Environmental Radon Newsletter

AUTUMN 2010 ISSUE 64

New HPA radon advice published

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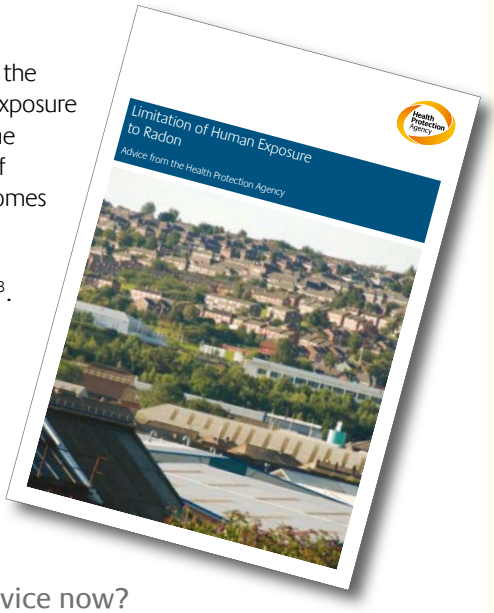
In July 2010 the Health Protection Agency (HPA) published its latest advice on limiting human exposure to radon. This replaces advice given by the HPA (National Radiological Protection Board prior to 2005) in 1990.

Radon inside buildings is the main source of human exposure to ionising radiation in the UK. The concentration of radon-222 in air in UK homes is about 20 Bq m^{-3} on average, with a range of at least 5–10,000 Bq m^{-3}. The comparable radon level outdoors in the UK is about 4 Bq m^{-3}. It is therefore impossible to completely eliminate exposure to radon, only to limit exposure to it.



Why update the advice now?

Radon remains the single biggest source of UK public radiation exposure. A significant proportion of the homes with elevated radon concentrations have been found but many remain to be identified and large numbers of homes with elevated concentrations have yet to be remediated. The International Commission on Radiological Protection (ICRP) and the World Health Organization (WHO) have recently issued revised advice on protection against radon, including recommendations for reference levels, supported by improved evidence about risks from radon. The HPA Advisory Group on Ionising Radiation (AGIR) has issued recommendations about radon and public health. There is therefore, updated national and international advice and guidance on which the HPA has developed its new advice.

The key HPA recommendations are briefly listed here, with an extract on radon risks overleaf. The HPA document should be consulted for full details and additional background and explanatory text.

The full report *Limitation of Human Exposure to Radon: Advice from the Health Protection Agency*, RCE-15, ISBN 978-0-85951-669-3, is available as a free download on the websites operated by the Health Protection Agency, www.hpa.org.uk and www.ukradon.org, and printed copies are also available at a cost of £13 each.

Action Level and Target Level

The HPA recommends that the current radon UK **Action Level** for homes should be retained. A new **Target Level** for radon in homes should be introduced. The values of the Action Level and Target Level, expressed as the annual average concentration in the home, should be 200 Bq m^{-3} and 100 Bq m^{-3}, respectively.

The role of the Target Level is to provide an objective for remedial action in existing homes and preventive action in new homes. Use of the two levels retains the emphasis on reducing the highest radon concentrations, while recognising that concentrations below the Action Level entail radiation exposures higher than desirable. Having two levels avoids the false impression that there is a clear boundary between safe and unsafe radon concentrations, and the impression that remediation has failed if it does not reduce concentrations below the Action Level.

Identifying areas where elevated radon is more likely

Areas where less than 1% of homes are estimated to be above the Action Level should be regarded as lower probability radon areas. Areas where 1% or more and less than 10% of homes are estimated to be above the Action Level should be regarded as intermediate probability radon areas. Areas where 10% or more of homes are estimated to be above the Action Level should be regarded as higher probability radon areas.

The term 'radon Affected Area' is retained, for consistency with current administrative measures to control radon, and is defined as those parts of the country with 1% or more of homes estimated to be above the Action Level. Taken together, the intermediate and higher probability radon areas constitute radon Affected Areas.

Deciding whether to test for radon

Householders in intermediate and higher probability radon areas should make measurements of indoor radon concentration in their homes. Householders in lower probability radon areas need not make measurements of radon concentration in their homes unless they have a specific reason to suspect that occupants may be exposed to higher radon concentrations, such as in those homes which have underground rooms that are often occupied.

Reducing radon levels

Householders with radon concentrations above the Action Level (200 Bq m^{-3}) should reduce their radon concentration to as low as reasonably practicable, if possible to below the Target Level (100 Bq m^{-3}). Householders with radon measurement results in between the Target and Action Levels should seriously consider taking remedial action, informed by the risk to the occupants of the home, particularly their smoking status. Householders with radon concentrations below the Target Level are not advised to remediate.

Application in other places where the public spend prolonged periods

The Action Level and Target Level should be applied to non-domestic buildings with public occupancy exceeding 2000 hours per year and to all schools.

POINTS OF CONTACT

www.UKradon.org provides general information on radon, and also an estimate of the probability that an individual property in England and Wales is above the Action Level for radon.

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www.hse.gov.uk/radiation/ionising/radon.htm

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Laboratories validated by the HPA for making measurements of radon concentrations in homes are listed at:
www.hpa.org.uk/radonvalidation

To obtain a report on the requirement for radon protective measures for building sites, go to http://shop.bgs.ac.uk/Georeports for sites in England and Wales, and www.ukradon.org for sites in the rest of the UK.

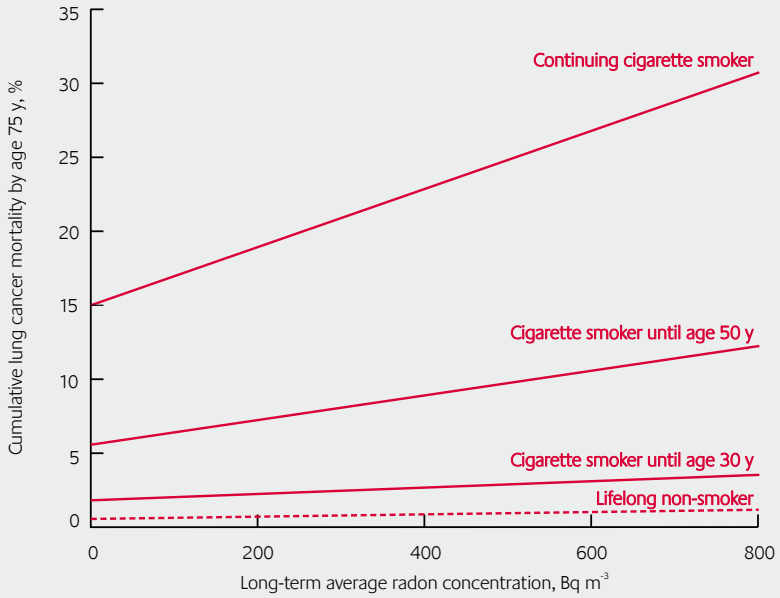
Radon risks

Extract from the HPA Advice on the Limitation of Human Exposure to Radon

Currently, the best information on the risks from radon exposure in homes is that published by Darby et al (2005, 2006), which shows the association between the long-term average residential radon concentration and the risk of lung cancer in a pooled analysis of individual data from 13 European studies. From this analysis, it was estimated that any increase in radon concentration of 100 Bq m^{-3} would increase an individual's risk of lung cancer by between 5% and 31%, with a central estimate of 16%.

A number of factors could not be taken into account in this pooled analysis of European studies. As a result, it is possible that the true percentage increase in lung cancer risk from radon exposure is somewhat higher than the central risk estimate of 16% per 100 Bq m^{-3}. A slightly higher risk estimate is also suggested by the studies of miners exposed to radon (BEIR VI Committee, 1999), although the overall conclusion from such comparisons is that the data are remarkably consistent (ICRP, 2009; UNSCEAR, 2009).

The available evidence suggests that the same percentage increase in lung cancer risk per 100 Bq m^{-3} increase in radon concentration applies for men and women, across all age groups and for current smokers, ex-smokers and lifelong non-smokers (see the figure). Since the baseline risk of lung cancer is much higher among smokers than among non-smokers, this means that – in absolute terms – the increase in lung cancer risk due to radon is much higher among smokers than it is among non-smokers. The findings of the European pooling study imply that at long-term average radon concentrations of 20, 100 and 200 Bq m^{-3}, the cumulative absolute risks of lung cancer by age 75 years in the UK would be about 0.42%, 0.47% and 0.53%, respectively, for lifelong non-smokers, and about 15%, 17% and 19%, respectively, for continuing cigarette smokers. For recent ex-smokers, the risks would be somewhat lower than those for current smokers, while for long-term ex-smokers, the risks would be close to those for lifelong non-smokers.



Cumulative absolute risk of death from lung cancer by age 75 years versus long-term average radon concentration at home for continuing cigarette smokers, ex-smokers and lifelong non-smokers in the UK (AGIR, 2009)

REFERENCES

AGIR (2009). Radon and Public Health. *Doc HPA*, RCE-11. Available at www.hpa.org.uk

BEIR VI Committee (1999). *The Health Effects of Exposure to Radon*. US NAS/NRC. Washington DC, National Academy Press

ICRP (2009). *Statement on Radon*. ICRP Ref. 00/902/09. Available at www.icrp.org

UNSCEAR (2009). *Effects of Ionizing Radiation*, Volume II, Annex E: Sources-to-effects assessment of radon in homes and workplaces. UNSCEAR 2006 Report. New York, UN. Available at www.unscear.org

Radon remedies – is my fan still going?

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Ever since the first installation of radon remedies that rely upon the continuous operation of an electric fan, homeowners have asked "How can I tell if it is still working?"

A three-month measurement using two passive detectors is the recommended method to confirm that, following remedial works, the radon concentration is below the Action Level of 200 Bq m^{-3} and, ideally, below the Target Level of 100 Bq m^{-3}. Radon fans will not, however, continue to run indefinitely, and, once a fan fails, the radon level will revert to its previously high level. The HPA recommends that the immediate post-remedial measurement should, therefore, be repeated every five to ten years. A measurement should also be carried out whenever significant changes are made to the building, the way it is used or a change in occupants. Improvements such as installing new double-glazed windows or up-grading the insulation can alter the ventilation and/or heating patterns in a building, as can a change in use or occupiers. Consequently any of these events may significantly alter the radon level. It is good practice to regularly check, as a minimum, that the fan is working, but for complete reassurance, it may be preferable to measure the radon level more frequently.

For some fans, simple inspections are possible but many are completely encased and/or in difficult to reach locations such as roof-spaces, under floors or mounted high up on external walls. In addition, many are designed to be virtually noise-free, ruling out a check of sound level. In these circumstances, routine inspection is less easy.

Many people might think that the red light of the isolation switch, controlling the electric supply to the fan, is a good indicator. This shows that the supply is live but is not a reliable guide to whether the fan is turning and even less that it is running at its design speed. Also the bulb might fail, which is why many experienced electricians will remove a fuse before working on an electrical system and not rely upon an unlit indicator light. A check that the isolation switch has not been turned off should become part of the routine check.

It might be tempting to design and build an electronic device to show that the fan is still working as intended, but how many car engines have been ruined because the oil-warning light failed? As a general rule, the more complex any device, the more prone it will be to failure and breakdown, so the ideal indicator will be very simple, robust, contain few if any moving parts, easy to check and not reliant upon a power supply.

Recently, a concerned householder discussed these issues with the HPA following the failure of his own and his neighbour's fan, soon after installation. The householder had many years' experience of electrical motors and their failure rates. There were a number of suggestions – some based on previous ideas, some new – on how to check if the fan was working. These are presented here as untried and untested ideas in the hope they will stimulate further discussion and experimentation, by manufacturers, installers and others, to discover a range of simple and effective solutions, which could be trialled and refined. The first two suggestions check the pressure differential in a sump system making them preferable, if applicable, to the others which only check whether the fan is working.

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The authors would be interested to hear readers' comments and practical experiences of detecting fan failures in radon remedial methods and of any other ideas, perhaps adapted from other applications. *The authors would like to acknowledge the useful discussions on these ideas with Dr Hedderly, Nottingham.*

Visual indicator of the pressure differential A simple manometer, attached directly to the low pressure side of the pipe-work leading to the fan: it is essentially a U-tube containing a non-volatile liquid such as a light oil. It is probable that the plastic airlocks used by amateur wine-makers to vent fermentation gases without allowing the ingress of air could be easily adapted for this purpose. The difference in the liquid height in the two sides of the U-tube gives a visual indication of whether the fan is creating an adequate pressure differential. Solutions similar to this are already used on some commercial radon extraction systems.

Audible indicator of low pressure Slightly more complicated would be an inlet tube on the low pressure side of the fan containing a whistle. The tube would normally be sealed with a flap held shut by the pressure differential. Lifting the flap with a finger or a simple string and pulley device if remote, would allow the whistle to sound, indicating a good pressure differential. A refinement of this system could be to carefully balance the flap so that the whistle would whimper if the pressure differential decreased beyond a certain value. The experience/technology is available in the devices used to moderate excessive draw on solid-fuel stoves and boilers in windy conditions.

Simple audio check for sound of the rotor turning It is important to stress that just the 50 cycle hum of the electricity in the coils of the armature is not a reliable check: a jammed motor will still hum. If the fan is difficult to access a listening rod (similar to those used by water companies to detect leaks), a stethoscope (similar in principle to those used by doctors) or a sound pipe (similar to voice-pipes used on steam ships of a certain vintage) could be employed.

Simple vibration check Gently touching the fan casing, if easily accessible, may enable the vibration of the turning fan to be felt: though this will be less obvious on well balanced, low energy fans with low friction bearings – such as those fitted in many positive ventilation units. Again it is important not to confuse the fan vibration with the 50 cycle hum.

Visual indicator of the air flow This could be as simple as ribbons or streamers at the outlet of the system. The drawback to this simple device is that the volume of air moved in positive ventilation units and in many radon sump systems is small as the fan is low powered or sucking on a dead-end. The flow at the outlet may not be sufficient to blow the ribbons enough to be easily distinguishable from the disturbance created by the wind. Fitting a streamer within the pipe, behind a transparent window, might be an option, but it would need to be well clear of the fan.

Next UK Radon Forum – Tuesday 23 November 2010

The ninth UK Radon Forum will be held at the HPA Centre for Radiation, Chemical and Environmental Hazards, Chilton, Oxfordshire, in November. The forum will cover the impact of the new HPA advice on radon and also remediation of existing dwellings to include effectiveness, delivery of advice and examples.

This will be of interest to anyone with responsibility for housing, planning, public health or regulation, and for radon remediation specialists and environmental radiation consultants. A small amount of space is available for relevant commercial displays and the forum also provides an opportunity for networking with other radon professionals.

Further information is available from Jane Bradley at the HPA (jane.bradley@hpa.org.uk).

Subscribe direct and readers' survey

The HPA has produced the Environmental Radon Newsletter (ERN) quarterly since 1994 as an means of communicating news and developments in practical protection against radon. It has been distributed to CIEH and REHIS members free of charge as a quarterly insert in members' journals and directly to HPA subscribers. **A free online subscription service to the ERN is now available** for anyone interested in UK radon issues. Please go to www.ukradon.org/ern to subscribe directly.

An important part of the national radon programme for many years has been publicity campaigns offering free measurement to some householders, and the ERN is an effective way of informing local environmental and health protection officials about the aims, scope and impact of these campaigns. Over the years, the science and practice of radon protection has evolved greatly and numerous new initiatives, studies and developments have been announced in its pages.

We are reviewing how the ERN is distributed. It would be extremely helpful to have your views on the most convenient and accessible format you would like to receive the ERN in. **Please complete our short survey** to let us know your views. The survey is given below, but it will be much easier for our analysis if you could use the online form at www.ukradon.org/ern_survey if you have access to the internet.

Our grateful thanks for your replies!

Environmental Radon Newsletter Survey

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6 *Do you have any other comments?*

Please complete the survey online or tear out and post to: ERN Survey, Health Protection Agency, Chilton, Didcot, Oxon OX11 0RQ, UK, by 31 December 2010.

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This newsletter is prepared for the Chartered Institute of Environmental Health and the Royal Environmental Health Institute for Scotland by the Centre for Radiation, Chemical and Environmental Hazards of the Health Protection Agency.

It is published quarterly as an insert in the CIEH journal Environmental Health News and the REHIS journal Environmental Health Scotland. In addition, it is circulated to interested parties by the HPA. The views expressed in the contributions are not necessarily those of the CIEH, REHIS or the HPA.