure (Wrixon *et al*, 1988). This survey, undertaken in the 1980s, which measured radon in more than 2,000 homes selected systematically, identified that the population weighted average radon concentration was around 20 Bq m^{-3}.

The results of these measurements, and many more, are stored in a national radon measurement database. The database currently holds the results from measurements made

in more than 550,000 homes and other premises. Statistical summaries of measurements made in dwellings are published on www.gov.uk/government/collections/radon.

1.2.2 Radon in buildings

Radon can be drawn into a building from the ground below. Indoors the radon is diluted less than if it is released to open air. A variety of processes, including indoor/outdoor temperature differential, heating, ventilation and the effect of prevailing winds, 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, but in some areas of the country gives significantly higher exposures (Oatway *et al*, 2016). Indoor radon concentrations in air range from a few to over ten thousand Bq m^{-3}.

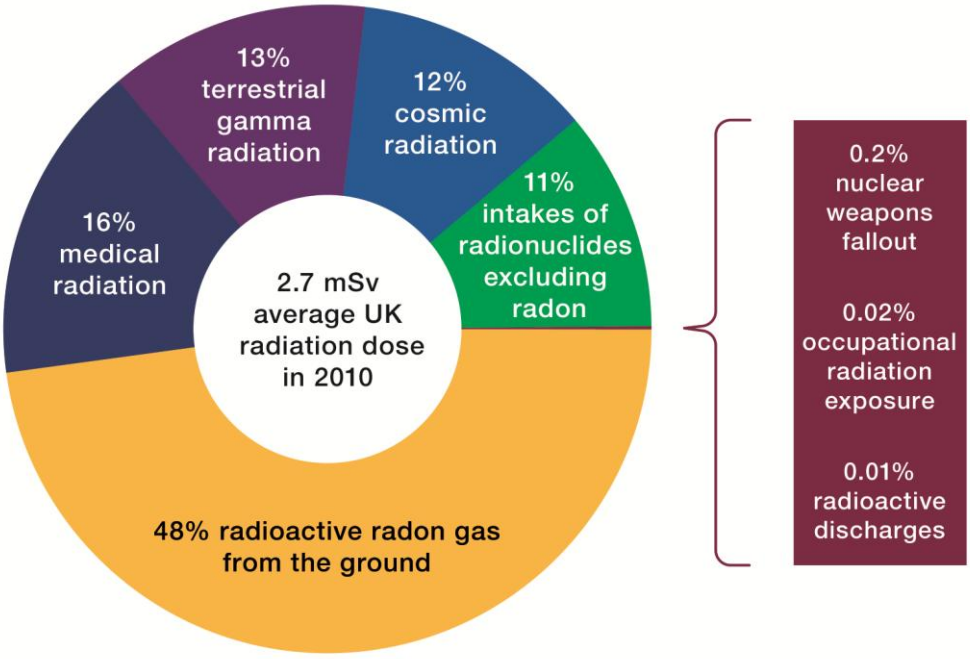

Figure 1 Sources of radiation exposure in the UK

1.2.3 Radon and thoron from building materials

The UK national radon survey found that 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 (Wrixon *et al*, 1988).

Building materials with high thorium content may exhale thoron into 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 of the material. In the UK, thoron contributes about 4% of the annual average radiation exposure (Wrixon *et al*, 1988).

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 used in the public drinking water supply networks generally has sufficient dilution, storage and treatment to reduce radon to very low levels. In some private domestic ground-water derived drinking water supplies, these processes may not operate to the same extent such that the water has elevated radon concentrations at the point of entry into the consumer's home. In these cases, 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, etc and to a lesser extent from the ingestion of radon in water. The inhalation pathway generally gives rise to the great majority of radiation exposure from radon present in drinking water.

Factories 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 past uses of radium

Radon can be generated from past human activities involving radium. Radium-226 (half-life 1,600 y) is the radioactive parent of radon and has been used in the past for research, in luminised instruments and in other devices, e.g. to eliminate static electricity. A small number of premises, including factories and laboratories, have been found to have high radon levels from this source.

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 (AGIR, 2009). 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, such as presence of primary or secondary double glazing, can adversely affect the indoor radon level. While these observations alone are not sufficient to impact on advice about testing or remediating radon, they inform an emerging area of investigation into the interaction between radon concentrations and energy efficiency measures that are retro-fitted to buildings or are a design feature of new buildings, although the latter are also often associated with other features such as additional ventilation that may reduce the effect.

There is regular interaction and cross-fertilisation between organisations working on radon and those engaged in related problems such as air quality and other environmental hazards.

2 UK radon strategy

Radon is the single biggest source of radiation exposure to the UK population in both homes and workplaces. The fundamental aim of the UK radon strategy is to reduce high individual radon exposures and the overall level of radon exposure to the population whether at home, at work or elsewhere, with a consequent reduction in individual and overall risks of lung cancer.

The UK's existing strategy meets the radon requirements of the European Union BSS Directive (EURATOM, 2013), including those transposed through the Ionising Radiation (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018 (BEIS, 2018) and other regulations.

The overall strategy is presented in this section. Further detail about the implementation of the strategy through existing provisions and activities is presented in Section 3.

The UK radon strategy is built on the scientific understanding of radon and its presence across the UK. It is informed by evidence, research, guidance and practical experience from within the UK and from international bodies, including the World Health Organisation and the International Commission on Radiological Protection and the International Atomic Energy Agency. The strategy has been developed within the wider context of how the UK addresses health risks in homes and workplaces, and sits alongside the public health goal of reducing health risks from smoking.

The UK radon strategy is implemented through various means including public health action; provision of advice and information; and legislation and regulation. Where appropriate, the strategy is implemented by including radon-specific elements into wider arrangements.

The strategy focuses mainly on the dominant radon exposure pathway, which is indoor exposure resulting from inhalation of radon that enters a building across its interface with underlying soil and rock. The strategy addresses radon exposure in new and existing premises, principally homes and workplaces. Other radon sources and exposure pathways are considered and reflected in the strategy and specific arrangements as appropriate.

For existing buildings, the main components of the strategy are risk assessment and action to reduce high exposures. The key elements are: a decision about whether the radon level in buildings should be measured; making suitable radon measurements; and choosing and implementing a suitable remediation where this is considered necessary.

Radon Affected Areas are defined as those where at least 1% of the homes are expected to exceed the UK radon Action Level. Radon measurements are recommended for buildings that are located in a radon Affected Area and for basement (below ground) rooms that are regularly occupied, irrespective of their geographical location.

The results of radon measurements are compared to the relevant reference levels (see sections 3.1.1 and 3.2.1) to inform decisions about action to reduce radon exposures, and in relation to occupational exposures, determining whether there is work with radiation and further regulations apply. High exposures can generally be reduced by remedial building works that lower the concentration of radon in indoor air. In some workplace circumstances, exposures may be managed by restricting the time spent in relevant rooms or spaces.

For new construction, the strategy aims to prevent high exposures occurring through the targeted requirement of protection from radon in new buildings and extensions in areas where high radon levels are more likely.

The strategy also takes account of the synergistic interaction between radon exposures and smoking that leads to current smokers and ex-smokers having a higher lung cancer risk than a lifelong non-smoker for a given level of radon exposure. The longstanding UK policy to reduce smoking contributes to reducing the lung cancer risks from radon exposure.

Since the presence of radon is not perceived by the human senses and is generally not determined by the type of human activity undertaken in a building, communication is an important element of the strategy, which aims to promote awareness of radon in those individuals and organisations that have to take action. This takes a number of forms including: addressing radon in existing processes, such as property transactions and workplace health and safety activities; targeted campaigns to address specific groups; and ongoing provision of information and guidance.

Radon will always be produced in the ground and its entry into homes and workplaces cannot be prevented completely. Radon levels in remediated buildings remain low only while a remediation system continues to work effectively and subsequent building modifications do not affect the entry of radon into the property. Radon is therefore a continuing source of radiation exposure and the UK radon strategy will need to be maintained to ensure that radon awareness, action and protection progresses at the national, local and individual levels.

3 Existing UK action on radon

Radon has been recognised for many years as a significant source of radiation exposure in UK homes and workplaces. The major elements that implement the UK radon strategy are described below. This report does not include exhaustive references to specific legislation, guidance and scientific evidence on the topics listed below.

3.1 Exposure to radon in homes

3.1.1 Radon reference level for homes

A radon Action Level (200 Bq m^{-3}) provides the primary UK reference level for informing decisions about reducing indoor radon concentrations in homes (HPA, 2010). The Action Level has been in place since 1990 (NRPB, 1990) and was reviewed and retained in 2010 (HPA, 2010).

This Action Level is within the ranges established by international standards and guidance published by WHO (WHO, 2009), the International Atomic Energy Agency (IAEA, 2014), ICRP (ICRP, 2010) and the European Union (EURATOM, 2013), each of which stipulates that indoor radon concentrations should not exceed an annual average of 300 Bq m^{-3}.

In 2010, a supporting Target Level (100 Bq m^{-3}) was introduced (HPA, 2010) to serve two purposes: to represent a target, below which remediation should aim to reach, and as a point above which those at higher individual risk, such as current smokers and ex-smokers, should seriously consider radon reduction.

3.1.2 Radon maps to support decision making

High indoor radon levels occur in a small percentage of UK buildings and in many cases can be reduced by practical remediation methods. Indoor radon concentrations depend on a number of factors, including the geological characteristics of the ground underneath the building. This can be taken into account in maps of radon potential, but other factors, including 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. This generally results in indoor radon concentrations in an area exhibiting a distribution that is characterised by most premises having relatively low concentrations but with some having considerably higher levels.

In order to identify whether a particular building has high radon levels, it is necessary to measure the radon level in the building.

Maps are produced that identify radon Affected Areas (Miles *et al*, 2007; Miles *et al*, 2011; Daraktchieva *et al*, 2015), where at least 1% of homes are expected to be above the radon Action Level (200 Bq m^{-3}). Databases of radon measurements and geological features are maintained and used to prepare these maps. The maps (Figure 2) are used to determine whether a home should be measured for radon.

The maps are accessible in indicative form in published atlases on www.gov.uk and as an online interactive resource (www.ukradon.org). 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 irrespective of their geographical location (HPA, 2010).

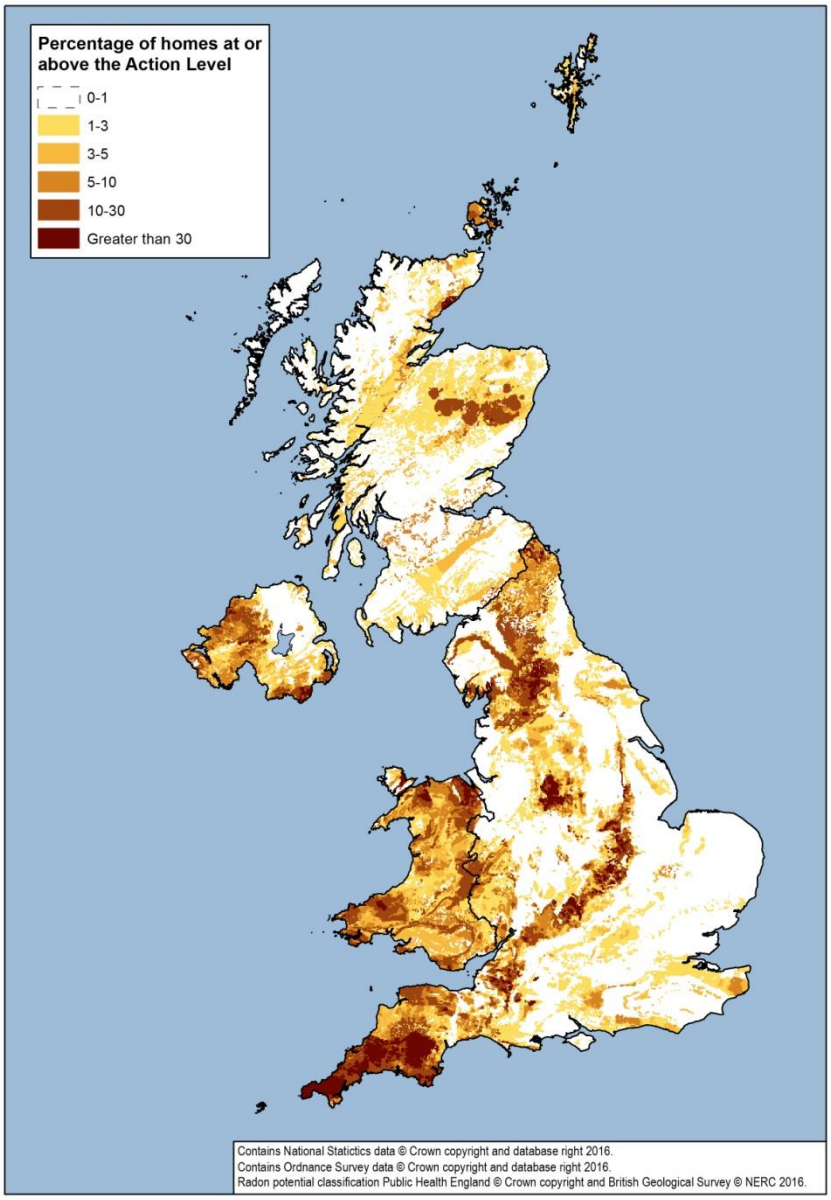

Figure 2 Indicative UK radon map

A programme is maintained, involving the British Geological Survey, PHE and other organisations, to review and update the UK radon risk maps to reflect significant new information, such as improved geological mapping, additional radon measurements and improvements to the methodology for mapping radon potential.

3.1.3 Measuring radon in homes

Services are available from a number of organisations to undertake measurements of radon in homes. Most domestic measurements are made using two detectors, one each placed in the main living room and an occupied bedroom for a period of at least 3 months, to smooth out short term fluctuations. This is often a postal service but individual placement services are also offered by some providers, along with measurements with electronic (active) monitors.

In exceptional situations, it may be appropriate to make additional measurements in the home. The results can be combined to reflect typical domestic occupancy and corrected for seasonal variations in radon levels to allow the estimation of the radon concentration (expressed as an annual average) to which occupants are exposed. The result can be compared with the Action Level and Target Level to inform decisions about installing appropriate radon remediation.

A validation scheme for organisations offering radon measurements in homes has been run for many years (Howarth and Miles, 2008). 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 remediation. In addition, regular international intercomparison exercises are available (Howarth, 2017) that allow those offering radon measurement services to check the technical performance of their measurement capability.

3.1.4 Reducing indoor radon levels in homes

Where high radon levels are identified, practical remediation methods, and supporting technical guidance, are available to reduce radon concentrations, including from the Building Research Establishment (www.bre.co.uk). Householders are advised to reduce radon levels below the Action Level and to seriously consider reducing levels between the Target and Action Levels, informed by the risk to the occupants and taking account of the greater risk to current smokers and ex-smokers. Specific guidance for individual properties, such as the design and location of remediation systems, is available from specialist companies in the radon sector. If the source of high radon levels was identified as being from the private water supply, remediation must be focused accordingly.

A number of companies undertake radon remediation work, some of whom are members of industry groupings including the Radon Council (www.radoncouncil.org) and the UK Radon Association (www.radonassociation.co.uk), who publish lists of services provided by their members.

Those with responsibility for a building with radon remediation installed are advised to follow the installer's maintenance instructions and to re-test the building periodically to ensure that protection is maintained.

3.1.5 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 (Housing Act, 2004); in Scotland, a recent review of the housing standards has included radon as a topic that may be included in an updated standard for tolerable housing; in Northern Ireland, a

consultation included adoption of HHSRS (and hence explicit consideration of radon) as an option. At the time of writing, the reviews in Scotland and Northern Ireland were still under way.

3.1.6 Promoting action on radon and encouraging remediation in homes

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, in partnership with local authorities, in areas with significant numbers of homes in the higher bands of radon potential, typically where at least 5% of homes are expected to exceed the UK Action Level.

At the time of writing, with support from the relevant government departments, Public Health England (or forerunner organisations) had undertaken more than 20 programmes of this nature. Advice on further action is provided in the form of letters, leaflets, signposting to online resources and, in many cases, invitations to local "drop-in" sessions to obtain individual face-to-face advice about radon risks and remediation. A number of similar programmes have been undertaken as local initiatives, generally by local authorities.

Building Regulations require that new homes in certain areas should be constructed with protective measures that aim to prevent radon ingress (see section 3.3). PHE has published the results of a first survey to gauge home owner awareness of these measures (Hodgson *et al*, 2016). Work by the radon industry 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.

PHE maintains an ongoing programme of work covering these aspects of radon in homes, working closely with relevant local authorities and using resources from national governments where these are available.

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 remediation.

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

3.2 Radon in the workplace

3.2.1 Regulations

Under the Health and Safety at Work etc Act 1974 (HASAWA, 1974), employers must, so 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 (HSE, 1999) require the assessment of health and safety risks.

Where the radon concentration in a workplace exceeds the relevant reference level (300 Bq m^{-3} as an annual average), the Ionising Radiations Regulations 2017 (HSE, 2017;

HSENI, 2017) apply to work with radiation and the employer is required to take certain actions including those to restrict exposures.

3.2.2 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 typical workplaces and can be used to inform the risk assessment and need for radon measurements.

In occupied workplaces below ground, which includes basement areas of buildings, mines and caves, the risk assessment should include radon measurements irrespective of the radon Affected Area status (HSE, 2018).

3.2.3 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 remediation or other means. The services available for radon measurements in homes are often suitable for indoor workplaces. Most occupational radon measurements are made with passive monitors that are in place for three months. The number required in each building, however, 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 (www.ukradon.org).

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.

3.2.4 Controlling radon exposure in workplaces

The first choice is usually to reduce the concentration of radon. The same techniques for radon remediation in homes are usually applicable to workplace buildings, sometimes with adaptations depending upon the layout of the building, radon levels, and any ventilation systems. In mines and caves, radon levels are generally controlled by air handling techniques, which may be informed by specialist advice on optimising ventilation.

In some workplaces, radon exposures may be controlled by managing local occupancy, for instance by limiting access duration and frequency to a high radon area.

In a small minority of workplaces, where elevated concentrations are difficult to reduce in practice, some workers (classed as radiation workers) have their radon exposures assessed individually using personal radon dosemeters.

3.3 Protecting new buildings against radon

Building regulations, supporting documents and guidance provide for limitation of radon ingress in new buildings and extensions in a tiered approach. 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. 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.

The areas that are subject to each level of protection are identified in relation to the UK radon map. Specific criteria for and descriptions of the expected measures are established by the individual nations within the UK.

3.4 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. The requirement for testing can be different according to whether the supply is for commercial or public use, or for a single dwelling.

3.5 Radon exhalation from building materials

The EU Construction Products Regulation 2011 (DCLG, 2011) provides uniformity in assessing the performance of construction products through harmonised product standards and technical assessments, which include radiation. Although radon emitted from building materials generally leads to low indoor exposures (Wrixon *et al*, 1988), research is under way to identify if there are any building materials with significant radon exhalation and whether regulations or other controls on their use will be required.

3.6 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, whether it is a home or workplace, may remain unaware of the presence and potential significance of radon in the building unless it is brought to their attention and they are made aware, through appropriate communications, of what actions they should take.

Different groups and individuals need different radon information and guidance. Radon information and guidance is available and communicated to relevant groups and individuals through a range of processes.

3.6.1 Online information resources

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

- www.bgs.ac.uk – access to BGS technical guidance and services
- www.bre.co.uk – access to BRE technical guidance and services
- www.gov.uk - links to key government information on radon

- www.hse.gov.uk – guidance on radon in the workplace
- www.hseni.gov.uk – guidance on radon in the Northern Ireland workplaces
- www.radonassociation.co.uk – an industry association
- www.radoncouncil.org - an industry association
- www.ukradon.org – a dedicated radon website managed by PHE

Many local authorities have information about radon on their websites relevant to their areas.

Some individual companies provide radon information on their websites.

3.6.2 Media communications

Specific programmes, publications and events provide opportunities to promote radon awareness. A range of media channels are 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.

3.6.3 Targeted communications

In some contexts, communications are more closely targeted to those who may need to take action on radon. 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 remediation; 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.

PHE 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.

3.6.4 Training for professionals

A number of organisations offer short duration or online training courses in radon measurement and remediation and radon protection/ prevention aimed at professionals in the building sector. Practical training in remediation techniques is provided by industry professionals, along with mentoring. Training about radon is also provided as part of the Continuing Professional Development on indoor air quality.

3.7 Radon in UK overseas territories and crown dependencies

There are a number of British overseas territories and crown dependencies. Gibraltar is within the EU. 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.

3.8 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 the www.gov.uk portal.

4 Forward plan for action on radon

The radon strategy presented in section 2 is implemented through the elements described in section 3.

Radon will continue to be released naturally from the soils and rocks on which homes and workplaces are situated, and from private water supplies and building materials. Radon remediation systems that reduce high concentrations must continue to operate for the lifetime of a building in order to protect the building occupants. Since radon is imperceptible to the human senses, general awareness of radon and knowledge of the radon situation in particular buildings are at risk of diminishing over time, especially when the ownership or responsibility for the premises changes hands.

It is therefore important that 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.

This section identifies actions that will seek to maintain and enhance the UK's position on managing radon in an effective, evidence-based manner.

4.1 Maintain 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 3, will be maintained and reviewed in light of relevant evidence and experience. These provisions are summarised below:

- Maintain a suite of radon advice including reference levels for radon exposure and the definition of radon Affected Areas
- Maintain the capability and provision of resources that can be used by householders, landlords, employers and others to identify premises for which radon measurements are advised
- Maintain the capability for and provision of radon measurement services to support the assessment and management of indoor radon levels
- Maintain the provision of information, guidance and services relating to the reduction of indoor radon levels
- Maintain and consider radon in health and safety arrangements for housing
- Maintain the capability for and delivery of activities to promote householder and landlord awareness and action on radon in homes including testing and remediation
- Maintain legislation and guidance concerning radon exposures in the workplace

4.2 New topics for consideration

A review of Annex XVIII of the EU-BSS (EURATOM, 2013) identified a small number of topics that the national plan should consider but which are not currently in place in the UK. These are outlined below with specific proposals for future action.

4.2.1 Consider updating the national radon survey

The original UK national radon survey was undertaken in the mid 1980's (Wrixon *et al*, 1988) 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 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.

4.2.2 Consider extending measurement validation scheme to include workplaces

The current UK validation scheme applies to radon measurements made in dwellings. At present there is not a comparable UK scheme for measurements in workplaces. Such a scheme would need to address aspects of workplaces that are different from homes such as occupancy and physical size and layout.

ACTION: At the time of writing PHE is reviewing the current validation scheme for dwellings. As part of this review the scope will be extended to include measurements in standard above ground workplace buildings.

4.2.3 Consider developing an accreditation scheme for remediators

The UK has at least two 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 it 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.

4.2.4 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.

4.3 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 would meet the requirement of Article 103.1 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 online blogs, and existing forums (such as indoor routine air quality and UK Radon Forum events) 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.

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