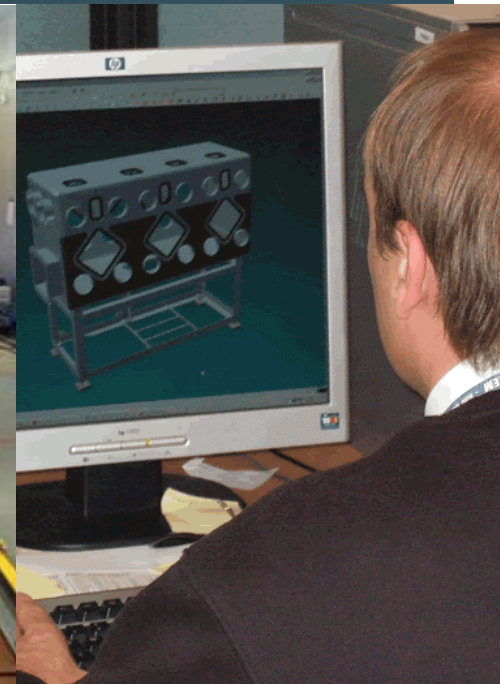


Variability in Ludlum 43-93 dual phosphor contamination probes

Sinclair Tait



Background

- 3 years ago UKAEA started to buy Ludlum 43-93 dual phosphor contamination probes
- NUKEM are responsible for testing and maintaining these probes, which are connected to Thermo Electra ratemeters
- Original setting up procedure devised by Pete Burgess and Reg Bosley

Traditional setting up procedure, DP6 probes

- Two ways
- The dip method – an alpha source, the beta function, increase HT.
- Initially alphas appear in the beta channel
- HT increases, alphas move into alpha channel, count rate drops
- Increase further, background and after pulses increase, count rate rises

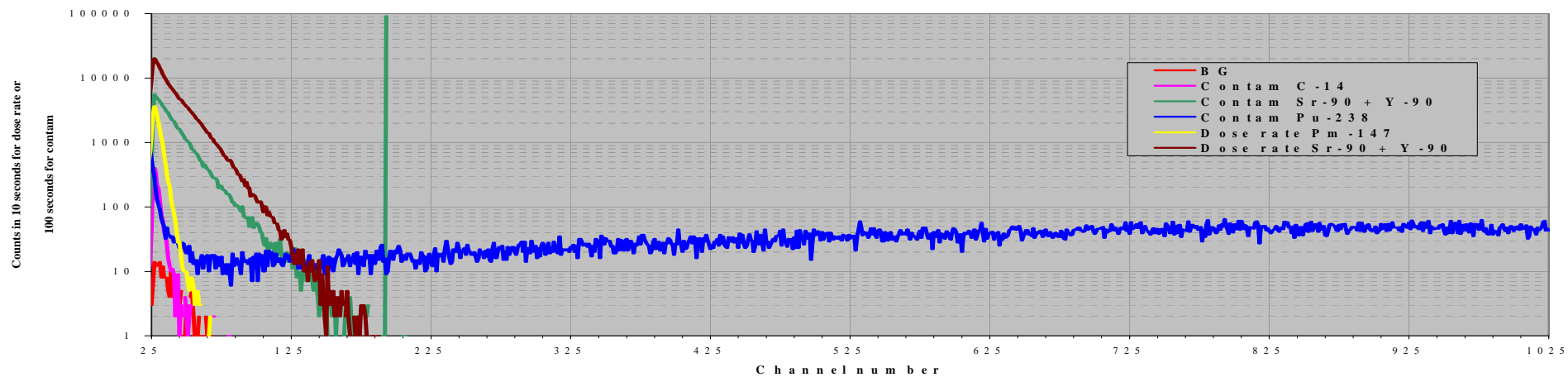
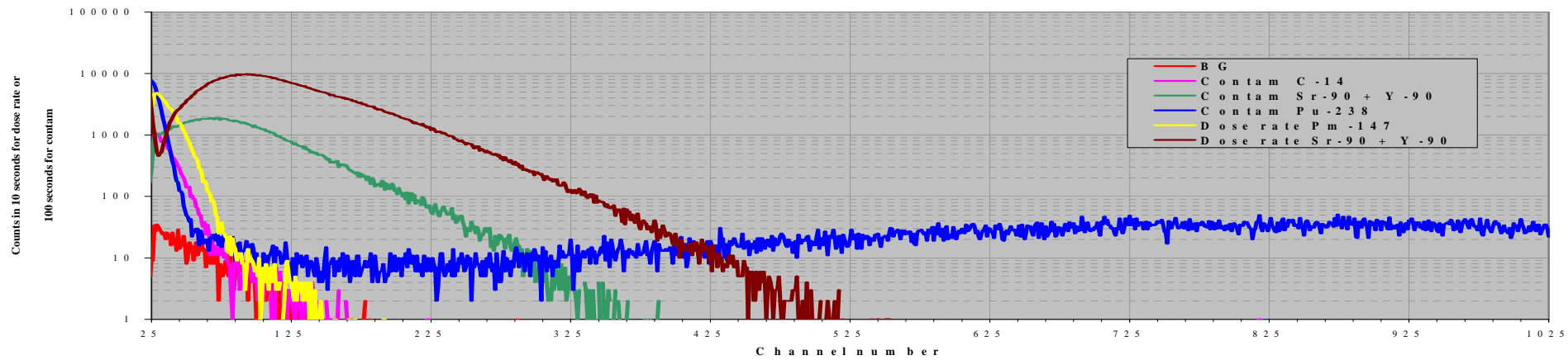
Beta breakthrough

- Alpha channel, Sr-90 + Y-90 source
- Increase HT until counts just appear in the alpha channel
- Back off slightly

43-93 probes

- Beta phosphor is very thin
- Therefore low energy deposition for Y-90 beta particles close to normal incidence
- So we couldn't get the Sr-90 + Y-90 response onto its plateau with the traditional 15:1 alpha/beta threshold ratio.
- And we knew there were genuine beta pulses not being counted.

DP6 and 43-93 MCA results (DP6 top)



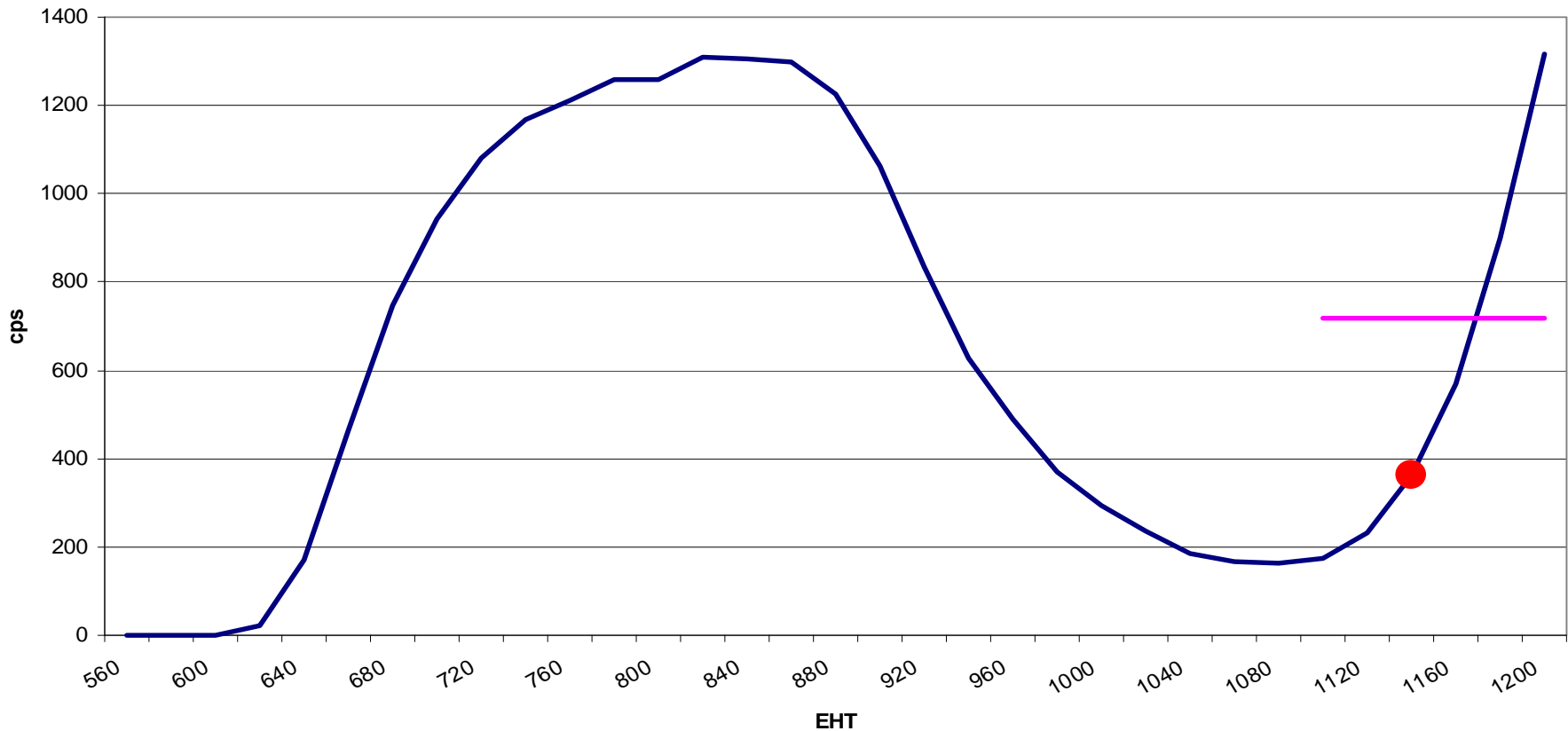
Subsequent changes for the 43-93

- Alpha threshold set to 2.25 V instead of 1.5 V
- Improves Co-60 response and consistency
- Gets Y-90 onto a plateau
- Set HT using C-14 to 3 % 2 pi efficiency
- Am-241 beta channel response < 20%
- Gave good alpha/beta separation
- Worked well for the first batch

Example

DIP GRAPH EARLY PROBE C-14 RESPONSE WAS 2.9%

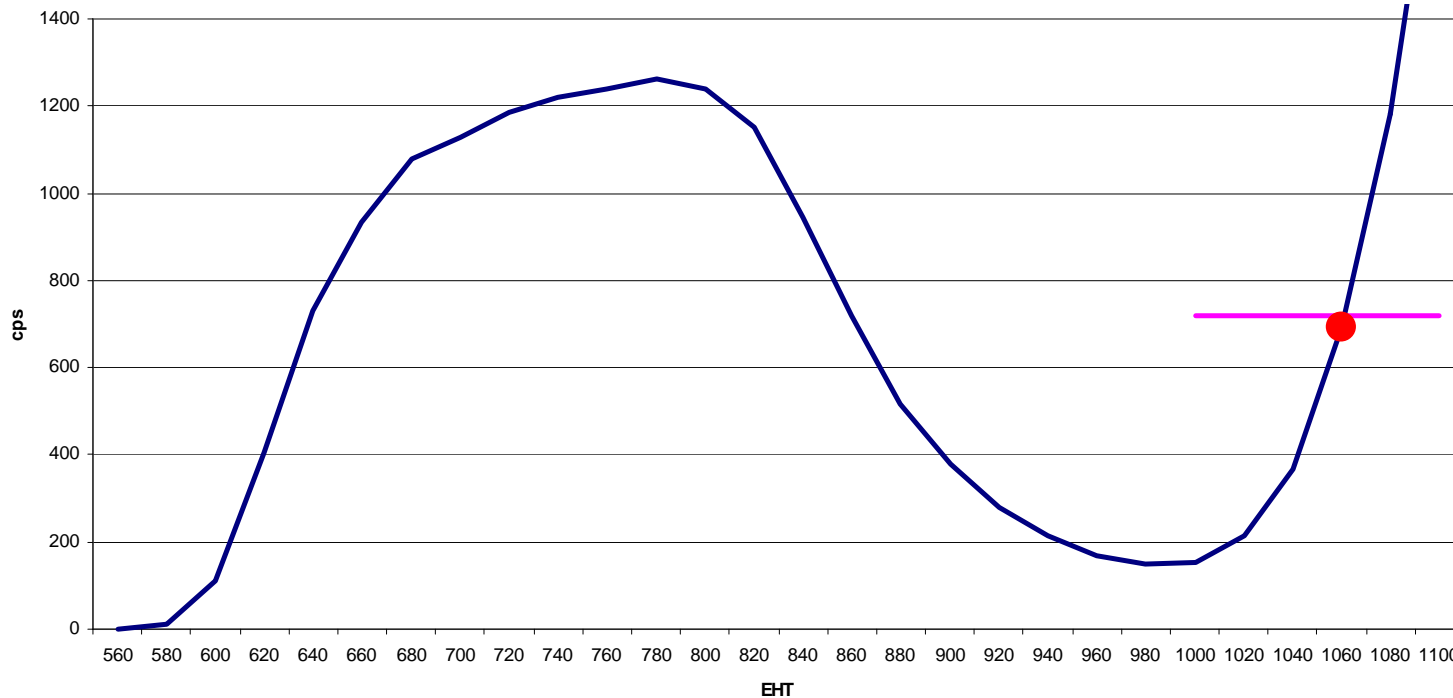
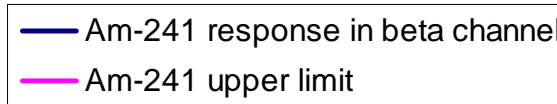
— Am-241 response in beta channel
— Am-241 upper limit



Later examples

- Can't achieve a 3 % response for C-14 and <20 % for Am-241 on the beta channel

**DIP GRAPH LATER PROBE
C-14 RESPONSE WAS 1.8%**



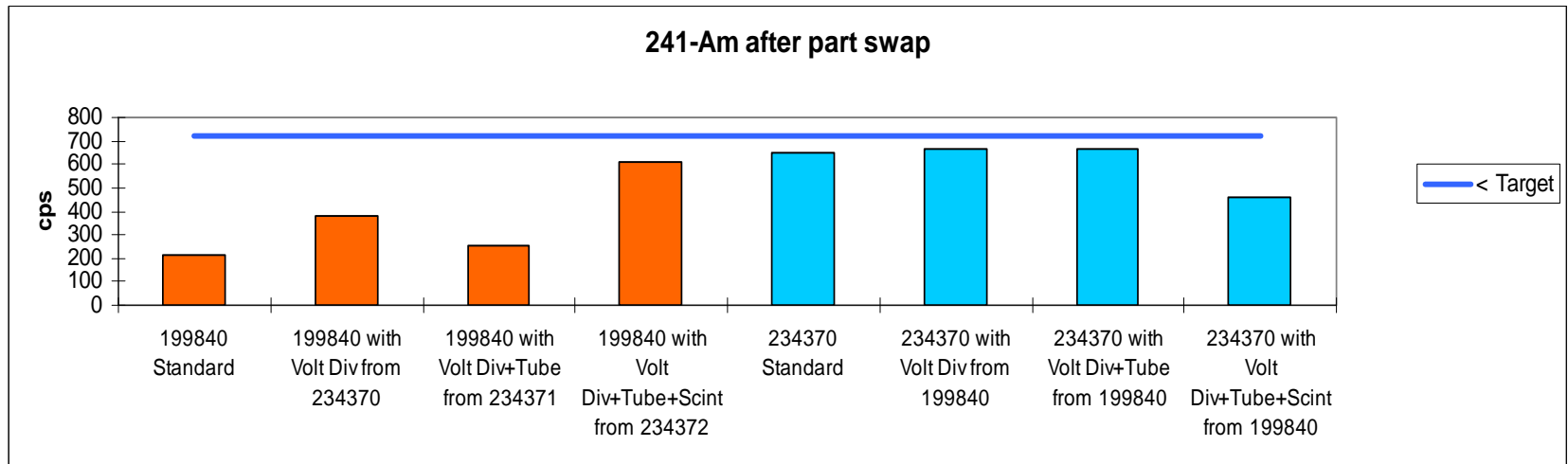
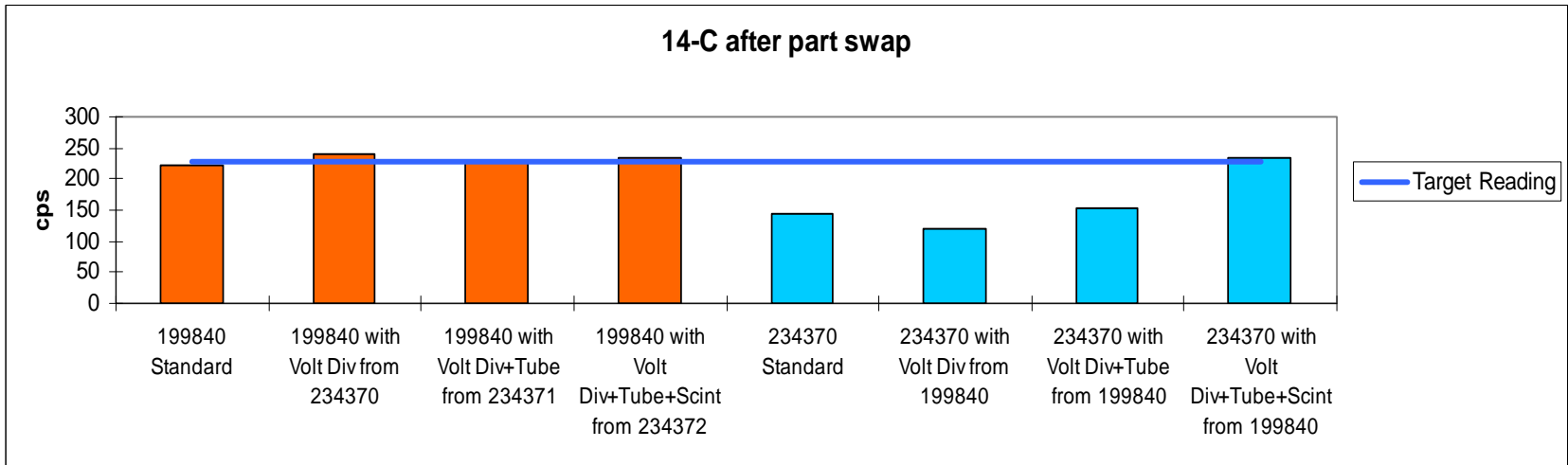
Significance

- This issue has stopped us introducing these newer probes into service as they do not meet our setup procedure.
- They are still very good probes
- But we need to understand why the newer probes are different from the older ones

Investigation

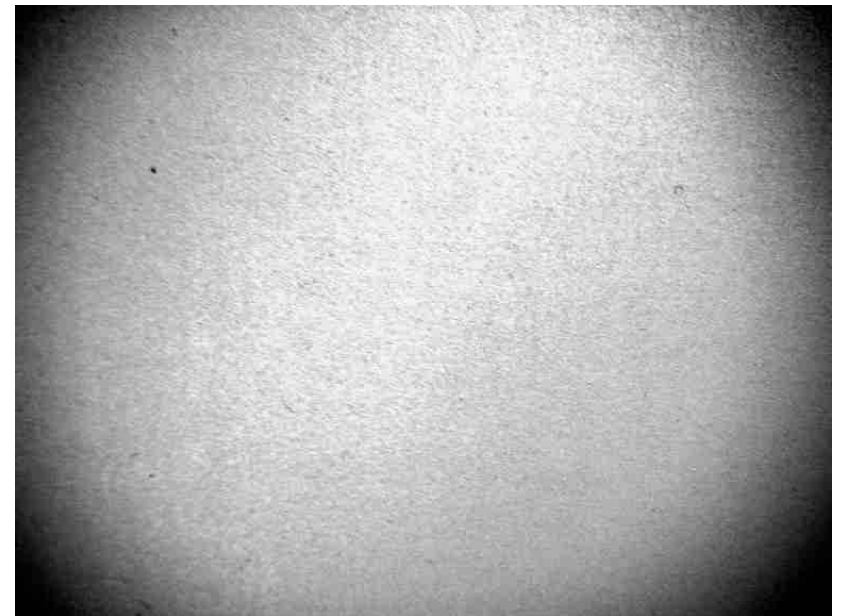
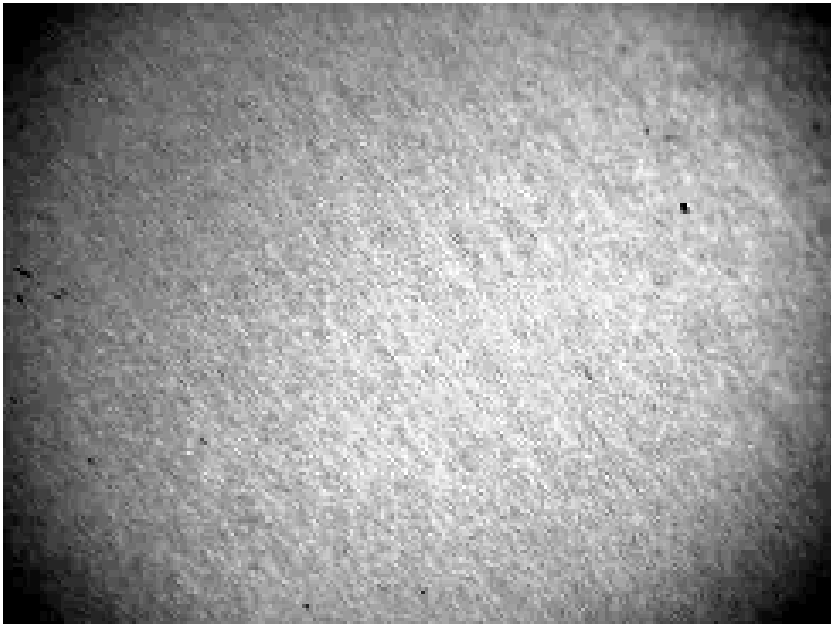
- Swap components between one “good” probe and one “bad” probe.
- Voltage divider, PM tube and scintillator.
- All make a difference but the scintillator dominates.

Example component swap



Visible differences?

- Original scintillator (left) looks more textured than the later ones (right)
- Brush rather than spray?



What now?

- Bill Snooks passed the information onto Ludlum.
- Ludlum are looking into it.
- UKAEA and NUKEM will revise the setting up process if the change in characteristics is permanent.
- Reference surface contamination responses will be reviewed.