Update on IAEA proficiency test exercises

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International Atomic Energy Agency

2014 IAEA proficiency test exercise (introduction)

2014 IAEA proficiency test exercise organised in cooperation with Nuclear Regulation Authority (Japan)

30 participants including 6 from HELCOM contracting parties (Denmark, Estonia, Germany (2), Poland and Sweden)

12 participants from Japan

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2014 IAEA proficiency test exercise (samples)

Samples supplied containing 5 L of Mediterranean sea water spiked with known amounts of H-3, Sr-90, Cs-134 and Cs-137

Suggested analytical method

H-3: Distillation and liquid scintillation counting

Sr-90: Ca/Sr precipitation followed by extraction and/or chromatography and LSC or GF-proportional counting

Cs-134 and Cs-137:

- Either direct gamma spectrometry (GS) or
- adsorption on $(NH_4)_3PO_4Mo_{12}O_{36}$ or $Cu_2[Fe(CN)_6]$ and GS

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2014 IAEA proficiency test exercise (assigned values)

Individual unique sea water samples prepared separately.
Traceable massic activities (Bq kg^{-1}) in samples:

H-3 between (2.78 ± 0.12) and (2.83 ± 0.12)

Sr-90 between (0.3453 ± 0.0042) and (0.3515 ± 0.0042)

Cs-134 between (0.1154 ± 0.0010) and (0.1175 ± 0.0010)

Cs-137 between (0.3064 ± 0.0038) and (0.3118 ± 0.0038)

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Evaluation of results (Test I)

$$Relative\ bias = \frac{Value_{Analyst} - Value_{IAEA}}{Value_{IAEA}} \times 100\%$$

^{3}H and ^{90}Sr

If absolute value of relative bias $< 25\%$: "Pass"

otherwise: "Fail"

^{134}Cs and ^{137}Cs

If absolute value of relative bias $< 20\%$: "Pass"

otherwise: "Fail"

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Evaluation of results (two additional Tests II and III)

$$A_1 \leq A_2$$

where:

$$A_1 = \left|Value_{IAEA} - Value_{Analyst}\right|$$

$$A_2 = 2.58 \times \sqrt{unc_{IAEA}^2 + unc_{Analyst}^2}$$

$P < 25\%$ (for ^{3}H and ^{90}Sr) or **$P < 20\%$ (^{134}Cs and ^{137}Cs)**
where:

$$P = \sqrt{\left(\frac{unc_{IAEA}}{Value_{IAEA}}\right)^2 + \left(\frac{unc_{Analyst}}{Value_{Analyst}}\right)^2} \times 100\%$$

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Evaluation

Test I. Relative bias test:	**Pass or Fail**
Test II. Zeta score	Pass or Fail
Test III. Precision test	Pass or Fail

Test I	Test II	Test III	Final evaluation
Pass	Pass	Pass	Accepted
Pass	Fail	Pass	Warning
Pass	Pass	Fail	Warning
Fail	Pass/Fail	Pass/Fail	Not Accepted

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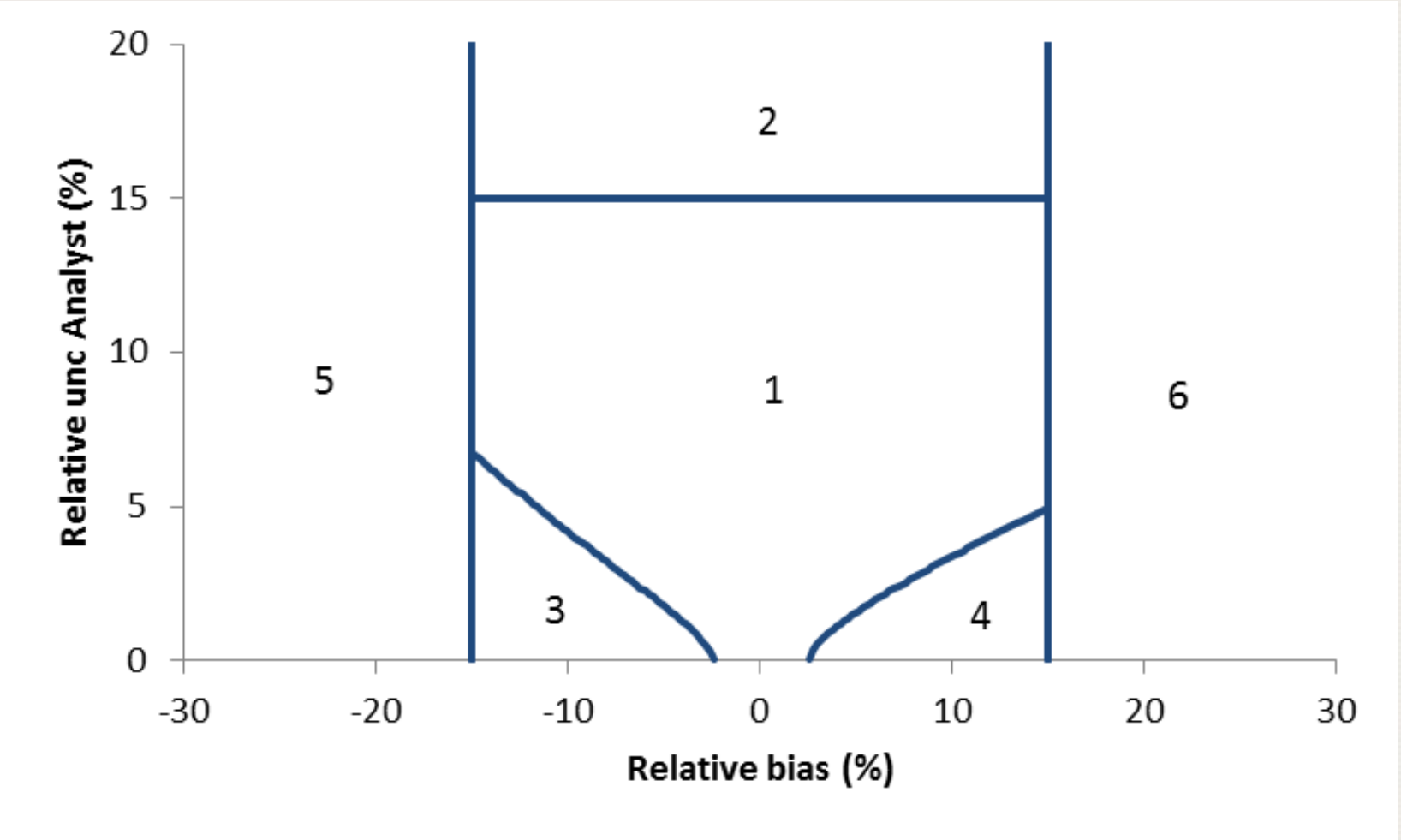
Evaluation



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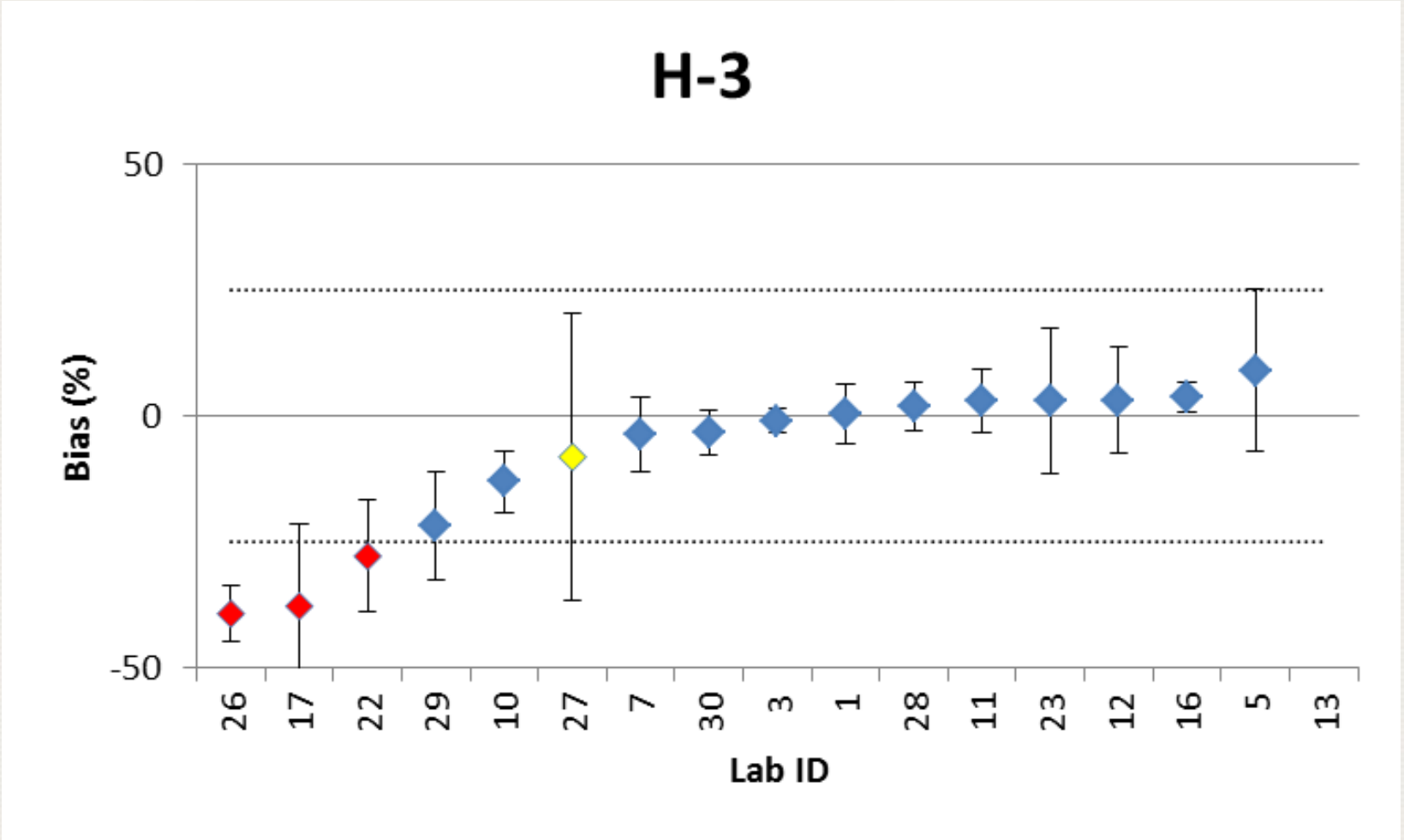
H-3 (all participants)



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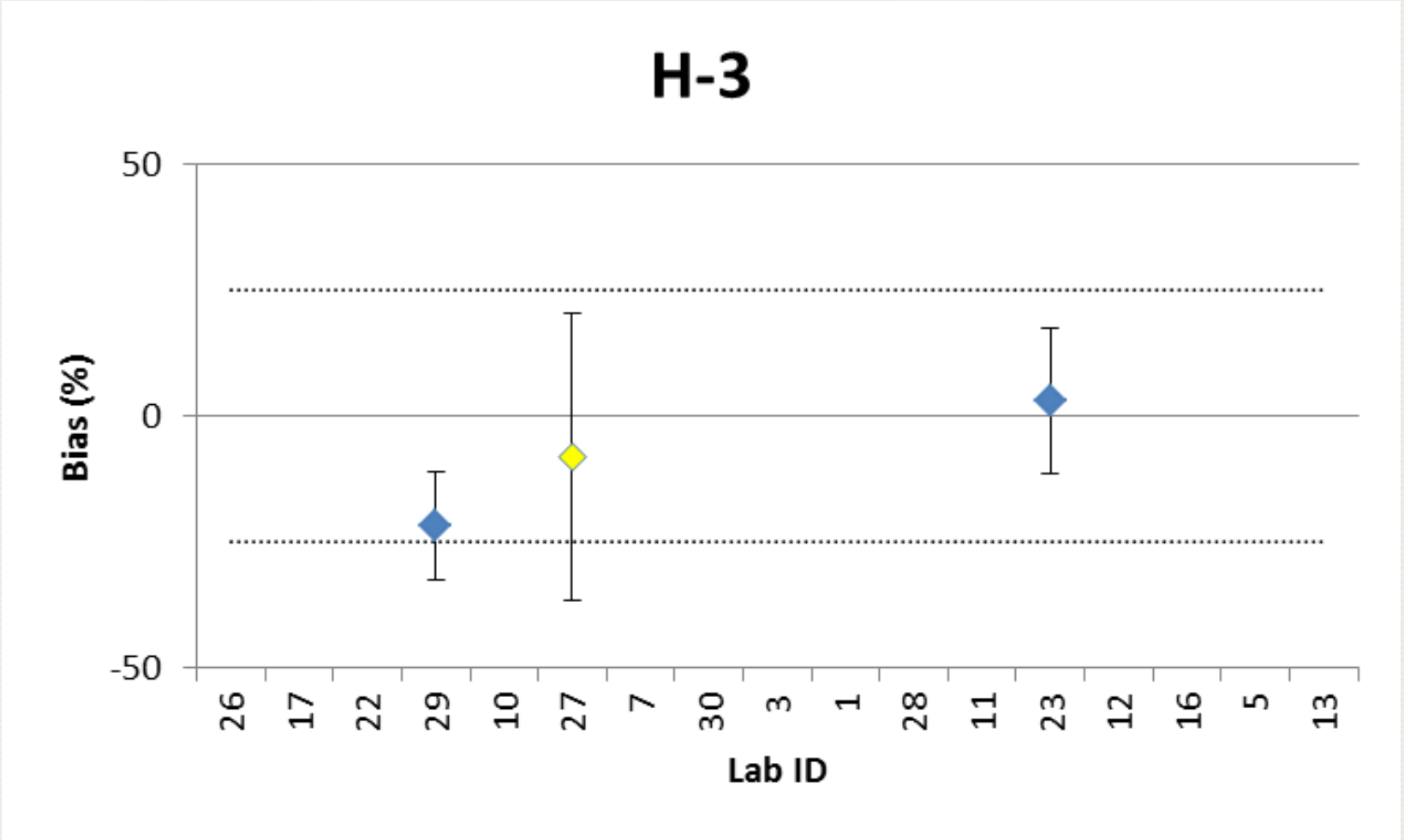
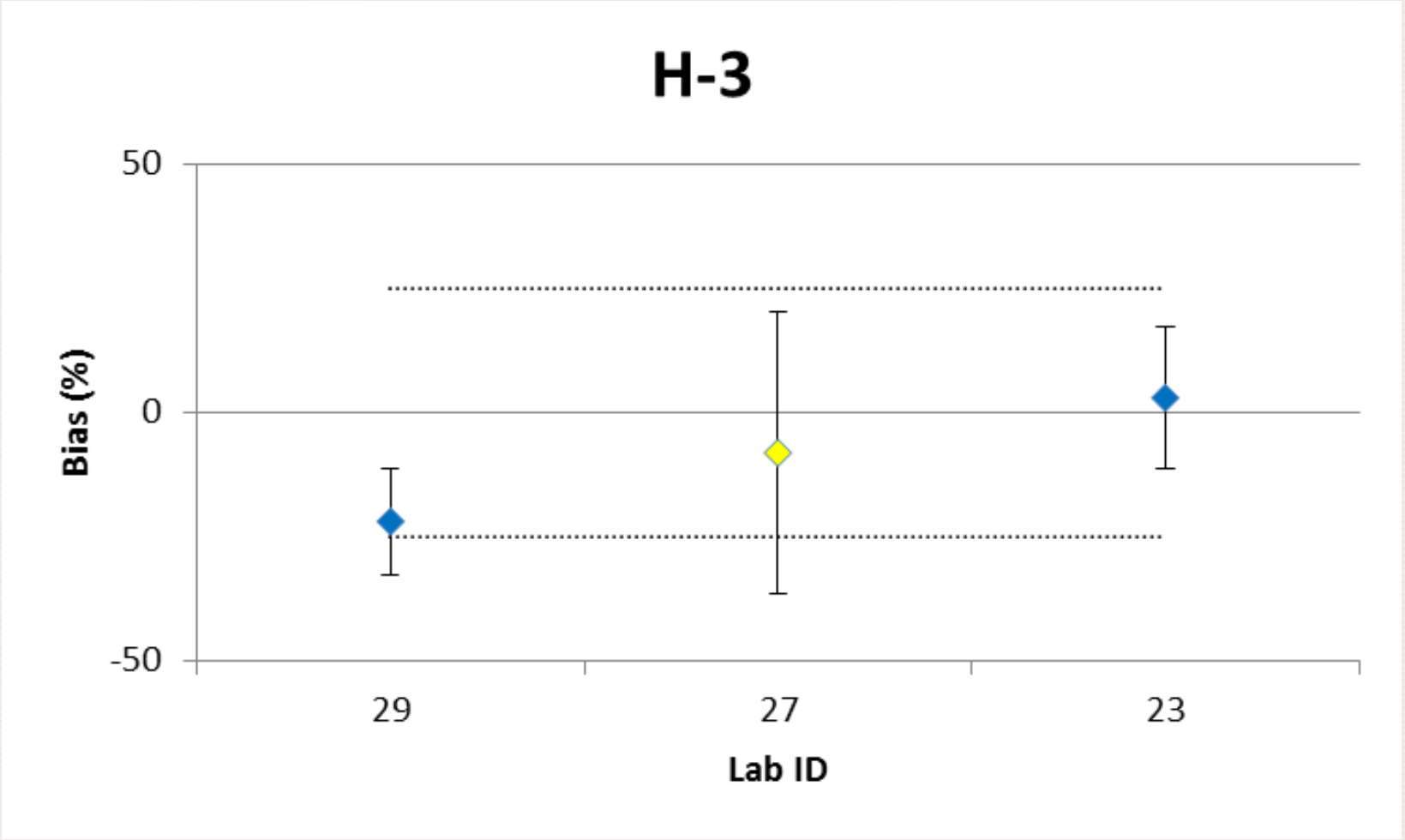
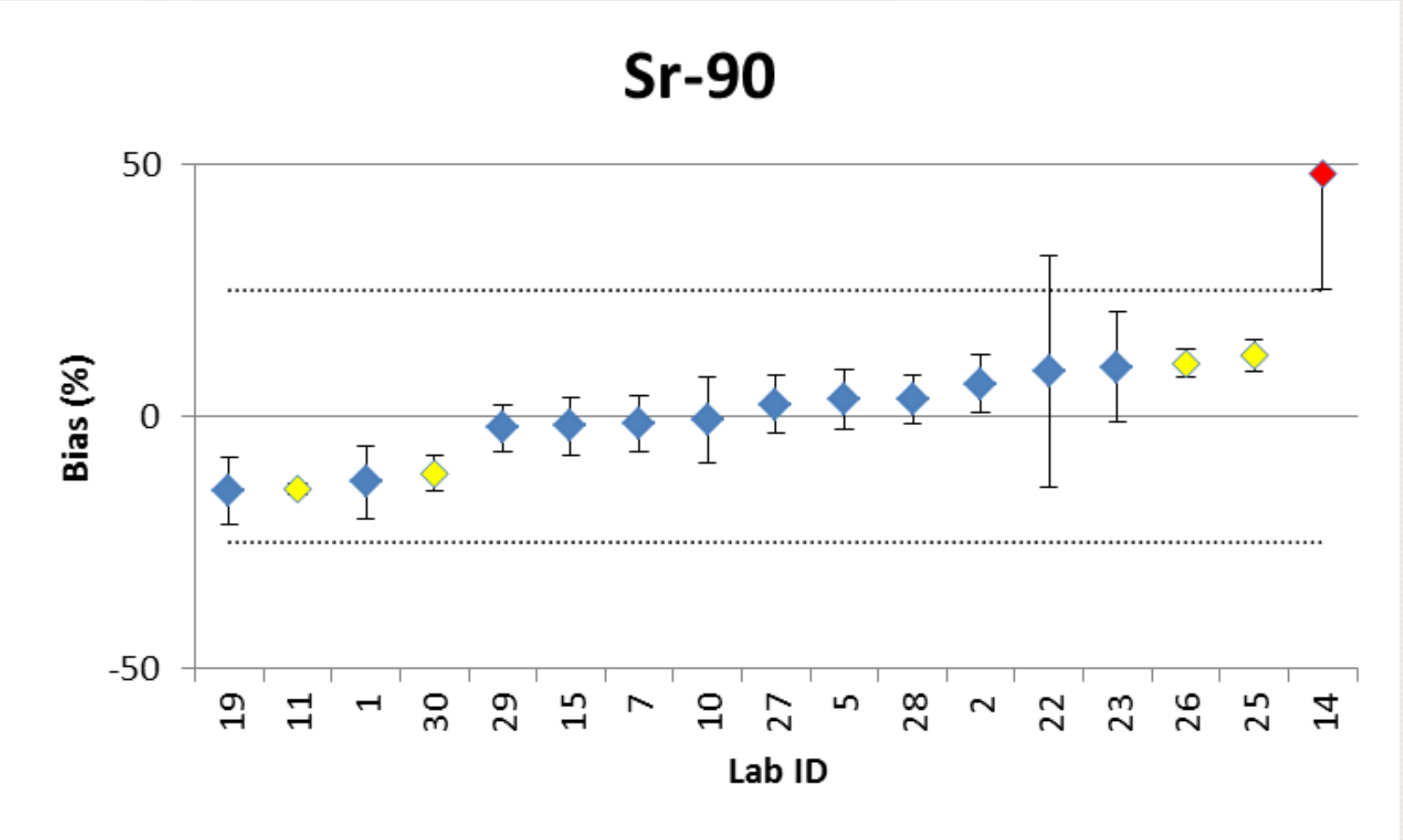
H-3 (HELCOM)



H-3 (HELCOM)



Sr-90 (all participants)



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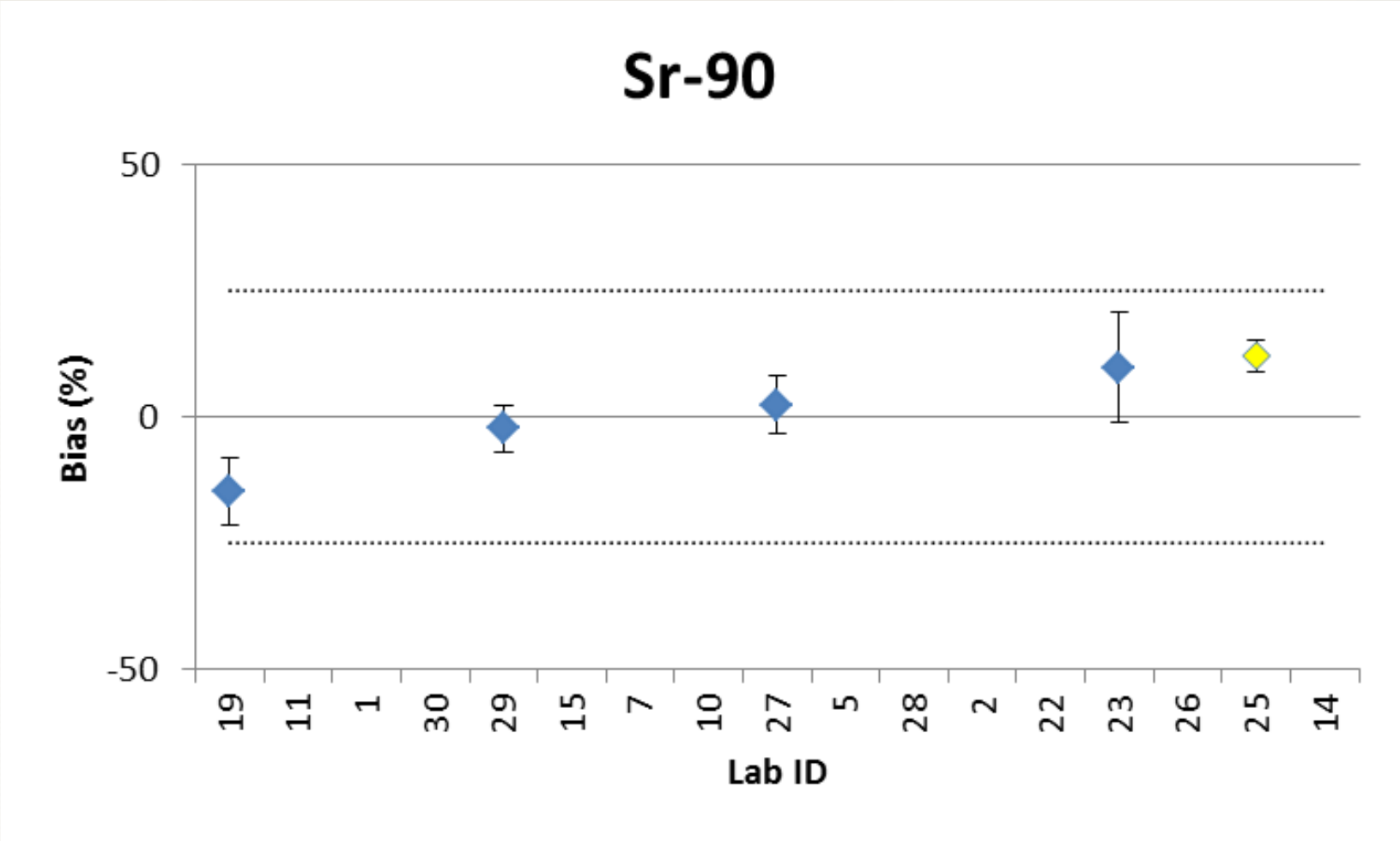
Sr-90 (HELCOM)



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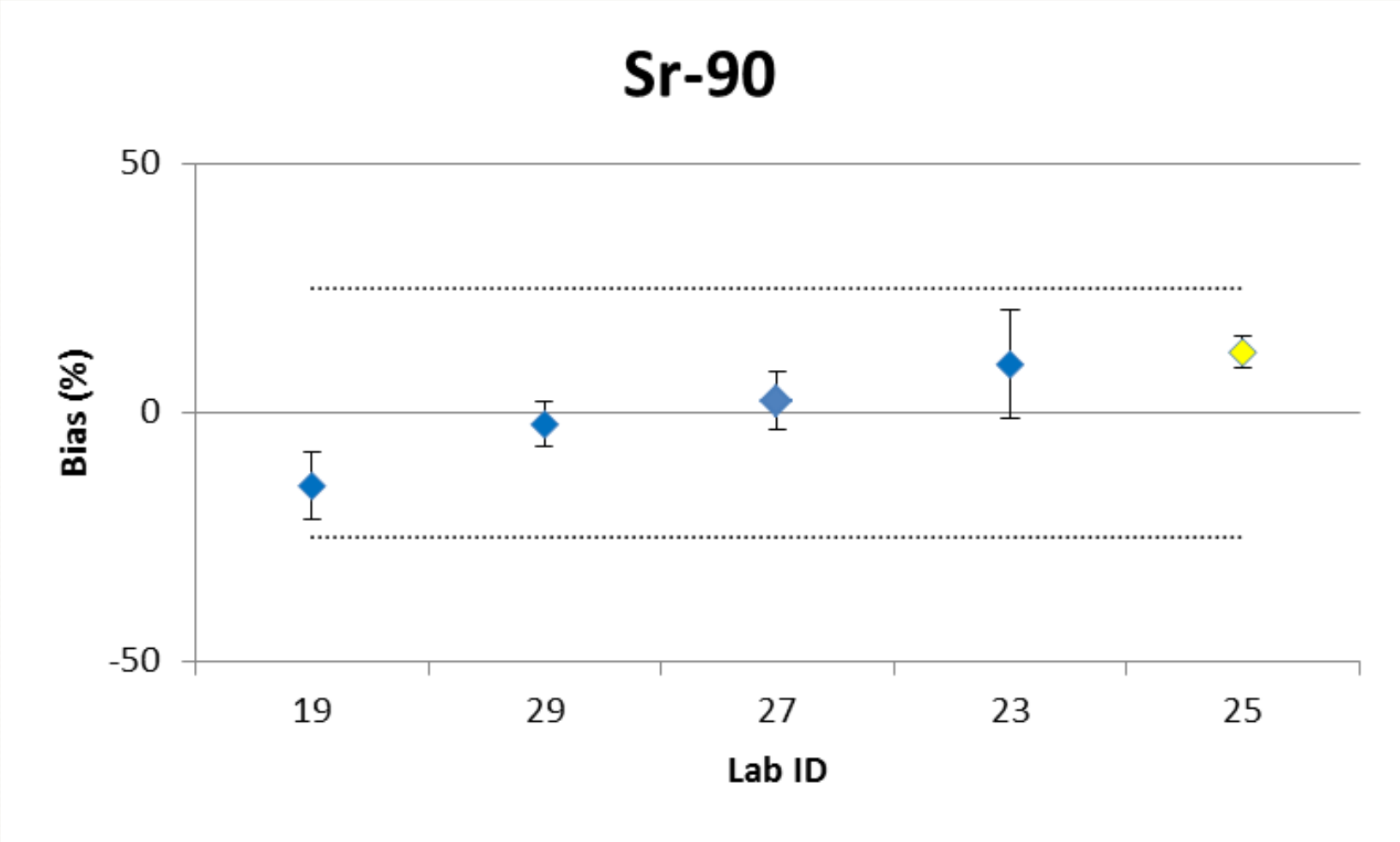
Sr-90 (HELCOM)



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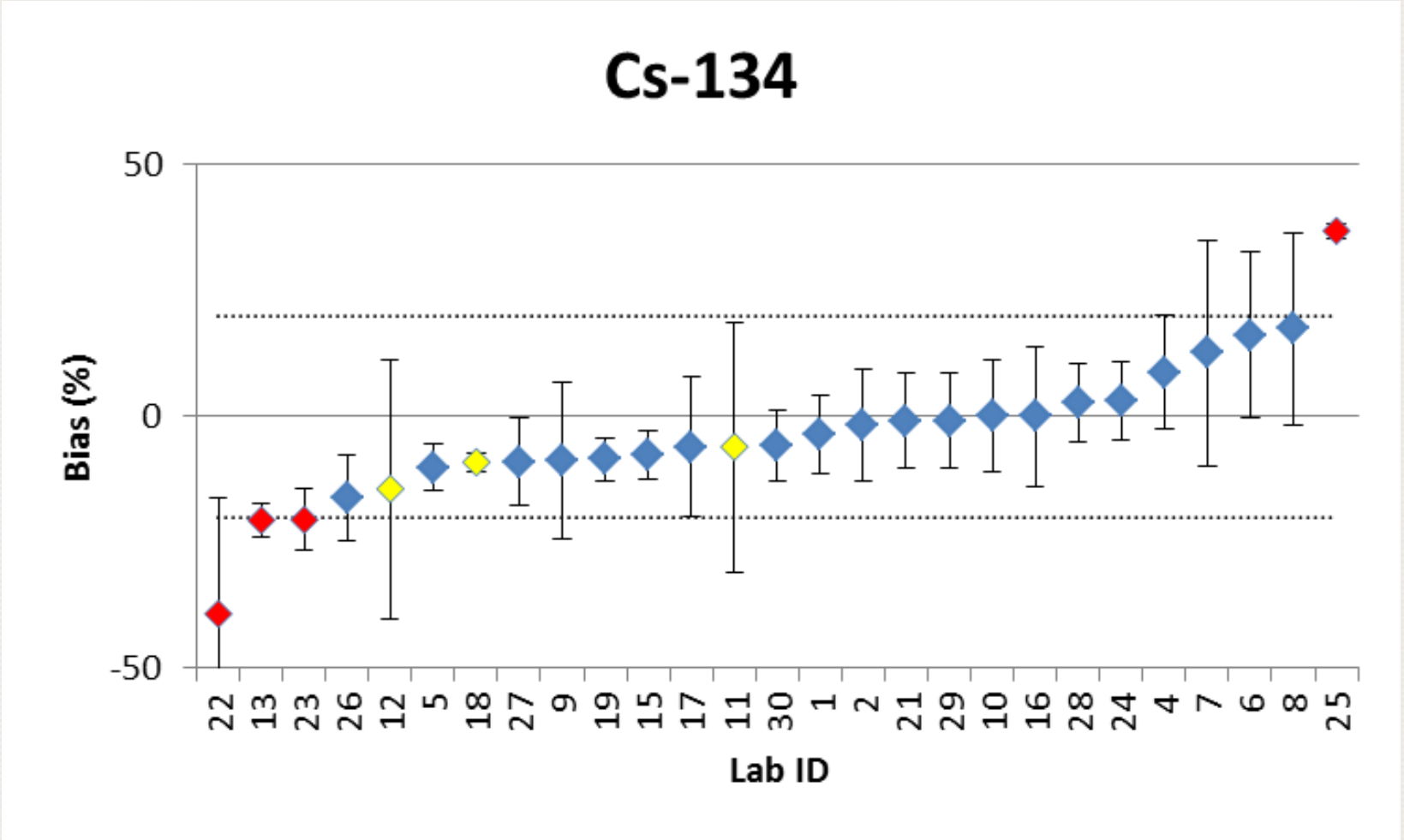
Cs-134 (all participants)



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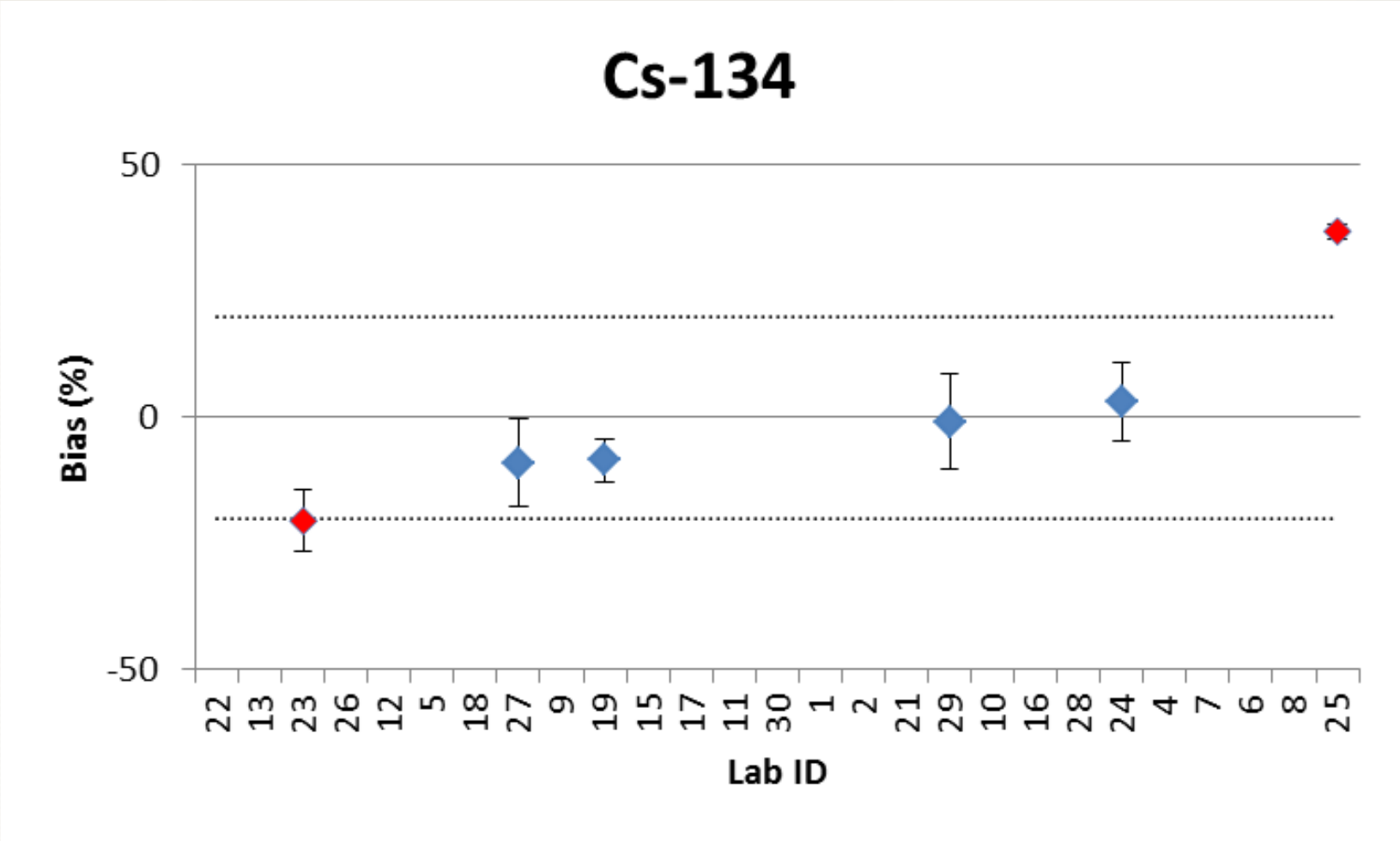
Cs-134 (HELCOM)



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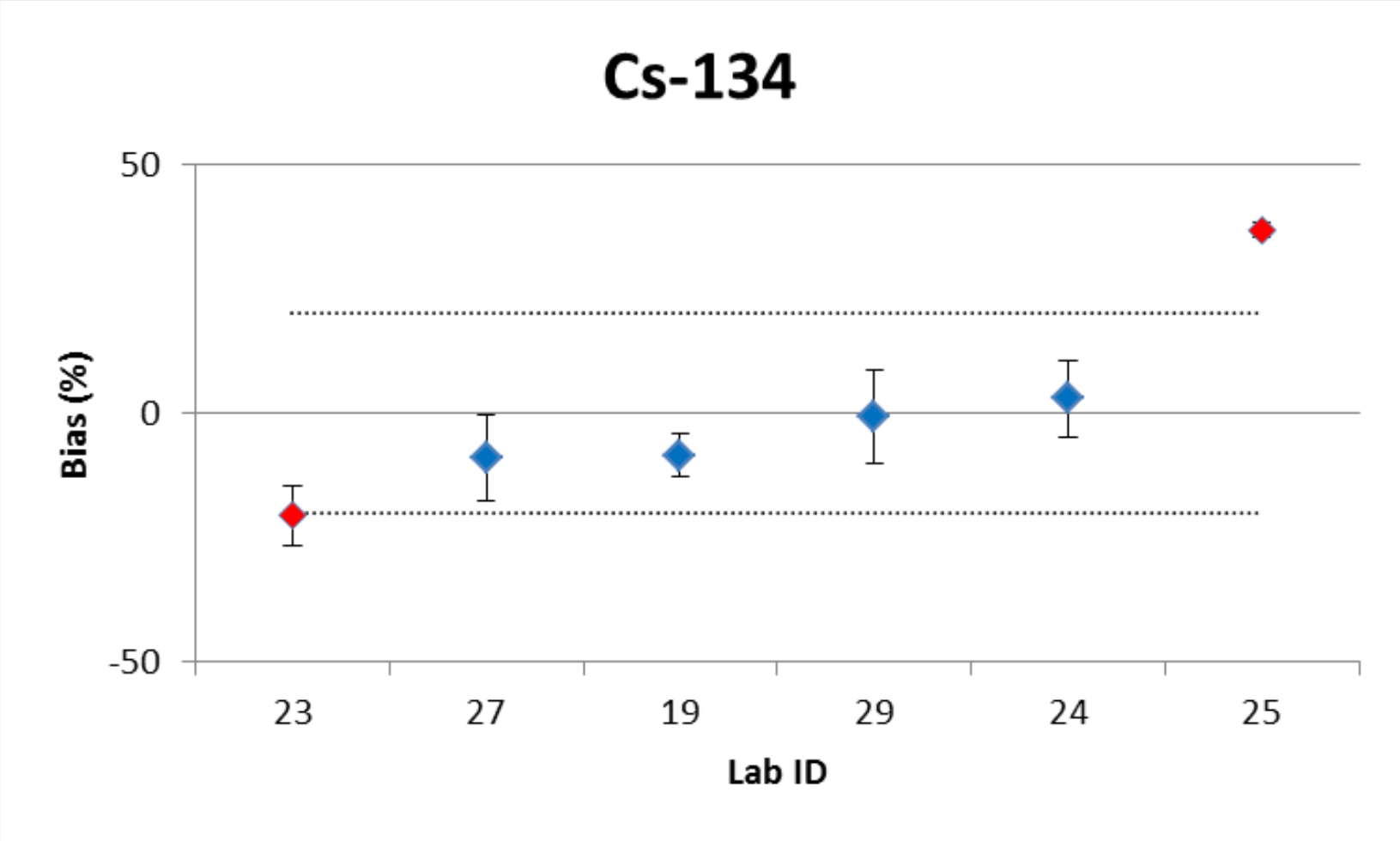
Cs-134 (HELCOM)



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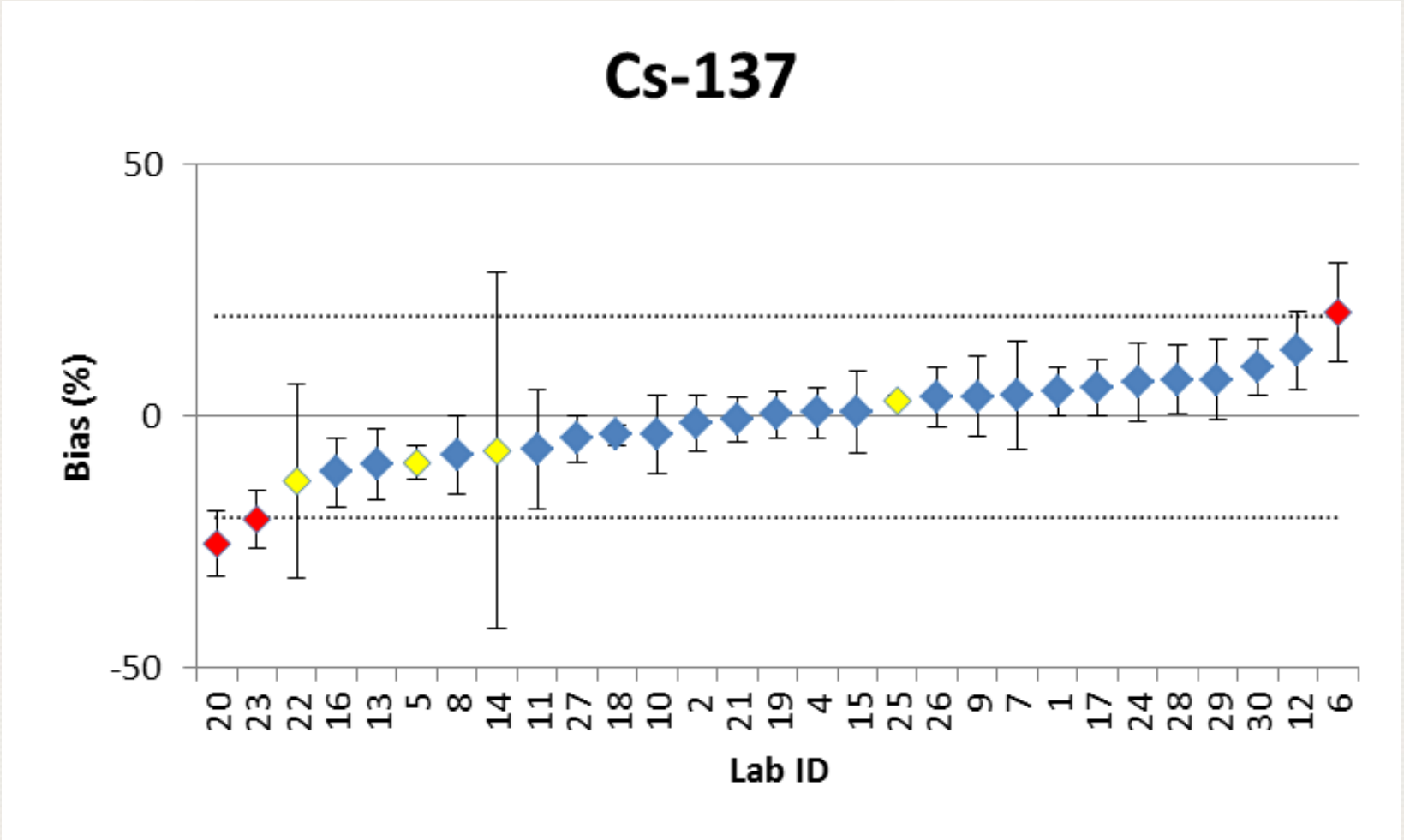
Cs-137 (all participants)



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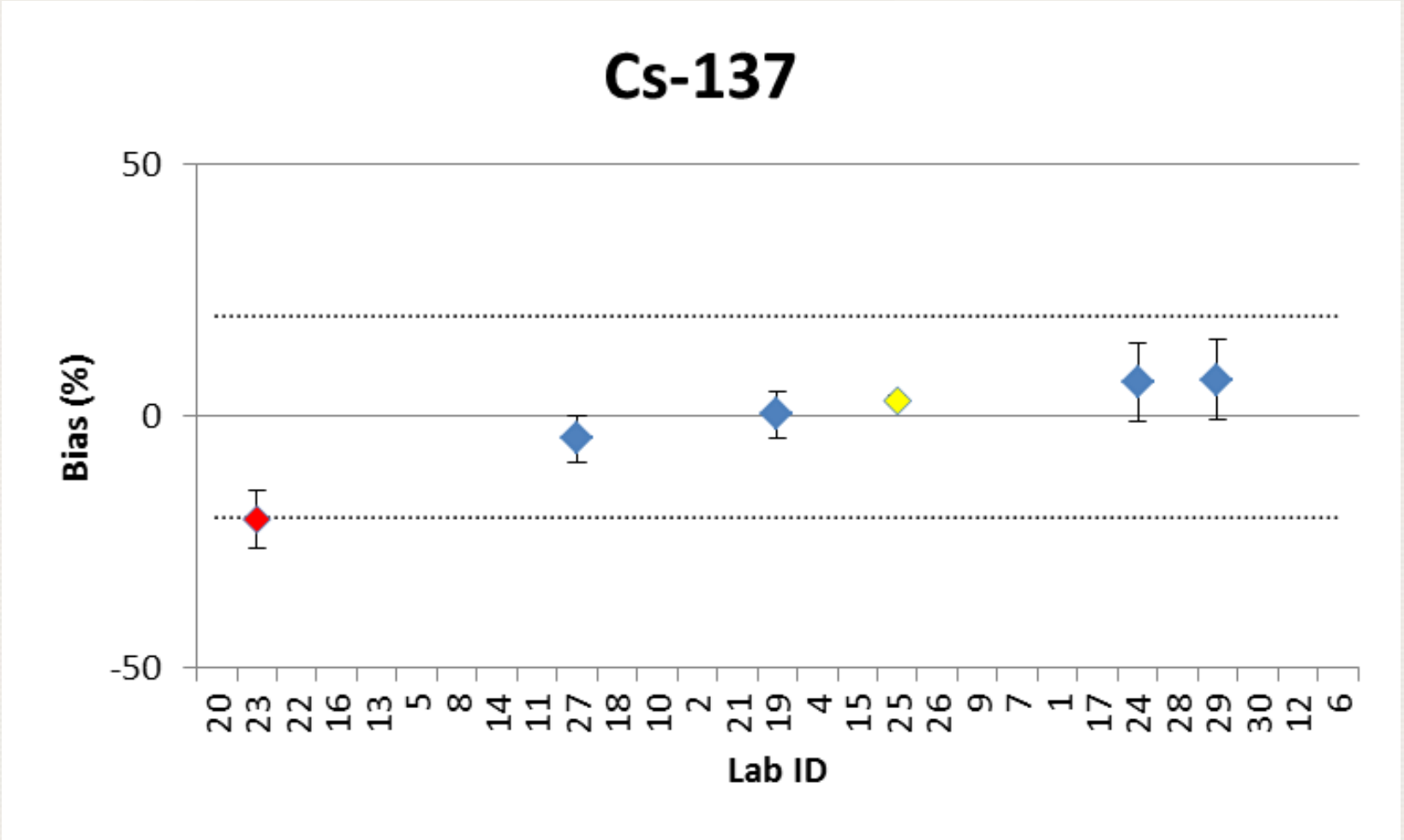
Cs-137 (HELCOM)



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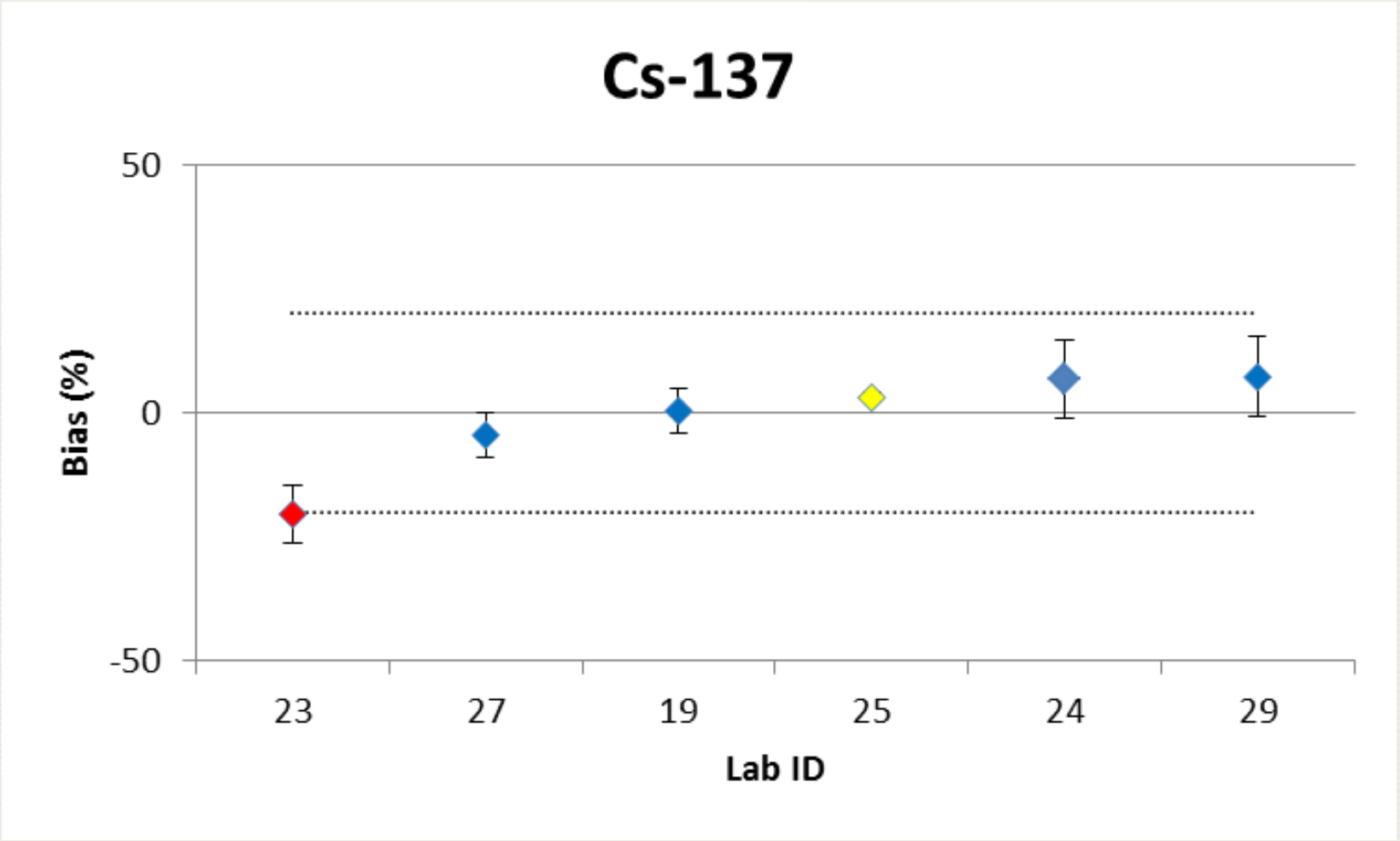
Cs-137 (HELCOM)



Overview

	H-3	Sr-90	Cs-134	Cs-137
All (30)				
Acceptable	12	12	20	22
Warning	1	4	3	4
Not Acceptable	4	1	4	3
HELCOM (6)				
Acceptable	2	4	4	4
Warning	1	1	0	1
Not Acceptable	0	0	2	1

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Comparison between data sets (Bq kg^{-1})

	H-3	Sr-90
Assigned value	2.818 ± 0.014	0.3491 ± 0.0038
HELCOM	2.46 ± 0.46	0.341 ± 0.022
Bias	-13%	-2.4%
Significant?	No	No
Assigned value	2.807 ± 0.020	0.3486 ± 0.0034
All participants	2.80 ± 0.06	0.347 ± 0.012
Bias	-0.3%	-0.4%
Significant?	No	No

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Comparison between data sets (Bq kg^{-1})

	Cs-134	Cs-137
Assigned value	0.1168 ± 0.0010	0.3099 ± 0.0024
HELCOM	0.106 ± 0.008	0.314 ± 0.012
Bias	-9.2%	1.3%
Significant?	Yes	No
Assigned value	0.1165 ± 0.0010	0.3092 ± 0.0026
All participants	0.1055 ± 0.0026	0.3128 ± 0.0048
Bias:	-9.4%	1.2%
Significant?	Yes	No

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Conclusion

Some participants seem not to make sufficient correction for coincidence summing (which leads to signal loss and hence underestimation of the Cs-134 activity level)

Large spread in the reported relative uncertainties (at $k = 2$):

	All participants	HELCOM
H-3:	2.2% - 62%	28% - 62%
Sr-90:	2.4% - 42%	5.6% - 20%
Cs-134:	2.2% - 76%	2.2% - 19%
Cs-137:	1.2% - 76%	1.2% - 15%

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Acknowledgements

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