

Radon in Northern Ireland Homes: Report of a Targeted Survey

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ABSTRACT

A programme, supported by funding from the Northern Ireland Environment Agency (NIEA), identified homes with radon concentrations above the Action Level of 200 Bq m⁻³ in the Armagh, Cookstown and Dungannon areas of Northern Ireland. Householders in the areas where the radon potential is at least 5% were contacted by letter and offered a free radon test. Where high levels were found, householders were encouraged to reduce radon concentrations. The programme commenced in January 2011 and was based on the current radon atlas of Northern Ireland.

Householders accepting the offer were sent measurement kits by post; these were placed in homes for 3 months to measure the concentration of radon. The householders received a report of the results and were advised whether action was necessary to reduce radon levels. Further advice was given to householders when required from the NIEA or from officers from their local council.

Around 540 householders were invited to participate; about 35% accepted the offer. Of these, 6 homes were identified above the UK radon Action Level of 200 Bq m⁻³ and 17 measured between the Target Level of 100 Bq m⁻³ and the Action Level.

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1 INTRODUCTION

A radon atlas of Northern Ireland (NI) was published in November 2009 showing the probability of high radon concentrations throughout Northern Ireland (HPA, 2009). The report, funded by the Northern Ireland Environment Agency, briefly reviewed the health effects of exposure to radon and its short-lived decay products and reported the completion of a project to map the distribution of radon levels in homes in NI within 1km squares of the Irish grid. The report confirmed a greater probability of finding homes with radon concentrations above the Action Level in several areas.

Prior to this project, 1,243 homes have been identified in NI out of the 2,400-4,400 estimated to be above the Action Level in the 2009 report. In several of the areas which have been heavily targeted in past campaigns, 30-50% of the homes estimated to be above the Action Level have been identified. However, in Dungannon, only 14 out of an estimated 70-160 homes (9-20%) have been identified. In Cookstown, it is 15 out of 70-130 (12-21%) and in Armagh, it is 11 out of 40-130 (8-28%). A programme was organised to target these areas with the following aims:

- Identify unmeasured homes in areas where the probability of houses being affected is greater than 5%.
- Complete measurements to identify homes with radon levels at or above the Action Level (200 Bq m⁻³) and the Target Level (100 Bq m⁻³).
- Support householders, through the local councils and the NIEA, to reduce high radon levels

This report details a programme, funded by the NIEA, to meet these objectives.

2 HEALTH RISKS FROM INDOOR RADON AND RADON POTENTIAL IN NORTHERN IRELAND

Indoor radon is a recognised carcinogen, the single biggest source of public radiation exposure and the second largest identified cause of lung cancer after smoking. In 2010, the HPA updated its advice on the limitation of human exposure to radon, maintaining the Action Level at 200 Bq m⁻³ and introducing the concept of a Target Level at 100 Bq m⁻³ (HPA 2010). Remediation work on homes with high radon levels should aim to reduce levels to below the Target Level. HPA advises that homes with smokers or ex-smokers should also seriously consider reducing radon levels where concentrations are measured above the Target Level because of the substantial risks associated with smoking and radon exposure combined.

A number of radon campaigns have previously been carried out in Northern Ireland on behalf of NIEA and its predecessor, the Environment and Heritage Service, and maps of radon potential produced (DOE(NI), 1989; NRPB, 1993; NRPB, 1999; HPA, 2009). These maps identify areas where homes are most likely to have an annual average

radon level above the Action Level. Where the probability is 1% or more of a home being over the Action level, these areas are known as Radon Affected Areas.

In Northern Ireland, a number of Radon Affected Areas have been identified in parts of the districts of Newry and Mourne, Down and, to a lesser extent, Banbridge in the south-east; an area in the west centred in Strabane District; areas of the far south-west, south of Lower Lough Erne; a small area east of Upper Lough Erne and several areas in the central districts of Cookstown, Dungannon and Omagh. In contrast, the probability of high radon concentrations is low in most of the north and north-east of Northern Ireland which lies on a basalt shield. The exception is a moderate risk area between Ballycastle and Ballintoy on the north coast.

Largely as a result of these previous campaigns, greater than 23,000 homes in Northern Ireland have had their indoor radon levels tested, representing approximately 3.3% of the housing stock and over 1,200 homes with radon levels above the Action Level have been identified.

3 THE WORK PROGRAMME

The overall objective of the programme is to combat the health risks to individuals from high exposures to radon in Northern Irish homes.

The programme was similar to other work completed elsewhere in the UK and had the following aims:-

- To increase awareness about radon in the population with particular emphasis on the communities in the selected areas of Cookstown, Dungannon and Armagh.
- To identify homes with high levels of radon by offering a free radon test to all householders in the areas where radon potential (percentage of homes estimated to be above the Action Level) is at least 5%
- To advise and encourage householders to reduce the radon levels in homes with significantly elevated radon levels

Overall programme co-ordination and support was provided by the HPA and the NIEA. The programme was planned to run for a nominal 6 months.

3.1 A generic approach

The same general approach was followed as that successfully employed by the HPA elsewhere in the UK and generally consisted of the elements detailed in Table 1.

Table 1 Elements of a targeted regional radon programme

Elements	Description
Initial planning	Identifying the areas of Cookstown, Dungannon and Armagh. NIEA discussed the campaign with the local councils including the advice to be given to householders about radon and what to do in the event of a high household level of radon.
Material and data preparation	Preparing letters and leaflets, extracting address data of those households that had not previously completed a radon measurement.
Test offers and measurements	Initial letter offering a free test was sent to previously unmeasured homes in the target areas (greater than 5% radon potential). A reminder letter was sent to non-responders after 4 to 6 weeks. Measurement kits were despatched by post to positive responders.
Advice for homes	All householders were provided with a report containing the annual average radon concentration for the home and supporting advice depending on the concentration.
Remediation and retesting	Following remediation work, householders are encouraged to retest their homes to confirm that radon levels have been reduced to an acceptable level.

3.2 Measuring radon in homes in targeted areas

3.2.1 Identification of dwellings in targeted risk areas

In each of the local authority regions, all the domestic dwellings in areas of at least 5% radon potential were identified using the Royal Mail Post Office Address Files. The resultant data-set of addresses was compared with the UK National Radon Database and addresses with an existing valid radon measurement were removed since these would not need to be re-measured. This procedure identified a total of 539 individual dwellings. Information for individual areas is shown in Table 2. Tables 2 and 3 include the administrative area code used by the Office for National Statistics.

3.2.2 Offers of free radon tests

Each of the target addresses in the areas of at least 5% radon potential was sent a letter addressed to 'The Occupier' with a bespoke leaflet (see Appendix A) offering a free radon measurement. At the bottom of the letter was a tear-off reply slip, with address details and a machine readable bar code, for the householder to sign to accept the offer and to return in the pre-paid and pre-addressed envelope provided.

After six weeks, a second reminder letter was sent if there was no response to the first letter.

Table 2 Distribution of free test offers

Code	Region	Number of households invited	Positive responses	
			Number	Percentage
95O	Armagh	30	10	33
95I	Cookstown	401	135	34
95M	Dungannon	108	45	42
	Overall	539	190	35

3.2.3 The measurement package

Householders who accepted the free measurement offer were sent a standard radon measurement pack by post. This consisted of two passive integrating radon detectors, one for the main living area and one for a regularly used bedroom, placement instructions, a short questionnaire and a pre-paid return envelope. Detectors are intended to remain in place for 3 months.

3.3 Reporting radon measurement results

Each household participating in the programme that completed the measurement received a report of their results (see example in Appendix A). This provided an estimate of the annual average concentration, based on established weighting and correction factors for room occupancy and time of year in which the measurement was made and included the two individual results for the rooms measured. The report gave advice on whether remedial action was recommended to reduce the radon concentration. The advice was based on a comparison of the estimated annual average concentration with the radon Action and Target levels.

4 SUMMARY OF RADON MEASUREMENT RESULTS

In total, 190 measurement kits were deployed and 153 results reported to householders. It is usual that results are not obtained for a small proportion of participating addresses. There are a variety of reasons for this including illness, death, moving house or loss of the detectors by the householder. The observed completion rate of over 80% is in line with previous surveys. A summary of results for each region is contained in Table 3. More detailed results by divisions of the postcode are in Table 4.

The scope of the programme was that homes would be offered measurements in areas where at least 5% of homes were expected to be over the radon Action Level. Table 3 shows that 4% of the total number of homes measured during this campaign were higher than the Action Level of 200 Bq m⁻³ with the highest result of 960 Bq m⁻³ measured in the Cookstown area. Around 11% of measured homes were in the concentration range of 100-200 Bq m⁻³ in the Cookstown and Dungannon areas and no homes were found that exceeded the Target Level in the Armagh area.

Numerical values in Table 4 have been rounded to whole numbers. It should be noted that in some cases, averages have been calculated using a small number of results and these could be misleading. To prevent this and to preserve confidentiality for individual householders, geographical divisions with fewer than 5 results have been omitted. This omission means that not all results are shown in this more detailed table.

Table 3 Radon measurement results by region

Code	Region	Results				At or above TL and below AL		At or above AL	
		Number	Arithmetic average (Bq m ⁻³)	Geometric average (Bq m ⁻³)	Highest (Bq m ⁻³)	Number	%	Number	%
95O	Armagh	9	35	32	74	0	0	0	0
95I	Cookstown	105	75	43	960	13	12	5	5
95M	Dungannon	39	57	45	240	4	10	1	3
	Totals	153	68	43	960	17	11	6	4

Table 4 Radon measurements in postcode districts with at least five results

Post code sector	Results				At or above TL and below AL		At or above AL	
	Number	Arithmetic average (Bq m ⁻³)	Geometric average (Bq m ⁻³)	Highest (Bq m ⁻³)	Number	%	Number	%
BT60 4	9	35	32	74	0	0	0	0
BT69 6	6	44	42	54	0	0	0	0
BT70 2	90	81	46	960	9	10	5	6
BT70 3	10	38	30	110	1	10	0	0
BT80 9	35	59	43	250	6	17	1	3

5 CONCLUSIONS AND RECOMMENDATIONS

Overall, the participation rate of householders in response to offers of a free radon measurement was around 35% and was similar to other radon programmes elsewhere in the UK.

The programme successfully identified 6 homes with a radon concentration at or above the UK radon Action Level, representing approximately 4% of those measured and there were a further 17 homes with a radon concentration between the Target Level and the Action Level.

HPA advises that householders should give serious consideration to reducing radon levels, especially if the household includes smokers or ex-smokers. The long term risk is

greater for this group of people because of the combined effects of smoking and radon compared with lifelong non-smokers (HPA 2010).

Overall the programme was a success with positive outcomes for all objectives of the survey. Information and awareness about radon was raised in the targeted areas, a number of homes with raised radon levels were identified and these householders given advice and encouragement to undertake remediation to reduce those levels.

6 GLOSSARY

Averages. The numerical radon results in this report are presented in two ways: arithmetic average and geometric average. The arithmetic average is the normal value used to describe numerical results: it is the sum of all the results divided by the number of results. The geometric average is the n^{th} root of n results multiplied together.

Becquerel. Symbol Bq. The unit of the amount or activity of a radionuclide. Describes the rate which transformations occur. 1 Bq = 1 transformation per second.

Becquerel per cubic metre of air. Symbol Bq m^{-3} . The amount of a radionuclide in each cubic metre of air. Often referred to as the activity concentration.

Radon Action Level. The recommended upper limit for the activity concentration of radon in UK homes. Its value, expressed as the annual average radon gas concentration in the home, is 200 Bq m^{-3} .

Radon Affected Areas. Parts of the country with a 1% probability or more of present or future homes being above the Action Level.

Radon Target Level. Remediation of existing homes with high radon levels should aim to reduce the radon concentration to below the Target Level. Its value, expressed as the annual average radon gas concentration in the home, is 100 Bq m^{-3} .

Further information about radon, including maps, health risks, measurement and reducing levels can be found at the web links below

- Health Protection Agency – main web site
www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/UnderstandingRadiationTopics/Radon
- HPA's dedicated radon web site
www.ukradon.org
- Building Research Establishment web site
www.bre.co.uk/radon

7 ACKNOWLEDGEMENTS

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8 REFERENCES

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- NRPB (1999) Radon in dwellings in Northern Ireland: Atlas and 1999 review. NRPB-R308

A2 CONTACT LETTER



The Occupier
1 Any Street
Anyplace
Anytown
AA11 2BB

Industrial Pollution & Radiochemical
Inspectorate
Northern Ireland Environment Agency
Kiondyke Building
Gasworks Business Park, Belfast
BT7 2JA

028 9056 9296
ipri@doeni.gov.uk
www.ni-environment.gov.uk

Our ref: STNI95OIM_1T/100111

6 December 2010

Dear Sir or Madam

RADON IN HOMES IN DUNGANNON/COOKSTOWN/ARMAGH

The Northern Ireland Environment Agency (NIEA) is working with the Health Protection Agency (HPA) to identify and reduce high levels of radon in homes. Radon is a naturally occurring radioactive gas known to increase the risk of developing lung cancer, especially in smokers.

Your home is in an area where we know that the levels of radon are likely to be high and it has been selected for a free radon measurement as part of our latest survey. The radon test is completely free and a test kit will be dispatched to you by post. To request a test, please fill in your name and telephone number on the form below, sign it and return to the HPA as soon as possible using the prepaid envelope. More details about the test are given in the enclosed leaflet. If a high level of radon is found in your home, relatively simple steps can be taken to reduce them.

The radon measurement is very simple to do and full instructions are included with the test kit. The result of the test will be explained and sent to you with further information and advice. The measurement for your home will be treated in confidence and will not be passed onto anyone else, without your permission. By taking part you will help us to assess the health risk from radon in your area and you will discover if you have an increased risk of developing lung cancer due to the radon in your home.

I look forward to receiving your reply. Please contact the NIEA at the address above if you have any queries or comments on this survey. Further information on radon can be obtained from your local council, please see the enclosed leaflet for contact details.

Yours faithfully

G Wasson

PS This is a free offer, but it is for a limited period only so reply today

-----X-----

«A1»		STNI95OIM_1FTT/«ID»/«Batch»
«A2»	<input type="text"/>	
«A3»		6 December 2010
«A4»	For admin use only	«ID»

I wish to accept a free radon measurement as described in the letter from HPA. I also confirm this is my main residence. **Please complete the form below in black ink and block capitals.**

Title	Mr	<input type="checkbox"/>	Initial(s)	<input type="text"/>	Surname	<input type="text"/>
	Mrs	<input type="checkbox"/>	Telephone	<input type="text"/>	This number will not be passed on to a third party	
	Miss	<input type="checkbox"/>			Signed	<input type="text"/>
	Other	<input type="checkbox"/>		<input type="text"/>		

**A3
LETTER**

EXAMPLE OF A MEASUREMENT RESULT



Name
Address 1
Address 2
Address 3
Postcode

Radon Studies
Health Protection Agency
Chilton, Didcot, Oxfordshire
OX11 0RQ

01235 822622
Email: Radon@hpa.org.uk
www.ukradon.org

Radon Measurement Report

Our Ref: LR_AT/88888888

2 May 2011

This report provides the result from the radon detectors sent by HPA on 21 January 2011.

Measurement address: Address1, Address 2, Address 3, Postcode

The result is 240 Bq m⁻³ (See over for the individual detector results)
The Action Level is 200 Bq m⁻³. The Target Level is 100 Bq m⁻³.
You should reduce the level, ideally to below the Target Level

How can you reduce your radon level?
According to information provided about the property and the radon level, the following methods should reduce the radon levels. The most effective is given first:
Radon Sump or Positive Ventilation
After completing work to reduce radon levels, it is important to retest the property to check that radon levels have been reduced sufficiently.

Important notes:
If you are not the owner of the property, your landlord should be told the result.

A high radon level increases your risk of developing lung cancer; smokers and ex-smokers are more at risk than non-smokers. If you have any queries, contact us or refer to www.ukradon.org.

A handwritten signature in black ink, appearing to read 'J Smithard'.

Mrs J Smithard – Radon Services Team Leader

KEEP THIS REPORT WITH YOUR HOUSE DOCUMENTS

An explanation of the Radon Measurement Report

Measurement address

It is assumed that the measurement address overleaf is where the detectors were placed.

The result

The annual average radon level of 240 is estimated from the living area and bedroom detector results.

Living area: 360

Bedroom : 300

If results are not available from both the living area and bedroom, the annual average is estimated from the remaining detector result.

A correction is applied to compensate for seasonal differences. Radon levels are usually higher in the winter than in the summer. The estimated annual average can be compared to the Action Level and Target Level described below.

All results are in Bq m⁻³

The advice is based on:

1. The result of this test and any other information we have recorded
2. The UK Action Level of 200 Bq m⁻³ and the UK Target Level of 100 Bq m⁻³

The Action Level is the threshold at which action should be taken to reduce the radon level.

The Target Level is the level you should aim to get below when reducing radon.

If the annual average radon level is between the Target Level and the Action Level and if any of the occupants are smokers or ex smokers you should seriously consider reducing the radon level to below the Target Level.

The average indoor radon level in UK homes is 20 Bq m⁻³.

How can you reduce your radon levels?

The choice of the most effective method to reduce radon levels is dependent upon factors such as:

The initial radon level

The floor construction; whether it is solid, suspended, or a mix

If there is a basement

See the enclosed leaflet 'Reducing your risk' and www.ukradon.org

Important notes

A valid radon result depends on the test being conducted according to instructions. If we believe there are added uncertainties, it will be indicated in the report.

If this is one of a series of tests in the property, consider all the results and take into account any work or change in use or occupier.

Further information can be obtained from www.ukradon.org

Telephone: 01235 822622