Environmental Radon Newsletter

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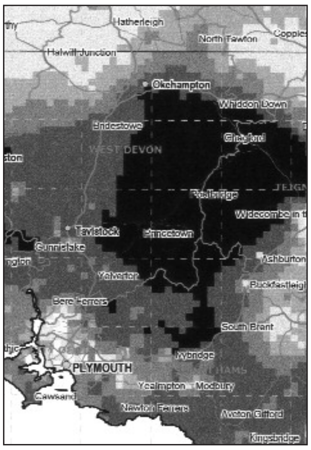
The uses of radon mapping

Jon Miles, National Radiological Protection Board

The National Radiological Protection Board (NRPB) has been producing radon maps since 1990, displaying the estimated proportion of homes above the UK radon Action Level. Although radon levels vary widely from house to house, such estimates are valuable in identifying areas where it is important to measure, or to prevent high radon levels in new buildings. This allows both public and private money to be used most effectively in avoiding excessive radon exposures.



The maps are also a clear and easily-understood way of presenting the radon issue to the public and policy-makers, and essential for persuading people to take it seriously. "Is there a problem in my area?" is the first question that people ask about radon. If the answer was "I don't know", very few people would bother to measure.

Initially the maps produced by NRPB covered just Cornwall and Devon, then other highly affected counties, then all of England, Wales and Northern Ireland. Work is currently underway to complete the radon map of Scotland (see Newsletter 36).

The uses to which these maps have been put include:

- Allowing national and local government radon programmes to focus on the houses at most risk of having high radon levels. Most recently, this has been through the radon roll-out programme in England, where local authorities have taken a leading role in encouraging measurement and remediation in high-radon areas. Similar initiatives are in progress in Wales and Northern Ireland. Many local authorities have commissioned NRPB to produce larger-scale radon maps of their own areas, to help in their campaigns.

  Recently, the radon roll-out campaign in Kerrier identified four houses with higher radon levels than had previously been found in the UK. These houses were found in areas where, according to the radon map, more than 30% of houses are above the Action Level.

- Outlining areas where radon preventive measures are required in new buildings. The guidance on protective measures for new dwellings, issued by the Building Research Establishment, has regularly been updated in line with the latest radon maps to define the areas where preventive measures need to be installed.

- Helping to target campaigns of measurement in workplaces. The radon levels found in buildings depend on their dimensions, construction and use, so radon levels in workplaces will not always be the same as those in houses in the same area. But the sources of radon are the same in both cases, so maps based on radon in houses also identify areas where high levels may be found in workplaces.

- Allowing house buyers to find out whether there is a likelihood of high radon levels in a house they may wish to buy. Since the cost of radon remedial measures is relatively small compared with the cost of a house, knowing that a house is in a radon Affected Area should not prevent a purchase. But such knowledge allows the buyer to make enquiries as to whether the radon level has been measured, or radon remedial measures installed. If no testing has taken place, the buyer may want to allow for testing and remedial measures in the purchase contract.

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Public responses to radon in the Southwest

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Technological, health and environmental issues span scientific, social, economic and political interests and concerns, with a multitude of conflicting interests and values. Radon risk issues are typical, displaying tensions between expert assessments of risk, public perceptions, and risk management priorities. Radon risk is highly localised therefore it is important to understand how people in particular communities gain information and respond to it.

In a recent small research project, a 'mental models' approach was applied to examine public understanding of, and responses to, radon in terms of how people might take mitigation decisions. The focus was on households living in the southwest of England. The research provides new information about the beliefs and understanding of the lay public compared to experts, and provides some useful information to assist in mediation at the expert-public interface.

Kerrier District Council, a key area in the Radon Roll-out Programme, run by the Department for Environment, Food and Rural Affairs (DEFRA), was selected as the geographical focus of the study and nineteen in-depth interviews were conducted with people with different lengths of residence in the area.

Analysis of the interviews reveals that:

1. People are knowledgeable about radon, with a relatively sophisticated understanding of certain aspects of the radon issue, such as indoor exposure
2. People understand inhalation of radon as an effect concept; with some understanding of lung cancer risks. However, people do not necessarily discuss sources and pathways of exposure in the same way as experts.

The people who are concerned about radon are those with direct personal experience, who have had a longer period of formal education and who have acquired local knowledge through living and working in a particular community and/or occupation.

People's discussion of radon risk reveals dynamic sense-making involving risk comparisons and lay epistemologies where people actively search for an explanation of different related phenomena and draw comparisons with things 'local' to them. In general people do not regard radon as a serious risk compared with to other risks in their locality.

Deviations between respondent's and expert knowledges indicate opportunity for enhancing information provision so as to respond to people's direct information needs. Any risk communication must be designed considering both what lay public already know and want to know, rather than experts want to tell them. For such a goal to be achieved ongoing mapping of the lay public's concerns is essential.

Any attempt to improve risk communication should address the role of information sources that shape public understanding and relations between them. Further research is being conducted on a comparative analysis of radon with other potential natural hazards such as river flooding or a rise in sea levels.

Thoron in houses

Lorna Proctor, RWE NUKEM

Radon is not the only natural radioactive gas entering homes: there is another one, thoron. Strictly, what we normally refer to as 'radon' is the isotope radon-222, and comes from uranium-238. 'Thoron', on the other hand, is the informal name for another isotope of radon, radon-220, which comes from thorium-232. Because there are traces of uranium and thorium in all rocks and soils, radon and thoron are always being emitted in the ground under our feet.

Much less attention is paid to thoron than to radon, because the radiation doses that thoron delivers to humans are much lower. In the UK it has been estimated that thoron doses are on average about 10% of radon doses, though in Italy and Japan the thoron doses can be much more significant.

The reason that thoron is generally less of a problem than radon is that thoron has a very short half-life, about one minute. Very soon after it is formed as a gas, thoron decays into a solid, and can no longer diffuse through the ground. In Italy and Japan thoron can cause problems because some building materials are high in thorium, and thoron can diffuse out of the walls, especially if they are not covered.

There have been earlier surveys of thoron in UK homes, aimed at estimating the average dose to the UK population. These established that on average thoron doses were low – at least compared to radon doses, though they are still a hundred times higher than the doses we receive from the nuclear industry. The possibility remained that there could be higher thoron doses in some parts of the country, so I carried out a survey as a project for my MSc in Radiation and Environmental Protection at the University of Surrey.

The regions surveyed for thoron in houses were selected on the basis of radiological and geological information that they were the most likely areas for high thoron levels. They included the granite areas and those around the margins of granite masses in Devon and Cornwall, the Eskdale granite of the Lake District, the limestone area south of Kendal and the sandstone areas of both Wensleydale and Grantham.

All of these regions have above-average radon concentrations. From geological data they are also identified as being likely to have above-average concentrations of natural radionuclides in the ground due to the presence of, for example, igneous rocks or uraniferous limestone. To provide a comparison with low radon areas, buildings at the University of Surrey and at the National Radiological Protection Board (NRPB) were also measured. A total of 35 locations were measured.

When thoron enters the air in a house, it rapidly decays into solid decay products which can be measured in the air. For this survey, the air in each building was sampled through a filter paper, and the radioactivity on the filter measured. Both thoron and radon decay products were measured on each filter. Each measurement took 16 hours.

The thoron levels found in these buildings covered a very wide range, but all of them would give radiation doses much smaller than those received in houses at the radon Action Level. The table shows the average annual thoron doses as a percentage of the annual dose received in a house with the radon concentration at the UK Action Level. It can be seen that the doses are relatively low. The house with the highest thoron concentration was in Cornwall, and had a radon concentration over the UK Action Level at the time of measurement. The thoron concentration in this house at the same time would give an annual radiation dose about 10% of the radon dose in the same house.

This survey focused on areas of the UK expected to have the highest thoron levels in houses. It did not identify any significant problems such as those found in Italy and Japan. The emphasis in UK surveys in future will therefore remain on radon-222.

Area	Number of locations measured	Average annual Thoron dose, percent of radon dose at Action Level
Cornwall	12	2.9%
Cumbria	6	2.2%
Yorkshire	3	0.2%
Leicestershire	2	3.8%
Surrey University	5	0.5%
NRPB	7	0.8%

Weekly variation in radon levels?

Jon Miles, National Radiological Protection Board

It is generally recognised that because indoor radon levels vary from day to day, measurements to determine the annual average radon concentration in a building should be carried out over a long period. Measurements to determine whether a house is above or below the radon Action Level are normally carried out over a three-month period.

Nevertheless, there are times when people require a quick answer, even if it is less accurate than waiting for the result of a three-month measurement. Such short-term measurements are regarded as screening measurements: in some cases the result may be so low or so high as to leave no doubt as to whether the house is below or above the Action Level, in other cases the result may show that a longer period of measurement is required.

It has sometimes been suggested that short-term measurements should be carried out over periods that are multiples of one week, on the grounds that people's behaviour is different at weekends, and so there could be a weekly cycle of variation in radon levels. The implication is that, for instance, a ten-day measurement would be less representative of the annual average radon level than a one-week or two-week measurement.

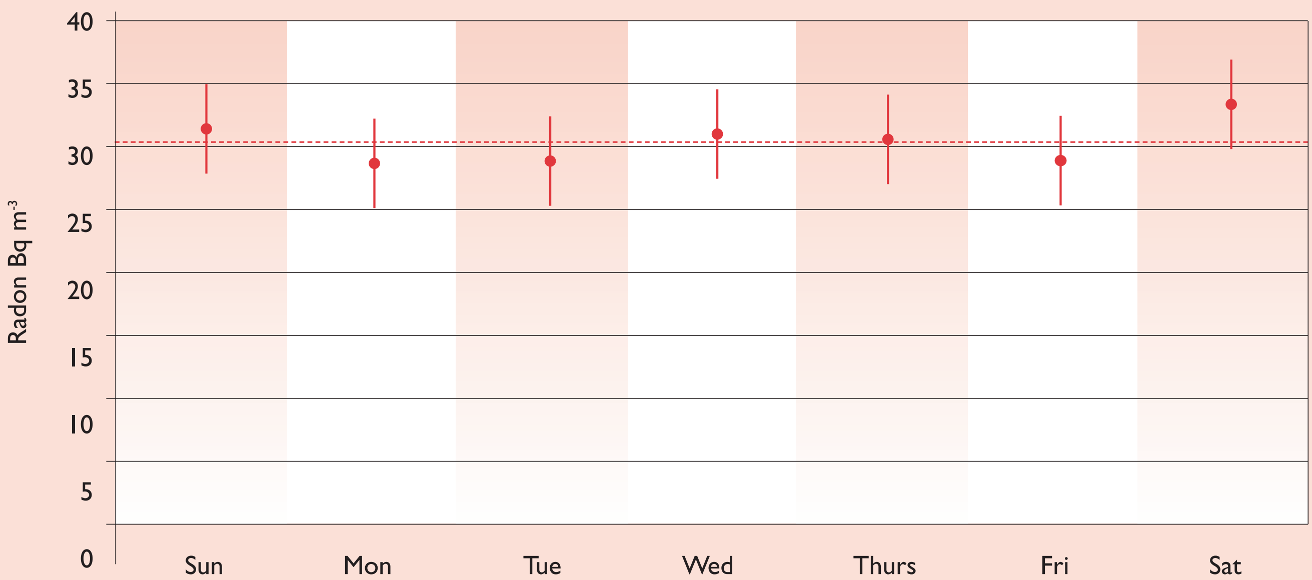
To find out whether this was the case, the results of continuous measurement of radon in a house over more than a year* were analysed. After excluding periods when the house was unoccupied, there were 314 days of measurement. The average radon level was calculated for each day of the week (see graph).

On this graph, the dotted line is the overall average radon level, and the vertical bars show the standard error on the daily results. The radon levels on each day are not significantly different from each other or from the mean.

More importantly, if radon levels followed this pattern every week, the average radon level over a ten-day period would be only 1% different from the average over a one-week or a two-week period. Clearly any weekly pattern of variation in this data is so small that it is not going to affect the results. The message for short-term measurements therefore seems to be the same as that for long-term ones: the longer the better, irrespective of whether it is in multiples of a week.

* Miles, JCH (2001). Temporal variation of radon levels in houses and implications for radon measurement strategies. *Radiation Protection Dosimetry* 93, 369-375.

Average radon by day of the week



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