



# Dealing with radon daughter alarms

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with thanks to Steve Learwood and Vaughan Rees  
(RSRL)

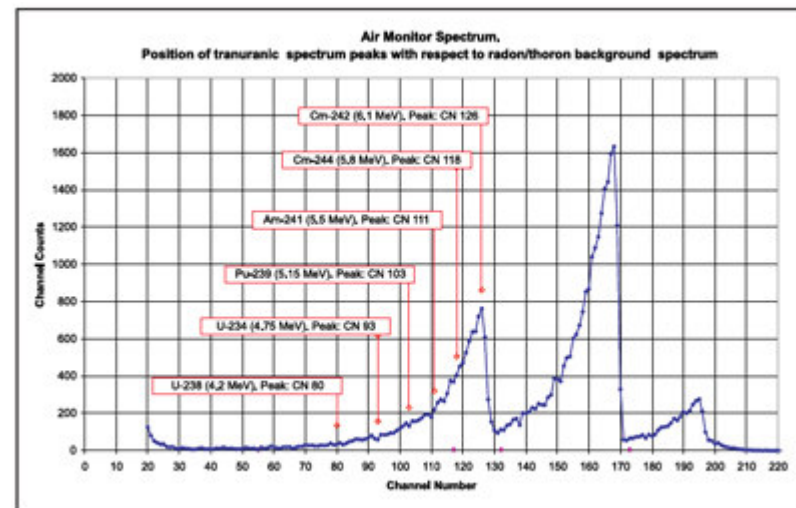
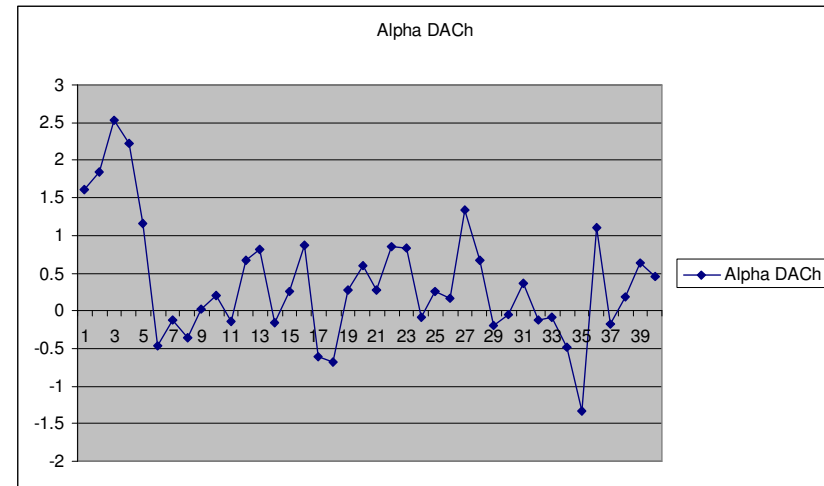
# Background

- **Harwell post-irradiation building**
- **Now in care and maintenance**
- **Regular alarms by an iCam monitor set to RSRL standard setting of 2.5 DACH**
- **Admittedly an ambitious value but generally achievable**



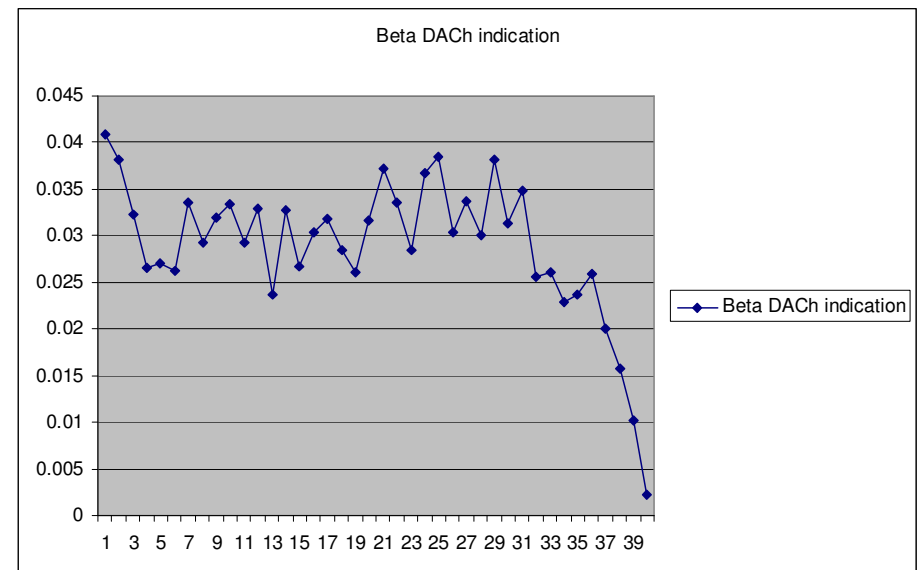
# What could we do about this?

- Alarms were being triggered by high radon levels
- There were similar negative offsets



# How about the beta channel?

- The beta range is much smaller
- Over 2300 readings, the maximum was 0.0665 DACH and the minimum was - 0.00017 DACH
- Feasible to set an alarm as low as 0.1 DACH



## Can we then ensure protection using the beta channel?

- **Consider the relative alarm levels in terms of activity**
- **2.5 DACH alpha =  $2.5 \times 0.26$  Bq Pu alpha = 0.65 Bq**
- **0.1 DACH beta =  $0.1 \times 108$  Bq energetic beta = 10.8 Bq**
- **So the proposed beta alarm is a factor of 16.6 times higher in terms of activity**

# Fold with the fingerprint

- **The building fingerprint is basically fission product biased**
- **Total alpha = 1.4 %**
- **Mid and high energy beta = 94.9 %**
- **Ratio = 68**

Nuclide	Emission	%
<b>Pu-238</b>	<b>Alpha</b>	<b>0.1</b>
<b>Pu-239</b>	<b>Alpha</b>	<b>0.2</b>
<b>Pu-240</b>	<b>Alpha</b>	<b>0.3</b>
<b>Cm-244</b>	<b>Alpha</b>	<b>0.3</b>
<b>Am-241</b>	<b>Alpha</b>	<b>0.5</b>
<b>Pu-241</b>	<b>Undetectable beta</b>	<b>1.8</b>
<b>Sr-90+</b>	<b>High E beta</b>	<b>13.3</b>
<b>Ni-63</b>	<b>Undetectable beta</b>	<b>1.6</b>
<b>Cs-137</b>	<b>Mid E beta</b>	<b>81.6</b>
<b>Co-60</b>	<b>Soft beta</b>	<b>0.4</b>

## Effective alpha alarm level

- **Ratio of energetic beta to alpha activity = 68**
- **Beta alarm level = 10.8 energetic beta Bq**
- **Alpha level corresponding to this =  $10.8/68$  Bq = 0.16 Bq**
- **Converted to DACh = 0.6**
- **A quarter of the previous alarm level**

## Actions following

- **The beta alarm level was actually set to 0.2 DACH to further reduce the chance of false alarms**
- **This gives an effective alpha alarm level of 1.2 DACH**
- **Total dosimetric exposure at alarm is then 1.4 DACH**
- **Alpha alarm level set at 8 DACH**

## Limitations of this approach

- **It all relies very heavily on the fingerprint**
- **No history of alpha only work in this building could be found**
- **Not a valid approach where there could be the possibility of releasing activity with a significantly higher alpha to beta ratio**
- **But still the backstop of the higher alpha alarm**
- **An iCam with a non-standard setting**

# Benefits

- **Fewer (or no?) radon induced false alarms**
- **No negative offsets effectively increasing the set alarm level**
- **A better overall standard of protection**