

Environmental **Radon** Newsletter

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New radon programme for England

A news release from the Department for Environment, Food and Rural Affairs (Defra), reproduced below, announced an important change to the management of radon work in England. From April, the Radiation Protection Division of the Health Protection Agency (HPA) took over responsibility for running the programme, and for further development of the programme.

It is anticipated that future work will follow the established pattern fairly closely, but with more emphasis on effective reduction of doses. The results of the previous programme show that many householders, understandably, select the cheapest option for remedial works. This often means using less effective methods with

correspondingly disappointing results. There is, therefore, considerable scope to increase the effectiveness of mitigation, as well as increasing the number of householders that carry out work.

HPA is discussing with the Building Research Establishment the most effective measures to increase the rate of dose reduction and ways of providing better information about mitigation methods to both householders and local builders. This could include, for example, publicising more widely the names of companies that participated in both the previous and forthcoming radon programmes. It is intended that local councils will continue to play a key role in delivering the programme to local householders. HPA expects to announce details of the programme shortly.

Defra-funded programme to help reduce risks from radon

Environment Minister Elliot Morley today [30 March 2005] announced a further Government-funded programme to help combat the health risks posed by exposure to radon in homes.

Radon is a naturally-occurring radioactive gas found in all rocks and soils. In the open air it disperses and poses no risk to health, but studies from around the world have found that it can cause lung cancer when high levels build up in homes, with smokers being most at risk.

The initiative, to be run over the next 2 years, will provide free radon tests for householders living in areas most affected by radon, and encourage and support them in carrying out work on their homes that prevents the build up of the gas.

To date, over 400,000 households across England have participated in previous schemes carried out by successive Governments since 1987.

Elliot Morley said: "Defra recognises that radon remains a significant public health issue. It is the second largest cause of lung cancer in the UK after smoking. For smokers, the radon risks are much greater than for non-smokers.

"But there are easy and effective solutions out there. Professional builders and specialist

companies can carry out building works to prevent radon gathering in homes. Costing between £500 and £1,000 these building works are relatively inexpensive given the return. Householders with competent DIY skills can also carry out works that are effective."

The National Radiological Protection Board (NRPB) will take over responsibility for running the programme on 1 April 2005 when it merges with the Health Protection Agency (HPA) and becomes the Radiation Protection Division of the HPA Centre for Radiation, Chemical and Environmental Hazards (CRCE).

HPA will work in partnership with local authorities in England to help house-holders living in areas most affected by radon to take action to reduce levels of this naturally-occurring radioactive gas in their homes.

Participating local authorities will be the main point of contact for householders.

To find out more about what radon is, where it is found, what the dangers are and the measures needed to get rid of radon problems see:

www.defra.gov.uk/environment/radioactivity/radon/index.htm
or www.hpa.org.uk/radiation/radon

This newsletter and previous editions can be seen at www.hpa.org.uk/radiation/radon

POINTS OF CONTACT

Building Research Establishment (BRE)
Garston, Watford, WD2 7JR
BRE Radon Hot Line:
Tel: 01923 664707 Fax: 01923 664010
www.bre.co.uk

Radon Survey
Radiation Protection Division, Health
Protection Agency
Chilton, Didcot, OX11 0RQ
Radon Freephone: 0800 614529
Fax: 01235 833891
www.hpa-rp.org.uk/radiation

Department for Environment,
Food and Rural Affairs
Zone 4-F7, Ashdown House
123 Victoria Street, London SW1 6DE
Tel: 020 7082 8497/8498 Fax: 020 7082 8474
www.defra.gov.uk

National Assembly for Wales
Housing Division
Cathays Park, Cardiff, CF1 3NQ
Tel: 01222 825219 Fax: 01222 825391

Environment and Heritage Service
Department of the Environment for
Northern Ireland
Calvert House, 23 Castle Place
Belfast, BT1 1FY
Tel: 01232 254754 Fax: 01232 254700

Scottish Executive Development Department
Housing Division 1
First Floor East, Victoria Quay
Edinburgh, EH6 6QQ
Tel: 0131 244 5575 Fax: 0131 244 5596

Health and Safety Executive
Health Directorate B6
Rose Court, 2 Southwark Bridge
London, SE1 9HF
Tel: 020 7717 6854 Fax: 020 7717 6717

Northern Radon Liaison Group
c/o Environmental Health Department
South Lakeland District Council
South Lakeland House, Lowther Street
Kendal, Cumbria, LA9 4UD

Radon South West Committee
Secretary: Gerald Hudd
46 Parkfield Drive, Taunton
Somerset TA1 5BU
Tel: 01823 355194
email: GAHudd@Somerset.gov.uk

Steering Group on Radon
(Northamptonshire and elsewhere)
Environmental Health Department,
Daventry District Council
Lodge Road, Daventry
Northamptonshire, NN11 5AF.

Derbyshire Radon Steering Group
c/o Environmental Health Department
Derbyshire Dales District Council
Town Hall, Matlock
Derbyshire, DE4 3NN

The Radon Council Limited
PO Box 39, Shepperton
Middlesex, TW17 8AD
Tel: 01932 221212 Fax: 01932 229779

How to measure radon

Jon Miles, Health Protection Agency (jon.miles@hpa-rp.org.uk)

There are various methods for measuring concentrations of radon and its decay products, from instantaneous methods to ones averaging over months. In selecting a method, both the purpose of the measurement and the properties of radon must be considered.

The risk that someone exposed to radon will develop lung cancer depends on their total exposure over many years. It would be very convenient if we could estimate this exposure from a quick measurement. But spot measurements of radon are very misleading because radon can vary in concentration, sometimes quite dramatically, from hour to hour, day to day and month to month. The highest levels are generally found in the small hours of the morning and in the middle of winter - in other words, the coldest times, when buildings are tightly closed.

Because of these variations, measurements are usually made of the long-term average radon concentration. Ideally the measurements would take place over a full year, to cover the variations with the seasons. However, detectors can easily get lost if left in a house for so long, and householders do not want to wait this long for results. For these reasons measurements are usually made over a period of 3 months, and the annual average estimated on the basis of typical seasonal variations in levels.

Screening measurements

There are times when people cannot wait for three months to get a radon result, and in these cases short-term measurements can be used for screening purposes. Such detectors are exposed from a few days to a couple of weeks, and give less accurate estimates of annual average concentration than long-term measurements. They require follow-up with long-term measurements where the screening results are ambiguous.

Charcoal detectors can only be used for short-term measurements, as the way in which they work means that the result reported is weighted towards the last four days of exposure. Electret detectors can be used for short-term measurements of a week or two if a high sensitivity electret is employed.

Etched track detectors are normally used to make longer measurements, but specially developed ones can make measurements over periods of a couple of weeks. The Health Protection Agency (HPA) has recently introduced such a service.



Etched track detector

Etched track detector

This is a small hollow device containing a plastic detector. Radon gas diffuses into the container and decays away, emitting alpha particles which leave invisible tracks of damage in the plastic detector. When the device is returned to the originating laboratory, the plastic is etched in a caustic solution, producing pits where the plastic has

been damaged by alpha particles. The pits are counted automatically under a microscope. Etched track detectors are usually deployed for 3 months. Because they can make long-term measurements, and because they are relatively cheap, the great majority of radon measurements are made with etched track detectors.

Details of laboratories offering etched track detectors are available on:

- www.hpa.org.uk/radiation/services/radon/validation.htm

Charcoal detector

This consists of a small container of activated charcoal, which is left exposed to the air in the measurement location. It works by absorbing radon out of the air and retaining it in the charcoal. After exposure, the detector is sealed up and returned to the originating laboratory, which can measure how much radon is still present. Because radon has a 3.8 day half-life, the radon absorbed at the beginning of the exposure decays away after a few days, so the measurement duration is limited.

Details of laboratories offering charcoal detectors are available on:

- www.brad.ac.uk/acad/envsci/radon_hotline/contractors.htm

Charcoal detectors



Active detectors

Electret

This is a passive device, properly described as an electret ion chamber. The electret holds an electrostatic charge which is gradually neutralised by the ionisation of the air by alpha particles emitted by radon and its decay products. Measuring the charge on the electret at the beginning and end of an exposure allows the radon concentration to be calculated. In making this calculation, an allowance must be made for ionisation caused by the natural background of gamma rays from rocks and building materials.



Electret detectors

Different types of electret are available, suitable for measurements over periods of a few days to a few months. Care must be taken with this device, as dropping it can cause a partial discharge of the electret, and an overestimation of the radon concentration.

Details of electrets are available on:

- www.radelec.com/product.html

Active monitors

Various types of electronic monitor are available. These sample the air continuously and measure either radon or its decay products, averaging over a time period which is typically one hour. The measurement is repeated over successive time periods. Results are either printed onto paper or stored in a memory for later readout. This allows the variation in radon levels from hour to hour to be determined. They are sometimes used in workplaces to determine whether the radon concentration is lower during working hours than at other times.

Details of active monitoring instruments are available on:

- www.genitron.de/products/alpha_slides.html
- www.gammadata.se/ULSimpleProductFiles/Atmos.pdf
- www.durridge.com/RAD7.htm
- www.radonlab.net/ramon.htm
- www.thomson-elec.com/radon.htm

Understanding radon entry into buildings

Daryl Dixon, Health Protection Agency (daryl.dixon@hpa-rp.org.uk)

Chris Scivyer, Building Research Establishment (scivyer@bre.co.uk)

The entry of radon into buildings depends on a chain of factors, each of which can vary. This results in a very wide range of indoor levels, from less than 20 Bq m⁻³ to a thousand times higher. A grasp of the physical principles involved can provide some insight into the likely effectiveness of remedial measures.

Concentration of radon in the ground

All rocks and soils contain traces of uranium, the natural radioactive element that produces radon, though in very variable amounts. Radon levels in soil gas are rarely less than several thousand Bq m⁻³, giving the potential for high indoor levels if the air is drawn in. Where properties are close to metal ore strata or mines, very high radon levels can occur in buildings.

Permeability of the ground

The ease with which air can move through the ground affects radon levels in overlying buildings. In particular, when high radon levels are found in buildings on limestone and chalk, it is largely because of the permeability of these rocks. Clay, when wet, can provide an effective barrier against gas

movement, but if it dries out and cracks the barrier effect is lost.

Pressure difference

The air pressure in a heated building will normally be lower than outdoors, so radon-laden air is pulled into the building from the ground. The pressure difference between the air inside and outside a building depends on the indoor-outdoor temperature difference, so it changes with the heating level and the outdoor temperature. This results in the highest radon levels being at night and in winter.

Nature of floor and coupling of building to the ground

A solid floor is not necessarily a barrier to entry: cracks around the edges of floors and service entries such as water and sewage pipes or electricity cables may allow ingress of air carrying radon. Similarly, gaps in a suspended floor allow entry of air, though good ventilation under a suspended floor will reduce the radon concentration in the air that is drawn in. The presence of basements, voids or ducts under a building can complicate matters, as can internal foundation walls extending down into the ground.

Ventilation conditions in the building

Once radon is inside a building, its concentration is affected by ventilation, which depends on factors such as draught proofing, occupancy patterns and the amount of heating. Radon levels in a property are, therefore, likely to change if the occupants change, or even with changes to occupants' circumstances, such as having children.

Increased ventilation does not always decrease the radon concentration, because extract fans or open windows on an upper floor can reduce indoor air pressure and increase radon ingress. The effect of ventilation factors varies greatly between buildings and can lead to large and sometimes surprising differences in radon level. Given the influence of lifestyle factors on radon levels, it is not unusual for repeat measurements of radon in a building to differ, particularly following installation of draught proofing or double glazing, or building an extension.

Radon remedial methods

The method of choice for mitigation depends on the required reduction factor and the type of floor. The table shows how effective the different methods are in typical buildings.

Principal radon remedial methods

Location	Remedial method	Method of operation	Effectiveness in a simple building without adjoining structures, basement or major modifications
Below floor	Sump with fan under solid floor	Soil gas drawn into low pressure cavity and exhausted outside	Usually very good, commonly a factor of ten or more reduction
	Mechanical ventilation under suspended floor	Increased flow of fresh air reduces underfloor radon concentration	Can be very effective if air path is unobstructed
Above floor	Powered input ventilation	Reduced underpressure, increased ventilation	Fairly effective in well sealed buildings
	Increased natural ventilation	Dilution of radon concentration	Not usually very effective
	Sealing of floor gaps and cracks	Increased resistance to flow of soil gas into building	Usually ineffective

Editor
Jon Miles
jon.miles@hpa-rp.org.uk

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