

Radon in Irish Above-Ground Workplaces: Regulatory and information efforts

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1. Abstract

Since 2000, occupational exposure to radon in Ireland is governed by national legislation. This legislation is enforced by the Radiological Protection Institute of Ireland (RPII), which is the competent authority for ionising radiation in Ireland. In this regard, the RPII's responsibilities include the licensing of radioactive substances as well as the provision of advice and information to government and the public on the hazards associated with radon.

The RPII has encouraged a pro-active approach by employers to measuring radon in their workplace and, where necessary, reducing exposure. The strategies adopted to increase the awareness of radon as a health and safety issue include:

- the use of newspaper advertising,
- by-line articles in relevant magazines and
- presentations to employer and employee representative groups.

Most recently, a road show targeting high radon areas has commenced. In parallel, a regulatory approach has been adopted whereby selected employers have been directed to measure radon in their workplace. Prosecutions have been initiated against those who failed to comply with that direction.

This paper describes the issues associated with each approach and concludes that while implementing legislation on radon in workplaces is a very slow process, regulation and information are essential and overlapping components of any effective national radon programme.

2. The extent of the radon problem in Ireland

During the 1990s, the Radiological Protection Institute of Ireland (RPII) conducted the national survey of radon in dwellings in Ireland (Fennell *et al.*, 2002). This was a geographically based survey of the 837 10 x 10 km grid squares of the Irish national grid. A conclusion of the survey was that 91,000 homes, corresponding to 7% of all homes in the country, were predicted to have radon concentrations above the national Reference Level of 200 Bq/m³. Another conclusion was that the population

weighted average radon concentration in Ireland is 91 Bq/m³. The results of the survey enabled the RPII to designate certain parts of the country as High Radon Areas, defined as any national grid square where it is predicted that more than 10% of dwellings will have radon concentrations above the national Reference Level. Radon maps for each of Ireland's 26 counties have been developed and are available on the RPII's website www.rpii.ie. These maps show the areas of the country in which the highest average and individual radon concentrations are most likely to be found and provide the basis for regulatory initiatives on radon exposure in workplaces.

3. National legislation on radon exposure in workplaces

3.1 Role of the Health and Safety Authority (HSA)

The Safety, Health and Welfare at Work Act, 2005 (Stationary Office, 2005), which supersedes the 1989 Act, (Stationary Office, 1989), requires employers to identify all hazards in the workplace, assess the risk to health and safety from these hazards and put in place measures to eliminate or reduce the risk. Where radon gas is identified as a hazard, the employer has a duty, as with any other hazard, to assess the risk and eliminate or reduce that risk. The National Authority for Occupational Safety and Health (commonly referred to as the Health and Safety Authority), which enforces legislation governing health and safety in the workplace has stated that, in order to assess the risk from radon, there is a general duty on employers to have all indoor workplaces in High Radon Areas tested for radon.

3.2 Role of the Radiological Protection Institute of Ireland (RPII)

The Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000 (Statutory Instrument No. 125 of 2000) (Stationary Office, 2000), hereafter referred to as the Ionising Radiation Order, enacts European Council Directive 96/29/EURATOM and deals specifically with work activities involving significant exposure to radon. The Ionising Radiation Order specifies a Reference Level for radon of 400 Bq/m³, averaged over any three-month period, above which employers are required to evaluate whether remedial measures to reduce radon concentrations should be taken. In addition, the Ionising Radiation Order empowers the RPII to direct employers to carry out radon measurements. Under this legislation, there is no general duty on employers to measure radon and an employer is only required to measure radon if directed to do so by the RPII. When directed, an employer has six months to carry out the measurement and forward the results to the RPII.

3.2.1 Valid measurement of radon in a workplace

The RPII has produced guidance notes to help employers plan a radon survey in their workplace. This guidance recommends that each ground floor or basement workplace where an employee will spend greater than 100 hours per year should be measured. It is recommended that one radon detector is needed per office. For open plan offices, one detector per 200 m² is required and for larger workplaces, such as warehouses or workshops, one detector per 400 m² is recommended.

3.2.2 Requirements on employer on finding high radon levels

An employer who finds that radon concentrations in a workplace exceed the Reference Level is required to take measures to safeguard the health of workers. In such cases the RPII recommends that the preferred course of action is for the employer to carry out early remedial work to reduce the radon concentrations. The employer, however, can choose to carry out an evaluation to determine if remedial measures to reduce the radon level are justified. The RPII have produced guidance material to help employers carry out this evaluation. These guidance notes specify that there are three fundamental steps the employer should consider:

- 1) If radon concentrations between 400 Bq/m^3 and 800 Bq/m^3 are found, the employer must evaluate whether remedial measures to reduce the radon concentration in the workplace should be undertaken. The RPII has produced guidance to assist employers in carrying out such an evaluation. The guidance recommends that the employer should first determine the radon exposure to employees by taking account of occupancy rates throughout the workplace. If the radon exposure of the most exposed employee is less than $800 \text{ kBq/m}^3 \cdot \text{h}$, remedial work is not required. However, the employer is recommended to retest the area every five years or immediately after any change in work practices. If the radon exposure is greater than $800 \text{ kBq/m}^3 \cdot \text{h}$, remedial work should be undertaken and completed within six months of first being notified of the high radon reading.
- 2) If the radon concentration is greater than 800 Bq/m^3 then remedial work must take place as soon as practicable but in any case before such time elapses that could give rise to a radon exposure of $800 \text{ kBq/m}^3 \cdot \text{h}$.
- 3) Where remedial work is not technically feasible or if a radon exposure greater than $800 \text{ kBq/m}^3 \cdot \text{h}$ is likely to be exceeded before remedial work can be completed, then the employer must apply radiation protection measures in the workplace. Such measures would be similar to those for radioactive sources used in practices, for example organising work schedules to reduce radon exposure, maintaining exposure records and controlling access to areas in the workplace where radon concentrations have been shown to be high.

3.2.3 Who can carry out a radon measurement in a workplace?

Criteria for the approval of laboratories offering a radon measurement service to workplaces are defined in the Ionising Radiation Order. For laboratories whose principal place of business is within Ireland, accreditation to European Standard EN 45001 (or its equivalent) is required. The radon measurement service offered by the RPII is accredited to this standard and is therefore regarded as an approved measurement service under the Ionising Radiation Order. In addition to the RPII there are currently two other radon measurement services in Ireland that are approved under the Ionising Radiation Order to carry out radon measurements in workplaces. Both of these use radon measurement services that are approved in other EU Member States.

4. Developing a strategy to reduce radon in the workplace

4.1 Role of the HSA

As mentioned above, implementing legislation on radon in the workplace falls between two statutory bodies in Ireland. The HSA, under the 2005 Act, has a wide remit covering all hazards in the workplace, of which radon is one. Under this Act, there is a general duty on employers to measure radon. This means that the employer is responsible for carrying out a radon measurement and ensuring that concentrations are below the Reference Level. As radon in workplaces is a relatively new issue and given its wide remit, the HSA has, to date, been unable to devote significant resources to dealing with radon. At present, the HSA and RPII are working closely to develop a Memorandum of Understanding (MoU) to clarify the respective roles of the two statutory bodies on a range of issues, including radon. This effort should help ensure that radon is considered during HSA inspections of workplaces, thereby increasing awareness of radon as an important health and safety issue among employers.

4.2 RPII's regulatory approach

Two approaches have been used to have employers carry out radon measurements in their workplaces. The first was mainly a regulatory approach took place during 2001 and 2002 when the RPII exercised its statutory powers, under the Ionising Radiation Order, in directing 2,610 employers to carry out radon measurements in their workplace. These employers were located in two towns situated in High Radon Areas (Colgan *et al.*, 2004).

The RPII also has a statutory function to provide advice to the public on all aspects of ionising radiation, including radon. Therefore, a second approach used an information campaign in parallel with the regulatory approach. In 2004, the RPII increased its efforts to provide information on radon prior to directing a small number of employers to measure radon in their workplace. This section reviews the lessons learned in earlier direction efforts and the new procedures for issuing directions.

4.2.1 Review of the lessons learned by RPII in 2001/2002 Direction Campaigns

In 2001 and 2002, the names of 2,610 employers who were directed were drawn from a commercial database, principally consisting of the trade names of the employers. Of these, 522 companies were exempted and only 408 completed measurements. A legitimate basis for exemption was that a radon measurement had previously been carried out, the workplace was located on an upper floor, or the workplace was an outdoor rather than an indoor workplace (Colgan *et al.*, 2004). This left some 1,680 employers who were in apparent breach of a statutory direction and therefore liable for prosecution.

A sample of these employers was selected and legal advice was sought with a view to bringing a prosecution. The legal advice recommended that it was unlikely that any of the prosecutions would succeed and the RPII decided not to initiate legal proceedings. The legal advice identified three main failings in the cases that were to be brought.

- 1) In most cases, the names and addresses of the employers stated on the direction letter were the trade names, which is often not the name of the legal entity responsible for safety in the workplace. This invalidated the direction and was considered to undermine any potential prosecution.
- 2) In some cases, the employer's name specified on the direction was correct, but the address (taken from the database) to which the direction was issued was incorrect. Consequently, even though the direction letters in question were registered and the RPII could verify that the letters were delivered, as the address specified on the direction letter was incorrect this was likely to invalidate the direction.
- 3) Some of the direction letters were not registered and therefore delivery of the letter and receipt of the direction could not be proven.

4.2.2 Direction Campaign in 2004

For the 2004 campaign, in addition to addressing these legal difficulties the RPII strengthened its internal procedures in the selection of employers for direction and the approval of the direction process. The reason for revising these procedures was to maximise the possibility of a successful prosecution for failing to comply with a direction.

Another important consideration arising from the 2001 and 2002 campaigns was the volume of work required to track the actions taken by each of the 2,610 employers. This became an extremely onerous task and quite clearly, if all employers were to be prosecuted, the staff resource demand would be very significant. Consequently, a much smaller and more manageable number of employers were directed in the 2004 campaign.

a) Selection procedure

In the previous direction campaigns, all employers on the commercial database were directed. However, in the 2004 campaign, only 60 were selected. A principal consideration in the selection process was to eliminate the selection of employers for direction on unfair grounds such as those based on religion or race. In addition, the RPII was mindful of not introducing a claim of bias by unfairly targeting an employer with whom it previously had problems. Conversely, the RPII was careful not to avoid directing employers with which it had a positive relationship. Furthermore, the selection process generally tried to target larger employers in order to ensure the limited resources available were used to the benefit of the greatest number of employees.

With these general considerations in mind, 60 employers were chosen. The majority of employers were taken from a commercial database of employers with a smaller number selected from the "Yellow Pages" commercial telephone directory. Each employer was contacted by telephone to identify a senior staff member within the company to whom the direction letter should be sent and by whom it was more likely to be actioned.

Prior to issuing the directions, care was taken to ensure insofar as possible the proper legal identification of each employer. This had been identified as a crucial failing in the 2001 and 2002 direction campaigns. Confirmation of the company's name and address of the particular employer was done through the Irish Companies Registration Office (CRO). The CRO maintains a register of companies in Ireland and care was taken to ensure that the employer's name and address as stated on the direction letter was the same as that specified as the company name and address by the CRO. (It is important to note that a company name is in many cases different from the business or trade name of an employer). This procedure worked for the majority of employers, particularly those who are limited companies. For employers who are self employed or for large companies with several company names, legal advice was sought to identify the appropriate entity to be directed.

When the list was completed, it was circulated internally within the RPII to help ensure each employer was fairly selected. Written approval to issue each direction was then given by the responsible senior manager within the RPII.

b) Direction procedure

In accordance with legal advice, the format of the direction letter was slightly different depending on whether the employer was a limited company or self employed. For limited companies, the direction letter was addressed to the employer and marked for the attention of the Managing Director or Chief Executive. For self-employed persons, the direction letter was addressed to that person. The direction letter was accompanied by guidance material advising the employer on how to carry out a valid radon measurement. These guidance notes also included a list of radon measurement services approved under the Ionising Radiation Order to carry out such measurements.

The direction procedure required records to be kept of all aspects of the direction process including:

- evidence of formal approval by Senior Management within the RPII to issue the directions;
- confirmation of posting of direction letter and the accompanying information, which specified how to carry out a valid radon measurement;
- confirmation that all relevant material was placed in the envelope to be posted and the name of the RPII staff member who posted the letter; and
- a hard copy of each direction letter issued.

All approved radon measurement services in Ireland were informed of the direction campaign to ensure that they were able to meet any request for radon detectors.

c) Status of the directions issued

Sixty direction letters were issued by July 2004. Four months after issuing the direction letters, the RPII wrote to those employers with whom it had had no contact reminding them of their responsibilities. This gave employers a further opportunity to

comply with the direction. Table 1 gives summary information on the status of the direction campaign at the end of August 2005.

Table 1. Status of the directed employers.

	Number of employers
Complied with the direction i.e. carried out a measurement and returned results within 6 months	16
Ignored the direction and reminder letters and against whom prosecutions were issued	16
Indicated that they were either awaiting the results of their radon measurements or were presently carrying out measurements	20
Indicated that they intended to carry out measurements	2
Invalid directions	3
Directions not delivered or the employer had moved premises	3
<i>TOTAL</i>	60

Sixteen employers complied fully with the direction. Of these, two had radon concentrations above the national Reference Level and undertook remediation work to reduce the radon concentration in their workplace. Following receipt of the reminder letter, 20 employers contacted the RPII and stated that they either were still awaiting the results of the radon measurements or informed the RPII that radon measurements were currently underway in their premises. A further two employers stated that they intended to carry out a radon measurements. By not returning the results of the radon measurement within six months of the direction, these 22 employers are in technically in breach of the direction. However, the RPII decided to await the outcome of other prosecutions before considering action against these employers.

Three directions were found to have been addressed to the wrong legal entity. In one case the wrong format of letter was used, that is, the format of direction to a limited company was sent to a self-employed person. In the other two cases, legal advice indicated that there was a strong risk that the wrong employer was directed.

At the end of the six-month statutory reporting period 16 of the 60 companies had fully ignored the direction, as well as the reminder. The RPII commenced legal action against these employers. At time of writing, a date has yet to be set for the court hearings.

d) Observations on the 2004 Direction Campaign

In Ireland, the RPII also has a regulatory function for the licensing of radioactive substances and X-ray equipment. In that context, it has taken several successful prosecutions for various offences for breaches of licensing regulations. In the case of licensing offences, the RPII has a working relationship with the defendants in the sense that they would have applied for and have been granted a license. In so doing, they have identified themselves and have declared that they hold items for which a license is required. In other words, the RPII has a good knowledge of who the employer is and that the regulations apply to them. These key elements are missing

in the radon prosecutions where the regulator has to prove that the correct employer was specified on the direction letter and that they received the direction letter.

The identification of the correct employer who is responsible for the workplace named in the direction is pivotal to the success of the direction campaign. For the 2004 Direction Campaign, this proved a difficult and time-consuming task, which was not helped by the fact the RPII staff generally have a scientific background and were not very familiar with carrying out legal company searches. The amount of time required to carry out the searches and implement procedures for the 60 directions was about two or three weeks. While the success or otherwise of the 2004 campaign has yet to be demonstrated in the courts it is likely that for future direction campaigns consideration will be given to asking a law firm who offers a legal search service to carry out the required company searches.

4.3 Encouraging employers to measure radon

4.3.1 RPII's education and information efforts

Starting in 2004 and continuing through 2005, the RPII carried out a number of different publicity initiatives aimed at heightening awareness of radon among employers. The efforts included newspaper advertising, writing articles in professional and trade publications as well as contributing to business supplements in newspapers. In addition to these efforts, the RPII also met with national employer and trade union groups to get their support in communicating its message to both employers and employees.

Also during 2004, the RPII initiated a series of radon 'roads shows' in known High Radon Areas. The purpose of each road show is to deliver the message of the risks from radon to a local audience through a number of planned and co-ordinated initiatives. This involves a combination of meetings with the local Chamber of Commerce, a presentation at a local school where high radon concentrations were previously found and the manning of a radon information stand in a local shopping centre. To date, four road shows have taken place and another two are planned in 2005. It is likely that further road shows will take place in 2006. During this time, the RPII continued to hold the national radon forum held under the aegis of the ERRICCA 2¹ program. The purpose of the forum is to provide the opportunity for radon stakeholders in Ireland – government agencies, professionals such as architects and engineers, researchers and the radon measurement and radon remediation industries – to meet to discuss and debate issues of mutual concern.

¹ ERRICCA2, the European Radon Research and Industrial Collaboration Concerted Action is a project funded by the European Commission (contract number FIRI-CT-2001-20142), the aim of which is to heighten awareness of radon and provide a mechanism for the co-ordination and dissemination of scientific and technical knowledge of radon related issues at a European level. More information on ERRICCA2 can be found on the ERRICCA website <http://european.radon.ntua.gr/>

4.3.2 Observations on the publicity efforts made to date

a) Advertising and contributing to relevant professional publications

Any effort in raising public awareness has a cost associated with it, both financial and in terms of staff time. A fundamental test of the success or otherwise of these efforts is if there has been an increase in the number of radon enquiries and radon measurements in workplaces. To date these efforts have not given rise to a discernable increase in the number enquiries from employers or of workplace radon measurements. In light of this, and from the point of view of the cost, newspaper advertising was least effective as this incurred the largest cost.

b) National Radon Forum and Radon Road Shows

The National Radon Forum and each road show are preceded by a press release, a briefing of local and national media, and every effort is made to maximise television and radio coverage. To date, the level of publicity generated has been high. In the days following the forum and each road show, there is a dramatic increase in the number of calls to the RPII and hits to the RPII's website seeking information on radon. However, while significant elements of the forum and road shows are aimed at employers, the vast majority of the enquiries on radon are from householders seeking information on radon in homes. This suggests that the message is not reaching employers or, if it is, they seem content not to act on it.

4.3.3 Initiative of the State Claims Agency

Since 2001, management of personal injury, property damage risks and claims against the Irish State is dealt with by the State Claims Agency (SCA). One of the functions of the SCA is to provide risk advisory services to State authorities with the aim of reducing over time the frequency and severity of claims. In the context of this function, the SCA identified the potential exposure of occupants of State buildings to radon as a matter that could give rise to future litigation (Kirwan, 2004). In particular, the SCA considered that there was a real risk of future litigation arising from cases where employees suffering from lung cancer may claim that their employer did not put in place the necessary control measures to minimise the risk of exposure to radon. The types of State premises covered by the SCA include government buildings, police stations, courts, museums and some long-stay hospital facilities.

In January 2004, the SCA launched its programme to encourage State employers to measure radon. The project proposed that all buildings in High Radon Areas should be tested and remediated by the end of 2005. The testing and remediation of buildings located in all other areas should be completed during 2007.

This effort was the most important initiative on radon in the workplace in Ireland in recent years and it has resulted in thousands of radon measurements being carried out. Radon measurements arising from this initiative probably comprise the largest proportion of all the radon measurements made in workplaces in Ireland to date.

5. Conclusions

- 1) Given the large number of workplaces that may be affected by radon and the limited resources of both the RPII and HSA, implementing legislation on radon in workplaces in Ireland is an onerous task and progress is inevitably slow. Many employers seem apathetic about radon, even when directed to carry out a radon measurement. The efforts of the SCA have helped encourage State employers to carry out radon measurements in their workplaces. In addition, larger companies with a national and/or international profile have also carried out measurements. However apart from these groups the remainder of employers, which comprises the majority of employers in the country, has yet to act on the radon issue.
- 2) Taking prosecutions and thereby testing the legislation in the courts is important to any regulatory effort. In Ireland, it is likely that publicity surrounding court cases from the 2004 directions will help raise awareness of radon in workplaces. However, the regulatory approach alone will not be successful in getting all employers to carry out radon measurements. More emphasis needs to be placed on making employers aware that radon is really a workplace health and safety issue and that, if they regard themselves as responsible employers, they will have radon measurements carried out.
- 3) Notwithstanding the slow progress in implementing legislation on radon in workplaces a regulatory approach taken in parallel with campaigns of education and the provision of information are seen as fundamental to a successful radon measurement program.

6. References

Colgan P A, Madden J S, Synnott H, Fennell S, Pollard D and Fenton D, 2004. Current status of programmes to measure and reduce radon exposure in Irish workplaces. *Journal of Radiological Protection* 24 (2004, 121-129).

Fennell, S.G.; Mackin, G.M.; Madden, J.S.; McGarry, A.T.; Duffy, J.T.; O'Colmain, M.; Colgan, P.A. and Pollard, D 2002 Radon in Dwellings. The Irish National Radon Survey. Report RPII-02/1. Radiological Protection Institute of Ireland.

Kirwan P. Radon Management in State buildings, 2004. Seminar on Radon Risk in State Buildings, State Claims Agency, January 2004.

Stationary Office 1989 Safety, Health and Welfare at Work Act (No. 7 of 1989). Department of Labour. Published by Government Publications Office, Molesworth St., Dublin 2.

Stationary Office 2000 The Radiological Protection Act, 1991 (Ionising Radiation) Order (Statutory Instrument 125 of 2000). Department of Public Enterprise. Published by Government Publications Office, Molesworth St., Dublin 2.

Stationary Office 2005 Safety, Health and Welfare at Work Act (No. 10 of 2005). Department of Enterprise, Trade and Employment. Published by Government Publications Office, Molesworth St., Dublin 2.