

Soft-waste Drum Comparison and Workshop

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Outline

- **Source preparation**
- **Conduct of exercise**
- **Methods and results**
- **Post-exercise workshop outcomes**

Objective

- **Standardised drum containing:**
 - ^{241}Am , ^{137}Cs and ^{60}Co
 - total activity concentration $< 0.4 \text{ Bq g}^{-1}$
 - density nominally 300 kg m^{-3}
- Spec determined at NPL 2005 workshop
- Would achieve target density using partially-filled bottles of ion-exchange resin

Preparation of drum

1. Dried resin and loaded into 240 x 500 ml plastic bottles (190 g per bottle)
2. Prepared mixed radionuclide standard solution (approx. 780 Bq g⁻¹):
 - Secondary standard ion chamber for assay
 - NaI(Tl) and Ge detectors for dilution checks



Preparation of drum

3. Added ~0.1 g standard solution to each bottle
4. Resin surface allowed to dry, bottles sealed and contents homogenised, then loaded into 205 L drum



Conduct of exercise

- **Approx. 440 contacts contacted in September 2006**
- **Identified 18 participants from 16 UK sites**
- **Moved drum 'site-to-site' March to August 2007**
- **Reporting form, drum and contents details provided**
- **September - Draft report and workshop**
- **Supporting info and extra data**
- **Final report issued in November (NPL Report IR 2)**

Methods

- **13 participants used HPGe γ -spectrometers**
- **2 used NaI(Tl)-based systems**
- **2 used plastic scintillator detectors**

- **Most participants rotated drum and used shielded/collimated detectors**
 - **6 used segmented scans**
 - **Counting times varied from 15 mins. to 2.7 days**

Calibrations

- **Several different efficiency modelling methods / calibration standards used**
 - **AI, Analytics, ‘traceable sources’**
 - **MCNP, ISOCS, NDA 2000, SNAP, ISOTOPIC**

Analysis of results

Participant's result: $L \pm u_L$

NPL value: $N \pm u_N$

Zeta test: Result passes if zeta $\leq \pm 2.58$

R_L outlier test: Result passes if not an outlier

Z-test: Result passes if $z \leq \pm 2.58$

n.b. R_{med} = median of participants' relative uncertainties

$$\zeta = \frac{L - N}{\sqrt{u_L^2 + u_N^2}}$$

$$R_L = \frac{u_L}{L}$$

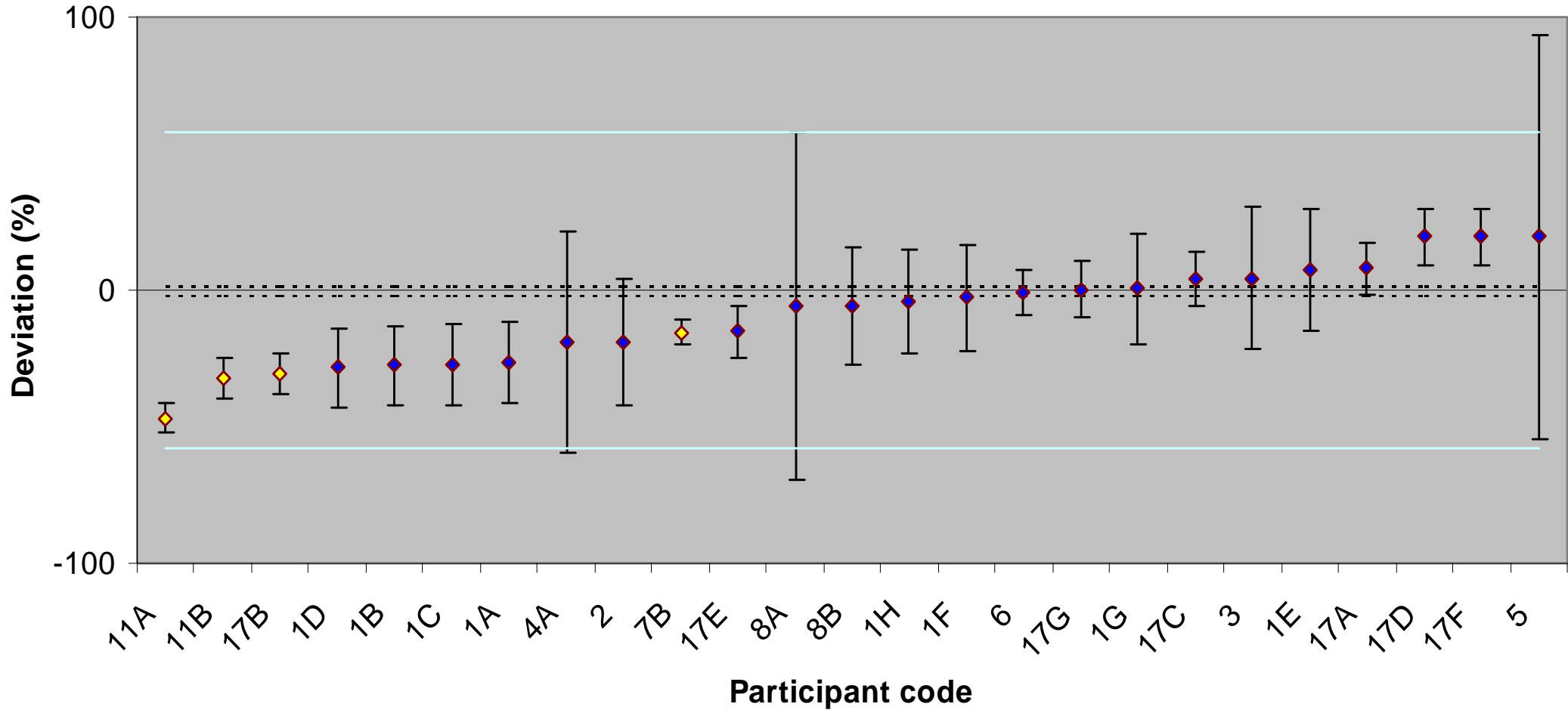
$$z = \frac{L - N}{R_{\text{med}} N}$$

Interpretation

Zeta test	R_L test	Z-test	Conclusion
Pass	Pass	Pass	In agreement
Pass	Fail	Pass	Questionable (a)
Fail	Pass/Fail	Pass	Questionable (b)
Pass	Pass/Fail	Fail	Questionable (c)
Fail	Pass/Fail	Fail	Discrepant

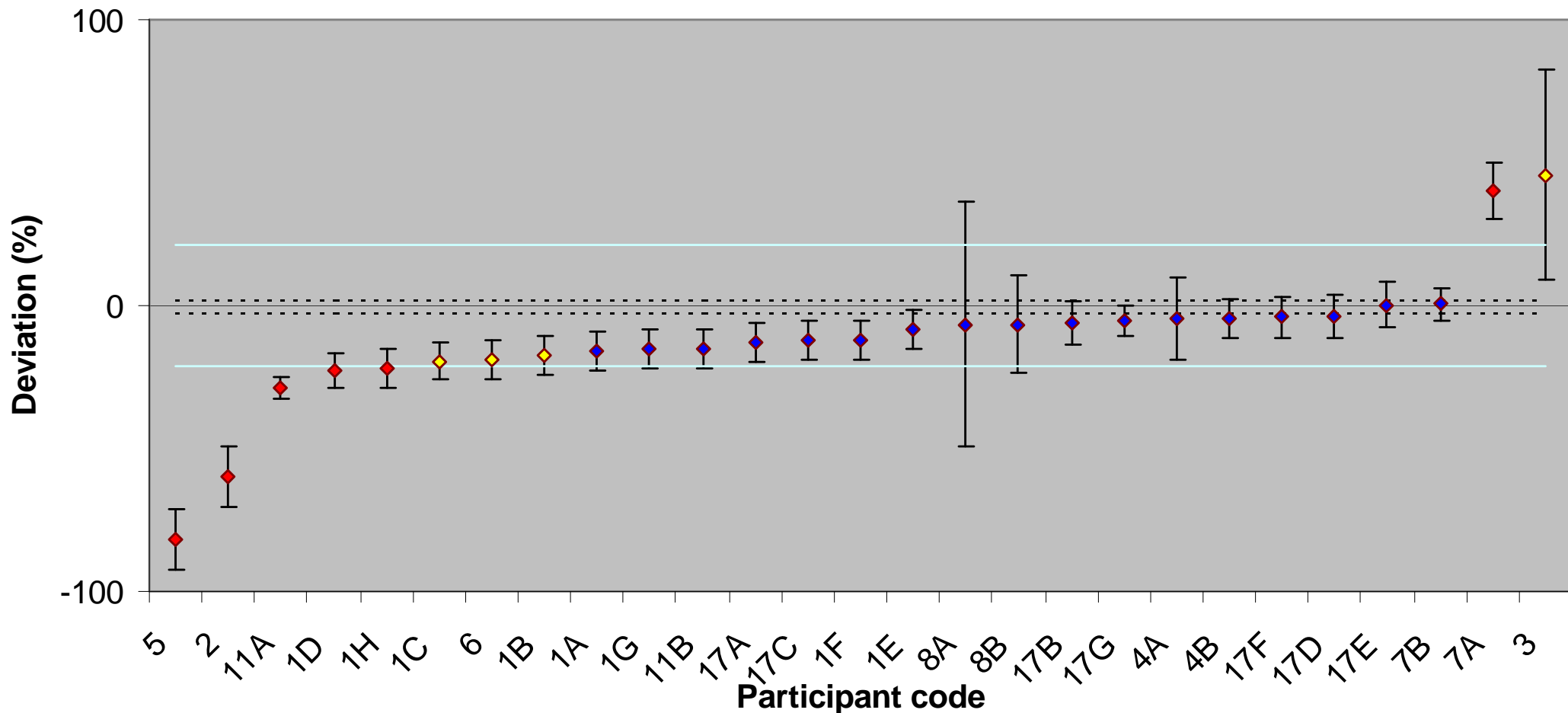
Deviation plot for ^{241}Am results

(Participants 4(B) and 7(A) outside limits of plot)



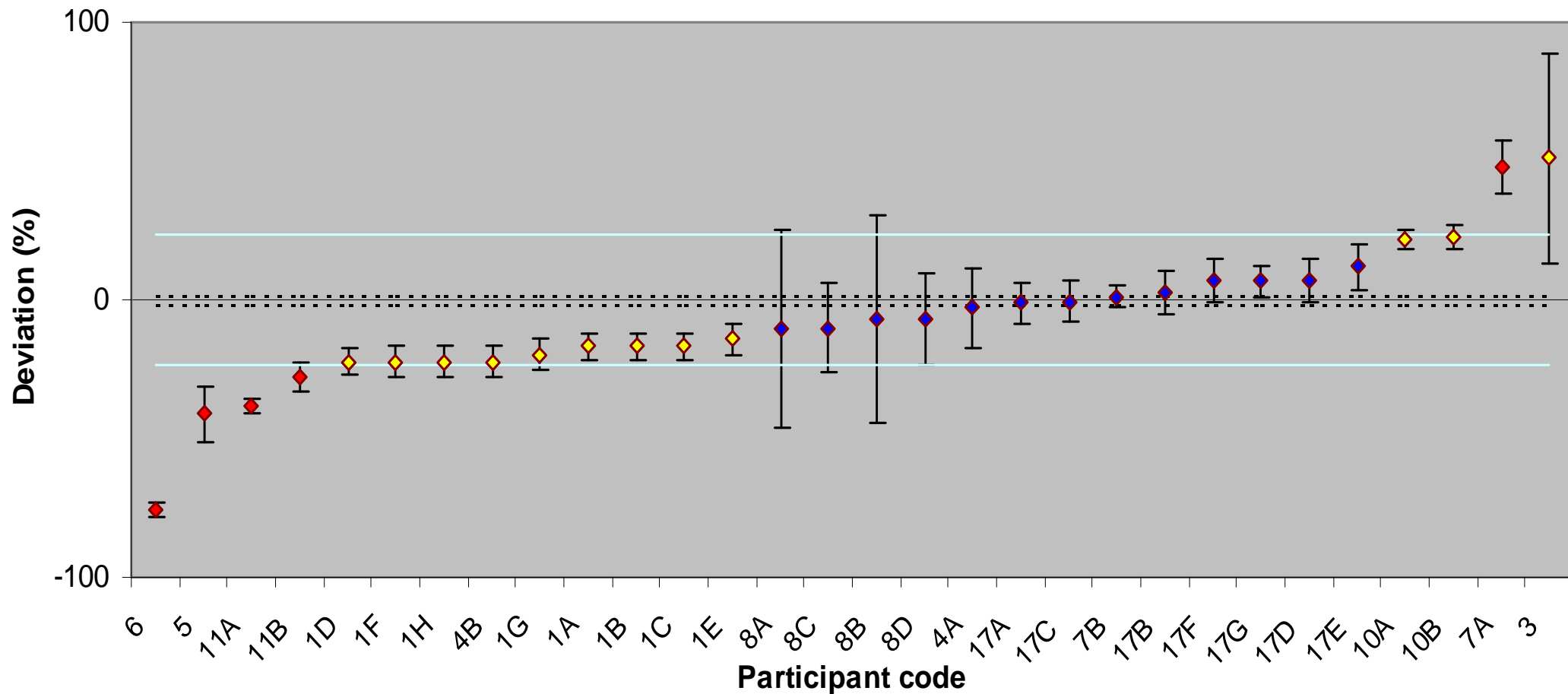
Deviation plot for ^{137}Cs results

(Participants 10(A) and 10(B) outside limits of plot)



Deviation plot for ^{60}Co results

(Participants 13 and 15 outside limits of plot)



Other reported results

Participant code	^{241}Am (Bq g ⁻¹)	^{137}Cs (Bq g ⁻¹)	^{60}Co (Bq g ⁻¹)
2	-	-	<0.01674
9	<0.004	<0.07	<0.06
12	<0.002997	<0.07118	<0.05529
14	-	<0.102	<0.227
16	Total activity = (0.081 ± 0.003) Bq g ⁻¹ (k=1)		

Workshop outcomes

- **No apparent concern over discrepant / questionable data**
- **Participants - submit further info / data**
- **ISOCS users - compare models**
- **NPL**
 - **consider revising GPG 34 for uncertainties**
 - **consider setting up MC modelling user forum**
 - **should run second comparison, with ‘hot-spot’**

Summary

- **Drum measured by 18 UK groups**
- **58% of total data set 'in agreement' with NPL**
- **15% of data discrepant or questionable for no clear reason**
- **^{137}Cs and ^{60}Co – low activities and layering of drum caused problems**
- **Differences between ISOCS users**
- **A range of quoted uncertainties**
- **Interest in an MC forum**
- **Second comparison requested – likely to be run in 2008**

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- **Lynsey Keightley (source preparation)**
- **Simon Jerome and Chris Gilligan (workshop)**