Parliamentary Office of Science and Technology

postnote

June 2001 Number 158

REDUCING RADON RISKS IN THE HOME

Radon is a naturally occurring radioactive gas found in rocks and soils that can cause lung cancer. Around 100,000 homes across the country are thought to be at particular risk. Previous efforts to encourage householders to take action to reduce their exposure have met with limited success, but the Government has recently launched a new programme in England in partnership with 32 local authorities to address the problem. This briefing outlines where radon comes from, its hazards, and ways to reduce its risks.

Radon and its risks

What is radon?

Radon (Rn) gas occurs from the decay of radioactive elements (uranium and radium) found in all rocks and soils. Typical soils contain around 3 parts per million (ppm) of uranium, but this can reach more than 10ppm in some areas, in particular, those underlain by granite and shale but also some limestone and sandstone. Radon can be detected only using specialised equipment[1], as it has no taste, colour or odour.

What are the risks?

Radon was first linked with lung cancer in the 1950s, following laboratory studies of radon exposure in animals, and population studies of miners and known lung cancer patients. Radon is now recognised to be the second largest cause of lung cancer in the UK after smoking. The National Radiological Protection Board (NRPB) estimates that 2000-3000 people in the UK die each year from radon-induced lung cancer[2].

Overall, around half of the annual average exposure of UK citizens to radiation comes from exposure to radon. However, this figure is averaged out across the country. In the regions with elevated radon concentrations (corresponding to the darker areas in the map over the page), the contribution of radon can be higher.

Hazards from radon

While radioactive decay occurs naturally in many rocks, radon release presents a particular hazard because it is a gas and so can escape from the solid rock through pores and cracks to reach the surface. It may then collect in buildings and present risks to people. Outdoors, radon exists in very dilute concentrations and poses negligible risk. Dissolved radon may also be present in water supplies, from which it can outgas when the water is used in the home. In some parts of the UK, this can be a significant source of exposure.

It is not the radioactive decay of radon itself that is the main hazard but its 'decay products'. These form as ultra-fine solid metallic particles in the air and attach to other airborne particles which are breathed in, become lodged in the lung, and irradiate the surrounding tissue. For simplicity, radon and its decay products are collectively referred to as radon.

Where is it found?

All rocks and soils produce radon to some extent. The British Geological Survey (BGS) has found that areas of England (particularly Cornwall, Devon, Somerset, Northamptonshire and Derbyshire), E Scotland and W and SW Northern Ireland are all affected.

The map on the next page shows the variation in the risk of high radon concentrations in homes across the UK. This pattern is determined largely by the underlying geology. The higher levels are found generally in areas underlain by rocks containing high uranium or radium levels, and in areas underlain by permeable rocks, in particular permeable limestone.

While radon is ubiquitous, it is considered to be a hazard only when levels are high, and these are more common in certain 'radon affected areas'. The box at the top of the next page describes how these affected areas have been designated.

Radon affected areas

These are places where more than 1% of houses are likely to have concentrations of radon above an 'Action Level'. In 1990, the National Radiological Protection Board (NRPB) recommended[3] that the level should be 200 bequerels per cubic metre (Bq/m^3) averaged over a year (1 Bq is one radioactive disintegration per second). This is ten times the measured UK average radon exposure level of $20Bq/m^3$. The action level corresponds to an annual average radiation dose of 10 millisieverts (mSv). Based on the assumption that all doses of radiation present some risk of cancer, the action level represents a risk of 1 in 30 of lung cancer over a lifetime. This is ten times higher than the average UK risk of 1 in 300 from all natural sources of radiation, and 1 in 20 from smoking.

Where concentrations are above the Action Level, the NRPB recommended reduction of concentrations in existing buildings and additionally, in certain localities in affected areas, that preventative measures should be taken against radon entering new dwellings.

Radon affected areas are defined using maps based on radon concentrations measured in the 400,000 houses surveyed to date. Of these around 40,000 were found to have radon concentrations above the Action Level. The maps are based on taking at least 5 measurements within 5km grid squares across the country[4].

Based on the survey data, NRPB has estimated that around 100,000 dwellings had radon concentrations above the action level. Most were in England, with Cornwall and Devon the most significantly affected areas. For example, in the Truro postcode district, NRPB found that 29% of dwellings had radon concentrations above the Action Level. In Plymouth, the figure was 14%.

Reducing the risks

The ideal strategy is to prevent radon from ever entering a dwelling. Practically, the aim is to reduce indoor radon levels to significantly below the action level of 200 Bq/m^3. High radon levels in houses are caused by the flow of air containing this gas through gaps and cracks in floors. This flow is driven by air pressure differences between the house and the underlying ground.

Remedial measures can be taken to prevent the gas from entering the dwelling areas of a house. These include:

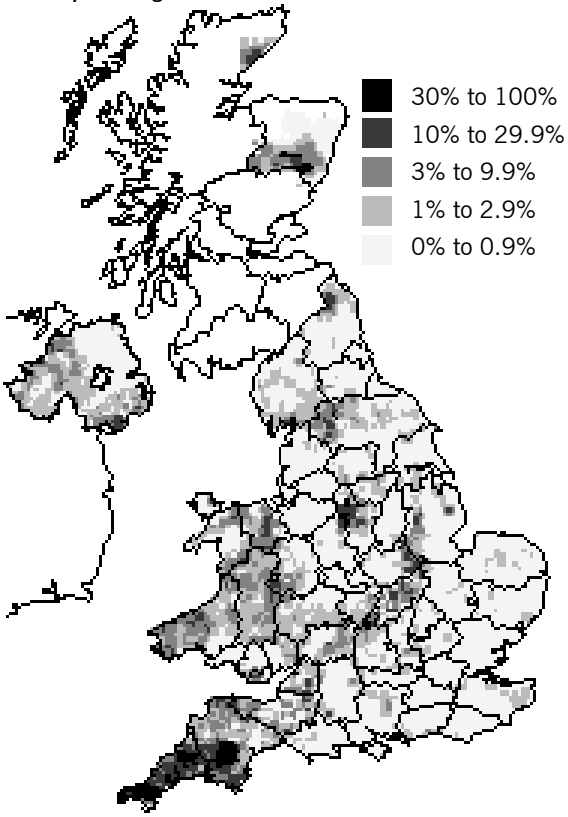
- reducing or eliminate the pressure difference between gas in the house and gas in the soil
- sealing the floor of the house or
- removing radon once it has entered a house.

The box on page 3 outlines the remedial methods available. The choice of method depends on the type of house and the existing level of radon in relation to the 200 Bq/m^3 Action Level.

For example, the most effective way to reduce radon levels in homes with solid floors is underfloor extraction using a radon sump (see box) powered by a small electric fan. With suspended floors, improving the ventilation under the floor with airbricks and perhaps a fan will also reduce levels.

Radon map of the United Kingdom

Estimated percentage of houses above the Action Level



Source: National Radiological Protection Board

Other methods will also often produce worthwhile results. Updated guidelines on protective measures for new dwellings[5] were introduced by the then DETR in 2000 for England and Wales, and by the Scottish Parliament for Scotland. New Building Regulations were introduced for Northern Ireland in April 2001.

Encouraging householders to take action

To date, radon measurements have been carried out in over 400,000 houses Around 40,000 houses were found to have radon concentrations above the Action Level. Estimates by the NRPB suggest that the total number of houses affected will be around 100,000.

NRPB has also found that householders who know that concentrations of radon in their homes exceed the Action Level tend not to take remedial action, despite there being a wide range of low-cost measures available. Various studies have estimated that around 10% of households in properties known to be above the Action Level have taken effective remedial action. Studies have shown that the principal explanations include:

- simple inertia about taking action even where people are aware of the risks and benefits
- reluctance to take action where radon concentrations only marginally exceed the Action Level
- some acceptance of 'natural' radiation, while at the same time being concerned about 'artificial' radiation (e.g. from nuclear power and waste disposal)
- inadequate access to sound (and trusted) advice about options for remedial action and probable costs.

Reducing domestic radon levels

Techniques (mostly costing £1000 or less) for reducing radon exposure in new and existing dwellings include:

Underfloor extraction or radon sump system – A sump is a small void (about the size of a bucket) into which the radon gas can be collected before being vented into the open air. The sump is dug under a solid floor from the side of a house, and a pipe and a fan are attached. For a typical house this is often the most effective method.

Improved ventilation under suspended timber floors - New air bricks are installed in walls to ventilate the underfloor space. In some cases a fan is added. This decreases the amount of radon entering the dwelling area of the house.

Positive ventilation - These blow air into the living space from the loft, both diluting radon and reducing its seepage into the house by slightly increasing air pressure.

Sealing cracks and gaps in solid concrete floors - The seals prevent radon entering the house through the floor. However, it is essential that all cracks are sealed. Sealing only, 90% of cracks is likely to have little effect on radon levels. The work involved, e.g. removing carpets and skirting boards, can be highly disruptive.

Additional permanent ventilation – This is the least effective way to reduce radon levels in homes, but can work when the levels are low. It includes trickle vents in windows and lockable catches that hold windows permanently open. It should not be possible to close the vents or windows fully.

Government campaigns

Responsibility for radon policy rests with the devolved administrations in Scotland, Wales and Northern Ireland, and the Department for Environment, Food and Rural Affairs (DEFRA) in England.

To tackle the barriers to taking action, the government had previously approached the problem in two main ways:

- In 1987 it began a radon measurement programme in England. A free radon test was offered to every home with a greater than 5% probability of being above the action level. The 400,000 measurements taken to date throughout the UK have cost a total of around £10-12 million of public money.
- Advice and awareness programmes including a guide for homebuyers and sellers; a householders' guide; a guide to reducing radon levels; and contacts to experts at the NRPB and the Building Research Establishment (BRE). The government has also worked with industry to establish an independent voluntary regulatory body for companies experienced in installing radon reduction measures (The Radon Council).

Recognising that the number of households in England taking remedial measures had been disappointing, the government ran pilot schemes where three local authorities[6] acted as the 'public face' of the campaigns. Central government, via the former DETR (DEFRA), the Department of Health, and the NRPB and the Building Research Establishment (BRE) played a 'back-stage' role offering advice and technical support. In addition, these bodies offered free radon measurements and retests to check the effectiveness of remediation.

The pilot schemes showed an overall doubling of the rate at which householders sought advice and took remedial action. Encouraged by these results, in July 2000 the Government announced, a new 3-year, £1m per year '*radon remediation roll-out programme*' in England, funded by DETR (now DEFRA). The programme involves local authorities working in partnership with DEFRA in areas with a greater than 5% probability of being above the Action Level to help householders there take action to reduce concentrations. To date, 32 local authorities (covering the areas most badly affected) that have formed themselves into 12 regional groups[7] have agreed to participate. Each group will develop an action plan.

The roll-out programme began in earnest in early 2001, with a group of local authorities in the north west of England[8]. The North West Action Plan is summarised in the box below. Action Plans from the other groups should be approved by the end of the year.

Radon remediation in the North West of England

The plan centres on three key elements:

Development work

This will include:

- refinement of NRPB data on homes to be targeted
- development of monitoring and evaluation approaches to enabling oversight of the programme
- preparation of information and publicity materials
- launch publicity
- awareness raising with housing and health professionals
- training events for local authority officials, local builders and other agencies in delivering the plan.

Working with 'High Testers'

These are households already known to have tested above the action level. In the North West, there are around 600 of these - mostly (about 400) in South Lakeland. The NRPB will offer these householders a free visit by local authority representatives from environmental health, housing and building services departments. After a brief survey of the property, oral advice will be offered and written information provided to assist people in making decisions about suitable methods of remediation (such as the names of builders with experience of radon remediation). The face-to-face interviews are the heart of the North West scheme, providing a personalised approach to tailor advice for households.

Working with 'First Time Testers'

These are households that have not in the past responded to free test offers. There are around 13,000 of these households in the North West (with about half in South Lakeland). After an invitation for a free test, home visits will be offered to households found to have high concentrations (conditional on agreeing to share data with local authorities).

Private householders are expected to cover their own remediation costs. The resources required for the remediation of council properties in the North West is estimated to be in the region of £26,000. However, the main resource from local authorities will be staff time – with the greatest commitment necessary in South Lakeland.

Elsewhere in the UK, the Department of the Environment, Northern Ireland, has held a series of radon exhibitions in conjunction with local authorities to raise public awareness. In Scotland and Wales, there are ongoing radon measurement programmes. Targeted surveys have already take place in SW Wales, and a further phase of surveys is now underway in NE Wales.

Issues

Costs

Much of the £1 million/year budget for the English roll-out programme is for household radon testing and providing expert health and remediation advice from the NRPB and BRE. It also covers consultancy to help local authorities draw up action plans and monitor and evaluate the programme. An additional budgetary element covers publicity costs.

DEFRA has not capped local authorities' individual budgets for the programme. Rather, allocation will be determined by the staff resources that local authorities can direct to the programme without over-stretching themselves and local radon priorities. This is clearly a pragmatic approach but it may mean only modest action plans can be implemented. Nevertheless, DEFRA is prepared to accept this. This leaves the question of whether the level of funding for the programme is driven more by budgetary expedience than the need to ensure an adequate level of protection from radon risks. As the programme develops, it will become clearer whether this concern is realised.

Support for low-income households

There are no funds specifically available from the programme to assist low income households. However, house renovation grants may be available from participating local authorities, subject to circumstances. The authority will assess eligibility and determine how much of the cost an applicant will have to pay. Agreement for the grant will have to be obtained before remedial work is carried out. This raises an issue over whether low-income households may face barriers to remediation, so exposing them more to radon risks.

Effect on the housing market

Buying and selling houses are based on the principle of *caveat emptor* (let the buyer beware). As part of this process, potential buyers normally carry out a local authority search which contains standard questions[9] (on planning, drainage, highways etc). Additional questions may be asked if the circumstances warrant it. Radon is included here - the current question reading: "*Is the property in an area where radon precautions are required for new dwellings? If so, are full or secondary precautions required?"* If interested, potential buyers have to enquire specifically about radon, and consult reference maps produced by NRPB, BGS and others. However, potential buyers and conveyancers need to be aware of these sources. NRPB points out that the relatively low cost of effective radon remedial measures (typically £1000 or less) means that high radon levels should not be a bar to house transactions.

Although failing to become law in the last Parliament, the Homes Bill proposed the introduction of a Seller's Pack which would have included a local authority search. However, the contents of this had not been decided, and indeed would have been set out in secondary legislation. The decision on whether the search should contain information on radon would need to recognise that in most parts of the country low radon levels render the question irrelevant. However, the Homes Bill did contain a section allowing different provisions to be made for different areas of the country, so a radon question in the Seller's Pack could have been a possibility.

Proposals for the Seller's Pack also included a 'home condition report' which would also have included a section on 'environmental and safety issues'. Here, comments could be provided (from visual inspection or local knowledge) on potential hazards such as radon and also contaminated land, flood risk and safety issues (e.g. unsafe glazing).

A seller may know that the property is in a radon affected area, and indeed he or she may well have had a radon test in that house. If this information is not disclosed to the potential buyer, this may leave the seller exposed to the risk of being sued for misrepresentation. The Homes Bill may be reintroduced in this new Parliament, the question remains over **what is the most cost-effective way to ensure that potential buyers are made aware of the possible risk of radon[10]**.

Endnotes

1 Measurements are available to householders at a cost of £30.80 + VAT for a pair of detectors.
2 The figures vary between 2000 and 3300 each year. This compares with around 40,000 deaths per year from all lung cancers.
3 NRPB (1990). Documents of the NRPB **1** No. 1 pp-15-16.
4 NRPB aimed to take 5 measurements per grid square, but this was not always possible, and so model-derived estimates were used.
5 BR211 *Radon: guidance on protective measures for new dwellings* enforced by Building Regulations applicable in England and Wales. Also, BR376 *Radon: guidance on protective measures for new dwellings in Scotland* enforced by Scottish Building Regulations.
6 Derbyshire Dales, Cherwell and Mendip District Councils.
7 The groups are: the North East; North West; Derbyshire; Northamptonshire; Devon; Somerset and Dorset; Somerset and Gloucestershire; Leicestershire; Lincolnshire; Shropshire; Kettering and Corby; and Cornwall. Cornwall has the highest number of houses likely to be affected - nearly 36% of houses above the action level.
8 The North West Group comprises South Lakeland, Richmondshire and Craven District Councils and Lancaster City Council.
9 These are currently under review.
10 Free information can be obtained from the NRPB (0800 614529) or the BRE (01923 664707).

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