Environmental Radon Newsletter

WINTER 1999 ISSUE 21

The Grim Seeper

Jon Miles, National Radiological Protection Board

Summary of a presentation given to the British Association Annual Festival, Sheffield

People often worry about the dangers of artificial radiation, but few realise that we get much higher doses from natural sources. In fact, for the average person, the radiation doses - and cancer risks - from natural radiation are more than a thousand times higher than those from the whole of the nuclear industry. And by far the biggest source of natural radiation is radon, seeping into our houses from the ground.

Radon is a radioactive gas arising from the uranium decay chain. Because there are traces of uranium in all rocks and soils, radon comes out of the soil everywhere, all the time. How much comes out in any location depends on how much uranium there is in the ground, and how permeable the soil is. Cornwall and Devon are famous for their radioactive granites, and the highest radon levels in the country are found there. But there are also problems in many other areas around the country, such as in the limestone areas of Derbyshire. Here the limestone is very permeable, and the many caves and fissures allow air to move easily in the ground. This air movement can carry radon from deep in the ground into people's houses.

There is much more air entering a house from the soil underneath than you would imagine. In a typical house, a couple of cubic metres of soil air enter each hour. The reason so much air comes in is that houses actually suck air in. Atmospheric pressure is usually lower indoors than outdoors owing to the warm indoor air rising. This creates a gentle suction which draws soil air into buildings, bringing radon with it. The air comes in through holes and gaps such as those between floorboards or around service entry points. The highest levels of radon 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.

Once radon is in a house, it undergoes radioactive decay and turns from a gas into atoms of a solid: polonium, an alpha particle emitter with a short half life. When we inhale these decay products they deposit on the lining of the lungs. The alpha particles they emit damage the sensitive cells which line the airways, and can cause lung cancer. This is just the same kind of risk as you would get from inhaling plutonium, another alpha particle emitter. But the difference is that everyone inhales radon.

Fortunately, it is much cheaper to control exposures to radon than it is to control artificial exposures. If a fan is connected to a pipe to suck radon out from under the floor before it gets into a house, this can often reduce the indoor concentration by 90%. And if you are building new houses in an area where there is a radon problem, there are reliable ways to build the floors to prevent the gas getting in.

First, though, you have to find the houses with the high levels. This is not as easy as it sounds - even in the areas where high radon levels are found, only a minority have a serious problem. The only way to find out if a particular house has a high level of radon is to measure it, usually using a passive detector left in place for 3 months. And then there is the problem of persuading people to do something about it. Many people would rather not know that they should really take action to reduce the radon level in their house.

INSIDE:

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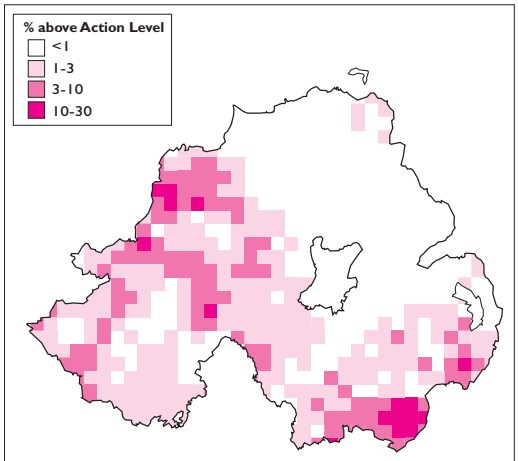
Radon Remediation in Northern Ireland

Elizabeth Brannigan, National Radiological Protection Board

Some 40,000 homes with radon levels above the Government-endorsed Action Level of 200 Bq m^{-3} (bequerels per cubic metre of air) have been identified throughout the United Kingdom. The householders concerned have been advised about the risk of lung cancer from radon exposure, and advised to reduce the levels in these houses. A survey of a large number of such householders in south-west England, (see issue 10 of the Newsletter, Spring 1997), suggested that only a minority of them take action.



Radon map of Northern Ireland

To see how effective the advice on remediation was in Northern Ireland, householders of houses above the Action Level were contacted by post some six to twelve months after receiving the result of the radon measurement. They were asked to complete a short questionnaire about any remedial measures taken to reduce the radon levels in their homes. The response was good - over one in three householders completed and returned the questionnaire - but the findings were disappointing and confirmed the findings of other such surveys.

Out of 302 householders sent the questionnaire, 112 replied and only 2 were returned undelivered by the Post Office: an overall response of 37% which is good for a postal survey of this type. However, only 21 householders, about 20% of the responders, had taken any remedial measures, and in less than half the cases could the measures taken be considered as reasonably effective and permanent solutions. Many people had merely increased the ventilation rate by more regular and frequent opening of windows: a measure unlikely to be sustained during the colder months of the year when the radon levels are often at their highest. More encouragingly, one in four householders still intended to put remedial measures in place. A further finding was that two-thirds of the householders had carried out the work themselves and only one-third had engaged a contractor.

The majority of the householders who completed the questionnaire had not taken any steps to reduce the high radon level in their homes. The perceived expense of remedial works was the single most-commonly quoted reason for inaction; given in over 50% of cases. The next most frequent reason was the perceived upheaval, followed by doubts as to whether radon was a serious risk to health and difficulty in obtaining advice on what to do.

The overall lesson from this small sample is clear: there is a communications failure in providing simple facts to householders. The facts are:

- Long-term exposure to high radon levels is a serious risk to health.
- Simple and effective measures to reduce high indoor radon levels are available.
- Expert advice is available.
- The cost is cheaper than many other common home improvements.

All the professionals involved in the matter of radon in homes need to consider ways of improving the way in which we communicate with the general public and householders in particular. Such steps are in hand. In Northern Ireland, some householders have been written to several times and the Environment and Heritage Service has organised radon road shows, attended agricultural shows and held radon seminars and workshops throughout the country in an attempt to inform people about radon. The guidance available is similar to that for Great Britain but contains specific information on the radon risk in Northern Ireland.

Basement Workplaces

Tracy Gooding, National Radiological Protection Board

Radon measurements of workplaces in parts of the UK have become a routine part of the risk assessment required by the Management of Health and Safety at Work Act 1992. High radon levels require action and the Ionising Radiations Regulations 1985 (IRR85), which will be revised next year, are usually applied if radon gas concentrations measured with passive monitors exceed 400 Bq m^{-3}.

As a result, the Health and Safety Executive and Environmental Health Departments of the local authorities have included radon in health and safety inspections of premises in some radon Affected Areas. Radon measurements in workplaces are usually straightforward: one etched track monitor is placed for every 100 m^2 of floor space, on the ground floor. Occupied basements are also often measured and these have thrown up some surprises and a little controversy.

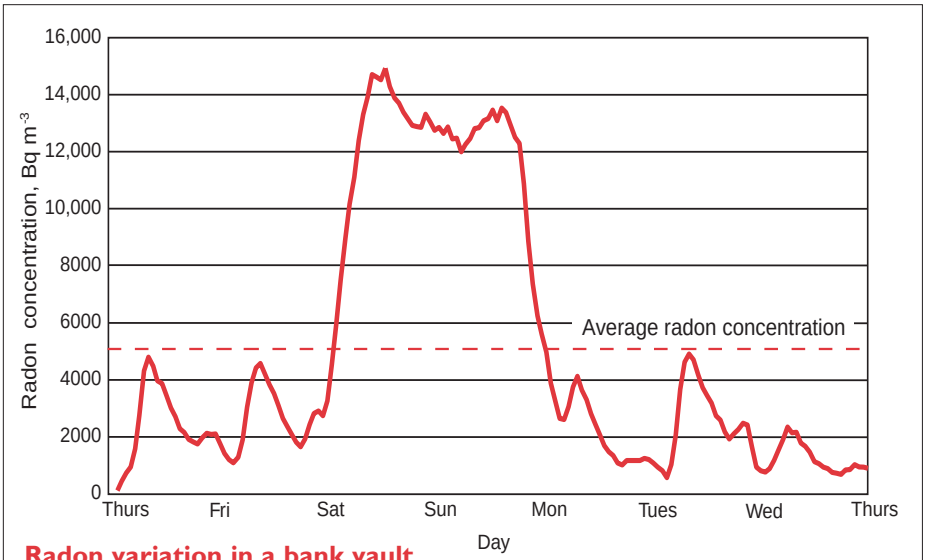
To Test or Not to Test

The need to test basements at all has been questioned. If a high radon level occurs in a location with a low occupancy, the exposures will be limited and may be of little concern. But basements include bank vaults, beer cellars, photocopying rooms and file archives, in which people can sometimes spend a considerable amount of their working day. Radon measurements in these locations are, therefore, necessary to give a complete radon survey of a workplace.

The potential for radon ingress in a basement room with walls and floor in contact with the ground is greater than for a ground floor room. Because of this, high radon levels have been found in basements in all parts of the UK, although the very highest concentrations have been restricted to the Affected Areas. When deciding whether to undertake screening measurements in a property, therefore, all premises with occupied basements should be considered, regardless of geographical location.

Radon Levels and Variations

One of the main driving forces for radon ingress is the temperature difference between indoors and outdoors, and radon levels are therefore generally highest at night and in the winter months. Passive, integrating radon monitors give the average radon level over the exposure time of several months. The practical application of the IRR85 takes into account typical diurnal variations, because the vast majority of employees will be working during the daytime.



Radon variation in a bank vault

Detailed measurements have shown that some basement bank vaults have variations in radon levels which are a result of low ventilation when the bank branch is closed. Radon levels increase rapidly at the end of the working day, and fall as soon as the vault is open in the morning, which can also increase levels briefly in the ground floor areas. The radon levels also remain high over the whole weekend, as shown in the figure. The fact that radon levels are lower during the working day is certainly of benefit to the bank employees, but any monitor that gives results in terms of the average radon level will greatly overestimate exposures.

Remediation and Control

Employers are understandably reluctant to spend large sums of money to reduce radon levels in an area where employees spend little time. Administrative control of entry to the basement is an acceptable alternative way of limiting exposures. But formal restrictions on the amount of time which a person can spend in an area, and the fact that the radon problem is never solved, are unpalatable for many businesses, and they may decide to remediate even when this is not the cheapest option.

There are effective ways of reducing radon levels in basements using sumps or improved ventilation, the latter being popular where the lack of windows has led to stale air and unpleasant working conditions. However, increased ventilation may not be possible in a bank vault because it could compromise security. Increased ventilation is also a problem for pub cellars, but for a different reason: the temperature must be maintained at 12°C.

In one bank, an attempt was made to reduce the high radon emanation rate from the walls by sealing them with epoxy resin, a long, messy, and only partially successful task. Some banks have transferred their secure areas to the ground floor, leaving them free to use traditional remedial methods where exposures in the basement might be significant.

Such difficulties can considerably increase the cost of remedial work. It can be very useful to discuss the need for action with local HSE Inspectors or professional advisers. There is, in any event, a legal requirement to notify the relevant enforcement agency about work with radiation.

Conclusions

Exposure to high radon levels in basements should not be ignored, especially since it occurs throughout the country. With a pragmatic mixture of risk assessment and remedial work, and drawing on the expertise of enforcement agencies and advisers, practical and effective solutions can usually be found without excessive cost.

Radon in Leeds

Phil Gamble and Anoop Sharda, Leeds City Council

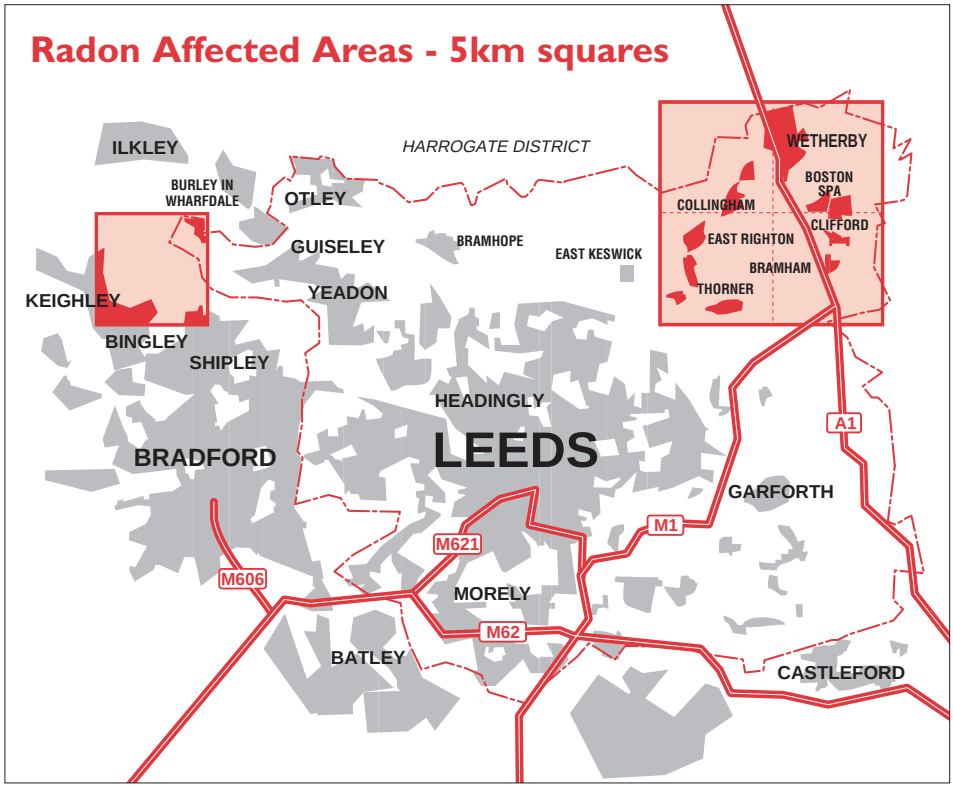
Before the publication of the Radon Atlas of England in April 1996, we in Leeds considered radon was a problem for others. We simply advised enquirers (of which there were few) that radon was not regarded as an issue in the Leeds area, but to contact NRPB if they wanted further information.

The Radon Atlas changed all that when it showed six 5 km squares wholly or partly within Leeds Metropolitan District which fell into the predicted range of 1% to 3% of homes requiring works to reduce radon levels. The radon affected areas in Leeds contain around 12000 homes of which about 1300 are in Council ownership. The areas themselves are mainly centred on the market town of Wetherby and it's surrounding villages but also include an area of moorland between Guiseley and Bingley in the west of the district.

We undertook to tackle the problem in several ways. Our standard advice pack issued to householders in response to radon enquiries was improved. It now includes details of the survey results for the Leeds City Council area, how to arrange radon tests, an NRPB booklet, and invites the householder to contact the Department of Housing Services for further advice in the event of an excess level of radon being found.

The Council's grant policy was also changed to enable a renovation grant to be made for radon remedial works in appropriate cases. All other Council Departments with property within the affected areas were briefed on the radon issue and advised to undertake radon testing of their residential and office buildings.

At the same time Wetherby Town Council and all the local Parish Councils were informed and offered officer attendance at one of their meetings. A press release was issued which resulted in coverage in the local, regional and national press and an interview on Radio Leeds.



It was decided to carry out radon tests in the 1276 Housing Services Department properties in the affected areas. Due to budget restraints within the Housing Revenue Account only 5% of the stock were to be tested each year. Sixty-five homes were tested in the first year, and 71 in the second year.

The overall average radon concentration found was 29 Bq m^{-3}, lower than found in the original NRPB survey of the area. This finding is in line with what has been found elsewhere: municipal housing usually has a lower radon concentration than private housing in the same area.

The two highest radon levels found in these surveys were 150 and 200 Bq m^{-3}. The property with the higher radon level was found to have all five fresh-air ventilators blocked. The property next door had only 30 Bq m^{-3}. Following advice from NRPB and BRE the ventilators will be unblocked and the radon level remeasured.

Preparatory work to enable the third phase of 65 properties to be tested is now being undertaken. On the basis of the results in the first two phases and advice from NRPB, it has been decided that 50 flats at first floor level do not need to be tested. The progress of the survey so far can be summarised:

Tested for radon concentration	136
Test refused by tenant	22
Test found not necessary	50
Total	208

(16% of the 1276 properties to be tested)

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.