

A long-term programme to measure and mitigate radon gas in English schools - progress review and lessons learned

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Abstract

Radon gas is the single largest source of radiation exposure to the UK population. It is the second largest cause of lung cancer after smoking. However, exposures are extremely variable and depend on multiple factors including the local geology, building construction and usage.

Radon measurements have been carried out in UK schools since the 1980s. After national level discussions in 2007, which concerned the radon exposure of children and radiation protection legislation, a co-ordinated programme was developed to measure and promote the reduction of radon in schools in England. This paper describes the first national radon campaign within a single occupational sector.

After detailed discussion with stakeholders including the Health and Safety Executive (HSE), a phased programme running over several years was proposed, with the following aims:

- To improve health protection by giving duty holders in schools the knowledge and awareness to ensure that no individual is exposed to excessive levels of radon gas
- To help duty holders plan and implement radon gas measurements
- To help duty holders understand the radon measurement results and take appropriate action.

This paper reviews the programme's progress to date, the successes and challenges, and the lessons learned. It covers working with diverse customers, each having their own governance, priorities, and processes at a time when aspects of the British education system are changing. One particular issue with schools is addressing the concerns of parents and school governors when a new source of radiation exposure is revealed within their buildings, to which students and staff may have been exposed for many years. For some schools, their radon situation requires them to become radiation employers under the Ionising Radiations Regulations 1999. The paper discusses what changes can be made to enhance future programmes of this nature, in the education and other occupational sectors.

Key words: radon, schools, buildings, England, workplaces

1. Introduction

Radon gas is the single largest source of radiation exposure to the UK population (HPA 2005). It is the second largest cause of lung cancer after smoking (AGIR 2009). For the average resident, it represents about half the annual dose of 2.7 mSv (millisievert). However, exposures are extremely variable and depend on multiple factors including the local geology, building construction and usage.

Radon measurements have been carried out in schools, houses and other buildings in the United Kingdom since the 1980s. The first maps of radon Affected Areas - those in which at least 1% of homes exceed the Action Level of 200 Bq m⁻³ - were published in 1990. The most recent Affected Areas for England and Wales were identified in 2007 (HPA, 2007). By combining radon measurements in homes with details of the underlying geology, a high resolution dataset was produced in partnership with the British Geological Survey, with many new radon areas being highlighted in locations previously thought to be at low risk.

From discussions at a national level in 2007, which concerned the radon exposure of children and radiation protection legislation, it transpired that there had never been a national, co-ordinated programme to survey and promote the reduction of radon in schools. The revised radon dataset provided the perfect opportunity to address that issue. The work described below represents the first, concerted effort to conduct a national radon campaign within a single occupational sector.

2. Legal requirements

Under the Health and Safety at Work, etc Act 1974 (HSE, 1974), the employer bears the principal duty to ensure the health and safety of employees and others, for instance students and other members of the public, who have access to their work environment. Other legislation is enacted under this Act addresses the control of radon at work.

The regulations include:

- The Management of Health and Safety at Work Regulations 1999 (HSE, 1999a) requires duty holders to undertake a risk assessment, act upon the findings, and ensure risk assessments remain suitable and sufficient.
- The Ionising Radiations Regulations 1999 (IRR99) (HSE, 1999b) apply to workplaces where the maximum radon level exceeds 400 Bq m^{-3} .
- Further legislation, such as the Provision and Use of Work Equipment Regulations 1998 (HSE, 1998), covers long-term maintenance of any remedial measures installed.

The risk assessment must include radon for workplaces in radon Affected Areas. The Health and Safety Executive (HSE) is responsible for enforcing these regulations in schools in Great Britain.

The established best practice for radon monitoring in workplace buildings is to install one radon gas passive monitor for every 100 square metres of floor space, on the ground floor and in any routinely occupied basements. The monitor remains in place for three months. If the radon concentration in any part of the workplace exceeds 400 Bq m^{-3} (when seasonally corrected to estimate the peak in mid-winter), the IRR99 are assumed to apply. These procedures apply to schools.

To assess the radiation dose, a generic assessment can then be compiled from the radon level and an assumed 1100 hours indoors at school for a student and 1600 hours for an employee. If the estimated dose from radon exceeds the public annual dose limit of 1 mSv, action must be taken to control exposures, which usually takes the form of minor building works of established designs (radon mitigation).

Additional advice on applying the Action Level to homes to residential workplaces and schools was issued by HPA in July 2010 (HPA, 2010), which is consistent with the increased recognition in the international arena of members of the public being exposed to radon in workplace buildings (ICRP 2012). The HPA Advice does not form part of the legal framework and exists over and above the duty of care.

3. Radon in schools programme

The programme was devised by HPA and HSE, with the following stated aims:

- To improve health protection by giving duty holders in schools the knowledge and awareness to ensure that no individual is exposed to excessive levels of radon gas
- To help duty holders plan and implement radon gas measurements

- To help duty holders understand the radon results and act upon them appropriately.

The scope of the programme was limited to the compulsory education age only, i.e. ages 5-16 inclusive, with the hope that once the duty of care had been recognised, further radon monitoring would be carried out in other sectors by the same employers. Nevertheless, more than 25,000 schools needed to be assessed for their radon potential by reference to the latest radon Affected Area dataset. A full list of educational establishments in England, which was held by the Department for Children, Schools and Families (DCSF - now Department for Education), was filtered and assessed accordingly. This work was supported by the Department of Health. Education in the United Kingdom is a matter for the devolved administrations, which means that Wales, Scotland and Northern Ireland are dealt with individually.

From the large number of schools identified, it was decided that a phased programme would be required. Two critical components were identified: support for the employers and the provision of any mitigation works required. For state schools, all initial contacts were to be made through the LEAs (Local Education Authorities). Further contacts, including monitoring, would be dependent upon the governance of the individual school. Contacts with organisations operating within the independent sector would be sought to provide efficiencies of scale.

Valuable lessons were learned from comparisons with the HSE's asbestos monitoring programme of CLASP (Consortium of Local Authorities Special Programme) schools that started in 2006, as there were common factors including:

- The identification and remediation of several thousand schools with an environmental carcinogen
- Duty holders needed appropriate training or instruction in order to comply with their 'duty to manage'
- Calls for specific health information and advice.



Figure 1 Schools leaflet and associated information for duty holders

For this radon programme, a package of information was compiled, which included a new leaflet (shown in Figure 1) specifically designed for schools and model information letters that could be sent by the duty holders to concerned parents and governors. HPA would also be proactive in offering to provide individual advice and support to any council that had specific radon issues.

4. Phasing and schools selection

Numerous councils have mature and ongoing radon measurement and mitigation programmes, especially in areas of widespread high radon potential such as Cornwall, Devon and Derbyshire. The first phase of the programme was therefore aimed at areas where radon awareness and action was not as widespread, and where there were significant numbers of councils with newly defined Affected Areas, based on the 2007 radon Affected Areas dataset. The areas covered were chosen to correspond to the regional Health Protection Units (HPUs, part of HPA), which could help with particular health concerns from members of the public as and when required. The experience gained from each phase would be applied to the next, to maximise its effect and efficiency.

Phase 1 covered the state sector schools in the English regions of the West Midlands and North West. Phase 2 covered the East Midlands (with the two well-established high radon counties of Derbyshire and Northamptonshire), the North East, and Yorkshire and Humberside. Phase 3 will include the South East, East Anglia and London - regions where many of the Affected Areas were newly identified. Phase 4 will cover the independent schools sector nationwide, before returning to the long-established radon areas in the South West in Phase 5. To date, Phases 1 and 2 have been implemented and the planning for Phases 3 and 4 is under way.

One complication that arose from the revised way of defining radon Affected Areas was the high resolution of the dataset. The location of a particular property is identified by its delivery point. Houses are usually of modest size, so their footprint will not extend too far in any direction. Schools and other workplaces can be considerably larger, which means that the building footprint can include a variety of radon potentials.

To accommodate this uncertainty, it was decided initially to use the highest radon potential for the Royal Mail postcode that included the school. However, this threw up a number of anomalies in sparsely populated areas where a single postcode might span a geographical area of more than 500 metres. A revised approach was used for Phase 2. An algorithm was applied to the address database that showed the distance from a delivery point to the nearest Affected Area. Any school initially identified as having a low radon potential, but less than 100 metres from an Affected Area, was flagged as such and the duty holder advised to look at the size and shape of the property in more detail.

5. Progress and problems

Phase 1 started in spring 2009. Letters outlining the radon in schools programme and supporting literature were sent to the Head of Children and Young Persons' Services (or equivalent post) in a total of 32 upper tier local authorities (county and unitary councils). Some 675 schools were identified as being in radon Affected Areas from a total of about 5600. There was a wide distribution in the number of schools requiring testing in each council, from 1 to 93. Several local authorities had no schools in Affected Areas and were not included in the programme.

The timing coincided unfortunately with a significant outbreak of swine flu, which presented the most pressing issue for the HPUs and limited their available support. However, many

councils recognised their duty of care and appreciated the support that HPA could provide. Other LEAs were less keen to take action and cited the pressure on budgets or other local issues. Ultimately, however, most councils in the Phase 1 regions have undertaken some or all of the necessary radon measurements, with HPA or other validated providers. The HSE, as enforcer for this sector, are ‘monitoring and supporting’ the progress of this programme.

Some of the councils with larger numbers of schools to be monitored have phased their own programmes. This is sensible as a large number of buildings requiring mitigation could cause an unmanageable short-term strain on resources.

Phase 2 started in autumn 2010 and involved 28 local authorities and more than 1400 schools. Derbyshire and Northamptonshire each had around 200 schools in Affected Areas, but many of their properties have been monitored over the past three decades as high radon areas in the two counties were identified early on in the UK radon programme. Their task has been to return to properties that were mitigated or refurbished, as radon levels can change substantially with building improvements such as double glazing. The progress to date of the programme is shown in Table 1 below.

Phase	Region	Councils		Schools		
		Committed/ monitored	Not committed/ no info	Monitored	> 400 Bq m ⁻³	% > 400 Bq m ⁻³
1	North West	15	4	261	24	9.2
1	West Midlands	7	6	190	11	5.8
2	East Midlands	5	3	437	64	14.6
2	North East	3	5	111	10	9.0
2	Yorkshire & Humberside	6	6	63	16	27.1
	Total	36	24	1061	125	11.8

Table 1 Summary of progress by HPU region

Numerous lessons were applied to Phase 2 following the experience of Phase 1. When contacting the council, the CEO was copied into the initial communications - going to the top helps with awareness and can help persuade budget holders, especially in these difficult financial times. Following up contacts in a timely fashion is also important, as is determining which council department will be handling the monitoring. Depending on the organisational structure, this could be the Environmental Health, Asset and Property Management, or Health and Safety departments. Part of the support offered by HPA was meeting with council officers, for instance to raise general awareness or offer radon training. Several invitations were received to talk to existing cross-council groups, for instance those dealing with contaminated land, which helped to promote a consistent approach.

Some responses were surprising: numerous councils were unaware that they could not pass their duty of care in radiation matters entirely to the HPA, whereas others were fearful that an initial radon measurement would lead to an annual cost and resource burden in all schools as for the Asbestos Register. Others wanted to make a big splash in the local press about radiation, or contact every parent to tell them that the monitoring was about to take place, whereas HPA advice was to treat it as a routine health and safety matter such as legionella testing of water. An additional complicating factor was the shift in schools’ governance, which is devolving budgets and responsibilities in many state schools away from the councils. This reduced the economies of scale that would have been achievable several years ago as

contacts and monitoring have to be arranged on an individual basis, but could prove to be useful experience in managing the independent schools in Phase 4.

As the programme continued, high radon levels were discovered in some schools. Mitigation measures were therefore required to reduce the radon levels and control the radon exposures of students and employees. Some councils found this relatively straightforward, having builders already employed or retained and able to follow the widely available remediation guidance. Others had to put work out to tender or found that a different budget was required for the work to proceed. One of the difficulties in targeting 'new' radon Affected Areas is that experienced radon mitigation contractors are not available locally, which can increase costs or introduce delays to the work. Lastly, although it is vital to repeat the measurements to ensure that the work has been successful, it has proven difficult in some cases to get the confirmation required. This has been because of either budgetary problems, or the main council contact moving elsewhere and the work having yet to be reassigned.

In some cases, where mitigation has proved to be difficult or a large number of schools are involved, the council has needed to contract a Radiation Protection Adviser (RPA) to ensure compliance with the IRR99. Although many councils will have an RPA who advises on small radioactive sources used for teaching, they might not have the knowledge and experience required to advise on radon.

6. Lessons learned and future plans

Although we have worked with many councils undertaking radon monitoring over the past three decades, there were still lessons to be learned from this programme. Some of them might seem obvious, but it is only when working with employers who are realising their duty of care concerning radon for the first time that their significance becomes apparent. Some of these are given below:

- Use existing contacts and resources
- Know your audience – use familiar terms and be aware of local issues
- Tailor the literature and other resources for the programme
- Give the clearest possible explanation of which schools have been chosen for monitoring and for what reason
- Ensure that responsibilities are allocated appropriately
- Establish clear lines of communication with contacts of sufficient authority
- Promote consistency of approach across councils and regions
- Follow up and offer support, especially when high radon levels are found.

Whilst this programme is continuing, we must consider how we might build on the experience and momentum to extend to other sectors. For instance, an obvious route is to include other educational establishments: nursery, further and higher education. The devolved administrations of Wales, Scotland and Northern Ireland are also considering how the schools' programme for England may influence radon monitoring in their countries. Moving away from education, other occupational groups could be targeted nationwide in the future, for instance residential premises where employees and members of the public have high occupancy times.

7. Conclusions

The aim of the Radon Programme for Schools in England is: *to improve health protection in schools by giving duty holders the knowledge and awareness to ensure that no individual is exposed to excessive levels of radon gas.* Since the start of the programme in 2009, more than 1000 schools have been monitored and over 100 schools have been found with radon levels

that require action. The programme has already succeeded by achieving this improvement in risk assessments. As schools mitigate and manage their radon exposure, the programme is succeeding in delivering reductions in radon exposures of staff and children. As the programme moves into its third phase, we must apply the lessons learnt so far to increase its effectiveness and efficiency.

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