Environmental **Radon Newsletter**

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Rapid testing for radon underground

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Procedures for measuring radon in workplaces are well established and have been used successfully for many years. Passive detectors are typically exposed for three months to allow exposures to be assessed reliably. The long exposure period allows for fluctuations in the radon levels to be averaged out and allows a better assessment of whether the Ionising Radiations Regulations 1999 should be applied.

There are some work conditions, however, in which long-term averaging is not appropriate, either because it does not provide a reliable guide to likely levels of exposure or because it is too slow. Employees in some industries have to enter underground locations that are not normally occupied, sometimes at short notice. Such work includes, for example, the inspection and maintenance of tunnels, shafts or other confined spaces with limited access found in the water or telecommunications industry. As very high radon levels are known to occur in this type of environment, employers (and frequently sub-contractors) need to know in advance whether restrictions on their working times will be required.

The difficulties with the normal measurement procedure are two-fold. Firstly, as soon as the confined space is opened to allow access, there will be a very substantial effect on the ventilation and hence on the radon level, especially if a short period of forced ventilation is undertaken prior to entry. Long-term measurements are thus likely to over-estimate the concentration. Secondly, a rapid result is often required to enable ongoing management of the exposures. A measurement and processing delay of several weeks for passive monitors can be highly disruptive.

In such circumstances, a test procedure using 'grab sampling' can provide a more appropriate estimate of radon concentration, and deliver the result in time for work to be planned. This procedure requires an air sample to be taken, and its radon concentration to be measured using an electronic instrument.

Previously, taking grab samples has required a site visit by a scientist to collect samples using delicate and expensive equipment, making the process time consuming and costly. A new approach to grab sampling has therefore been developed, which can be largely undertaken by the person on site, with no previous training. This method employs a one litre radon-proof bag for collecting the sample, which has been fitted with a simple and reliable valve that allows the sample to be securely isolated. The bag is contained within a robust plastic bottle for protection and labelling, and is accompanied by a simple bulb pump and connectors, which are sent to the measurement site. The gas sampling method requires minimal technical skill, so can be carried out simply and quickly by the site operative following the photographic instruction sheet supplied. Record sheets and return labels are provided to minimise the likelihood of samples being wrongly assigned or mislaid.

The samples are returned to the Health Protection Agency by overnight carrier for rapid analysis. The sample gas is transferred to a scintillation flask for counting. The results of these tests can be available within hours and are used to provide advice on any further protective measures required during the work, and a risk assessment to be completed for the site works project. Further samples taken by the contractor as the work progresses allow the risk assessment to be amended as necessary.

Although still undergoing development, the procedure has already been used successfully for operational measurements in the water industry. Feedback from the contractors has been good and this has proved to be a simple and effective way of providing protection advice for employers.

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Radon calibration facilities

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It is important for measurements of radon and its decay products, whether by active or passive detectors, to be supported by accurate calibrations of the detectors. Since 1981 the Airborne Radionuclides Group of the Health Protection Agency (HPA) has operated a radon exposure facility for calibration and research purposes, the only such facility in the UK.

Passive radon detectors exposed during an international intercomparison

The primary facility is a 43 cubic metre walk-in chamber accessed by an airlock. The chamber contains a radon atmosphere which is generated by four dry radium-226 sources. By using different combinations of these sources and controlling the ventilation rate of the chamber, the radon concentration can be varied and held stable from around 200 to 8,000 Bq m^{-3}. The radon concentration in the chamber is typically kept at around 4,000 Bq m^{-3}, which is high enough to allow exposures to be completed quite quickly, but is not too high to prevent staff from entering for short periods to carry out work within the chamber.

The size of the chamber allows large scale calibrations to be carried out, either several instruments simultaneously or more than 2,000 etched-track detectors. The chamber is in almost continuous use for calibrations of active and passive detectors of radon and its decay products for laboratories in the UK and abroad.

The radon gas concentration is monitored continuously using instruments that have calibrations traceable to national standards, either the UK National Physical Laboratory or Physikalisch-Technische Bundesanstalt, Germany. The data is stored in a networked database, together with measurements of parameters such as temperature, air pressure and relative humidity.

As well as calibrations, the chamber is used for quality assurance tests of HPA passive detectors. It is also used for the regular performance tests on laboratories validated for making measurements in UK houses, and for annual international intercomparisons of passive radon detectors. These intercomparisons typically involve 40 laboratories each year, most of them in Europe but also from other parts of the world.

Although most calibrations are carried out by HPA staff, it is also possible for customers to hire the chamber by the day in order to carry out work or calibrate instruments. HPA staff monitor, control and report the conditions in the radon chamber. The chamber has also been used to test other types of equipment, such as determining the radon response of actinide-in-air contamination monitors and etched track neutron dosemeters.

Some instruments are designed to measure concentrations of radon decay products, rather than radon gas. To calibrate such instruments, it is necessary to ensure that the calibration atmosphere they sample has a balance between radon and its decay products (known as the equilibrium factor) that is typical of the practical exposure conditions where they will be used. To obtain different equilibrium factors in the HPA radon exposure chamber, it is equipped with an aerosol generator and an electrostatic precipitator. Running these simultaneously and varying the fan speed of the precipitator allows staff to maintain an equilibrium factor in the chamber that is typical of that in houses, or in mines, or other locations.

See www.hpa.org.uk/radiation/services/radon/radon_calibration.htm for more details.

High radon results in Kerrier District

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Those of you who read this newsletter regularly may remember an article describing the participation of Kerrier District Council in a Defra-funded radon rollout programme between 2003 and 2005 (ERN 42). Under the programme we offered free radon tests to those households which had a greater than 5% probability of being above the Action Level (200 Bq m^{-3}), but had not yet been tested.

The Health Protection Agency (HPA) had already tested 13,000 homes in the district and found 5,200 to be above the Action Level. There remained 27,000 homes not yet tested, and at least 25,000 of these were to be included in the free test offer.

The object of the exercise was to find and fix high radon homes, so all householders with results above the Action Level were given the opportunity to have a face-to-face discussion with staff from the Building Research Establishment (BRE) and HPA. The discussions covered the measurement results, the risks to their health, and methods of remediation appropriate for their dwelling and radon concentration.

A further result of this programme has been to discover houses with the highest known radon concentrations in the UK. In total we have had eight results over 9,000 Bq m^{-3}. Almost without exception, these high readings come from properties which are situated on or very close to capped mine shafts or mine adits. Some of the residents were elderly.

These high radon houses were given special treatment, in addition to the opportunity to discuss their problems with BRE and HPA. The householders were contacted directly by HPA and given the result over the phone before receiving a letter. Any questions they had were answered. The householders were encouraged to contact me directly for further advice.

Property 1: 17,000 Bq m^{-3}

This is a small ground-floor one-bedroom flat in a block which has been converted from its original use as an arsenal. It is privately rented, and the only one within the block to be tested. The block is situated very close to old mine workings and almost directly above the main drainage adit. This radon problem is being addressed by the Housing Team under the Health and Housing Safety Rating Scheme (HHSRS). At this time I do not believe it to be remediated.

Property 2: 14,000 Bq m^{-3}

This is an old property associated with a now long-disused mine. The householder originally purchased the property to renovate it and resell. It would appear that the property is in quite bad repair, and any radon remediation will entail considerable work on existing flooring. The occupiers were understandably distressed to receive the result. They took the issue to the local MP with a view to the Government releasing extra funds for remediation works. At this time this has not happened and the situation at the property remains unchanged.

Property 3: 12,000 Bq m^{-3}

This was converted from a barn to a house around 1980, and unusual in that it is long and on many different levels. It is privately owned. In an effort to help as much as possible it was arranged for a local expert to draw up a comprehensive plan for remediation. The occupiers' family were in a position to be able to carry out the works specified, but it would seem that instead a local radon contractor fitted a second-hand system. This has reduced the concentration, but it is still high at 1,800 Bq m^{-3}.

Property 4: 12,000 Bq m^{-3}

This is a relatively modern bungalow built in the 1980's. The property was occupied by member of the owner's family, but is now being privately rented. A sump system has been fitted and the results are awaited.

Property 5: 12,000 Bq m^{-3}

This is a bungalow constructed before planning laws were introduced. The property was built over a drainage culvert, with a man hole cover in the master bedroom. Unfortunately the householder placed a detector on the floor, under the bed, beside this cover. The other detector was placed behind the plinth of the kitchen sink base unit, close to a service pipe with an unsealed gap around it. A repeat measurement (with the service pipe entry and man hole cover sealed and the detectors properly placed) gave a result just over 3,000 Bq m^{-3}. It appears that no further remedial action has been taken.

Property 6: 12,000 Bq m^{-3}

This is a former miner's terraced cottage, very typical of the area. It was privately rented, and the tenants reported that the property had recently had subsidence problems affecting the flooring. The radon problem was addressed using the HHSRS, including the possibility of serving a prohibition notice on the property. The tenants have now moved and the property is for sale by auction with its problems still present.

Property 7: 11,000 Bq m^{-3}

Little is known about this property. The family of the occupiers requested that we should not contact the residents, as this would unduly worry them. The indication was that the family would deal with the issue after the residents are no longer living there.

Property 8: 9,600 Bq m^{-3}

This is a terraced house in a known radon hot spot. The occupier has attended some exhibitions and was given advice. He said that there was an insurance claim concerning a mine shaft on the property. He was hoping that he could address both problems at the same time.

North Northumberland Radon Partnership – an example of public health good practice

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The North Northumberland Radon Partnership is a collaboration of local organisations established to highlight issues associated with radon in and around the Wooler area of Northumberland, and to encourage home owners to undertake radon testing and remediation where necessary.

Berwick upon Tweed Borough Council carried out a radon survey in conjunction with the Health Protection Agency (HPA) eight years ago with some success. However, given the level of risk of lung cancer associated with long term exposure to radon gas, staff within Northumberland Care Trust (NCT) proposed to develop this work further by establishing the North Northumberland Radon Partnership in late 2004. The aim was to develop an awareness-raising campaign driven by local people in local organisations, to see if this might be more successful than simply participating in the nationally-led programme.


BERWICK UPON TWEED BOROUGH COUNCIL

SureStart
Berwick-upon-Tweed Borough

The Glendale Gateway Trust

Northumberland NHS
Care Trust

Dear Householder

Reducing high radon levels in homes

A partnership, called the North Northumberland Radon Partnership has been formed between Berwick Borough Council, The Glendale Gateway Trust, the Northumberland Care Trust, the North-East Health Protection Agency (HPA) and SureStart. This Partnership is fully supported by the local GPs based in Wooler.

The Partnership comprises the NCT public health team, Berwick upon Tweed Environmental Health Officers and HPA North East (Local and Regional Services) with support from HPA Radiation Protection Division (HPA-RPD), local staff from Surestart, the Glendale Gateway Trust and the NCT smoking cessation team. Funding to support the campaign was made available under the radon programme for England, described in Environmental Radon Newsletter 44.

Half-day training sessions were arranged for frontline council staff, housing professionals, local builders and all kinds of local community workers. Invitations were issued on behalf of all members of the partnership, to emphasise the strong local participation.

A short lunchtime lecture for the local GPs was arranged by NCT to enlist their support in the form of a letter of endorsement signed by each GP, for inclusion in future mailings to the local population.

The partnership also set up a free phone number for residents to obtain information once the campaign publicity started. This was operated by local staff who knew the area and the people involved, which further emphasised to the public that it was a local problem being addressed locally.

Offers of free radon tests were made to residents using a standard HPA-RPD letter, accompanied by letters from the partnership and the GPs, rather than from the from the council alone, emphasising the associated health effects and encouraging the uptake of testing. A variety of media statements, posters and advertorials were also produced by the partnership. All media opportunities were championed by the centre manager from the Glendale Gateway trust, a well known member of the local community.

As a result of this work, the uptake of radon tests was 39%. Of the households tested, 16% exceeded the 200 Bq m^{-3} Action Level, and a further 21% were between 100 and 200 Bq m^{-3}.

All of the householders with results above 100 Bq m^{-3} were invited by the partnership to road shows in the local community, in letters endorsed by the GPs and HPA-RPD. At these meetings residents had the opportunity to discuss their results and possible remediation methods with experts from HPA-RPD, the Building Research Establishment and a commercial remediation company. The level of attendance was 44% of householders whose property exceeded the Action Level and 35% of those identified with levels between 100 and 200 Bq m^{-3}.

We are now approaching perhaps the most important phase of the partnership's work. The results we have currently achieved are good, with approximately 60% of all residential properties having been tested. However, when our results are combined with the previous tests, there remain 40% of residential properties that have not been tested. It is also critical to encourage a high level of remediation in properties identified with elevated radon levels. The partnership is currently discussing how we can use local initiatives similar to those described above to achieve these aims.

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