



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

**A.R. Denman, R.G.M. Crockett, C.J. Groves-Kirkby,  
P.S. Phillips.**

SCHOOL OF SCIENCE AND TECHNOLOGY, THE UNIVERSITY OF  
NORTHAMPTON, ST GEORGES AVENUE, NORTHAMPTON, NN2 6JD, UK

# 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<sup>-3</sup> 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  $200 \text{ Bq.m}^{-3}$
- The risk is linear at least down to  $150 \text{ Bq.m}^{-3}$
- There are therefore some lung cancers induced by radon in occupants of houses with radon levels below  $200 \text{ Bq.m}^{-3}$
- As a result, HPA has recommended a Target Level of  $100 \text{ Bq.m}^{-3}$
- 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

# Measurement of Radon

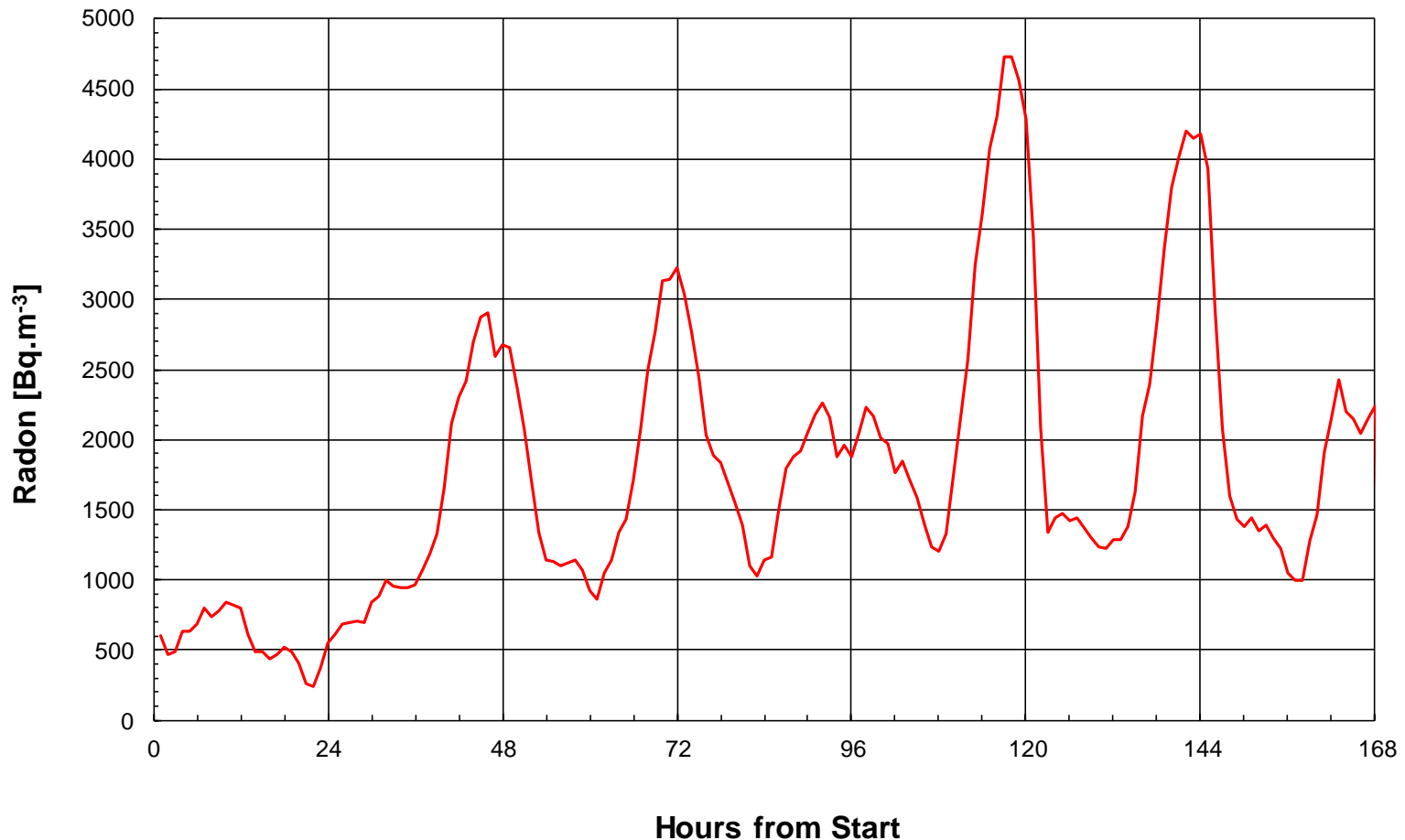
- Needs to estimate the annual average radon level
- But levels are higher in winter than summer
- Standard measurement is 3-month exposure with seasonal correction
- But there are times when a shorter exposure is preferred
  - For example, when buying and selling a house
- 1-week and 1-month exposures,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



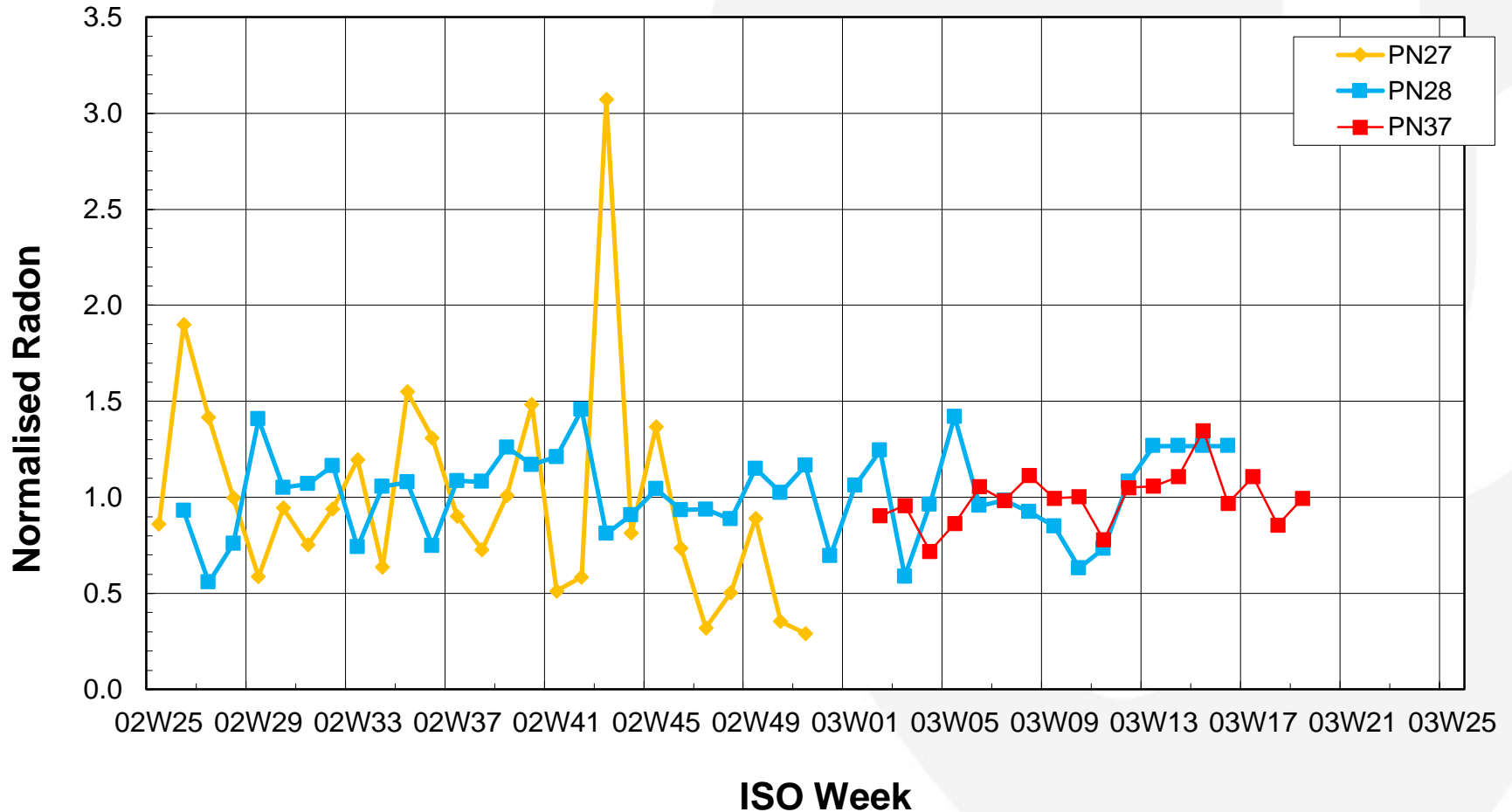
## Measurement Outcomes

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.

<b>Below both levels</b>
<b>Below Action Level, but may be above Target Level</b>
<b>May be above Action Level, may be above Target Level</b>
<b>Above Target Level, and may be above Action Level</b>
<b>Above Action Level, and Target Level</b>



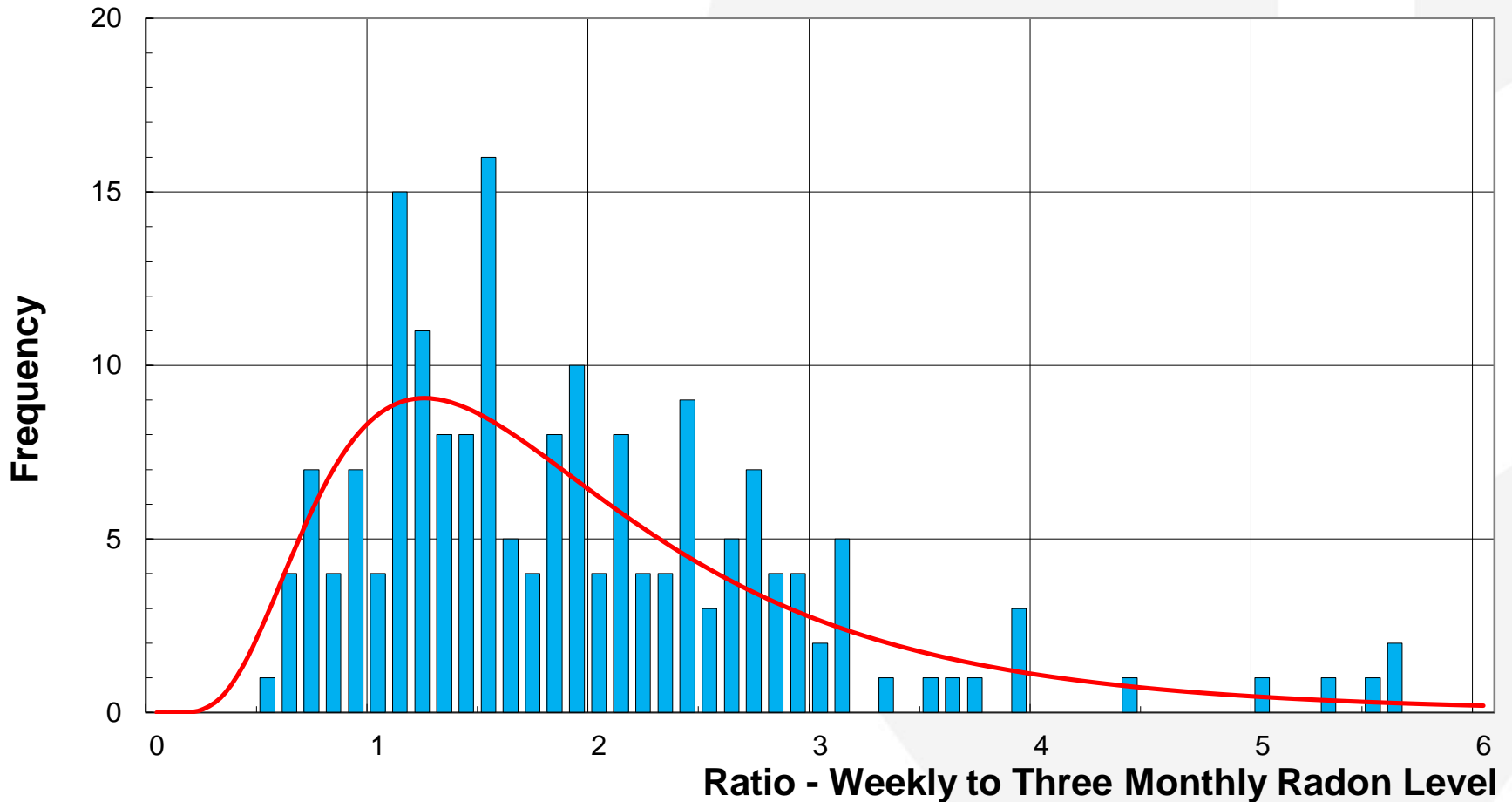
# Variation of Average Weekly Radon Levels in three houses







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

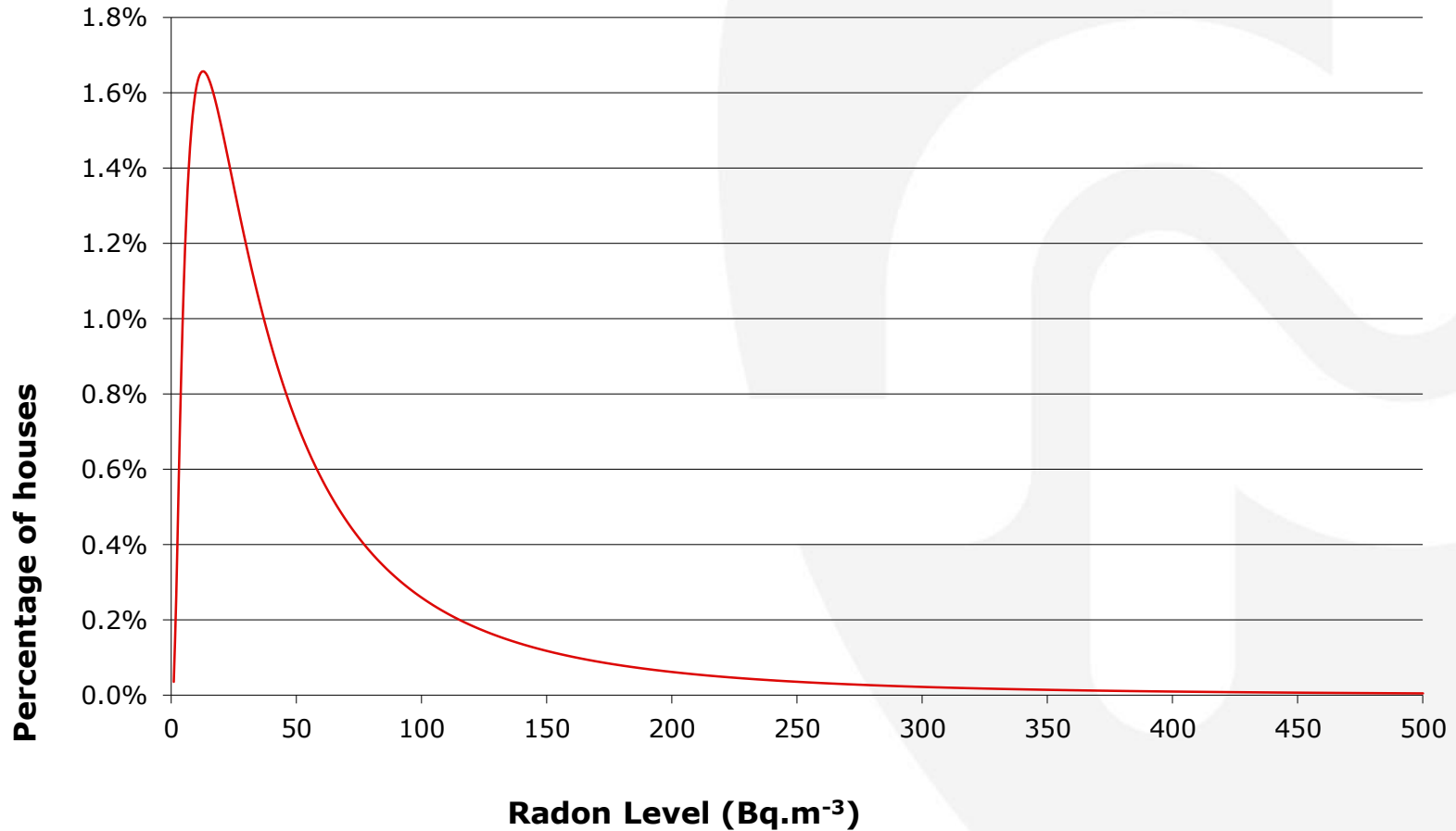


## 95% Confidence Levels that a measurement indicates an annual average radon level above or below the target or action level

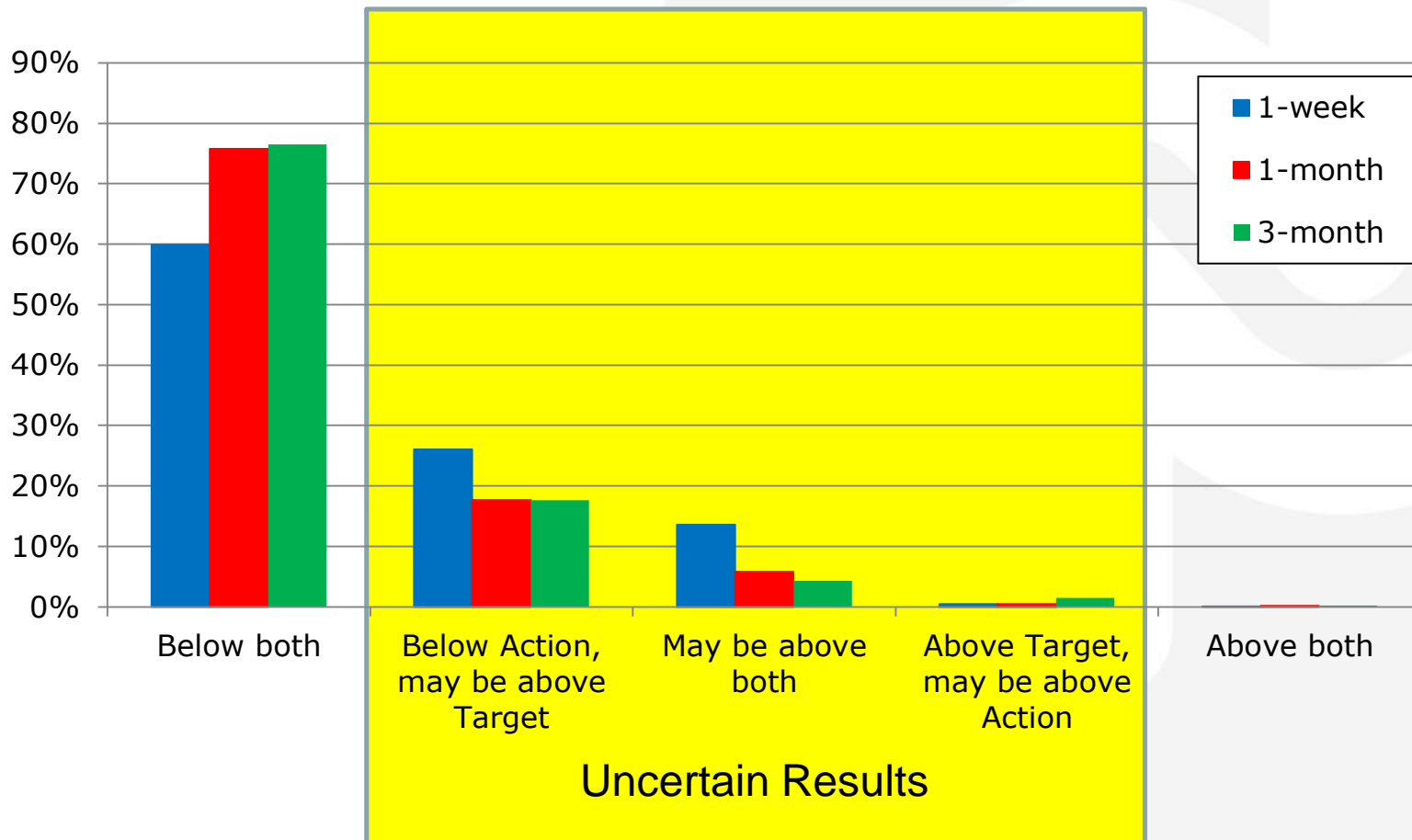
	1-week	3-months
Below Target Level (100 Bq.m <sup>-3</sup> )	38	56
Below Action Level (200 Bq.m <sup>-3</sup> )	75	130
Above Target Level (100 Bq.m <sup>-3</sup> )	333	180
Above Action Level (200 Bq.m <sup>-3</sup> )	518	360



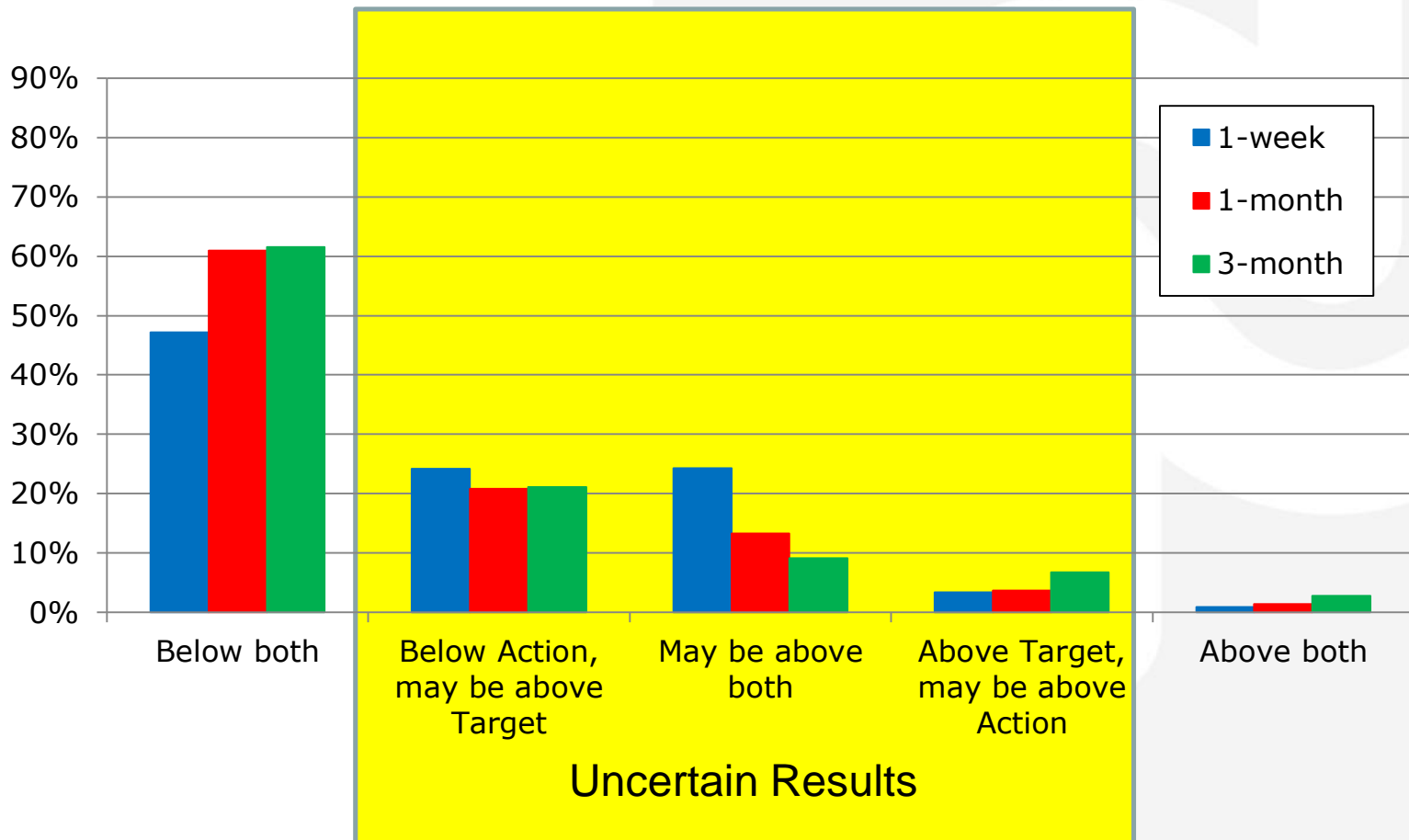
# Distribution of Radon Levels in a local group of houses



# Expected Distribution of Domestic Radon Measurements – Buckinghamshire – 1.2 %



# Expected Distribution of Domestic Radon Measurements – Northamptonshire – 7%



# Expected Distribution of Domestic Radon Measurements – Cornwall – 23.3%





## 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.