Short and Long-Term Radon Measurements in Domestic Premises: Reporting Results in Terms of the HPA Action and Target Levels


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Introduction

- Radon gas can concentrate in the built environment – including domestic housing
- Radon is a risk factor for lung cancer, second only to tobacco smoking
- The risk is related to the total exposure to radon
- Estimation of the long-term average radon level is therefore a measure of the degree of risk
- An Action Level of an annual average of 200 Bq.m$^{-3}$ has been established in the UK, above which remediation to reduce the radon level is advised.
Public Response to Radon Remediation Programmes

- In Radon Affected Areas in the UK, around 40% of householders have measured radon levels in their homes.

- Of those who found levels above the Action Level, around 15% have taken action to reduce radon levels.

- Surveys show that smokers, young adults and those with large families are less likely to remediate.
Current Understanding of Risk

- Meta-analysis has shown that there is some risk below 200 Bq.m$^{-3}$
- The risk is linear at least down to 150 Bq.m$^{-3}$
- There are therefore some lung cancers induced by radon in occupants of houses with radon levels below 200 Bq.m$^{-3}$
- As a result, HPA has recommended a Target Level of 100 Bq.m$^{-3}$
- Householders are encouraged to consider remediation if levels are above the Target Level, but below the Action Level, especially if they are at greater risk – i.e. -
  - They smoke tobacco
  - They have young children

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Measurement of Radon

- Needs to estimate the annual average radon level
- But levels are higher in winter than summer
- Standard measurement is 3-month exposure with seasonal correction
- But there are times when a shorter exposure is preferred
  - For example, when buying and selling a house
- 1-week and 1-month exposures, using a variety of technologies which are simple and cheap, are scientifically accurate measures of radon

In 2003 we undertook a survey on behalf of DEFRA to look at the value of short-term measurements in 37 houses in Northamptonshire over a one-year period
Diurnal Variation of Radon Levels in a House

[Graph showing the diurnal variation of Radon levels in a house, with the y-axis representing Radon [Bq.m^-3] and the x-axis representing hours from start.]
Measurement Outcomes

As there is such a wide variation in short term radon levels, there is a probability that a shorter term measurement will not accurately predict the annual average level.

<table>
<thead>
<tr>
<th>Below both levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Action Level, but may be above Target Level</td>
</tr>
<tr>
<td>May be above Action Level, may be above Target Level</td>
</tr>
<tr>
<td>Above Target Level, and may be above Action Level</td>
</tr>
</tbody>
</table>

Above Action Level, and Target Level
Variation of Average Weekly Radon Levels in three houses

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Comparison of average weekly radon levels to average three-monthly levels in one house

![Graph showing the comparison of average weekly radon levels to average three-monthly levels in one house.](image-url)

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95% Confidence Levels that a measurement indicates an annual average radon level above or below the target or action level

<table>
<thead>
<tr>
<th></th>
<th>1-week</th>
<th>3-months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Target Level (100 Bq.m(^{-3}))</td>
<td>38</td>
<td>56</td>
</tr>
<tr>
<td>Below Action Level (200 Bq.m(^{-3}))</td>
<td>75</td>
<td>130</td>
</tr>
<tr>
<td>Above Target Level (100 Bq.m(^{-3}))</td>
<td>333</td>
<td>180</td>
</tr>
<tr>
<td>Above Action Level (200 Bq.m(^{-3}))</td>
<td>518</td>
<td>360</td>
</tr>
</tbody>
</table>
Distribution of Radon Levels in a local group of houses

Percentage of houses vs. Radon Level (Bq.m\(^{-3}\))
Expected Distribution of Domestic Radon Measurements – Buckinghamshire – 1.2 %

- Below both
- Below Action, may be above Target
- May be above both
- Above Target, may be above Action
- Above both

Uncertain Results
Expected Distribution of Domestic Radon Measurements – Northamptonshire – 7%

- Below both
- Below Action, may be above Target
- May be above both
- Above Target, may be above Action

Uncertain Results

- 1-week
- 1-month
- 3-month
Expected Distribution of Domestic Radon Measurements – Cornwall – 23.3%

Uncertain Results

- Below both
- Below Action, may be above Target
- May be above both
- Above Target, may be above Action
- Above both
Conclusions

• The large variability of radon levels means that short-term measurements are less accurate than longer-term ones.

• The concept of a Target Level introduces additional unnecessary complexity.

• 1-week exposures can be of value to assess radon levels in low radon areas or for new properties.

• However, in Affected Areas –
  – 3-month exposures are preferable
  – but the majority of tests will not result in a clear-cut result, but will require repeat measurements, or decisions on the significance of an equivocal result.

• The general public may find this confusing.