Environmental **Radon Newsletter**

SPRING 2001 ISSUE 26

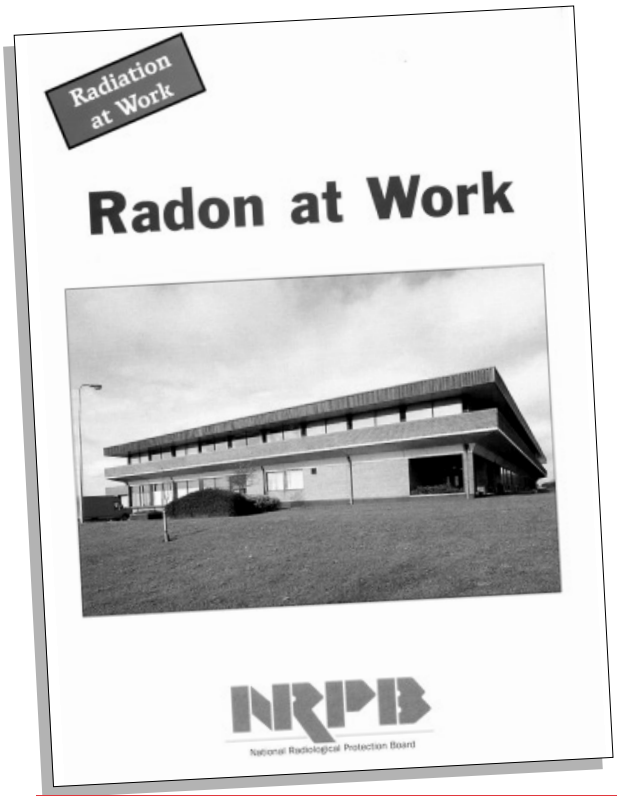
Roll Out Programme Gathers Momentum

As reported in issue number 24, the Department of the Environment, Transport and the Regions (DETR) is providing resources for many local councils to mount radon programmes in their areas. The first of these programmes is now under way in several areas of England. Planning meetings have been held with over half a dozen council groupings and the first action plans agreed.

Even before the turn of the year, radon information seminars had been held in several locations in the north of the country. These seminars, run by experts from both the National Radiological Protection Board (NRPB) and the Building Research Establishment (BRE), provide a solid grounding in many aspects of radon for both elected members and council staff.

The talks are also an opportunity for elected members, who may have to deal with constituency questions, and the council officers, who will be in the front line of the programme, to question the experts and to discuss any likely problems.

Radon at Work Broadsheet



A second edition of this broadsheet, one of NRPB's *Radiation at Work* series, has now been published.

It updates the previous edition with revised information for employers, covering the Ionising Radiations Regulations 1999. There is also information on the types of workplace likely to be affected, including those in radon Affected Areas or underground, and what action can be taken to reduce the doses to employees.

Single copies of the broadsheet are available free from NRPB (see contacts on page 2), and it is being issued as part of information packs for employers and professionals. Multiple copies are charged at £1.65 each including postage and packing.

This newsletter and previous editions can be seen at: http://www.nrpb.org.uk/env-rn.htm

POINTS OF CONTACT

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

National Radiological Protection Board
Radon Survey
Chilton, Didcot, OX11 0RQ
Radon Freephone: 0800 614529
Fax: 01235 833891

Department of the Environment,
Transport and the Regions
Zone 4-E8, Ashdown House
123 Victoria Street, London SW1 6DE
Tel: 020 7890 6266/6265 Fax: 020 7890 6289

Welsh Office 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
c/o Environmental Health
Teignbridge District Council
Forde House, Newton Abbott
Devon, TQ12 4XX

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

Somerset Radon Campaign Steering Group
c/o Taunton Deane Borough Council
The Deane House, Belvedere Road
Taunton, Somerset, TA1 1HE

Learn the Lesson - Correct Placement of Radon Detectors

Martyn Green, National Radiological Protection Board

The standard NRPB radon test kit for homes contains two passive radon detectors, one labelled "Living area", the other "Bedroom". The pack also includes placement instructions for the detectors, the result of the many years of experience in undertaking postal surveys. Nevertheless, a small proportion of clients still either fail to place the detectors or place them in inappropriate locations.

The householder is prompted by letter to return the detectors after some 14 weeks if he/she has not done so spontaneously. It is not uncommon, at this stage, to be told that the detectors were never placed. Normally they have lain forgotten in a drawer, behind the clock, on the hall table or in a similar location for the whole 12 week measure-ment period. In other cases, the similarity of the results from the two detectors raise our suspicions which are often proved correct on further investigation.

In a few cases, an abnormally high result will trigger an immediate investigation. This needs to be carefully conducted to avoid unduly alarming the householder. However, it must be undertaken without delay as the potential annual radiation doses are often in the range of 0.5 to 2 Sv (sieverts), well over an order of magnitude greater than the annual dose limit for a radiation worker.

In a recent case, the reading from the living room detector indicated a concentration of 30,000 becquerels per cubic metre (Bq m^{-3}), well over 100 times the Action Level. Telephone contact was not possible as the householder was ex-directory and the only option was a carefully worded letter asking where the living area detector had been placed and inviting the householder to telephone us. Fortunately, in a few days, a call was received and we were able to ascertain that the living area detector had indeed been placed in the living room, but on the floor. The bedroom room detector had been placed in the attic and recorded a much lower reading. More worryingly, young children could be heard playing in the background. Fortunately, a member of NRPB staff was passing the area within the week and it was possible to arrange a visit.

The house was a modern conversion of old, single-storey, farm buildings occupied by a family with two young daughters. The floor construction was a new, solid concrete slab poured within the existing walls and incorporating a damp-proof membrane. The living room detector had been placed on the floor against the skirting board, behind a toy box in a recess next to the fireplace. Instantaneous readings with an active radon monitor indicated quite high radon levels close to the wall-floor interface, but not as high as the 30,000 Bq m^{-3} recorded by the passive detector. Readings in the main space of the room indicated above average levels, but lower than the levels found near the wall-floor interface.

A further four passive monitors were placed in the house, two in the living room (one in the original position on the floor and one on a sideboard) and one each in the master bedroom and the children's bedroom. The results from all six measurements are given in the table. It is immediately apparent that the results from the initial detectors do not reflect the exposure of the family to radon in their home. The reason for this was the incorrect location of both the detectors. The final estimate of the annual average radon level for the house was 720 Bq m^{-3} and remedial works are planned.

The incorrect placement of these two detectors caused extra work and effort for the staff of NRPB. Much more importantly, it prolonged the exposure of all the family to high levels of radon and caused a period of concern and uncertainty for the adults in the family. The delay in reducing the radon level resulted in each member of this family incurring an extra radiation dose of about 6 mSv, about double the annual radiation dose received by aircrew flying 600 hours a year, or 1000 times the annual average radiation dose we receive from man-made radiation (excluding medical sources).

Measured radon levels (becquerels per cubic metre)

Location	Living room, on floor	Living room, on furniture	Master bedroom	Children's bedroom	Attic
First measurement	30,000	-	-	-	76
Second measurement	37,000	510	590	420	-

Long Term Reduction of Very High Radon Levels

Chris Scivyer and Kim Noonan, Building Research Establishment Limited

During the late 1980s and early 1990s, BRE worked closely with various homeowners in the South West of England who had houses with very high indoor radon levels. BRE provided homeowners with advice and guidance on remedial measures, and in some cases funded remedial measures. During 1999, contact was re-established with 24 of these homeowners and their houses were re-measured to see whether the remedial measures continue to work over time. These studies have been funded by Department of the Environment, Transport and the Regions (DETR).

Although the sample is small and many of the systems included within the study were experimental installations, the findings below are both interesting and relatively positive.

- Long term durability of fans has been better than expected. Only three houses have had to have fans replaced, and then only after some six to eight years of continuous operation. In one case the original fan is still working after running continuously for more than eleven years.
- In more than half of the houses (55%) radon levels remain below the 200 Bq m^{-3} recommended Action Level.
- Although levels have increased to above the recommended Action Level in 11 houses (45%), the majority of these remain below 300 Bq m^{-3}. Although this is not ideal, the levels have not returned to anywhere near their original levels. Importantly, in all cases simple low cost improvements have been recommended that should return levels to below 200 Bq m^{-3}.
- Two of the failures were due to homeowners switching systems off and four were almost certainly due to major alterations having been made to the houses. Further investigation is in progress in the remainder.
- There is a need to retest remedial measures if significant alteration works are carried out in a house.

No	Average Radon Level, Bq m^{-3}			Original remedial measure	Comment
	Orginal Test	System Fitted	Retest 1999		
1	1574	61	64	Sump	
2	512	22	98	Sump and mechanical underfloor ventilation.	
3	2000	132	132	Sump system	
4	1300	100	52	Sump system	
5	1100	55	42	Sump	
6	2300	23	30	Sump	
7	1200	71	51	Sump beneath suspended timber floor	
8	3500	65	128	Sump - extended.	
9	1400	37	124	Sump	
10	2800	14	27	Sump	
11	1800	83	86	Sump under new floor	
12	1200	20	22	Sump	
13	1477	13	15	Sump	
14	1900	175	**203**	Old Cornish Engine House - Sump and fan to cellar	Continuous monitoring by owner averages just below 200 Bq m^{-3}
15	2100	35	**1884**	Sump	Fan switched off! Further measurement - 30 Bq m^{-3}
16	6200	221	**856**	Sealing, airbricks, mechanical underfloor ventilation	Fan not run continuously
17	1424	202	**264**	Sump	New heating system fitted, Possible fan wear.
18	1740	122	**474**	Sump	Large house, now single occupancy, new ventilation system fitted
19	1800	122	**230**	Mechanical ventilation to suspended timber floor, renewed part of floor.	Changes made to indoor ventilation
20	1000	167	**263**	Natural underfloor ventilation to suspended timber floor.	Thick spray paint applied to rendered walls severely obstructing vents
21	2100	129	**293**	Sump - large T3 fan	Large house no obvious reason for increase - Further investigation in progress
22	1400	215	**305**	Sump	Further investigation in progress
23	2819	146	**597**	Sump, sealing, new heating system	Further investigation in progress
24	5400	46	**239**	Sump	Further investigation in progress

BRE's Radon Test House

Chris Scivyer, Building Research Establishment Limited

In 1994 the Building Research Establishment (BRE) purchased a house in Devon to use as a dedicated test house for radon research. It was chosen because it had a high indoor radon level (more than 1200 Bq m^{-3}), and suspended timber ground floors constructed over bare earth. This is a common form of construction in older houses, many of which have been found to have very high radon levels.

The test house has given us the opportunity to undertake an extensive series of experiments better to understand the mechanisms by which different radon remedies work. Being unoccupied it has been possible to control the indoor environment and eliminate many of the factors which can make it difficult to interpret radon measurements, such as door and window opening regimes and heating patterns.

Between 1994 and 2000 a comprehensive series of trials has been carried out in the house, funded by the Department of the Environment, Transport and the Regions (DETR). Studies to date have examined the effects on indoor radon levels when various radon remedies and major alterations are applied to the house. Some of the results are shown in the table.

These show that mechanical underfloor ventilation offered the greatest reduction in radon level, particularly when the air vents below the floor were blocked. Even when the vents were open, this remedy kept radon levels below 200 Bq m^{-3} . This is important because BRE recommend that air vents should not be blocked, to reduce the risk of timber rot.

Trials with a pair of underfloor fans (one on each side of the house) instead of a single large fan, showed the effectiveness of this arrangement. Each of these fans provided 50% of the air flow that would normally be expected from a typical 75 watt in-line centrifugal duct fan. The advantage of using two smaller fans is that they are easier to install, less visually obtrusive and quieter.

The effects of common alterations such as replacing old single glazed windows with new double glazed units and installing a replacement timber floor have also been monitored, with mixed results.

A significant finding was that replacing the windows in the house with double-glazing resulted in an increase of about 25% in the radon level in the house. This was not unexpected, as the new windows are far more airtight than the original windows, resulting in less air infiltration and dilution of radon inside the house. It also increases the stack or chimney effect within the house which draws radon up from the ground. This is an important observation which highlights the need to remeasure radon levels in homes after replacing windows.

Another interesting finding was that the radon level inside the house changed very little when the old timber ground floor was replaced by a new, well-sealed timber floor. It is thought that the reason for this is that the new sealed floor has caused a rise in the average temperature inside the house, increasing the stack or chimney effect thereby drawing more radon into the house.

One novel technique investigated is the use of a spray-on foam material for sealing the bare earth beneath the timber ground floor. The aim of this is either to form a radon barrier or to cap the soil to enable sub-slab depressurisation to be applied. Unfortunately the results have so far not been particularly encouraging.

Although we are aware that the results gained from this research relate to a single dwelling, BRE are fortunate in having a wealth of experience against which the results from the test house could be compared. This comparison shows that the house does behave in a typical way: there are no unusual variations in the radon levels measured within the house, the seasonal variation seems small and the remedies are achieving the radon reductions typically quoted in other scientific papers. All of this strongly suggests that the house is representative of the UK housing stock and supports the generalised nature of our conclusions.

Radon levels with original suspended timber floor and single glazed windows.

Remedy	Whole House Average
None *natural underfloor ventilation (vents blocked)*	1218 Bq m^{-3}
Improved natural underfloor ventilation *vents upgraded to current Building Regulation requirements*	742 Bq m^{-3}
Underfloor extract ventilation *includes single and twin fan trials with fans running at various speed settings - best results achieved with single 75Watt in-line centrifugal duct fan running at full flow with airbricks closed*	11-122 Bq m^{-3}
Underfloor supply ventilation *includes single and twin fan trials with fans running at various speed settings - best results achieved with single 75Watt in-line centrifugal duct fan running at full flow with airbricks closed*	65-579 Bq m^{-3}
Whole house positive ventilation	340 Bq m^{-3}

This newsletter is prepared for the Chartered Institute of Environmental Health by the National Radiological Protection Board. It is published quarterly as an insert in Environmental Health and distributed by the Royal Environmental Health Institute for Scotland. Any suggestions for topics for future issues should be sent to Jon Miles at NRPB (see address on page 2). The views expressed in the contributions here are not necessarily those of the Chartered Institute of Environmental Health, the Royal Environmental Health Institute for Scotland or the National Radiological Protection Board.