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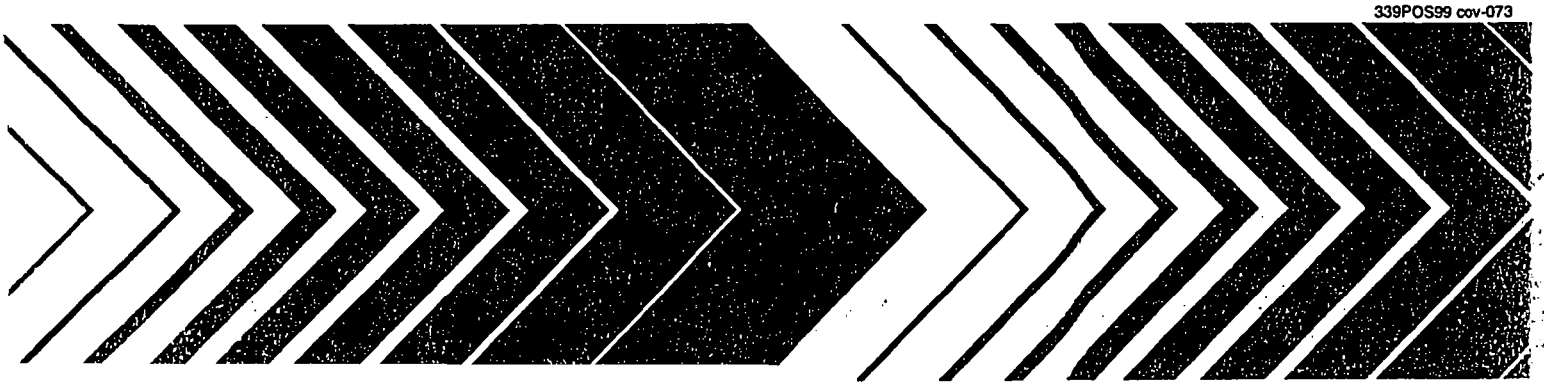
August 1999

Results from EPA's Drinking Water Radiochemistry Performance Evaluation Studies for Calendar Year 1995

339POS99 cov-073



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16. Abstract

Notice of termination of EPA's radiochemistry performance evaluation program was announced in the Federal Register on June 12, 1997 (62:113). Therefore, as of March 1999, all technical assistance available from the radiochemistry component at the EPA in Las Vegas, NV, is terminated.

The following report contains in chronological order the results for radiochemistry studies for the period indicated. The results are organized by radiochemistry study title and date and under each title a summary report. The summary report contains the laboratory code for each participant, the triplicate results submitted by each participant, the average of the submitted results, and summary statistics. Introducing each report is a discussion of the statistics and the scoring criterion.

We are providing this report to assist organizations interested in an historical account of radiochemistry Performance Evaluation Studies. Mention of trade names, corporate names or commercial products does not constitute endorsement or recommendation by EPA.

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5. Title

Results from EPA's Drinking Water Radiochemistry Performance Evaluation Studies for Calendar Year 1995

6. Author(s) in order of authorship, Affiliation, and Address (Identify EPA authors with Lab/Center)

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Las Vegas, NV 89193-3478

7. Internet Address (indicate whether it is your preferred or active URL). Attach diskette containing the abstract in WordPerfect.

N/A

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Project # J0477	S. Pia, 702/798-2102

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- ☐ Summary
- ☐ Symposium Paper (See block 12)
- ☐ Book Chapter (See block 12)
- ☐ Exhibit/Poster
- ☐ EPA-Sponsored Conference/Seminar/Workshop
- ☐ Research Brief or Issue Paper
- ☐ Newsletter
- ☐ Internal Report (distribution limited to EPA)
- ☐ Unpublished Report
- ☐ Computer Product, Scientific Data
- ☐ Other _____

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12. Bibliographic Citation (For symposia papers and abstracts, give name, place and date. For refereed publications, give name where manuscript is being submitted, accepted or published.)

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- ☐ 2. Important sci. & tech. work product (LD signs in 18)
- ☐ 3. General sci. & tech. work product (BC signs 14, DD signs 18)
- X 4. Other science & tech. work product (BC signs 14 and 18)

16b. _____
Contact for peer review comments (Signature and date)

17. This product enunciates new policy or affects existing policy? (Choose and initial one). ☐ Yes, memo attached. X No.

18. Lab/Center Director Signature and Date

(Title and Signature) _____ — 22.vii.99 — Date

Christian G. Daughton, Chief, Environmental Chemistry Branch

United States
Environmental Protection
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Office of Research and
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Washington, DC 20460

EPA 600/R-95/056
April 1995

EPA

Strontium in Water Performance Evaluation Study

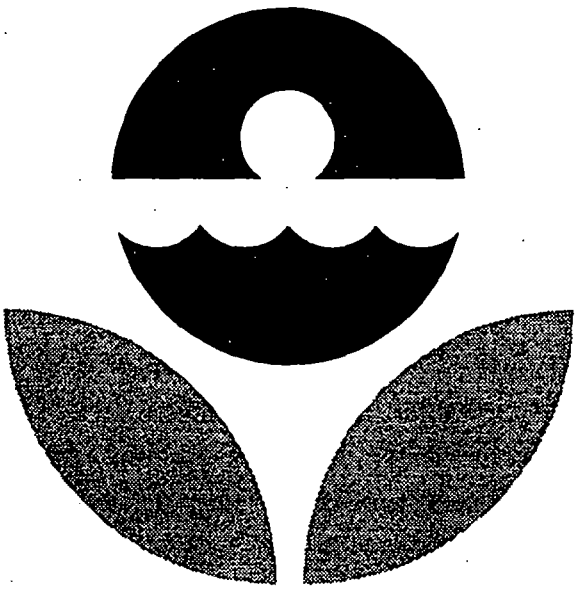
A Statistical Evaluation of the January 13, 1995 Data

0593RSD94 cov-056

Strontium in Water

Performance Evaluation Study

January 13, 1995



Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Las Vegas, Nevada

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ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
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(702/798-2100)

Dear Participant,

Enclosed are the results of the Nuclear Radiation Assessment Division (EMSL-LV) Performance Evaluation Study for ***Strontium in Water; January 13, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by EMSL-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Branch

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

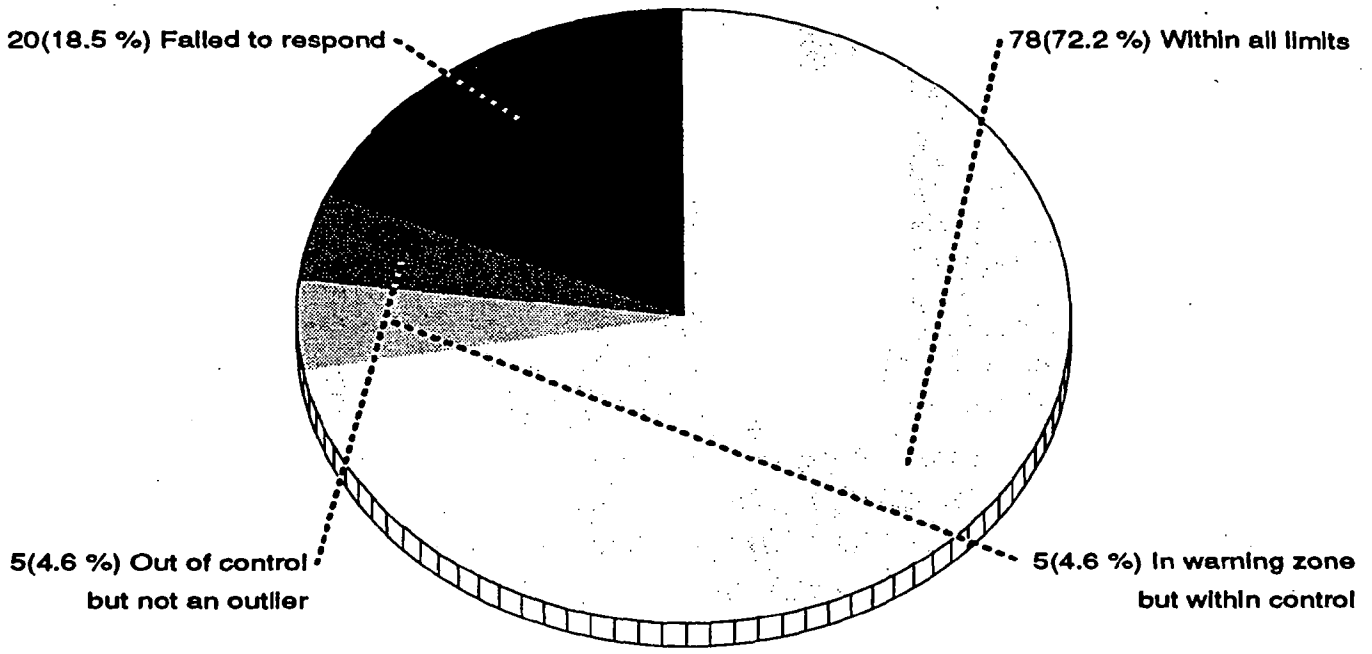
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

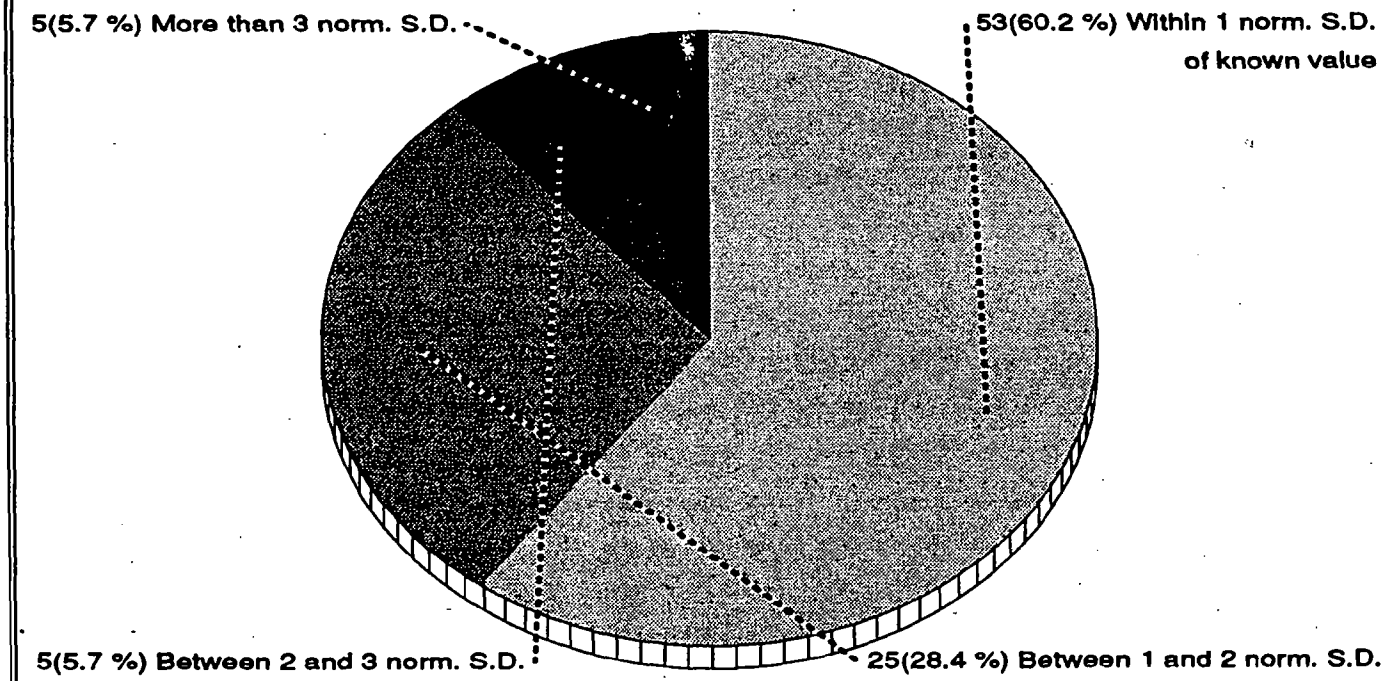
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, EMSL-LV, 702/798-2104.

Strontium-89 Statistical Summary 108 Participants

The known value of this nuclide is **20.0 pCi/l** with an expected precision of **5.0**; the control limits are 11.3 to 28.7; the warning regions are 11.3 to 14.2 and 25.8 to 28.7



Statistic	Respondents	Non-outliers
Mean	18.77	**Grand Avg 18.77**
Std. Dev.	3.77	3.77
Variance	14.20	14.20
% Coef. of Var.	20.08	20.08
% deviation of mean from known value	-6.17	-6.17
Norm. dev. of mean from known value	-0.33	-0.33
Median	19.33	19.33
% deviation of median from known value	-3.33	-3.33
Norm. dev. of median from known value	-0.18	-0.18



EMSL-LV Performance Evaluation: Strontium in Water, 13-Jan-1995

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	19.0	19.0	20.0	0.58	0.118	19.33	0.20	-0.23	
AE	20.0	20.0	19.0	0.58	0.118	19.67	0.31	-0.12	
AF	22.0	23.0	22.0	0.58	0.118	22.33	1.24	0.81	
AJ	21.0	22.0	16.0	3.21	0.709	19.67	0.31	-0.12	
AK	23.0	22.0	23.0	0.58	0.118	22.67	1.35	0.92	
AL	23.0	25.0	23.0	1.15	0.236	23.67	1.70	1.27	
AU	20.0	18.0	21.0	1.53	0.354	19.67	0.31	-0.12	
AW	17.0	17.0	15.0	1.15	0.236	16.33	-0.84	-1.27	
AY									•
AZ	20.0	19.0	20.0	0.58	0.118	19.67	0.31	-0.12	
BA	22.0	23.0	24.0	1.00	0.236	23.00	1.47	1.04	
BB									•
BC	18.0	18.0	17.0	0.58	0.118	17.67	-0.38	-0.81	
BG									•
BH	18.0	17.0	17.0	0.58	0.118	17.33	-0.50	-0.92	
BL	20.0	22.0	20.0	1.15	0.236	20.67	0.66	0.23	
BM	19.0	20.0	20.0	0.58	0.118	19.67	0.31	-0.12	
BO	21.0	21.0	22.0	0.58	0.118	21.33	0.89	0.46	
C	22.0	22.0	22.0	0.00	0.000	22.00	1.12	0.69	
CA	16.0	19.0	18.0	1.53	0.354	17.67	-0.38	-0.81	
CE									•
CG	22.0	20.0	18.0	2.00	0.473	20.00	0.43	0.00	
CJ	21.0	16.0	20.0	2.65	0.591	19.00	0.08	-0.35	
CK	17.0	18.0	19.0	1.00	0.236	18.00	-0.27	-0.69	
CO	9.0	8.0	4.0	2.65	0.591	7.00	-4.08	-4.50	⇓
CQ	15.0	15.0	14.0	0.58	0.118	14.67	-1.42	-1.85	
CS	15.0	16.0	16.0	0.58	0.118	15.67	-1.07	-1.50	
CX	14.0	12.0	22.0	5.29	1.345	16.00	-0.96	-1.39	
D	14.0	9.0	10.0	2.65	0.591	11.00	-2.69	-3.12	⇓
DD	23.0	22.0	24.0	1.00	0.236	23.00	1.47	1.04	
DE	20.0	21.0	21.0	0.58	0.118	20.67	0.66	0.23	
DG	28.0	25.0	23.0	2.52	0.591	25.33	2.28	1.85	
DO	21.0	20.0	18.0	1.53	0.354	19.67	0.31	-0.12	
DT	20.0	19.0	18.0	1.00	0.236	19.00	0.08	-0.35	
DZ	23.0	25.0	24.0	1.00	0.236	24.00	1.81	1.39	
E	18.0	19.0	17.0	1.00	0.236	18.00	-0.27	-0.69	
EB	27.0	28.0	29.0	1.00	0.236	28.00	3.20	2.77	
EL	22.0	22.0	22.0	0.00	0.000	22.00	1.12	0.69	
FU	26.0	23.0	25.0	1.53	0.354	24.67	2.04	1.62	
FZ									•
GQ	18.0	18.0	18.0	0.00	0.000	18.00	-0.27	-0.69	
HK	18.0	18.0	18.0	0.00	0.000	18.00	-0.27	-0.69	
HP	17.0	15.0	15.0	1.15	0.236	15.67	-1.07	-1.50	
I	24.0	24.0	27.0	1.73	0.354	25.00	2.16	1.73	
IC	18.0	18.0	19.0	0.58	0.118	18.33	-0.15	-0.58	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
J	20.0	21.0	21.0	0.58	0.118	20.67	0.66	0.23	
JE	19.0	21.0	20.0	1.00	0.236	20.00	0.43	0.00	
JS	17.0	19.0	20.0	1.53	0.354	18.67	-0.03	-0.46	
JY	13.0	12.0	17.0	2.65	0.591	14.00	-1.65	-2.08	
K	19.0	19.0	16.0	1.73	0.354	18.00	-0.27	-0.69	
KH	21.0	20.0	21.0	0.58	0.118	20.67	0.66	0.23	
KL	20.0	18.0	20.0	1.15	0.236	19.33	0.20	-0.23	
KX	10.0	10.0	10.0	0.00	0.000	10.00	-3.04	-3.46	⇓
L	22.0	21.0	23.0	1.00	0.236	22.00	1.12	0.69	
LT	19.0	20.0	21.0	1.00	0.236	20.00	0.43	0.00	
M	20.0	18.0	20.0	1.15	0.236	19.33	0.20	-0.23	
MQ	16.0	18.0	15.0	1.53	0.354	16.33	-0.84	-1.27	
N	20.0	21.0	18.0	1.53	0.354	19.67	0.31	-0.12	
NJ									•
NT	21.0	20.0	20.0	0.58	0.118	20.33	0.54	0.12	
OA	21.0	24.0	23.0	1.53	0.354	22.67	1.35	0.92	
OL									•
PB	19.0	20.0	20.0	0.58	0.118	19.67	0.31	-0.12	
PU									•
PV	15.0	18.0	11.0	3.51	0.827	14.67	-1.42	-1.85	
Q	25.0	27.0	21.0	3.06	0.709	24.33	1.93	1.50	
QJ									•
QU	19.0	27.0	26.0	4.36	0.945	24.00	1.81	1.39	
QW	17.0	20.0	19.0	1.53	0.354	18.67	-0.03	-0.46	
QZ	20.0	21.0	20.0	0.58	0.118	20.33	0.54	0.12	
R	16.0	13.0	14.0	1.53	0.354	14.33	-1.54	-1.96	
RC									•
RM									•
RR	20.0	19.0	19.0	0.58	0.118	19.33	0.20	-0.23	
RV	13.0	13.0	14.0	0.58	0.118	13.33	-1.88	-2.31	
S	19.0	19.0	19.0	0.00	0.000	19.00	0.08	-0.35	
SC	18.0	19.0	21.0	1.53	0.354	19.33	0.20	-0.23	
SD	16.0	16.0	16.0	0.00	0.000	16.00	-0.96	-1.39	
SF									•
SI	17.0	15.0	14.0	1.53	0.354	15.33	-1.19	-1.62	
SM	12.0	14.0	12.0	1.15	0.236	12.67	-2.11	-2.54	
SS	20.0	15.0	17.0	2.52	0.591	17.33	-0.50	-0.92	
ST	17.0	18.0	18.0	0.58	0.118	17.67	-0.38	-0.81	
SZ									•
T	21.0	19.0	19.0	1.15	0.236	19.67	0.31	-0.12	
TD	20.0	15.0	25.0	5.00	1.345	20.00	0.43	0.00	
TE									•
TH									•
TI	18.0	14.0	17.0	2.08	0.473	16.33	-0.84	-1.27	
TL	25.0	19.0	25.0	3.46	0.709	23.00	1.47	1.04	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

EMSL-LV Performance Evaluation: Strontium in Water, 13-Jan-1995

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
TQ	17.0	17.0	20.0	1.73	0.354	18.00	-0.27	-0.69	
U	18.0	18.0	17.0	0.58	0.118	17.67	-0.38	-0.81	
UE	22.0	22.0	22.0	0.00	0.000	22.00	1.12	0.69	
UN	21.0	20.0	20.0	0.58	0.118	20.33	0.54	0.12	
UP	17.0	15.0	17.0	1.15	0.236	16.33	-0.84	-1.27	
UW	16.0	16.0	16.0	0.00	0.000	16.00	-0.96	-1.39	
VA	10.0	15.0	12.0	2.52	0.591	12.33	-2.23	-2.66	
VC									•
VG	9.0	9.0	8.0	0.58	0.118	8.67	-3.50	-3.93	⇓
VI	27.0	25.0	18.0	4.73	1.120	23.33	1.58	1.15	
VQ									•
VR									•
VU									•
W	19.0	16.0	15.0	2.08	0.473	16.67	-0.73	-1.15	
WF	14.0	12.0							Ø
WG	16.0	22.0	18.0	3.06	0.709	18.67	-0.03	-0.46	
X	11.0	10.0	12.0	1.00	0.236	11.00	-2.69	-3.12	⇓
Z	20.0	21.0	21.0	0.58	0.118	20.67	0.66	0.23	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
7.00	⇓	CO	17.33		BH	19.67		PB
8.67	⇓	VG	17.67		U	19.67		N
10.00	⇓	KX	17.67		ST	19.67		DO
11.00	⇓	X	17.67		CA	19.67		BM
11.00	⇓	D	17.67		BC	19.67		AZ
12.33		VA	18.00		TQ	19.67		AU
12.67		SM	18.00		K	19.67		AJ
13.33		RV	18.00		HK	19.67		AE
14.00		JY	18.00		GQ	20.00		TD
14.33		R	18.00		E	20.00		LT
14.67		PV	18.00		CK	20.00		JE
14.67		CQ	18.33		IC	20.00		CG
15.33		SI	18.67		WG	20.33		UN
15.67		HP	18.67		QW	20.33		QZ
15.67		CS	18.67		JS	20.33		NT
16.00		UW	19.00		S	20.67		Z
16.00		SD	19.00		DT	20.67		KH
16.00		CX	19.00		CJ	20.67		J
16.33		UP	19.33		SC	20.67		DE
16.33		TI	19.33		RR	20.67		BL
16.33		MQ	19.33		M	21.33		BO
16.33		AW	19.33		KL	22.00		UE
16.67		W	19.33		A	22.00		L
17.33		SS	19.67		T	22.00		EL

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

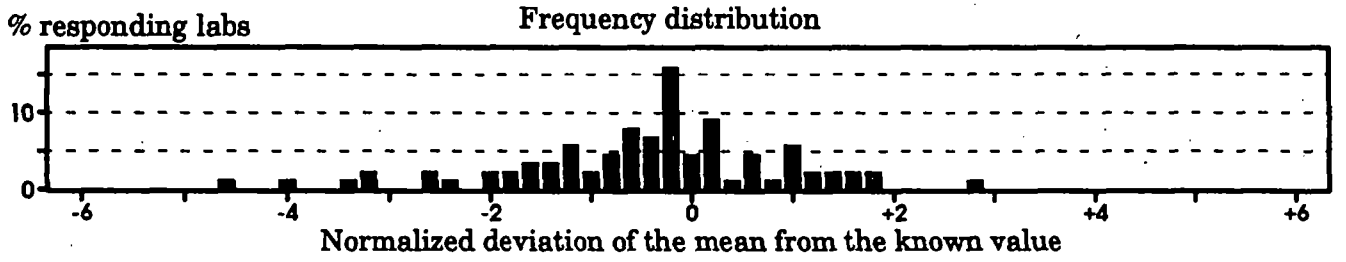
⇑ ≡ Above control limit

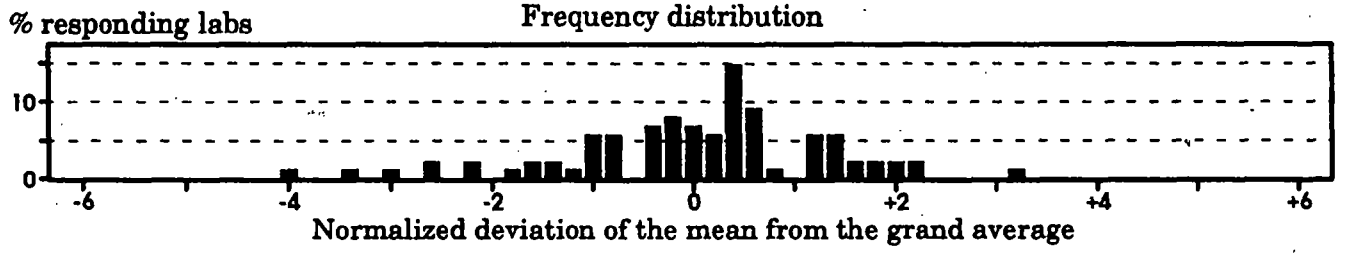
⇓ ≡ Below control limit

Strontium-89

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
22.00		C	23.00		DD	24.00		DZ
22.33		AF	23.00		BA	24.33		Q
22.67		OA	23.33		VI	24.67		FU
22.67		AK	23.67		AL	25.00		I
23.00		TL	24.00		QU	25.33		DG
						28.00		EB





• ≡ No data submitted
∅ ≡ Insufficient data

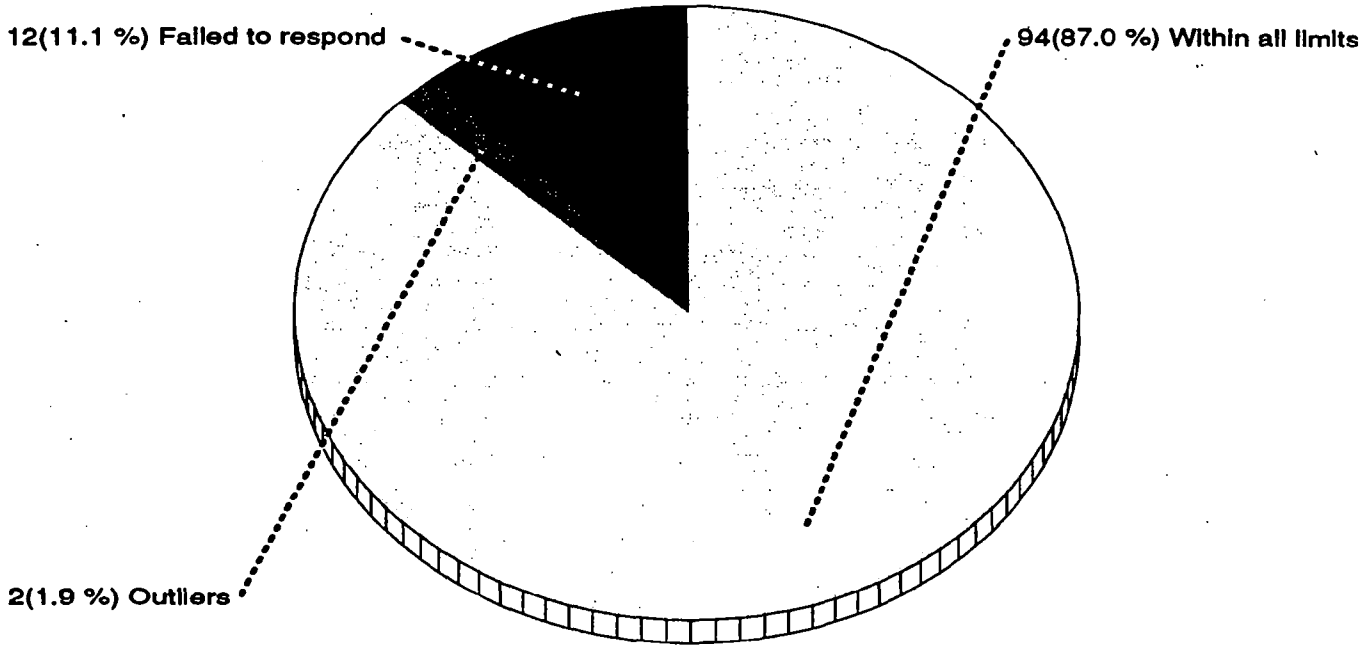
TAG SYMBOLS

× ≡ Determined to be an outlier

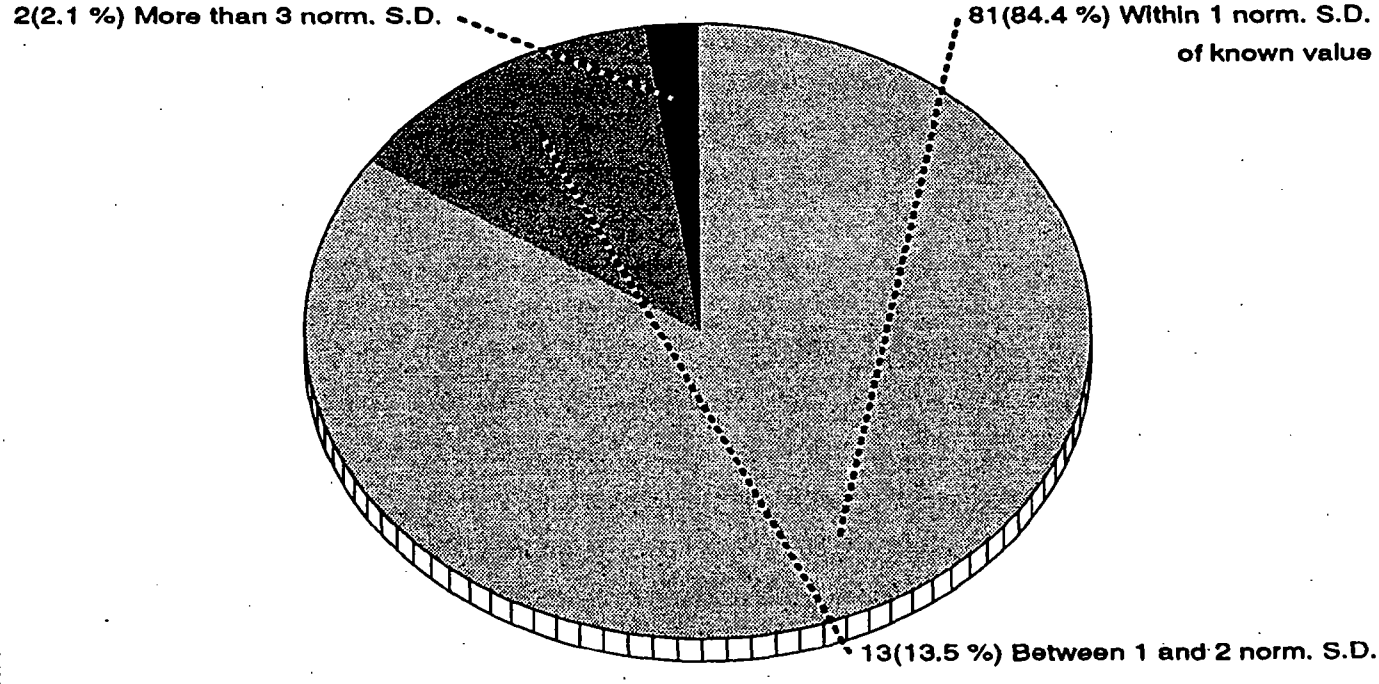
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90 Statistical Summary 108 Participants

The known value of this nuclide is **15.0 pCi/l** with an expected precision of **5.0**; the control limits are 6.3 to 23.7; the warning regions are 6.3 to 9.2 and 20.8 to 23.7



Statistic	Respondents	Non-outliers
Mean	14.52	**Grand Avg 14.27**
Std. Dev.	2.54	1.86
Variance	6.44	3.47
% Coef. of Var.	17.48	13.06
% deviation of mean from known value	-3.22	-4.89
Norm. dev. of mean from known value	-0.19	-0.39
Median	14.00	14.00
% deviation of median from known value	-6.67	-6.67
Norm. dev. of median from known value	-0.39	-0.54



Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
AE	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
AF	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
AJ	14.0	12.0	14.0	1.15	0.236	13.33	-0.32	-0.58	
AK	13.0	15.0	13.0	1.15	0.236	13.67	-0.21	-0.46	
AL	13.0	14.0	13.0	0.58	0.118	13.33	-0.32	-0.58	
AU	15.0	14.0	16.0	1.00	0.236	15.00	0.25	0.00	
AW	18.0	18.0	16.0	1.15	0.236	17.33	1.06	0.81	
AY	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
AZ	14.0	14.0	13.0	0.58	0.118	13.67	-0.21	-0.46	
BA	12.0	12.0	13.0	0.58	0.118	12.33	-0.67	-0.92	
BB	14.0	13.0	14.0	0.58	0.118	13.67	-0.21	-0.46	
BC	13.0	13.0	13.0	0.00	0.000	13.00	-0.44	-0.69	
BG	13.0	13.0	12.0	0.58	0.118	12.67	-0.55	-0.81	
BH	16.0	17.0	18.0	1.00	0.236	17.00	0.95	0.69	
BL	16.0	15.0	13.0	1.53	0.354	14.67	0.14	-0.12	
BM	13.0	14.0	15.0	1.00	0.236	14.00	-0.09	-0.35	
BO	13.0	12.0	13.0	0.58	0.118	12.67	-0.55	-0.81	
C	15.0	14.0	13.0	1.00	0.236	14.00	-0.09	-0.35	
CA	14.0	14.0	13.0	0.58	0.118	13.67	-0.21	-0.46	
CE	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	
CG	16.0	16.0	15.0	0.58	0.118	15.67	0.49	0.23	
CJ	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
CK	15.0	16.0	16.0	0.58	0.118	15.67	0.49	0.23	
CO	10.0	10.0	8.0	1.15	0.236	9.33	-1.71	-1.96	
CQ	11.0	11.0	12.0	0.58	0.118	11.33	-1.02	-1.27	
CS	17.0	17.0	16.0	0.58	0.118	16.67	0.83	0.58	
CX	17.0	18.0	15.0	1.53	0.354	16.67	0.83	0.58	
D	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	
DD	14.0	14.0	13.0	0.58	0.118	13.67	-0.21	-0.46	
DE	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	
DG	11.0	11.0	12.0	0.58	0.118	11.33	-1.02	-1.27	
DO	13.0	14.0	14.0	0.58	0.118	13.67	-0.21	-0.46	
DT	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	
DZ	17.0	18.0	19.0	1.00	0.236	18.00	1.29	1.04	
E	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	
EB	9.0	11.0	9.0	1.15	0.236	9.67	-1.59	-1.85	
EL	17.0	20.0	18.0	1.53	0.354	18.33	1.41	1.15	
FU	14.0	12.0	13.0	1.00	0.236	13.00	-0.44	-0.69	
FZ									•
GQ	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
HK	13.0	13.0	13.0	0.00	0.000	13.00	-0.44	-0.69	
HP	14.0	18.0	19.0	2.65	0.591	17.00	0.95	0.69	
I	13.0	12.0	13.0	0.58	0.118	12.67	-0.55	-0.81	
IC	13.0	13.0	12.0	0.58	0.118	12.67	-0.55	-0.81	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
J	15.0	15.0	14.0	0.58	0.118	14.67	0.14	-0.12	
JE	16.0	15.0	17.0	1.00	0.236	16.00	0.60	0.35	
JS	15.0	14.0	14.0	0.58	0.118	14.33	0.02	-0.23	
JY	13.0	14.0	14.0	0.58	0.118	13.67	-0.21	-0.46	
K	12.0	14.0	14.0	1.15	0.236	13.33	-0.32	-0.58	
KH	14.0	13.0	14.0	0.58	0.118	13.67	-0.21	-0.46	
KL	15.0	18.0	16.0	1.53	0.354	16.33	0.72	0.46	
KX	14.0	15.0	14.0	0.58	0.118	14.33	0.02	-0.23	
L	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
LT	17.0	17.0	17.0	0.00	0.000	17.00	0.95	0.69	
M	12.0	11.0	12.0	0.58	0.118	11.67	-0.90	-1.15	
MQ	17.0	14.0	16.0	1.53	0.354	15.67	0.49	0.23	
N	15.0	14.0	14.0	0.58	0.118	14.33	0.02	-0.23	
NJ									•
NT	16.0	16.0	16.0	0.00	0.000	16.00	0.60	0.35	
OA	14.0	14.0	13.0	0.58	0.118	13.67	-0.21	-0.46	
OL									•
PB	15.0	14.0	15.0	0.58	0.118	14.67	0.14	-0.12	
PU									•
PV	29.0	16.0	30.0	7.81	2.245	25.00	3.72	3.46	×
Q	14.0	15.0	16.0	1.00	0.236	15.00	0.25	0.00	
QJ	13.0	12.0	10.0	1.53	0.354	11.67	-0.90	-1.15	
QU	15.0	20.0	20.0	2.89	0.591	18.33	1.41	1.15	
QW	14.0	14.0	10.0	2.31	0.473	12.67	-0.55	-0.81	
QZ	13.0	12.0	13.0	0.58	0.118	12.67	-0.55	-0.81	
R	11.0	9.0	11.0	1.15	0.236	10.33	-1.36	-1.62	
RC									•
RM									•
RR	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
RV	16.0	15.0	15.0	0.58	0.118	15.33	0.37	0.12	
S	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	
SC	13.0	13.0	14.0	0.58	0.118	13.33	-0.32	-0.58	
SD	14.0	14.0	13.0	0.58	0.118	13.67	-0.21	-0.46	
SF									•
SI	12.0	12.0	13.0	0.58	0.118	12.33	-0.67	-0.92	
SM	16.0	14.0	13.0	1.53	0.354	14.33	0.02	-0.23	
SS	14.0	14.0	15.0	0.58	0.118	14.33	0.02	-0.23	
ST	16.0	15.0	15.0	0.58	0.118	15.33	0.37	0.12	
SZ	11.0	12.0	13.0	1.00	0.236	12.00	-0.78	-1.04	
T	14.0	14.0	13.0	0.58	0.118	13.67	-0.21	-0.46	
TD	12.0	16.0	10.0	3.06	0.709	12.67	-0.55	-0.81	
TE	15.0	12.0	13.0	1.53	0.354	13.33	-0.32	-0.58	
TH	28.0	27.0	28.0	0.58	0.118	27.67	4.64	4.39	×
TI	13.0	13.0	13.0	0.00	0.000	13.00	-0.44	-0.69	
TL	14.0	16.0	16.0	1.15	0.236	15.33	0.37	0.12	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

EMSL-LV Performance Evaluation: Strontium in Water, 13-Jan-1995

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
TQ	15.0	17.0	16.0	1.00	0.236	16.00	0.60	0.35	
U	16.0	16.0	16.0	0.00	0.000	16.00	0.60	0.35	
UE	13.0	13.0	13.0	0.00	0.000	13.00	-0.44	-0.69	
UN	13.0	13.0	12.0	0.58	0.118	12.67	-0.55	-0.81	
UP	14.0	15.0	15.0	0.58	0.118	14.67	0.14	-0.12	
UW	14.0	14.0	14.0	0.00	0.000	14.00	-0.09	-0.35	
VA	19.0	13.0	17.0	3.06	0.709	16.33	0.72	0.46	
VC									•
VG	13.0	13.0	13.0	0.00	0.000	13.00	-0.44	-0.69	
VI	18.0	23.0	18.0	2.89	0.591	19.67	1.87	1.62	
VQ									•
VR									•
VU									•
W	13.0	14.0	13.0	0.58	0.118	13.33	-0.32	-0.58	
WF	16.0	17.0							Ø
WG	15.0	15.0	16.0	0.58	0.118	15.33	0.37	0.12	
X	19.0	19.0	19.0	0.00	0.000	19.00	1.64	1.39	
Z	15.0	15.0	15.0	0.00	0.000	15.00	0.25	0.00	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.33		CO	13.33		W	14.00		AY
9.67		EB	13.33		TE	14.00		AF
10.33		R	13.33		SC	14.00		AE
11.33		DG	13.33		K	14.00		A
11.33		CQ	13.33		AL	14.33		SS
11.67		QJ	13.33		AJ	14.33		SM
11.67		M	13.67		T	14.33		N
12.00		SZ	13.67		SD	14.33		KX
12.33		SI	13.67		OA	14.33		JS
12.33		BA	13.67		KH	14.67		UP
12.67		UN	13.67		JY	14.67		PB
12.67		TD	13.67		DO	14.67		J
12.67		QZ	13.67		DD	14.67		BL
12.67		QW	13.67		CA	15.00		Z
12.67		IC	13.67		BB	15.00		S
12.67		I	13.67		AZ	15.00		Q
12.67		BO	13.67		AK	15.00		E
12.67		BG	14.00		UW	15.00		DT
13.00		VG	14.00		RR	15.00		DE
13.00		UE	14.00		L	15.00		D
13.00		TI	14.00		GQ	15.00		CE
13.00		HK	14.00		CJ	15.00		AU
13.00		FU	14.00		C	15.33		WG
13.00		BC	14.00		BM	15.33		TL

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

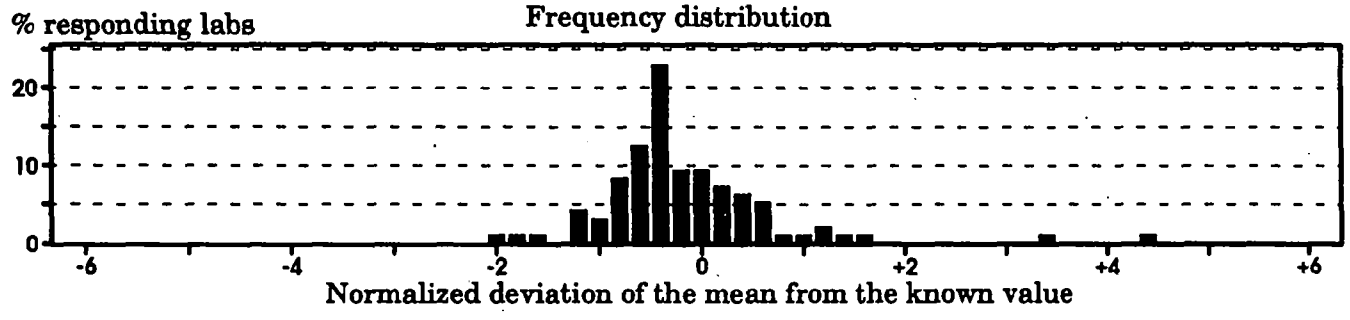
⇑ ≡ Above control limit

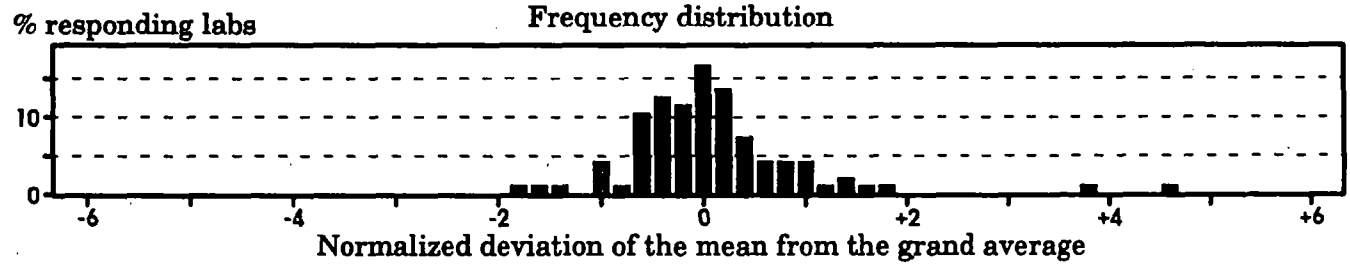
⇓ ≡ Below control limit

Strontium-90

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
15.33		ST	16.00		JE	17.33		AW
15.33		RV	16.33		VA	18.00		DZ
15.67		MQ	16.33		KL	18.33		QU
15.67		CK	16.67		CX	18.33		EL
15.67		CG	16.67		CS	19.00		X
16.00		U	17.00		LT	19.67		VI
16.00		TQ	17.00		HP	25.00	×	PV
16.00		NT	17.00		BH	27.67	×	TH





• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/043
March 1995

EPA

Gross Alpha-Beta in Water Performance Evaluation Study

A Statistical Evaluation of the January 27, 1995 Data

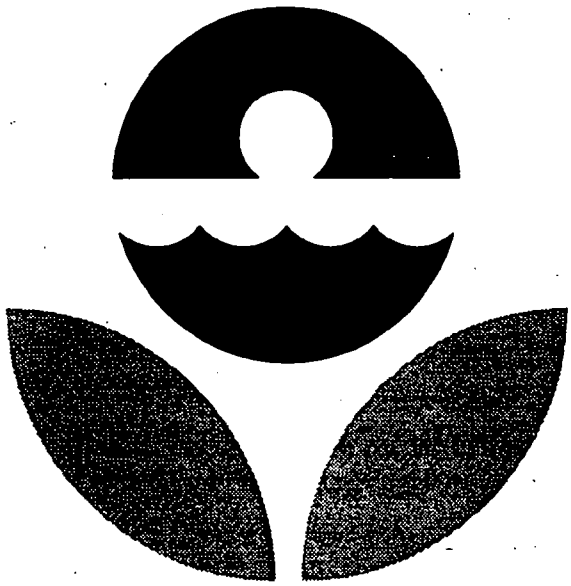
Library Use Only

0593RSD94.crw-043

Gross Alpha-Beta in Water

Performance Evaluation Study

January 27, 1995



Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Nuclear Radiation Assessment Division (EMSL-LV) Performance Evaluation Study for ***Gross Alpha-Beta in Water; January 27, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by EMSL-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck
Chemist
Radioanalysis Branch

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

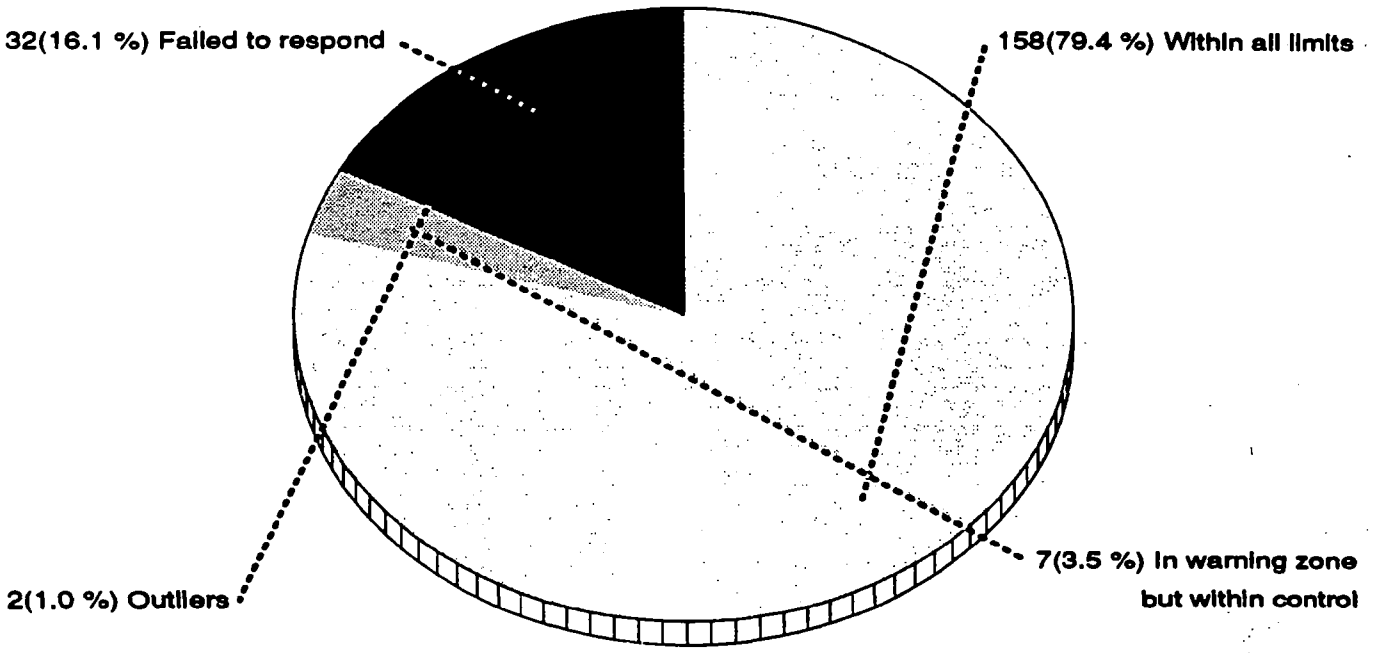
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

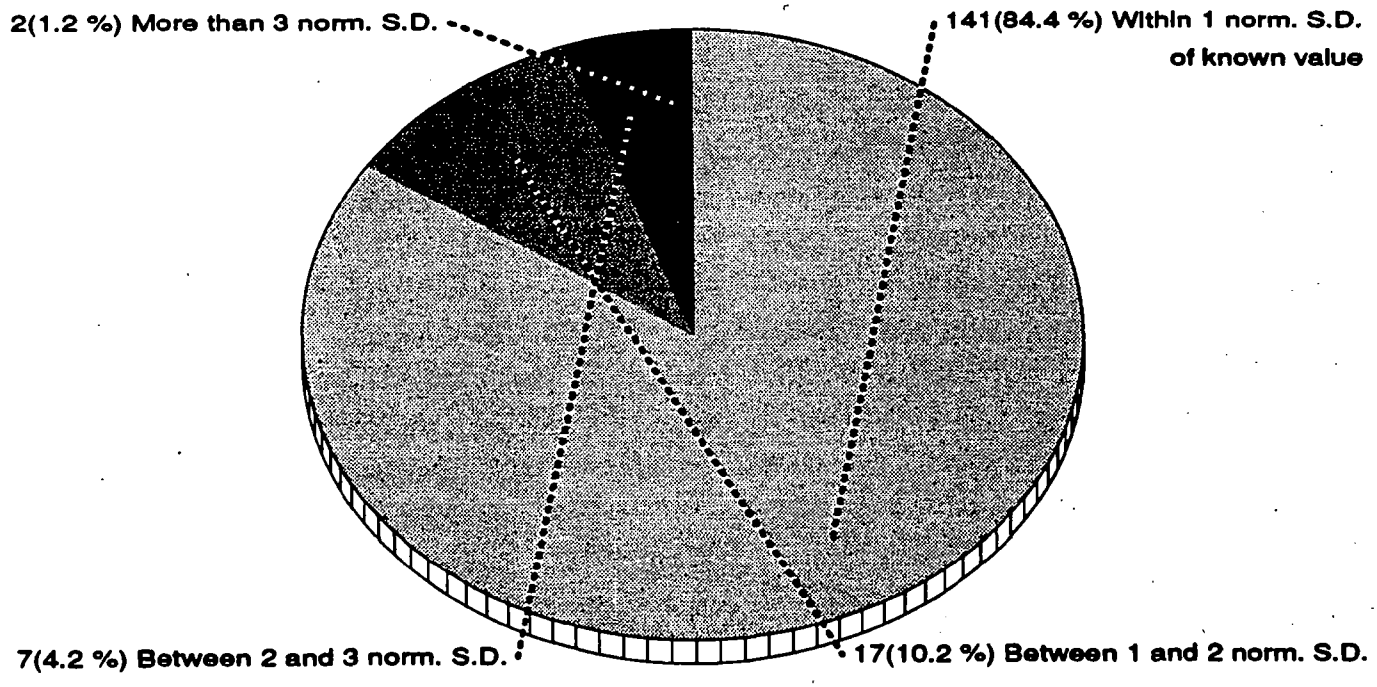
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, EMSL-LV, 702/798-2104.

Gross Alpha Statistical Summary 199 Participants

The known value of this nuclide is **5.0 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 13.7; the warning regions are 0.0 to 0.0 and 10.8 to 13.7



Statistic	Respondents	Non-outliers
Mean	5.85	**Grand Avg 5.68**
Std. Dev.	2.60	2.04
Variance	6.76	4.17
% Coef. of Var.	44.43	35.94
% deviation of mean from known value	17.05	13.58
Norm. dev. of mean from known value	0.33	0.33
Median	5.00	5.00
% deviation of median from known value	0.00	0.00
Norm. dev. of median from known value	0.00	0.00



EMSL-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Jan-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	7.0	6.0	7.0	0.58	0.118	6.67	0.34	0.58	
AE	5.0	5.0	4.0	0.58	0.118	4.67	-0.35	-0.12	
AF	3.0	4.0	4.0	0.58	0.118	3.67	-0.70	-0.46	
AH									•
AJ	10.0	11.0	6.0	2.65	0.591	9.00	1.15	1.39	
AK	8.0	6.0	6.0	1.15	0.236	6.67	0.34	0.58	
AL	8.0	6.0	7.0	1.00	0.236	7.00	0.46	0.69	
AN	6.0	4.0	5.0	1.00	0.236	5.00	-0.24	0.00	
AP	7.0	6.0	5.0	1.00	0.236	6.00	0.11	0.35	
AR	6.0	6.0	6.0	0.00	0.000	6.00	0.11	0.35	
AU	7.0	5.0	7.0	1.15	0.236	6.33	0.23	0.46	
AW	5.0	6.0	6.0	0.58	0.118	5.67	0.00	0.23	
AZ	6.0	8.0	6.0	1.15	0.236	6.67	0.34	0.58	
BA	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
BB	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
BC	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
BG	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
BH	7.0	6.0	6.0	0.58	0.118	6.33	0.23	0.46	
BI									•
BK	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
BL	9.0	6.0	8.0	1.53	0.354	7.67	0.69	0.92	
BM	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
BN	6.0	6.0	8.0	1.15	0.236	6.67	0.34	0.58	
BO	4.0	5.0	2.0	1.53	0.354	3.67	-0.70	-0.46	
BW									•
C	6.0	5.0	5.0	0.58	0.118	5.33	-0.12	0.12	
CA	5.0	4.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
CE	5.0	5.0	13.0	4.62	0.945	7.67	0.69	0.92	
CG	5.0	4.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
CJ	4.0	6.0	5.0	1.00	0.236	5.00	-0.24	0.00	
CK	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
CO	3.0	3.0	4.0	0.58	0.118	3.33	-0.81	-0.58	
CP									•
CQ	5.0	6.0	7.0	1.00	0.236	6.00	0.11	0.35	
CS	6.0	6.0	5.0	0.58	0.118	5.67	0.00	0.23	
CX	4.0	5.0	5.0	0.58	0.118	4.67	-0.35	-0.12	
D	5.0	5.0	7.0	1.15	0.236	5.67	0.00	0.23	
DB	7.0	7.0	6.0	0.58	0.118	6.67	0.34	0.58	
DD	8.0	12.0	8.0	2.31	0.473	9.33	1.27	1.50	
DE	12.0	12.0	13.0	0.58	0.118	12.33	2.31	2.54	
DG									•
DH	6.0	6.0	6.0	0.00	0.000	6.00	0.11	0.35	
DM	1.0	1.0	1.0	0.00	0.000	1.00	-1.62	-1.39	
DO	3.0	3.0	7.0	2.31	0.473	4.33	-0.47	-0.23	
DS	10.0	11.0	7.0	2.08	0.473	9.33	1.27	1.50	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DT	6.0	5.0	4.0	1.00	0.236	5.00	-0.24	0.00	
DZ	9.0	8.0	10.0	1.00	0.236	9.00	1.15	1.39	
E	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
EB	7.0	6.0	6.0	0.58	0.118	6.33	0.23	0.46	
EL	5.0	6.0	4.0	1.00	0.236	5.00	-0.24	0.00	
EN	5.0	5.0	4.0	0.58	0.118	4.67	-0.35	-0.12	
EO	3.0	3.0	4.0	0.58	0.118	3.33	-0.81	-0.58	
ER	6.0	5.0	6.0	0.58	0.118	5.67	0.00	0.23	
EV	2.0	2.0	2.0	0.00	0.000	2.00	-1.27	-1.04	
EW									•
FF									•
FJ	8.0	9.0	6.0	1.53	0.354	7.67	0.69	0.92	
FL	9.0	9.0	8.0	0.58	0.118	8.67	1.04	1.27	
FN	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
FP									•
FZ									•
GE									•
GJ									•
GQ	5.0	6.0	7.0	1.00	0.236	6.00	0.11	0.35	
GT	7.0	4.0	4.0	1.73	0.354	5.00	-0.24	0.00	
GZ	6.0	5.0	5.0	0.58	0.118	5.33	-0.12	0.12	
HI	5.0	6.0	4.0	1.00	0.236	5.00	-0.24	0.00	
HK	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
HL	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
HP	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
I	6.0	5.0	5.0	0.58	0.118	5.33	-0.12	0.12	
IC	6.0	5.0	4.0	1.00	0.236	5.00	-0.24	0.00	
ID	5.0	5.0	6.0	0.58	0.118	5.33	-0.12	0.12	
IE	6.0	6.0	7.0	0.58	0.118	6.33	0.23	0.46	
J	6.0	7.0	6.0	0.58	0.118	6.33	0.23	0.46	
JE	4.0	4.0	6.0	1.15	0.236	4.67	-0.35	-0.12	
JG	3.0	4.0	3.0	0.58	0.118	3.33	-0.81	-0.58	
JM	5.0	5.0	4.0	0.58	0.118	4.67	-0.35	-0.12	
JN	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
JP	6.0	6.0	5.0	0.58	0.118	5.67	0.00	0.23	
JQ	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
JS	7.0	8.0	7.0	0.58	0.118	7.33	0.57	0.81	
JY	7.0	6.0	5.0	1.00	0.236	6.00	0.11	0.35	
K	3.0	4.0	3.0	0.58	0.118	3.33	-0.81	-0.58	
KC	11.0	11.0	11.0	0.00	0.000	11.00	1.84	2.08	
KE	3.0	4.0	3.0	0.58	0.118	3.33	-0.81	-0.58	
KH	5.0	7.0	10.0	2.52	0.591	7.33	0.57	0.81	
KT	5.0	6.0	7.0	1.00	0.236	6.00	0.11	0.35	
KX	8.0	6.0	6.0	1.15	0.236	6.67	0.34	0.58	
L	5.0	4.0	5.0	0.58	0.118	4.67	-0.35	-0.12	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

6 / 18 EMSL-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Jan-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LE									•
LF									•
LL									•
LR	3.0	3.0	4.0	0.58	0.118	3.33	-0.81	-0.58	
LT	9.0	7.0	10.0	1.53	0.354	8.67	1.04	1.27	
M	7.0	9.0	8.0	1.00	0.236	8.00	0.80	1.04	
MA									•
MF	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
MQ	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
MV	7.0	5.0	6.0	1.00	0.236	6.00	0.11	0.35	
MY	12.0	13.0	25.0	7.23	2.020	16.67	3.81	4.04	x
N	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
NA	11.0	12.0	12.0	0.58	0.118	11.67	2.07	2.31	
NB	6.0	10.0	6.0	2.31	0.473	7.33	0.57	0.81	
NE									•
NJ	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
NK	4.0	3.0	4.0	0.58	0.118	3.67	-0.70	-0.46	
NO	4.0	5.0	6.0	1.00	0.236	5.00	-0.24	0.00	
NT	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
O	7.0	7.0	7.0	0.00	0.000	7.00	0.46	0.69	
OA	10.0	12.0	14.0	2.00	0.473	12.00	2.19	2.42	
OB	9.0	9.0	10.0	0.58	0.118	9.33	1.27	1.50	
OF	3.0	3.0	4.0	0.58	0.118	3.33	-0.81	-0.58	
OS	3.0	4.0	3.0	0.58	0.118	3.33	-0.81	-0.58	
OX	4.0	5.0	5.0	0.58	0.118	4.67	-0.35	-0.12	
OY	8.0	8.0	9.0	0.58	0.118	8.33	0.92	1.15	
P	4.0	6.0	4.0	1.15	0.236	4.67	-0.35	-0.12	
PB	6.0	5.0	6.0	0.58	0.118	5.67	0.00	0.23	
PE									•
PG	6.0	6.0	6.0	0.00	0.000	6.00	0.11	0.35	
PM	4.0	7.0	6.0	1.53	0.354	5.67	0.00	0.23	
PQ	3.0	3.0	3.0	0.00	0.000	3.00	-0.93	-0.69	
PR	9.0	9.0	11.0	1.15	0.236	9.67	1.38	1.62	
PV	8.0	8.0	8.0	0.00	0.000	8.00	0.80	1.04	
Q	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
QC	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
QJ									•
QP	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
QQ	4.0	6.0	5.0	1.00	0.236	5.00	-0.24	0.00	
QT	7.0	13.0	14.0	3.79	0.827	11.33	1.96	2.19	
QU	7.0	9.0	11.0	2.00	0.473	9.00	1.15	1.39	
QW	9.0	10.0	11.0	1.00	0.236	10.00	1.50	1.73	
QX	6.0	5.0	6.0	0.58	0.118	5.67	0.00	0.23	
QZ	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
R	5.0	6.0	4.0	1.00	0.236	5.00	-0.24	0.00	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RB	4.0	4.0	5.0	0.58	0.118	4.33	-0.47	-0.23	
RD	5.0	6.0	8.0	1.53	0.354	6.33	0.23	0.46	
RE	5.0	6.0	5.0	0.58	0.118	5.33	-0.12	0.12	
RF									•
RG	3.0	4.0	3.0	0.58	0.118	3.33	-0.81	-0.58	
RH									•
RI	4.0	6.0	5.0	1.00	0.236	5.00	-0.24	0.00	
RJ	6.0	7.0	8.0	1.00	0.236	7.00	0.46	0.69	
RR	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
RU	2.0	2.0	2.0	0.00	0.000	2.00	-1.27	-1.04	
RV	6.0	6.0	6.0	0.00	0.000	6.00	0.11	0.35	
RW	6.0	6.0	8.0	1.15	0.236	6.67	0.34	0.58	
RZ									•
S	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
SC	4.0	5.0	5.0	0.58	0.118	4.67	-0.35	-0.12	
SD	5.0	5.0	4.0	0.58	0.118	4.67	-0.35	-0.12	
SF	4.0	5.0	3.0	1.00	0.236	4.00	-0.58	-0.35	
SI	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
SL	6.0	5.0	4.0	1.00	0.236	5.00	-0.24	0.00	
SM	3.0	3.0	3.0	0.00	0.000	3.00	-0.93	-0.69	
SN									•
SO	6.0	5.0	6.0	0.58	0.118	5.67	0.00	0.23	
SR	4.0	5.0	3.0	1.00	0.236	4.00	-0.58	-0.35	
SS	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
SU	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
SW									•
SX	5.0	6.0	5.0	0.58	0.118	5.33	-0.12	0.12	
SZ	4.0	4.0	3.0	0.58	0.118	3.67	-0.70	-0.46	
T	4.0	3.0	5.0	1.00	0.236	4.00	-0.58	-0.35	
TC									•
TD	7.0	7.0	8.0	0.58	0.118	7.33	0.57	0.81	
TE	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
TH	8.0	8.0	7.0	0.58	0.118	7.67	0.69	0.92	
TI	12.0	7.0	9.0	2.52	0.591	9.33	1.27	1.50	
TL	8.0	6.0	6.0	1.15	0.236	6.67	0.34	0.58	
TN	5.0	4.0	5.0	0.58	0.118	4.67	-0.35	-0.12	
TQ	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
TW	5.0	7.0	4.0	1.53	0.354	5.33	-0.12	0.12	
TY	6.0	6.0	6.0	0.00	0.000	6.00	0.11	0.35	
U	6.0	5.0	6.0	0.58	0.118	5.67	0.00	0.23	
UA	24.0	26.0	21.0	2.52	0.591	23.67	6.23	6.47	×
UE	5.0	5.0	5.0	0.00	0.000	5.00	-0.24	0.00	
UG									•
UN	3.0	3.0	3.0	0.00	0.000	3.00	-0.93	-0.69	
UP	7.0	8.0	8.0	0.58	0.118	7.67	0.69	0.92	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

8 / 18 EMSL-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Jan-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
UQ	4.0	4.0	4.0	0.00	0.000	4.00	-0.58	-0.35	
UY									•
VA									•
VC									•
VG	4.0	3.0	3.0	0.58	0.118	3.33	-0.81	-0.58	
VH									•
VI	10.0	9.0	15.0	3.21	0.709	11.33	1.96	2.19	
VJ	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
VM									•
VO	4.0	5.0	4.0	0.58	0.118	4.33	-0.47	-0.23	
VT	9.0	12.0	12.0	1.73	0.354	11.00	1.84	2.08	
VX									•
W	6.0	7.0	7.0	0.58	0.118	6.67	0.34	0.58	
WD									•
WE	8.0	6.0	7.0	1.00	0.236	7.00	0.46	0.69	
WF	3.0	4.0	2.0	1.00	0.236	3.00	-0.93	-0.69	
WH	7.0	6.0	7.0	0.58	0.118	6.67	0.34	0.58	
X	6.0	8.0	4.0	2.00	0.473	6.00	0.11	0.35	
Z	5.0	5.0	6.0	0.58	0.118	5.33	-0.12	0.12	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00		DM	4.00		T	4.33		BK
2.00		RU	4.00		SU	4.33		BB
2.00		EV	4.00		SR	4.33		BA
3.00		WF	4.00		SF	4.67		TN
3.00		UN	4.00		RR	4.67		SD
3.00		SM	4.00		QZ	4.67		SC
3.00		PQ	4.00		JN	4.67		P
3.33		VG	4.00		HP	4.67		OX
3.33		RG	4.00		BG	4.67		L
3.33		OS	4.33		VO	4.67		JM
3.33		OF	4.33		VJ	4.67		JE
3.33		LR	4.33		TQ	4.67		EN
3.33		KE	4.33		RB	4.67		CX
3.33		K	4.33		QP	4.67		AE
3.33		JG	4.33		QC	5.00		UE
3.33		EO	4.33		Q	5.00		SS
3.33		CO	4.33		MQ	5.00		SL
3.67		SZ	4.33		HL	5.00		SI
3.67		NK	4.33		FN	5.00		S
3.67		BO	4.33		E	5.00		RI
3.67		AF	4.33		DO	5.00		R
4.00		UQ	4.33		CG	5.00		QQ
4.00		TE	4.33		CA	5.00		NT

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

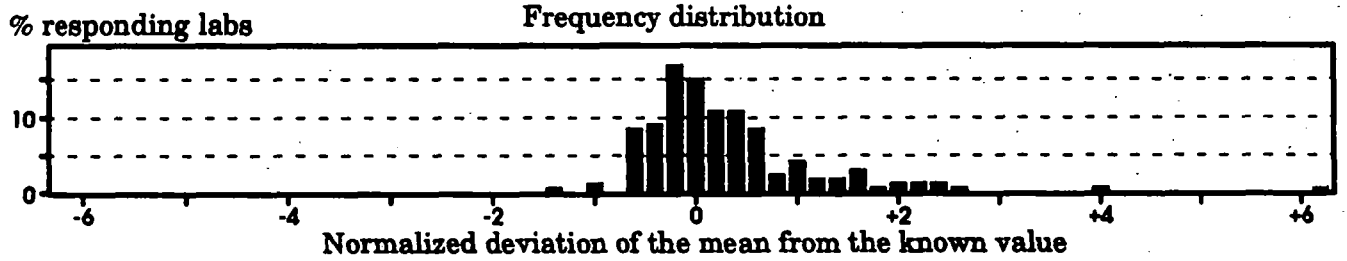
× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.00		NO	5.67		CS	7.00		AL
5.00		NJ	5.67		AW	7.33		TD
5.00		N	6.00		X	7.33		NB
5.00		MF	6.00		TY	7.33		KH
5.00		JQ	6.00		RV	7.33		JS
5.00		IC	6.00		PG	7.67		UP
5.00		HK	6.00		MV	7.67		TH
5.00		HI	6.00		KT	7.67		FJ
5.00		GT	6.00		JY	7.67		CE
5.00		EL	6.00		GQ	7.67		BL
5.00		DT	6.00		DH	8.00		PV
5.00		CK	6.00		CQ	8.00		M
5.00		CJ	6.00		AR	8.33		OY
5.00		BM	6.00		AP	8.67		LT
5.00		BC	6.33		RD	8.67		FL
5.00		AN	6.33		J	9.00		QU
5.33		Z	6.33		IE	9.00		DZ
5.33		TW	6.33		EB	9.00		AJ
5.33		SX	6.33		BH	9.33		TI
5.33		RE	6.33		AU	9.33		OB
5.33		ID	6.67		WH	9.33		DS
5.33		I	6.67		W	9.33		DD
5.33		GZ	6.67		TL	9.67		PR
5.33		C	6.67		RW	10.00		QW
5.67		U	6.67		KX	11.00		VT
5.67		SO	6.67		DB	11.00		KC
5.67		QX	6.67		BN	11.33		VI
5.67		PM	6.67		AZ	11.33		QT
5.67		PB	6.67		AK	11.67		NA
5.67		JP	6.67		A	12.00		OA
5.67		ER	7.00		WE	12.33		DE
5.67		D	7.00		RJ	16.67	×	MY
			7.00		O	23.67	×	UA

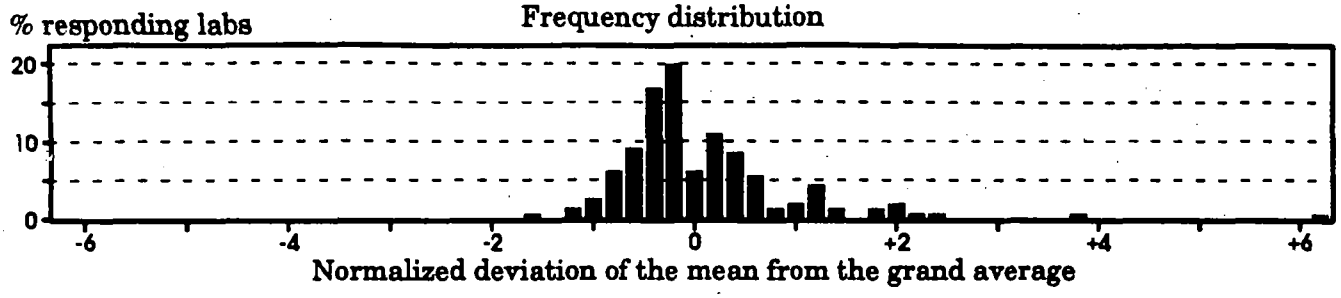


• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

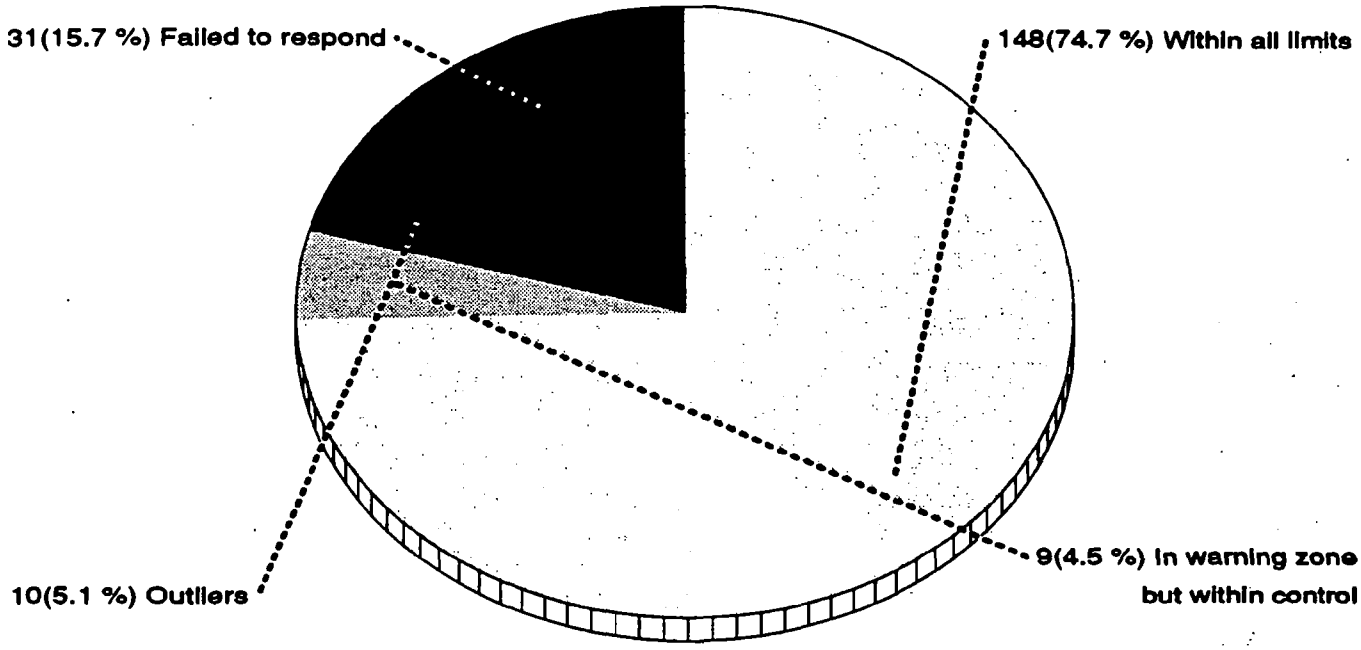
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

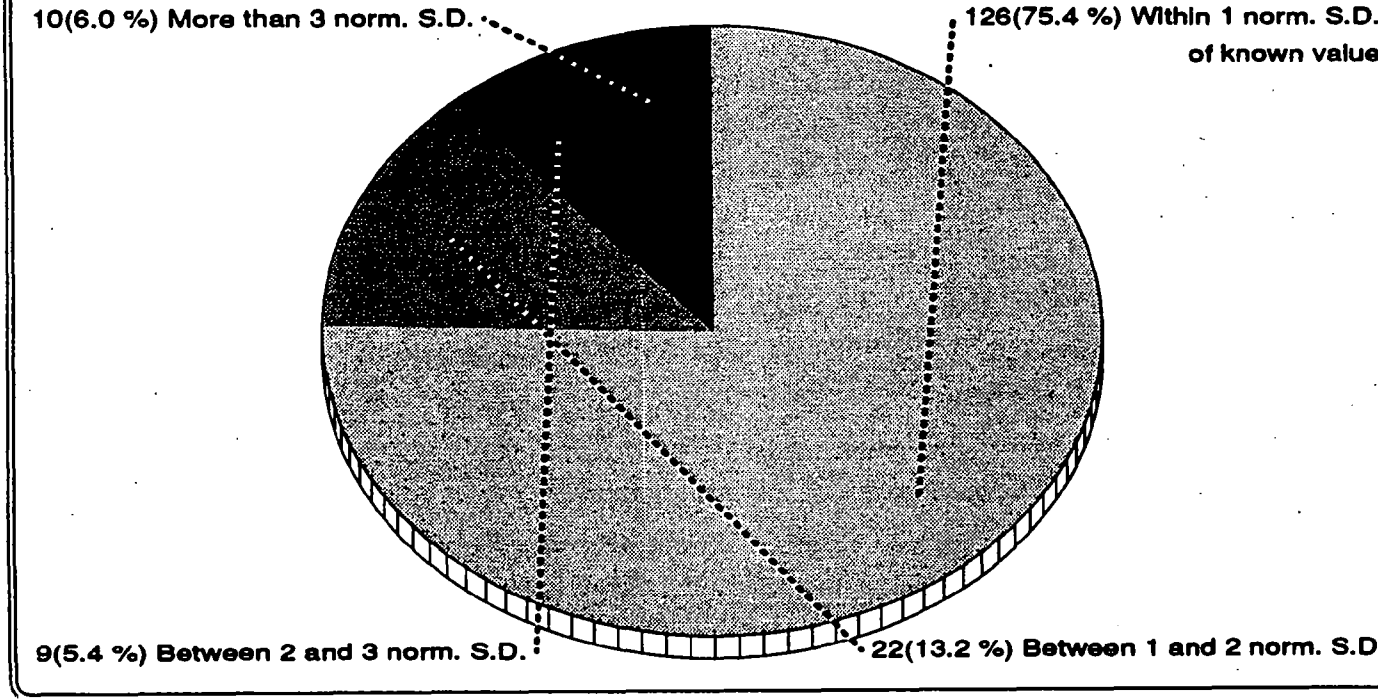

% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Gross Beta Statistical Summary 198 Participants

The known value of this nuclide is **5.0 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 13.7; the warning regions are 0.0 to 0.0 and 10.8 to 13.7



Statistic	Respondents	Non-outliers
Mean	9.97	**Grand Avg 6.62**
Std. Dev.	29.48	1.93
Variance	869.10	3.74
% Coef. of Var.	295.81	29.20
% deviation of mean from known value	99.32	32.48
Norm. dev. of mean from known value	0.17	0.84
Median	6.33	6.33
% deviation of median from known value	26.67	26.67
Norm. dev. of median from known value	0.05	0.69



12 / 18 EMSL-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Jan-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	6.0	6.0	11.0	2.89	0.591	7.67	0.36	0.92	
AE	5.0	4.0	4.0	0.58	0.118	4.33	-0.79	-0.23	
AF	6.0	8.0	5.0	1.53	0.354	6.33	-0.10	0.46	
AH									•
AJ	6.0	6.0	2.0	2.31	0.473	4.67	-0.68	-0.12	
AK	9.0	8.0	8.0	0.58	0.118	8.33	0.59	1.15	
AL	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
AN	9.0	10.0	10.0	0.58	0.118	9.67	1.05	1.62	
AP	7.0	5.0	7.0	1.15	0.236	6.33	-0.10	0.46	
AR	9.0	9.0	7.0	1.15	0.236	8.33	0.59	1.15	
AU	7.0	6.0	5.0	1.00	0.236	6.00	-0.22	0.35	
AW	7.0	7.0	6.0	0.58	0.118	6.67	0.01	0.58	
AZ	5.0	5.0	5.0	0.00	0.000	5.00	-0.56	0.00	
BA	6.0	5.0	6.0	0.58	0.118	5.67	-0.33	0.23	
BB	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
BC	4.0	4.0	3.0	0.58	0.118	3.67	-1.02	-0.46	
BG	5.0	4.0	5.0	0.58	0.118	4.67	-0.68	-0.12	
BH	7.0	7.0	7.0	0.00	0.000	7.00	0.13	0.69	
BI									•
BK	6.0	3.0	5.0	1.53	0.354	4.67	-0.68	-0.12	
BL	7.0	7.0	6.0	0.58	0.118	6.67	0.01	0.58	
BM	5.0	5.0	5.0	0.00	0.000	5.00	-0.56	0.00	
BN	5.0	6.0	5.0	0.58	0.118	5.33	-0.45	0.12	
BO	7.0	8.0	7.0	0.58	0.118	7.33	0.25	0.81	
BW									•
C	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
CA	5.0	4.0	5.0	0.58	0.118	4.67	-0.68	-0.12	
CE	6.0	7.0	5.0	1.00	0.236	6.00	-0.22	0.35	
CG	2.0	6.0	7.0	2.65	0.591	5.00	-0.56	0.00	
CJ	5.0	6.0	7.0	1.00	0.236	6.00	-0.22	0.35	
CK	8.0	11.0	9.0	1.53	0.354	9.33	0.94	1.50	
CO	12.0	11.0	12.0	0.58	0.118	11.67	1.75	2.31	
CP									•
CQ	5.0	6.0	7.0	1.00	0.236	6.00	-0.22	0.35	
CS	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
CX	13.0	5.0	6.0	4.36	0.945	8.00	0.48	1.04	
D	6.0	9.0	8.0	1.53	0.354	7.67	0.36	0.92	
DB	8.0	10.0	10.0	1.15	0.236	9.33	0.94	1.50	
DD	3.0	6.0	4.0	1.53	0.354	4.33	-0.79	-0.23	
DE	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
DG									•
DH	5.0	8.0	8.0	1.73	0.354	7.00	0.13	0.69	
DM	5.0	5.0	6.0	0.58	0.118	5.33	-0.45	0.12	
DO	5.0	6.0	6.0	0.58	0.118	5.67	-0.33	0.23	
DS	7.0	7.0	9.0	1.15	0.236	7.67	0.36	0.92	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DT	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
DZ	11.0	10.0	12.0	1.00	0.236	11.00	1.52	2.08	
E	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
EB	7.0	6.0	5.0	1.00	0.236	6.00	-0.22	0.35	
EL	6.0	6.0	5.0	0.58	0.118	5.67	-0.33	0.23	
EN	11.0	10.0	12.0	1.00	0.236	11.00	1.52	2.08	
EO	6.0	8.0	9.0	1.53	0.354	7.67	0.36	0.92	
ER									•
EV	5.0	6.0	6.0	0.58	0.118	5.67	-0.33	0.23	
EW									•
FF									•
FJ	38.0	58.0	36.0	12.17	4.046	44.00	12.95	13.51	×
FL	31.0	31.0	30.0	0.58	0.118	30.67	8.33	8.89	×
FN	7.0	6.0	7.0	0.58	0.118	6.67	0.01	0.58	
FP									•
FZ									•
GE	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
GJ									•
GQ	7.0	7.0	7.0	0.00	0.000	7.00	0.13	0.69	
GT	3.0	4.0	4.0	0.58	0.118	3.67	-1.02	-0.46	
GZ									•
HI	11.0	11.0	12.0	0.58	0.118	11.33	1.63	2.19	
HK	12.0	10.0	11.0	1.00	0.236	11.00	1.52	2.08	
HL	5.0	5.0	5.0	0.00	0.000	5.00	-0.56	0.00	
HP	7.0	6.0	11.0	2.65	0.591	8.00	0.48	1.04	
I	5.0	5.0	6.0	0.58	0.118	5.33	-0.45	0.12	
IC	6.0	7.0	7.0	0.58	0.118	6.67	0.01	0.58	
ID	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
IE	11.0	9.0	6.0	2.52	0.591	8.67	0.71	1.27	
J	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
JE	6.0	8.0	8.0	1.15	0.236	7.33	0.25	0.81	
JG	20.0	13.0	11.0	4.73	1.120	14.67	2.79	3.35	×
JM	9.0	8.0	8.0	0.58	0.118	8.33	0.59	1.15	
JN	5.0	6.0	6.0	0.58	0.118	5.67	-0.33	0.23	
JP	10.0	7.0	6.0	2.08	0.473	7.67	0.36	0.92	
JQ	6.0	9.0	8.0	1.53	0.354	7.67	0.36	0.92	
JS	9.0	10.0	10.0	0.58	0.118	9.67	1.05	1.62	
JY	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
K	7.0	6.0	9.0	1.53	0.354	7.33	0.25	0.81	
KC	19.0	20.0	18.0	1.00	0.236	19.00	4.29	4.85	×
KE	5.0	6.0	6.0	0.58	0.118	5.67	-0.33	0.23	
KH	10.0	4.0	7.0	3.00	0.709	7.00	0.13	0.69	
KT	4.0	5.0	7.0	1.53	0.354	5.33	-0.45	0.12	
KX	7.0	7.0	5.0	1.15	0.236	6.33	-0.10	0.46	
L	7.0	7.0	8.0	0.58	0.118	7.33	0.25	0.81	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

14 / 18 EMSL-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Jan-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LE									•
LF									•
LL									•
LR	7.0	8.0	6.0	1.00	0.236	7.00	0.13	0.69	
LT	4.0	5.0	7.0	1.53	0.354	5.33	-0.45	0.12	
M	63.0	68.0	64.0	2.65	0.591	65.00	20.22	20.78	×
MA	8.0	7.0	9.0	1.00	0.236	8.00	0.48	1.04	
MF	13.0	13.0	12.0	0.58	0.118	12.67	2.09	2.66	
MQ	9.0	8.0	10.0	1.00	0.236	9.00	0.82	1.39	
MV	9.0	10.0	10.0	0.58	0.118	9.67	1.05	1.62	
MY	7.0	15.0	18.0	5.69	1.570	13.33	2.32	2.89	
N	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
NA	9.0	9.0	10.0	0.58	0.118	9.33	0.94	1.50	
NB	218.0	234.0	688.0	266.86	104.853	380.00	129.34	129.90	×
NE									•
NJ	5.0	6.0	6.0	0.58	0.118	5.67	-0.33	0.23	
NK	7.0	7.0	5.0	1.15	0.236	6.33	-0.10	0.46	
NO	7.0	10.0	14.0	3.51	0.827	10.33	1.28	1.85	
NT	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
O	7.0	6.0	7.0	0.58	0.118	6.67	0.01	0.58	
OA	13.0	13.0	18.0	2.89	0.591	14.67	2.79	3.35	×
OB	12.0	10.0	11.0	1.00	0.236	11.00	1.52	2.08	
OF	4.0	5.0	6.0	1.00	0.236	5.00	-0.56	0.00	
OS	7.0	7.0	7.0	0.00	0.000	7.00	0.13	0.69	
OX	7.0	6.0	5.0	1.00	0.236	6.00	-0.22	0.35	
OY	4.0	3.0	6.0	1.53	0.354	4.33	-0.79	-0.23	
P	4.0	4.0	4.0	0.00	0.000	4.00	-0.91	-0.35	
PB	5.0	5.0	6.0	0.58	0.118	5.33	-0.45	0.12	
PE									•
PG	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
PM	8.0	10.0	13.0	2.52	0.591	10.33	1.28	1.85	
PQ	6.0	5.0	6.0	0.58	0.118	5.67	-0.33	0.23	
PR	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
PV	5.0	6.0	8.0	1.53	0.354	6.33	-0.10	0.46	
Q	5.0	7.0	7.0	1.15	0.236	6.33	-0.10	0.46	
QC	6.0	5.0	5.0	0.58	0.118	5.33	-0.45	0.12	
QJ									•
QP	5.0	6.0	4.0	1.00	0.236	5.00	-0.56	0.00	
QQ	6.0	7.0	7.0	0.58	0.118	6.67	0.01	0.58	
QT	25.0	19.0	21.0	3.06	0.709	21.67	5.21	5.77	×
QU	4.0	5.0	7.0	1.53	0.354	5.33	-0.45	0.12	
QW	8.0	8.0	7.0	0.58	0.118	7.67	0.36	0.92	
QX	7.0	7.0	7.0	0.00	0.000	7.00	0.13	0.69	
QZ	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
R	8.0	8.0	6.0	1.15	0.236	7.33	0.25	0.81	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RB	5.0	5.0	5.0	0.00	0.000	5.00	-0.56	0.00	
RD	7.0	6.0	8.0	1.00	0.236	7.00	0.13	0.69	
RE	21.0	21.0	20.0	0.58	0.118	20.67	4.86	5.43	×
RF									•
RG	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
RH									•
RI	5.0	2.0	3.0	1.53	0.354	3.33	-1.14	-0.58	
RJ	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
RR	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
RU	5.0	6.0	5.0	0.58	0.118	5.33	-0.45	0.12	
RV	6.0	8.0	7.0	1.00	0.236	7.00	0.13	0.69	
RW	7.0	7.0	6.0	0.58	0.118	6.67	0.01	0.58	
RZ									•
S	7.0	8.0	7.0	0.58	0.118	7.33	0.25	0.81	
SC	5.0	4.0	5.0	0.58	0.118	4.67	-0.68	-0.12	
SD	4.0	4.0	4.0	0.00	0.000	4.00	-0.91	-0.35	
SF	7.0	6.0	5.0	1.00	0.236	6.00	-0.22	0.35	
SI	5.0	5.0	5.0	0.00	0.000	5.00	-0.56	0.00	
SL	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
SM	2.0	2.0	2.0	0.00	0.000	2.00	-1.60	-1.04	
SN									•
SO	8.0	9.0	7.0	1.00	0.236	8.00	0.48	1.04	
SR	3.0	6.0	6.0	1.73	0.354	5.00	-0.56	0.00	
SS	6.0	5.0	6.0	0.58	0.118	5.67	-0.33	0.23	
SU	6.0	7.0	5.0	1.00	0.236	6.00	-0.22	0.35	
SW									•
SX	6.0	7.0	7.0	0.58	0.118	6.67	0.01	0.58	
SZ	1.0	2.0	3.0	1.00	0.236	2.00	-1.60	-1.04	
T	4.0	5.0	4.0	0.58	0.118	4.33	-0.79	-0.23	
TC									•
TD	5.0	4.0	4.0	0.58	0.118	4.33	-0.79	-0.23	
TE	7.0	3.0	6.0	2.08	0.473	5.33	-0.45	0.12	
TH	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
TI	8.0	7.0	7.0	0.58	0.118	7.33	0.25	0.81	
TL	6.0	5.0	5.0	0.58	0.118	5.33	-0.45	0.12	
TN	5.0	7.0	8.0	1.53	0.354	6.67	0.01	0.58	
TQ	8.0	6.0	4.0	2.00	0.473	6.00	-0.22	0.35	
TW	4.0	3.0	3.0	0.58	0.118	3.33	-1.14	-0.58	
TY	7.0	7.0	8.0	0.58	0.118	7.33	0.25	0.81	
U	6.0	7.0	7.0	0.58	0.118	6.67	0.01	0.58	
UA	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
UE	8.0	8.0	8.0	0.00	0.000	8.00	0.48	1.04	
UG									•
UN	7.0	6.0	9.0	1.53	0.354	7.33	0.25	0.81	
UP	8.0	9.0	11.0	1.53	0.354	9.33	0.94	1.50	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

16 / 18 EMSL-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Jan-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
UQ	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
UY	7.0	7.0	6.0	0.58	0.118	6.67	0.01	0.58	
VA									•
VC									•
VG	5.0	4.0	4.0	0.58	0.118	4.33	-0.79	-0.23	
VH									•
VI	3.0	3.0	5.0	1.15	0.236	3.67	-1.02	-0.46	
VJ	6.0	6.0	6.0	0.00	0.000	6.00	-0.22	0.35	
VM									•
VO	7.0	6.0	6.0	0.58	0.118	6.33	-0.10	0.46	
VT	12.0	15.0	15.0	1.73	0.354	14.00	2.56	3.12	×
VX									•
W	6.0	6.0	7.0	0.58	0.118	6.33	-0.10	0.46	
WD									•
WE	11.0	11.0	11.0	0.00	0.000	11.00	1.52	2.08	
WF	10.0	13.0	9.0	2.08	0.473	10.67	1.40	1.96	
X	8.0	7.0	7.0	0.58	0.118	7.33	0.25	0.81	
Z	5.0	6.0	6.0	0.58	0.118	5.67	-0.33	0.23	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.00		SZ	5.00		OF	5.67		DO
2.00		SM	5.00		HL	5.67		BA
3.33		TW	5.00		CG	6.00		VJ
3.33		RI	5.00		BM	6.00		TQ
3.67		VI	5.00		AZ	6.00		TH
3.67		GT	5.33		TL	6.00		SU
3.67		BC	5.33		TE	6.00		SF
4.00		SD	5.33		RU	6.00		RG
4.00		P	5.33		QU	6.00		QZ
4.33		VG	5.33		QC	6.00		PR
4.33		TD	5.33		PB	6.00		OX
4.33		T	5.33		LT	6.00		N
4.33		OY	5.33		KT	6.00		J
4.33		DD	5.33		I	6.00		EB
4.33		AE	5.33		DM	6.00		E
4.67		SC	5.33		BN	6.00		DT
4.67		CA	5.67		Z	6.00		CQ
4.67		BK	5.67		SS	6.00		CJ
4.67		BG	5.67		PQ	6.00		CE
4.67		AJ	5.67		NJ	6.00		C
5.00		SR	5.67		KE	6.00		BB
5.00		SI	5.67		JN	6.00		AU
5.00		RB	5.67		EV	6.33		W
5.00		QP	5.67		EL	6.33		VO

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

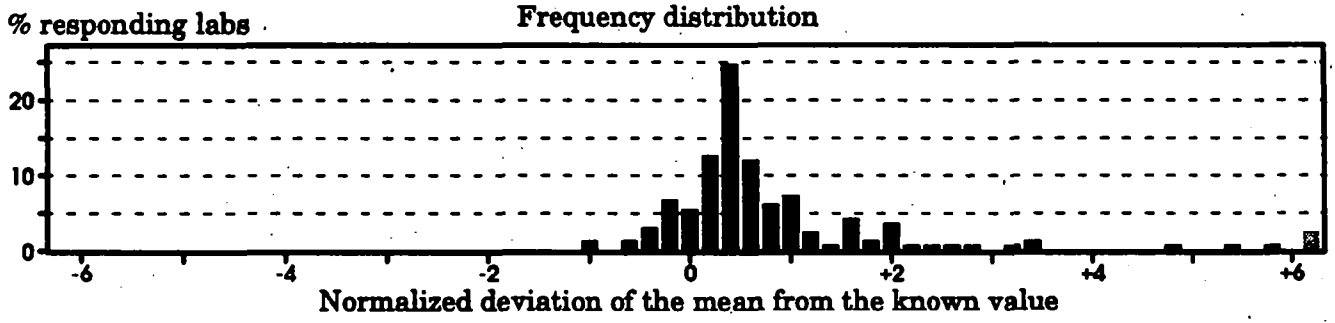
⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.33		UQ	7.00		RD	8.33		AK
6.33		UA	7.00		QX	8.67		IE
6.33		SL	7.00		OS	9.00		MQ
6.33		RR	7.00		LR	9.33		UP
6.33		RJ	7.00		KH	9.33		NA
6.33		Q	7.00		GQ	9.33		DB
6.33		PV	7.00		DH	9.33		CK
6.33		PG	7.00		BH	9.67		MV
6.33		NT	7.33		X	9.67		JS
6.33		NK	7.33		UN	9.67		AN
6.33		KX	7.33		TY	10.33		PM
6.33		JY	7.33		TI	10.33		NO
6.33		ID	7.33		S	10.67		WF
6.33		GE	7.33		R	11.00		WE
6.33		DE	7.33		L	11.00		OB
6.33		CS	7.33		K	11.00		HK
6.33		AP	7.33		JE	11.00		EN
6.33		AL	7.33		BO	11.00		DZ
6.33		AF	7.67		QW	11.33		HI
6.67		UY	7.67		JQ	11.67		CO
6.67		U	7.67		JP	12.67		MF
6.67		TN	7.67		EO	13.33		MY
6.67		SX	7.67		DS	14.00	×	VT
6.67		RW	7.67		D	14.67	×	OA
6.67		QQ	7.67		A	14.67	×	JG
6.67		O	8.00		UE	19.00	×	KC
6.67		IC	8.00		SO	20.67	×	RE
6.67		FN	8.00		MA	21.67	×	QT
6.67		BL	8.00		HP	30.67	×	FL
6.67		AW	8.00		CX	44.00	×	FJ
7.00		RV	8.33		JM	65.00	×	M
			8.33		AR	380.00	×	NB



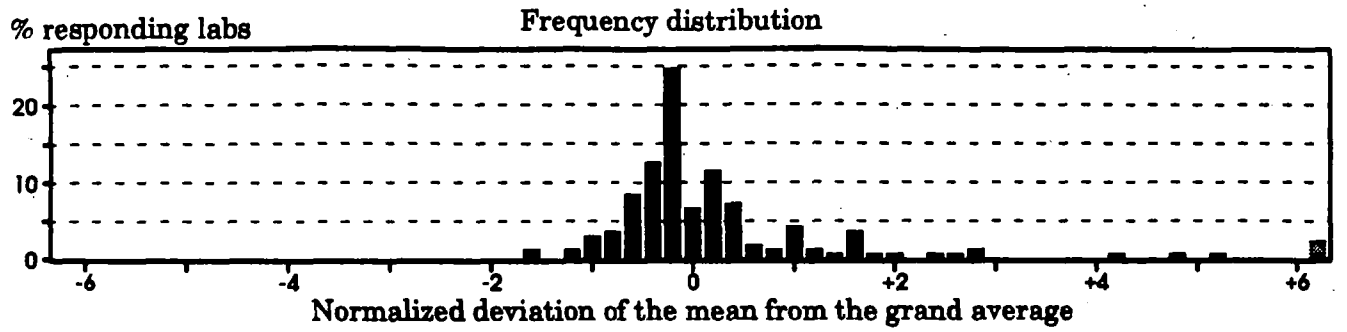
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta


% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/055
April 1995

EPA

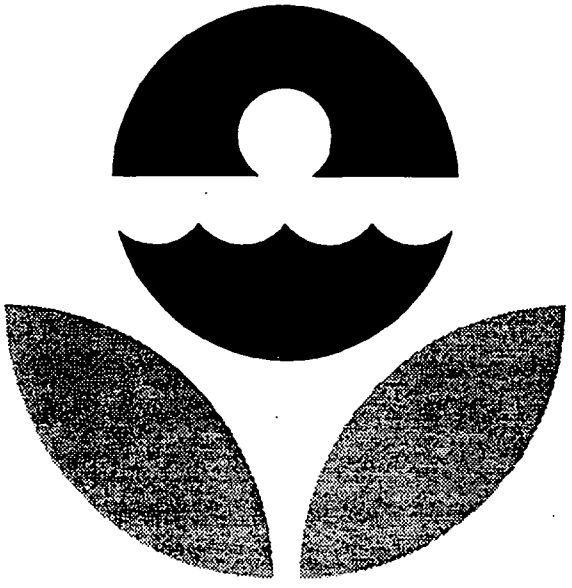
Iodine in Water Performance Evaluation Study

A Statistical Evaluation of the February 3, 1995 Data

Iodine in Water

Performance Evaluation Study

February 3, 1995



Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Nuclear Radiation Assessment Division (EMSL-LV) Performance Evaluation Study for ***Iodine in Water; February 3, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by EMSL-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Branch

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

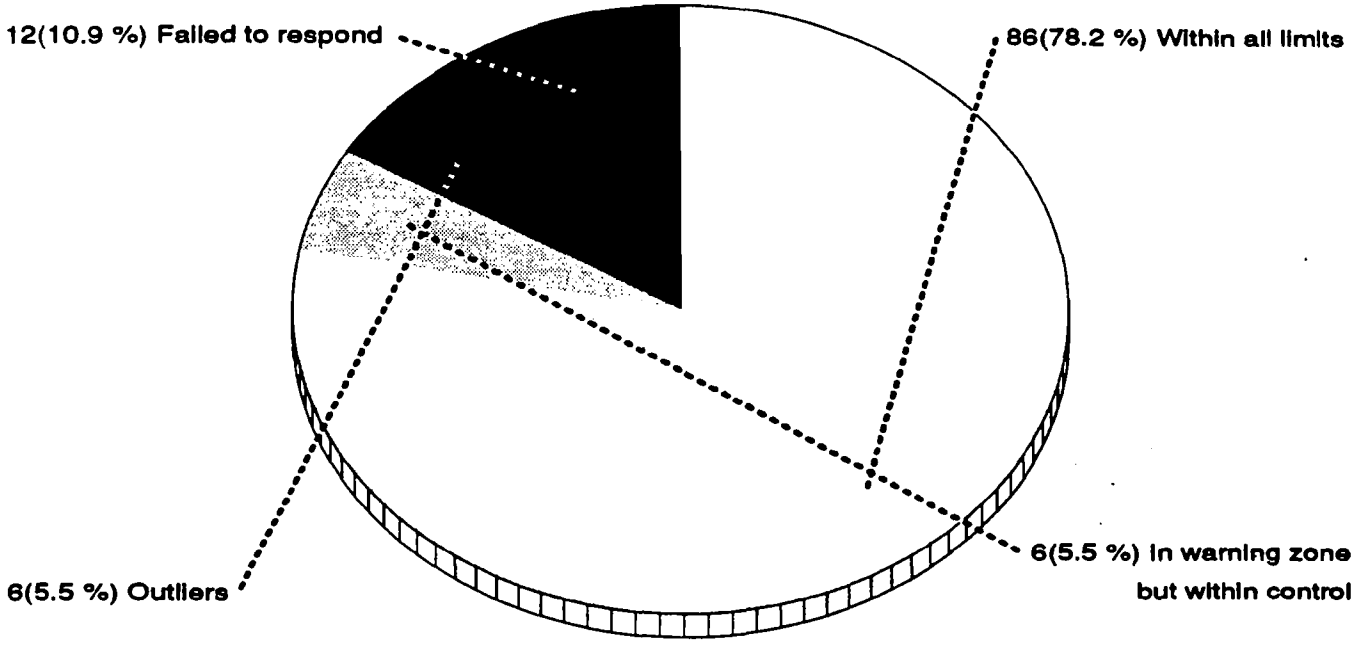
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

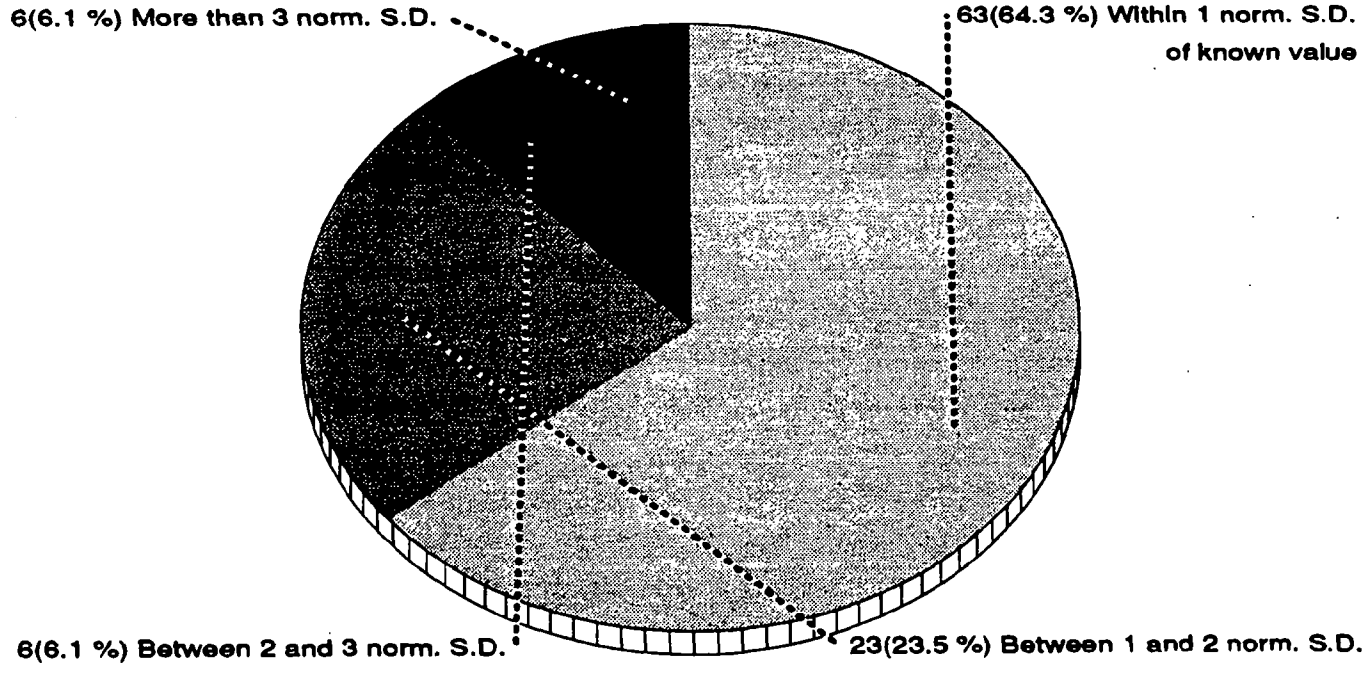
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, EMSL-LV, 702/798-2104.

Iodine-131 Statistical Summary 110 Participants

The known value of this nuclide is **100.0 pCi/l** with an expected precision of **10.0**; the control limits are 82.7 to 117.3; the warning regions are 82.7 to 88.4 and 111.6 to 117.3



Statistic	Respondents	Non-outliers
Mean	99.48	**Grand Avg 98.53**
Std. Dev.	13.07	5.59
Variance	170.73	31.28
% Coef. of Var.	13.14	5.68
% deviation of mean from known value	-0.52	-1.47
Norm. dev. of mean from known value	-0.04	-0.26
Median	98.67	98.50
% deviation of median from known value	-1.33	-1.50
Norm. dev. of median from known value	-0.10	-0.27



EMSL-LV Performance Evaluation: Iodine in Water, 3-Feb-1995

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	92.0	88.0	84.0	4.00	0.473	88.00	-1.82	-2.08	
AF	107.0	107.0	110.0	1.73	0.177	108.00	1.64	1.39	
AI	95.0	88.0	89.0	3.79	0.413	90.67	-1.36	-1.62	
AJ	100.0	97.0	93.0	3.51	0.413	96.67	-0.32	-0.58	
AK	97.0	98.0	98.0	0.58	0.059	97.67	-0.15	-0.40	
AL	101.0	100.0	98.0	1.53	0.177	99.67	0.20	-0.06	
AN	98.0	101.0	100.0	1.53	0.177	99.67	0.20	-0.06	
AP	98.0	103.0	99.0	2.65	0.295	100.00	0.26	0.00	
AU	100.0	96.0	96.0	2.31	0.236	97.33	-0.21	-0.46	
AW	83.0	85.0	85.0	1.15	0.118	84.33	-2.46	-2.71	
AY	101.0	99.0	100.0	1.00	0.118	100.00	0.26	0.00	
AZ	94.0	95.0	96.0	1.00	0.118	95.00	-0.61	-0.87	
BA	97.0	104.0	99.0	3.61	0.413	100.00	0.26	0.00	
BC	83.0	94.0	85.0	5.86	0.650	87.33	-1.94	-2.19	
BH	100.0	97.0	100.0	1.73	0.177	99.00	0.08	-0.17	
BL	85.0	102.0	93.0	8.50	1.008	93.33	-0.90	-1.15	
BM	95.0	99.0	98.0	2.08	0.236	97.33	-0.21	-0.46	
BO	93.0	102.0	97.0	4.51	0.532	97.33	-0.21	-0.46	
C	102.0	99.0	100.0	1.53	0.177	100.33	0.31	0.06	
CA	101.0	102.0	94.0	4.36	0.473	99.00	0.08	-0.17	
CE									•
CJ	87.0	87.0	91.0	2.31	0.236	88.33	-1.77	-2.02	
CP	97.0	98.0	101.0	2.08	0.236	98.67	0.02	-0.23	
CQ	97.0	99.0	100.0	1.53	0.177	98.67	0.02	-0.23	
CX	99.0	106.0	95.0	5.57	0.650	100.00	0.26	0.00	
D	97.0	108.0	94.0	7.37	0.827	99.67	0.20	-0.06	
DD	107.0	105.0	105.0	1.15	0.118	105.67	1.24	0.98	
DE	90.0	90.0	91.0	0.58	0.059	90.33	-1.42	-1.67	
DL	90.0	94.0	94.0	2.31	0.236	92.67	-1.01	-1.27	
DM	99.0	98.0	103.0	2.65	0.295	100.00	0.26	0.00	
DT	98.0	94.0	99.0	2.65	0.295	97.00	-0.26	-0.52	
DY	99.0	98.0	103.0	2.65	0.295	100.00	0.26	0.00	
E	95.0	96.0	99.0	2.08	0.236	96.67	-0.32	-0.58	
EB	103.0	99.0	102.0	2.08	0.236	101.33	0.49	0.23	
EL	99.0	101.0	101.0	1.15	0.118	100.33	0.31	0.06	
EX	152.0	183.0	136.0	23.90	4.383	157.00	10.13	9.87	×
EZ	106.0	116.0	99.0	8.54	1.008	107.00	1.47	1.21	
FK									•
FL	97.0	103.0	97.0	3.46	0.354	99.00	0.08	-0.17	
FU	94.0	90.0	101.0	5.57	0.650	95.00	-0.61	-0.87	
GE	89.0	90.0	87.0	1.53	0.177	88.67	-1.71	-1.96	
GI	103.0	95.0	107.0	6.11	0.709	101.67	0.54	0.29	
HJ	99.0	89.0	91.0	5.29	0.591	93.00	-0.96	-1.21	
HK	95.0	97.0	98.0	1.53	0.177	96.67	-0.32	-0.58	
HP	106.0	102.0	104.0	2.00	0.236	104.00	0.95	0.69	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
I	97.0	97.0	101.0	2.31	0.236	98.33	-0.03	-0.29	
IC	107.0	101.0	107.0	3.46	0.354	105.00	1.12	0.87	
J	94.0	96.0	97.0	1.53	0.177	95.67	-0.50	-0.75	
JR	14.0	17.0	19.0	2.52	0.295	16.67	-14.18	-14.43	×
JS	97.0	92.0	95.0	2.52	0.295	94.67	-0.67	-0.92	
JY	114.0	110.0	101.0	6.66	0.768	108.33	1.70	1.44	
K	103.0	103.0	103.0	0.00	0.000	103.00	0.78	0.52	
KL	99.0	97.0	99.0	1.15	0.118	98.33	-0.03	-0.29	
KX	94.0	96.0	98.0	2.00	0.236	96.00	-0.44	-0.69	
L	89.0	91.0	95.0	3.06	0.354	91.67	-1.19	-1.44	
LF	100.0	95.0	97.0	2.52	0.295	97.33	-0.21	-0.46	
LT									•
M	95.0	98.0	95.0	1.73	0.177	96.00	-0.44	-0.69	
MA	94.0	97.0	94.0	1.73	0.177	95.00	-0.61	-0.87	
MP	106.0	104.0	108.0	2.00	0.236	106.00	1.29	1.04	
MQ	93.0	99.0	95.0	3.06	0.354	95.67	-0.50	-0.75	
MV	114.0	114.0	114.0	0.00	0.000	114.00	2.68	2.42	
N	103.0	101.0	99.0	2.00	0.236	101.00	0.43	0.17	
NJ									•
NZ	93.0	90.0	89.0	2.08	0.236	90.67	-1.36	-1.62	
O	99.0	99.0	100.0	0.58	0.059	99.33	0.14	-0.12	
OA	109.0	103.0	110.0	3.79	0.413	107.33	1.53	1.27	
OB	108.0	105.0	104.0	2.08	0.236	105.67	1.24	0.98	
PB									•
PE	107.0	101.0	102.0	3.21	0.354	103.33	0.83	0.58	
PV	88.0	91.0	97.0	4.58	0.532	92.00	-1.13	-1.39	
PW	93.0	92.0	93.0	0.58	0.059	92.67	-1.01	-1.27	
Q	94.0	95.0	93.0	1.00	0.118	94.00	-0.78	-1.04	
QJ	98.0	101.0	102.0	2.08	0.236	100.33	0.31	0.06	
QU									•
QX	104.0	105.0	102.0	1.53	0.177	103.67	0.89	0.64	
QZ									•
R	96.0	97.0	98.0	1.00	0.118	97.00	-0.26	-0.52	
S	99.0	93.0	99.0	3.46	0.354	97.00	-0.26	-0.52	
SC	142.0	150.0	122.0	14.42	2.245	138.00	6.84	6.58	×
SF	90.0	95.0	97.0	3.61	0.413	94.00	-0.78	-1.04	
SM	82.0	90.0	86.0	4.00	0.473	86.00	-2.17	-2.42	
SS	104.0	104.0	105.0	0.58	0.059	104.33	1.01	0.75	
SV	97.0	94.0	102.0	4.04	0.473	97.67	-0.15	-0.40	
SW									•
SZ	104.0	104.0	104.0	0.00	0.000	104.00	0.95	0.69	
TC	102.0	108.0	111.0	4.58	0.532	107.00	1.47	1.21	
TD	96.0	101.0	100.0	2.65	0.295	99.00	0.08	-0.17	
TE	107.0	99.0	117.0	9.02	1.120	107.67	1.58	1.33	
TH									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

EMSL-LV Performance Evaluation: Iodine in Water, 3-Feb-1995

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
TI	107.0	105.0	105.0	1.15	0.118	105.67	1.24	0.98	
TL	127.0	123.0	110.0	8.89	1.008	120.00	3.72	3.46	×
TQ									•
U	82.0	110.0	86.0	15.14	2.245	92.67	-1.01	-1.27	
UC	130.0	134.0	138.0	4.00	0.473	134.00	6.14	5.89	×
UE	99.0	97.0	98.0	1.00	0.118	98.00	-0.09	-0.35	
UN	109.0	102.0	103.0	3.79	0.413	104.67	1.06	0.81	
UP	105.0	107.0	109.0	2.00	0.236	107.00	1.47	1.21	
UW	99.0	94.0	98.0	2.65	0.295	97.00	-0.26	-0.52	
UY	101.0	99.0	103.0	2.00	0.236	101.00	0.43	0.17	
VA	95.0	98.0	94.0	2.08	0.236	95.67	-0.50	-0.75	
VC	108.0	107.0	104.0	2.08	0.236	106.33	1.35	1.10	
VG	99.0	97.0	100.0	1.53	0.177	98.67	0.02	-0.23	
VM	97.0	100.0	98.0	1.53	0.177	98.33	-0.03	-0.29	
VN	116.0	119.0	121.0	2.52	0.295	118.67	3.49	3.23	×
VQ									•
VX									•
W	99.0	88.0	94.0	5.51	0.650	93.67	-0.84	-1.10	
X	96.0	99.0	94.0	2.52	0.295	96.33	-0.38	-0.64	
Z	105.0	100.0	112.0	6.03	0.709	105.67	1.24	0.98	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
16.67	×	JR	95.00		FU	98.33		VM
84.33		AW	95.00		AZ	98.33		KL
86.00		SM	95.67		VA	98.33		I
87.33		BC	95.67		MQ	98.67		VG
88.00		A	95.67		J	98.67		CQ
88.33		CJ	96.00		M	98.67		CP
88.67		GE	96.00		KX	99.00		TD
90.33		DE	96.33		X	99.00		FL
90.67		NZ	96.67		HK	99.00		CA
90.67		AI	96.67		E	99.00		BH
91.67		L	96.67		AJ	99.33		O
92.00		PV	97.00		UW	99.67		D
92.67		U	97.00		S	99.67		AN
92.67		PW	97.00		R	99.67		AL
92.67		DL	97.00		DT	100.00		DY
93.00		HJ	97.33		LF	100.00		DM
93.33		BL	97.33		BO	100.00		CX
93.67		W	97.33		BM	100.00		BA
94.00		SF	97.33		AU	100.00		AY
94.00		Q	97.67		SV	100.00		AP
94.67		JS	97.67		AK	100.33		QJ
95.00		MA	98.00		UE	100.33		EL

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

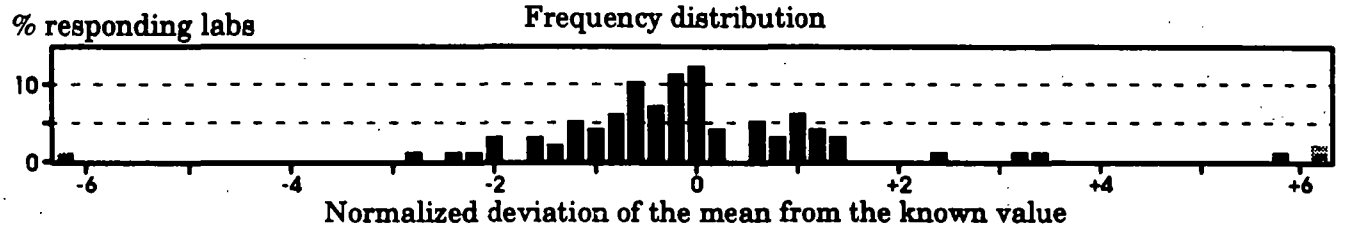
⇑ ≡ Above control limit

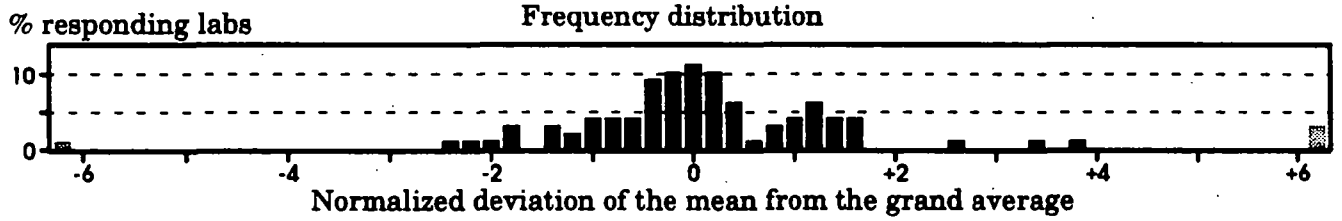
⇓ ≡ Below control limit

Iodine-131

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
100.33		C	104.33		SS	107.00		EZ
101.00		UY	104.67		UN	107.33		OA
101.00		N	105.00		IC	107.67		TE
101.33		EB	105.67		Z	108.00		AF
101.67		GI	105.67		TI	108.33		JY
103.00		K	105.67		OB	114.00		MV
103.33		PE	105.67		DD	118.67	×	VN
103.67		QX	106.00		MP	120.00	×	TL
104.00		SZ	106.33		VC	134.00	×	UC
104.00		HP	107.00		UP	138.00	×	SC
			107.00		TC	157.00	×	EX





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TAG SYMBOLS

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⇑ ≡ Above control limit
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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/062
May 1995

EPA

Uranium-Radium in Water Performance Evaluation Study

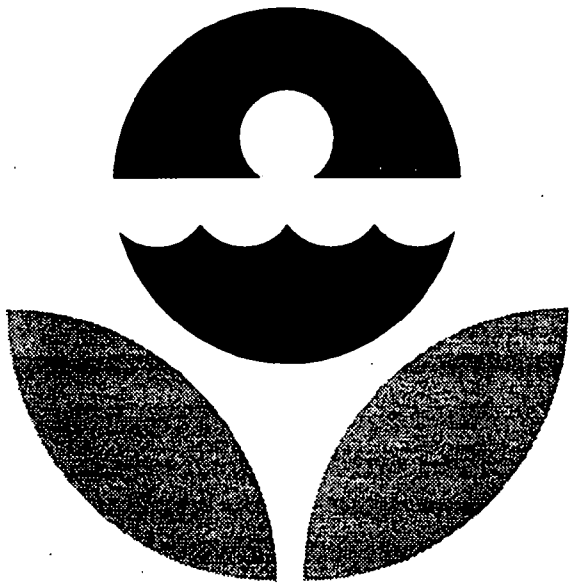
A Statistical Evaluation of the February 10, 1995 Data

0593RSD94 cov-062

Uranium-Radium in Water

Performance Evaluation Study

February 10, 1995



Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Nuclear Radiation Assessment Division (EMSL-LV) Performance Evaluation Study for ***Uranium-Radium in Water; February 10, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by EMSL-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Branch

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

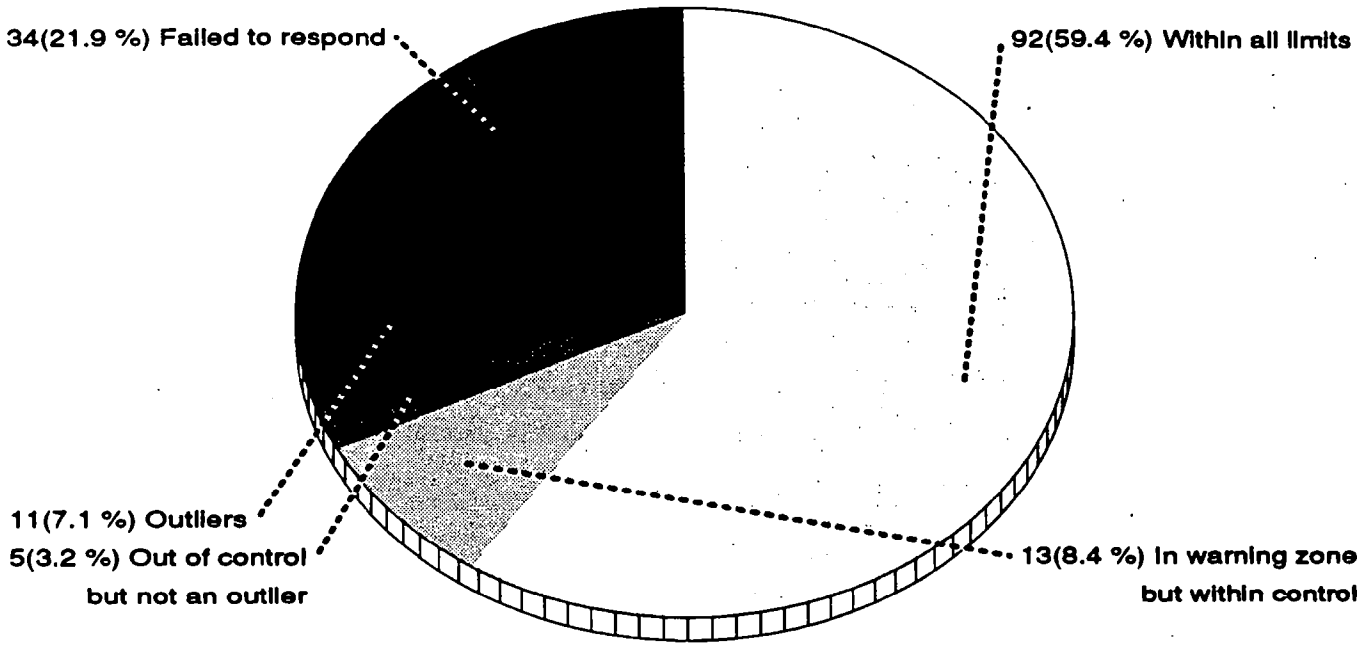
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

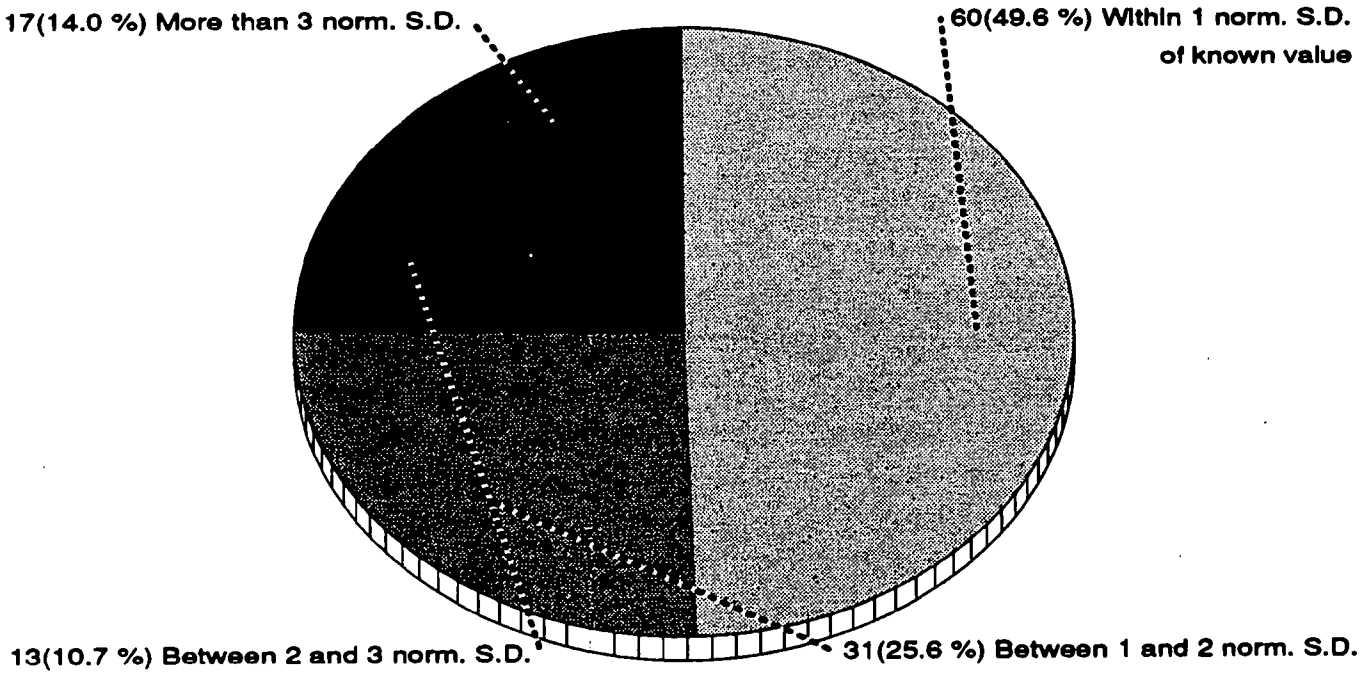
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, EMSL-LV, 702/798-2104.

Uranium (Natural) Statistical Summary 155 Participants

The known value of this nuclide is **25.5 pCi/l** with an expected precision of **3.0**; the control limits are 20.3 to 30.7; the warning regions are 20.3 to 22.0 and 29.0 to 30.7



Statistic	Respondents	Non-outliers
Mean	27.80	**Grand Avg 24.74**
Std. Dev.	24.49	2.46
Variance	599.86	6.03
% Coef. of Var.	88.11	9.93
% deviation of mean from known value	9.00	-2.99
Norm. dev. of mean from known value	0.09	-0.31
Median	25.07	25.00
% deviation of median from known value	-1.70	-1.96
Norm. dev. of median from known value	-0.02	-0.20



EMSL-LV Performance Evaluation: Uranium-Radium in Water, 10-Feb-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	24.7	25.1	25.8	0.56	0.217	25.20	0.27	-0.17	
AE	24.9	24.7	23.4	0.81	0.295	24.33	-0.23	-0.67	
AF	26.0	25.8	27.1	0.70	0.256	26.30	0.90	0.46	
AH	23.0	22.8	22.6	0.20	0.079	22.80	-1.12	-1.56	
AI									•
AJ	26.7	28.2	26.8	0.84	0.295	27.23	1.44	1.00	
AK	27.0	28.1	28.7	0.86	0.335	27.93	1.85	1.40	
AL	25.5	27.6	26.4	1.05	0.413	26.50	1.02	0.58	
AP	23.7	25.1	26.4	1.35	0.532	25.07	0.19	-0.25	
AR	21.0	23.9	22.1	1.46	0.571	22.33	-1.39	-1.83	
AU									•
AW	23.9	25.1	25.4	0.79	0.295	24.80	0.04	-0.40	
AZ	26.9	26.2	26.4	0.36	0.138	26.50	1.02	0.58	
BA	24.9	26.0	25.4	0.55	0.217	25.43	0.40	-0.04	
BC	25.0	25.1	24.2	0.49	0.177	24.77	0.02	-0.42	
BG	25.0	29.8	26.0	2.53	0.945	26.93	1.27	0.83	
BG	24.3	24.0	22.7	0.85	0.315	23.67	-0.62	-1.06	
BG	25.7	24.0	25.3	0.89	0.335	25.00	0.15	-0.29	
BH	36.8	37.0	33.0	2.25	0.788	35.60	6.27	5.83	×
BK	23.4	22.4	23.1	0.51	0.197	22.97	-1.02	-1.46	
BM	13.6	13.3	12.4	0.62	0.236	13.10	-6.72	-7.16	×
BN	25.5	25.6	24.9	0.38	0.138	25.33	0.34	-0.10	
BO	23.8	23.4	24.0	0.31	0.118	23.73	-0.58	-1.02	
C	28.2	26.5	24.9	1.65	0.650	26.53	1.04	0.60	
CA	25.0	25.0	24.7	0.17	0.059	24.90	0.09	-0.35	
CE	25.4	25.6	24.9	0.36	0.138	25.30	0.33	-0.12	
CG	24.0	25.0	26.0	1.00	0.394	25.00	0.15	-0.29	
CJ	24.0	25.0	25.0	0.58	0.197	24.67	-0.04	-0.48	
CK									•
CM	25.2	25.2	23.8	0.81	0.276	24.73	0.00	-0.44	
CO									•
CS	20.8	20.9	20.6	0.15	0.059	20.77	-2.29	-2.73	
CX	25.9	27.7	26.4	0.93	0.354	26.67	1.11	0.67	
D	25.7	24.9	25.0	0.44	0.158	25.20	0.27	-0.17	
DB	37.0	38.0	36.0	1.00	0.394	37.00	7.08	6.64	×
DE	30.3	30.3	30.4	0.06	0.020	30.33	3.23	2.79	
DO	24.0	28.3	23.7	2.57	0.906	25.33	0.34	-0.10	
DP									•
DT	23.6	17.8	20.3	2.91	1.270	20.57	-2.41	-2.85	
DZ	26.0	28.2	30.3	2.15	0.847	28.17	1.98	1.54	
E	23.1	23.5	22.8	0.35	0.138	23.13	-0.93	-1.37	
EB	23.6	23.3	23.7	0.21	0.079	23.53	-0.69	-1.14	
EO									•
EP									•
ER									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
FJ	30.6	38.3	35.0	3.86	1.983	34.63	5.71	5.27	×
FN	87.0	87.0	79.4	4.39	1.945	84.47	34.48	34.04	×
FP									•
FZ	26.0	26.0	25.3	0.40	0.138	25.77	0.59	0.15	
GN	25.0	25.0	23.7	0.75	0.256	24.57	-0.10	-0.54	
GQ	27.4	28.9	30.3	1.45	0.571	28.87	2.38	1.94	
HK	25.4	24.6	25.3	0.44	0.158	25.10	0.21	-0.23	
HL	21.8	22.4	22.5	0.38	0.138	22.23	-1.45	-1.89	
HP	23.6	23.7	24.0	0.21	0.079	23.77	-0.56	-1.00	
I	21.0	24.1	30.3	4.74	2.583	25.13	0.23	-0.21	
ID	32.1	27.9	32.1	2.42	0.827	30.70	3.44	3.00	
IE	25.1	25.1	24.8	0.17	0.059	25.00	0.15	-0.29	
J	25.5	25.9	25.2	0.35	0.138	25.53	0.46	0.02	
JE	24.6	20.0	23.4	2.39	0.906	22.67	-1.20	-1.64	
JG									•
JK	23.0	22.3	20.0	1.57	0.591	21.77	-1.71	-2.16	
JN									•
JP	42.5	43.4	43.2	0.47	0.177	43.03	10.56	10.12	×
JS	22.6	22.6	22.8	0.12	0.039	22.67	-1.20	-1.64	
JX									•
JY	23.4	23.6	22.8	0.42	0.158	23.27	-0.85	-1.29	
K	23.4	24.1	21.4	1.40	0.532	22.97	-1.02	-1.46	
KH	24.8	25.2	25.2	0.23	0.079	25.07	0.19	-0.25	
KL									•
L	25.0	25.3	25.6	0.30	0.118	25.30	0.33	-0.12	
LH									•
LT	39.9	36.1	38.0	1.90	0.748	38.00	7.66	7.22	×
LZ	20.8	21.0	22.0	0.64	0.236	21.27	-2.00	-2.44	
M									•
MY									•
N	23.4	24.8	22.2	1.30	0.512	23.47	-0.73	-1.17	
NA	18.0	19.0	21.0	1.53	0.591	19.33	-3.12	-3.56	⇓
NH	25.9	26.1	26.5	0.31	0.118	26.17	0.83	0.38	
NJ	24.0	24.0	22.0	1.15	0.394	23.33	-0.81	-1.25	
NK	24.3	25.3	23.5	0.90	0.354	24.37	-0.21	-0.65	
NO	26.0	26.4	26.8	0.40	0.158	26.40	0.96	0.52	
NT	25.1	25.1	25.1	0.01	0.000	25.10	0.21	-0.23	
OB	25.6	25.6	25.4	0.12	0.039	25.53	0.46	0.02	
OF									•
OS	23.1	23.0	22.7	0.21	0.079	22.93	-1.04	-1.48	
OX	21.5	20.4	20.3	0.67	0.236	20.73	-2.31	-2.75	
OY	26.5	26.2	27.2	0.51	0.197	26.63	1.09	0.65	
P	21.8	21.8	14.2	4.39	1.945	19.27	-3.16	-3.60	⇓
PB	27.3	25.7	27.6	1.02	0.374	26.87	1.23	0.79	
PG	26.7	25.3	26.3	0.72	0.276	26.10	0.79	0.35	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 EMSL-LV Performance Evaluation: Uranium-Radium in Water, 10-Feb-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
PQ	25.0	24.9	25.8	0.49	0.177	25.23	0.29	-0.15	
PV	18.0	21.4	22.4	2.31	0.866	20.60	-2.39	-2.83	
PW	23.8	29.2	24.2	3.01	1.120	25.73	0.58	0.13	
PX									•
Q	27.7	28.3	27.8	0.32	0.118	27.93	1.85	1.40	
QJ									•
QQ	27.2	25.4	24.0	1.60	0.630	25.53	0.46	0.02	
QU	26.3	29.9	33.8	3.75	1.908	30.00	3.04	2.60	
QX	13.6	14.2	14.1	0.32	0.118	13.97	-6.22	-6.66	×
QZ	27.2	27.3	27.2	0.06	0.020	27.23	1.44	1.00	
R									•
RD	20.0	20.9	20.7	0.47	0.177	20.53	-2.43	-2.87	
RF									•
RG	25.1	25.8	26.9	0.91	0.354	25.93	0.69	0.25	
RK	24.9	22.6	27.4	2.40	0.945	24.97	0.13	-0.31	
RL									•
RP	25.9	25.9	24.9	0.58	0.197	25.57	0.48	0.04	
RR	25.8	24.2	24.7	0.82	0.315	24.90	0.09	-0.35	
RV	24.8	25.7	25.7	0.52	0.177	25.40	0.38	-0.06	
RW	21.9	21.9	22.3	0.23	0.079	22.03	-1.56	-2.00	
RX	45.0	40.0	42.0	2.52	0.984	42.33	10.16	9.72	×
RZ	27.2	25.7	28.8	1.55	0.610	27.23	1.44	1.00	
S	22.6	22.1	23.2	0.55	0.217	22.63	-1.21	-1.66	
SC	25.5	24.2	27.1	1.45	0.571	25.60	0.50	0.06	
SD	23.1	24.9	24.3	0.92	0.354	24.10	-0.37	-0.81	
SF	23.3	23.3	23.3	0.01	0.000	23.30	-0.83	-1.27	
SI	24.8	24.7	24.3	0.26	0.098	24.60	-0.08	-0.52	
SL	25.0	25.7	30.0	2.71	0.984	26.90	1.25	0.81	
SM	26.8	26.7	27.2	0.26	0.098	26.90	1.25	0.81	
SO	21.7	21.8	22.2	0.26	0.098	21.90	-1.64	-2.08	
SS	22.4	24.6	23.3	1.11	0.433	23.43	-0.75	-1.19	
ST	24.6	24.1	24.6	0.29	0.098	24.43	-0.18	-0.62	
SW									•
SX									•
SZ	23.0	23.2	23.6	0.31	0.118	23.27	-0.85	-1.29	
T	30.2	26.9	30.2	1.91	0.650	29.10	2.52	2.08	
TD	27.8	28.3	28.2	0.26	0.098	28.10	1.94	1.50	
TE	25.9	25.7	27.1	0.76	0.276	26.23	0.86	0.42	
TH									•
TI	24.7	24.2	24.7	0.29	0.098	24.53	-0.12	-0.56	
TL	21.5	21.2	21.1	0.21	0.079	21.27	-2.00	-2.44	
TN									•
TQ	25.2	28.9	24.9	2.23	0.788	26.33	0.92	0.48	
TS	22.7	22.4	22.5	0.15	0.059	22.53	-1.27	-1.71	
U	26.6	26.4	25.6	0.53	0.197	26.20	0.84	0.40	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
UE	23.3	22.2	24.1	0.95	0.374	23.20	-0.89	-1.33	
UN	16.7	17.1	16.7	0.23	0.079	16.83	-4.56	-5.00	⇓
UP	19.0	19.7	19.9	0.47	0.177	19.53	-3.00	-3.44	⇓
UQ									•
US									•
UW	26.8	27.3	26.4	0.45	0.177	26.83	1.21	0.77	
UZ	12.2	16.3	19.0	3.42	1.645	15.83	-5.14	-5.58	×
VA	306.6	297.0	249.3	30.69	20.584	284.30	149.86	149.42	×
VG	26.4	25.4	26.4	0.58	0.197	26.07	0.77	0.33	
VH									•
VI	23.1	22.6	22.1	0.50	0.197	22.60	-1.23	-1.67	
VK									•
VT									•
VV									•
W	24.8	25.5	23.8	0.85	0.335	24.70	-0.02	-0.46	
WC									•
WG	31.3	31.2	31.2	0.06	0.020	31.23	3.75	3.31	⇑
WH									•
X	31.5	22.9	24.8	4.52	2.320	26.40	0.96	0.52	
Z	24.7	23.4	23.7	0.68	0.256	23.93	-0.46	-0.90	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
13.10	×	BM	22.67		JS	24.43		ST
13.97	×	QX	22.67		JE	24.53		TI
15.83	×	UZ	22.80		AH	24.57		GN
16.83	⇓	UN	22.93		OS	24.60		SI
19.27	⇓	P	22.97		K	24.67		CJ
19.33	⇓	NA	22.97		BK	24.70		W
19.53	⇓	UP	23.13		E	24.73		CM
20.53		RD	23.20		UE	24.77		BC
20.57		DT	23.27		SZ	24.80		AW
20.60		PV	23.27		JY	24.90		RR
20.73		OX	23.30		SF	24.90		CA
20.77		CS	23.33		NJ	24.97		RK
21.27		LZ	23.43		SS	25.00		IE
21.27		TL	23.47		N	25.00		CG
21.77		JK	23.53		EB	25.00		BG
21.90		SO	23.67		BG	25.07		KH
22.03		RW	23.73		BO	25.07		AP
22.23		HL	23.77		HP	25.10		NT
22.33		AR	23.93		Z	25.10		HK
22.53		TS	24.10		SD	25.13		I
22.60		VI	24.33		AE	25.20		D
22.63		S	24.37		NK	25.20		A

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

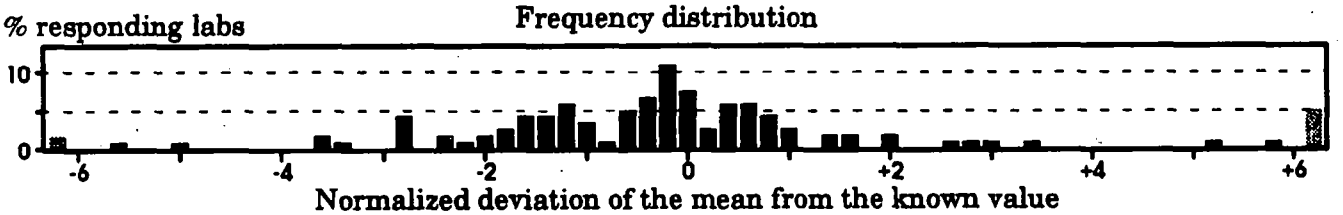
⇑ ≡ Above control limit

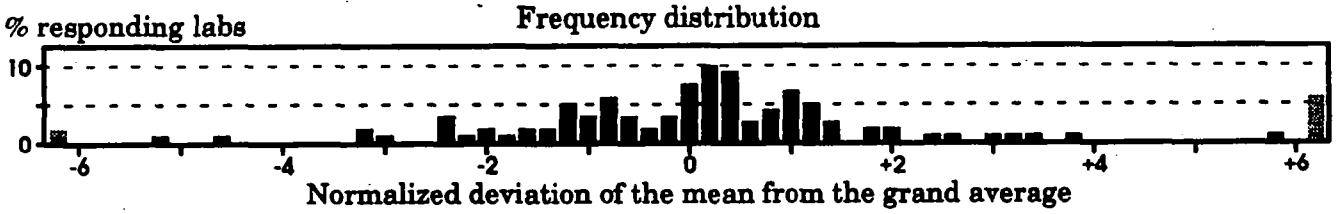
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
25.23		PQ	26.20		U	27.23		AJ
25.30		L	26.23		TE	27.93		Q
25.30		CE	26.30		AF	27.93		AK
25.33		DO	26.33		TQ	28.10		TD
25.33		BN	26.40		X	28.17		DZ
25.40		RV	26.40		NO	28.87		GQ
25.43		BA	26.50		AZ	29.10		T
25.53		QQ	26.50		AL	30.00		QU
25.53		OB	26.53		C	30.33		DE
25.53		J	26.63		OY	30.70		ID
25.57		RP	26.67		CX	31.23	⇑	WG
25.60		SC	26.83		UW	34.63	×	FJ
25.73		PW	26.87		PB	35.60	×	BH
25.77		FZ	26.90		SM	37.00	×	DB
25.93		RG	26.90		SL	38.00	×	LT
26.07		VG	26.93		BG	42.33	×	RX
26.10		PG	27.23		RZ	43.03	×	JP
26.17		NH	27.23		QZ	84.47	×	FN
						284.30	×	VA





• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

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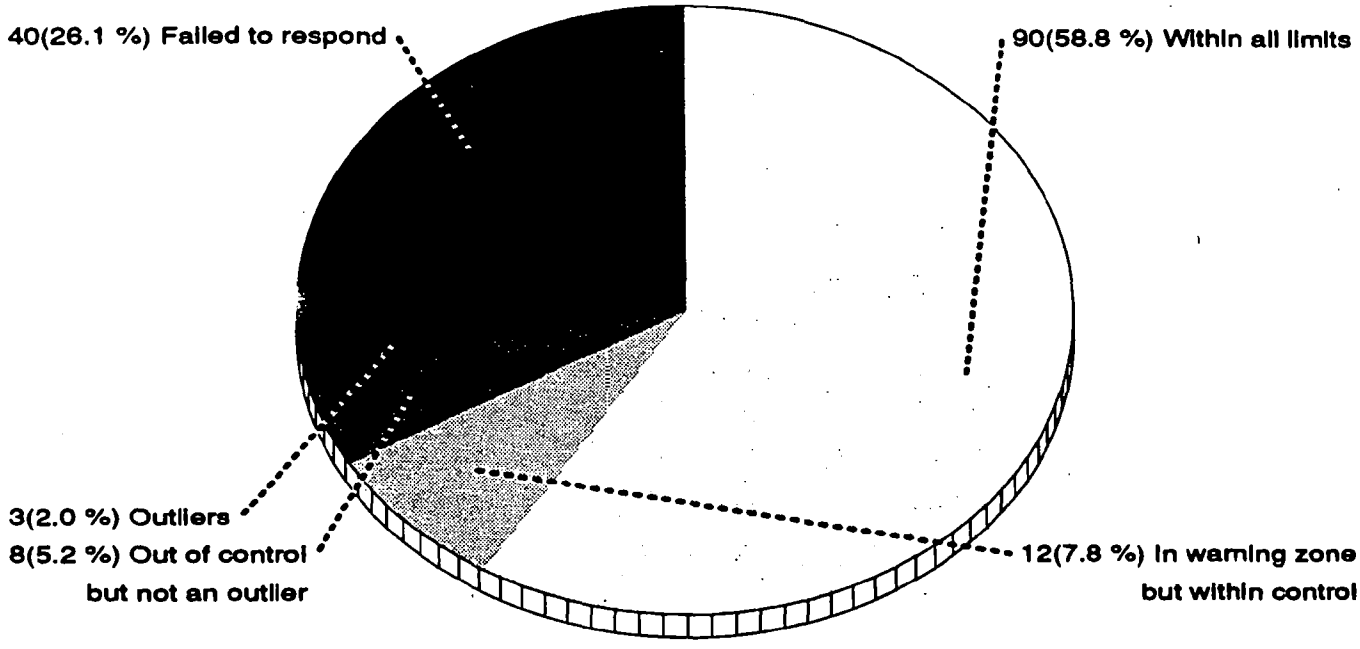
⇑ ≡ Above control limit

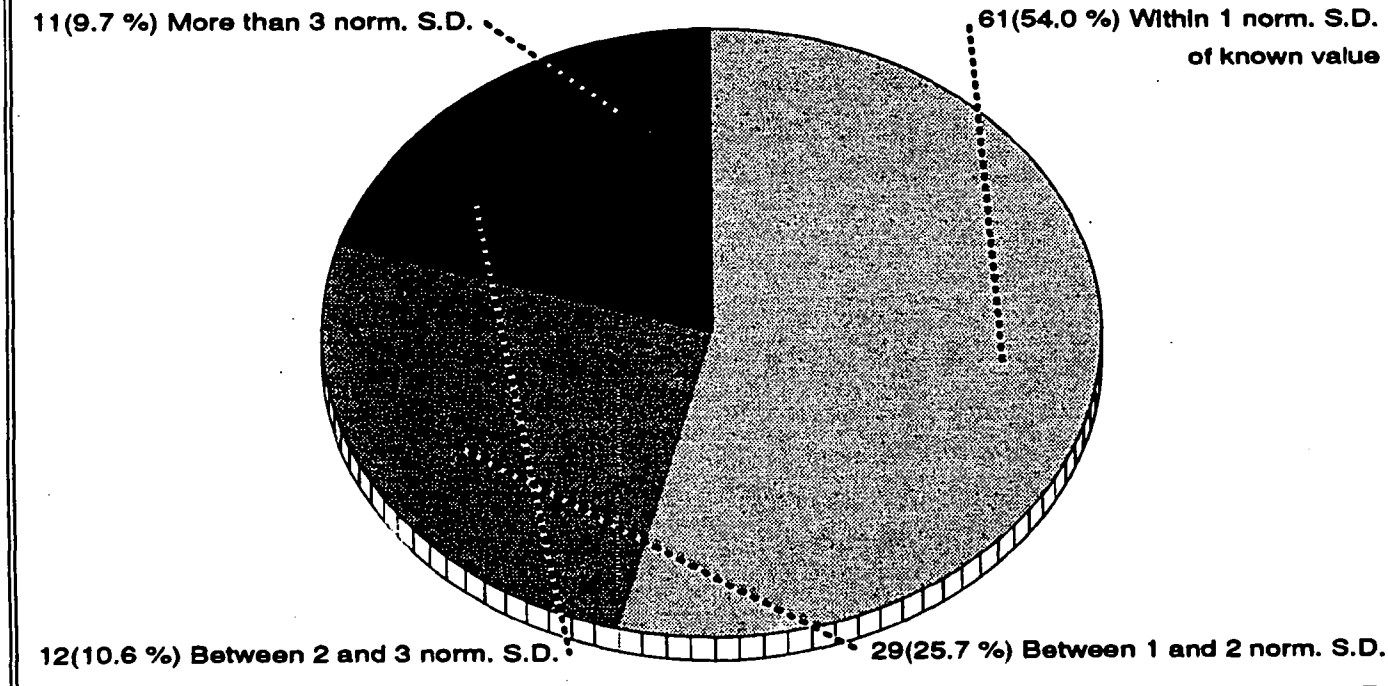
⇓ ≡ Below control limit

Radium-226 Statistical Summary 153 Participants

The known value of this nuclide is **19.1 pCi/l** with an expected precision of **2.9**; the control limits are 14.1 to 24.1; the warning regions are 14.1 to 15.7 and 22.5 to 24.1



Statistic	Respondents	Non-outliers
Mean	18.84	**Grand Avg 18.62**
Std. Dev.	3.67	2.71
Variance	13.48	7.32
% Coef. of Var.	19.49	14.53
% deviation of mean from known value	-1.38	-2.54
Norm. dev. of mean from known value	-0.07	-0.18
Median	18.83	18.83
% deviation of median from known value	-1.40	-1.40
Norm. dev. of median from known value	-0.07	-0.10



10 / 20 EMSL-LV Performance Evaluation: Uranium-Radium in Water, 10-Feb-1995

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	18.1	16.1	18.4	1.25	0.468	17.53	-0.65	-0.94	
AE	17.4	16.8	17.2	0.31	0.122	17.13	-0.89	-1.17	
AF	18.3	18.4	18.4	0.06	0.020	18.37	-0.15	-0.44	
AH									•
AI									•
AJ	18.1	19.6	20.1	1.04	0.407	19.27	0.39	0.10	
AK	19.9	20.4	19.1	0.66	0.265	19.80	0.71	0.42	
AL	17.1	17.7	17.7	0.35	0.122	17.50	-0.67	-0.96	
AP	19.8	19.1	20.1	0.51	0.204	19.67	0.63	0.34	
AR									•
AU	15.5	17.0	17.9	1.21	0.489	16.80	-1.08	-1.37	
AW	9.4	10.7	10.1	0.65	0.265	10.07	-5.11	-5.40	⇓
AZ	14.3	18.6	17.1	2.18	0.876	16.67	-1.16	-1.45	
BA	18.2	18.3	18.2	0.06	0.020	18.23	-0.23	-0.52	
BC	17.9	19.1	18.6	0.60	0.244	18.53	-0.05	-0.34	
BG									•
BH	16.0	15.3	18.3	1.57	0.611	16.53	-1.24	-1.53	
BK	18.5	18.2	18.2	0.17	0.061	18.30	-0.19	-0.48	
BM	17.5	17.7	17.5	0.12	0.041	17.57	-0.63	-0.92	
BN	18.9	18.9	19.2	0.17	0.061	19.00	0.23	-0.06	
BO	19.0	19.8	19.6	0.42	0.163	19.47	0.51	0.22	
C	19.6	20.2	20.6	0.50	0.204	20.13	0.91	0.62	
CA	19.6	19.1	18.8	0.40	0.163	19.17	0.33	0.04	
CE	18.0	13.5	15.9	2.25	0.917	15.80	-1.68	-1.97	
CG	18.8	20.2	20.4	0.87	0.326	19.80	0.71	0.42	
CJ	21.0	21.0	20.0	0.58	0.204	20.67	1.22	0.94	
CK									•
CM									•
CO									•
CS	19.3	20.2	21.1	0.90	0.367	20.20	0.95	0.66	
CX									•
D									•
DB	17.6	18.0	17.3	0.35	0.143	17.63	-0.59	-0.88	
DE	19.8	19.8	19.8	0.00	0.000	19.80	0.71	0.42	
DO									•
DP									•
DT	19.0	17.2	17.0	1.10	0.407	17.73	-0.53	-0.82	
DZ	21.0	20.7	19.9	0.57	0.224	20.53	1.15	0.86	
E	20.5	20.1	19.8	0.35	0.143	20.13	0.91	0.62	
EB	18.6	19.1	19.2	0.32	0.122	18.97	0.21	-0.08	
EO	22.5	20.2	21.4	1.15	0.468	21.37	1.64	1.35	
EP	17.9	17.3	17.4	0.32	0.122	17.53	-0.65	-0.94	
ER									•
FJ									•
FN	18.7	17.0	17.6	0.86	0.346	17.77	-0.51	-0.80	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
FP									•
FZ	18.2	12.8	18.0	3.06	1.190	16.33	-1.36	-1.65	
GN	18.5	19.1	18.2	0.46	0.183	18.60	-0.01	-0.30	
GQ	20.8	21.4	20.3	0.55	0.224	20.83	1.32	1.04	
HK	18.6	19.6	19.1	0.50	0.204	19.10	0.29	0.00	
HL	16.2	16.5	18.9	1.48	0.550	17.20	-0.85	-1.13	
HP	18.8	19.5	20.6	0.91	0.367	19.63	0.61	0.32	
I	26.0	24.1	17.1	4.69	2.548	22.40	2.26	1.97	
ID	13.3	14.8	13.9	0.75	0.306	14.00	-2.76	-3.05	⇓
IE									•
J	17.0	19.1	18.4	1.07	0.428	18.17	-0.27	-0.56	
JE	21.7	22.5	21.1	0.70	0.285	21.77	1.88	1.59	
JG	21.2	20.0	21.5	0.79	0.306	20.90	1.36	1.08	
JK									•
JN									•
JP									•
JS	24.0	23.9	21.8	1.24	0.448	23.23	2.76	2.47	
JX	19.1	18.8	20.1	0.68	0.265	19.33	0.43	0.14	
JY	20.2	19.9	21.2	0.68	0.265	20.43	1.09	0.80	
K	14.2	14.3	9.9	2.51	0.896	12.80	-3.47	-3.76	⇓
KH	18.7	18.4	17.9	0.40	0.163	18.33	-0.17	-0.46	
KL	22.7	22.5	19.5	1.79	0.652	21.57	1.76	1.47	
L	17.4	17.4	17.8	0.23	0.081	17.53	-0.65	-0.94	
LH									•
LT	41.2	35.7	43.3	3.92	2.044	40.07	12.81	12.52	×
LZ	20.0	20.1	20.0	0.06	0.020	20.03	0.85	0.56	
M	19.6	21.9	17.3	2.30	0.937	19.60	0.59	0.30	
MY									•
N	19.3	18.6	19.2	0.38	0.143	19.03	0.25	-0.04	
NA									•
NH	22.9	20.1	21.1	1.42	0.570	21.37	1.64	1.35	
NJ	20.0	20.0	21.0	0.58	0.204	20.33	1.03	0.74	
NK									•
NO	19.8	20.2	20.5	0.35	0.143	20.17	0.93	0.64	
NT	18.9	19.3	19.7	0.40	0.163	19.30	0.41	0.12	
OB	9.0	9.3	9.2	0.15	0.061	9.17	-5.64	-5.93	×
OF	17.0	14.9	15.8	1.05	0.428	15.90	-1.62	-1.91	
OS									•
OX	19.1	19.5	19.4	0.21	0.081	19.33	0.43	0.14	
OY	13.5	13.2	13.0	0.25	0.102	13.23	-3.21	-3.50	⇓
P	22.6	22.0	22.3	0.30	0.122	22.30	2.20	1.91	
PB	20.2	20.9	19.9	0.51	0.204	20.33	1.03	0.74	
PG	18.0	19.9	18.6	0.97	0.387	18.83	0.13	-0.16	
PQ									•
PV	19.0	17.4	16.0	1.50	0.611	17.47	-0.69	-0.98	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
PW	22.8	24.5	22.7	1.01	0.367	23.33	2.82	2.53	
PX	•								
Q	24.1	22.6	21.7	1.21	0.489	22.80	2.50	2.21	
QJ	18.7	18.7	17.5	0.69	0.244	18.30	-0.19	-0.48	
QQ	•								
QU	16.2	16.2	19.1	1.67	0.591	17.17	-0.87	-1.15	
QX	23.6	23.4	24.0	0.31	0.122	23.67	3.02	2.73	
QZ	17.7	18.1	17.5	0.31	0.122	17.77	-0.51	-0.80	
R	14.9	15.5	15.1	0.31	0.122	15.17	-2.06	-2.35	
RD	18.5	18.2	18.4	0.15	0.061	18.37	-0.15	-0.44	
RF	21.7	23.3	21.9	0.87	0.326	22.30	2.20	1.91	
RG	•								
RK	14.2	15.9	15.1	0.85	0.346	15.07	-2.12	-2.41	
RL	•								
RP	•								
RR	•								
RV	13.2	16.5	16.1	1.80	0.672	15.27	-2.00	-2.29	
RW	17.2	16.5	16.3	0.47	0.183	16.67	-1.16	-1.45	
RX	13.7	15.6	14.8	0.95	0.387	14.70	-2.34	-2.63	
RZ	18.5	19.0	19.2	0.36	0.143	18.90	0.17	-0.12	
S	19.7	20.1	20.2	0.26	0.102	20.00	0.83	0.54	
SC	15.8	14.5	18.8	2.21	0.876	16.37	-1.34	-1.63	
SD	16.2	17.3	17.3	0.64	0.224	16.93	-1.00	-1.29	
SF	19.3	19.6	18.4	0.62	0.244	19.10	0.29	0.00	
SI	14.4	14.8	17.9	1.92	0.713	15.70	-1.74	-2.03	
SL	•								
SM	15.5	15.0	15.1	0.26	0.102	15.20	-2.04	-2.33	
SO	•								
SS	20.0	18.4	19.7	0.85	0.326	19.37	0.45	0.16	
ST	19.3	19.5	19.4	0.10	0.041	19.40	0.47	0.18	
SW	•								
SX	17.7	19.0	18.3	0.65	0.265	18.33	-0.17	-0.46	
SZ	18.7	15.5	17.9	1.67	0.652	17.37	-0.75	-1.04	
T	18.9	18.7	19.5	0.42	0.163	19.03	0.25	-0.04	
TD	11.5	13.3	14.0	1.29	0.509	12.93	-3.39	-3.68	⇓
TE	17.1	16.8	18.2	0.74	0.285	17.37	-0.75	-1.04	
TH	17.0	17.0	18.0	0.58	0.204	17.33	-0.77	-1.06	
TI	18.3	18.2	18.8	0.32	0.122	18.43	-0.11	-0.40	
TL	15.9	15.3	11.4	2.44	0.917	14.20	-2.64	-2.93	
TN	20.3	23.3	23.1	1.68	0.611	22.23	2.16	1.87	
TQ	18.4	21.2	22.0	1.89	0.733	20.53	1.15	0.86	
TS	26.7	25.5	25.9	0.61	0.244	26.03	4.43	4.14	⇑
U	18.1	14.0	10.3	3.90	2.121	14.13	-2.68	-2.97	
UE	21.5	20.8	21.5	0.40	0.143	21.27	1.58	1.29	
UN	17.9	18.3	20.8	1.57	0.591	19.00	0.23	-0.06	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
UP	17.4	17.3	18.1	0.44	0.163	17.60	-0.61	-0.90	
UQ	18.5	18.9	19.1	0.31	0.122	18.83	0.13	-0.16	
US									•
UW	17.4	17.5	19.2	1.01	0.367	18.03	-0.35	-0.64	
UZ									•
VA	22.5	20.3	21.0	1.12	0.448	21.27	1.58	1.29	
VG	25.1	23.2	27.8	2.31	0.937	25.37	4.03	3.74	⇑
VH	8.8	11.2	11.5	1.48	0.550	10.50	-4.85	-5.14	⇓
VI	18.2	18.5	17.8	0.35	0.143	18.17	-0.27	-0.56	
VK									•
VT	21.0	21.3	21.6	0.30	0.122	21.30	1.60	1.31	
VV									•
W	18.8	17.0	18.6	0.99	0.367	18.13	-0.29	-0.58	
WC	43.8	38.3	12.6	16.65	11.200	31.57	7.74	7.45	×
WG									•
WH									•
X	21.1	22.8	21.3	0.93	0.346	21.73	1.86	1.57	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.17	×	OB	17.13		AE	18.33		SX
10.07	⇓	AW	17.17		QU	18.33		KH
10.50	⇓	VH	17.20		HL	18.37		RD
12.80	⇓	K	17.33		TH	18.37		AF
12.93	⇓	TD	17.37		TE	18.43		TI
13.23	⇓	OY	17.37		SZ	18.53		BC
14.00	⇓	ID	17.47		PV	18.60		GN
14.13		U	17.50		AL	18.83		UQ
14.20		TL	17.53		L	18.83		PG
14.70		RX	17.53		EP	18.90		RZ
15.07		RK	17.53		A	18.97		EB
15.17		R	17.57		BM	19.00		UN
15.20		SM	17.60		UP	19.00		BN
15.27		RV	17.63		DB	19.03		T
15.70		SI	17.73		DT	19.03		N
15.80		CE	17.77		QZ	19.10		SF
15.90		OF	17.77		FN	19.10		HK
16.33		FZ	18.03		UW	19.17		CA
16.37		SC	18.13		W	19.27		AJ
16.53		BH	18.17		VI	19.30		NT
16.67		RW	18.17		J	19.33		OX
16.67		AZ	18.23		BA	19.33		JX
16.80		AU	18.30		QJ	19.37		SS
16.93		SD	18.30		BK	19.40		ST

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

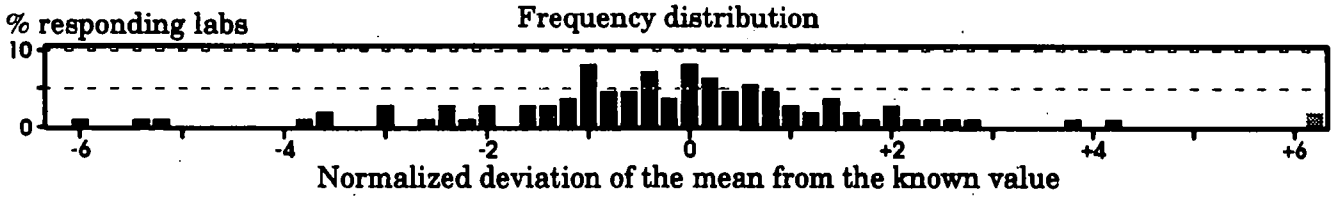
× ≡ Determined to be an outlier

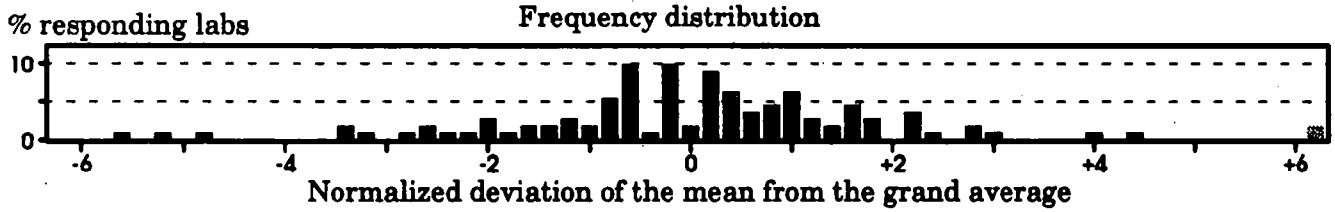
⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
19.47		BO	20.33		PB	21.73		X
19.60		M	20.33		NJ	21.77		JE
19.63		HP	20.43		JY	22.23		TN
19.67		AP	20.53		TQ	22.30		RF
19.80		DE	20.53		DZ	22.30		P
19.80		CG	20.67		CJ	22.40		I
19.80		AK	20.83		GQ	22.80		Q
20.00		S	20.90		JG	23.23		JS
20.03		LZ	21.27		VA	23.33		PW
20.13		E	21.27		UE	23.67		QX
20.13		C	21.30		VT	25.37	⇑	VG
20.17		NO	21.37		NH	26.03	⇑	TS
20.20		CS	21.37		EO	31.57	×	WC
			21.57		KL	40.07	×	LT





• ≡ No data submitted
Ø ≡ Insufficient data

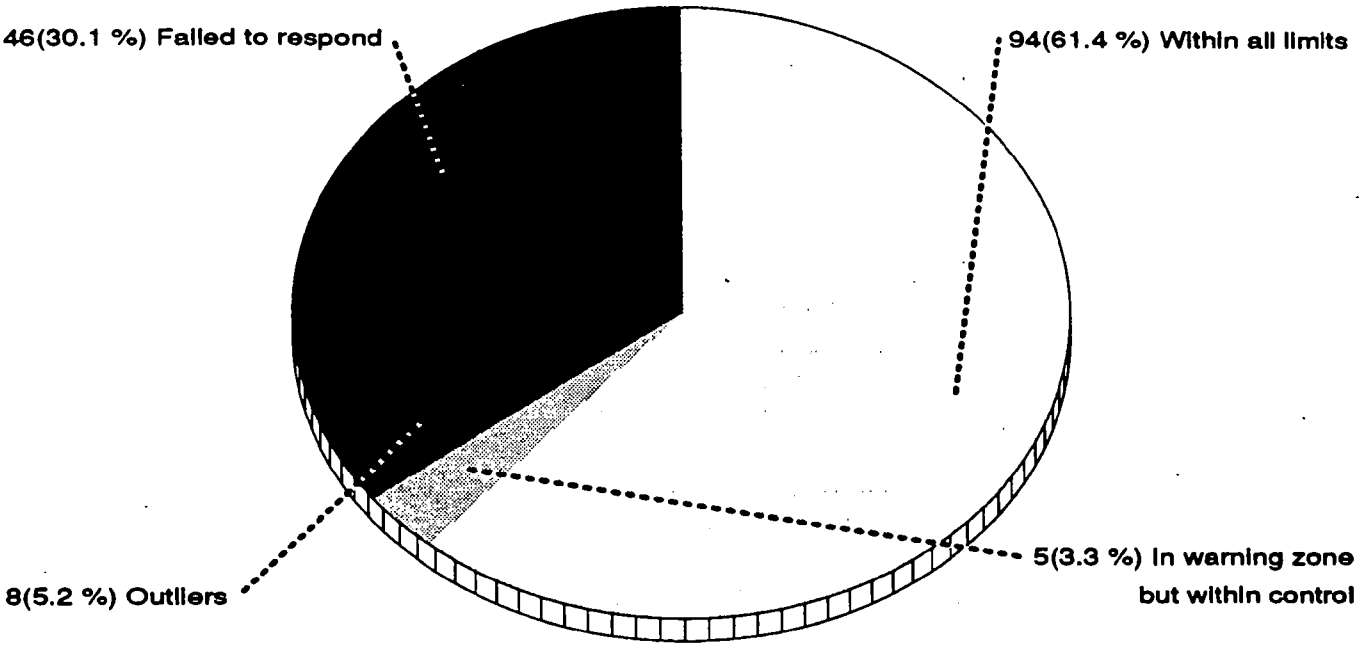
TAG SYMBOLS

× ≡ Determined to be an outlier

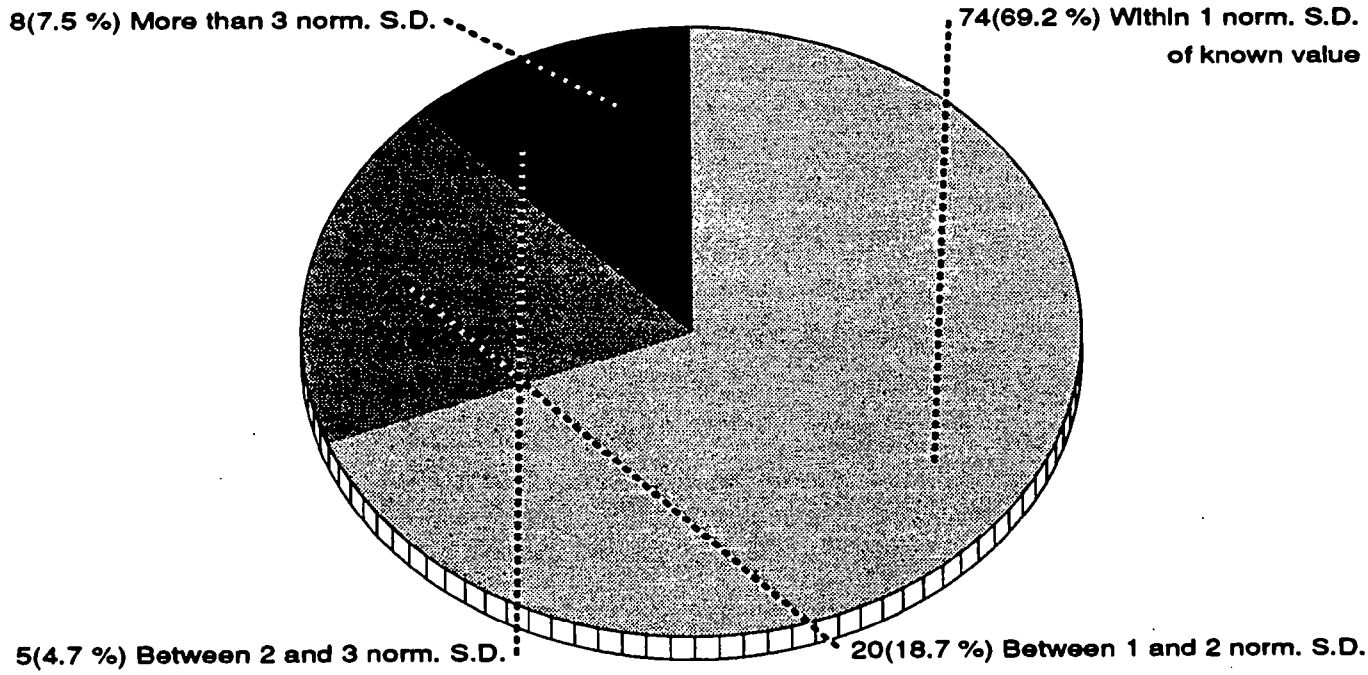
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 153 Participants

The known value of this nuclide is **20.0 pCi/l** with an expected precision of **5.0**; the control limits are 11.3 to 28.7; the warning regions are 11.3 to 14.2 and 25.8 to 28.7



Statistic	Respondents	Non-outliers
Mean	21.10	**Grand Avg 19.64**
Std. Dev.	9.22	2.65
Variance	84.92	7.03
% Coef. of Var.	43.67	13.50
% deviation of mean from known value	5.51	-1.80
Norm. dev. of mean from known value	0.12	-0.14
Median	19.93	19.90
% deviation of median from known value	-0.33	-0.50
Norm. dev. of median from known value	-0.01	-0.04



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	20.0	21.8	22.6	1.33	0.307	21.47	0.63	0.51	
AE	17.6	16.4	16.3	0.72	0.154	16.77	-1.00	-1.12	
AF	19.3	19.7	19.4	0.21	0.047	19.47	-0.06	-0.18	
AH	22.6	21.1	22.3	0.79	0.177	22.00	0.82	0.69	
AI	19.0	19.4	19.4	0.23	0.047	19.27	-0.13	-0.25	
AJ	21.8	21.4	21.7	0.21	0.047	21.63	0.69	0.57	
AK	20.4	20.2	18.2	1.22	0.260	19.60	-0.01	-0.14	
AL	24.9	24.6	23.5	0.74	0.165	24.33	1.63	1.50	
AP	20.9	19.2	17.6	1.65	0.390	19.23	-0.14	-0.27	
AR									•
AU	4.8	11.7	5.4	3.82	0.815	7.30	-4.27	-4.40	×
AW	23.6	24.5	22.9	0.80	0.189	23.67	1.40	1.27	
AZ	20.6	12.8	17.9	3.96	0.921	17.10	-0.88	-1.00	
BA	20.4	19.0	20.5	0.84	0.177	19.97	0.11	-0.01	
BC	18.7	19.4	19.3	0.38	0.083	19.13	-0.18	-0.30	
BG									•
BH	19.6	22.2	22.1	1.47	0.307	21.30	0.58	0.45	
BK	18.3	22.5	21.4	2.18	0.496	20.73	0.38	0.25	
BM	21.1	20.8	20.3	0.40	0.095	20.73	0.38	0.25	
BN									•
BO	20.1	21.2	21.7	0.82	0.189	21.00	0.47	0.35	
C	23.9	23.4	22.8	0.55	0.130	23.37	1.29	1.17	
CA	18.3	17.7	21.5	2.04	0.449	19.17	-0.16	-0.29	
CE	19.2	16.8	19.8	1.59	0.354	18.60	-0.36	-0.48	
CG	4.2	3.9	2.7	0.79	0.177	3.60	-5.56	-5.68	×
CJ	19.0	19.0	18.0	0.58	0.118	18.67	-0.34	-0.46	
CK									•
CM									•
CO									•
CS	14.4	15.3	13.5	0.90	0.213	14.40	-1.81	-1.94	
CX									•
D									•
DB	20.7	20.3	20.4	0.21	0.047	20.47	0.29	0.16	
DE	22.4	22.4	22.5	0.06	0.012	22.43	0.97	0.84	
DO									•
DP									•
DT	19.4	20.8	20.7	0.78	0.165	20.30	0.23	0.10	
DZ	17.1	18.9	20.0	1.46	0.343	18.67	-0.34	-0.46	
E									•
EB	15.9	16.0	16.2	0.15	0.035	16.03	-1.25	-1.37	
EO	15.8	16.3	16.1	0.25	0.059	16.07	-1.24	-1.36	
EP	19.3	18.8	19.5	0.36	0.083	19.20	-0.15	-0.28	
ER									•
FJ									•
FN	16.0	15.9	14.8	0.67	0.142	15.57	-1.41	-1.54	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
FP									•
FZ	20.0	29.9	11.8	9.06	3.168	20.57	0.32	0.20	
GN									•
GQ	12.6	11.9	12.3	0.35	0.083	12.27	-2.55	-2.68	
HK	18.5	18.3	19.0	0.36	0.083	18.60	-0.36	-0.48	
HL	17.8	17.8	18.7	0.52	0.106	18.10	-0.53	-0.66	
HP	20.2	20.1	21.0	0.49	0.106	20.43	0.28	0.15	
I	13.3	19.3	16.1	3.00	0.709	16.23	-1.18	-1.30	
ID	21.0	26.4	23.5	2.70	0.638	23.63	1.38	1.26	
IE									•
J	21.3	21.4	20.6	0.44	0.095	21.10	0.51	0.38	
JE	19.1	19.3	15.5	2.14	0.449	17.97	-0.58	-0.70	
JG	20.7	25.0	29.2	4.25	1.008	24.97	1.85	1.72	
JK									•
JN									•
JP									•
JS	18.8	18.9	19.8	0.55	0.118	19.17	-0.16	-0.29	
JX	18.4	18.9	18.8	0.26	0.059	18.70	-0.33	-0.45	
JY	17.3	18.1	19.3	1.01	0.236	18.23	-0.49	-0.61	
K	17.2	14.8	10.1	3.61	0.839	14.03	-1.94	-2.07	
KH	20.1	20.3	20.1	0.12	0.024	20.17	0.18	0.06	
KL	22.3	23.3	21.4	0.95	0.224	22.33	0.93	0.81	
L	19.0	18.1	19.1	0.55	0.118	18.73	-0.31	-0.44	
LH									•
LT	32.5	33.7	38.9	3.40	0.756	35.03	5.33	5.21	×
LZ									•
M	22.0	21.0	22.0	0.58	0.118	21.67	0.70	0.58	
MY									•
N	20.2	22.4	21.1	1.11	0.260	21.23	0.55	0.43	
NA									•
NH	20.6	19.8	21.9	1.06	0.248	20.77	0.39	0.27	
NJ	21.0	21.0	21.0	0.00	0.000	21.00	0.47	0.35	
NK									•
NO	19.1	20.0	21.3	1.11	0.260	20.13	0.17	0.05	
NT	19.7	20.1	19.9	0.20	0.047	19.90	0.09	-0.03	
OB									•
OF	16.0	14.4	16.2	0.99	0.213	15.53	-1.42	-1.55	
OS									•
OX	20.6	20.2	20.3	0.21	0.047	20.37	0.25	0.13	
OY	20.3	20.7	19.7	0.50	0.118	20.23	0.21	0.08	
P	16.8	13.8	13.7	1.76	0.366	14.77	-1.69	-1.81	
PB	19.4	19.8	20.3	0.45	0.106	19.83	0.07	-0.06	
PG									•
PQ									•
PV	19.2	17.8	16.2	1.50	0.354	17.73	-0.66	-0.79	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
PW	18.1	17.0	17.2	0.59	0.130	17.43	-0.76	-0.89	
PX									•
Q	15.4	19.2	21.1	2.90	0.673	18.57	-0.37	-0.50	
QJ	19.9	17.5	20.4	1.55	0.343	19.27	-0.13	-0.25	
QQ									•
QU	12.7	14.6	15.6	1.47	0.343	14.30	-1.85	-1.97	
QX	39.8	40.5	40.0	0.36	0.083	40.10	7.09	6.96	×
QZ	17.1	17.5	17.0	0.26	0.059	17.20	-0.84	-0.97	
R									•
RD	11.0	16.7	14.9	2.91	0.673	14.20	-1.88	-2.01	
RF	21.1	21.8	23.2	1.07	0.248	22.03	0.83	0.70	
RG									•
RK	57.4	52.2	55.0	2.60	0.614	54.87	12.20	12.08	×
RL									•
RP									•
RR									•
RV	22.6	23.4	24.1	0.75	0.177	23.37	1.29	1.17	
RW	20.9	20.2	19.4	0.75	0.177	20.17	0.18	0.06	
RX	19.9	21.5	20.0	0.90	0.189	20.47	0.29	0.16	
RZ	18.8	19.1	18.9	0.15	0.035	18.93	-0.24	-0.37	
S	19.0	18.9	19.4	0.26	0.059	19.10	-0.19	-0.31	
SC	17.2	17.3	17.0	0.15	0.035	17.17	-0.86	-0.98	
SD	19.6	14.9	22.0	3.61	0.839	18.83	-0.28	-0.40	
SF	17.7	18.5	19.5	0.90	0.213	18.57	-0.37	-0.50	
SI	17.4	20.0	17.4	1.50	0.307	18.27	-0.48	-0.60	
SL									•
SM	20.5	21.1	20.0	0.55	0.130	20.53	0.31	0.18	
SO									•
SS	19.8	19.9	19.4	0.26	0.059	19.70	0.02	-0.10	
ST	20.7	21.1	21.5	0.40	0.095	21.10	0.51	0.38	
SW									•
SX	20.2	18.5	24.3	2.98	0.685	21.00	0.47	0.35	
SZ	35.3	42.3	36.0	3.86	0.827	37.87	6.31	6.19	×
T	21.7	21.2	22.3	0.55	0.130	21.73	0.73	0.60	
TD	35.8	42.8	46.2	5.30	1.435	41.60	7.61	7.48	×
TE	20.6	19.8	19.0	0.80	0.189	19.80	0.06	-0.07	
TH	20.0	19.0	19.0	0.58	0.118	19.33	-0.11	-0.23	
TI	13.0	11.4	12.5	0.82	0.189	12.30	-2.54	-2.67	
TL	20.4	22.6	18.5	2.05	0.484	20.50	0.30	0.17	
TN	24.7	25.6	27.4	1.37	0.319	25.90	2.17	2.04	
TQ	16.7	23.7	21.7	3.61	0.827	20.70	0.37	0.24	
TS	23.9	18.6	20.3	2.71	0.626	20.93	0.45	0.32	
U	16.7	23.1	20.0	3.20	0.756	19.93	0.10	-0.02	
UE	20.4	21.4	19.6	0.90	0.213	20.47	0.29	0.16	
UN	25.1	22.3	20.5	2.32	0.543	22.63	1.04	0.91	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
UP	25.5	22.0	20.9	2.40	0.543	22.80	1.09	0.97	
UQ	24.3	24.9	24.4	0.32	0.071	24.53	1.70	1.57	
US									•
UW	19.0	19.9	19.6	0.46	0.106	19.50	-0.05	-0.17	
UZ									•
VA									•
VG	16.4	16.6	16.9	0.25	0.059	16.63	-1.04	-1.17	
VH	17.3	17.6	23.0	3.21	0.673	19.30	-0.12	-0.24	
VI	26.7	24.1	22.7	2.03	0.473	24.50	1.68	1.56	
VK									•
VT	21.3	23.5	26.5	2.61	0.614	23.77	1.43	1.30	
VV									•
W	18.9	20.1	21.4	1.25	0.295	20.13	0.17	0.05	
WC	100.4	119.7	59.7	30.63	12.596	93.27	25.51	25.38	×
WG									•
WH									•
X	18.4	19.2	22.2	2.00	0.449	19.93	0.10	-0.02	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.60	×	CG	18.27		SI	19.70		SS
7.30	×	AU	18.57		SF	19.80		TE
12.27		GQ	18.57		Q	19.83		PB
12.30		TI	18.60		HK	19.90		NT
14.03		K	18.60		CE	19.93		X
14.20		RD	18.67		DZ	19.93		U
14.30		QU	18.67		CJ	19.97		BA
14.40		CS	18.70		JX	20.13		W
14.77		P	18.73		L	20.13		NO
15.53		OF	18.83		SD	20.17		RW
15.57		FN	18.93		RZ	20.17		KH
16.03		EB	19.10		S	20.23		OY
16.07		EO	19.13		BC	20.30		DT
16.23		I	19.17		JS	20.37		OX
16.63		VG	19.17		CA	20.43		HP
16.77		AE	19.20		EP	20.47		UE
17.10		AZ	19.23		AP	20.47		RX
17.17		SC	19.27		QJ	20.47		DB
17.20		QZ	19.27		AI	20.50		TL
17.43		PW	19.30		VH	20.53		SM
17.73		PV	19.33		TH	20.57		FZ
17.97		JE	19.47		AF	20.70		TQ
18.10		HL	19.50		UW	20.73		BM
18.23		JY	19.60		AK	20.73		BK

• ≡ No data submitted
Ø ≡ Insufficient data

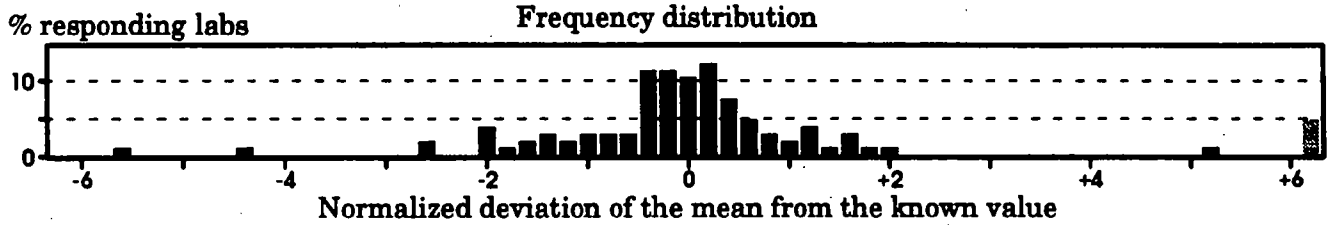
TAG SYMBOLS
× ≡ Determined to be an outlier

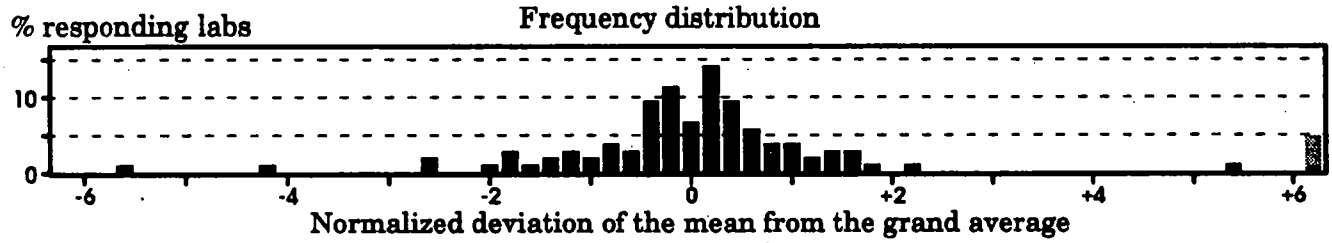
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
20.77		NH	21.67		M	23.77		VT
20.93		TS	21.73		T	24.33		AL
21.00		SX	22.00		AH	24.50		VI
21.00		NJ	22.03		RF	24.53		UQ
21.00		BO	22.33		KL	24.97		JG
21.10		ST	22.43		DE	25.90		TN
21.10		J	22.63		UN	35.03	×	LT
21.23		N	22.80		UP	37.87	×	SZ
21.30		BH	23.37		RV	40.10	×	QX
21.47		A	23.37		C	41.60	×	TD
21.63		AJ	23.63		ID	54.87	×	RK
			23.67		AW	93.27	×	WC





• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/059
April 1995

EPA

Tritium in Water Performance Evaluation Study

A Statistical Evaluation of the March 10, 1995 Data

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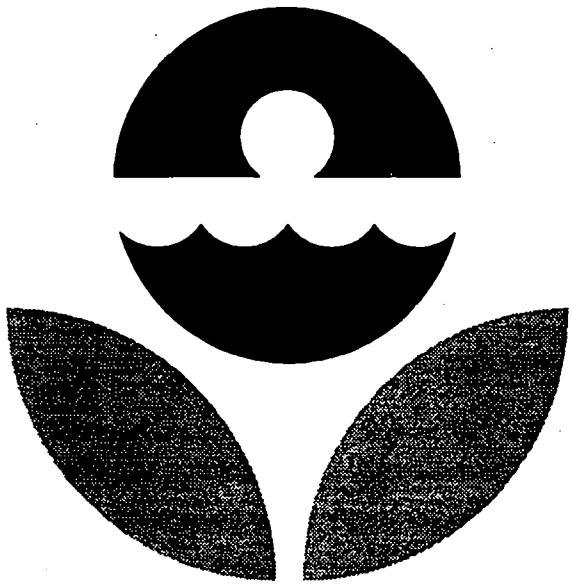
Tritium in Water

Performance Evaluation Study

March 10, 1995



Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Nuclear Radiation Assessment Division (EMSL-LV) Performance Evaluation Study for ***Tritium in Water; March 10, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by EMSL-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Branch

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

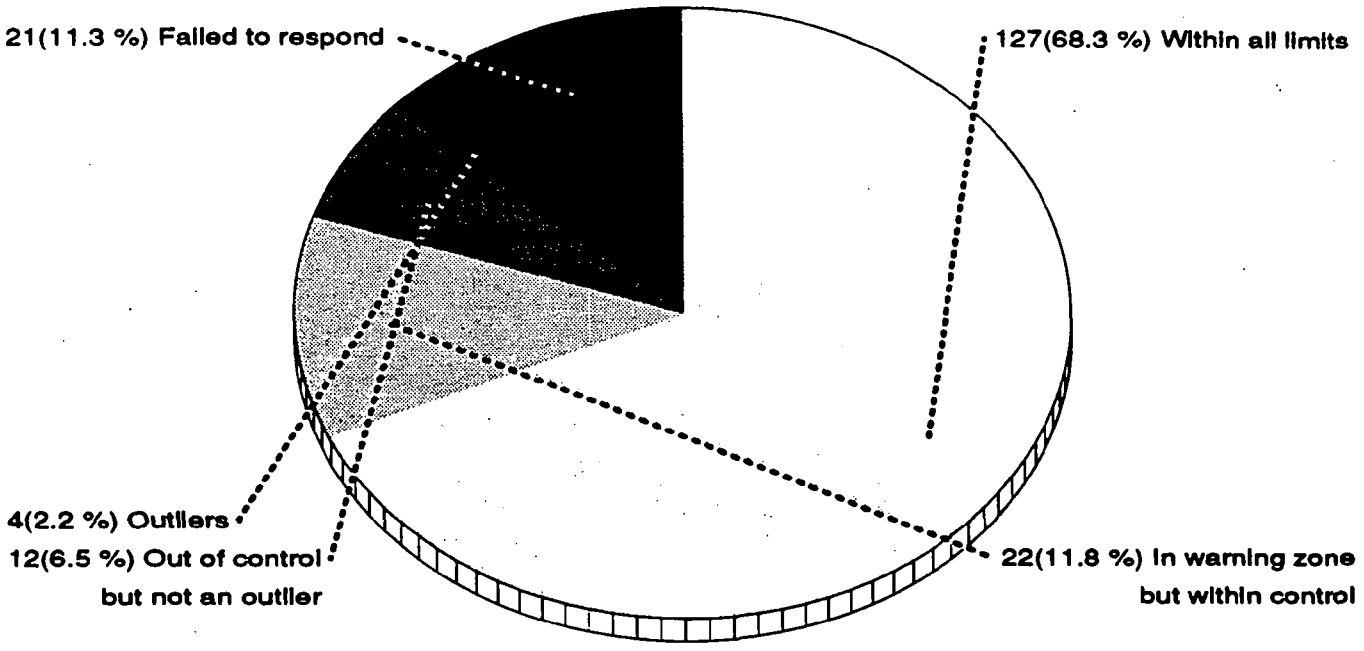
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

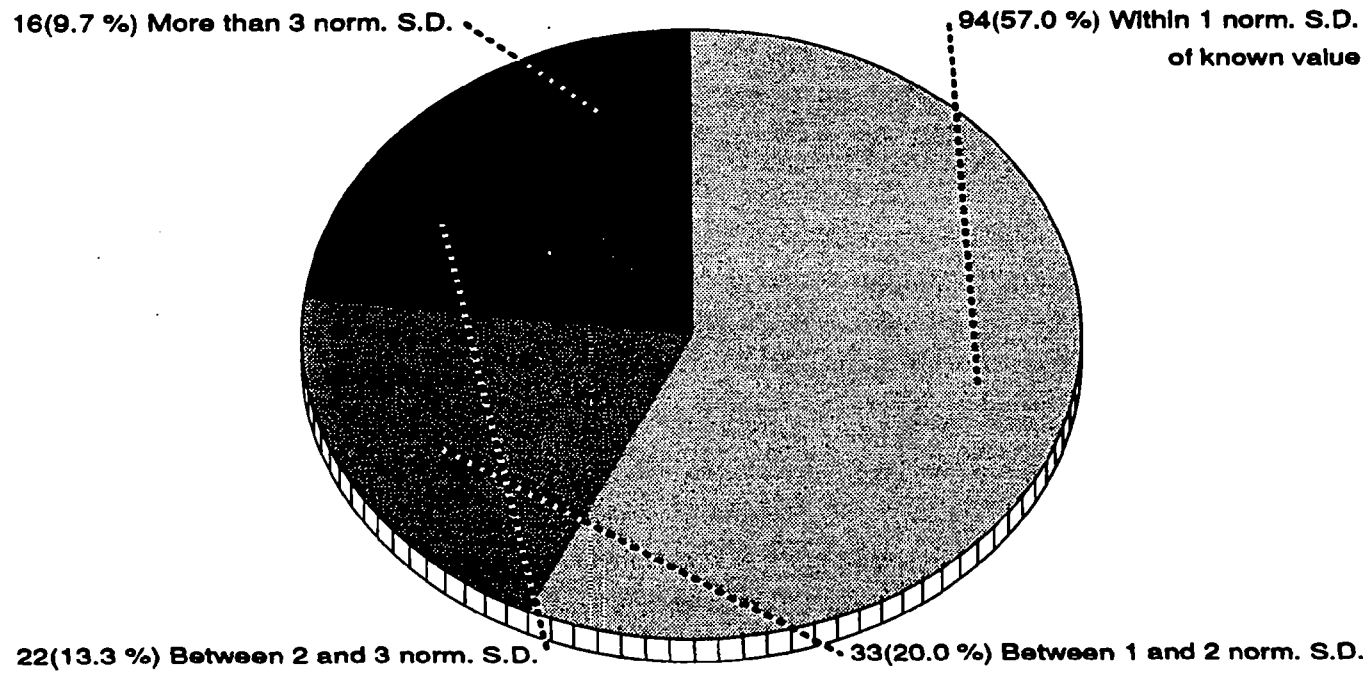
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, EMSL-LV, 702/798-2104.

Tritium Statistical Summary 186 Participants

The known value of this nuclide is **7435.0 pCi/l** with an expected precision of **744.0**; the control limits are 6144.2 to 8725.8; the warning regions are 6144.2 to 6573.8 and 8296.2 to 8725.8



Statistic	Respondents	Non-outliers
Mean	7223.50	**Grand Avg 7299.15**
Std. Dev.	1020.24	682.97
Variance	1040885.03	466446.40
% Coef. of Var.	14.12	9.36
% deviation of mean from known value	-2.84	-1.83
Norm. dev. of mean from known value	-0.21	-0.20
Median	7236.67	7244.67
% deviation of median from known value	-2.67	-2.56
Norm. dev. of median from known value	-0.19	-0.28



EMSL-LV Performance Evaluation: Tritium in Water, 10-Mar-1995

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	6250.0	6430.0	6340.0	90.00	0.143	6340.00	-2.23	-2.55	
AE	7780.0	7660.0	7740.0	61.10	0.095	7726.67	1.00	0.68	
AF	7113.0	7019.0	6862.0	126.81	0.199	6998.00	-0.70	-1.02	
AH	7060.0	7030.0	7080.0	25.13	0.040	7056.67	-0.56	-0.88	
AI	5040.0	5120.0	5030.0	49.35	0.071	5063.33	-5.21	-5.52	⇓
AJ	6042.0	5961.0	5912.0	65.66	0.103	5971.67	-3.09	-3.41	⇓
AK	7645.0	7838.0	7645.0	111.42	0.153	7709.33	0.95	0.64	
AP	7418.0	7041.0	7205.0	189.03	0.299	7221.33	-0.18	-0.50	
AU	7500.0	7000.0	7500.0	288.68	0.397	7333.33	0.08	-0.24	
AW	6996.0	7017.0	7051.0	27.81	0.044	7021.33	-0.65	-0.96	
AY	6890.0	6968.0	7217.0	170.78	0.260	7025.00	-0.64	-0.95	
AZ	7742.0	7448.0	7327.0	213.42	0.329	7505.67	0.48	0.16	
BA	7538.0	7653.0	7351.0	152.43	0.240	7514.00	0.50	0.18	
BB	7030.0	7130.0	7400.0	191.41	0.294	7186.67	-0.26	-0.58	
BC	7505.0	6024.0	6765.0	740.50	1.335	6764.67	-1.24	-1.56	
BG	8700.0	8100.0	8500.0	305.51	0.476	8433.33	2.64	2.32	
BI	7330.0	7300.0	6480.0	482.32	0.675	7036.67	-0.61	-0.93	
BL	7134.0	7259.0	7124.0	75.23	0.107	7172.33	-0.30	-0.61	
BM	8230.0	8100.0	8000.0	115.32	0.183	8110.00	1.89	1.57	
BO	6230.0	6230.0	6130.0	57.75	0.079	6196.67	-2.57	-2.88	
BW	6600.0	6700.0	6700.0	57.74	0.079	6666.67	-1.47	-1.79	
C	7051.0	7438.0	7245.0	193.49	0.307	7244.67	-0.13	-0.44	
CA	7360.0	7500.0	7520.0	87.18	0.127	7460.00	0.37	0.06	
CC									•
CE	7470.0	7480.0	7130.0	199.26	0.278	7360.00	0.14	-0.17	
CG	8764.0	9768.0	9498.0	519.56	0.797	9343.33	4.76	4.44	⇑
CJ	7200.0	7000.0	7000.0	115.47	0.159	7066.67	-0.54	-0.86	
CK									•
CM									•
CO									•
CP	7188.0	7202.0	7007.0	108.76	0.155	7132.33	-0.39	-0.70	
CQ	6960.0	7160.0	7230.0	140.11	0.214	7116.67	-0.42	-0.74	
CS	7390.0	7820.0	7800.0	242.69	0.341	7670.00	0.86	0.55	
CX	7830.0	11300.0	11100.0	1948.24	4.343	10076.67	6.47	6.15	×
D	7270.0	6863.0	7236.0	225.80	0.323	7123.00	-0.41	-0.73	
DD									•
DE	7800.0	7850.0	7900.0	49.98	0.079	7850.00	1.28	0.97	
DG	7260.0	5920.0	6480.0	673.00	1.122	6553.33	-1.74	-2.05	
DH	7721.0	7251.0	7464.0	235.35	0.373	7478.67	0.42	0.10	
DI	7120.0	7140.0	7090.0	25.13	0.040	7116.67	-0.42	-0.74	
DL	7744.0	7655.0	7545.0	99.68	0.158	7648.00	0.81	0.50	
DM	7090.0	6870.0	7130.0	140.01	0.206	7030.00	-0.63	-0.94	
DT	7500.0	7500.0	7300.0	115.47	0.159	7433.33	0.31	0.00	
E	7409.0	7752.0	7606.0	172.12	0.272	7589.00	0.67	0.36	
EA	7910.0	7990.0	7900.0	49.37	0.071	7933.33	1.48	1.16	

TAG SYMBOLS

• ≡ No data submitted
⇑ ≡ Above control limit
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇓ ≡ Below control limit

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
EB	7030.0	7140.0	7480.0	234.59	0.357	7216.67	-0.19	-0.51	
EL	7272.0	6934.0	6811.0	238.71	0.366	7005.67	-0.68	-1.00	
EN									•
EW	7016.0	7376.0	7027.0	204.75	0.286	7139.67	-0.37	-0.69	
EX	6403.0	6504.0	6458.0	50.58	0.080	6455.00	-1.97	-2.28	
FJ	6127.0	6059.0	5815.0	164.06	0.248	6000.33	-3.02	-3.34	⇓
FK									•
FL	7052.0	7557.0	7262.0	253.69	0.401	7290.33	-0.02	-0.34	
FU	7514.0	6936.0	6049.0	737.91	1.311	6833.00	-1.09	-1.40	
FZ	4900.0	4800.0	4700.0	100.00	0.159	4800.00	-5.82	-6.13	×
GE	7625.0	7458.0	7517.0	84.70	0.133	7533.33	0.55	0.23	
GQ	6490.0	6450.0	6500.0	26.46	0.040	6480.00	-1.91	-2.22	
HI	7020.0	7027.0	7090.0	38.57	0.056	7045.67	-0.59	-0.91	
HJ	7740.0	7700.0	7500.0	128.58	0.191	7646.67	0.81	0.49	
HK	7519.0	7457.0	7389.0	65.04	0.103	7455.00	0.36	0.05	
HP	7020.0	7030.0	7340.0	181.93	0.254	7130.00	-0.39	-0.71	
HR	8114.0	8106.0	8172.0	36.07	0.052	8130.67	1.94	1.62	
I	6846.0	6874.0	6937.0	46.65	0.072	6885.67	-0.96	-1.28	
IC	7410.0	7481.0	7392.0	47.03	0.071	7427.67	0.30	-0.02	
II									•
J	7219.0	7284.0	7207.0	41.46	0.061	7236.67	-0.15	-0.46	
JE	7477.0	7816.0	7670.0	170.05	0.269	7654.33	0.83	0.51	
JI	9400.0	9200.0	9600.0	200.00	0.318	9400.00	4.89	4.57	⇑
JK	7380.0	7100.0	6960.0	213.85	0.333	7146.67	-0.35	-0.67	
JM	7521.0	7183.0	6744.0	389.59	0.617	7149.33	-0.35	-0.67	
JN									•
JP	7280.0	7235.0	7225.0	29.35	0.044	7246.67	-0.12	-0.44	
JR	8167.0	8360.0	8258.0	96.54	0.153	8261.67	2.24	1.92	
JS	7200.0	7380.0	7500.0	151.00	0.238	7360.00	0.14	-0.17	
JY	7740.0	7480.0	7500.0	144.68	0.206	7573.33	0.64	0.32	
K	7297.0	7673.0	8162.0	433.72	0.687	7710.67	0.96	0.64	
KH	7344.0	7021.0	7044.0	180.22	0.256	7136.33	-0.38	-0.70	
KX	7160.0	7060.0	7040.0	64.29	0.095	7086.67	-0.49	-0.81	
L	6774.0	6694.0	6848.0	77.05	0.122	6772.00	-1.23	-1.54	
LE	7290.0	6980.0	7010.0	170.99	0.246	7093.33	-0.48	-0.80	
LF									•
LR	7030.0	6910.0	6970.0	60.02	0.095	6970.00	-0.77	-1.08	
LT	5591.0	4853.0	6391.0	769.21	1.421	5611.67	-3.93	-4.24	⇓
M	7850.0	7800.0	7900.0	49.98	0.079	7850.00	1.28	0.97	
MA	6631.0	6612.0	6705.0	49.13	0.074	6649.33	-1.51	-1.83	
ML	5580.0	5805.0	5496.0	159.77	0.245	5627.00	-3.89	-4.21	⇓
MQ	7220.0	6740.0	7140.0	257.16	0.381	7033.33	-0.62	-0.94	
MT	7452.0	7513.0	7566.0	57.02	0.091	7510.33	0.49	0.18	
MV	6335.0	6330.0	6590.0	148.69	0.206	6418.33	-2.05	-2.37	
N	7236.0	7113.0	7159.0	62.14	0.098	7169.33	-0.30	-0.62	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

EMSL-LV Performance Evaluation: Tritium in Water, 10-Mar-1995

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NB	**14.0**	**12.0**	**16.0**	**2.00**	**0.003**	**14.00**	**-16.96**	**-17.28**	×
NH	7214.0	7498.0	7234.0	158.52	0.225	7315.33	0.04	-0.28	
NI									•
NJ	6900.0	6300.0	6400.0	321.46	0.476	6533.33	-1.78	-2.10	
NO	7921.0	8014.0	8097.0	88.03	0.140	8010.67	1.66	1.34	
NP	7192.0	6637.0	6849.0	280.07	0.441	6892.67	-0.95	-1.26	
O	7290.0	7471.0	7432.0	95.25	0.144	7397.67	0.23	-0.09	
OA	7421.0	6618.0	6930.0	404.81	0.638	6989.67	-0.72	-1.04	
OK	7758.0	7722.0	7749.0	18.72	0.029	7743.00	1.03	0.72	
OL	6290.0	6536.0	6859.0	285.37	0.452	6561.67	-1.72	-2.03	
OX	7161.0	7555.0	7358.0	197.00	0.313	7358.00	0.14	-0.18	
PB	7737.0	7365.0	7324.0	227.54	0.328	7475.33	0.41	0.09	
PE	6932.0	7122.0	6748.0	187.00	0.297	6934.00	-0.85	-1.17	
PI	7330.0	7630.0	7651.0	179.57	0.255	7537.00	0.55	0.24	
PJ	9084.0	9841.0	8667.0	595.15	0.932	9197.33	4.42	4.10	⇑
PM	7658.0	7421.0	7488.0	122.18	0.188	7522.33	0.52	0.20	
PQ	7327.0	7240.0	7331.0	51.45	0.072	7299.33	0.00	-0.32	
PV	8576.0	5841.0	4852.0	1929.01	4.727	6423.00	-2.04	-2.36	
Q	6480.0	6643.0	6480.0	94.11	0.129	6534.33	-1.78	-2.10	
QA									•
QC	7190.0	7190.0	7280.0	52.00	0.071	7220.00	-0.18	-0.50	
QD	7932.0	7592.0	7436.0	253.62	0.394	7653.33	0.82	0.51	
QI	6477.0	6720.0	6513.0	131.14	0.193	6570.00	-1.70	-2.01	
QJ	7250.0	7630.0	7413.0	190.64	0.302	7431.00	0.31	-0.01	
QP	7690.0	7840.0	7896.0	106.51	0.164	7808.67	1.19	0.87	
QQ	7942.0	8112.0	8024.0	85.01	0.135	8026.00	1.69	1.38	
QT	8636.0	7927.0	7734.0	474.96	0.716	8099.00	1.86	1.55	
QU	8393.0	8493.0	8625.0	116.38	0.184	8503.67	2.80	2.49	
QW	8443.0	8325.0	8504.0	90.99	0.142	8424.00	2.62	2.30	
QX	8364.0	8540.0	8540.0	101.61	0.140	8481.33	2.75	2.44	
QZ	7719.0	7550.0	7460.0	131.48	0.206	7576.33	0.65	0.33	
R	7195.0	7438.0	7432.0	138.60	0.193	7355.00	0.13	-0.19	
RB	6780.0	6890.0	6990.0	105.06	0.167	6886.67	-0.96	-1.28	
RH	7407.0	6777.0	7181.0	319.17	0.500	7121.67	-0.41	-0.73	
RL									•
RO	7482.0	7334.0	7407.0	74.03	0.117	7407.67	0.25	-0.06	
RQ									•
RR	7233.0	7256.0	7399.0	89.93	0.132	7296.00	-0.01	-0.32	
RU	5856.0	6883.0	6952.0	613.83	0.870	6563.67	-1.71	-2.03	
RV	7088.0	6183.0	6496.0	459.61	0.718	6589.00	-1.65	-1.97	
RX	8861.0	9118.0	8604.0	257.00	0.408	8861.00	3.64	3.32	⇑
S	7309.0	7479.0	7629.0	160.10	0.254	7472.33	0.40	0.09	
SC	7225.0	6988.0	6715.0	255.22	0.405	6976.00	-0.75	-1.07	
SD	7218.0	7418.0	7703.0	243.75	0.385	7446.33	0.34	0.03	
SF	7112.0	7114.0	7103.0	5.64	0.009	7109.67	-0.44	-0.76	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
SI	6980.0	6950.0	7050.0	51.35	0.079	6993.33	-0.71	-1.03	
SM	7740.0	7450.0	7450.0	167.44	0.230	7546.67	0.58	0.26	
SN	7091.0	6959.0	7064.0	69.76	0.105	7038.00	-0.61	-0.92	
SS	7675.0	7453.0	7827.0	188.10	0.297	7651.67	0.82	0.50	
ST	6750.0	6850.0	7400.0	350.01	0.516	7000.00	-0.70	-1.01	
SU	7042.0	6829.0	6587.0	227.65	0.361	6819.33	-1.12	-1.43	
SZ	7550.0	7578.0	7340.0	130.10	0.189	7489.33	0.44	0.13	
T	6800.0	6900.0	6800.0	57.74	0.079	6833.33	-1.08	-1.40	
TC	5814.0	7111.0	9213.0	1715.31	4.235	7379.33	0.19	-0.13	
TD	1980.0	1860.0	1630.0	177.86	0.278	1823.33	-12.75	-13.06	×
TE	6800.0	7000.0	7200.0	200.00	0.318	7000.00	-0.70	-1.01	
TF	8160.0	8640.0	8480.0	244.40	0.381	8426.67	2.62	2.31	
TH	7320.0	7492.0	7535.0	113.77	0.171	7449.00	0.35	0.03	
TI	8720.0	8280.0	8500.0	220.00	0.349	8500.00	2.80	2.48	
TL	7480.0	7018.0	7434.0	254.51	0.367	7310.67	0.03	-0.29	
TN	8321.0	8420.0	8530.0	104.54	0.166	8423.67	2.62	2.30	
TO	6219.0	7574.0	6707.0	686.27	1.144	6833.33	-1.08	-1.40	
TQ	7280.0	7410.0	6710.0	372.34	0.556	7133.33	-0.39	-0.70	
TX	6184.0	6547.0	6096.0	239.06	0.358	6275.67	-2.38	-2.70	
U	7490.0	7400.0	7240.0	126.61	0.198	7376.67	0.18	-0.14	
UC									•
UD									•
UE	7371.0	7468.0	7376.0	54.65	0.077	7405.00	0.25	-0.07	
UK	7200.0	7200.0	6900.0	173.21	0.238	7100.00	-0.46	-0.78	
UN	7457.0	6616.0	7498.0	497.81	0.700	7190.33	-0.25	-0.57	
UO	6261.0	6203.0	5923.0	180.74	0.268	6129.00	-2.72	-3.04	⇓
UP	7517.0	6901.0	7200.0	308.04	0.489	7206.00	-0.22	-0.53	
UT	7370.0	7552.0	7391.0	99.56	0.144	7437.67	0.32	0.01	
UW	7900.0	7768.0	7733.0	88.09	0.133	7800.33	1.17	0.85	
UX									•
UY	7045.0	7063.0	6902.0	88.22	0.128	7003.33	-0.69	-1.00	
VA	10547.0	9354.0	8706.0	933.85	1.879	9535.67	5.21	4.89	⇑
VC	7870.0	7875.0	7996.0	71.36	0.100	7913.67	1.43	1.11	
VE									•
VG	7520.0	7330.0	7260.0	134.53	0.206	7370.00	0.16	-0.15	
VI	6261.0	6357.0	6216.0	72.01	0.112	6278.00	-2.38	-2.69	
VM	7532.0	7473.0	7548.0	39.49	0.060	7517.67	0.51	0.19	
VN	6170.0	6099.0	6542.0	237.93	0.352	6270.33	-2.40	-2.71	
VP	7908.0	7308.0	7908.0	346.41	0.476	7708.00	0.95	0.64	
VQ									•
VR	8998.0	8022.0	7567.0	731.14	1.259	8195.67	2.09	1.77	
VW	8627.0	9056.0	9488.0	430.50	0.684	9057.00	4.09	3.78	⇑
VX									•
VZ	9000.0	7000.0	6000.0	1527.53	3.632	7333.33	0.08	-0.24	
W	7006.0	7036.0	6597.0	245.26	0.349	6879.67	-0.98	-1.29	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

EMSL-LV Performance Evaluation: Tritium in Water, 10-Mar-1995

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
WD	7163.0	7185.0	7162.0	13.04	0.018	7170.00	-0.30	-0.62	
WF	6900.0	6900.0	6900.0	0.00	0.000	6900.00	-0.93	-1.25	
WH	7980.0	7660.0	7820.0	160.00	0.254	7820.00	1.21	0.90	
WI									•
X	7550.0	7280.0	7360.0	138.68	0.214	7396.67	0.23	-0.09	
Z	6688.0	7043.0	7023.0	199.44	0.282	6918.00	-0.89	-1.20	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
14.00	×	NB	6892.67		NP	7149.33		JM
1823.33	×	TD	6900.00		WF	7169.33		N
4800.00	×	FZ	6918.00		Z	7170.00		WD
5063.33	⇓	AI	6934.00		PE	7172.33		BL
5611.67	⇓	LT	6970.00		LR	7186.67		BB
5627.00	⇓	ML	6976.00		SC	7190.33		UN
5971.67	⇓	AJ	6989.67		OA	7206.00		UP
6000.33	⇓	FJ	6993.33		SI	7216.67		EB
6129.00	⇓	UO	6998.00		AF	7220.00		QC
6196.67		BO	7000.00		TE	7221.33		AP
6270.33		VN	7000.00		ST	7236.67		J
6275.67		TX	7003.33		UY	7244.67		C
6278.00		VI	7005.67		EL	7246.67		JP
6340.00		A	7021.33		AW	7290.33		FL
6418.33		MV	7025.00		AY	7296.00		RR
6423.00		PV	7030.00		DM	7299.33		PQ
6455.00		EX	7033.33		MQ	7310.67		TL
6480.00		GQ	7036.67		BI	7315.33		NH
6533.33		NJ	7038.00		SN	7333.33		VZ
6534.33		Q	7045.67		HI	7333.33		AU
6553.33		DG	7056.67		AH	7355.00		R
6561.67		OL	7066.67		CJ	7358.00		OX
6563.67		RU	7086.67		KX	7360.00		JS
6570.00		QI	7093.33		LE	7360.00		CE
6589.00		RV	7100.00		UK	7370.00		VG
6649.33		MA	7109.67		SF	7376.67		U
6666.67		BW	7116.67		DI	7379.33		TC
6764.67		BC	7116.67		CQ	7396.67		X
6772.00		L	7121.67		RH	7397.67		O
6819.33		SU	7123.00		D	7405.00		UE
6833.00		FU	7130.00		HP	7407.67		RO
6833.33		TO	7132.33		CP	7427.67		IC
6833.33		T	7133.33		TQ	7431.00		QJ
6879.67		W	7136.33		KH	7433.33		DT
6885.67		I	7139.67		EW	7437.67		UT
6886.67		RB	7146.67		JK	7446.33		SD

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

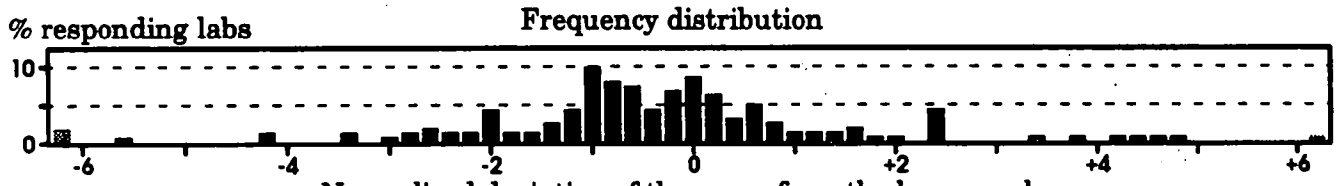
⇑ ≡ Above control limit

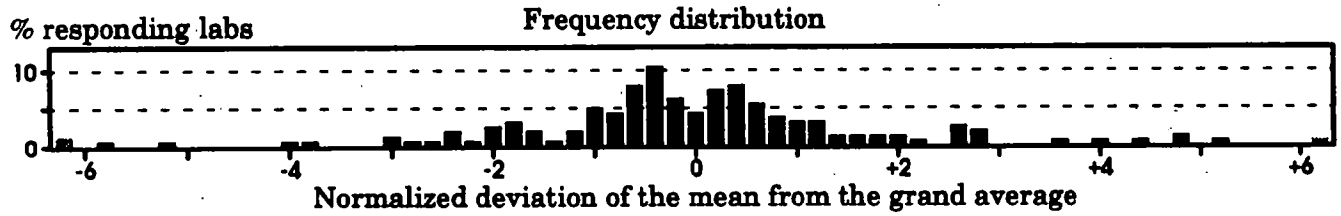
⇓ ≡ Below control limit

Tritium

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
7449.00		TH	7648.00		DL	8099.00		QT
7455.00		HK	7651.67		SS	8110.00		BM
7460.00		CA	7653.33		QD	8130.67		HR
7472.33		S	7654.33		JE	8195.67		VR
7475.33		PB	7670.00		CS	8261.67		JR
7478.67		DH	7708.00		VP	8423.67		TN
7489.33		SZ	7709.33		AK	8424.00		QW
7505.67		AZ	7710.67		K	8426.67		TF
7510.33		MT	7726.67		AE	8433.33		BG
7514.00		BA	7743.00		OK	8481.33		QX
7517.67		VM	7800.33		UW	8500.00		TI
7522.33		PM	7808.67		QP	8503.67		QU
7533.33		GE	7820.00		WH	8861.00	⇑	RX
7537.00		PI	7850.00		M	9057.00	⇑	VW
7546.67		SM	7850.00		DE	9197.33	⇑	PJ
7573.33		JY	7913.67		VC	9343.33	⇑	CG
7576.33		QZ	7933.33		EA	9400.00	⇑	JI
7589.00		E	8010.67		NO	9535.67	⇑	VA
7646.67		HJ	8026.00		QQ	10076.67	×	CX





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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

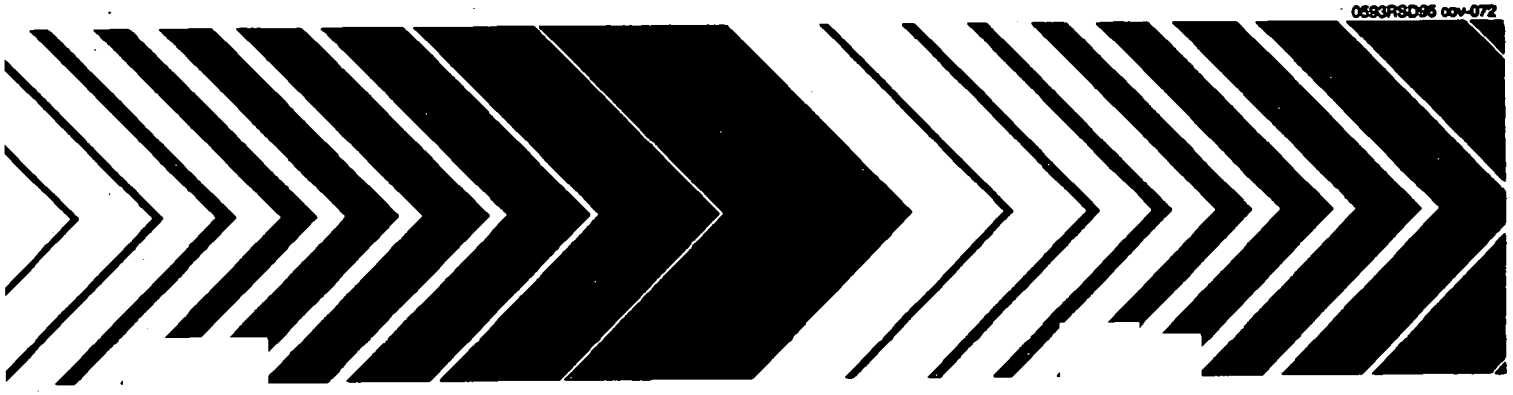
EPA 600/R-95/072
May 1995

EPA

Plutonium in Water Performance Evaluation Study

A Statistical Evaluation of the March 17, 1995 Data

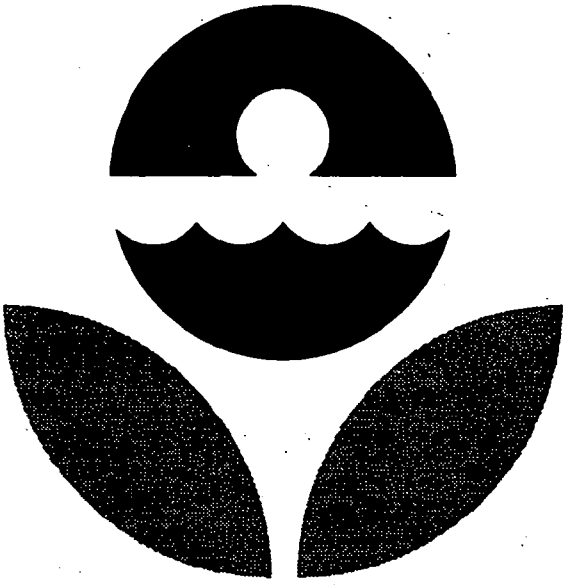
0593RSD95 cov-072



Plutonium in Water

Performance Evaluation Study

March 17, 1995



Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Nuclear Radiation Assessment Division (EMSL-LV) Performance Evaluation Study for ***Plutonium in Water; March 17, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by EMSL-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Branch

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

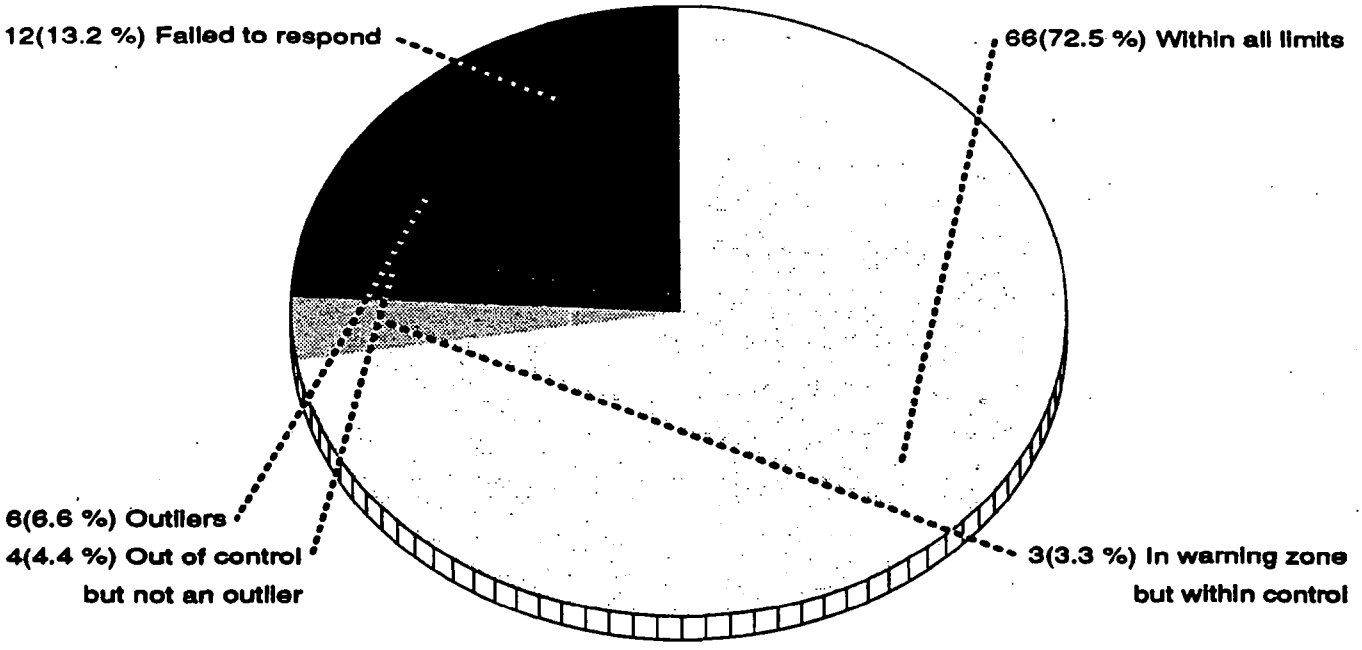
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

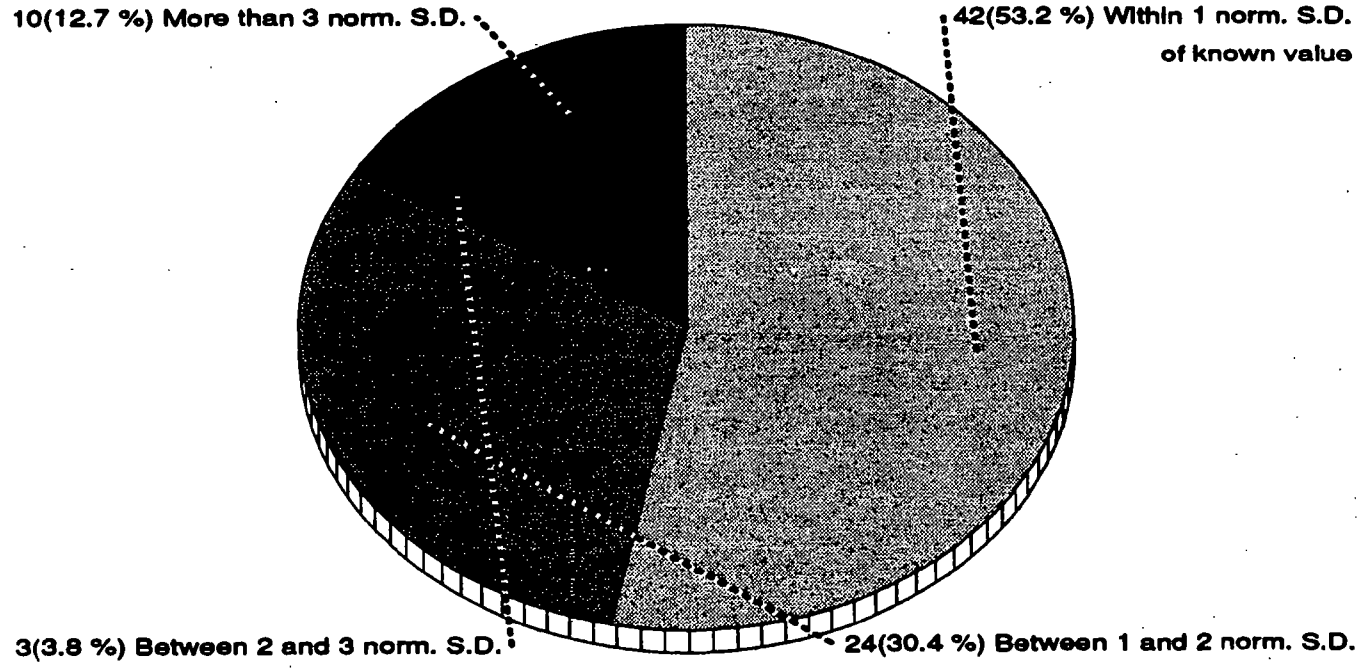
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, EMSL-LV, 702/798-2104.

Plutonium-239 Statistical Summary 91 Participants

The known value of this nuclide is 11.1 pCi/l with an expected precision of 1.1; the control limits are 9.2 to 13.0; the warning regions are 9.2 to 9.8 and 12.4 to 13.0



Statistic	Respondents	Non-outliers
Mean	13.78	**Grand Avg 10.61**
Std. Dev.	19.85	0.69
Variance	393.94	0.47
% Coef. of Var.	143.98	6.49
% deviation of mean from known value	24.19	-4.43
Norm. dev. of mean from known value	0.14	-0.71
Median	10.70	10.67
% deviation of median from known value	-3.60	-3.90
Norm. dev. of median from known value	-0.02	-0.63



EMSL-LV Performance Evaluation: Plutonium in Water, 17-Mar-1995

Plutonium-239

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	10.7	11.2	11.8	0.55	0.591	11.23	0.98	0.21	
AH	11.0	10.8	11.1	0.15	0.161	10.97	0.56	-0.21	
AI									•
AZ	10.7	10.5	10.6	0.10	0.107	10.60	-0.01	-0.79	
BB	9.8	9.9	10.5	0.38	0.376	10.07	-0.85	-1.63	
BC	11.2	11.4	11.3	0.10	0.107	11.30	1.09	0.31	
BG	9.6	10.9	10.0	0.67	0.698	10.17	-0.70	-1.47	
BG	11.1	9.8	10.0	0.70	0.698	10.30	-0.49	-1.26	
BG	10.2	10.0	10.3	0.15	0.161	10.17	-0.70	-1.47	
BK	9.7	9.9	9.9	0.12	0.107	9.83	-1.22	-1.99	
BL	10.7	10.1	10.5	0.31	0.322	10.43	-0.28	-1.05	
BM	10.5	10.0	9.8	0.36	0.376	10.10	-0.80	-1.57	
BO	10.8	10.8	10.9	0.06	0.054	10.83	0.35	-0.42	
CA	11.7	10.8	10.6	0.59	0.591	11.03	0.67	-0.10	
CJ	10.0	11.0	10.0	0.58	0.537	10.33	-0.43	-1.21	
CK	11.7	10.8	11.9	0.59	0.591	11.47	1.35	0.58	
CM	10.4	10.0	10.3	0.21	0.215	10.23	-0.59	-1.36	
CO	10.6	10.9	10.6	0.17	0.161	10.70	0.14	-0.63	
CQ	11.0	11.0	10.0	0.58	0.537	10.67	0.09	-0.68	
CS	10.9	11.0	11.0	0.06	0.054	10.97	0.56	-0.21	
CX	10.8	10.2	10.8	0.35	0.322	10.60	-0.01	-0.79	
D	10.1	8.7	9.8	0.74	0.752	9.53	-1.69	-2.47	
DO	11.7	11.5	12.3	0.42	0.430	11.83	1.93	1.15	
DT	10.7	10.3	11.1	0.40	0.430	10.70	0.14	-0.63	
E	10.9	11.2	11.2	0.17	0.161	11.10	0.77	0.00	
EL	8.8	8.9	9.0	0.10	0.107	8.90	-2.69	-3.46	⇓
FJ	10.4	10.8	10.8	0.23	0.215	10.67	0.09	-0.68	
FU	75.1	95.8	73.9	12.31	21.495	81.60	111.78	111.01	×
FZ	11.0	11.2	10.8	0.20	0.215	11.00	0.62	-0.16	
GQ	16.1	17.0	16.6	0.45	0.483	16.57	9.38	8.61	×
HP	8.0	10.4	8.9	1.21	1.550	9.10	-2.37	-3.15	⇓
J	10.4	10.4	10.6	0.12	0.107	10.47	-0.22	-1.00	
JE	13.7	10.1	11.8	1.80	2.777	11.87	1.98	1.21	
JK	11.1	11.5	11.1	0.23	0.215	11.23	0.98	0.21	
JP	22.4	21.9	20.9	0.76	0.805	21.73	17.52	16.74	×
JS	10.6	10.3	11.3	0.51	0.537	10.73	0.20	-0.58	
JY	9.8	9.1	7.5	1.18	1.448	8.80	-2.85	-3.62	⇓
KH	10.9	10.7	10.6	0.15	0.161	10.73	0.20	-0.58	
L	11.3	11.5	11.6	0.15	0.161	11.47	1.35	0.58	
LT	10.7	10.8	10.9	0.10	0.107	10.80	0.30	-0.47	
M									•
NH	11.0	11.0	11.7	0.40	0.376	11.23	0.98	0.21	
NI									•
NJ	10.0	10.0	10.0	0.00	0.000	10.00	-0.96	-1.73	
NK	10.4	10.5	11.7	0.72	0.698	10.87	0.41	-0.37	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Plutonium-239

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
OB	9.9	10.4	10.4	0.29	0.268	10.23	-0.59	-1.36	
OK									•
OS	10.4	10.3	10.6	0.15	0.161	10.43	-0.28	-1.05	
PM									•
PQ	180.0	165.0	173.0	7.51	14.437	172.67	255.18	254.40	×
PV	6.1	8.6	7.2	1.25	1.652	7.30	-5.21	-5.98	×
PW									•
QC									•
QJ	9.4	10.8	9.2	0.87	0.859	9.80	-1.27	-2.05	
QU									•
QZ	9.5	10.3	9.8	0.40	0.430	9.87	-1.17	-1.94	
RF	10.4	9.2	8.7	0.87	0.913	9.43	-1.85	-2.62	
RL	9.6	9.6	10.3	0.40	0.376	9.83	-1.22	-1.99	
RR	11.9	10.9	11.4	0.50	0.537	11.40	1.25	0.47	
RV	12.0	11.8	10.9	0.59	0.591	11.57	1.51	0.73	
SC	10.1	10.8	10.0	0.44	0.430	10.30	-0.49	-1.26	
SD	11.1	13.1	12.6	1.04	1.141	12.27	2.61	1.84	
SF	10.8	10.9	10.9	0.06	0.054	10.87	0.41	-0.37	
SI	11.0	10.2	10.8	0.42	0.430	10.67	0.09	-0.68	
SM	10.1	9.6	11.2	0.82	0.859	10.30	-0.49	-1.26	
SS	10.4	9.7	10.7	0.51	0.537	10.27	-0.54	-1.31	
ST	10.8	10.1	10.6	0.36	0.376	10.50	-0.17	-0.94	
SX	10.4	10.9	8.9	1.04	1.141	10.07	-0.85	-1.63	
SZ	10.4	10.1	11.6	0.79	0.805	10.70	0.14	-0.63	
TD	10.6	11.7	10.0	0.86	0.913	10.77	0.25	-0.52	
TE	11.2	11.3	11.5	0.15	0.161	11.33	1.14	0.37	
TH	10.7	11.0	10.2	0.40	0.430	10.63	0.04	-0.73	
TI	10.8	10.9	10.7	0.10	0.107	10.80	0.30	-0.47	
TL	11.4	9.7	10.4	0.85	0.913	10.50	-0.17	-0.94	
TQ	10.0	10.1	10.3	0.15	0.161	10.13	-0.75	-1.52	
TS	14.6	15.3	14.4	0.49	0.483	14.73	6.50	6.72	×
UE	11.2	10.7	11.0	0.25	0.268	10.97	0.56	-0.21	
UN									•
UP	8.9	8.9	9.5	0.35	0.322	9.10	-2.37	-3.15	⇓
UW									•
VB	11.1	10.7	11.4	0.35	0.376	11.07	0.72	-0.05	
VO									•
VE	11.0	10.7	10.5	0.25	0.268	10.73	0.20	-0.58	
VG	11.8	11.9	12.2	0.21	0.215	11.97	2.14	1.36	
VI	11.1	10.5	11.4	0.46	0.483	11.00	0.62	-0.16	
VO	10.3	12.8	8.6	2.11	3.391	10.57	-0.07	-0.84	
VQ									•
W	10.3	10.2	9.8	0.26	0.268	10.10	-0.80	-1.57	
WG	12.1	10.9	11.5	0.60	0.644	11.50	1.40	0.63	
WI	10.6	10.7	10.8	0.10	0.107	10.70	0.14	-0.63	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

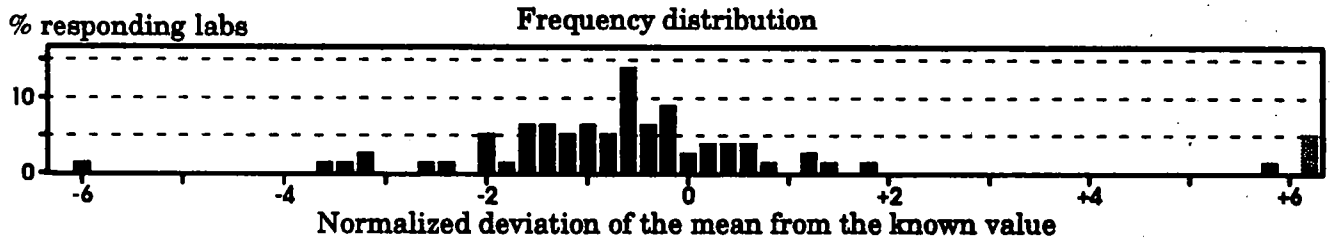
EMSL-LV Performance Evaluation: Plutonium in Water, 17-Mar-1995

Plutonium-239

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
Z	11.2	11.6	10.2	0.72	0.752	11.00	0.62	-0.16	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
7.30	×	PV	10.43		OS	10.97		CS
8.80	⇓	JY	10.43		BL	10.97		AH
8.90	⇓	EL	10.47		J	11.00		Z
9.10	⇓	UP	10.50		TL	11.00		VI
9.10	⇓	HP	10.50		ST	11.00		FZ
9.43		RF	10.57		VO	11.03		CA
9.53		D	10.60		CX	11.07		VB
9.80		QJ	10.60		AZ	11.10		E
9.83		BK	10.63		TH	11.23		NH
9.83		RL	10.67		SI	11.23		JK
9.87		QZ	10.67		FJ	11.23		A
10.00		NJ	10.67		CQ	11.30		BC
10.07		SX	10.70		WI	11.33		TE
10.07		BB	10.70		SZ	11.40		RR
10.10		W	10.70		DT	11.47		L
10.10		BM	10.70		CO	11.47		CK
10.13		TQ	10.73		VE	11.50		WG
10.17		BG	10.73		KH	11.57		RV
10.17		BG	10.73		JS	11.83		DO
10.23		OB	10.77		TD	11.87		JE
10.23		CM	10.80		TI	11.97		VG
10.27		SS	10.80		LT	12.27		SD
10.30		SM	10.83		BO	14.73	×	TS
10.30		SC	10.87		SF	16.57	×	GQ
10.30		BG	10.87		NK	21.73	×	JP
10.33		CJ	10.97		UE	81.60	×	FU
						172.67	×	PQ



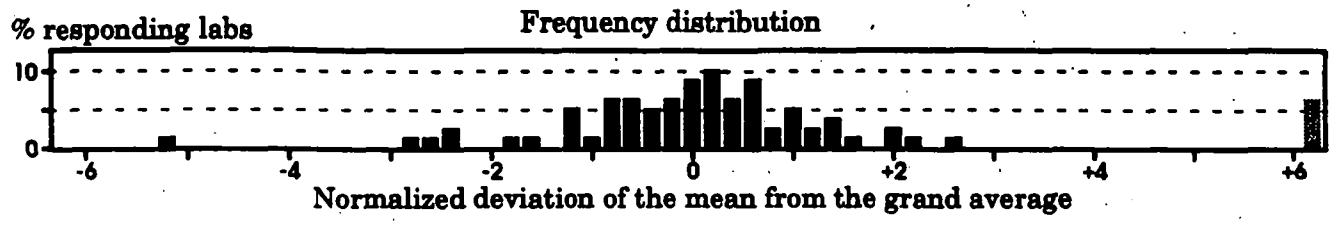
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Plutonium-239



United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/116A
August 1995

EPA

Blind-A Performance Evaluation Study

A Statistical Evaluation of the April 18, 1995 Data

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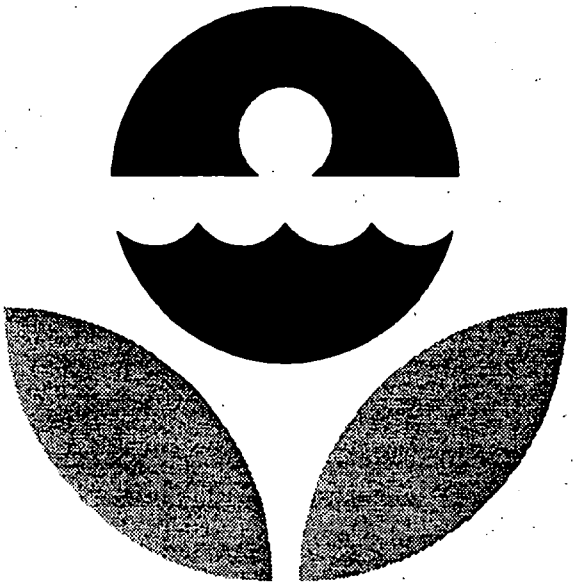
Blind-A

Performance Evaluation Study

April 18, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Radiation Sciences Branch (CRD-LV) Performance Evaluation Study for ***Blind-A; April 18, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Hönsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Program

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

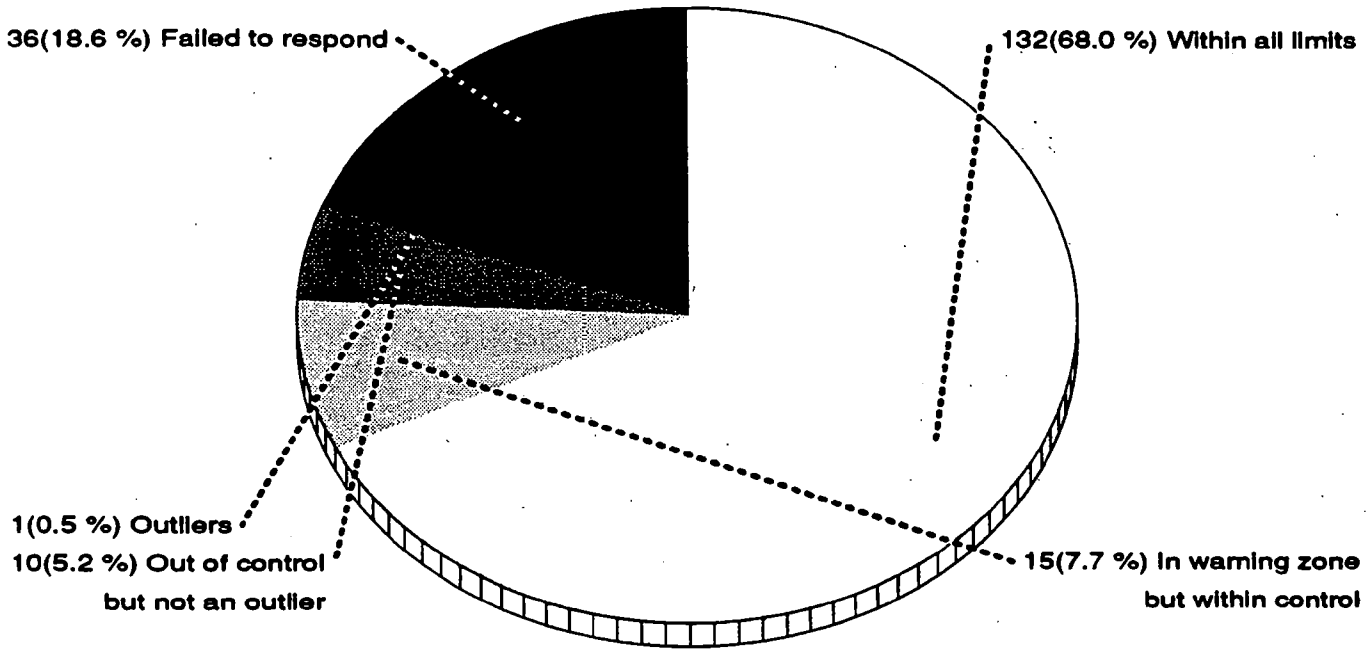
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

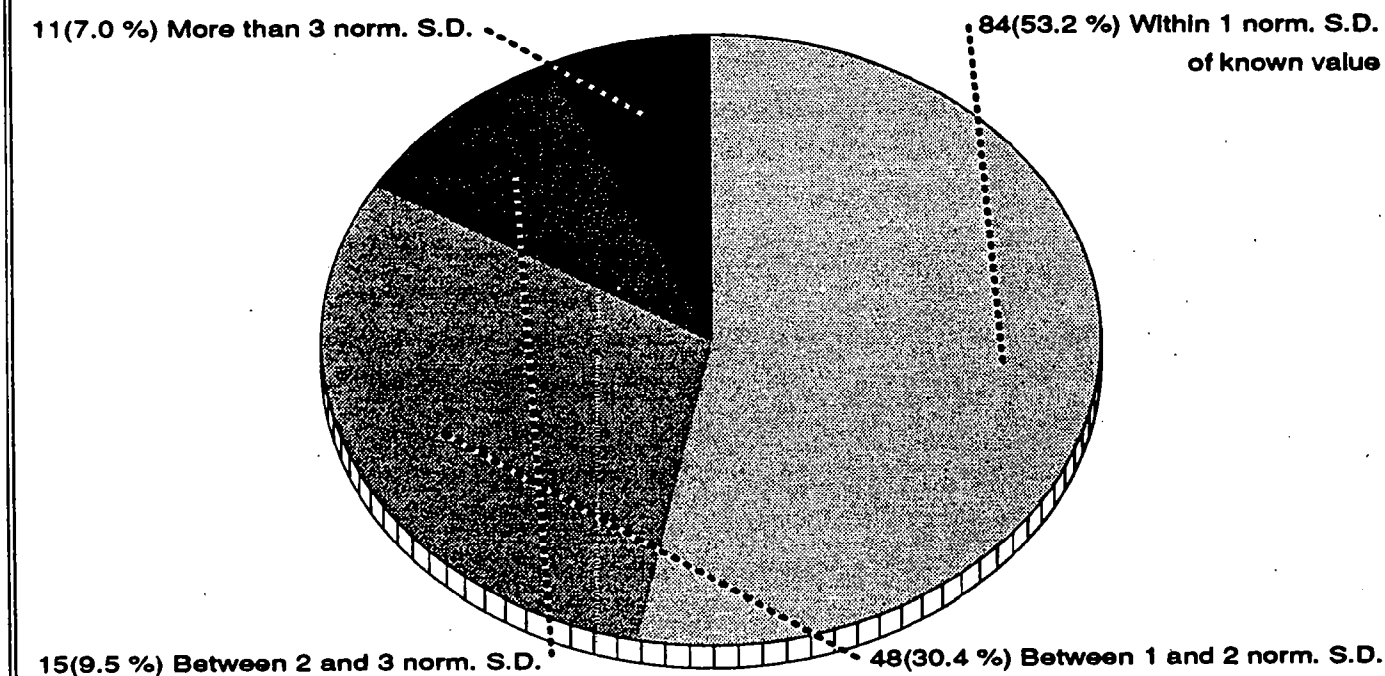
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, CRD-LV, 702/798-2104.

Gross Alpha Statistical Summary 194 Participants

The known value of this nuclide is **47.5 pCi/l** with an expected precision of **11.9**; the control limits are 26.9 to 68.1; the warning regions are 26.9 to 33.7 and 61.3 to 68.1



Statistic	Respondents	Non-outliers
Mean	56.42	**Grand Avg 50.90**
Std. Dev.	70.05	10.06
Variance	4906.76	101.12
% Coef. of Var.	124.16	19.76
% deviation of mean from known value	18.77	7.16
Norm. dev. of mean from known value	0.13	0.34
Median	50.58	50.47
% deviation of median from known value	6.49	6.25
Norm. dev. of median from known value	0.04	0.30



CRD-LV Performance Evaluation: Blind-A, 18-Apr-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	53.6	51.8	49.0	2.32	0.228	51.47	0.08	0.58	
AE	49.9	51.7	50.5	0.92	0.089	50.70	-0.03	0.47	
AF	65.0	66.0	52.0	7.81	0.695	61.00	1.47	1.96	
AH	50.9	52.4	43.2	4.94	0.457	48.83	-0.30	0.19	
AI									•
AJ	44.3	57.2	55.1	6.92	0.640	52.20	0.19	0.68	
AK	51.6	52.3	58.1	3.57	0.323	54.00	0.45	0.95	
AL	62.1	59.7	59.5	1.45	0.129	60.43	1.39	1.88	
AO									•
AP	40.8	43.5	48.0	3.64	0.357	44.10	-0.99	-0.49	
AR	61.4	62.7	60.2	1.25	0.124	61.43	1.53	2.03	
AU	56.0	50.0	49.0	3.79	0.347	51.67	0.11	0.61	
AW	40.3	41.3	39.6	0.85	0.084	40.40	-1.53	-1.03	
AZ	61.3	63.5	57.7	2.93	0.288	60.83	1.45	1.94	
BA	48.7	50.4	50.1	0.91	0.084	49.73	-0.17	0.33	
BB	51.7	54.2	50.6	1.84	0.179	52.17	0.18	0.68	
BC	69.0	70.8	70.4	0.94	0.089	70.07	2.79	3.28	⇑
BG									•
BH	52.3	48.2	55.5	3.66	0.362	52.00	0.16	0.65	
BK	46.6	46.1	46.4	0.25	0.025	46.37	-0.66	-0.16	
BL									•
BM	47.8	49.3	49.7	1.00	0.094	48.93	-0.29	0.21	
BN	76.2	68.6	66.4	5.14	0.486	70.40	2.84	3.33	⇑
BO	42.6	45.2	42.5	1.53	0.134	43.43	-1.09	-0.59	
BS	50.6	49.6	51.2	0.81	0.079	50.47	-0.06	0.43	
BW									•
C	45.4	45.5	45.6	0.10	0.010	45.50	-0.79	-0.29	
CA	41.1	42.3	41.8	0.60	0.060	41.73	-1.33	-0.84	
CE	53.0	53.5	56.9	2.12	0.194	54.47	0.52	1.01	
CG	57.6	54.4	59.7	2.67	0.263	57.23	0.92	1.42	
CJ	42.0	40.0	37.0	2.52	0.248	39.67	-1.64	-1.14	
CK	48.4	45.6	44.4	2.05	0.199	46.13	-0.69	-0.20	
CM									•
CO	50.8	50.8	49.7	0.64	0.055	50.43	-0.07	0.43	
CP	33.0	33.0	34.0	0.58	0.050	33.33	-2.56	-2.06	
CQ	53.0	54.0	57.0	2.08	0.199	54.67	0.55	1.04	
CS	46.2	49.4	44.1	2.67	0.263	46.57	-0.63	-0.14	
CX	54.3	54.6	50.9	2.06	0.184	53.27	0.34	0.84	
D	42.3	50.4	52.0	5.20	0.481	48.23	-0.39	0.11	
DB	49.1	49.7	51.0	0.97	0.094	49.93	-0.14	0.35	
DD	49.4	49.7	53.4	2.23	0.199	50.83	-0.01	0.49	
DE	59.8	59.9	60.0	0.10	0.010	59.90	1.31	1.80	
DG									•
DJ									•
DL									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM									•
DO									•
DS	51.7	52.6	54.8	1.59	0.154	53.03	0.31	0.81	
DT	52.0	55.0	59.0	3.51	0.347	55.33	0.64	1.14	
DZ	41.8	41.2	41.6	0.31	0.030	41.53	-1.36	-0.87	
E	49.0	51.0	51.0	1.15	0.099	50.33	-0.08	0.41	
EB	55.6	57.8	57.4	1.17	0.109	56.93	0.88	1.37	
EL									•
EO	44.0	47.0	45.0	1.53	0.149	45.33	-0.81	-0.32	
ER	58.3	55.5	53.9	2.23	0.218	55.90	0.73	1.22	
EV	43.6	41.8	46.3	2.26	0.223	43.90	-1.02	-0.52	
EX									•
FF	52.0	51.0	50.0	1.00	0.099	51.00	0.01	0.51	
FJ	41.8	45.7	41.6	2.31	0.204	43.03	-1.15	-0.65	
FL	36.5	41.5	34.5	3.61	0.347	37.50	-1.95	-1.46	
FN	47.1	47.1	44.0	1.79	0.154	46.07	-0.70	-0.21	
FU	49.8	49.8	52.8	1.73	0.149	50.80	-0.01	0.48	
FZ	59.0	53.0	56.0	3.00	0.298	56.00	0.74	1.24	
GE									•
GI									•
GQ	33.2	30.9	32.1	1.15	0.114	32.07	-2.74	-2.25	
GT	47.5	37.7	33.8	7.06	0.680	39.67	-1.64	-1.14	
GZ	54.1	54.4	53.9	0.25	0.025	54.13	0.47	0.97	
HI	52.0	55.0	57.0	2.52	0.248	54.67	0.55	1.04	
HK	65.1	63.9	61.7	1.72	0.169	63.57	1.84	2.34	
HL	54.9	54.9	54.9	0.02	0.000	54.90	0.58	1.08	
HP	43.8	44.4	43.1	0.65	0.065	43.77	-1.04	-0.54	
I	41.0	38.5	37.3	1.89	0.184	38.93	-1.74	-1.25	
IC	53.9	52.3	55.4	1.55	0.154	53.87	0.43	0.93	
ID	45.1	47.0	44.8	1.19	0.109	45.63	-0.77	-0.27	
J	54.5	55.9	47.6	4.44	0.412	52.67	0.26	0.75	
JE	45.6	48.8	45.1	2.01	0.184	46.50	-0.64	-0.15	
JG	51.0	49.5	49.7	0.81	0.074	50.07	-0.12	0.37	
JN	61.5	57.7	57.9	2.14	0.189	59.03	1.18	1.68	
JQ	54.8	55.6	50.5	2.74	0.253	53.63	0.40	0.89	
JS	53.8	57.6	54.0	2.14	0.189	55.13	0.62	1.11	
JY									•
K	58.9	61.1	65.9	3.58	0.347	61.97	1.61	2.11	
KE	70.8	86.2	76.5	7.79	0.764	77.83	3.92	4.42	⇑
KT	45.0	50.0	55.0	5.00	0.496	50.00	-0.13	0.36	
KX	53.0	61.0	61.0	4.62	0.397	58.33	1.08	1.58	
L	51.0	51.0	51.0	0.00	0.000	51.00	0.01	0.51	
LF	34.0	28.0	33.0	3.21	0.298	31.67	-2.80	-2.30	
LG									•
LL	35.0	37.1	33.8	1.67	0.164	35.30	-2.27	-1.78	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	43.0	44.0	46.0	1.53	0.149	44.33	-0.96	-0.46	
LT	47.5	42.1	44.1	2.73	0.268	44.57	-0.92	-0.43	
M	75.0	80.0	72.0	4.04	0.397	75.67	3.60	4.10	⇑
MA									•
MF	61.6	61.8	60.0	0.99	0.089	61.13	1.49	1.98	
MP									•
MQ	51.0	49.0	53.0	2.00	0.199	51.00	0.01	0.51	
MV	52.0	53.0	58.0	3.21	0.298	54.33	0.50	0.99	
MY									•
N	53.5	58.8	51.3	3.86	0.372	54.53	0.53	1.02	
NA	48.1	48.6	48.5	0.26	0.025	48.40	-0.36	0.13	
NH	65.0	72.0	61.0	5.57	0.546	66.00	2.20	2.69	
NI									•
NJ	48.6	45.9	40.0	4.40	0.427	44.83	-0.88	-0.39	
NK	32.4	32.4	35.5	1.79	0.154	33.43	-2.54	-2.05	
NO	51.5	54.5	57.3	2.90	0.288	54.43	0.51	1.01	
NT	53.0	54.0	53.5	0.50	0.050	53.50	0.38	0.87	
O	48.6	54.1	47.9	3.40	0.308	50.20	-0.10	0.39	
OF	52.4	56.4	68.4	8.33	0.794	59.07	1.19	1.68	
OS	49.5	47.8	51.1	1.65	0.164	49.47	-0.21	0.29	
OX									•
OY	874.0	978.0	915.0	52.39	8.928	922.33	126.84	127.33	×
OZ	55.4	61.0	62.0	3.56	0.328	59.47	1.25	1.74	
P	84.0	87.4	82.0	2.73	0.268	84.47	4.89	5.38	⇑
PA	33.4	34.9	40.7	3.86	0.362	36.33	-2.12	-1.63	
PB	49.8	52.7	50.7	1.48	0.144	51.07	0.02	0.52	
PG	77.5	67.0	71.2	5.28	0.521	71.90	3.06	3.55	⇑
PI									•
PM	38.2	40.6	39.4	1.20	0.119	39.40	-1.67	-1.18	
PQ	45.7	46.2	39.4	3.79	0.338	43.77	-1.04	-0.54	
PR	44.0	41.0	39.0	2.52	0.248	41.33	-1.39	-0.90	
PV	48.1	51.4	55.8	3.86	0.382	51.77	0.13	0.62	
PW									•
Q	50.4	47.2	45.3	2.58	0.253	47.63	-0.48	0.02	
QC	39.8	39.9	40.0	0.10	0.010	39.90	-1.60	-1.11	
QJ	38.3	35.1	39.3	2.19	0.208	37.57	-1.94	-1.45	
QP	53.0	46.0	47.0	3.79	0.347	48.67	-0.33	0.17	
QQ	53.2	59.4	66.5	6.66	0.660	59.70	1.28	1.78	
QT	48.1	44.0	50.7	3.38	0.333	47.60	-0.48	0.01	
QU	28.2	30.0	32.2	2.00	0.199	30.13	-3.02	-2.53	
QW	33.8	37.3	35.6	1.75	0.174	35.57	-2.23	-1.74	
QX	48.4	49.7	50.7	1.15	0.114	49.60	-0.19	0.31	
QY									•
QZ	42.5	43.0	42.9	0.26	0.025	42.80	-1.18	-0.68	
RD	46.0	53.0	51.0	3.61	0.347	50.00	-0.13	0.36	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE	55.3	51.2	43.6	5.94	0.581	50.03	-0.13	0.37	
RF	46.7	45.3	47.8	1.25	0.124	46.60	-0.63	-0.13	
RG	49.0	39.0	47.0	5.29	0.496	45.00	-0.86	-0.36	
RJ									•
RK	33.3	37.8	30.8	3.55	0.347	33.97	-2.46	-1.97	
RP									•
RR	38.0	43.0	43.0	2.89	0.248	41.33	-1.39	-0.90	
RV	46.0	64.0	63.0	10.12	0.893	57.67	0.98	1.48	
RZ	55.1	56.0	54.4	0.80	0.079	55.17	0.62	1.12	
S	56.8	56.4	56.1	0.35	0.035	56.43	0.81	1.30	
SC	45.8	36.9	47.0	5.52	0.501	43.23	-1.12	-0.62	
SD	69.1	63.8	68.5	2.90	0.263	67.13	2.36	2.86	
SF	57.1	58.7	62.3	2.66	0.258	59.37	1.23	1.73	
SI	63.8	66.1	67.4	1.82	0.179	65.77	2.16	2.66	
SL	52.8	56.0	67.6	7.79	0.735	58.80	1.15	1.64	
SM	66.4	68.9	73.0	3.33	0.328	69.43	2.70	3.19	⇑
SN	60.4	59.6	47.2	7.40	0.655	55.73	0.70	1.20	
SO	48.7	47.7	48.9	0.64	0.060	48.43	-0.36	0.14	
SR	55.0	55.0	55.0	0.00	0.000	55.00	0.60	1.09	
SS	50.2	52.8	49.4	1.78	0.169	50.80	-0.01	0.48	
ST	41.0	39.8	48.3	4.60	0.422	43.03	-1.15	-0.65	
SX	40.7	36.0	36.0	2.71	0.233	37.57	-1.94	-1.45	
SZ	49.9	53.2	49.3	2.10	0.194	50.80	-0.01	0.48	
T	43.2	44.9	43.3	0.95	0.084	43.80	-1.03	-0.54	
TD	52.5	46.8	50.8	2.93	0.283	50.03	-0.13	0.37	
TE	63.0	69.0	65.0	3.06	0.298	65.67	2.15	2.64	
TH	51.0	45.0	49.0	3.06	0.298	48.33	-0.37	0.12	
TI	56.4	58.4	54.4	2.00	0.199	56.40	0.80	1.30	
TL	57.8	58.1	64.0	3.50	0.308	59.97	1.32	1.81	
TN	45.3	44.2	43.4	0.95	0.094	44.30	-0.96	-0.47	
TQ	43.6	35.9	38.4	3.93	0.382	39.30	-1.69	-1.19	
TS	50.3	45.7	50.9	2.84	0.258	48.97	-0.28	0.21	
TY	55.0	56.0	53.0	1.53	0.149	54.67	0.55	1.04	
U	76.6	85.8	68.2	8.80	0.874	76.87	3.78	4.27	⇑
UA	49.2	56.3	48.0	4.49	0.412	51.17	0.04	0.53	
UE	50.2	43.7	48.3	3.34	0.323	47.40	-0.51	-0.01	
UG									•
UK									•
UN	31.4	33.5	35.7	2.15	0.213	33.53	-2.53	-2.03	
UP	47.2	48.6	48.4	0.76	0.069	48.07	-0.41	0.08	
UQ	68.0	69.0	70.0	1.00	0.099	69.00	2.63	3.13	⇑
UW	54.8	53.1	52.6	1.15	0.109	53.50	0.38	0.87	
UY									•
VA	49.4	54.2	51.5	2.41	0.238	51.70	0.12	0.61	
VC									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 18-Apr-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	40.3	41.4	41.5	0.67	0.060	41.07	-1.43	-0.94	
VI	45.6	52.6	51.6	3.79	0.347	49.93	-0.14	0.35	
VJ	41.3	42.1	40.4	0.85	0.084	41.27	-1.40	-0.91	
VM									•
VN									•
VO	35.8	39.8	38.9	2.10	0.199	38.17	-1.85	-1.36	
VQ									•
VT	51.8	50.5	53.0	1.25	0.124	51.77	0.13	0.62	
VU									•
W	63.4	64.6	66.5	1.56	0.154	64.83	2.03	2.52	
WE	81.3	83.8	81.0	1.54	0.139	82.03	4.53	5.03	⇑
WF	32.2	33.6	27.5	3.20	0.303	31.10	-2.88	-2.39	
X	41.7	39.2	40.2	1.26	0.124	40.37	-1.53	-1.04	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
30.13		QU	41.73		CA	48.07		UP
31.10		WF	42.80		QZ	48.23		D
31.67		LF	43.03		ST	48.33		TH
32.07		GQ	43.03		FJ	48.40		NA
33.33		CP	43.23		SC	48.43		SO
33.43		NK	43.43		BO	48.67		QP
33.53		UN	43.77		PQ	48.83		AH
33.97		RK	43.77		HP	48.93		BM
35.30		LL	43.80		T	48.97		TS
35.57		QW	43.90		EV	49.47		OS
36.33		PA	44.10		AP	49.60		QX
37.50		FL	44.30		TN	49.73		BA
37.57		QJ	44.33		LR	49.93		VI
37.57		SX	44.57		LT	49.93		DB
38.17		VO	44.83		NJ	50.00		RD
38.93		I	45.00		RG	50.00		KT
39.30		TQ	45.33		EO	50.03		TD
39.40		PM	45.50		C	50.03		RE
39.67		GT	45.63		ID	50.07		JG
39.67		CJ	46.07		FN	50.20		O
39.90		QC	46.13		CK	50.33		E
40.37		X	46.37		BK	50.43		CO
40.40		AW	46.50		JE	50.47		BS
41.07		VG	46.57		CS	50.70		AE
41.27		VJ	46.60		RF	50.80		FU
41.33		RR	47.40		UE	50.80		SZ
41.33		PR	47.60		QT	50.80		SS
41.53		DZ	47.63		Q	50.83		DD

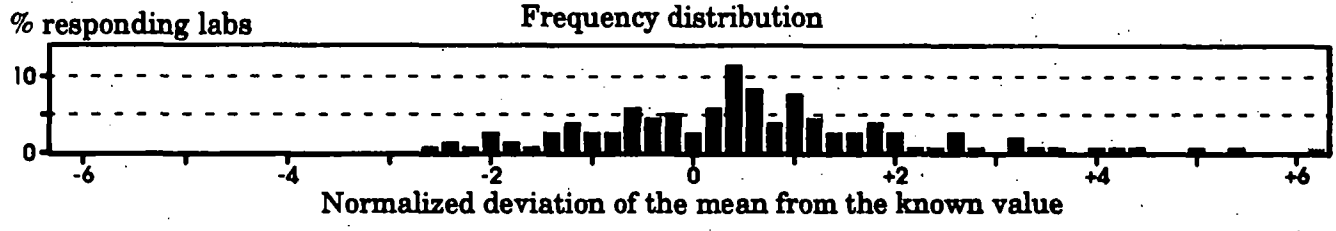
TAG SYMBOLS

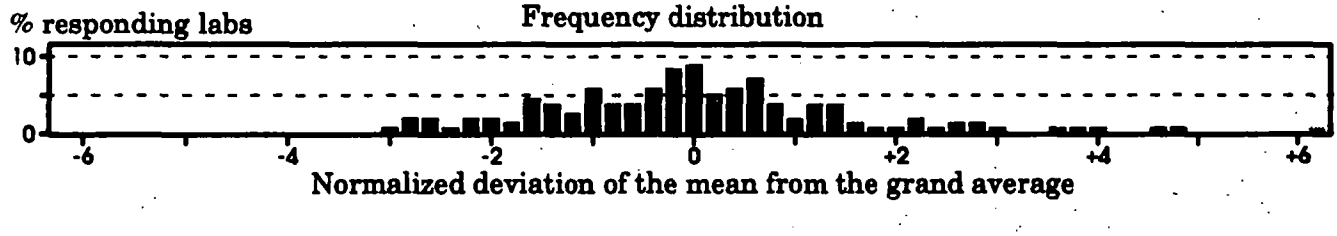
• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
51.00		MQ	54.47		CE	59.90		DE
51.00		L	54.53		N	59.97		TL
51.00		FF	54.67		TY	60.43		AL
51.07		PB	54.67		HI	60.83		AZ
51.17		UA	54.67		CQ	61.00		AF
51.47		A	54.90		HL	61.13		MF
51.67		AU	55.00		SR	61.43		AR
51.70		VA	55.13		JS	61.97		K
51.77		VT	55.17		RZ	63.57		HK
51.77		PV	55.33		DT	64.83		W
52.00		BH	55.73		SN	65.67		TE
52.17		BB	55.90		ER	65.77		SI
52.20		AJ	56.00		FZ	66.00		NH
52.67		J	56.40		TI	67.13		SD
53.03		DS	56.43		S	69.00	⇑	UQ
53.27		CX	56.93		EB	69.43	⇑	SM
53.50		UW	57.23		CG	70.07	⇑	BC
53.50		NT	57.67		RV	70.40	⇑	BN
53.63		JQ	58.33		KX	71.90	⇑	PG
53.87		IC	58.80		SL	75.67	⇑	M
54.00		AK	59.03		JN	76.87	⇑	U
54.13		GZ	59.07		OF	77.83	⇑	KE
54.33		MV	59.37		SF	82.03	⇑	WE
54.43		NO	59.47		OZ	84.47	⇑	P
			59.70		QQ	922.33	×	OY





• ≡ No data submitted
∅ ≡ Insufficient data

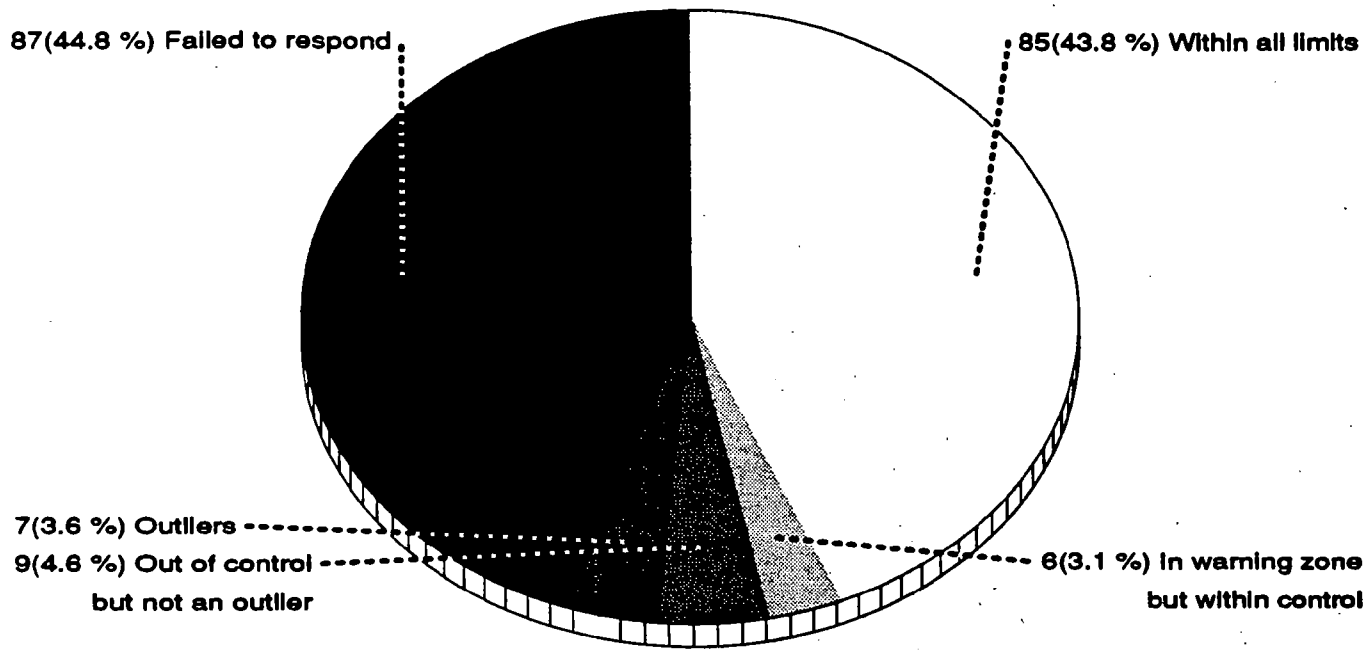
TAG SYMBOLS

× ≡ Determined to be an outlier

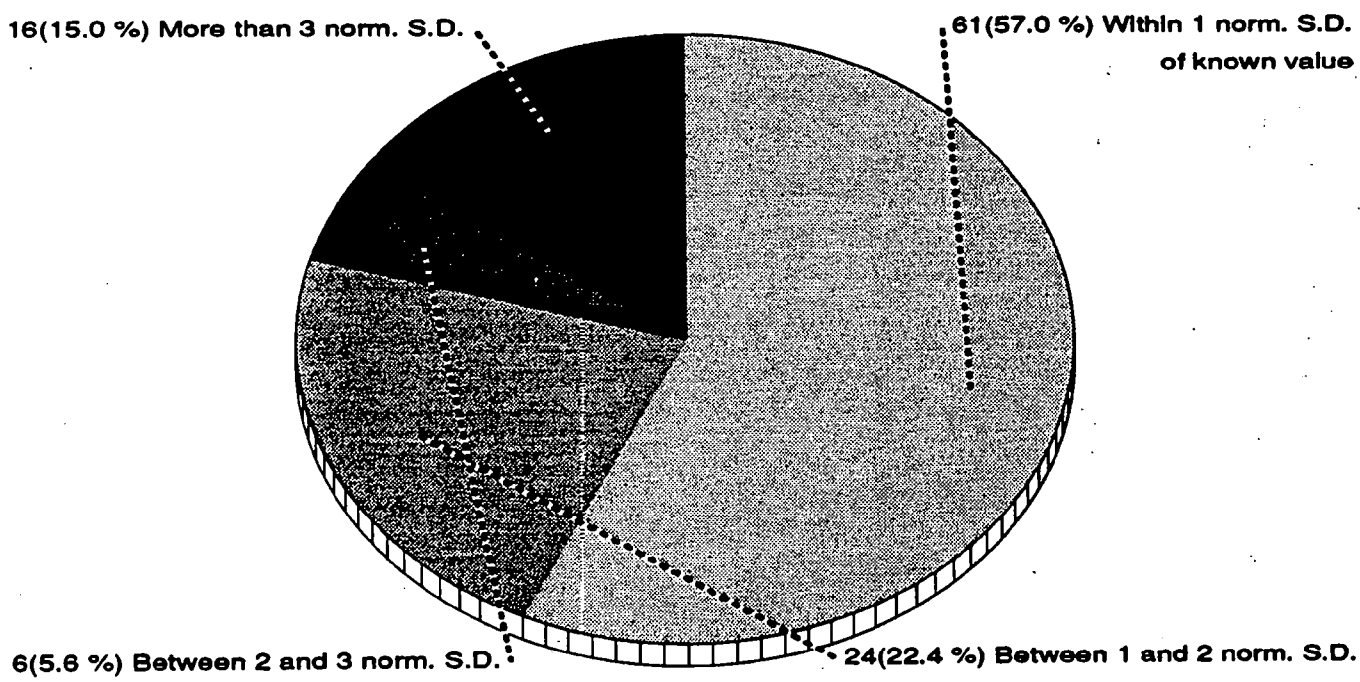
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 194 Participants

The known value of this nuclide is **14.9 pCi/l** with an expected precision of **2.2**; the control limits are 11.1 to 18.7; the warning regions are 11.1 to 12.4 and 17.4 to 18.7



Statistic	Respondents	Non-outliers
Mean	14.74	**Grand Avg 14.66**
Std. Dev.	3.03	1.96
Variance	9.20	3.83
% Coef. of Var.	20.58	13.36
% deviation of mean from known value	-1.10	-1.64
Norm. dev. of mean from known value	-0.05	-0.13
Median	14.67	14.62
% deviation of median from known value	-1.57	-1.90
Norm. dev. of median from known value	-0.08	-0.14



Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	15.0	14.6	14.8	0.20	0.107	14.80	0.11	-0.08	
AE	13.2	13.5	13.7	0.25	0.134	13.47	-0.94	-1.13	
AF	14.7	14.7	14.2	0.29	0.134	14.53	-0.10	-0.29	
AH	20.6	14.6	16.3	3.09	2.164	17.17	1.98	1.78	
AI									•
AJ	14.2	14.9	14.6	0.35	0.188	14.57	-0.07	-0.26	
AK	16.7	17.9	17.7	0.64	0.322	17.43	2.19	1.99	
AL	13.2	13.7	13.9	0.36	0.188	13.60	-0.83	-1.02	
AO									•
AP	15.1	15.3	15.7	0.31	0.161	15.37	0.56	0.37	
AR									•
AU	12.7	12.5	12.5	0.12	0.054	12.57	-1.64	-1.84	
AW	13.8	13.4	13.9	0.26	0.134	13.70	-0.75	-0.94	
AZ	16.9	15.2	18.4	1.60	0.859	16.83	1.71	1.52	
BA	14.1	13.3	14.1	0.46	0.215	13.83	-0.65	-0.84	
BB									•
BC	14.8	16.4	14.9	0.90	0.430	15.37	0.56	0.37	
BG									•
BH	13.3	14.1	13.7	0.40	0.215	13.70	-0.75	-0.94	
BK	14.1	13.8	14.1	0.17	0.081	14.00	-0.52	-0.71	
BL									•
BM	15.8	16.7	15.0	0.85	0.456	15.83	0.93	0.73	
BN	15.6	17.7	15.3	1.31	0.644	16.20	1.22	1.02	
BO	12.7	12.7	13.3	0.35	0.161	12.90	-1.38	-1.57	
BS									•
BW									•
C	15.5	15.6	15.6	0.06	0.027	15.57	0.72	0.52	
CA	13.9	13.2	13.0	0.47	0.242	13.37	-1.01	-1.21	
CE	11.9	13.4	13.9	1.04	0.537	13.07	-1.25	-1.44	
CG	17.0	15.0	14.5	1.32	0.671	15.50	0.67	0.47	
CJ	16.0	16.0	15.0	0.58	0.268	15.67	0.80	0.60	
CK	11.9	10.6	12.1	0.81	0.403	11.53	-2.46	-2.65	
CM									•
CO									•
CP									•
CQ									•
CS									•
CX									•
D									•
DB	14.8	14.3	14.5	0.25	0.134	14.53	-0.10	-0.29	
DD									•
DE	15.5	15.6	15.6	0.06	0.027	15.57	0.72	0.52	
DG									•
DJ									•
DL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM									•
DO									•
DS									•
DT	14.3	13.7	13.0	0.65	0.349	13.67	-0.78	-0.97	
DZ	14.4	14.7	14.4	0.17	0.081	14.50	-0.12	-0.31	
E	13.8	13.9	13.1	0.44	0.215	13.60	-0.83	-1.02	
EB	15.8	15.8	15.7	0.06	0.027	15.77	0.88	0.68	
EL	14.0	14.9	15.5	0.75	0.403	14.80	0.11	-0.08	
EO	14.7	14.5	15.3	0.42	0.215	14.83	0.14	-0.05	
ER	14.2	14.3	14.7	0.26	0.134	14.40	-0.20	-0.39	
EV									•
EX									•
FF									•
FJ									•
FL									•
FN	12.2	13.9	14.4	1.15	0.591	13.50	-0.91	-1.10	
FU									•
FZ	3.4	3.3	3.3	0.06	0.027	3.33	-8.91	-9.11	×
GE									•
GI									•
GQ	14.9	14.2	15.7	0.75	0.403	14.93	0.22	0.03	
GT									•
GZ									•
HI									•
HK	14.2	15.2	14.2	0.58	0.268	14.53	-0.10	-0.29	
HL	14.0	14.0	14.3	0.17	0.081	14.10	-0.44	-0.63	
HP	15.8	14.4	15.1	0.70	0.376	15.10	0.35	0.16	
I	15.6	16.6	15.2	0.72	0.376	15.80	0.90	0.71	
IC									•
ID	12.5	13.1	11.3	0.92	0.483	12.30	-1.85	-2.05	
J	14.1	15.6	15.4	0.81	0.403	15.03	0.30	0.10	
JE	19.0	17.6	18.3	0.70	0.376	18.30	2.87	2.68	
JG	9.3	11.2	11.2	1.10	0.510	10.57	-3.22	-3.41	⇓
JN									•
JQ									•
JS	15.9	16.2	11.9	2.40	1.294	14.67	0.01	-0.18	
JY									•
K	11.1	12.9	13.4	1.21	0.618	12.47	-1.72	-1.92	
KE									•
KT									•
KX									•
L	13.9	14.1	13.8	0.15	0.081	13.93	-0.57	-0.76	
LF									•
LG									•
LL									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	27.0	25.0	24.0	1.53	0.805	25.33	8.41	8.21	×
LT	14.8	14.7	12.9	1.07	0.510	14.13	-0.41	-0.60	
M	15.5	15.8	16.9	0.74	0.376	16.07	1.11	0.92	
MA									•
MF									•
MP									•
MQ									•
MV									•
MY									•
N	15.7	14.0	13.9	1.01	0.483	14.53	-0.10	-0.29	
NA									•
NH	16.1	17.2	15.9	0.70	0.349	16.40	1.37	1.18	
NI									•
NJ	20.6	18.3	18.5	1.27	0.618	19.13	3.53	3.33	⇑
NK									•
NO	15.2	15.7	16.3	0.55	0.295	15.73	0.85	0.66	
NT	14.6	15.3	16.0	0.70	0.376	15.30	0.51	0.31	
O									•
OF	10.9	11.6	14.0	1.63	0.832	12.17	-1.96	-2.15	
OS									•
OX	15.3	15.2	15.1	0.10	0.054	15.20	0.43	0.24	
OY	14.8	14.0	14.0	0.46	0.215	14.27	-0.31	-0.50	
OZ									•
P	18.0	18.3	18.5	0.25	0.134	18.27	2.84	2.65	
PA									•
PB	14.7	14.6	15.1	0.26	0.134	14.80	0.11	-0.08	
PG	13.9	12.7	13.2	0.60	0.322	13.27	-1.09	-1.29	
PI									•
PM									•
PQ	9.3	11.7	12.1	1.51	0.752	11.03	-2.85	-3.04	⇓
PR									•
PV	10.8	10.6	9.3	0.81	0.403	10.23	-3.48	-3.67	⇓
PW	16.0	17.8	13.3	2.26	1.397	15.70	0.82	0.63	
Q	16.0	15.7	18.9	1.77	0.859	16.87	1.74	1.55	
QC									•
QJ	14.9	15.0	15.0	0.06	0.027	14.97	0.25	0.05	
QP									•
QQ	17.4	16.3	17.0	0.56	0.295	16.90	1.77	1.57	
QT	9.4	7.6	8.3	0.91	0.483	8.43	-4.90	-5.09	⇓
QU	7.2	7.7	7.8	0.32	0.161	7.57	-5.58	-5.77	×
QW									•
QX	21.8	22.4	20.8	0.81	0.430	21.67	5.52	5.33	×
QY	15.1	15.0	15.0	0.06	0.027	15.03	0.30	0.10	
QZ	13.0	14.8	14.8	1.04	0.483	14.20	-0.36	-0.55	
RD	14.2	14.2	14.9	0.40	0.188	14.43	-0.17	-0.37	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF	16.2	16.0	15.0	0.64	0.322	15.73	0.85	0.66	
RG									•
RJ									•
RK	14.1	12.1	13.7	1.06	0.537	13.30	-1.07	-1.26	
RP									•
RR									•
RV	11.8	15.8	15.2	2.16	1.141	14.27	-0.31	-0.50	
RZ	14.1	14.2	14.0	0.10	0.054	14.10	-0.44	-0.63	
S	16.3	16.4	16.2	0.10	0.054	16.30	1.30	1.10	
SC	17.0	16.5	17.1	0.32	0.161	16.87	1.74	1.55	
SD	14.2	15.1	14.4	0.47	0.242	14.57	-0.07	-0.26	
SF	13.5	13.3	13.7	0.20	0.107	13.50	-0.91	-1.10	
SI	16.4	14.3	16.8	1.34	0.671	15.83	0.93	0.73	
SL									•
SM	12.6	12.9	13.2	0.30	0.161	12.90	-1.38	-1.57	
SN									•
SO	15.4	16.5	16.3	0.59	0.295	16.07	1.11	0.92	
SR									•
SS	16.6	14.7	13.7	1.47	0.779	15.00	0.27	0.08	
ST	14.8	15.3	14.2	0.55	0.295	14.77	0.09	-0.10	
SX	13.4	13.6	14.4	0.53	0.268	13.80	-0.67	-0.87	
SZ	14.0	15.1	16.2	1.10	0.591	15.10	0.35	0.16	
T	15.2	14.4	14.9	0.40	0.215	14.83	0.14	-0.05	
TD	24.4	16.7	26.0	4.97	3.851	22.37	6.07	5.88	×
TE	11.7	15.0	14.2	1.72	0.886	13.63	-0.80	-1.00	
TH	11.9	11.9	11.4	0.29	0.134	11.73	-2.30	-2.49	
TI	17.4	15.2	17.6	1.33	0.644	16.73	1.64	1.44	
TL	5.4	5.8	5.9	0.26	0.134	5.70	-7.05	-7.24	×
TN	20.8	21.4	19.4	1.03	0.537	20.53	4.63	4.44	⇑
TQ	17.4	17.2	17.0	0.20	0.107	17.20	2.00	1.81	
TS	18.9	21.6	21.0	1.42	0.725	20.50	4.60	4.41	⇑
TY									•
U	11.7	10.8	10.5	0.62	0.322	11.00	-2.88	-3.07	⇓
UA									•
UE	14.0	13.6	15.2	0.83	0.430	14.27	-0.31	-0.50	
UG									•
UK									•
UN	11.4	9.1	9.6	1.21	0.618	10.03	-3.64	-3.83	⇓
UP	14.5	15.1	15.0	0.32	0.161	14.87	0.17	-0.03	
UQ	14.6	14.4	15.7	0.70	0.349	14.90	0.19	0.00	
UW	15.3	16.8	15.7	0.78	0.403	15.93	1.01	0.81	
UY									•
VA	29.2	26.3	20.6	4.38	3.493	25.37	8.43	8.24	×
VC									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VG									•
VI	14.7	13.0	14.8	1.01	0.483	14.17	-0.38	-0.58	
VJ									•
VM									•
VN									•
VO									•
VQ									•
VT									•
VU									•
W	13.4	14.6	13.9	0.60	0.322	13.97	-0.54	-0.73	
WE									•
WF									•
X	15.1	13.6	15.0	0.84	0.403	14.57	-0.07	-0.26	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.33	×	FZ	13.70		AW	14.80		EL
5.70	×	TL	13.70		BH	14.80		A
7.57	×	QU	13.80		SX	14.83		T
8.43	⇓	QT	13.83		BA	14.83		EO
10.03	⇓	UN	13.93		L	14.87		UP
10.23	⇓	PV	13.97		W	14.90		UQ
10.57	⇓	JG	14.00		BK	14.93		GQ
11.00	⇓	U	14.10		RZ	14.97		QJ
11.03	⇓	PQ	14.10		HL	15.00		SS
11.53		CK	14.13		LT	15.03		QY
11.73		TH	14.17		VI	15.03		J
12.17		OF	14.20		QZ	15.10		HP
12.30		ID	14.27		UE	15.10		SZ
12.47		K	14.27		RV	15.20		OX
12.57		AU	14.27		OY	15.30		NT
12.90		SM	14.40		ER	15.37		BC
12.90		BO	14.43		RD	15.37		AP
13.07		CE	14.50		DZ	15.50		CG
13.27		PG	14.53		N	15.57		DE
13.30		RK	14.53		HK	15.57		C
13.37		CA	14.53		AF	15.67		CJ
13.47		AE	14.53		DB	15.70		PW
13.50		SF	14.57		X	15.73		RF
13.50		FN	14.57		SD	15.73		NO
13.60		E	14.57		AJ	15.77		EB
13.60		AL	14.67		JS	15.80		I
13.63		TE	14.77		ST	15.83		SI
13.67		DT	14.80		PB	15.83		BM

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

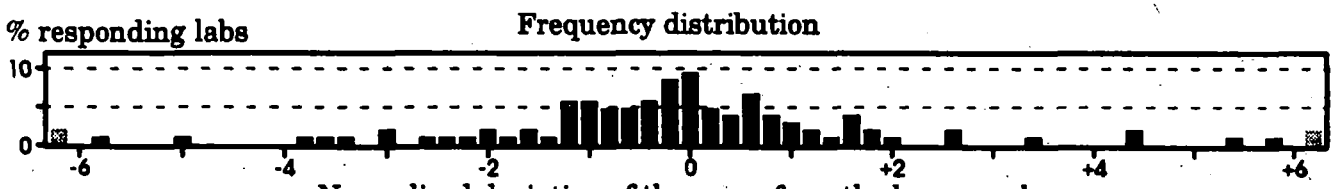
⇑ ≡ Above control limit

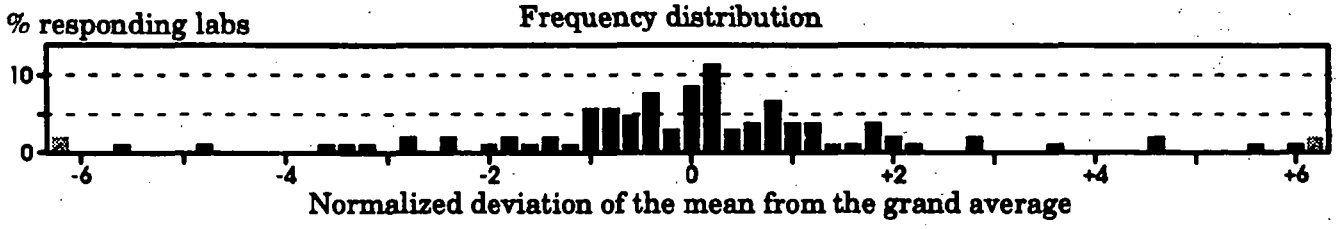
⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
15.93		UW	16.83		AZ	18.30		JE
16.07		SO	16.87		SC	19.13	⇑	NJ
16.07		M	16.87		Q	20.50	⇑	TS
16.20		BN	16.90		QQ	20.53	⇑	TN
16.30		S	17.17		AH	21.67	×	QX
16.40		NH	17.20		TQ	22.37	×	TD
16.73		TI	17.43		AK	25.33	×	LR
			18.27		P	25.37	×	VA





• ≡ No data submitted
∅ ≡ Insufficient data

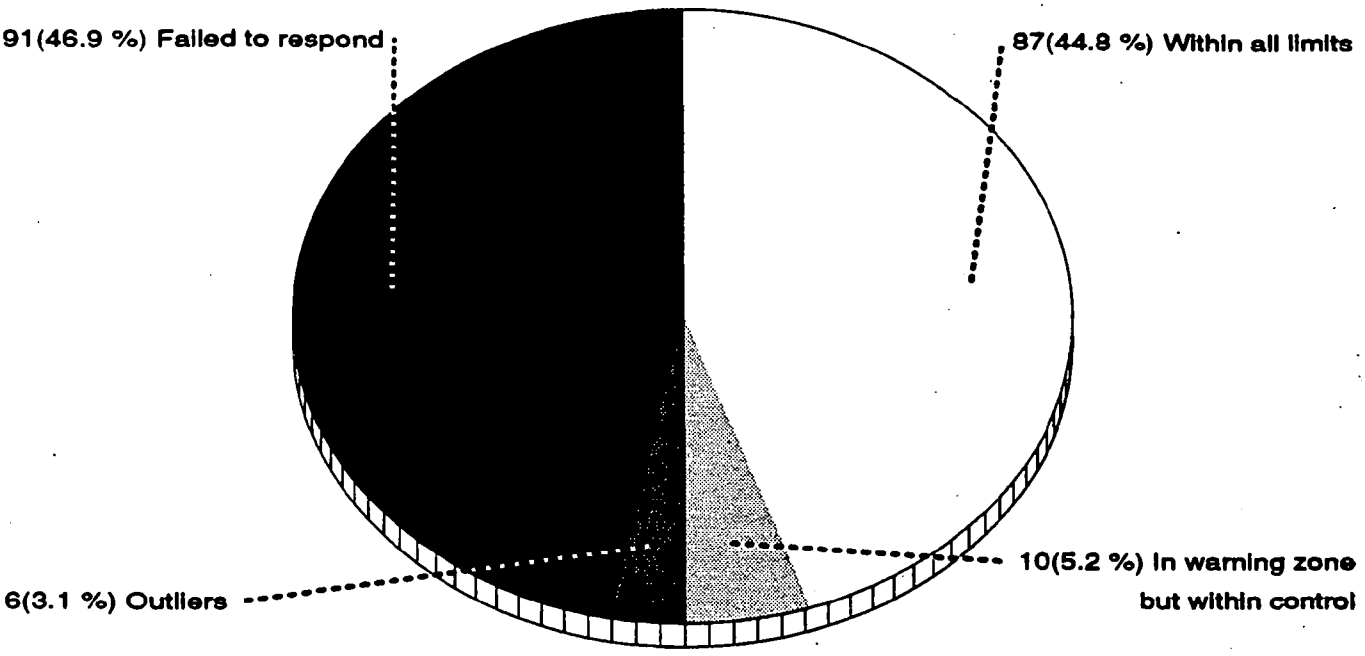
TAG SYMBOLS

× ≡ Determined to be an outlier

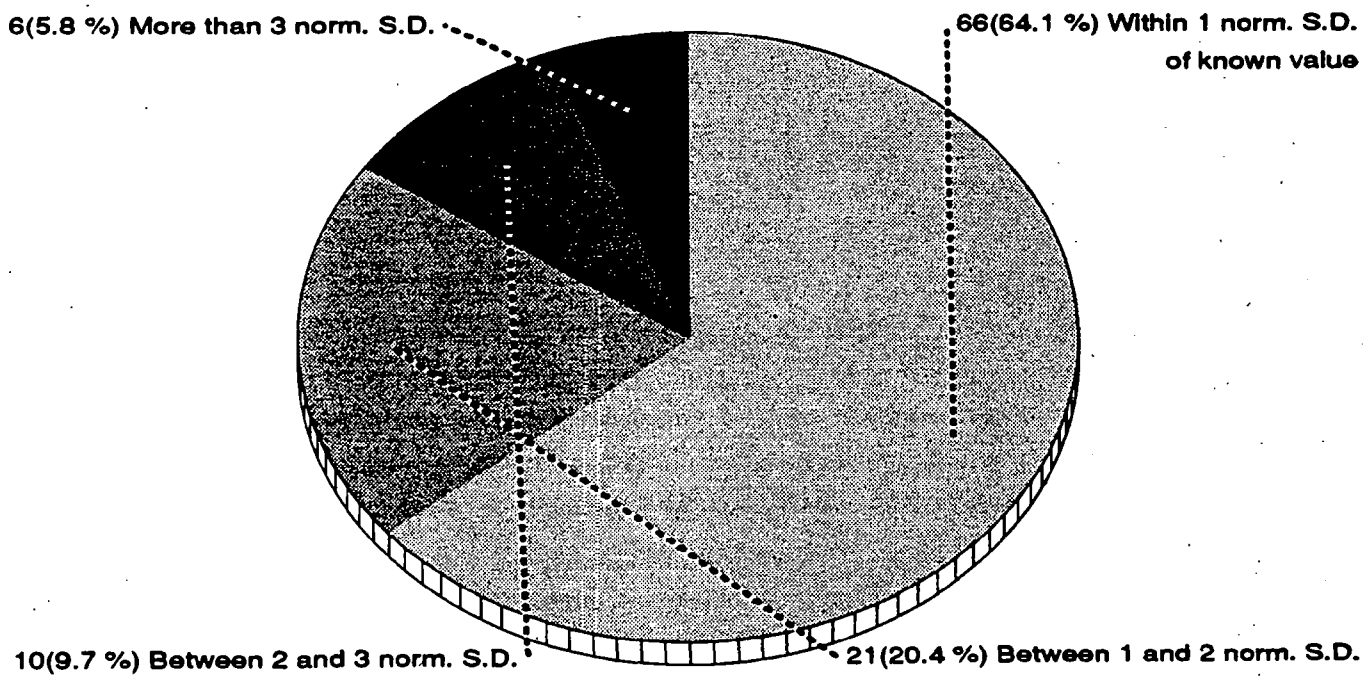
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 194 Participants

The known value of this nuclide is **15.8 pCi/l** with an expected precision of **4.0**; the control limits are 8.9 to 22.7; the warning regions are 8.9 to 11.2 and 20.4 to 22.7



Statistic	Respondents	Non-outliers
Mean	15.48	**Grand Avg 15.42**
Std. Dev.	3.91	2.49
Variance	15.29	6.19
% Coef. of Var.	25.26	16.13
% deviation of mean from known value	-2.03	-2.38
Norm. dev. of mean from known value	-0.08	-0.15
Median	15.60	15.60
% deviation of median from known value	-1.27	-1.27
Norm. dev. of median from known value	-0.05	-0.08



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	13.1	10.5	11.3	1.33	0.384	11.63	-1.64	-1.80	
AE	16.5	15.9	15.9	0.35	0.089	16.10	0.29	0.13	
AF	16.7	16.7	17.1	0.23	0.059	16.83	0.61	0.45	
AH	18.8	19.1	16.3	1.54	0.413	18.07	1.14	0.98	
AI	16.8	13.9	16.5	1.59	0.428	15.73	0.13	-0.03	
AJ	15.9	15.7	15.3	0.31	0.089	15.63	0.09	-0.07	
AK	17.0	18.3	19.3	1.15	0.340	18.20	1.20	1.04	
AL	14.1	13.9	13.4	0.36	0.103	13.80	-0.70	-0.87	
AO									•
AP	10.1	8.3	12.3	2.00	0.591	10.23	-2.25	-2.41	
AR									•
AU	2.3	4.2	2.0	1.19	0.325	2.83	-5.45	-5.61	×
AW	20.1	19.0	18.3	0.91	0.266	19.13	1.61	1.44	
AZ	15.5	16.9	16.8	0.78	0.207	16.40	0.42	0.26	
BA	12.9	13.8	11.6	1.11	0.325	12.77	-1.15	-1.31	
BB									•
BC	11.1	11.2	11.4	0.15	0.044	11.23	-1.81	-1.98	
BG									•
BH	11.4	11.0	10.6	0.40	0.118	11.00	-1.92	-2.08	
BK	18.7	17.5	17.0	0.87	0.251	17.73	1.00	0.84	
BL									•
BM	15.9	15.8	15.7	0.10	0.030	15.80	0.16	0.00	
BN									•
BO	15.0	14.5	16.6	1.10	0.310	15.37	-0.02	-0.19	
BS									•
BW									•
C	19.1	18.3	17.8	0.66	0.192	18.40	1.29	1.13	
CA	15.9	11.4	12.0	2.44	0.665	13.10	-1.01	-1.17	
CE	14.6	17.0	14.5	1.42	0.369	15.37	-0.02	-0.19	
CG	15.9	16.1	15.3	0.42	0.118	15.77	0.15	-0.01	
CJ	14.0	11.0	14.0	1.73	0.443	13.00	-1.05	-1.21	
CK	12.5	12.5	13.8	0.75	0.192	12.93	-1.08	-1.24	
CM									•
CO									•
CP									•
CQ									•
CS	13.4	13.5	15.6	1.24	0.325	14.17	-0.54	-0.71	
CX									•
D									•
DB	14.0	14.9	14.5	0.45	0.133	14.47	-0.41	-0.58	
DD									•
DE	16.7	16.8	16.8	0.06	0.015	16.77	0.58	0.42	
DG									•
DJ									•
DL									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM									•
DO									•
DS									•
DT	15.1	16.0	15.5	0.45	0.133	15.53	0.05	-0.12	
DZ	15.7	15.3	15.8	0.26	0.074	15.60	0.08	-0.09	
E									•
EB	15.8	16.0	16.7	0.47	0.133	16.17	0.32	0.16	
EL	15.9	19.5	17.0	1.84	0.532	17.47	0.88	0.72	
EO	17.9	17.4	17.0	0.45	0.133	17.43	0.87	0.71	
ER									•
EV									•
EX									•
FF									•
FJ									•
FL									•
FN	18.3	18.1	18.4	0.15	0.044	18.27	1.23	1.07	
FU									•
FZ	11.0	7.6	14.0	3.20	0.945	10.87	-1.97	-2.14	
GE									•
GI									•
GQ	13.8	12.7	12.0	0.91	0.266	12.83	-1.12	-1.28	
GT									•
GZ									•
HI									•
HK	13.7	14.0	13.3	0.35	0.103	13.67	-0.76	-0.92	
HL	13.1	13.1	13.1	0.01	0.000	13.10	-1.01	-1.17	
HP	16.5	15.4	14.2	1.15	0.340	15.37	-0.02	-0.19	
I	13.0	14.9	14.7	1.04	0.281	14.20	-0.53	-0.69	
IC									•
ID	14.2	16.8	15.7	1.31	0.384	15.57	0.06	-0.10	
J	16.5	15.6	15.6	0.52	0.133	15.90	0.21	0.04	
JE	11.7	14.2	16.9	2.60	0.768	14.27	-0.50	-0.66	
JG	12.4	12.2	13.7	0.81	0.222	12.77	-1.15	-1.31	
JN									•
JQ									•
JS	14.6	16.2	15.4	0.80	0.236	15.40	-0.01	-0.17	
JY									•
K	10.9	11.9	8.3	1.86	0.532	10.37	-2.19	-2.35	
KE									•
KT									•
KX									•
L	16.1	16.8	16.5	0.35	0.103	16.47	0.45	0.29	
LF									•
LG									•
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 18-Apr-1995

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR	20.0	27.0	26.0	3.79	1.064	24.33	3.86	3.70	×
LT	18.7	19.5	24.5	3.14	0.856	20.90	2.37	2.21	
M	17.9	16.1	17.1	0.90	0.266	17.03	0.70	0.53	
MA									•
MF									•
MP									•
MQ									•
MV									•
MY									•
N	16.9	16.8	16.0	0.49	0.133	16.57	0.49	0.33	
NA									•
NH	16.3	17.7	15.8	0.98	0.281	16.60	0.51	0.35	
NI									•
NJ	15.0	19.0	17.0	2.00	0.591	17.00	0.68	0.52	
NK									•
NO	12.2	14.1	16.2	2.00	0.591	14.17	-0.54	-0.71	
NT	15.3	15.6	15.9	0.30	0.089	15.60	0.08	-0.09	
O									•
OF	11.0	9.4	10.4	0.81	0.236	10.27	-2.23	-2.40	
OS									•
OX	15.7	15.9	15.9	0.12	0.030	15.83	0.18	0.01	
OY	15.0	13.0	14.5	1.04	0.295	14.17	-0.54	-0.71	
OZ									•
P	16.4	16.8	16.2	0.31	0.089	16.47	0.45	0.29	
PA									•
PB	15.1	15.6	15.8	0.36	0.103	15.50	0.03	-0.13	
PG									•
PI									•
PM									•
PQ	19.2	14.3	18.1	2.57	0.724	17.20	0.77	0.61	
PR									•
PV	18.0	16.3	12.2	2.98	0.856	15.50	0.03	-0.13	
PW	16.3	16.0	16.5	0.25	0.074	16.27	0.36	0.20	
Q	19.6	21.6	20.6	1.00	0.295	20.60	2.24	2.08	
QC									•
QJ	16.1	20.0	16.0	2.28	0.591	17.37	0.84	0.68	
QP									•
QQ									•
QT	13.3	13.1	12.4	0.47	0.133	12.93	-1.08	-1.24	
QU	7.7	4.9	5.3	1.51	0.413	5.97	-4.10	-4.26	×
QW									•
QX	27.8	26.4	24.0	1.92	0.561	26.07	4.61	4.45	×
QY									•
QZ	13.8	15.2	14.9	0.74	0.207	14.63	-0.34	-0.51	
RD	14.0	13.9	10.3	2.11	0.546	12.73	-1.17	-1.33	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF	16.2	16.1	18.1	1.13	0.295	16.80	0.60	0.43	
RG									•
RJ									•
RK	35.4	34.1	36.1	1.01	0.295	35.20	8.56	8.40	×
RP									•
RR									•
RV	16.9	15.1	17.5	1.25	0.354	16.50	0.47	0.30	
RZ	18.2	15.3	15.6	1.59	0.428	16.37	0.41	0.25	
S	16.1	14.8	14.5	0.85	0.236	15.13	-0.13	-0.29	
SC	14.4	13.4	13.7	0.51	0.148	13.83	-0.69	-0.85	
SD	15.6	15.1	12.2	1.84	0.502	14.30	-0.49	-0.65	
SF	18.5	18.7	19.0	0.25	0.074	18.73	1.43	1.27	
SI	2.6	3.8	5.2	1.30	0.384	3.87	-5.00	-5.17	×
SL									•
SM	20.6	16.9	21.0	2.26	0.605	19.50	1.76	1.60	
SN									•
SO									•
SR									•
SS	18.1	16.7	15.8	1.16	0.340	16.87	0.62	0.46	
ST	14.9	14.4	14.1	0.40	0.118	14.47	-0.41	-0.58	
SX	19.0	14.0	13.4	3.07	0.827	15.47	0.02	-0.14	
SZ	8.1	8.9	9.7	0.80	0.236	8.90	-2.82	-2.99	
T	15.8	16.6	18.0	1.11	0.325	16.80	0.60	0.43	
TD	19.0	14.8	14.3	2.58	0.694	16.03	0.26	0.10	
TE	16.9	14.9	16.2	1.01	0.295	16.00	0.25	0.09	
TH	15.9	16.9	17.2	0.68	0.192	16.67	0.54	0.38	
TI	11.8	14.8	10.3	2.29	0.665	12.30	-1.35	-1.52	
TL	12.7	13.6	17.9	2.78	0.768	14.73	-0.30	-0.46	
TN	14.4	13.7	12.5	0.96	0.281	13.53	-0.82	-0.98	
TQ	18.2	19.1	16.5	1.32	0.384	17.93	1.09	0.92	
TS	16.3	14.1	17.0	1.51	0.428	15.80	0.16	0.00	
TY									•
U	10.3	11.4	14.7	2.29	0.650	12.13	-1.42	-1.59	
UA									•
UE	17.5	14.5	16.1	1.50	0.443	16.03	0.26	0.10	
UG									•
UK									•
UN	17.8	15.7	13.7	2.05	0.605	15.73	0.13	-0.03	
UP	19.5	17.6	22.6	2.52	0.738	19.90	1.94	1.78	
UQ	14.5	14.6	13.2	0.78	0.207	14.10	-0.57	-0.74	
UW	14.5	16.8	15.5	1.15	0.340	15.60	0.08	-0.09	
UY									•
VA	21.6	23.1	19.2	1.97	0.576	21.30	2.54	2.38	
VC									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	13.1	13.6	13.6	0.29	0.074	13.43	-0.86	-1.02	
VI	15.7	18.6	17.4	1.46	0.428	17.23	0.78	0.62	
VJ									•
VM									•
VN									•
VO									•
VQ									•
VT									•
VU									•
W	12.3	14.6	13.6	1.15	0.340	13.50	-0.83	-1.00	
WE									•
WF									•
X	18.7	23.0	25.2	3.31	0.960	22.30	2.98	2.81	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.83	×	AU	14.10		UQ	15.80		TS
3.87	×	SI	14.17		OY	15.80		BM
5.97	×	QU	14.17		NO	15.83		OX
8.90		SZ	14.17		CS	15.90		J
10.23		AP	14.20		I	16.00		TE
10.27		OF	14.27		JE	16.03		UE
10.37		K	14.30		SD	16.03		TD
10.87		FZ	14.47		ST	16.10		AE
11.00		BH	14.47		DB	16.17		EB
11.23		BC	14.63		QZ	16.27		PW
11.63		A	14.73		TL	16.37		RZ
12.13		U	15.13		S	16.40		AZ
12.30		TI	15.37		HP	16.47		P
12.73		RD	15.37		CE	16.47		L
12.77		JG	15.37		BO	16.50		RV
12.77		BA	15.40		JS	16.57		N
12.83		GQ	15.47		SX	16.60		NH
12.93		QT	15.50		PV	16.67		TH
12.93		CK	15.50		PB	16.77		DE
13.00		CJ	15.53		DT	16.80		T
13.10		CA	15.57		ID	16.80		RF
13.10		HL	15.60		UW	16.83		AF
13.43		VG	15.60		NT	16.87		SS
13.50		W	15.60		DZ	17.00		NJ
13.53		TN	15.63		AJ	17.03		M
13.67		HK	15.73		UN	17.20		PQ
13.80		AL	15.73		AI	17.23		VI
13.83		SC	15.77		CG	17.37		QJ

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

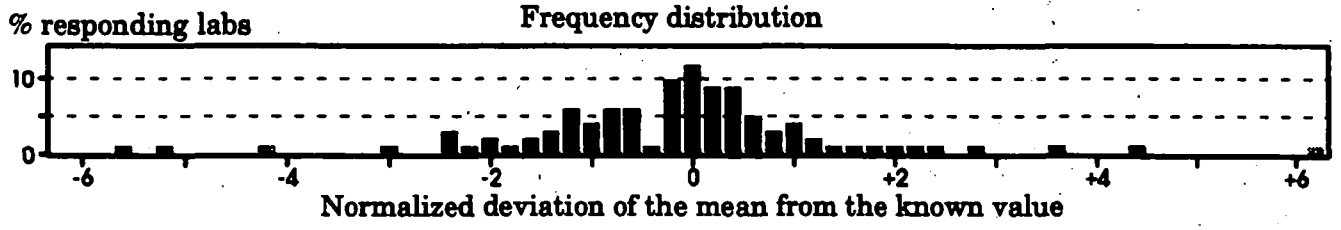
⇑ ≡ Above control limit

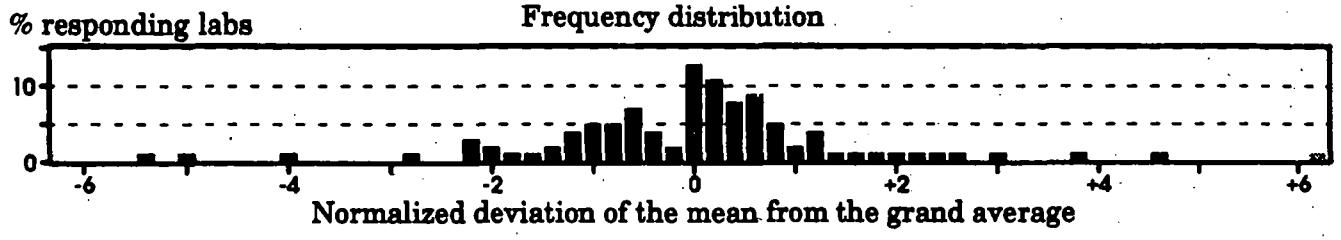
⇓ ≡ Below control limit

Radium-228

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
17.43		EO	18.27		FN	20.60		Q
17.47		EL	18.40		C	20.90		LT
17.73		BK	18.73		SF	21.30		VA
17.93		TQ	19.13		AW	22.30		X
18.07		AH	19.50		SM	24.33	×	LR
18.20		AK	19.90		UP	26.07	×	QX
						35.20	×	RK





• ≡ No data submitted
∅ ≡ Insufficient data

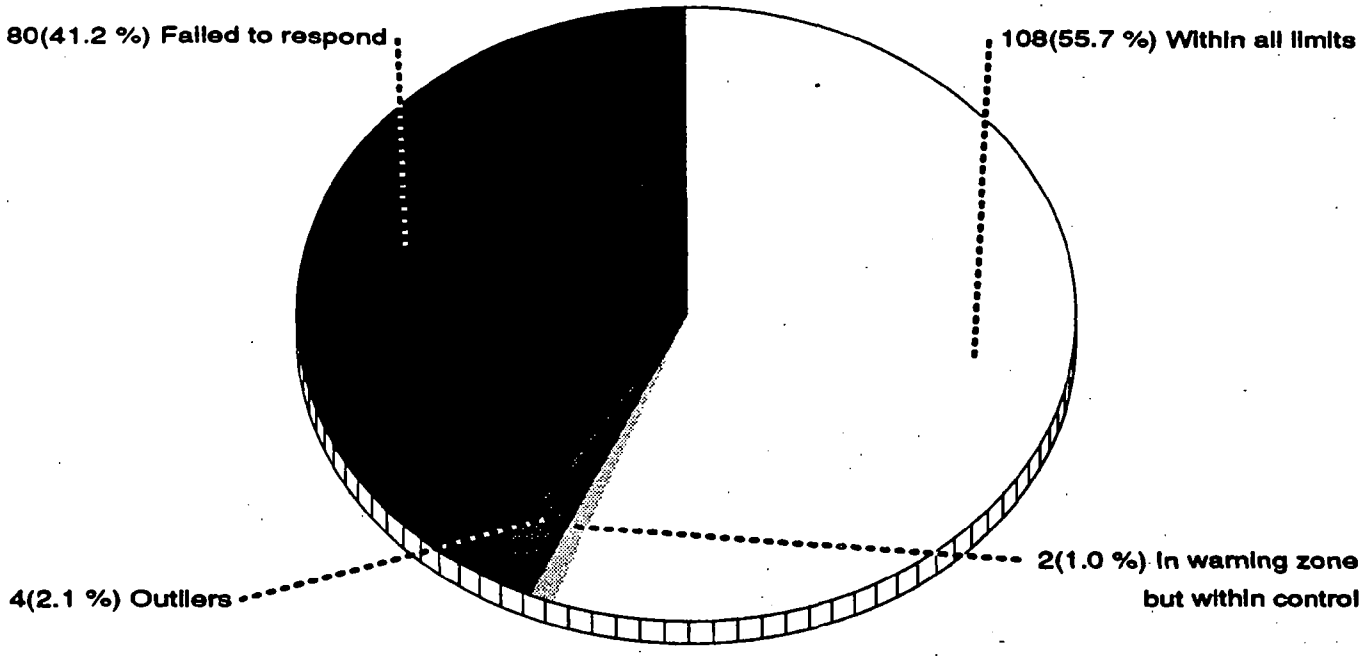
TAG SYMBOLS

× ≡ Determined to be an outlier

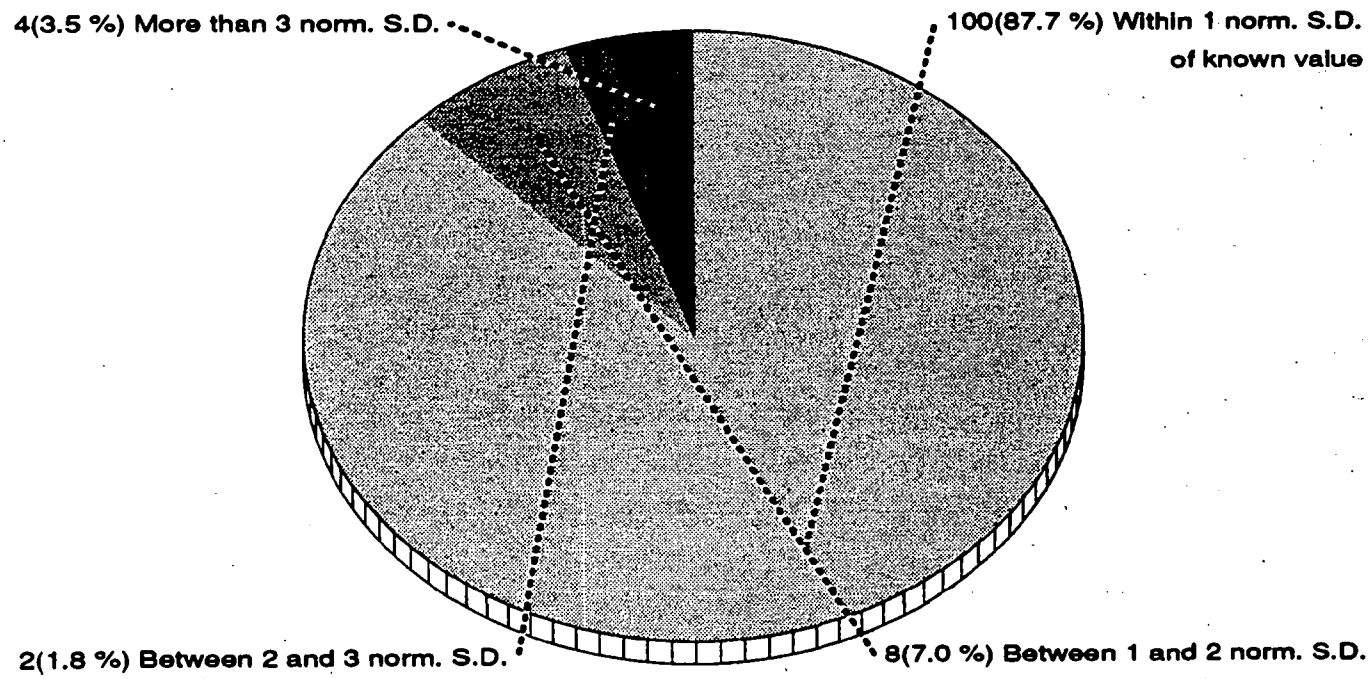
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural) Statistical Summary 194 Participants

The known value of this nuclide is **10.0 pCi/l** with an expected precision of **3.0**; the control limits are 4.8 to 15.2; the warning regions are 4.8 to 6.5 and 13.5 to 15.2



Statistic	Respondents	Non-outliers
Mean	10.30	**Grand Avg 9.93**
Std. Dev.	2.43	1.07
Variance	5.88	1.15
% Coef. of Var.	23.56	10.81
% deviation of mean from known value	2.96	-0.72
Norm. dev. of mean from known value	0.12	-0.07
Median	9.90	9.87
% deviation of median from known value	-1.00	-1.33
Norm. dev. of median from known value	-0.04	-0.12



CRD-LV Performance Evaluation: Blind-A, 18-Apr-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	10.8	10.6	10.2	0.31	0.118	10.53	0.35	0.31	
AE	11.2	11.4	11.5	0.15	0.059	11.37	0.83	0.79	
AF	9.8	9.2	10.2	0.50	0.197	9.73	-0.11	-0.15	
AH	9.0	9.4	9.4	0.23	0.079	9.27	-0.38	-0.42	
AI									•
AJ	10.4	8.8	8.7	0.95	0.335	9.30	-0.36	-0.40	
AK	11.2	11.6	10.7	0.45	0.177	11.17	0.72	0.67	
AL	10.2	10.8	10.9	0.38	0.138	10.63	0.41	0.37	
AO									•
AP	11.4	11.6	11.7	0.15	0.059	11.57	0.95	0.90	
AR	8.3	7.9	8.1	0.20	0.079	8.10	-1.06	-1.10	
AU									•
AW	9.5	10.0	10.6	0.55	0.217	10.03	0.06	0.02	
AZ	10.7	10.6	10.4	0.15	0.059	10.57	0.37	0.33	
BA	9.7	9.2	8.7	0.50	0.197	9.20	-0.42	-0.46	
BB	7.5	8.0	9.3	0.93	0.354	8.27	-0.96	-1.00	
BC	9.6	9.6	9.6	0.00	0.000	9.60	-0.19	-0.23	
BG									•
BH	10.1	9.4	10.3	0.47	0.177	9.93	0.00	-0.04	
BK	9.4	9.4	10.0	0.35	0.118	9.60	-0.19	-0.23	
BL									•
BM	10.9	10.3	11.0	0.38	0.138	10.73	0.47	0.42	
BN	8.7	9.9	10.7	1.01	0.394	9.77	-0.09	-0.13	
BO	8.6	8.9	9.2	0.30	0.118	8.90	-0.59	-0.64	
BS									•
BW									•
C	10.3	9.6	8.9	0.70	0.276	9.60	-0.19	-0.23	
CA	9.9	8.9	9.8	0.55	0.197	9.53	-0.23	-0.27	
CE	9.8	10.0	9.8	0.12	0.039	9.87	-0.04	-0.08	
CG	10.5	11.0	11.9	0.71	0.276	11.13	0.70	0.65	
CJ	10.0	10.0	11.0	0.58	0.197	10.33	0.23	0.19	
CK	9.3	9.6	10.3	0.51	0.197	9.73	-0.11	-0.15	
CM	9.6	10.0	9.7	0.21	0.079	9.77	-0.09	-0.13	
CO									•
CP									•
CQ									•
CS	10.7	10.2	10.3	0.26	0.098	10.40	0.27	0.23	
CX	11.4	11.4	11.8	0.23	0.079	11.53	0.93	0.89	
D									•
DB	9.9	12.4	11.6	1.28	0.492	11.30	0.79	0.75	
DD									•
DE	9.4	9.4	9.5	0.06	0.020	9.43	-0.29	-0.33	
DG									•
DJ									•
DL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM									•
DO	10.0	9.7	10.0	0.17	0.059	9.90	-0.02	-0.06	
DS									•
DT	9.7	9.5	9.2	0.25	0.098	9.47	-0.27	-0.31	
DZ	10.1	11.2	11.4	0.70	0.256	10.90	0.56	0.52	
E	8.8	8.7	8.7	0.06	0.020	8.73	-0.69	-0.73	
EB	10.5	10.9	11.1	0.31	0.118	10.83	0.52	0.48	
EL	9.0	10.0	10.6	0.81	0.315	9.87	-0.04	-0.08	
EO									•
ER	9.3	9.4	9.5	0.10	0.039	9.40	-0.30	-0.35	
EV									•
EX									•
FF									•
FJ	8.8	8.4	8.8	0.23	0.079	8.67	-0.73	-0.77	
FL									•
FN	9.6	9.9	9.9	0.17	0.059	9.80	-0.07	-0.12	
FU									•
FZ	12.0	9.7	10.0	1.25	0.453	10.57	0.37	0.33	
GE									•
GI									•
GQ	9.3	10.1	9.3	0.46	0.158	9.57	-0.21	-0.25	
GT									•
GZ									•
HI									•
HK	9.4	9.1	9.8	0.35	0.138	9.43	-0.29	-0.33	
HL	8.1	8.1	8.1	0.00	0.000	8.10	-1.06	-1.10	
HP	10.4	10.4	10.1	0.17	0.059	10.30	0.22	0.17	
I	12.4	11.9	12.9	0.50	0.197	12.40	1.43	1.39	
IC									•
ID	12.0	10.6	9.4	1.30	0.512	10.67	0.43	0.38	
J	10.4	10.0	10.1	0.21	0.079	10.17	0.14	0.10	
JE	9.8	9.8	10.4	0.35	0.118	10.00	0.04	0.00	
JG									•
JN									•
JQ									•
JS	9.8	10.0	9.8	0.12	0.039	9.87	-0.04	-0.08	
JY									•
K	11.1	11.7	10.9	0.42	0.158	11.23	0.75	0.71	
KE									•
KT	10.0	11.0	13.0	1.53	0.591	11.33	0.81	0.77	
KX									•
L	11.3	10.6	11.4	0.44	0.158	11.10	0.68	0.64	
LF									•
LG									•
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR									•
LT	10.0	11.2	11.5	0.79	0.295	10.90	0.56	0.52	
M									•
MA									•
MF									•
MP									•
MQ									•
MV									•
MY									•
N	9.2	9.6	8.9	0.35	0.138	9.23	-0.40	-0.44	
NA	9.8	10.1	8.8	0.68	0.256	9.57	-0.21	-0.25	
NH	10.5	10.3	10.6	0.15	0.059	10.47	0.31	0.27	
NI									•
NJ	10.2	10.4	10.6	0.20	0.079	10.40	0.27	0.23	
NK	10.2	9.7	9.1	0.55	0.217	9.67	-0.15	-0.19	
NO	9.9	10.0	10.1	0.10	0.039	10.00	0.04	0.00	
NT	8.7	10.8	12.8	2.05	0.807	10.77	0.48	0.44	
O									•
OF									•
OS	8.4	8.4	8.7	0.17	0.059	8.50	-0.82	-0.87	
OX									•
OY	8.9	9.1	9.2	0.15	0.059	9.07	-0.50	-0.54	
OZ	20.8	21.2	21.0	0.20	0.079	21.00	6.39	6.35	×
P	14.9	17.6	15.3	1.46	0.532	15.93	3.47	3.43	×
PA									•
PB	10.1	9.9	9.7	0.20	0.079	9.90	-0.02	-0.06	
PG	12.1	12.7	10.8	0.97	0.374	11.87	1.12	1.08	
PI									•
PM									•
PQ	10.1	10.3	9.7	0.31	0.118	10.03	0.06	0.02	
PR									•
PV	9.8	9.9	10.0	0.10	0.039	9.90	-0.02	-0.06	
PW	29.0	30.8	27.0	1.90	0.748	28.93	10.97	10.93	×
Q	11.7	10.5	12.3	0.92	0.354	11.50	0.91	0.87	
QC									•
QJ	10.0	10.0	8.0	1.15	0.394	9.33	-0.34	-0.38	
QP									•
QQ	10.5	10.8	9.6	0.62	0.236	10.30	0.22	0.17	
QT									•
QU	6.2	6.2	6.7	0.29	0.098	6.37	-2.06	-2.10	
QW									•
QX	4.5	4.5	6.1	0.92	0.315	5.03	-2.83	-2.87	
QY	10.2	9.9	9.7	0.25	0.098	9.93	0.00	-0.04	
QZ	10.5	10.7	9.6	0.59	0.217	10.27	0.20	0.15	
RD	9.2	9.2	9.2	0.00	0.000	9.20	-0.42	-0.46	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF	7.8	7.7	9.2	0.84	0.295	8.23	-0.98	-1.02	
RG	10.3	10.1	10.1	0.12	0.039	10.17	0.14	0.10	
RJ									•
RK	9.4	10.5	9.4	0.64	0.217	9.77	-0.09	-0.13	
RP	10.0	9.7	9.7	0.17	0.059	9.80	-0.07	-0.12	
RR	10.1	10.4	10.1	0.17	0.059	10.20	0.16	0.12	
RV	10.2	10.1	10.0	0.10	0.039	10.10	0.10	0.06	
RZ	9.0	9.0	9.2	0.12	0.039	9.07	-0.50	-0.54	
S	9.0	8.9	9.3	0.21	0.079	9.07	-0.50	-0.54	
SC	10.4	9.7	10.0	0.35	0.138	10.03	0.06	0.02	
SD	9.8	9.8	9.6	0.12	0.039	9.73	-0.11	-0.15	
SF	8.8	8.8	8.8	0.00	0.000	8.80	-0.65	-0.69	
SI	9.5	9.6	9.7	0.10	0.039	9.60	-0.19	-0.23	
SL	10.8	14.0	12.1	1.61	0.630	12.30	1.37	1.33	
SM	11.0	10.7	11.3	0.30	0.118	11.00	0.62	0.58	
SN									•
SO	10.0	9.5	9.4	0.32	0.118	9.63	-0.17	-0.21	
SR									•
SS	9.1	9.8	9.6	0.36	0.138	9.50	-0.25	-0.29	
ST	9.2	9.5	10.0	0.40	0.158	9.57	-0.21	-0.25	
SX	11.0	10.0	13.0	1.53	0.591	11.33	0.81	0.77	
SZ	10.2	9.0	9.1	0.67	0.236	9.43	-0.29	-0.33	
T	11.6	8.9	11.1	1.44	0.532	10.53	0.35	0.31	
TD	9.0	11.8	9.0	1.62	0.551	9.93	0.00	-0.04	
TE	10.0	10.3	10.1	0.15	0.059	10.13	0.12	0.08	
TH	9.9	9.2	9.8	0.38	0.138	9.63	-0.17	-0.21	
TI	9.2	9.7	9.6	0.26	0.098	9.50	-0.25	-0.29	
TL	8.9	9.1	9.1	0.12	0.039	9.03	-0.52	-0.56	
TN									•
TQ	9.4	9.3	9.2	0.10	0.039	9.30	-0.36	-0.40	
TS	8.8	8.6	9.0	0.20	0.079	8.80	-0.65	-0.69	
TY									•
U	9.8	10.1	10.1	0.17	0.059	10.00	0.04	0.00	
UA									•
UE	10.1	9.7	9.3	0.40	0.158	9.70	-0.13	-0.17	
UG									•
UK									•
UN	9.3	9.6	9.5	0.15	0.059	9.47	-0.27	-0.31	
UP	10.9	10.0	9.8	0.59	0.217	10.23	0.18	0.13	
UQ									•
UW									•
UY									•
VA	12.8	17.3	17.4	2.63	0.906	15.83	3.41	3.37	×
VC									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	10.5	10.9	10.4	0.26	0.098	10.60	0.39	0.35	
VI	13.5	13.4	12.9	0.32	0.118	13.27	1.93	1.89	
VJ									•
VM									•
VN									•
VO	9.6	9.7	9.7	0.06	0.020	9.67	-0.15	-0.19	
VQ									•
VT									•
VU									•
W	9.5	9.8	9.4	0.21	0.079	9.57	-0.21	-0.25	
WE									•
WF									•
X	9.5	11.0	9.3	0.93	0.335	9.93	0.00	-0.04	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.03		QX	9.47		UN	9.90		PV
6.37		QU	9.50		TI	9.90		PB
8.10		HL	9.50		SS	9.90		DO
8.10		AR	9.53		CA	9.93		X
8.23		RF	9.57		W	9.93		TD
8.27		BB	9.57		ST	9.93		QY
8.50		OS	9.57		NA	9.93		BH
8.67		FJ	9.57		GQ	10.00		NO
8.73		E	9.60		BK	10.00		JE
8.80		TS	9.60		SI	10.00		U
8.80		SF	9.60		C	10.03		SC
8.90		BO	9.60		BC	10.03		PQ
9.03		TL	9.63		TH	10.03		AW
9.07		S	9.63		SO	10.10		RV
9.07		RZ	9.67		VO	10.13		TE
9.07		OY	9.67		NK	10.17		RG
9.20		RD	9.70		UE	10.17		J
9.20		BA	9.73		SD	10.20		RR
9.23		N	9.73		CK	10.23		UP
9.27		AH	9.73		AF	10.27		QZ
9.30		TQ	9.77		RK	10.30		QQ
9.30		AJ	9.77		BN	10.30		HP
9.33		QJ	9.77		CM	10.33		CJ
9.40		ER	9.80		RP	10.40		NJ
9.43		SZ	9.80		FN	10.40		CS
9.43		HK	9.87		JS	10.47		NH
9.43		DE	9.87		EL	10.53		T
9.47		DT	9.87		CE	10.53		A

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

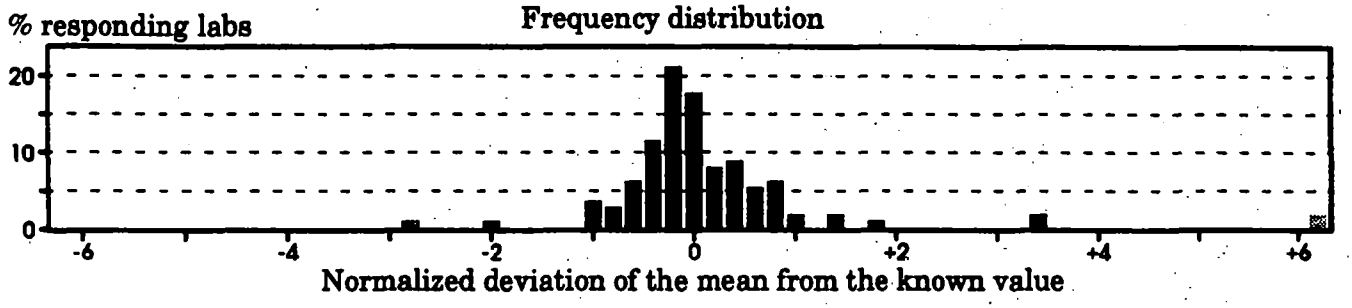
⇑ ≡ Above control limit

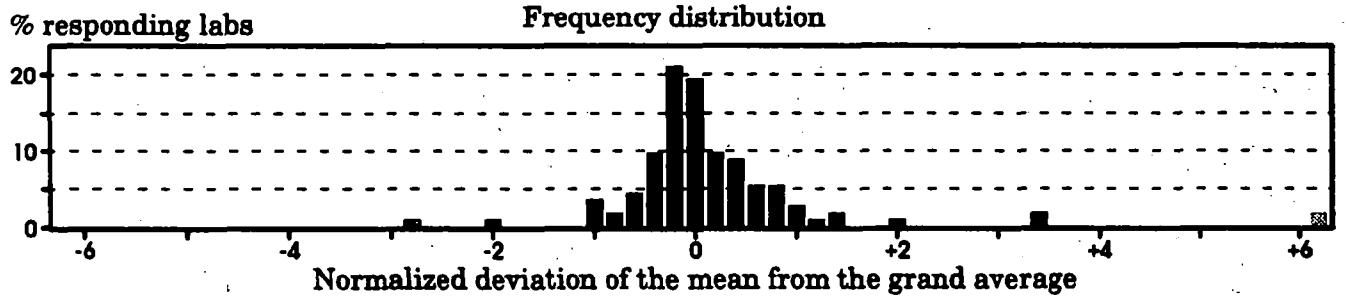
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
10.57		FZ	11.00		SM	11.53		CX
10.57		AZ	11.10		L	11.57		AP
10.60		VG	11.13		CG	11.87		PG
10.63		AL	11.17		AK	12.30		SL
10.67		ID	11.23		K	12.40		I
10.73		BM	11.30		DB	13.27		VI
10.77		NT	11.33		SX	15.83	×	VA
10.83		EB	11.33		KT	15.93	×	P
10.90		LT	11.37		AE	21.00	×	OZ
10.90		DZ	11.50		Q	28.93	×	PW





• ≡ No data submitted
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TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/116B
August 1995

EPA

Blind-B Performance Evaluation Study

A Statistical Evaluation of the April 18, 1995 Data

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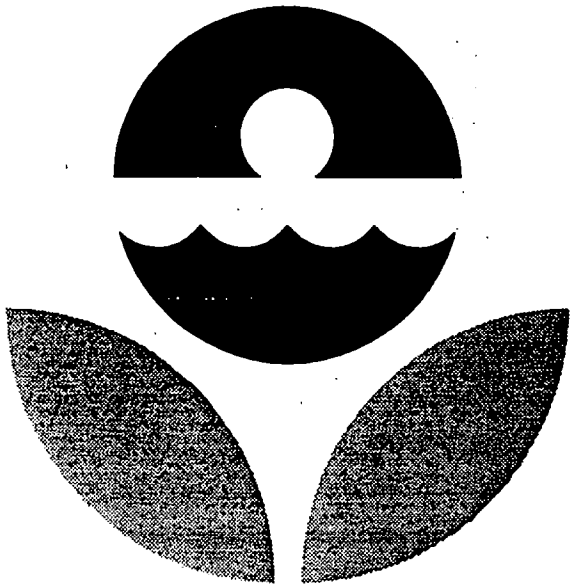
Blind-B

Performance Evaluation Study

April 18, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Radiation Sciences Branch (CRD-LV) Performance Evaluation Study for ***Blind-B; April 18, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Program

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

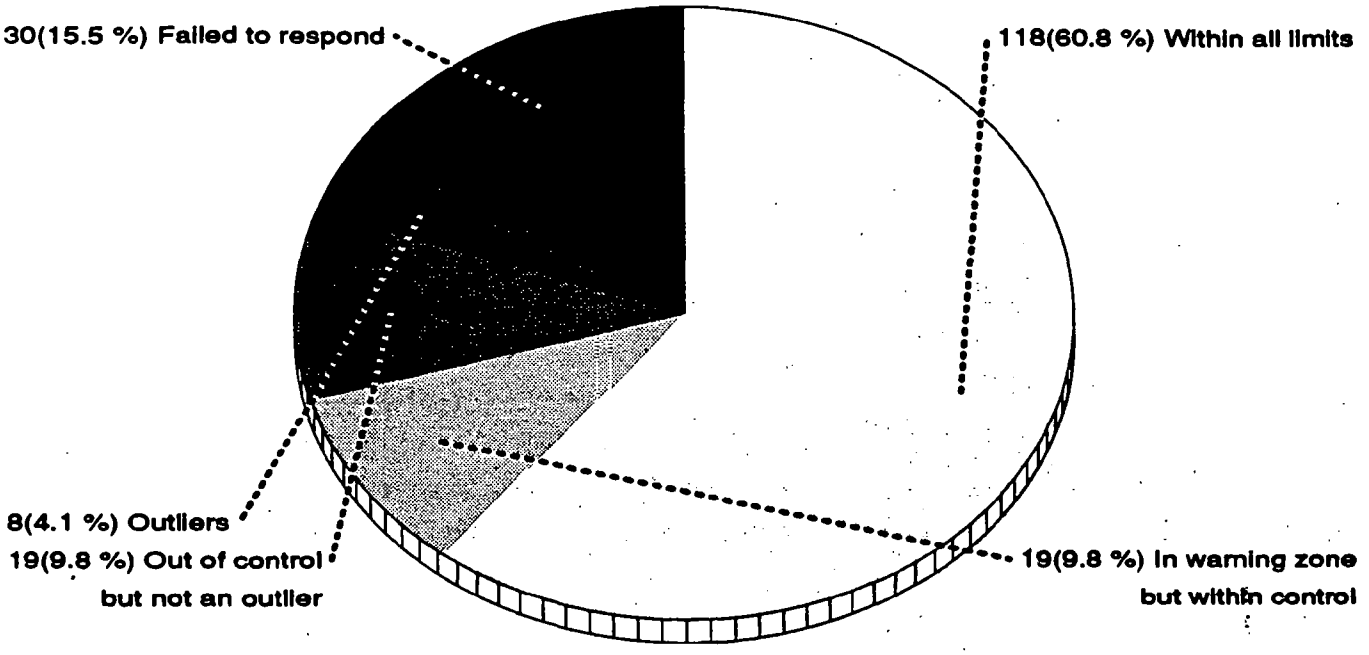
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

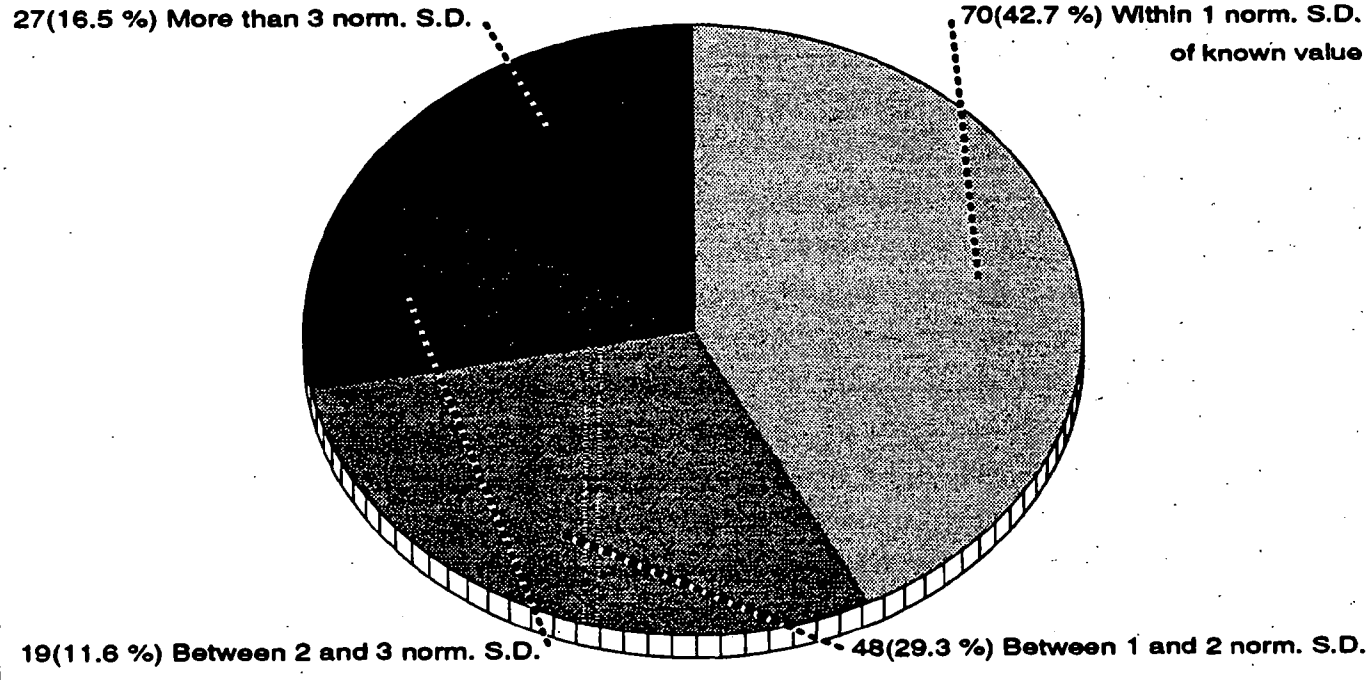
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, CRD-LV, 702/798-2104.

Gross Beta Statistical Summary 194 Participants

The known value of this nuclide is **86.6 pCi/l** with an expected precision of **10.0**; the control limits are 69.3 to 103.9; the warning regions are 69.3 to 75.0 and 98.2 to 103.9



Statistic	Respondents	Non-outliers
Mean	94.96	**Grand Avg 86.93**
Std. Dev.	83.40	10.42
Variance	6954.79	108.56
% Coef. of Var.	87.83	11.99
% deviation of mean from known value	9.65	0.38
Norm. dev. of mean from known value	0.10	0.03
Median	88.02	87.97
% deviation of median from known value	1.64	1.58
Norm. dev. of median from known value	0.02	0.13



CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	91.2	90.1	90.6	0.55	0.065	90.63	0.64	0.70	
AE	66.3	70.0	70.1	2.17	0.224	68.80	-3.14	-3.08	⇓
AF	89.0	86.0	95.0	4.58	0.532	90.00	0.53	0.59	
AH	91.0	93.1	78.2	8.06	0.880	87.43	0.09	0.14	
AI									•
AJ	97.7	96.9	86.3	6.36	0.673	93.63	1.16	1.22	
AK	83.2	87.4	86.1	2.15	0.248	85.57	-0.24	-0.18	
AL	103.7	97.7	99.7	3.05	0.354	100.37	2.33	2.38	
AO									•
AP	90.8	90.4	87.3	1.92	0.207	89.50	0.45	0.50	
AR	103.0	92.2	93.9	5.81	0.638	96.37	1.63	1.69	
AU	107.0	103.0	108.0	2.65	0.295	106.00	3.30	3.36	⇑
AW	92.9	90.1	90.0	1.65	0.171	91.00	0.70	0.76	
AZ	71.0	62.7	60.5	5.54	0.620	64.73	-3.84	-3.79	⇓
BA	86.6	85.7	87.7	1.00	0.118	86.67	-0.05	0.01	
BB	68.6	69.8	69.2	0.60	0.071	69.20	-3.07	-3.01	⇓
BC	81.8	83.1	83.3	0.81	0.089	82.73	-0.73	-0.67	
BG									•
BH	82.2	83.5	83.9	0.89	0.100	83.20	-0.65	-0.59	
BK	91.4	95.6	93.0	2.12	0.248	93.33	1.11	1.17	
BL									•
BM	90.8	90.2	89.8	0.50	0.059	90.27	0.58	0.64	
BN	90.0	90.5	92.1	1.10	0.124	90.87	0.68	0.74	
BO	88.1	91.1	86.9	2.16	0.248	88.70	0.31	0.36	
BS	95.9	97.6	94.3	1.65	0.195	95.93	1.56	1.62	
BW	44.0	62.0	30.0	16.04	2.695	45.33	-7.20	-7.15	×
C	97.1	96.5	95.9	0.60	0.071	96.50	1.66	1.71	
CA	78.2	71.9	74.2	3.19	0.372	74.77	-2.11	-2.05	
CE	94.0	91.5	91.1	1.57	0.171	92.20	0.91	0.97	
CG	90.1	85.6	88.4	2.27	0.266	88.03	0.19	0.25	
CJ	78.0	83.0	80.0	2.52	0.295	80.33	-1.14	-1.09	
CK	85.1	91.1	97.0	5.95	0.703	91.07	0.72	0.77	
CM									•
CO	78.0	78.0	72.7	3.06	0.313	76.23	-1.85	-1.80	
CP	342.0	468.0	405.0	63.00	13.271	405.00	55.09	55.15	×
CQ	85.0	86.0	86.0	0.58	0.059	85.67	-0.22	-0.16	
CS	77.0	83.0	88.1	5.56	0.656	82.70	-0.73	-0.68	
CX	90.3	92.8	93.5	1.68	0.189	92.20	0.91	0.97	
D	96.0	92.3	93.8	1.86	0.219	94.03	1.23	1.29	
DB	98.0	98.0	101.0	1.73	0.177	99.00	2.09	2.15	
DD	91.9	87.6	89.3	2.17	0.254	89.60	0.46	0.52	
DE	89.0	89.0	89.1	0.06	0.006	89.03	0.36	0.42	
DG									•
DJ									•
DL	91.0	89.0	88.0	1.53	0.177	89.33	0.42	0.47	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	75.7	77.9	80.2	2.25	0.266	77.93	-1.56	-1.50	
DO									•
DS	76.0	76.4	77.6	0.83	0.095	76.67	-1.78	-1.72	
DT	106.0	100.0	106.0	3.46	0.354	104.00	2.96	3.01	⇑
DZ	90.6	91.2	95.0	2.39	0.260	92.27	0.92	0.98	
E	90.0	90.0	90.0	0.00	0.000	90.00	0.53	0.59	
EB	91.5	89.9	89.9	0.92	0.095	90.43	0.61	0.66	
EL									•
EO	86.0	86.0	90.0	2.31	0.236	87.33	0.07	0.13	
ER									•
EV	81.3	81.4	79.6	1.01	0.106	80.77	-1.07	-1.01	
EX									•
FF	67.0	73.0	73.0	3.46	0.354	71.00	-2.76	-2.70	
FJ	75.8	77.1	88.5	6.99	0.750	80.47	-1.12	-1.06	
FL	70.3	75.8	75.2	3.02	0.325	73.77	-2.28	-2.22	
FN	90.9	88.8	87.8	1.58	0.183	89.17	0.39	0.44	
FU	74.2	72.0	75.5	1.77	0.207	73.90	-2.26	-2.20	
FZ	85.0	90.0	89.0	2.65	0.295	88.00	0.19	0.24	
GE	87.0	88.0	88.0	0.58	0.059	87.67	0.13	0.18	
GI									•
GQ	85.3	78.5	80.0	3.57	0.402	81.27	-0.98	-0.92	
GT	67.9	66.4	67.1	0.75	0.089	67.13	-3.43	-3.37	⇓
GZ	122.7	123.5	126.2	1.83	0.207	124.13	6.44	6.50	×
HI	79.0	85.0	75.0	5.03	0.591	79.67	-1.26	-1.20	
HK	93.1	98.7	93.5	3.12	0.331	95.10	1.42	1.47	
HL	81.0	81.0	81.0	0.00	0.000	81.00	-1.03	-0.97	
HP	87.2	86.7	93.2	3.62	0.384	89.03	0.36	0.42	
I	78.8	77.9	76.8	1.00	0.118	77.83	-1.58	-1.52	
IC	75.5	80.0	78.4	2.28	0.266	77.97	-1.55	-1.50	
ID	76.4	80.6	78.6	2.10	0.248	78.53	-1.45	-1.40	
J	87.8	88.9	90.3	1.25	0.148	89.00	0.36	0.42	
JE	100.1	91.6	95.8	4.25	0.502	95.83	1.54	1.60	
JG	95.3	94.6	92.5	1.46	0.165	94.13	1.25	1.30	
JN	76.5	75.2	75.8	0.65	0.077	75.83	-1.92	-1.86	
JQ	121.5	114.9	120.3	3.52	0.390	118.90	5.54	5.59	⇑
JS	102.8	104.9	104.2	1.07	0.124	103.97	2.95	3.01	⇑
JY	79.4	76.9	78.4	1.26	0.148	78.23	-1.51	-1.45	
K	70.2	72.1	72.1	1.10	0.112	71.47	-2.68	-2.62	
KE	80.4	82.2	78.9	1.65	0.195	80.50	-1.11	-1.06	
KT	96.0	96.0	95.0	0.58	0.059	95.67	1.51	1.57	
KX	90.0	91.0	93.0	1.53	0.177	91.33	0.76	0.82	
L	99.0	96.0	98.0	1.53	0.177	97.67	1.86	1.92	
LF	75.0	77.0	73.0	2.00	0.236	75.00	-2.07	-2.01	
LG									•
LL	84.2	81.9	81.6	1.42	0.154	82.57	-0.76	-0.70	

• ≡ No data submitted — **TAG SYMBOLS** — ⇑ ≡ Above control limit

∅ ≡ Insufficient data — × ≡ Determined to be an outlier — ⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR	94.0	91.0	91.0	1.73	0.177	92.00	0.88	0.94	
LT	84.6	75.7	79.9	4.45	0.526	80.07	-1.19	-1.13	
M	104.0	96.0	100.0	4.00	0.473	100.00	2.26	2.32	
MA	37.0	41.0	45.0	4.00	0.473	41.00	-7.96	-7.90	×
MF	77.0	75.1	76.4	0.97	0.112	76.17	-1.86	-1.81	
MP									•
MQ	87.0	88.0	88.0	0.58	0.059	87.67	0.13	0.18	
MV	83.0	87.0	88.0	2.65	0.295	86.00	-0.16	-0.10	
MY									•
N	89.2	89.6	89.1	0.27	0.030	89.30	0.41	0.47	
NA	117.8	121.4	121.0	1.97	0.213	120.07	5.74	5.80	⇑
NH	83.0	81.0	88.0	3.61	0.413	84.00	-0.51	-0.45	
NI									•
NJ	81.0	83.0	81.0	1.15	0.118	81.67	-0.91	-0.85	
NK	94.4	98.7	73.1	13.71	1.975	88.73	0.31	0.37	
NO	98.6	104.0	110.5	5.96	0.703	104.37	3.02	3.08	⇑
NT	88.0	86.6	88.6	1.03	0.118	87.73	0.14	0.20	
O	80.7	79.9	79.6	0.57	0.065	80.07	-1.19	-1.13	
OF	89.5	89.9	86.0	2.15	0.230	88.47	0.27	0.32	
OS	100.7	98.6	98.4	1.27	0.136	99.23	2.13	2.19	
OX									•
OY	1143.0	1090.0	1037.0	53.00	11.021	1090.00	173.74	173.79	×
OZ	164.2	174.0	172.8	5.35	0.579	170.33	14.45	14.50	×
P	101.0	102.0	101.2	0.53	0.059	101.40	2.51	2.56	
PA	90.2	84.9	90.8	3.25	0.348	88.63	0.30	0.35	
PB	99.8	97.1	100.0	1.62	0.171	98.97	2.08	2.14	
PG	88.9	90.7	92.3	1.70	0.201	90.63	0.64	0.70	
PI									•
PM	92.1	88.3	90.1	1.90	0.224	90.17	0.56	0.62	
PQ	86.9	86.6	86.9	0.17	0.018	86.80	-0.02	0.03	
PR	69.0	71.0	70.0	1.00	0.118	70.00	-2.93	-2.88	
PV	77.2	78.3	83.5	3.37	0.372	79.67	-1.26	-1.20	
PW									•
Q	97.7	95.9	96.8	0.90	0.106	96.80	1.71	1.77	
QC	8.2	8.3	7.9	0.21	0.024	8.13	-13.65	-13.59	×
QJ	86.0	87.4	86.7	0.70	0.083	86.70	-0.04	0.02	
QP	98.0	100.0	95.0	2.52	0.295	97.67	1.86	1.92	
QQ	89.0	90.6	90.0	0.81	0.095	89.87	0.51	0.57	
QT	84.2	86.9	88.3	2.08	0.242	86.47	-0.08	-0.02	
QU	76.0	80.8	79.9	2.55	0.284	78.90	-1.39	-1.33	
QW	86.4	85.7	81.3	2.76	0.301	84.47	-0.43	-0.37	
QX	98.6	98.2	95.7	1.57	0.171	97.50	1.83	1.89	
QY									•
QZ	100.6	99.2	101.2	1.03	0.118	100.33	2.32	2.38	
RD	80.0	76.0	81.0	2.65	0.295	79.00	-1.37	-1.32	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE	67.1	70.1	65.8	2.21	0.254	67.67	-3.34	-3.28	⇓
RF	84.5	85.6	89.5	2.63	0.295	86.53	-0.07	-0.01	
RG	93.0	93.0	96.0	1.73	0.177	94.00	1.22	1.28	
RJ									•
RK	62.1	70.8	61.8	5.11	0.532	64.90	-3.82	-3.76	⇓
RP									•
RR	82.0	83.0	83.0	0.58	0.059	82.67	-0.74	-0.68	
RV	91.0	99.0	99.0	4.62	0.473	96.33	1.63	1.69	
RZ	91.2	90.2	91.6	0.72	0.083	91.00	0.70	0.76	
S	97.3	99.9	97.8	1.38	0.154	98.33	1.98	2.03	
SC	81.1	80.3	86.8	3.54	0.384	82.73	-0.73	-0.67	
SD	65.5	68.1	67.3	1.33	0.154	66.97	-3.46	-3.40	⇓
SF	96.5	90.7	82.5	7.03	0.827	89.90	0.51	0.57	
SI	82.0	84.8	85.5	1.85	0.207	84.10	-0.49	-0.43	
SL	107.0	75.5	104.0	17.39	2.639	95.50	1.48	1.54	
SM	84.5	84.1	83.6	0.45	0.053	84.07	-0.50	-0.44	
SN	79.9	82.3	85.4	2.76	0.325	82.53	-0.76	-0.70	
SO	87.8	85.5	89.3	1.91	0.224	87.53	0.10	0.16	
SR	82.0	82.0	75.0	4.04	0.413	79.67	-1.26	-1.20	
SS	79.8	75.3	72.0	3.92	0.461	75.70	-1.95	-1.89	
ST	85.6	85.3	84.9	0.35	0.041	85.27	-0.29	-0.23	
SX	74.5	100.5	88.8	13.02	2.020	87.93	0.17	0.23	
SZ	117.5	119.8	122.1	2.30	0.272	119.80	5.69	5.75	⇑
T	85.0	82.1	85.0	1.67	0.171	84.03	-0.50	-0.44	
TD	74.2	88.0	72.2	8.60	0.933	78.13	-1.52	-1.47	
TE	71.0	65.0	68.0	3.00	0.354	68.00	-3.28	-3.22	⇓
TH	94.0	96.0	96.0	1.15	0.118	95.33	1.46	1.51	
TI	90.1	97.4	90.3	4.16	0.431	92.60	0.98	1.04	
TL	96.7	97.9	98.8	1.05	0.124	97.80	1.88	1.94	
TN	91.2	100.6	86.1	7.36	0.856	92.63	0.99	1.05	
TQ	76.5	74.9	72.2	2.17	0.254	74.53	-2.15	-2.09	
TS	107.1	104.9	106.4	1.12	0.130	106.13	3.33	3.38	⇑
TY	80.0	79.0	81.0	1.00	0.118	80.00	-1.20	-1.14	
U	85.4	90.3	92.1	3.47	0.396	89.27	0.40	0.46	
UA	130.0	128.0	125.0	2.52	0.295	127.67	7.06	7.11	×
UE	91.9	96.6	89.5	3.61	0.419	92.67	0.99	1.05	
UG									•
UK									•
UN	78.9	68.2	53.3	12.86	1.975	66.80	-3.49	-3.43	⇓
UP	90.3	92.5	92.4	1.24	0.130	91.73	0.83	0.89	
UQ	89.0	90.0	90.0	0.58	0.059	89.67	0.47	0.53	
UW	92.5	93.7	93.6	0.67	0.071	93.27	1.10	1.15	
UY	87.9	86.1	87.1	0.90	0.106	87.03	0.02	0.08	
VA	75.5	52.0	70.7	12.42	1.739	66.07	-3.61	-3.56	⇓
VC									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	71.6	70.0	68.0	1.80	0.213	69.87	-2.96	-2.90	
VI	69.3	67.6	68.9	0.89	0.100	68.60	-3.17	-3.12	⇓
VJ	76.2	79.8	76.8	1.93	0.213	77.60	-1.62	-1.56	
VM									•
VN									•
VO	90.5	132.0	85.3	25.59	4.349	102.60	2.71	2.77	
VQ									•
VT	91.8	89.4	93.8	2.20	0.260	91.67	0.82	0.88	
VU									•
W	95.7	92.8	93.1	1.59	0.171	93.87	1.20	1.26	
WE	92.1	88.8	89.5	1.74	0.195	90.13	0.55	0.61	
WF	72.3	74.5	76.3	2.00	0.236	74.37	-2.18	-2.12	
X	90.9	86.3	84.9	3.14	0.354	87.37	0.08	0.13	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.13	×	QC	76.67		DS	82.73		BC
41.00	×	MA	77.60		VJ	83.20		BH
45.33	×	BW	77.83		I	84.00		NH
64.73	⇓	AZ	77.93		DM	84.03		T
64.90	⇓	RK	77.97		IC	84.07		SM
66.07	⇓	VA	78.13		TD	84.10		SI
66.80	⇓	UN	78.23		JY	84.47		QW
66.97	⇓	SD	78.53		ID	85.27		ST
67.13	⇓	GT	78.90		QU	85.57		AK
67.67	⇓	RE	79.00		RD	85.67		CQ
68.00	⇓	TE	79.67		SR	86.00		MV
68.60	⇓	VI	79.67		PV	86.47		QT
68.80	⇓	AE	79.67		HI	86.53		RF
69.20	⇓	BB	80.00		TY	86.67		BA
69.87		VG	80.07		O	86.70		QJ
70.00		PR	80.07		LT	86.80		PQ
71.00		FF	80.33		CJ	87.03		UY
71.47		K	80.47		FJ	87.33		EO
73.77		FL	80.50		KE	87.37		X
73.90		FU	80.77		EV	87.43		AH
74.37		WF	81.00		HL	87.53		SO
74.53		TQ	81.27		GQ	87.67		MQ
74.77		CA	81.67		NJ	87.67		GE
75.00		LF	82.53		SN	87.73		NT
75.70		SS	82.57		LL	87.93		SX
75.83		JN	82.67		RR	88.00		FZ
76.17		MF	82.70		CS	88.03		CG
76.23		CO	82.73		SC	88.47		OF

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

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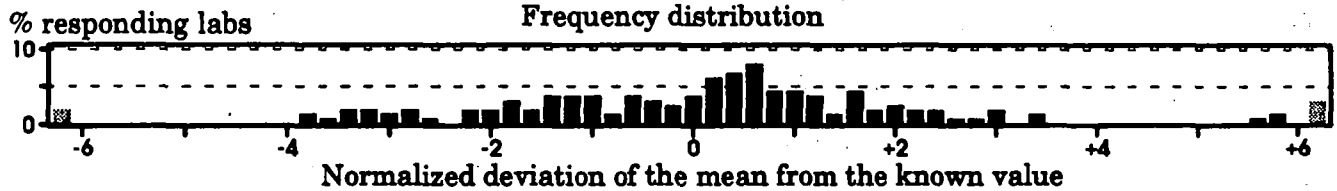
⇑ ≡ Above control limit

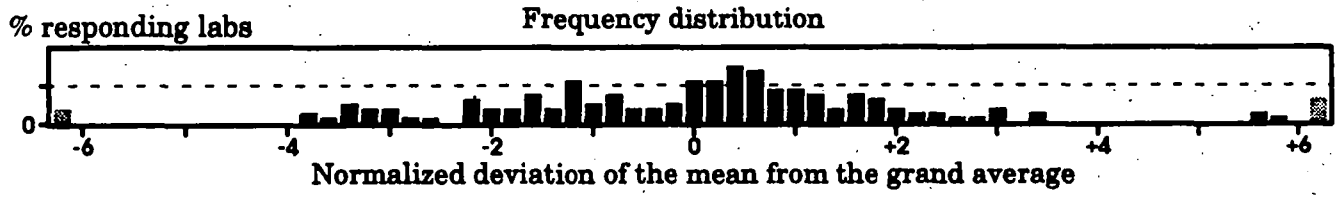
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
88.63		PA	91.07		CK	96.80		Q
88.70		BO	91.33		KX	97.50		QX
88.73		NK	91.67		VT	97.67		QP
89.00		J	91.73		UP	97.67		L
89.03		HP	92.00		LR	97.80		TL
89.03		DE	92.20		CX	98.33		S
89.17		FN	92.20		CE	98.97		PB
89.27		U	92.27		DZ	99.00		DB
89.30		N	92.60		TI	99.23		OS
89.33		DL	92.63		TN	100.00		M
89.50		AP	92.67		UE	100.33		QZ
89.60		DD	93.27		UW	100.37		AL
89.67		UQ	93.33		BK	101.40		P
89.87		QQ	93.63		AJ	102.60		VO
89.90		SF	93.87		W	103.97	⇑	JS
90.00		E	94.00		RG	104.00	⇑	DT
90.00		AF	94.03		D	104.37	⇑	NO
90.13		WE	94.13		JG	106.00	⇑	AU
90.17		PM	95.10		HK	106.13	⇑	TS
90.27		BM	95.33		TH	118.90	⇑	JQ
90.43		EB	95.50		SL	119.80	⇑	SZ
90.63		PG	95.67		KT	120.07	⇑	NA
90.63		A	95.83		JE	124.13	×	GZ
90.87		BN	95.93		BS	127.67	×	UA
91.00		RZ	96.33		RV	170.33	×	OZ
91.00		AW	96.37		AR	405.00	×	CP
			96.50		C	1090.00	×	OY





• ≡ No data submitted
∅ ≡ Insufficient data

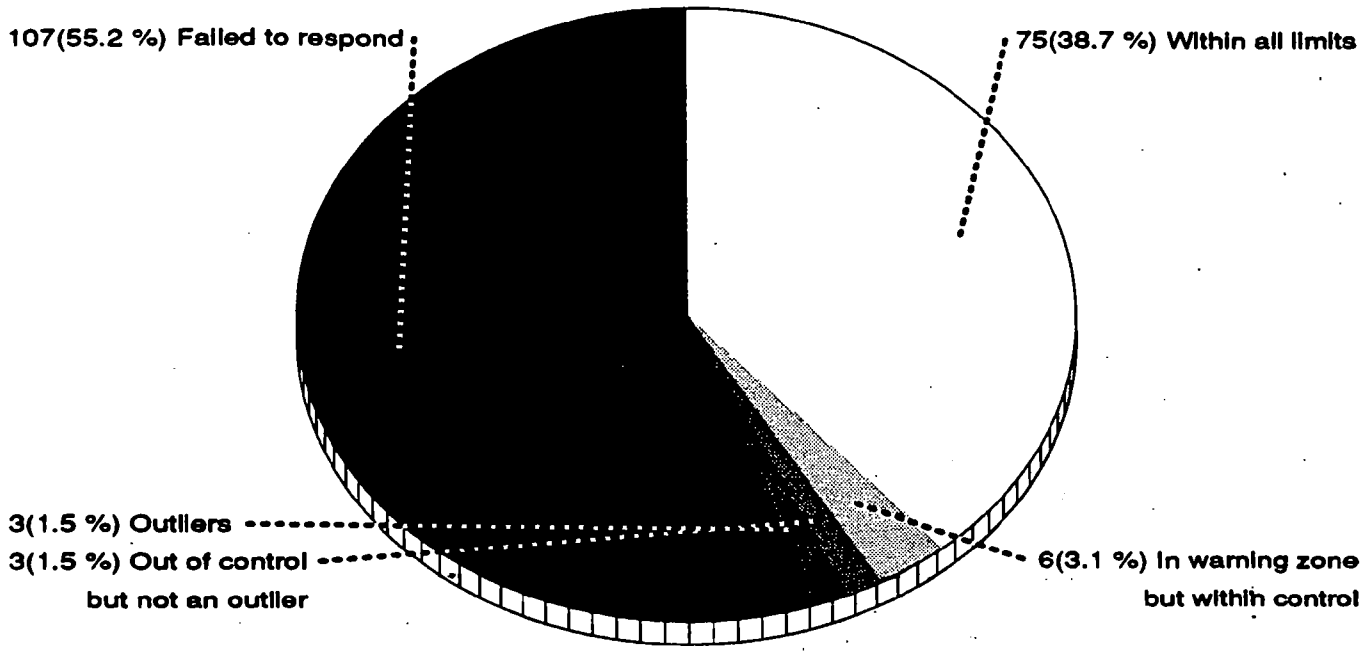
TAG SYMBOLS

× ≡ Determined to be an outlier

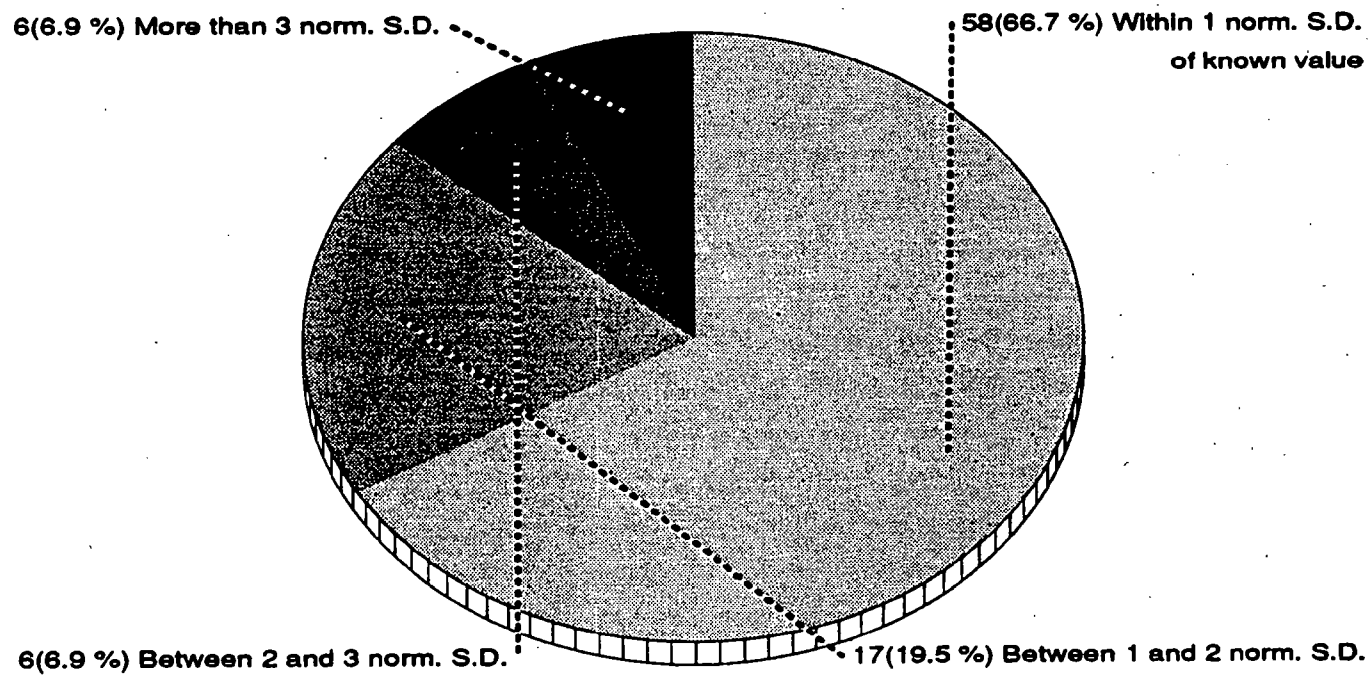
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89 Statistical Summary 194 Participants

The known value of this nuclide is **20.0 pCi/l** with an expected precision of **5.0**; the control limits are 11.3 to 28.7; the warning regions are 11.3 to 14.2 and 25.8 to 28.7



Statistic	Respondents	Non-outliers
Mean	18.65	**Grand Avg 19.09**
Std. Dev.	3.95	3.23
Variance	15.59	10.46
% Coef. of Var.	21.17	16.95
% deviation of mean from known value	-6.76	-4.56
Norm. dev. of mean from known value	-0.34	-0.28
Median	19.67	19.83
% deviation of median from known value	-1.67	-0.83
Norm. dev. of median from known value	-0.08	-0.05



CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	18.0	20.0	19.0	1.00	0.236	19.00	-0.03	-0.35	
AE	22.0	23.0	22.0	0.58	0.118	22.33	1.12	0.81	
AF	20.0	21.0	20.0	0.58	0.118	20.33	0.43	0.12	
AH									•
AI									•
AJ	23.0	16.0	17.0	3.79	0.827	18.67	-0.15	-0.46	
AK	20.0	20.0	22.0	1.15	0.236	20.67	0.55	0.23	
AL	23.0	24.0	23.0	0.58	0.118	23.33	1.47	1.15	
AO									•
AP									•
AR									•
AU	20.0	22.0	24.0	2.00	0.473	22.00	1.01	0.69	
AW	20.0	19.0	17.0	1.53	0.354	18.67	-0.15	-0.46	
AZ	20.0	20.0	22.0	1.15	0.236	20.67	0.55	0.23	
BA	20.0	20.0	21.0	0.58	0.118	20.33	0.43	0.12	
BB									•
BC	18.0	18.0	17.0	0.58	0.118	17.67	-0.49	-0.81	
BG									•
BH	21.0	21.0	20.0	0.58	0.118	20.67	0.55	0.23	
BK									•
BL	21.0	23.0	17.0	3.06	0.709	20.33	0.43	0.12	
BM	18.0	20.0	19.0	1.00	0.236	19.00	-0.03	-0.35	
BN									•
BO	21.0	20.0	20.0	0.58	0.118	20.33	0.43	0.12	
BS									•
BW									•
C	25.0	23.0	22.0	1.53	0.354	23.33	1.47	1.15	
CA	17.0	17.0	17.0	0.00	0.000	17.00	-0.72	-1.04	
CE									•
CG	22.0	23.0	23.0	0.58	0.118	22.67	1.24	0.92	
CJ	20.0	20.0	22.0	1.15	0.236	20.67	0.55	0.23	
CK	11.0	11.0	20.0	5.20	1.120	14.00	-1.76	-2.08	
CM									•
CO	18.0	17.0	18.0	0.58	0.118	17.67	-0.49	-0.81	
CP	23.0	26.0	28.0	2.52	0.591	25.67	2.28	1.96	
CQ	17.0	18.0	18.0	0.58	0.118	17.67	-0.49	-0.81	
CS	15.0	19.0	19.0	2.31	0.473	17.67	-0.49	-0.81	
CX	14.0	16.0	19.0	2.52	0.591	16.33	-0.95	-1.27	
D									•
DB									•
DD	21.0	20.0	20.0	0.58	0.118	20.33	0.43	0.12	
DE	20.0	20.0	21.0	0.58	0.118	20.33	0.43	0.12	
DG	12.0	12.0	12.0	0.00	0.000	12.00	-2.46	-2.77	
DJ									•
DL									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM									•
DO	19.0	21.0	20.0	1.00	0.236	20.00	0.32	0.00	
DS									•
DT	20.0	18.0	17.0	1.53	0.354	18.33	-0.26	-0.58	
DZ	20.0	22.0	21.0	1.00	0.236	21.00	0.66	0.35	
E	20.0	19.0	20.0	0.58	0.118	19.67	0.20	-0.12	
EB	20.0	25.0	22.0	2.52	0.591	22.33	1.12	0.81	
EL	27.0	24.0	24.0	1.73	0.354	25.00	2.05	1.73	
EO									•
ER									•
EV									•
EX									•
FF									•
FJ									•
FL									•
FN									•
FU	24.0	23.0	25.0	1.00	0.236	24.00	1.70	1.39	
FZ									•
GE									•
GI									•
GQ	20.0	20.0	20.0	0.00	0.000	20.00	0.32	0.00	
GT									•
GZ									•
HI									•
HK	17.0	17.0	17.0	0.00	0.000	17.00	-0.72	-1.04	
HL									•
HP	25.0	22.0	18.0	3.51	0.827	21.67	0.89	0.58	
I	22.0	22.0	22.0	0.00	0.000	22.00	1.01	0.69	
IC	17.0	18.0	17.0	0.58	0.118	17.33	-0.61	-0.92	
ID									•
J	20.0	20.0	21.0	0.58	0.118	20.33	0.43	0.12	
JE	8.0	5.0	6.0	1.53	0.354	6.33	-4.42	-4.73	x
JG									•
JN									•
JQ									•
JS	17.0	16.0	16.0	0.58	0.118	16.33	-0.95	-1.27	
JY									•
K	19.0	19.0	22.0	1.73	0.354	20.00	0.32	0.00	
KE									•
KT									•
KX	21.0	21.0	21.0	0.00	0.000	21.00	0.66	0.35	
L	19.0	20.0	21.0	1.00	0.236	20.00	0.32	0.00	
LF									•
LG									•
LL									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR									•
LT	9.0	9.0	11.0	1.15	0.236	9.67	-3.26	-3.58	⇓
M	26.0	25.0	28.0	1.53	0.354	26.33	2.51	2.19	
MA									•
MF									•
MP									•
MQ	19.0	20.0	20.0	0.58	0.118	19.67	0.20	-0.12	
MV									•
MY									•
N	21.0	21.0	20.0	0.58	0.118	20.67	0.55	0.23	
NA									•
NH									•
NI									•
NJ	17.0	18.0	18.0	0.58	0.118	17.67	-0.49	-0.81	
NK									•
NO	12.0	13.0	14.0	1.00	0.236	13.00	-2.11	-2.42	
NT	21.0	21.0	22.0	0.58	0.118	21.33	0.78	0.46	
O									•
OF									•
OS									•
OX									•
OY									•
OZ									•
P									•
PA									•
PB	20.0	20.0	20.0	0.00	0.000	20.00	0.32	0.00	
PG									•
PI									•
PM									•
PQ									•
PR									•
PV	17.0	20.0	28.0	5.69	1.570	21.67	0.89	0.58	
PW									•
Q	18.0	20.0	22.0	2.00	0.473	20.00	0.32	0.00	
QC									•
QJ									•
QP									•
QQ									•
QT									•
QU	16.0	12.0	13.0	2.08	0.473	13.67	-1.88	-2.19	
QW	18.0	12.0	14.0	3.06	0.709	14.67	-1.53	-1.85	
QX									•
QY									•
QZ	20.0	21.0	23.0	1.53	0.354	21.33	0.78	0.46	
RD									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RE									•
RF									•
RG									•
RJ									•
RK	6.0	6.0	5.0	0.58	0.118	5.67	-4.65	-4.97	×
RP									•
RR	21.0	21.0	20.0	0.58	0.118	20.67	0.55	0.23	
RV	19.0	20.0	20.0	0.58	0.118	19.67	0.20	-0.12	
RZ									•
S	19.0	18.0	18.0	0.58	0.118	18.33	-0.26	-0.58	
SC	17.0	21.0	21.0	2.31	0.473	19.67	0.20	-0.12	
SD	20.0	17.0	15.0	2.52	0.591	17.33	-0.61	-0.92	
SF	18.0	17.0	19.0	1.00	0.236	18.00	-0.38	-0.69	
SI	16.0	12.0	13.0	2.08	0.473	13.67	-1.88	-2.19	
SL									•
SM	20.0	22.0	21.0	1.00	0.236	21.00	0.66	0.35	
SN									•
SO									•
SR									•
SS	16.0	20.0	17.0	2.08	0.473	17.67	-0.49	-0.81	
ST	24.0	21.0	27.0	3.00	0.709	24.00	1.70	1.39	
SX									•
SZ									•
T	17.0	17.0	19.0	1.15	0.236	17.67	-0.49	-0.81	
TD	16.0	16.0	15.0	0.58	0.118	15.67	-1.18	-1.50	
TE	18.0	21.0	17.0	2.08	0.473	18.67	-0.15	-0.46	
TH									•
TI	18.0	15.0	16.0	1.53	0.354	16.33	-0.95	-1.27	
TL	20.0	21.0	24.0	2.08	0.473	21.67	0.89	0.58	
TN									•
TQ	18.0	21.0	18.0	1.73	0.354	19.00	-0.03	-0.35	
TS	10.0	11.0	11.0	0.58	0.118	10.67	-2.92	-3.23	⇓
TY									•
U	17.0	17.0	16.0	0.58	0.118	16.67	-0.84	-1.15	
UA									•
UE	22.0	21.0	20.0	1.00	0.236	21.00	0.66	0.35	
UG									•
UK									•
UN	22.0	19.0	21.0	1.53	0.354	20.67	0.55	0.23	
UP	17.0	17.0	16.0	0.58	0.118	16.67	-0.84	-1.15	
UQ									•
UW	22.0	21.0	22.0	0.58	0.118	21.67	0.89	0.58	
UY									•
VA									•
VC									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	15.0	16.0	16.0	0.58	0.118	15.67	-1.18	-1.50	
VI	13.0	8.0	11.0	2.52	0.591	10.67	-2.92	-3.23	⇓
VJ									•
VM									•
VN									•
VO									•
VQ									•
VT									•
VU									•
W	19.0	19.0	18.0	0.58	0.118	18.67	-0.15	-0.46	
WE									•
WF	6.0	8.0	7.0	1.00	0.236	7.00	-4.19	-4.50	×
X	17.0	19.0	15.0	2.00	0.473	17.00	-0.72	-1.04	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.67	×	RK	17.67		CQ	20.33		BA
6.33	×	JE	17.67		CO	20.33		AF
7.00	×	WF	17.67		BC	20.67		UN
9.67	⇓	LT	18.00		SF	20.67		RR
10.67	⇓	VI	18.33		S	20.67		N
10.67	⇓	TS	18.33		DT	20.67		CJ
12.00		DG	18.67		W	20.67		BH
13.00		NO	18.67		TE	20.67		AZ
13.67		SI	18.67		AW	20.67		AK
13.67		QU	18.67		AJ	21.00		UE
14.00		CK	19.00		TQ	21.00		SM
14.67		QW	19.00		BM	21.00		KX
15.67		VG	19.00		A	21.00		DZ
15.67		TD	19.67		SC	21.33		QZ
16.33		TI	19.67		RV	21.33		NT
16.33		JS	19.67		MQ	21.67		UW
16.33		CX	19.67		E	21.67		TL
16.67		UP	20.00		Q	21.67		PV
16.67		U	20.00		PB	21.67		HP
17.00		X	20.00		L	22.00		I
17.00		HK	20.00		K	22.00		AU
17.00		CA	20.00		GQ	22.33		EB
17.33		SD	20.00		DO	22.33		AE
17.33		IC	20.33		J	22.67		CG
17.67		T	20.33		DE	23.33		C
17.67		SS	20.33		DD	23.33		AL
17.67		NJ	20.33		BO	24.00		ST
17.67		CS	20.33		BL	24.00		FU

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

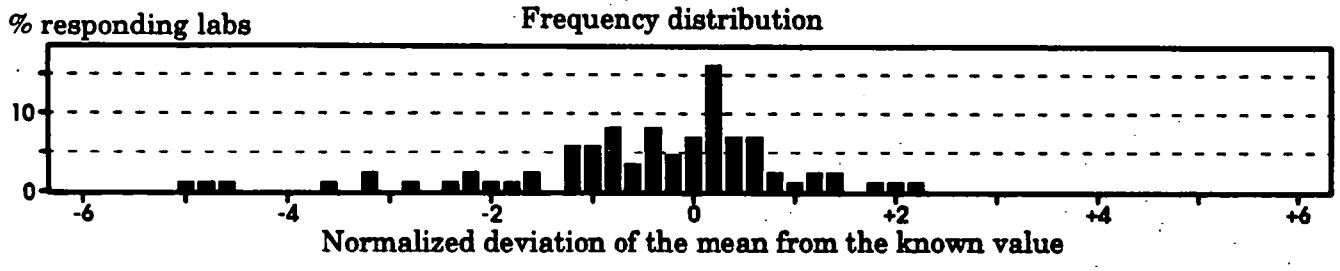
⇑ ≡ Above control limit

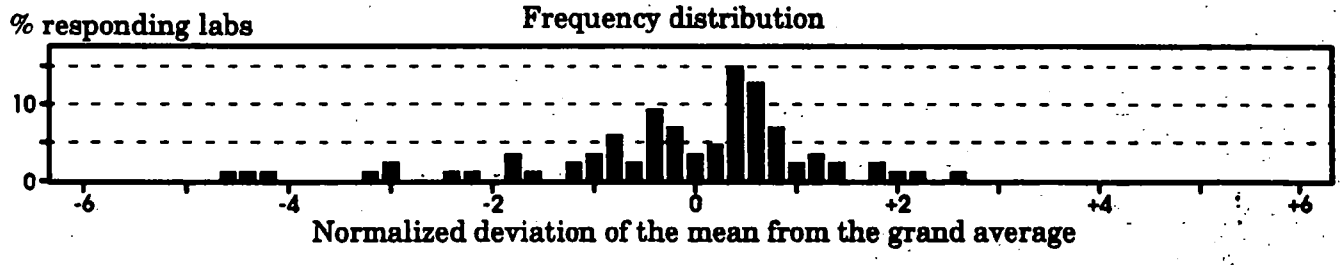
⇓ ≡ Below control limit

Strontium-89

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
25.00		EL	25.67		CP	26.33		M





• ≡ No data submitted
∅ ≡ Insufficient data

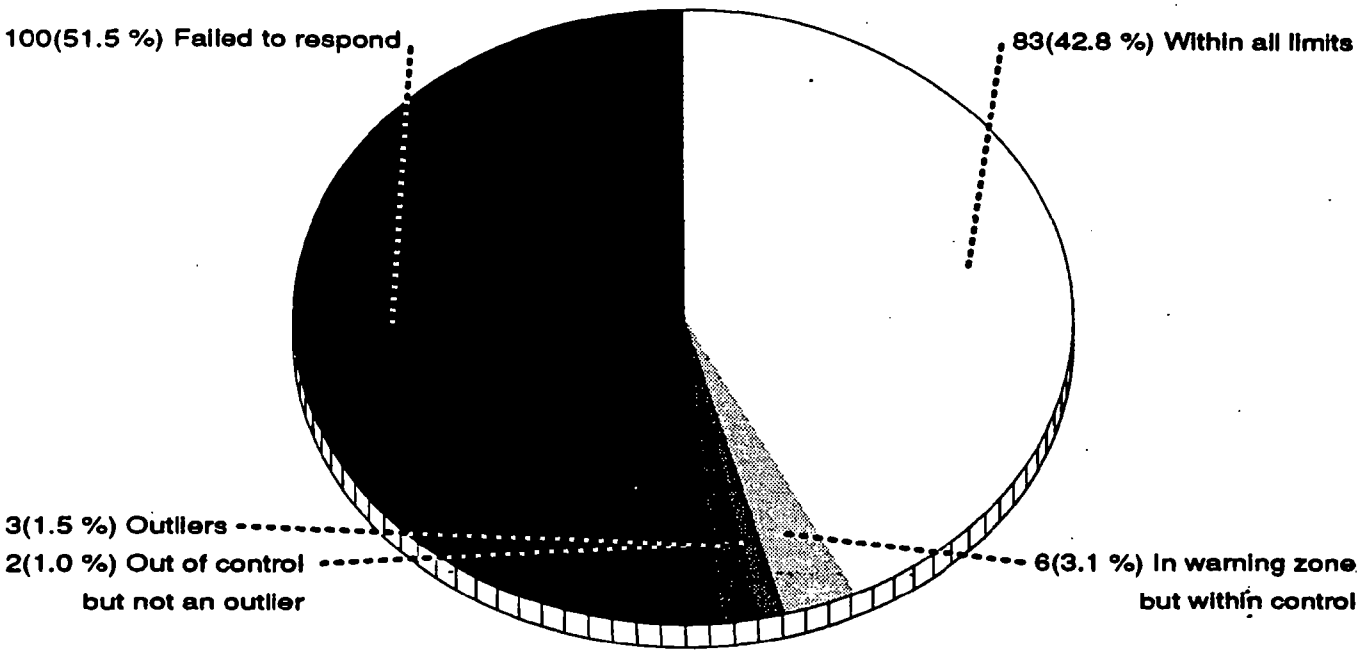
TAG SYMBOLS

× ≡ Determined to be an outlier

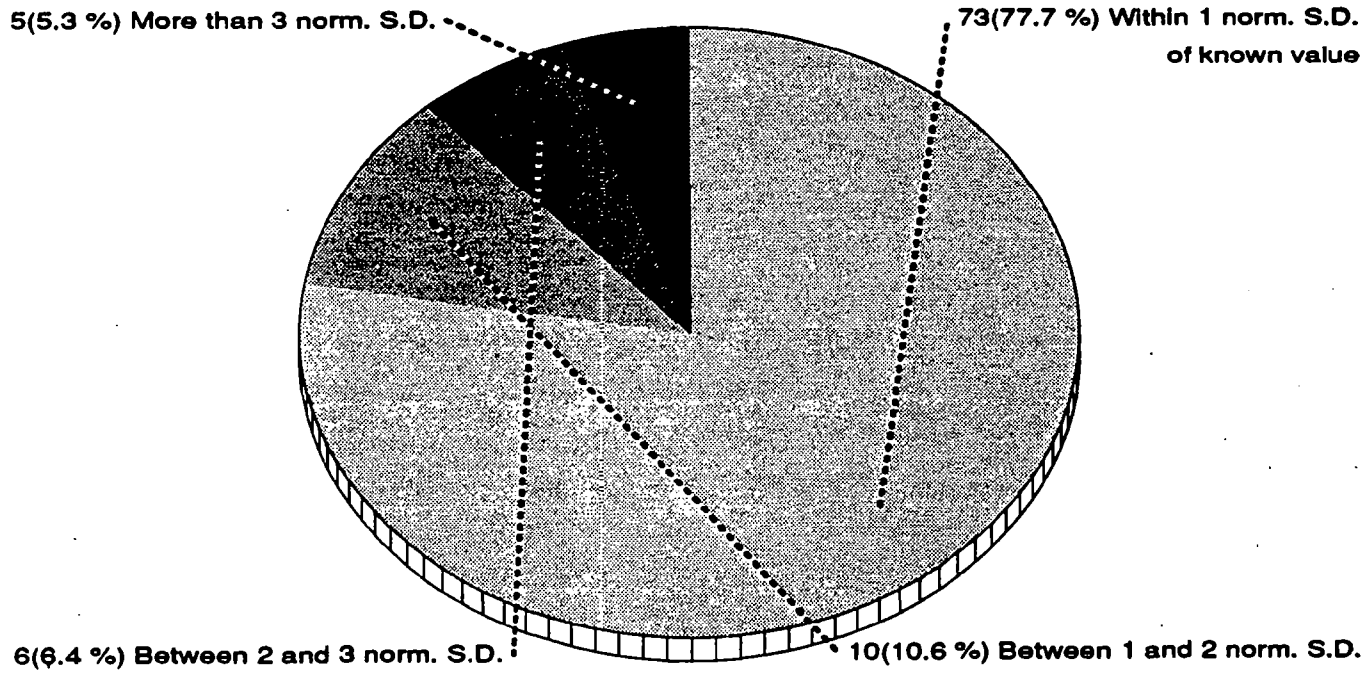
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90 Statistical Summary 194 Participants

The known value of this nuclide is **15.0 pCi/l** with an expected precision of **5.0**; the control limits are 6.3 to 23.7; the warning regions are 6.3 to 9.2 and 20.8 to 23.7



Statistic	Respondents	Non-outliers
Mean	14.63	**Grand Avg 14.16**
Std. Dev.	3.77	2.74
Variance	14.21	7.48
% Coef. of Var.	25.76	19.31
% deviation of mean from known value	-2.43	-5.57
Norm. dev. of mean from known value	-0.10	-0.31
Median	14.33	14.00
% deviation of median from known value	-4.44	-6.67
Norm. dev. of median from known value	-0.18	-0.37



Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	14.0	13.0	14.0	0.58	0.118	13.67	-0.17	-0.46	
AE	11.0	15.0	15.0	2.31	0.473	13.67	-0.17	-0.46	
AF	14.0	14.0	14.0	0.00	0.000	14.00	-0.06	-0.35	
AH									•
AI									•
AJ	13.0	15.0	15.0	1.15	0.236	14.33	0.06	-0.23	
AK	15.0	16.0	15.0	0.58	0.118	15.33	0.40	0.12	
AL	13.0	13.0	13.0	0.00	0.000	13.00	-0.40	-0.69	
AO									•
AP									•
AR									•
AU	14.0	13.0	14.0	0.58	0.118	13.67	-0.17	-0.46	
AW	17.0	18.0	17.0	0.58	0.118	17.33	1.10	0.81	
AZ	14.0	15.0	15.0	0.58	0.118	14.67	0.17	-0.12	
BA	13.0	14.0	14.0	0.58	0.118	13.67	-0.17	-0.46	
BB	12.0	13.0	12.0	0.58	0.118	12.33	-0.63	-0.92	
BC	14.0	14.0	13.0	0.58	0.118	13.67	-0.17	-0.46	
BG									•
BH	14.0	14.0	15.0	0.58	0.118	14.33	0.06	-0.23	
BK									•
BL	15.0	13.0	18.0	2.52	0.591	15.33	0.40	0.12	
BM	15.0	14.0	15.0	0.58	0.118	14.67	0.17	-0.12	
BN									•
BO	14.0	14.0	14.0	0.00	0.000	14.00	-0.06	-0.35	
BS									•
BW									•
C	14.0	15.0	15.0	0.58	0.118	14.67	0.17	-0.12	
CA	14.0	12.0	12.0	1.15	0.236	12.67	-0.52	-0.81	
CE	15.0	15.0	15.0	0.00	0.000	15.00	0.29	0.00	
CG	15.0	15.0	12.0	1.73	0.354	14.00	-0.06	-0.35	
CJ	14.0	15.0	15.0	0.58	0.118	14.67	0.17	-0.12	
CK	22.0	18.0	13.0	4.51	1.120	17.67	1.21	0.92	
CM									•
CO	17.0	17.0	16.0	0.58	0.118	16.67	0.87	0.58	
CP	18.0	26.0	25.0	4.36	0.945	23.00	3.06	2.77	
CQ	13.0	13.0	13.0	0.00	0.000	13.00	-0.40	-0.69	
CS	16.0	15.0	16.0	0.58	0.118	15.67	0.52	0.23	
CX	14.0	15.0	16.0	1.00	0.236	15.00	0.29	0.00	
D									•
DB									•
DD	14.0	15.0	15.0	0.58	0.118	14.67	0.17	-0.12	
DE	16.0	16.0	16.0	0.00	0.000	16.00	0.64	0.35	
DG	12.0	11.0	10.0	1.00	0.236	11.00	-1.10	-1.39	
DJ									•
DL									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM									•
DO	13.0	12.0	14.0	1.00	0.236	13.00	-0.40	-0.69	
DS									•
DT	12.0	15.0	15.0	1.73	0.354	14.00	-0.06	-0.35	
DZ	15.0	16.0	17.0	1.00	0.236	16.00	0.64	0.35	
E	17.0	16.0	16.0	0.58	0.118	16.33	0.75	0.46	
EB	14.0	11.0	12.0	1.53	0.354	12.33	-0.63	-0.92	
EL	17.0	16.0	15.0	1.00	0.236	16.00	0.64	0.35	
EO									•
ER									•
EV									•
EX									•
FF									•
FJ									•
FL									•
FN									•
FU	14.0	12.0	13.0	1.00	0.236	13.00	-0.40	-0.69	
FZ									•
GE									•
GI									•
GQ	18.0	19.0	20.0	1.00	0.236	19.00	1.67	1.39	
GT									•
GZ									•
HI									•
HK	13.0	13.0	13.0	0.00	0.000	13.00	-0.40	-0.69	
HL									•
HP	10.0	16.0	14.0	3.06	0.709	13.33	-0.29	-0.58	
I	13.0	13.0	14.0	0.58	0.118	13.33	-0.29	-0.58	
IC	15.0	14.0	15.0	0.58	0.118	14.67	0.17	-0.12	
ID									•
J	15.0	15.0	15.0	0.00	0.000	15.00	0.29	0.00	
JE	6.0	5.0	6.0	0.58	0.118	5.67	-2.94	-3.23	⇓
JG									•
JN									•
JQ									•
JS	12.0	12.0	12.0	0.00	0.000	12.00	-0.75	-1.04	
JY	17.0	20.0	20.0	1.73	0.354	19.00	1.67	1.39	
K	13.0	12.0	12.0	0.58	0.118	12.33	-0.63	-0.92	
KE									•
KT									•
KX	13.0	14.0	14.0	0.58	0.118	13.67	-0.17	-0.46	
L	14.0	14.0	15.0	0.58	0.118	14.33	0.06	-0.23	
LF									•
LG									•
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR									•
LT	9.0	8.0	9.0	0.58	0.118	8.67	-1.90	-2.19	
M	8.0	8.0	7.0	0.58	0.118	7.67	-2.25	-2.54	
MA									•
MF									•
MP									•
MQ	14.0	14.0	14.0	0.00	0.000	14.00	-0.06	-0.35	
MV									•
MY									•
N	14.0	14.0	15.0	0.58	0.118	14.33	0.06	-0.23	
NA									•
NH									•
NI									•
NJ	12.0	13.0	13.0	0.58	0.118	12.67	-0.52	-0.81	
NK									•
NO	25.0	26.0	27.0	1.00	0.236	26.00	4.10	3.81	×
NT	15.0	15.0	16.0	0.58	0.118	15.33	0.40	0.12	
O									•
OF									•
OS									•
OX									•
OY									•
OZ									•
P									•
PA									•
PB	15.0	15.0	15.0	0.00	0.000	15.00	0.29	0.00	
PG									•
PI									•
PM									•
PQ									•
PR									•
PV	27.0	31.0	38.0	5.57	1.570	32.00	6.18	5.89	×
PW									•
Q	13.0	14.0	15.0	1.00	0.236	14.00	-0.06	-0.35	
QC									•
QJ	12.0	13.0	14.0	1.00	0.236	13.00	-0.40	-0.69	
QP									•
QQ									•
QT									•
QU	5.0	6.0	6.0	0.58	0.118	5.67	-2.94	-3.23	⇓
QW	14.0	11.0	13.0	1.53	0.354	12.67	-0.52	-0.81	
QX									•
QY									•
QZ	14.0	14.0	13.0	0.58	0.118	13.67	-0.17	-0.46	
RD									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF									•
RG									•
RJ									•
RK	11.0	9.0	10.0	1.00	0.236	10.00	-1.44	-1.73	
RP									•
RR	14.0	14.0	14.0	0.00	0.000	14.00	-0.06	-0.35	
RV	16.0	16.0	16.0	0.00	0.000	16.00	0.64	0.35	
RZ									•
S	15.0	15.0	15.0	0.00	0.000	15.00	0.29	0.00	
SC	15.0	16.0	16.0	0.58	0.118	15.67	0.52	0.23	
SD	15.0	14.0	16.0	1.00	0.236	15.00	0.29	0.00	
SF	14.0	12.0	13.0	1.00	0.236	13.00	-0.40	-0.69	
SI	15.0	15.0	15.0	0.00	0.000	15.00	0.29	0.00	
SL									•
SM	20.0	20.0	24.0	2.31	0.473	21.33	2.48	2.19	
SN									•
SO									•
SR									•
SS	16.0	15.0	15.0	0.58	0.118	15.33	0.40	0.12	
ST	14.0	15.0	13.0	1.00	0.236	14.00	-0.06	-0.35	
SX									•
SZ	18.0	19.0	20.0	1.00	0.236	19.00	1.67	1.39	
T	12.0	11.0	13.0	1.00	0.236	12.00	-0.75	-1.04	
TD	11.0	12.0	13.0	1.00	0.236	12.00	-0.75	-1.04	
TE	18.0	11.0	15.0	3.51	0.827	14.67	0.17	-0.12	
TH	15.0	17.0	16.0	1.00	0.236	16.00	0.64	0.35	
TI	14.0	16.0	14.0	1.15	0.236	14.67	0.17	-0.12	
TL	16.0	17.0	18.0	1.00	0.236	17.00	0.98	0.69	
TN									•
TQ	16.0	15.0	16.0	0.58	0.118	15.67	0.52	0.23	
TS	8.0	8.0	8.0	0.00	0.000	8.00	-2.14	-2.42	
TY									•
U	14.0	16.0	16.0	1.15	0.236	15.33	0.40	0.12	
UA									•
UE	13.0	13.0	15.0	1.15	0.236	13.67	-0.17	-0.46	
UG									•
UK									•
UN	15.0	16.0	14.0	1.00	0.236	15.00	0.29	0.00	
UP	14.0	12.0	13.0	1.00	0.236	13.00	-0.40	-0.69	
UQ									•
UW	15.0	14.0	14.0	0.58	0.118	14.33	0.06	-0.23	
UY									•
VA									•
VC									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	10.0	10.0	11.0	0.58	0.118	10.33	-1.33	-1.62	
VI	13.0	11.0	12.0	1.00	0.236	12.00	-0.75	-1.04	
VJ									•
VM									•
VN									•
VO	30.0	29.0	27.0	1.53	0.354	28.67	5.02	4.73	×
VQ									•
VT									•
VU									•
W	13.0	13.0	14.0	0.58	0.118	13.33	-0.29	-0.58	
WE									•
WF	20.0	21.0	22.0	1.00	0.236	21.00	2.37	2.08	
X	12.0	15.0	14.0	1.53	0.354	13.67	-0.17	-0.46	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.67	⇓	QU	13.33		HP	14.67		C
5.67	⇓	JE	13.67		X	14.67		BM
7.67		M	13.67		UE	14.67		AZ
8.00		TS	13.67		QZ	15.00		UN
8.67		LT	13.67		KX	15.00		SI
10.00		RK	13.67		BC	15.00		SD
10.33		VG	13.67		BA	15.00		S
11.00		DG	13.67		AU	15.00		PB
12.00		VI	13.67		AE	15.00		J
12.00		TD	13.67		A	15.00		CX
12.00		T	14.00		ST	15.00		CE
12.00		JS	14.00		RR	15.33		U
12.33		K	14.00		Q	15.33		SS
12.33		EB	14.00		MQ	15.33		NT
12.33		BB	14.00		DT	15.33		BL
12.67		QW	14.00		CG	15.33		AK
12.67		NJ	14.00		BO	15.67		TQ
12.67		CA	14.00		AF	15.67		SC
13.00		UP	14.33		UW	15.67		CS
13.00		SF	14.33		N	16.00		TH
13.00		QJ	14.33		L	16.00		RV
13.00		HK	14.33		BH	16.00		EL
13.00		FU	14.33		AJ	16.00		DZ
13.00		DO	14.67		TI	16.00		DE
13.00		CQ	14.67		TE	16.33		E
13.00		AL	14.67		IC	16.67		CO
13.33		W	14.67		DD	17.00		TL
13.33		I	14.67		CJ	17.33		AW

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

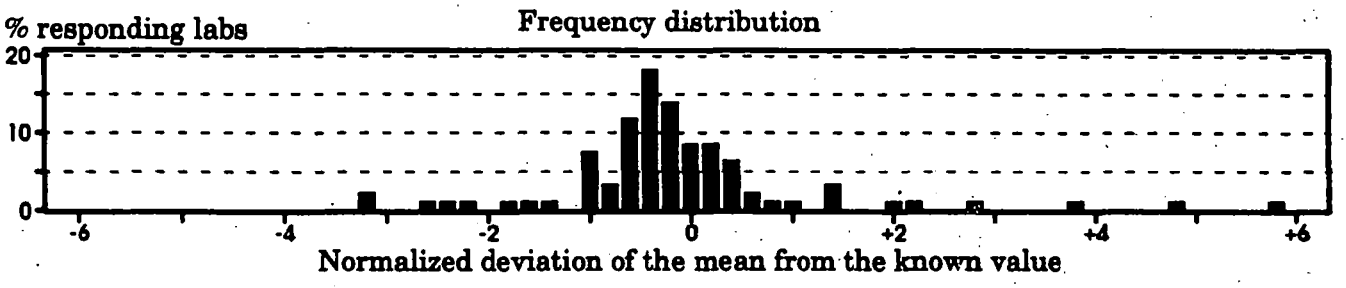
× ≡ Determined to be an outlier

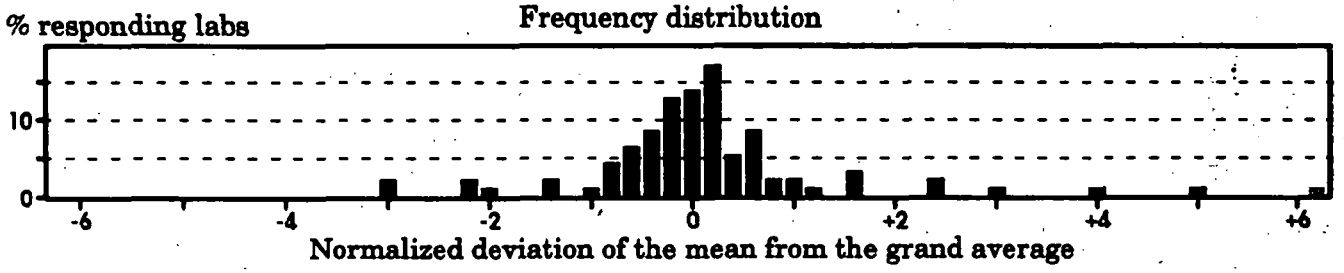
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
17.67		CK	19.00		GQ	23.00		CP
19.00		SZ	21.00		WF	26.00	×	NO
19.00		JY	21.33		SM	28.67	×	VO
						32.00	×	PV





• ≡ No data submitted
∅ ≡ Insufficient data

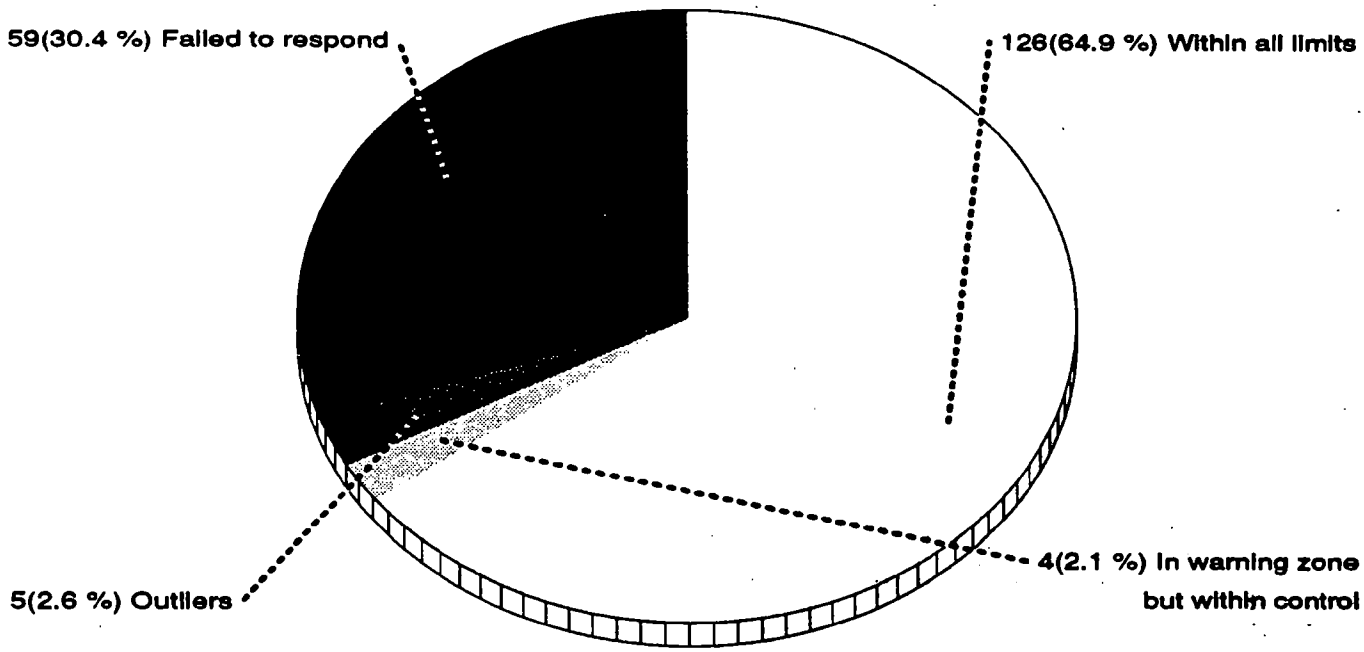
TAG SYMBOLS

× ≡ Determined to be an outlier

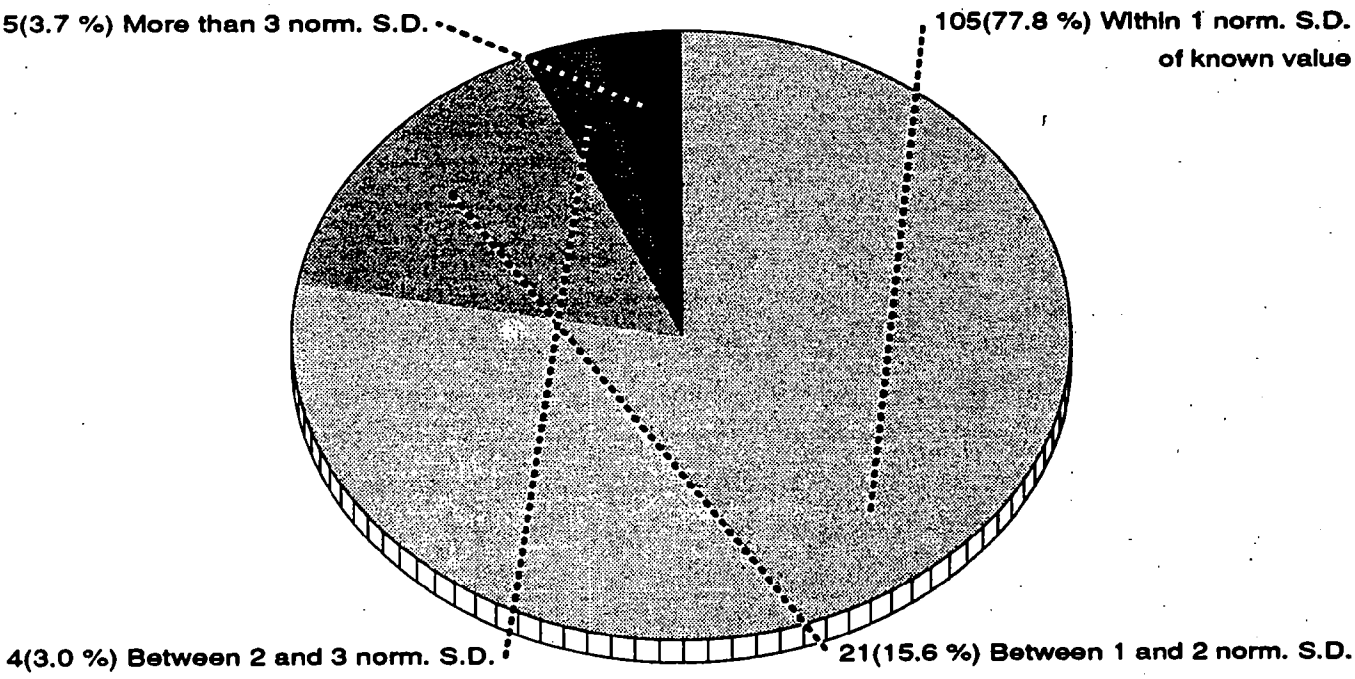
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cobalt-60 Statistical Summary 194 Participants

The known value of this nuclide is **29.0 pCi/l** with an expected precision of **5.0**; the control limits are 20.3 to 37.7; the warning regions are 20.3 to 23.2 and 34.8 to 37.7



Statistic	Respondents	Non-outliers
Mean	30.34	**Grand Avg 29.39**
Std. Dev.	8.73	2.24
Variance	76.17	5.00
% Coef. of Var.	28.77	7.61
% deviation of mean from known value	4.61	1.36
Norm. dev. of mean from known value	0.15	0.18
Median	29.33	29.33
% deviation of median from known value	1.15	1.15
Norm. dev. of median from known value	0.04	0.15



CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	27.0	25.0	27.0	1.15	0.236	26.33	-1.06	-0.92	
AE	31.0	32.0	31.0	0.58	0.118	31.33	0.67	0.81	
AF	29.0	29.0	31.0	1.15	0.236	29.67	0.09	0.23	
AH	27.0	26.0	27.0	0.58	0.118	26.67	-0.95	-0.81	
AI	25.0	25.0	24.0	0.58	0.118	24.67	-1.64	-1.50	
AJ	30.0	28.0	26.0	2.00	0.473	28.00	-0.48	-0.35	
AK	30.0	29.0	30.0	0.58	0.118	29.67	0.09	0.23	
AL	29.0	21.0	30.0	4.93	1.120	26.67	-0.95	-0.81	
AO									•
AP	31.0	30.0	30.0	0.58	0.118	30.33	0.33	0.46	
AR									•
AU	30.0	28.0	28.0	1.15	0.236	28.67	-0.25	-0.12	
AW	29.0	29.0	28.0	0.58	0.118	28.67	-0.25	-0.12	
AZ	26.0	20.0	26.0	3.46	0.709	24.00	-1.87	-1.73	
BA	36.0	32.0	34.0	2.00	0.473	34.00	1.60	1.73	
BB	31.0	33.0	32.0	1.00	0.236	32.00	0.90	1.04	
BC	29.0	28.0	28.0	0.58	0.118	28.33	-0.37	-0.23	
BG									•
BH	31.0	30.0	27.0	2.08	0.473	29.33	-0.02	0.12	
BK	32.0	32.0	32.0	0.00	0.000	32.00	0.90	1.04	
BL	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
BM	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
BN	29.0	28.0	27.0	1.00	0.236	28.00	-0.48	-0.35	
BO	31.0	31.0	27.0	2.31	0.473	29.67	0.09	0.23	
BS									•
BW	25.0	42.0	20.0	11.53	4.046	29.00	-0.14	0.00	
C	27.0	26.0	26.0	0.58	0.118	26.33	-1.06	-0.92	
CA	30.0	27.0	30.0	1.73	0.354	29.00	-0.14	0.00	
CE	32.0	32.0	34.0	1.15	0.236	32.67	1.13	1.27	
CG									•
CJ	34.0	31.0	30.0	2.08	0.473	31.67	0.79	0.92	
CK	32.0	28.0	28.0	2.31	0.473	29.33	-0.02	0.12	
CM	27.0	28.0	29.0	1.00	0.236	28.00	-0.48	-0.35	
CO	27.0	30.0	29.0	1.53	0.354	28.67	-0.25	-0.12	
CP	32.0	30.0	30.0	1.15	0.236	30.67	0.44	0.58	
CQ	31.0	32.0	33.0	1.00	0.236	32.00	0.90	1.04	
CS	29.0	30.0	27.0	1.53	0.354	28.67	-0.25	-0.12	
CX	31.0	30.0	31.0	0.58	0.118	30.67	0.44	0.58	
D									•
DB									•
DD	32.0	30.0	29.0	1.53	0.354	30.33	0.33	0.46	
DE	30.0	30.0	30.0	0.00	0.000	30.00	0.21	0.35	
DG	31.0	28.0	31.0	1.73	0.354	30.00	0.21	0.35	
DJ									•
DL	31.0	31.0	30.0	0.58	0.118	30.67	0.44	0.58	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	30.0	30.0	28.0	1.15	0.236	29.33	-0.02	0.12	
DO	37.0	32.0	33.0	2.65	0.591	34.00	1.60	1.73	
DS									•
DT	28.0	31.0	28.0	1.73	0.354	29.00	-0.14	0.00	
DZ	25.0	24.0	26.0	1.00	0.236	25.00	-1.52	-1.39	
E	30.0	30.0	30.0	0.00	0.000	30.00	0.21	0.35	
EB	28.0	28.0	28.0	0.00	0.000	28.00	-0.48	-0.35	
EL	28.0	29.0	28.0	0.58	0.118	28.33	-0.37	-0.23	
EO									•
ER									•
EV									•
EX	28.0	30.0	32.0	2.00	0.473	30.00	0.21	0.35	
FF									•
FJ	31.0	29.0	30.0	1.00	0.236	30.00	0.21	0.35	
FL	30.0	30.0	29.0	0.58	0.118	29.67	0.09	0.23	
FN									•
FU	30.0	29.0	28.0	1.00	0.236	29.00	-0.14	0.00	
FZ	38.0	33.0	32.0	3.21	0.709	34.33	1.71	1.85	
GE	32.0	30.0	31.0	1.00	0.236	31.00	0.56	0.69	
GI	29.0	30.0	29.0	0.58	0.118	29.33	-0.02	0.12	
GQ	30.0	30.0	30.0	0.00	0.000	30.00	0.21	0.35	
GT									•
GZ									•
HI	22.0	21.0	23.0	1.00	0.236	22.00	-2.56	-2.42	
HK	29.0	31.0	29.0	1.15	0.236	29.67	0.09	0.23	
HL	28.0	29.0	28.0	0.58	0.118	28.33	-0.37	-0.23	
HP	31.0	30.0	29.0	1.00	0.236	30.00	0.21	0.35	
I	31.0	30.0	26.0	2.65	0.591	29.00	-0.14	0.00	
IC	32.0	31.0	31.0	0.58	0.118	31.33	0.67	0.81	
ID									•
J	29.0	30.0	29.0	0.58	0.118	29.33	-0.02	0.12	
JE	29.0	30.0	29.0	0.58	0.118	29.33	-0.02	0.12	
JG	27.0	29.0	25.0	2.00	0.473	27.00	-0.83	-0.69	
JN									•
JQ									•
JS	30.0	30.0	31.0	0.58	0.118	30.33	0.33	0.46	
JY	32.0	41.0	37.0	4.51	1.120	36.67	2.52	2.66	
K	26.0	25.0	28.0	1.53	0.354	26.33	-1.06	-0.92	
KE									•
KT									•
KX	30.0	30.0	29.0	0.58	0.118	29.67	0.09	0.23	
L	30.0	28.0	30.0	1.15	0.236	29.33	-0.02	0.12	
LF	29.0	30.0	30.0	0.58	0.118	29.67	0.09	0.23	
LG									•
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	32.0	30.0	29.0	1.53	0.354	30.33	0.33	0.46	
LT	29.0	29.0	30.0	0.58	0.118	29.33	-0.02	0.12	
M	30.0	29.0	30.0	0.58	0.118	29.67	0.09	0.23	
MA	29.0	29.0	28.0	0.58	0.118	28.67	-0.25	-0.12	
MF									•
MP	125.0	121.0	122.0	2.08	0.473	122.67	32.31	32.45	×
MQ	25.0	27.0	26.0	1.00	0.236	26.00	-1.18	-1.04	
MV	18.0	17.0	17.0	0.58	0.118	17.33	-4.18	-4.04	×
MY									•
N	31.0	29.0	32.0	1.53	0.354	30.67	0.44	0.58	
NA									•
NH	28.0	28.0	27.0	0.58	0.118	27.67	-0.60	-0.46	
NI									•
NJ	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
NK	28.0	32.0	31.0	2.08	0.473	30.33	0.33	0.46	
NO	32.0	33.0	33.0	0.58	0.118	32.67	1.13	1.27	
NT									•
O	33.0	32.0	33.0	0.58	0.118	32.67	1.13	1.27	
OF									•
OS									•
OX									•
OY									•
OZ	54.0	54.0	54.0	0.00	0.000	54.00	8.52	8.66	×
P	42.0	41.0	42.0	0.58	0.118	41.67	4.25	4.39	×
PA									•
PB	30.0	30.0	30.0	0.00	0.000	30.00	0.21	0.35	
PG									•
PI	29.0	29.0	28.0	0.58	0.118	28.67	-0.25	-0.12	
PM	31.0	33.0	33.0	1.15	0.236	32.33	1.02	1.15	
PQ	30.0	31.0	30.0	0.58	0.118	30.33	0.33	0.46	
PR									•
PV	32.0	35.0	31.0	2.08	0.473	32.67	1.13	1.27	
PW	28.0	27.0	28.0	0.58	0.118	27.67	-0.60	-0.46	
Q	28.0	29.0	28.0	0.58	0.118	28.33	-0.37	-0.23	
QC									•
QJ	31.0	29.0	30.0	1.00	0.236	30.00	0.21	0.35	
QP	29.0	28.0	31.0	1.53	0.354	29.33	-0.02	0.12	
QQ									•
QT	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
QU	28.0	29.0	30.0	1.00	0.236	29.00	-0.14	0.00	
QW	27.0	29.0	30.0	1.53	0.354	28.67	-0.25	-0.12	
QX	35.0	37.0	35.0	1.15	0.236	35.67	2.17	2.31	
QY									•
QZ	28.0	28.0	28.0	0.00	0.000	28.00	-0.48	-0.35	
RD									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF	26.0	26.0	25.0	0.58	0.118	25.67	-1.29	-1.15	
RG									•
RJ									•
RK	26.0	26.0	26.0	0.00	0.000	26.00	-1.18	-1.04	
RP									•
RR	30.0	31.0	31.0	0.58	0.118	30.67	0.44	0.58	
RV	23.0	28.0	30.0	3.61	0.827	27.00	-0.83	-0.69	
RZ	31.0	31.0	31.0	0.00	0.000	31.00	0.56	0.69	
S	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
SC	27.0	30.0	27.0	1.73	0.354	28.00	-0.48	-0.35	
SD	32.0	29.0	30.0	1.53	0.354	30.33	0.33	0.46	
SF	31.0	30.0	34.0	2.08	0.473	31.67	0.79	0.92	
SI	31.0	34.0	31.0	1.73	0.354	32.00	0.90	1.04	
SL									•
SM	27.0	32.0	29.0	2.52	0.591	29.33	-0.02	0.12	
SN	25.0	28.0	25.0	1.73	0.354	26.00	-1.18	-1.04	
SO									•
SR	24.0	27.0	29.0	2.52	0.591	26.67	-0.95	-0.81	
SS	30.0	28.0	30.0	1.15	0.236	29.33	-0.02	0.12	
ST	27.0	28.0	27.0	0.58	0.118	27.33	-0.71	-0.58	
SX	31.0	29.0	31.0	1.15	0.236	30.33	0.33	0.46	
SZ	28.0	28.0	28.0	0.00	0.000	28.00	-0.48	-0.35	
T	28.0	26.0	29.0	1.53	0.354	27.67	-0.60	-0.46	
TD	29.0	31.0	36.0	3.61	0.827	32.00	0.90	1.04	
TE	28.0	29.0	27.0	1.00	0.236	28.00	-0.48	-0.35	
TH	34.0	32.0	29.0	2.52	0.591	31.67	0.79	0.92	
TI	29.0	30.0	29.0	0.58	0.118	29.33	-0.02	0.12	
TL	25.0	26.0	28.0	1.53	0.354	26.33	-1.06	-0.92	
TN									•
TQ	27.0	27.0	28.0	0.58	0.118	27.33	-0.71	-0.58	
TS	33.0	30.0	31.0	1.53	0.354	31.33	0.67	0.81	
TY									•
U	30.0	30.0	28.0	1.15	0.236	29.33	-0.02	0.12	
UA									•
UE	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
UG									•
UK									•
UN	32.0	25.0	24.0	4.36	0.945	27.00	-0.83	-0.69	
UP	28.0	32.0	29.0	2.08	0.473	29.67	0.09	0.23	
UQ									•
UW	29.0	27.0	30.0	1.53	0.354	28.67	-0.25	-0.12	
UY	34.0	30.0	30.0	2.31	0.473	31.33	0.67	0.81	
VA	32.0	30.0	29.0	1.53	0.354	30.33	0.33	0.46	
VC									•

• ≡ No data submitted
Ø ≡ Insufficient data
TAG SYMBOLS
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	30.0	29.0	30.0	0.58	0.118	29.67	0.09	0.23	
VI	29.0	29.0	29.0	0.00	0.000	29.00	-0.14	0.00	
VJ									•
VM	42.0	33.0	31.0	5.86	1.570	35.33	2.06	2.19	
VN									•
VO	25.0	27.0	25.0	1.15	0.236	25.67	-1.29	-1.15	
VQ									•
VT									•
VU									•
W	31.0	28.0	27.0	2.08	0.473	28.67	-0.25	-0.12	
WE									•
WF	38.0	40.0	37.0	1.53	0.354	38.33	3.10	3.23	×
X	30.0	31.0	30.0	0.58	0.118	30.33	0.33	0.46	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
17.33	×	MV	28.00		QZ	29.00		BW
22.00		HI	28.00		EB	29.00		BM
24.00		AZ	28.00		CM	29.00		BL
24.67		AI	28.00		BN	29.33		U
25.00		DZ	28.00		AJ	29.33		TI
25.67		VO	28.33		Q	29.33		SS
25.67		RF	28.33		HL	29.33		SM
26.00		SN	28.33		EL	29.33		QP
26.00		RK	28.33		BC	29.33		LT
26.00		MQ	28.67		W	29.33		L
26.33		TL	28.67		UW	29.33		JE
26.33		K	28.67		QW	29.33		J
26.33		C	28.67		PI	29.33		GI
26.33		A	28.67		MA	29.33		DM
26.67		SR	28.67		CS	29.33		CK
26.67		AL	28.67		CO	29.33		BH
26.67		AH	28.67		AW	29.67		VG
27.00		UN	28.67		AU	29.67		UP
27.00		RV	29.00		VI	29.67		M
27.00		JG	29.00		UE	29.67		LF
27.33		TQ	29.00		S	29.67		KX
27.33		ST	29.00		QU	29.67		HK
27.67		T	29.00		QT	29.67		FL
27.67		PW	29.00		NJ	29.67		BO
27.67		NH	29.00		I	29.67		AK
28.00		TE	29.00		FU	29.67		AF
28.00		SZ	29.00		DT	30.00		QJ
28.00		SC	29.00		CA	30.00		PB

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

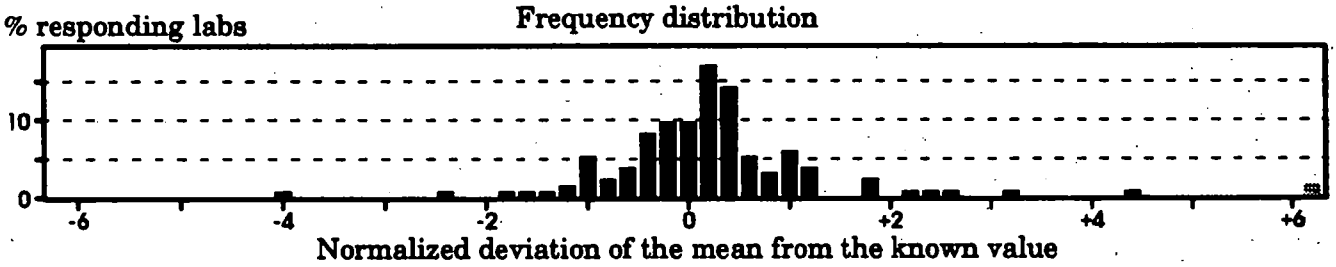
× ≡ Determined to be an outlier

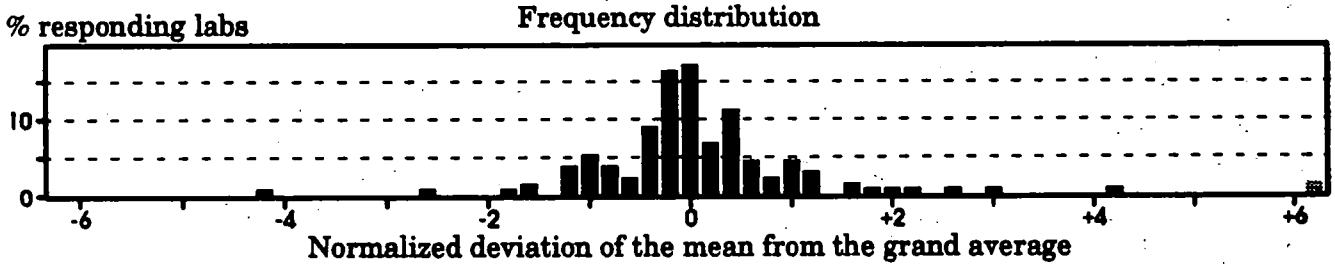
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cobalt-60

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
30.00		HP	30.67		RR	32.00		BK
30.00		GQ	30.67		N	32.00		BB
30.00		FJ	30.67		DL	32.33		PM
30.00		EX	30.67		CX	32.67		PV
30.00		E	30.67		CP	32.67		O
30.00		DG	31.00		RZ	32.67		NO
30.00		DE	31.00		GE	32.67		CE
30.33		X	31.33		UY	34.00		DO
30.33		VA	31.33		TS	34.00		BA
30.33		SX	31.33		IC	34.33		FZ
30.33		SD	31.33		AE	35.33		VM
30.33		PQ	31.67		TH	35.67		QX
30.33		NK	31.67		SF	36.67		JY
30.33		LR	31.67		CJ	38.33	×	WF
30.33		JS	32.00		TD	41.67	×	P
30.33		DD	32.00		SI	54.00	×	OZ
30.33		AP	32.00		CQ	122.67	×	MP





• ≡ No data submitted
∅ ≡ Insufficient data

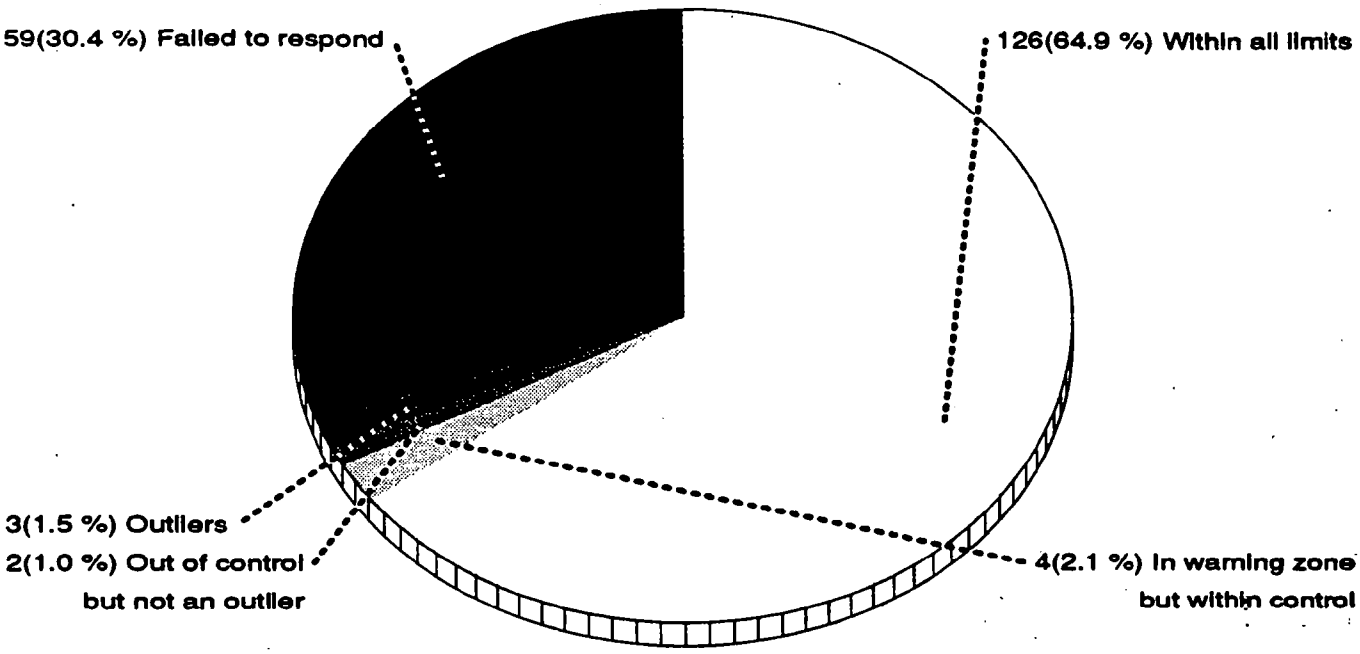
TAG SYMBOLS

× ≡ Determined to be an outlier

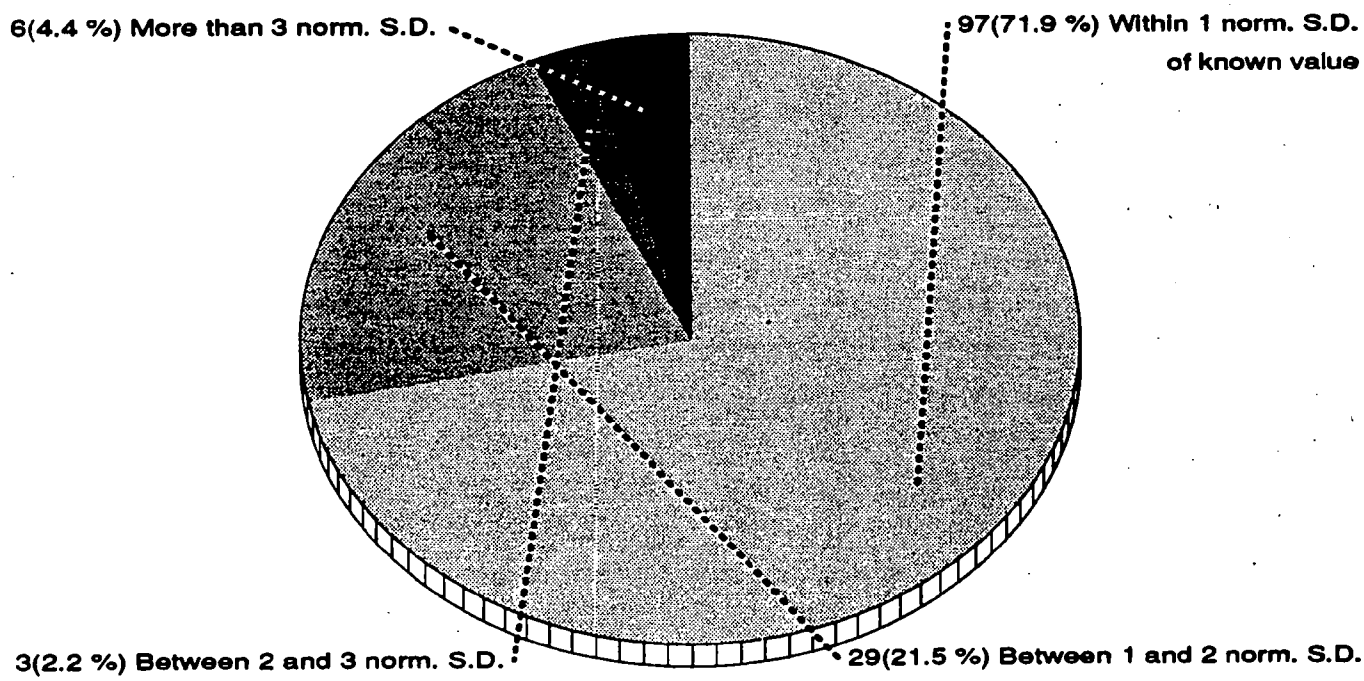
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134 Statistical Summary **194 Participants**

The known value of this nuclide is **20.0 pCi/l** with an expected precision of **5.0**; the control limits are 11.3 to 28.7; the warning regions are 11.3 to 14.2 and 25.8 to 28.7



Statistic	Respondents	Non-outliers
Mean	20.26	**Grand Avg 18.33**
Std. Dev.	17.58	2.38
Variance	309.06	5.68
% Coef. of Var.	86.76	13.00
% deviation of mean from known value	1.31	-8.35
Norm. dev. of mean from known value	0.01	-0.70
Median	18.33	18.17
% deviation of median from known value	-8.33	-9.17
Norm. dev. of median from known value	-0.09	-0.77



Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	16.0	16.0	16.0	0.00	0.000	16.00	-0.81	-1.39	
AE	16.0	18.0	17.0	1.00	0.236	17.00	-0.46	-1.04	
AF	18.0	18.0	18.0	0.00	0.000	18.00	-0.11	-0.69	
AH	17.0	17.0	17.0	0.00	0.000	17.00	-0.46	-1.04	
AI	16.0	17.0	16.0	0.58	0.118	16.33	-0.69	-1.27	
AJ	14.0	17.0	20.0	3.00	0.709	17.00	-0.46	-1.04	
AK	19.0	18.0	20.0	1.00	0.236	19.00	0.23	-0.35	
AL	13.0	20.0	21.0	4.36	0.945	18.00	-0.11	-0.69	
AO									•
AP	20.0	21.0	22.0	1.00	0.236	21.00	0.92	0.35	
AR									•
AU	20.0	18.0	18.0	1.15	0.236	18.67	0.12	-0.46	
AW	19.0	17.0	17.0	1.15	0.236	17.67	-0.23	-0.81	
AZ	22.0	19.0	21.0	1.53	0.354	20.67	0.81	0.23	
BA	20.0	21.0	20.0	0.58	0.118	20.33	0.69	0.12	
BB	20.0	19.0	21.0	1.00	0.236	20.00	0.58	0.00	
BC	18.0	17.0	18.0	0.58	0.118	17.67	-0.23	-0.81	
BG									•
BH	16.0	17.0	16.0	0.58	0.118	16.33	-0.69	-1.27	
BK	21.0	21.0	21.0	0.00	0.000	21.00	0.92	0.35	
BL	19.0	20.0	18.0	1.00	0.236	19.00	0.23	-0.35	
BM	18.0	19.0	18.0	0.58	0.118	18.33	0.00	-0.58	
BN	18.0	18.0	17.0	0.58	0.118	17.67	-0.23	-0.81	
BO	18.0	19.0	19.0	0.58	0.118	18.67	0.12	-0.46	
BS									•
BW	14.0	26.0	12.0	7.57	2.245	17.33	-0.35	-0.92	
C	14.0	15.0	16.0	1.00	0.236	15.00	-1.15	-1.73	
CA	16.0	18.0	18.0	1.15	0.236	17.33	-0.35	-0.92	
CE	18.0	17.0	18.0	0.58	0.118	17.67	-0.23	-0.81	
CG									•
CJ	18.0	22.0	19.0	2.08	0.473	19.67	0.46	-0.12	
CK	20.0	18.0	18.0	1.15	0.236	18.67	0.12	-0.46	
CM	14.0	13.0	12.0	1.00	0.236	13.00	-1.85	-2.42	
CO	20.0	21.0	17.0	2.08	0.473	19.33	0.35	-0.23	
CP	211.0	216.0	214.0	2.52	0.591	213.67	67.67	67.09	×
CQ	17.0	17.0	18.0	0.58	0.118	17.33	-0.35	-0.92	
CS	17.0	20.0	19.0	1.53	0.354	18.67	0.12	-0.46	
CX	24.0	24.0	19.0	2.89	0.591	22.33	1.39	0.81	
D									•
DB									•
DD	20.0	20.0	23.0	1.73	0.354	21.00	0.92	0.35	
DE	20.0	20.0	20.0	0.00	0.000	20.00	0.58	0.00	
DG	17.0	18.0	18.0	0.58	0.118	17.67	-0.23	-0.81	
DJ									•
DL	17.0	18.0	17.0	0.58	0.118	17.33	-0.35	-0.92	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM	18.0	20.0	18.0	1.15	0.236	18.67	0.12	-0.46	
DO	17.0	20.0	16.0	2.08	0.473	17.67	-0.23	-0.81	
DS									•
DT	17.0	20.0	16.0	2.08	0.473	17.67	-0.23	-0.81	
DZ	15.0	14.0	16.0	1.00	0.236	15.00	-1.15	-1.73	
E	19.0	19.0	19.0	0.00	0.000	19.00	0.23	-0.35	
EB	16.0	17.0	16.0	0.58	0.118	16.33	-0.69	-1.27	
EL	18.0	18.0	18.0	0.00	0.000	18.00	-0.11	-0.69	
EO									•
ER									•
EV									•
EX	22.0	21.0	22.0	0.58	0.118	21.67	1.16	0.58	
FF									•
FJ	19.0	19.0	19.0	0.00	0.000	19.00	0.23	-0.35	
FL	19.0	18.0	19.0	0.58	0.118	18.67	0.12	-0.46	
FN									•
FU	19.0	18.0	18.0	0.58	0.118	18.33	0.00	-0.58	
FZ	21.0	20.0	17.0	2.08	0.473	19.33	0.35	-0.23	
GE	17.0	20.0	17.0	1.73	0.354	18.00	-0.11	-0.69	
GI	17.0	17.0	17.0	0.00	0.000	17.00	-0.46	-1.04	
GQ	20.0	20.0	20.0	0.00	0.000	20.00	0.58	0.00	
GT									•
GZ									•
HI	10.0	13.0	10.0	1.73	0.354	11.00	-2.54	-3.12	⇓
HK	18.0	18.0	18.0	0.00	0.000	18.00	-0.11	-0.69	
HL	19.0	18.0	18.0	0.58	0.118	18.33	0.00	-0.58	
HP	19.0	19.0	18.0	0.58	0.118	18.67	0.12	-0.46	
I	18.0	19.0	17.0	1.00	0.236	18.00	-0.11	-0.69	
IC	19.0	21.0	19.0	1.15	0.236	19.67	0.46	-0.12	
ID									•
J	17.0	17.0	17.0	0.00	0.000	17.00	-0.46	-1.04	
JE	17.0	18.0	17.0	0.58	0.118	17.33	-0.35	-0.92	
JG	14.0	15.0	16.0	1.00	0.236	15.00	-1.15	-1.73	
JN									•
JQ									•
JS	19.0	19.0	19.0	0.00	0.000	19.00	0.23	-0.35	
JY	31.0	25.0	21.0	5.03	1.345	25.67	2.54	1.96	
K	18.0	17.0	18.0	0.58	0.118	17.67	-0.23	-0.81	
KE									•
KT									•
KX	18.0	20.0	21.0	1.53	0.354	19.67	0.46	-0.12	
L	19.0	17.0	20.0	1.53	0.354	18.67	0.12	-0.46	
LF	19.0	18.0	19.0	0.58	0.118	18.67	0.12	-0.46	
LG									•
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	32.0	28.0	20.0	6.11	1.795	26.67	2.89	2.31	
LT	20.0	20.0	18.0	1.15	0.236	19.33	0.35	-0.23	
M	17.0	17.0	16.0	0.58	0.118	16.67	-0.58	-1.15	
MA	17.0	16.0	19.0	1.53	0.354	17.33	-0.35	-0.92	
MF									•
MP	74.0	72.0	70.0	2.00	0.473	72.00	18.59	18.01	×
MQ	18.0	19.0	19.0	0.58	0.118	18.67	0.12	-0.46	
MV	9.0	10.0	8.0	1.00	0.236	9.00	-3.23	-3.81	⇓
MY									•
N	20.0	18.0	19.0	1.00	0.236	19.00	0.23	-0.35	
NA									•
NH	17.0	16.0	18.0	1.00	0.236	17.00	-0.46	-1.04	
NI									•
NJ	16.0	20.0	18.0	2.00	0.473	18.00	-0.11	-0.69	
NK	16.0	15.0	13.0	1.53	0.354	14.67	-1.27	-1.85	
NO	21.0	22.0	22.0	0.58	0.118	21.67	1.16	0.58	
NT									•
O	21.0	21.0	21.0	0.00	0.000	21.00	0.92	0.35	
OF									•
OS									•
OX									•
OY									•
OZ	32.0	28.0	30.0	2.00	0.473	30.00	4.04	3.46	×
P	23.0	21.0	21.0	1.15	0.236	21.67	1.16	0.58	
PA									•
PB	20.0	20.0	20.0	0.00	0.000	20.00	0.58	0.00	
PG									•
PI	17.0	17.0	18.0	0.58	0.118	17.33	-0.35	-0.92	
PM	18.0	14.0	23.0	4.51	1.120	18.33	0.00	-0.58	
PQ	18.0	17.0	17.0	0.58	0.118	17.33	-0.35	-0.92	
PR									•
PV	18.0	18.0	25.0	4.04	0.827	20.33	0.69	0.12	
PW	17.0	18.0	18.0	0.58	0.118	17.67	-0.23	-0.81	
Q	17.0	18.0	19.0	1.00	0.236	18.00	-0.11	-0.69	
QC									•
QJ	15.0	17.0	18.0	1.53	0.354	16.67	-0.58	-1.15	
QP	27.0	31.0	28.0	2.08	0.473	28.67	3.58	3.00	
QQ									•
QT	18.0	18.0	18.0	0.00	0.000	18.00	-0.11	-0.69	
QU	13.0	14.0	15.0	1.00	0.236	14.00	-1.50	-2.08	
QW	16.0	13.0	15.0	1.53	0.354	14.67	-1.27	-1.85	
QX	19.0	20.0	19.0	0.58	0.118	19.33	0.35	-0.23	
QY									•
QZ	18.0	16.0	17.0	1.00	0.236	17.00	-0.46	-1.04	
RD									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF	19.0	19.0	19.0	0.00	0.000	19.00	0.23	-0.35	
RG									•
RJ									•
RK	15.0	15.0	15.0	0.00	0.000	15.00	-1.15	-1.73	
RP									•
RR	19.0	17.0	18.0	1.00	0.236	18.00	-0.11	-0.69	
RV	21.0	21.0	22.0	0.58	0.118	21.33	1.04	0.46	
RZ	19.0	19.0	20.0	0.58	0.118	19.33	0.35	-0.23	
S	18.0	18.0	18.0	0.00	0.000	18.00	-0.11	-0.69	
SC	15.0	20.0	20.0	2.89	0.591	18.33	0.00	-0.58	
SD	21.0	22.0	18.0	2.08	0.473	20.33	0.69	0.12	
SF	20.0	17.0	19.0	1.53	0.354	18.67	0.12	-0.46	
SI	20.0	21.0	24.0	2.08	0.473	21.67	1.16	0.58	
SL									•
SM	18.0	19.0	18.0	0.58	0.118	18.33	0.00	-0.58	
SN	16.0	17.0	18.0	1.00	0.236	17.00	-0.46	-1.04	
SO									•
SR	17.0	16.0	18.0	1.00	0.236	17.00	-0.46	-1.04	
SS	18.0	19.0	21.0	1.53	0.354	19.33	0.35	-0.23	
ST	17.0	17.0	17.0	0.00	0.000	17.00	-0.46	-1.04	
SX	16.0	19.0	18.0	1.53	0.354	17.67	-0.23	-0.81	
SZ	17.0	17.0	17.0	0.00	0.000	17.00	-0.46	-1.04	
T	17.0	19.0	18.0	1.00	0.236	18.00	-0.11	-0.69	
TD	20.0	19.0	19.0	0.58	0.118	19.33	0.35	-0.23	
TE	16.0	19.0	18.0	1.53	0.354	17.67	-0.23	-0.81	
TH	18.0	18.0	19.0	0.58	0.118	18.33	0.00	-0.58	
TI	18.0	19.0	19.0	0.58	0.118	18.67	0.12	-0.46	
TL	17.0	18.0	20.0	1.53	0.354	18.33	0.00	-0.58	
TN									•
TQ	16.0	18.0	17.0	1.00	0.236	17.00	-0.46	-1.04	
TS	17.0	18.0	17.0	0.58	0.118	17.33	-0.35	-0.92	
TY									•
U	19.0	18.0	19.0	0.58	0.118	18.67	0.12	-0.46	
UA									•
UE	20.0	18.0	19.0	1.00	0.236	19.00	0.23	-0.35	
UG									•
UK									•
UN	18.0	18.0	19.0	0.58	0.118	18.33	0.00	-0.58	
UP	18.0	15.0	16.0	1.53	0.354	16.33	-0.69	-1.27	
UQ									•
UW	21.0	20.0	20.0	0.58	0.118	20.33	0.69	0.12	
UY	18.0	18.0	17.0	0.58	0.118	17.67	-0.23	-0.81	
VA	18.0	19.0	19.0	0.58	0.118	18.67	0.12	-0.46	
VC									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 18-Apr-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	18.0	18.0	19.0	0.58	0.118	18.33	0.00	-0.58	
VI	17.0	16.0	17.0	0.58	0.118	16.67	-0.58	-1.15	
VJ									•
VM	24.0	22.0	24.0	1.15	0.236	23.33	1.73	1.15	
VN									•
VO	19.0	16.0	17.0	1.53	0.354	17.33	-0.35	-0.92	
VQ									•
VT									•
VU									∅
W	16.0	17.0	16.0	0.58	0.118	16.33	-0.69	-1.27	
WE									•
WF	21.0	21.0	22.0	0.58	0.118	21.33	1.04	0.46	
X	17.0	17.0	18.0	0.58	0.118	17.33	-0.35	-0.92	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.00	⇓	MV	17.00		AJ	18.00		RR
11.00	⇓	HI	17.00		AH	18.00		QT
13.00		CM	17.00		AE	18.00		Q
14.00		QU	17.33		X	18.00		NJ
14.67		QW	17.33		VO	18.00		I
14.67		NK	17.33		TS	18.00		HK
15.00		RK	17.33		PQ	18.00		GE
15.00		JG	17.33		PI	18.00		EL
15.00		DZ	17.33		MA	18.00		AL
15.00		C	17.33		JE	18.00		AF
16.00		A	17.33		DL	18.33		VG
16.33		W	17.33		CQ	18.33		UN
16.33		UP	17.33		CA	18.33		TL
16.33		EB	17.33		BW	18.33		TH
16.33		BH	17.67		UY	18.33		SM
16.33		AI	17.67		TE	18.33		SC
16.67		VI	17.67		SX	18.33		PM
16.67		QJ	17.67		PW	18.33		HL
16.67		M	17.67		K	18.33		FU
17.00		TQ	17.67		DT	18.33		BM
17.00		SZ	17.67		DO	18.67		VA
17.00		ST	17.67		DG	18.67		U
17.00		SR	17.67		CE	18.67		TI
17.00		SN	17.67		BN	18.67		SF
17.00		QZ	17.67		BC	18.67		MQ
17.00		NH	17.67		AW	18.67		LF
17.00		J	18.00		T	18.67		L
17.00		GI	18.00		S	18.67		HP

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

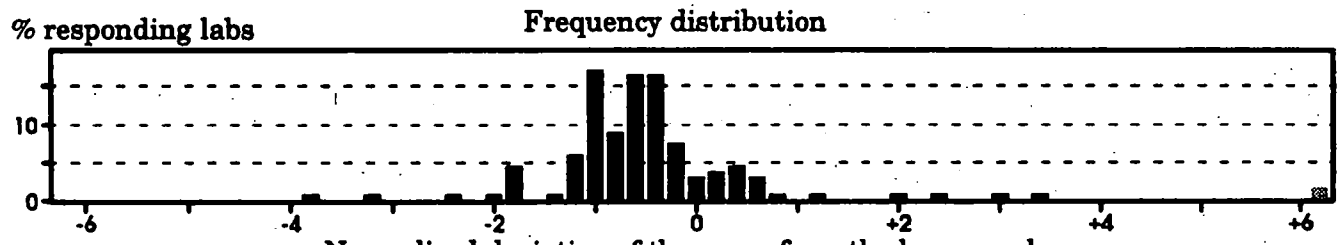
× ≡ Determined to be an outlier

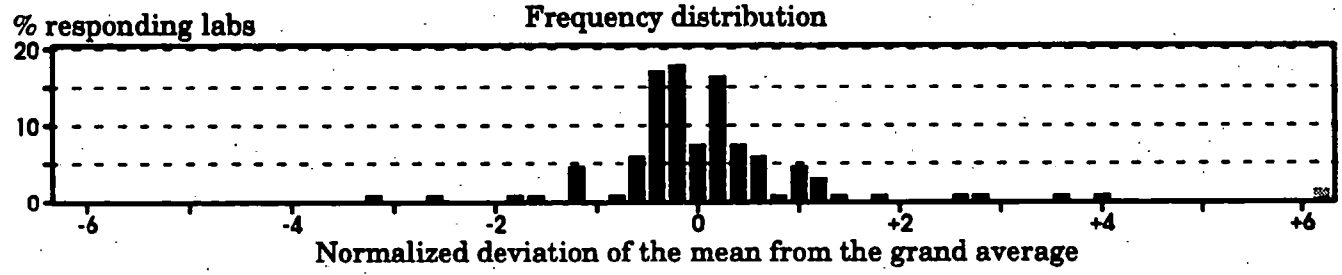
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
18.67		FL	19.33		QX	21.00		DD
18.67		DM	19.33		LT	21.00		BK
18.67		CS	19.33		FZ	21.00		AP
18.67		CK	19.33		CO	21.33		WF
18.67		BO	19.67		KX	21.33		RV
18.67		AU	19.67		IC	21.67		SI
19.00		UE	19.67		CJ	21.67		P
19.00		RF	20.00		PB	21.67		NO
19.00		N	20.00		GQ	21.67		EX
19.00		JS	20.00		DE	22.33		CX
19.00		FJ	20.00		BB	23.33		VM
19.00		E	20.33		UW	25.67		JY
19.00		BL	20.33		SD	26.67		LR
19.00		AK	20.33		PV	28.67		QP
19.33		TD	20.33		BA	30.00	×	OZ
19.33		SS	20.67		AZ	72.00	×	MP
19.33		RZ	21.00		O	213.67	×	CP





• ≡ No data submitted
∅ ≡ Insufficient data

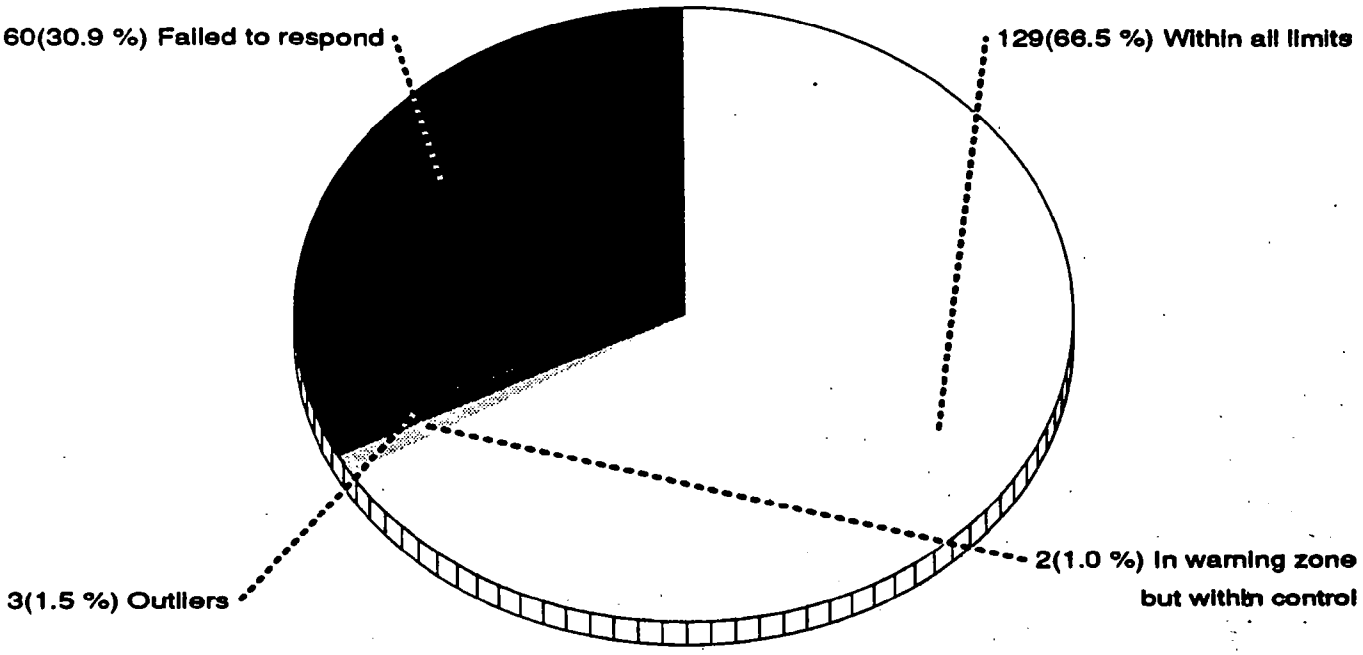
TAG SYMBOLS

× ≡ Determined to be an outlier

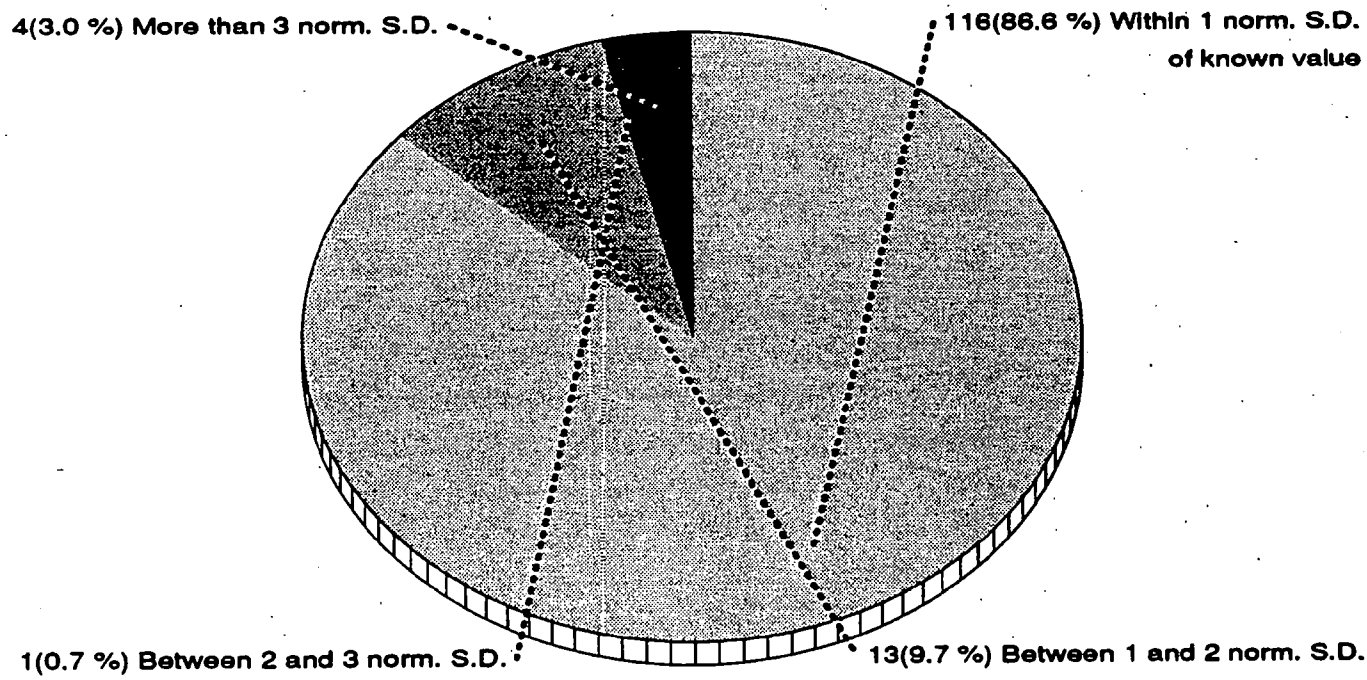
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137 Statistical Summary 194 Participants

The known value of this nuclide is **11.0 pCi/l** with an expected precision of **5.0**; the control limits are 2.3 to 19.7; the warning regions are 2.3 to 5.2 and 16.8 to 19.7



Statistic	Respondents	Non-outliers
Mean	14.07	**Grand Avg 11.78**
Std. Dev.	23.08	1.68
Variance	532.72	2.84
% Coef. of Var.	164.02	14.29
% deviation of mean from known value	27.93	7.12
Norm. dev. of mean from known value	0.13	0.47
Median	11.67	11.67
% deviation of median from known value	6.06	6.06
Norm. dev. of median from known value	0.03	0.40



Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	10.0	10.0	10.0	0.00	0.000	10.00	-0.62	-0.35	
AE	12.0	13.0	10.0	1.53	0.354	11.67	-0.04	0.23	
AF	13.0	11.0	10.0	1.53	0.354	11.33	-0.16	0.12	
AH	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
AI	10.0	11.0	11.0	0.58	0.118	10.67	-0.39	-0.12	
AJ	12.0	12.0	12.0	0.00	0.000	12.00	0.07	0.35	
AK	12.0	11.0	13.0	1.00	0.236	12.00	0.07	0.35	
AL	17.0	17.0	11.0	3.46	0.709	15.00	1.11	1.39	
AO									•
AP	15.0	12.0	9.0	3.00	0.709	12.00	0.07	0.35	
AR									•
AU	11.0	13.0	13.0	1.15	0.236	12.33	0.19	0.46	
AW	12.0	13.0	13.0	0.58	0.118	12.67	0.31	0.58	
AZ	16.0	11.0	12.0	2.65	0.591	13.00	0.42	0.69	
BA	5.0	6.0	8.0	1.53	0.354	6.33	-1.89	-1.62	
BB	11.0	11.0	12.0	0.58	0.118	11.33	-0.16	0.12	
BC	12.0	12.0	12.0	0.00	0.000	12.00	0.07	0.35	
BG									•
BH	14.0	14.0	12.0	1.15	0.236	13.33	0.54	0.81	
BK	13.0	14.0	14.0	0.58	0.118	13.67	0.65	0.92	
BL	12.0	12.0	13.0	0.58	0.118	12.33	0.19	0.46	
BM	13.0	12.0	12.0	0.58	0.118	12.33	0.19	0.46	
BN	13.0	12.0	12.0	0.58	0.118	12.33	0.19	0.46	
BO	9.0	11.0	13.0	2.00	0.473	11.00	-0.27	0.00	
BS									•
BW	10.0	17.0	12.0	3.61	0.827	13.00	0.42	0.69	
C	10.0	10.0	10.0	0.00	0.000	10.00	-0.62	-0.35	
CA	10.0	11.0	12.0	1.00	0.236	11.00	-0.27	0.00	
CE	10.0	13.0	12.0	1.53	0.354	11.67	-0.04	0.23	
CG									•
CJ	12.0	13.0	10.0	1.53	0.354	11.67	-0.04	0.23	
CK	15.0	15.0	12.0	1.73	0.354	14.00	0.77	1.04	
CM	19.0	18.0	18.0	0.58	0.118	18.33	2.27	2.54	
CO	12.0	10.0	11.0	1.00	0.236	11.00	-0.27	0.00	
CP	275.0	278.0	276.0	1.53	0.354	276.33	91.64	91.91	x
CQ	12.0	13.0	14.0	1.00	0.236	13.00	0.42	0.69	
CS	11.0	10.0	10.0	0.58	0.118	10.33	-0.50	-0.23	
CX	12.0	15.0	14.0	1.53	0.354	13.67	0.65	0.92	
D									•
DB									•
DD	13.0	12.0	13.0	0.58	0.118	12.67	0.31	0.58	
DE	12.0	12.0	12.0	0.00	0.000	12.00	0.07	0.35	
DG	13.0	15.0	16.0	1.53	0.354	14.67	1.00	1.27	
DJ									•
DL	9.0	12.0	11.0	1.53	0.354	10.67	-0.39	-0.12	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	10.0	12.0	11.0	1.00	0.236	11.00	-0.27	0.00	
DO	10.0	10.0	7.0	1.73	0.354	9.00	-0.96	-0.69	
DS									•
DT	10.0	13.0	10.0	1.73	0.354	11.00	-0.27	0.00	
DZ	14.0	14.0	14.0	0.00	0.000	14.00	0.77	1.04	
E	14.0	13.0	9.0	2.65	0.591	12.00	0.07	0.35	
EB	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
EL	11.0	12.0	14.0	1.53	0.354	12.33	0.19	0.46	
EO									•
ER									•
EV									•
EX	14.0	12.0	12.0	1.15	0.236	12.67	0.31	0.58	
FF									•
FJ	11.0	12.0	14.0	1.53	0.354	12.33	0.19	0.46	
FL	12.0	12.0	12.0	0.00	0.000	12.00	0.07	0.35	
FN									•
FU	12.0	12.0	12.0	0.00	0.000	12.00	0.07	0.35	
FZ	14.0	18.0	16.0	2.00	0.473	16.00	1.46	1.73	
GE	12.0	12.0	11.0	0.58	0.118	11.67	-0.04	0.23	
GI	11.0	11.0	12.0	0.58	0.118	11.33	-0.16	0.12	
GQ	12.0	12.0	12.0	0.00	0.000	12.00	0.07	0.35	
GT									•
GZ									•
HI	10.0	7.0	12.0	2.52	0.591	9.67	-0.73	-0.46	
HK	12.0	12.0	11.0	0.58	0.118	11.67	-0.04	0.23	
HL	14.0	13.0	13.0	0.58	0.118	13.33	0.54	0.81	
HP	12.0	13.0	13.0	0.58	0.118	12.67	0.31	0.58	
I	12.0	14.0	13.0	1.00	0.236	13.00	0.42	0.69	
IC	12.0	11.0	11.0	0.58	0.118	11.33	-0.16	0.12	
ID									•
J	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
JE	11.0	11.0	12.0	0.58	0.118	11.33	-0.16	0.12	
JG	12.0	9.0	11.0	1.53	0.354	10.67	-0.39	-0.12	
JN									•
JQ									•
JS	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
JY									•
K	10.0	10.0	11.0	0.58	0.118	10.33	-0.50	-0.23	
KE									•
KT									•
KX	11.0	11.0	12.0	0.58	0.118	11.33	-0.16	0.12	
L	13.0	14.0	11.0	1.53	0.354	12.67	0.31	0.58	
LF	11.0	10.0	9.0	1.00	0.236	10.00	-0.62	-0.35	
LG									•
LL									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	12.0	12.0	10.0	1.15	0.236	11.33	-0.16	0.12	
LT	13.0	11.0	13.0	1.15	0.236	12.33	0.19	0.46	
M	10.0	11.0	11.0	0.58	0.118	10.67	-0.39	-0.12	
MA	12.0	11.0	11.0	0.58	0.118	11.33	-0.16	0.12	
MF									•
MP	47.0	42.0	47.0	2.89	0.591	45.33	11.62	11.89	×
MQ	13.0	12.0	11.0	1.00	0.236	12.00	0.07	0.35	
MV	9.0	7.0	6.0	1.53	0.354	7.33	-1.54	-1.27	
MY									•
N	11.0	12.0	13.0	1.00	0.236	12.00	0.07	0.35	
NA									•
NH	12.0	12.0	11.0	0.58	0.118	11.67	-0.04	0.23	
NI									•
NJ	10.0	10.0	10.0	0.00	0.000	10.00	-0.62	-0.35	
NK	10.0	11.0	9.0	1.00	0.236	10.00	-0.62	-0.35	
NO	11.0	11.0	12.0	0.58	0.118	11.33	-0.16	0.12	
NT									•
O	13.0	13.0	13.0	0.00	0.000	13.00	0.42	0.69	
OF									•
OS									•
OX									•
OY									•
OZ	22.0	20.0	19.0	1.53	0.354	20.33	2.96	3.23	×
P	15.0	13.0	14.0	1.00	0.236	14.00	0.77	1.04	
PA									•
PB	10.0	10.0	10.0	0.00	0.000	10.00	-0.62	-0.35	
PG									•
PI	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
PM	14.0	16.0	12.0	2.00	0.473	14.00	0.77	1.04	
PQ	10.0	11.0	10.0	0.58	0.118	10.33	-0.50	-0.23	
PR									•
PV	8.0	11.0	12.0	2.08	0.473	10.33	-0.50	-0.23	
PW	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
Q	11.0	12.0	12.0	0.58	0.118	11.67	-0.04	0.23	
QC									•
QJ	12.0	16.0	15.0	2.08	0.473	14.33	0.88	1.15	
QP	16.0	21.0	22.0	3.21	0.709	19.67	2.73	3.00	
QQ									•
QT	11.0	10.0	11.0	0.58	0.118	10.67	-0.39	-0.12	
QU	11.0	10.0	12.0	1.00	0.236	11.00	-0.27	0.00	
QW	9.0	10.0	12.0	1.53	0.354	10.33	-0.50	-0.23	
QX	15.0	14.0	15.0	0.58	0.118	14.67	1.00	1.27	
QY									•
QZ	10.0	10.0	11.0	0.58	0.118	10.33	-0.50	-0.23	
RD									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE									•
RF	11.0	11.0	9.0	1.15	0.236	10.33	-0.50	-0.23	
RG									•
RJ									•
RK	10.0	10.0	10.0	0.00	0.000	10.00	-0.62	-0.35	
RP									•
RR	12.0	11.0	13.0	1.00	0.236	12.00	0.07	0.35	
RV	14.0	12.0	10.0	2.00	0.473	12.00	0.07	0.35	
RZ	11.0	12.0	12.0	0.58	0.118	11.67	-0.04	0.23	
S	12.0	11.0	12.0	0.58	0.118	11.67	-0.04	0.23	
SC	11.0	9.0	10.0	1.00	0.236	10.00	-0.62	-0.35	
SD	12.0	13.0	16.0	2.08	0.473	13.67	0.65	0.92	
SF	10.0	13.0	14.0	2.08	0.473	12.33	0.19	0.46	
SI	13.0	13.0	9.0	2.31	0.473	11.67	-0.04	0.23	
SL									•
SM	13.0	12.0	11.0	1.00	0.236	12.00	0.07	0.35	
SN	12.0	11.0	10.0	1.00	0.236	11.00	-0.27	0.00	
SO									•
SR	15.0	9.0	13.0	3.06	0.709	12.33	0.19	0.46	
SS	14.0	15.0	14.0	0.58	0.118	14.33	0.88	1.15	
ST	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
SX	12.0	10.0	10.0	1.15	0.236	10.67	-0.39	-0.12	
SZ	12.0	11.0	12.0	0.58	0.118	11.67	-0.04	0.23	
T	10.0	10.0	12.0	1.15	0.236	10.67	-0.39	-0.12	
TD	12.0	14.0	13.0	1.00	0.236	13.00	0.42	0.69	
TE	11.0	11.0	11.0	0.00	0.000	11.00	-0.27	0.00	
TH	12.0	11.0	12.0	0.58	0.118	11.67	-0.04	0.23	
TI	11.0	11.0	13.0	1.15	0.236	11.67	-0.04	0.23	
TL	8.0	8.0	13.0	2.89	0.591	9.67	-0.73	-0.46	
TN									•
TQ	11.0	12.0	13.0	1.00	0.236	12.00	0.07	0.35	
TS	8.0	10.0	10.0	1.15	0.236	9.33	-0.85	-0.58	
TY									•
U	12.0	12.0	10.0	1.15	0.236	11.33	-0.16	0.12	
UA									•
UE	12.0	11.0	11.0	0.58	0.118	11.33	-0.16	0.12	
UG									•
UK									•
UN	12.0	12.0	13.0	0.58	0.118	12.33	0.19	0.46	
UP	11.0	11.0	10.0	0.58	0.118	10.67	-0.39	-0.12	
UQ									•
UW	10.0	10.0	10.0	0.00	0.000	10.00	-0.62	-0.35	
UY	12.0	13.0	14.0	1.00	0.236	13.00	0.42	0.69	
VA	11.0	12.0	11.0	0.58	0.118	11.33	-0.16	0.12	
VC									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VG	10.0	11.0	10.0	0.58	0.118	10.33	-0.50	-0.23	
VI	13.0	11.0	13.0	1.15	0.236	12.33	0.19	0.46	
VJ									•
VM	11.0	13.0	12.0	1.00	0.236	12.00	0.07	0.35	
VN									•
VO	13.0	13.0	11.0	1.15	0.236	12.33	0.19	0.46	
VQ									•
VT									•
VU									•
W	11.0	11.0	9.0	1.15	0.236	10.33	-0.50	-0.23	
WE									•
WF	15.0	14.0	16.0	1.00	0.236	15.00	1.11	1.39	
X	10.0	11.0	13.0	1.53	0.354	11.33	-0.16	0.12	
Z									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.33		BA	10.67		M	11.33		IC
7.33		MV	10.67		JG	11.33		GI
9.00		DO	10.67		DL	11.33		BB
9.33		TS	10.67		AI	11.33		AF
9.67		TL	11.00		TE	11.67		TI
9.67		HI	11.00		ST	11.67		TH
10.00		UW	11.00		SN	11.67		SZ
10.00		SC	11.00		QU	11.67		SI
10.00		RK	11.00		PW	11.67		S
10.00		PB	11.00		PI	11.67		RZ
10.00		NK	11.00		JS	11.67		Q
10.00		NJ	11.00		J	11.67		NH
10.00		LF	11.00		EB	11.67		HK
10.00		C	11.00		DT	11.67		GE
10.00		A	11.00		DM	11.67		CJ
10.33		W	11.00		CO	11.67		CE
10.33		VG	11.00		CA	11.67		AE
10.33		RF	11.00		BO	12.00		VM
10.33		QZ	11.00		AH	12.00		TQ
10.33		QW	11.33		X	12.00		SM
10.33		PV	11.33		VA	12.00		RV
10.33		PQ	11.33		UE	12.00		RR
10.33		K	11.33		U	12.00		N
10.33		CS	11.33		NO	12.00		MQ
10.67		UP	11.33		MA	12.00		GQ
10.67		T	11.33		LR	12.00		FU
10.67		SX	11.33		KX	12.00		FL
10.67		QT	11.33		JE	12.00		E

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

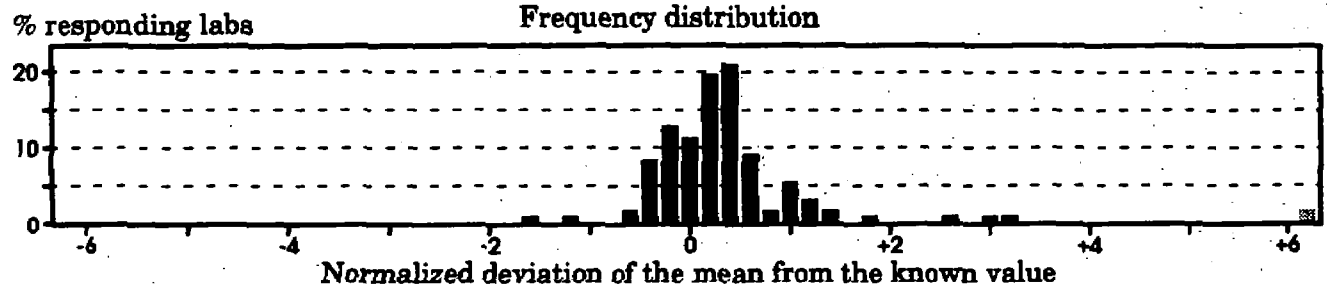
× ≡ Determined to be an outlier

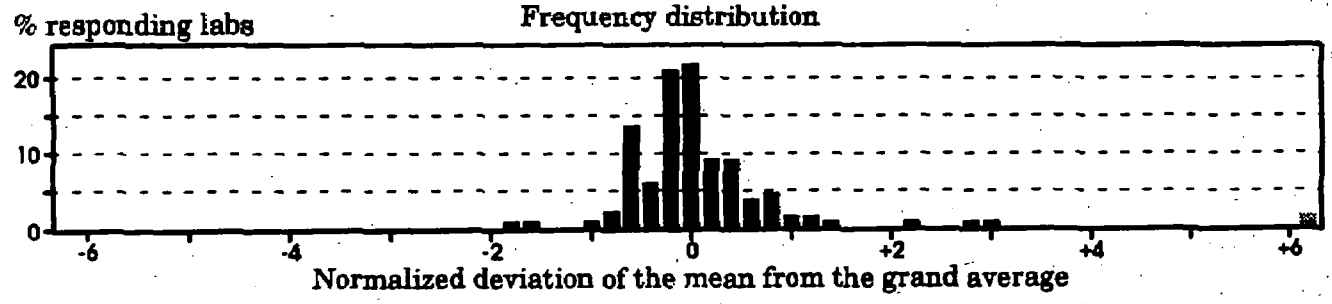
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
12.00		DE	12.33		AU	13.67		BK
12.00		BC	12.67		L	14.00		PM
12.00		AP	12.67		HP	14.00		P
12.00		AK	12.67		EX	14.00		DZ
12.00		AJ	12.67		DD	14.00		CK
12.33		VO	12.67		AW	14.33		SS
12.33		VI	13.00		UY	14.33		QJ
12.33		UN	13.00		TD	14.67		QX
12.33		SR	13.00		O	14.67		DG
12.33		SF	13.00		I	15.00		WF
12.33		LT	13.00		CQ	15.00		AL
12.33		FJ	13.00		BW	16.00		FZ
12.33		EL	13.00		AZ	18.33		CM
12.33		BN	13.33		HL	19.67		QP
12.33		BM	13.33		BH	20.33	×	OZ
12.33		BL	13.67		SD	45.33	×	MP
			13.67		CX	276.33	×	CP





• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-96/011
February 1996

EPA

Gamma in Water Performance Evaluation Study

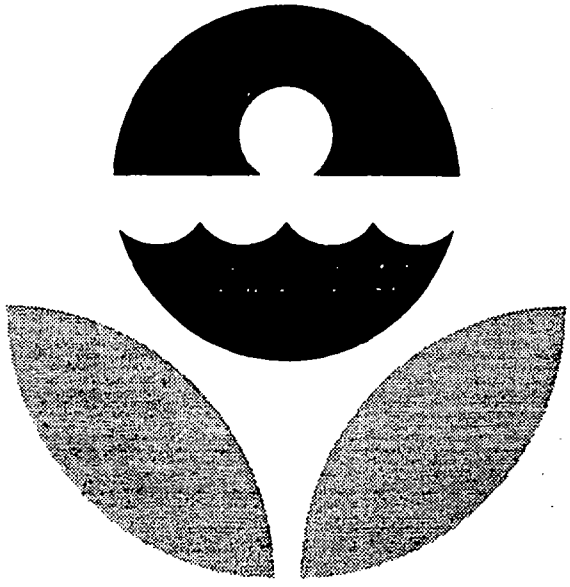
A Statistical Evaluation of the June 9, 1995 Data

023RSL96 cov-011

Gamma in Water

Performance Evaluation Study

June 9, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Analytical Sciences Branch (CRD-LV) Performance Evaluation Study for ***Gamma in Water; June 9, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivit Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subjected to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

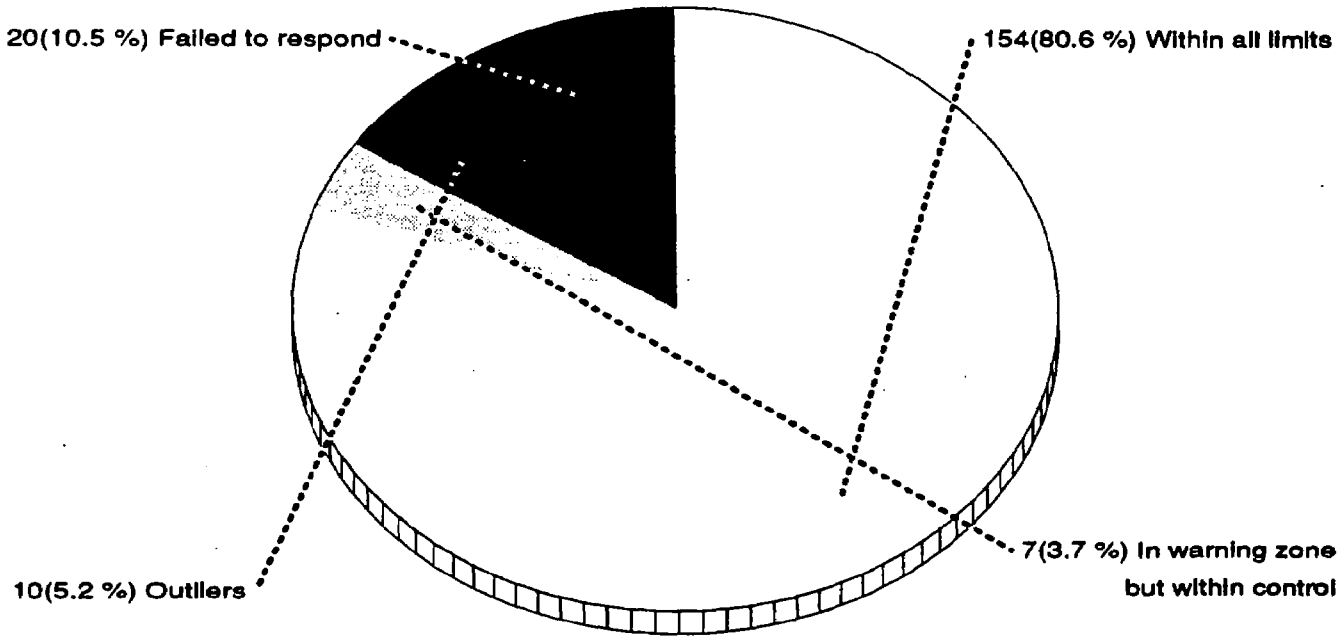
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

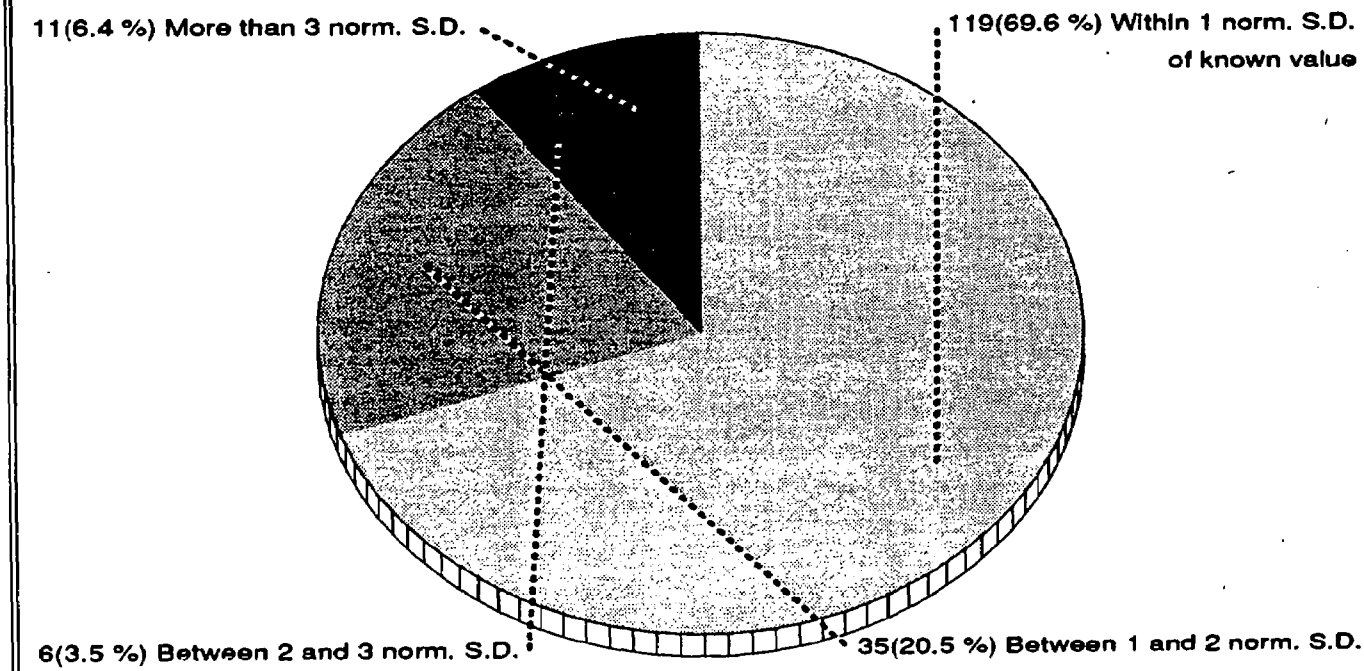
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa. CRD-LV. 702/798-2141

Cobalt-60 Statistical Summary 191 Participants

The known value of this nuclide is **40.0 pCi/l** with an expected precision of **5.0**; the control limits are 31.3 to 48.7; the warning regions are 31.3 to 34.2 and 45.8 to 48.7



Statistic	Respondents	Non-outliers
Mean	41.91	**Grand Avg** 39.71
Std. Dev.	23.58	2.52
Variance	555.84	6.33
% Coef. of Var.	56.25	6.34
% deviation of mean from known value	4.78	-0.71
Norm. dev. of mean from known value	0.08	-0.11
Median	39.67	39.67
% deviation of median from known value	-0.83	-0.83
Norm. dev. of median from known value	-0.01	-0.13



CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	34.0	36.0	37.0	1.53	0.354	35.67	-1.40	-1.50	
AE	40.0	42.0	39.0	1.53	0.354	40.33	0.21	0.12	
AF	37.0	40.0	42.0	2.52	0.591	39.67	-0.02	-0.12	
AH	35.0	36.0	34.0	1.00	0.236	35.00	-1.63	-1.73	
AI	32.0	38.0	35.0	3.00	0.709	35.00	-1.63	-1.73	
AJ	39.0	40.0	39.0	0.58	0.118	39.33	-0.13	-0.23	
AK	39.0	36.0	40.0	2.08	0.473	38.33	-0.48	-0.58	
AL	45.0	42.0	45.0	1.73	0.354	44.00	1.48	1.39	
AN	36.0	38.0	36.0	1.15	0.236	36.67	-1.06	-1.15	
AP	40.0	41.0	40.0	0.58	0.118	40.33	0.21	0.12	
AU	43.0	42.0	37.0	3.21	0.709	40.67	0.33	0.23	
AW	42.0	39.0	36.0	3.00	0.709	39.00	-0.25	-0.35	
AY	38.0	36.0	37.0	1.00	0.236	37.00	-0.94	-1.04	
AZ	47.0	34.0	36.0	7.00	2.020	39.00	-0.25	-0.35	
BA	44.0	40.0	40.0	2.31	0.473	41.33	0.56	0.46	
BB	41.0	41.0	41.0	0.00	0.000	41.00	0.45	0.35	
BC	38.0	38.0	38.0	0.00	0.000	38.00	-0.59	-0.69	
BG	49.0	82.0	71.0	16.80	6.521	67.33	9.57	9.47	×
BH	44.0	42.0	43.0	1.00	0.236	43.00	1.14	1.04	
BI	41.0	42.0	37.0	2.65	0.591	40.00	0.10	0.00	
BK	43.0	44.0	44.0	0.58	0.118	43.67	1.37	1.27	
BL	40.0	41.0	38.0	1.53	0.354	39.67	-0.02	-0.12	
BM	38.0	39.0	39.0	0.58	0.118	38.67	-0.36	-0.46	
BN									•
BO	39.0	40.0	40.0	0.58	0.118	39.67	-0.02	-0.12	
BW	31.0	26.0	28.0	2.52	0.591	28.33	-3.94	-4.04	×
C	40.0	43.0	41.0	1.53	0.354	41.33	0.56	0.46	
CA	40.0	39.0	44.0	2.65	0.591	41.00	0.45	0.35	
CC	41.0	40.0	40.0	0.58	0.118	40.33	0.21	0.12	
CE	44.0	44.0	44.0	0.00	0.000	44.00	1.48	1.39	
CG									•
CJ	40.0	45.0	42.0	2.52	0.591	42.33	0.91	0.81	
CK	43.0	38.0	34.0	4.51	1.120	38.33	-0.48	-0.58	
CM	44.0	40.0	44.0	2.31	0.473	42.67	1.02	0.92	
CO	43.0	42.0	43.0	0.58	0.118	42.67	1.02	0.92	
CP	42.0	41.0	42.0	0.58	0.118	41.67	0.68	0.58	
CQ	40.0	41.0	42.0	1.00	0.236	41.00	0.45	0.35	
CS	40.0	36.0	39.0	2.08	0.473	38.33	-0.48	-0.58	
CX	43.0	41.0	40.0	1.53	0.354	41.33	0.56	0.46	
D	38.0	40.0	41.0	1.53	0.354	39.67	-0.02	-0.12	
DD	40.0	38.0	37.0	1.53	0.354	38.33	-0.48	-0.58	
DE	40.0	40.0	40.0	0.00	0.000	40.00	0.10	0.00	
DG	38.0	39.0	39.0	0.58	0.118	38.67	-0.36	-0.46	
DH	40.0	39.0	39.0	0.58	0.118	39.33	-0.13	-0.23	
DL	39.0	39.0	41.0	1.15	0.236	39.67	-0.02	-0.12	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	38.0	39.0	42.0	2.08	0.473	39.67	-0.02	-0.12	
DO	40.0	41.0	38.0	1.53	0.354	39.67	-0.02	-0.12	
DT	44.0	39.0	38.0	3.21	0.709	40.33	0.21	0.12	
DZ	40.0	39.0	42.0	1.53	0.354	40.33	0.21	0.12	
E	40.0	40.0	40.0	0.00	0.000	40.00	0.10	0.00	
EA	39.0	39.0	40.0	0.58	0.118	39.33	-0.13	-0.23	
EB	38.0	38.0	38.0	0.00	0.000	38.00	-0.59	-0.69	
EL	39.0	37.0	40.0	1.53	0.354	38.67	-0.36	-0.46	
EN									•
EW	39.0	37.0	43.0	3.06	0.709	39.67	-0.02	-0.12	
EX	38.0	44.0	35.0	4.58	1.120	39.00	-0.25	-0.35	
EZ	40.0	41.0	43.0	1.53	0.354	41.33	0.56	0.46	
FJ	39.0	41.0	40.0	1.00	0.236	40.00	0.10	0.00	
FK									•
FL	40.0	40.0	40.0	0.00	0.000	40.00	0.10	0.00	
FU	42.0	39.0	39.0	1.73	0.354	40.00	0.10	0.00	
FZ	20.0	25.0	18.0	3.61	0.827	21.00	-6.48	-6.58	×
GE	37.0	39.0	41.0	2.00	0.473	39.00	-0.25	-0.35	
GI	38.0	39.0	40.0	1.00	0.236	39.00	-0.25	-0.35	
GL	40.0	40.0	39.0	0.58	0.118	39.67	-0.02	-0.12	
GQ	44.0	43.0	42.0	1.00	0.236	43.00	1.14	1.04	
HI	47.0	49.0	53.0	3.06	0.709	49.67	3.45	3.35	×
HJ	46.0	46.0	40.0	3.46	0.709	44.00	1.48	1.39	
HK	40.0	39.0	41.0	1.00	0.236	40.00	0.10	0.00	
HL	39.0	39.0	39.0	0.00	0.000	39.00	-0.25	-0.35	
HP	38.0	39.0	38.0	0.58	0.118	38.33	-0.48	-0.58	
HX	42.0	42.0	38.0	2.31	0.473	40.67	0.33	0.23	
I	44.0	43.0	38.0	3.21	0.709	41.67	0.68	0.58	
IC	38.0	40.0	39.0	1.00	0.236	39.00	-0.25	-0.35	
J	41.0	41.0	40.0	0.58	0.118	40.67	0.33	0.23	
JE	40.0	41.0	38.0	1.53	0.354	39.67	-0.02	-0.12	
JG	41.0	37.0	38.0	2.08	0.473	38.67	-0.36	-0.46	
JI	36.0	37.0	35.0	1.00	0.236	36.00	-1.29	-1.39	
JS	40.0	40.0	40.0	0.00	0.000	40.00	0.10	0.00	
JY	340.0	345.0	340.0	2.89	0.591	341.67	104.60	104.50	×
K	31.0	38.0	33.0	3.61	0.827	34.00	-1.98	-2.08	
KH	40.0	41.0	41.0	0.58	0.118	40.67	0.33	0.23	
KL	38.0	37.0	37.0	0.58	0.118	37.33	-0.82	-0.92	
KX	39.0	40.0	38.0	1.00	0.236	39.00	-0.25	-0.35	
L	44.0	44.0	45.0	0.58	0.118	44.33	1.60	1.50	
LE	40.0	34.0	40.0	3.46	0.709	38.00	-0.59	-0.69	
LF	42.0	40.0	39.0	1.53	0.354	40.33	0.21	0.12	
LR	40.0	43.0	37.0	3.00	0.709	40.00	0.10	0.00	
LT	40.0	40.0	40.0	0.00	0.000	40.00	0.10	0.00	
M	38.0	36.0	39.0	1.53	0.354	37.67	-0.71	-0.81	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
MA									•
ML	49.0	52.0	45.0	3.51	0.827	48.67	3.10	3.00	
MP	41.0	42.0	41.0	0.58	0.118	41.33	0.56	0.46	
MQ	41.0	41.0	34.0	4.04	0.827	38.67	-0.36	-0.46	
MV	44.0	46.0	48.0	2.00	0.473	46.00	2.18	2.08	
MY									•
N	43.0	41.0	42.0	1.00	0.236	42.00	0.79	0.69	
NH	36.0	37.0	37.0	0.58	0.118	36.67	-1.06	-1.15	
NJ	37.0	39.0	38.0	1.00	0.236	38.00	-0.59	-0.69	
NK	25.0	35.0	30.0	5.00	1.345	30.00	-3.37	-3.46	×
NO	35.0	36.0	36.0	0.58	0.118	35.67	-1.40	-1.50	
NP	40.0	42.0	38.0	2.00	0.473	40.00	0.10	0.00	
NZ	55.0	37.0	51.0	9.45	3.146	47.67	2.75	2.66	
O	44.0	44.0	44.0	0.00	0.000	44.00	1.48	1.39	
OA	37.0	38.0	38.0	0.58	0.118	37.67	-0.71	-0.81	
OB	37.0	35.0	40.0	2.52	0.591	37.33	-0.82	-0.92	
OK	36.0	37.0	38.0	1.00	0.236	37.00	-0.94	-1.04	
OL	44.0	49.0	36.0	6.56	2.020	43.00	1.14	1.04	
OM	38.0	38.0	38.0	0.00	0.000	38.00	-0.59	-0.69	
OZ	42.0	41.0	42.0	0.58	0.118	41.67	0.68	0.58	
P	52.0	51.0	55.0	2.08	0.473	52.67	4.49	4.39	×
PB	39.0	40.0	41.0	1.00	0.236	40.00	0.10	0.00	
PE									•
PI	39.0	39.0	38.0	0.58	0.118	38.67	-0.36	-0.46	
PM	42.0	50.0	46.0	4.00	0.945	46.00	2.18	2.08	
PQ	34.0	36.0	40.0	3.06	0.709	36.67	-1.06	-1.15	
PU									•
PV	40.0	36.0	40.0	2.31	0.473	38.67	-0.36	-0.46	
PW	37.0	38.0	39.0	1.00	0.236	38.00	-0.59	-0.69	
Q	38.0	37.0	39.0	1.00	0.236	38.00	-0.59	-0.69	
QJ									•
QP	39.0	38.0	38.0	0.58	0.118	38.33	-0.48	-0.58	
QT	36.0	37.0	38.0	1.00	0.236	37.00	-0.94	-1.04	
QU	35.0	36.0	34.0	1.00	0.236	35.00	-1.63	-1.73	
QW	33.0	34.0	35.0	1.00	0.236	34.00	-1.98	-2.08	
QX	43.0	45.0	45.0	1.15	0.236	44.33	1.60	1.50	
QZ	37.0	37.0	40.0	1.73	0.354	38.00	-0.59	-0.69	
R	40.0	38.0	39.0	1.00	0.236	39.00	-0.25	-0.35	
RF	35.0	37.0	37.0	1.15	0.236	36.33	-1.17	-1.27	
RH	33.0	37.0	36.0	2.08	0.473	35.33	-1.52	-1.62	
RL									•
RO	39.0	40.0	40.0	0.58	0.118	39.67	-0.02	-0.12	
RR	41.0	39.0	40.0	1.00	0.236	40.00	0.10	0.00	
RU	42.0	45.0	38.0	3.51	0.827	41.67	0.68	0.58	
RV	43.0	39.0	37.0	3.06	0.709	39.67	-0.02	-0.12	

• ≡ No data submitted | **TAG SYMBOLS** | ⇑ ≡ Above control limit

∅ ≡ Insufficient data | × ≡ Determined to be an outlier | ⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RX									•
RZ	39.0	37.0	37.0	1.15	0.236	37.67	-0.71	-0.81	
S	39.0	40.0	38.0	1.00	0.236	39.00	-0.25	-0.35	
SC	39.0	34.0	38.0	2.65	0.591	37.00	-0.94	-1.04	
SD	38.0	40.0	43.0	2.52	0.591	40.33	0.21	0.12	
SF	41.0	40.0	40.0	0.58	0.118	40.33	0.21	0.12	
SI	41.0	44.0	44.0	1.73	0.354	43.00	1.14	1.04	
SM	42.0	41.0	43.0	1.00	0.236	42.00	0.79	0.69	
SN	38.0	43.0	41.0	2.52	0.591	40.67	0.33	0.23	
SR	39.0	38.0	37.0	1.00	0.236	38.00	-0.59	-0.69	
SS	39.0	39.0	38.0	0.58	0.118	38.67	-0.36	-0.46	
ST									•
SV	47.0	52.0	51.0	2.65	0.591	50.00	3.56	3.46	×
SX	41.0	42.0	43.0	1.00	0.236	42.00	0.79	0.69	
SZ	37.0	40.0	38.0	1.53	0.354	38.33	-0.48	-0.58	
T	37.0	36.0	37.0	0.58	0.118	36.67	-1.06	-1.15	
TB	64.0	58.0	63.0	3.21	0.709	61.67	7.60	7.51	×
TC	33.0	39.0	42.0	4.58	1.120	38.00	-0.59	-0.69	
TD	39.0	43.0	40.0	2.08	0.473	40.67	0.33	0.23	
TE									•
TH	38.0	35.0	38.0	1.73	0.354	37.00	-0.94	-1.04	
TI	41.0	39.0	40.0	1.00	0.236	40.00	0.10	0.00	
TL	34.0	37.0	44.0	5.13	1.345	38.33	-0.48	-0.58	
TO	42.0	39.0	39.0	1.73	0.354	40.00	0.10	0.00	
TQ	34.0	38.0	40.0	3.06	0.709	37.33	-0.82	-0.92	
TR	70.0	71.0	70.0	0.58	0.118	70.33	10.61	10.51	×
TS	41.0	40.0	39.0	1.00	0.236	40.00	0.10	0.00	
U	40.0	41.0	41.0	0.58	0.118	40.67	0.33	0.23	
UE	41.0	41.0	39.0	1.15	0.236	40.33	0.21	0.12	
UM									•
UN	46.0	43.0	38.0	4.04	0.945	42.33	0.91	0.81	
UP	40.0	41.0	40.0	0.58	0.118	40.33	0.21	0.12	
UR	45.0	43.0	43.0	1.15	0.236	43.67	1.37	1.27	
UT									•
UW	39.0	39.0	39.0	0.00	0.000	39.00	-0.25	-0.35	
UX									•
UY	40.0	42.0	41.0	1.00	0.236	41.00	0.45	0.35	
VA	46.0	45.0	44.0	1.00	0.236	45.00	1.83	1.73	
VC	40.0	40.0	41.0	0.58	0.118	40.33	0.21	0.12	
VE									•
VG	39.0	39.0	39.0	0.00	0.000	39.00	-0.25	-0.35	
VH	37.0	38.0	39.0	1.00	0.236	38.00	-0.59	-0.69	
VI	39.0	40.0	39.0	0.58	0.118	39.33	-0.13	-0.23	
VM	40.0	39.0	40.0	0.58	0.118	39.67	-0.02	-0.12	
VO	42.0	45.0	40.0	2.52	0.591	42.33	0.91	0.81	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VR									•
VS	42.0	40.0	42.0	1.15	0.236	41.33	0.56	0.46	
VT									•
VU									•
W	36.0	35.0	37.0	1.00	0.236	36.00	-1.29	-1.39	
WD	38.0	36.0	35.0	1.53	0.354	36.33	-1.17	-1.27	
WF	40.0	38.0	37.0	1.53	0.354	38.33	-0.48	-0.58	
WI	37.0	34.0	39.0	2.52	0.591	36.67	-1.06	-1.15	
WJ	43.0	41.0	45.0	2.00	0.473	43.00	1.14	1.04	
WK	40.0	28.0	34.0	6.00	1.795	34.00	-1.98	-2.08	
X	45.0	43.0	42.0	1.53	0.354	43.33	1.25	1.15	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
21.00	×	FZ	37.67		M	39.00		S
28.33	×	BW	38.00		VH	39.00		R
30.00	×	NK	38.00		TC	39.00		KX
34.00		WK	38.00		SR	39.00		IC
34.00		QW	38.00		QZ	39.00		HL
34.00		K	38.00		Q	39.00		GI
35.00		QU	38.00		PW	39.00		GE
35.00		AI	38.00		OM	39.00		EX
35.00		AH	38.00		NJ	39.00		AZ
35.33		RH	38.00		LE	39.00		AW
35.67		NO	38.00		EB	39.33		VI
35.67		A	38.00		BC	39.33		EA
36.00		W	38.33		WF	39.33		DH
36.00		JI	38.33		TL	39.33		AJ
36.33		WD	38.33		SZ	39.67		VM
36.33		RF	38.33		QP	39.67		RV
36.67		WI	38.33		HP	39.67		RO
36.67		T	38.33		DD	39.67		JE
36.67		PQ	38.33		CS	39.67		GL
36.67		NH	38.33		CK	39.67		EW
36.67		AN	38.33		AK	39.67		DO
37.00		TH	38.67		SS	39.67		DM
37.00		SC	38.67		PV	39.67		DL
37.00		QT	38.67		PI	39.67		D
37.00		OK	38.67		MQ	39.67		BO
37.00		AY	38.67		JG	39.67		BL
37.33		TQ	38.67		EL	39.67		AF
37.33		OB	38.67		DG	40.00		TS
37.33		KL	38.67		BM	40.00		TO
37.67		RZ	39.00		VG	40.00		TI
37.67		OA	39.00		UW	40.00		RR

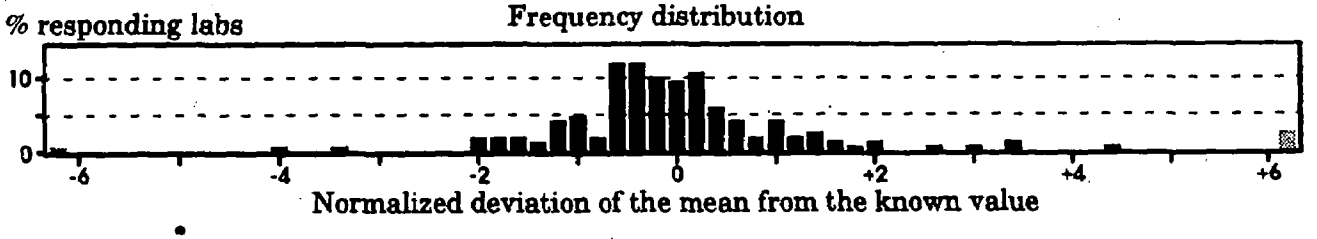
TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cobalt-60

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
40.00		PB	40.67		KH	43.00		WJ
40.00		NP	40.67		J	43.00		SI
40.00		LT	40.67		HX	43.00		OL
40.00		LR	40.67		AU	43.00		GQ
40.00		JS	41.00		UY	43.00		BH
40.00		HK	41.00		CQ	43.33		X
40.00		FU	41.00		CA	43.67		UR
40.00		FL	41.00		BB	43.67		BK
40.00		FJ	41.33		VS	44.00		O
40.00		E	41.33		MP	44.00		HJ
40.00		DE	41.33		EZ	44.00		CE
40.00		BI	41.33		CX	44.00		AL
40.33		VC	41.33		C	44.33		QX
40.33		UP	41.33		BA	44.33		L
40.33		UE	41.67		RU	45.00		VA
40.33		SF	41.67		OZ	46.00		PM
40.33		SD	41.67		I	46.00		MV
40.33		LF	41.67		CP	47.67		NZ
40.33		DZ	42.00		SX	48.67		ML
40.33		DT	42.00		SM	49.67	×	HI
40.33		CC	42.00		N	50.00	×	SV
40.33		AP	42.33		VO	52.67	×	P
40.33		AE	42.33		UN	61.67	×	TB
40.67		U	42.33		CJ	67.33	×	BG
40.67		TD	42.67		CO	70.33	×	TR
40.67		SN	42.67		CM	341.67	×	JY

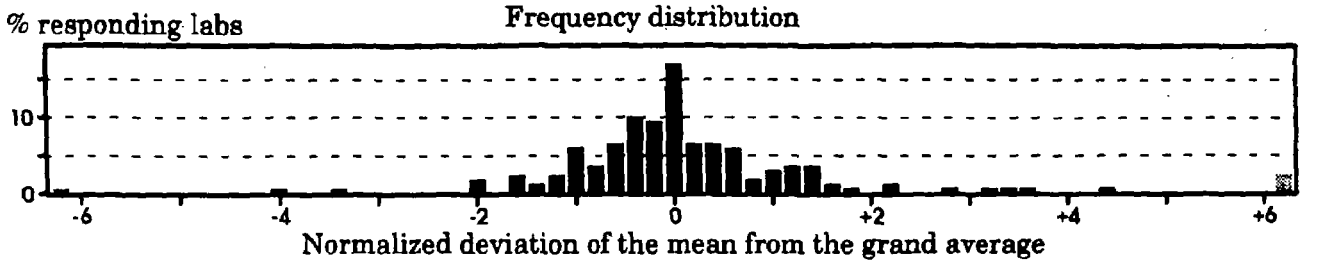


• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

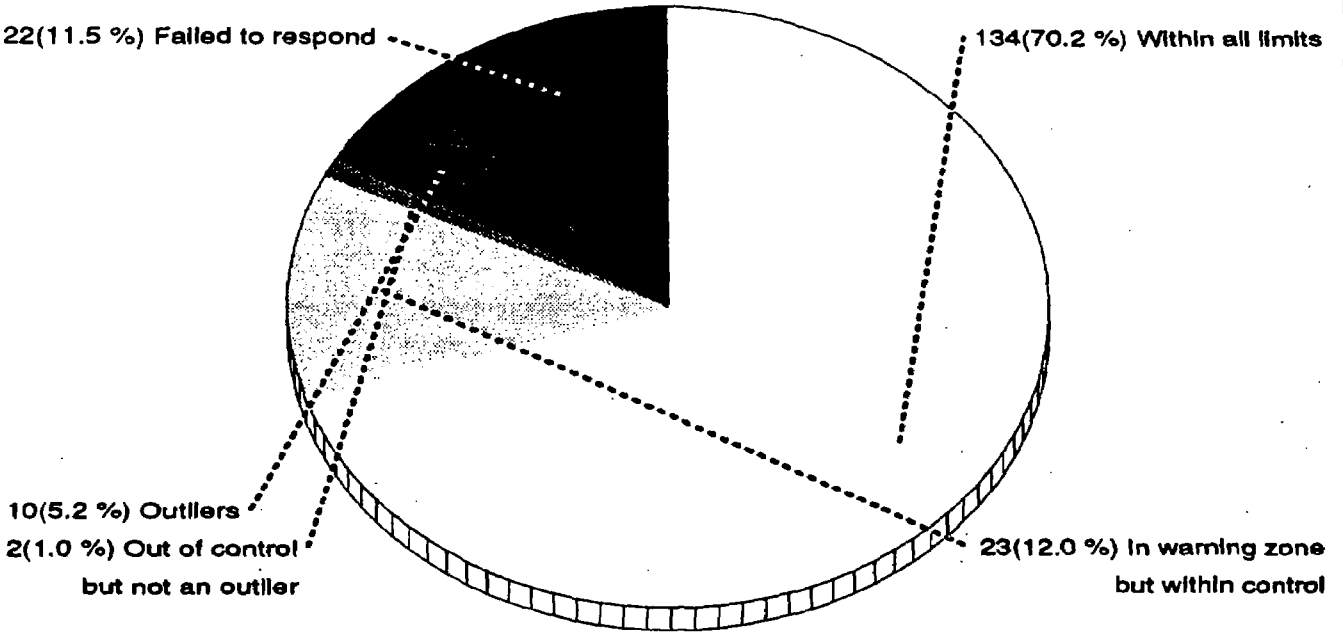
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cobalt-60

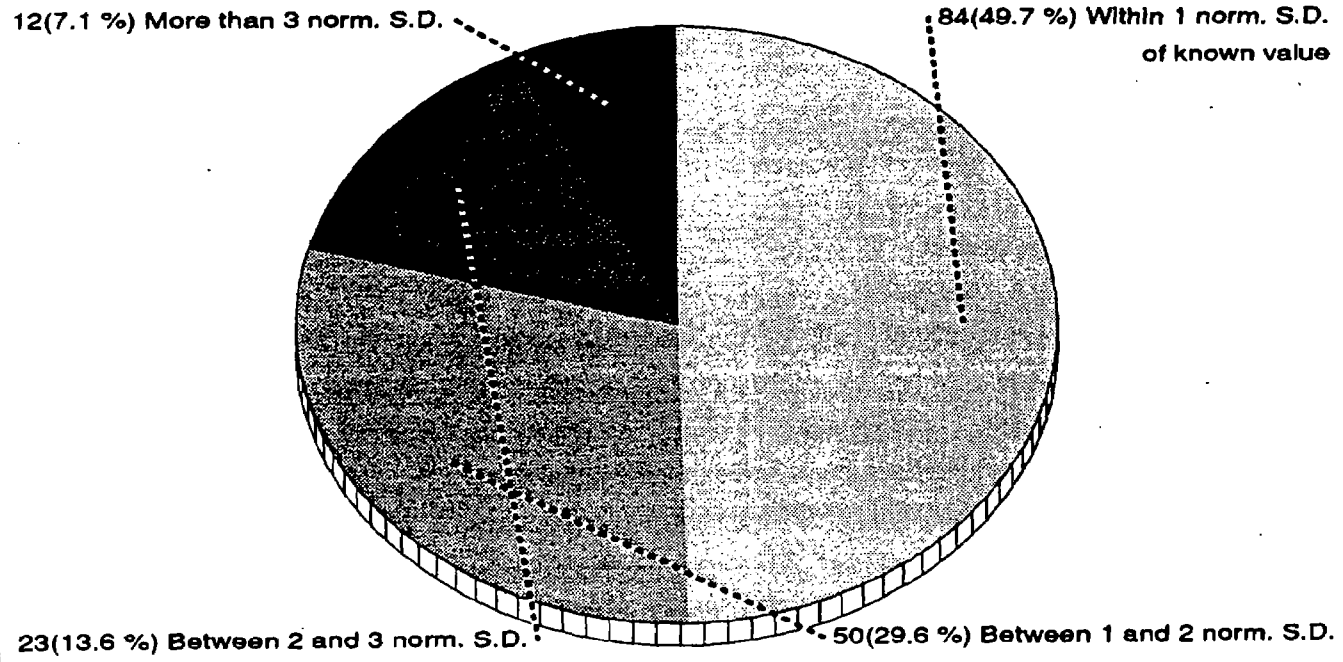

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Zinc-65 Statistical Summary 191 Participants

The known value of this nuclide is **76.0 pCi/l** with an expected precision of **8.0**; the control limits are 62.1 to 89.9; the warning regions are 62.1 to 66.7 and 85.3 to 89.9



Statistic	Respondents	Non-outliers
Mean	87.37	**Grand Avg 78.75**
Std. Dev.	75.19	5.52
Variance	5653.88	30.48
% Coef. of Var.	86.06	7.01
% deviation of mean from known value	14.96	3.62
Norm. dev. of mean from known value	0.15	0.50
Median	79.33	79.33
% deviation of median from known value	4.39	4.39
Norm. dev. of median from known value	0.04	0.60



Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	67.0	75.0	75.0	4.62	0.591	72.33	-1.39	-0.79	
AE	88.0	77.0	77.0	6.35	0.812	80.67	0.41	1.01	
AF	82.0	78.0	79.0	2.08	0.295	79.67	0.20	0.79	
AH	76.0	71.0	75.0	2.65	0.369	74.00	-1.03	-0.43	
AI	68.0	74.0	71.0	3.00	0.443	71.00	-1.68	-1.08	
AJ	79.0	82.0	77.0	2.52	0.369	79.33	0.13	0.72	
AK	76.0	78.0	78.0	1.15	0.148	77.33	-0.31	0.29	
AL	92.0	85.0	91.0	3.79	0.517	89.33	2.29	2.89	
AN	76.0	77.0	80.0	2.08	0.295	77.67	-0.23	0.36	
AP	74.0	76.0	83.0	4.73	0.665	77.67	-0.23	0.36	
AU	80.0	69.0	72.0	5.69	0.812	73.67	-1.10	-0.51	
AW	75.0	77.0	74.0	1.53	0.222	75.33	-0.74	-0.14	
AY	70.0	74.0	65.0	4.51	0.665	69.67	-1.97	-1.37	
AZ	90.0	84.0	85.0	3.21	0.443	86.33	1.64	2.24	
BA	805.0	831.0	798.0	17.39	3.736	811.33	158.61	159.20	×
BB	81.0	85.0	83.0	2.00	0.295	83.00	0.92	1.52	
BC	81.0	82.0	77.0	2.65	0.369	80.00	0.27	0.87	
BG	105.0	117.0	105.0	6.93	0.886	109.00	6.55	7.14	×
BH	82.0	86.0	84.0	2.00	0.295	84.00	1.14	1.73	
BI	11.0	90.0	10.0	45.90	10.346	37.00	-9.04	-8.44	×
BK	93.0	93.0	94.0	0.58	0.074	93.33	3.16	3.75	⇑
BL	71.0	70.0	73.0	1.53	0.222	71.33	-1.61	-1.01	
BM	75.0	77.0	80.0	2.52	0.369	77.33	-0.31	0.29	
BN									•
BO	79.0	81.0	78.0	1.53	0.222	79.33	0.13	0.72	
BW	26.0	26.0	32.0	3.46	0.443	28.00	-10.99	-10.39	×
C	83.0	88.0	82.0	3.21	0.443	84.33	1.21	1.80	
CA	74.0	78.0	80.0	3.06	0.443	77.33	-0.31	0.29	
CC	87.0	87.0	87.0	0.00	0.000	87.00	1.79	2.38	
CE	86.0	89.0	88.0	1.53	0.222	87.67	1.93	2.53	
CG									•
CJ	79.0	86.0	82.0	3.51	0.517	82.33	0.78	1.37	
CK	70.0	74.0	68.0	3.06	0.443	70.67	-1.75	-1.15	
CM	89.0	85.0	88.0	2.08	0.295	87.33	1.86	2.45	
CO	82.0	69.0	83.0	7.81	1.064	78.00	-0.16	0.43	
CP	82.0	80.0	81.0	1.00	0.148	81.00	0.49	1.08	
CQ	77.0	82.0	85.0	4.04	0.591	81.33	0.56	1.15	
CS	79.0	83.0	85.0	3.06	0.443	82.33	0.78	1.37	
CX	82.0	84.0	77.0	3.61	0.517	81.00	0.49	1.08	
D	80.0	76.0	82.0	3.06	0.443	79.33	0.13	0.72	
DD	79.0	78.0	76.0	1.53	0.222	77.67	-0.23	0.36	
DE	75.0	75.0	76.0	0.58	0.074	75.33	-0.74	-0.14	
DG	68.0	74.0	74.0	3.46	0.443	72.00	-1.46	-0.87	
DH	74.0	74.0	73.0	0.58	0.074	73.67	-1.10	-0.51	
DL	74.0	67.0	72.0	3.61	0.517	71.00	-1.68	-1.08	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM	78.0	79.0	83.0	2.65	0.369	80.00	0.27	0.87	
DO	64.0	88.0	73.0	12.12	2.470	75.00	-0.81	-0.22	
DT	75.0	86.0	73.0	7.00	0.960	78.00	-0.16	0.43	
DZ	65.0	67.0	64.0	1.53	0.222	65.33	-2.90	-2.31	
E	81.0	81.0	76.0	2.89	0.369	79.33	0.13	0.72	
EA	73.0	74.0	80.0	3.79	0.517	75.67	-0.67	-0.07	
EB	83.0	84.0	85.0	1.00	0.148	84.00	1.14	1.73	
EL	76.0	77.0	80.0	2.08	0.295	77.67	-0.23	0.36	
EN									•
EW	76.0	73.0	75.0	1.53	0.222	74.67	-0.88	-0.29	
EX	83.0	78.0	81.0	2.52	0.369	80.67	0.41	1.01	
EZ	75.0	90.0	72.0	9.64	1.627	79.00	0.05	0.65	
FJ	86.0	89.0	85.0	2.08	0.295	86.67	1.71	2.31	
FK									•
FL	81.0	79.0	77.0	2.00	0.295	79.00	0.05	0.65	
FU	75.0	74.0	73.0	1.00	0.148	74.00	-1.03	-0.43	
FZ	38.0	37.0	34.0	2.08	0.295	36.33	-9.18	-8.59	×
GE	74.0	74.0	72.0	1.15	0.148	73.33	-1.17	-0.58	
GI	80.0	81.0	83.0	1.53	0.222	81.33	0.56	1.15	
GL	81.0	79.0	79.0	1.15	0.148	79.67	0.20	0.79	
GQ	85.0	89.0	94.0	4.51	0.665	89.33	2.29	2.89	
HI	82.0	86.0	75.0	5.57	0.812	81.00	0.49	1.08	
HJ	77.0	84.0	80.0	3.51	0.517	80.33	0.34	0.94	
HK	84.0	82.0	82.0	1.15	0.148	82.67	0.85	1.44	
HL	83.0	83.0	83.0	0.00	0.000	83.00	0.92	1.52	
HP	73.0	77.0	74.0	2.08	0.295	74.67	-0.88	-0.29	
HX	79.0	77.0	80.0	1.53	0.222	78.67	-0.02	0.58	
I	73.0	77.0	83.0	5.03	0.738	77.67	-0.23	0.36	
IC	82.0	84.0	76.0	4.16	0.591	80.67	0.41	1.01	
J	79.0	80.0	79.0	0.58	0.074	79.33	0.13	0.72	
JE	77.0	77.0	78.0	0.58	0.074	77.33	-0.31	0.29	
JG	75.0	63.0	62.0	7.23	0.960	66.67	-2.62	-2.02	
JI	74.0	76.0	72.0	2.00	0.295	74.00	-1.03	-0.43	
JS	77.0	84.0	80.0	3.51	0.517	80.33	0.34	0.94	
JY	728.0	678.0	660.0	35.23	8.658	688.67	132.05	132.65	×
K	71.0	70.0	69.0	1.00	0.148	70.00	-1.89	-1.30	
KH	80.0	79.0	79.0	0.58	0.074	79.33	0.13	0.72	
KL	73.0	70.0	66.0	3.51	0.517	69.67	-1.97	-1.37	
KX	74.0	77.0	76.0	1.53	0.222	75.67	-0.67	-0.07	
L	89.0	90.0	90.0	0.58	0.074	89.67	2.36	2.96	
LE	279.0	255.0	291.0	18.33	4.158	275.00	42.49	43.08	×
LF	70.0	77.0	81.0	5.57	0.812	76.00	-0.60	0.00	
LR	86.0	69.0	64.0	11.53	2.189	73.00	-1.25	-0.65	
LT	82.0	79.0	84.0	2.52	0.369	81.67	0.63	1.23	
M	79.0	80.0	79.0	0.58	0.074	79.33	0.13	0.72	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
MA									•
ML	97.0	101.0	108.0	5.57	0.812	102.00	5.03	5.63	×
MP	82.0	81.0	79.0	1.53	0.222	80.67	0.41	1.01	
MQ	91.0	70.0	80.0	10.50	2.049	80.33	0.34	0.94	
MV	85.0	88.0	89.0	2.08	0.295	87.33	1.86	2.45	
MY									•
N	81.0	79.0	84.0	2.52	0.369	81.33	0.56	1.15	
NH	80.0	79.0	79.0	0.58	0.074	79.33	0.13	0.72	
NJ	75.0	79.0	75.0	2.31	0.295	76.33	-0.52	0.07	
NK	71.0	79.0	73.0	4.16	0.591	74.33	-0.96	-0.36	
NO	79.0	88.0	90.0	5.86	0.812	85.67	1.50	2.09	
NP	76.0	78.0	76.0	1.15	0.148	76.67	-0.45	0.14	
NZ	50.0	86.0	86.0	20.78	4.158	74.00	-1.03	-0.43	
O	87.0	87.0	86.0	0.58	0.074	86.67	1.71	2.31	
OA	76.0	77.0	81.0	2.65	0.369	78.00	-0.16	0.43	
OB									•
OK	69.0	70.0	75.0	3.21	0.443	71.33	-1.61	-1.01	
OL	90.0	75.0	76.0	8.39	1.205	80.33	0.34	0.94	
OM	67.0	68.0	68.0	0.58	0.074	67.67	-2.40	-1.80	
OZ	79.0	80.0	79.0	0.58	0.074	79.33	0.13	0.72	
P	90.0	94.0	101.0	5.57	0.812	95.00	3.52	4.11	⇑
PB	76.0	75.0	76.0	0.58	0.074	75.67	-0.67	-0.07	
PE									•
PI	76.0	71.0	78.0	3.61	0.517	75.00	-0.81	-0.22	
PM	80.0	92.0	76.0	8.33	1.345	82.67	0.85	1.44	
PQ	67.0	64.0	70.0	3.00	0.443	67.00	-2.54	-1.95	
PU									•
PV	69.0	77.0	80.0	5.69	0.812	75.33	-0.74	-0.14	
PW	74.0	74.0	83.0	5.20	0.665	77.00	-0.38	0.22	
Q	77.0	77.0	78.0	0.58	0.074	77.33	-0.31	0.29	
QJ									•
QP									•
QT	80.0	72.0	72.0	4.62	0.591	74.67	-0.88	-0.29	
QU	75.0	72.0	72.0	1.73	0.222	73.00	-1.25	-0.65	
QW	72.0	76.0	76.0	2.31	0.295	74.67	-0.88	-0.29	
QX	79.0	76.0	73.0	3.00	0.443	76.00	-0.60	0.00	
QZ	82.0	80.0	80.0	1.15	0.148	80.67	0.41	1.01	
R	80.0	81.0	87.0	3.79	0.517	82.67	0.85	1.44	
RF	41.0	41.0	41.0	0.00	0.000	41.00	-8.17	-7.58	×
RH	71.0	64.0	71.0	4.04	0.517	68.67	-2.18	-1.59	
RL									•
RO	76.0	85.0	84.0	4.93	0.665	81.67	0.63	1.23	
RR	77.0	76.0	79.0	1.53	0.222	77.33	-0.31	0.29	
RU	85.0	76.0	78.0	4.73	0.665	79.67	0.20	0.79	
RV	75.0	72.0	76.0	2.08	0.295	74.33	-0.96	-0.36	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RX									•
RZ	82.0	81.0	79.0	1.53	0.222	80.67	0.41	1.01	
S	75.0	77.0	76.0	1.00	0.148	76.00	-0.60	0.00	
SC	72.0	89.0	72.0	9.81	1.486	77.67	-0.23	0.36	
SD	78.0	95.0	96.0	10.12	1.627	89.67	2.36	2.96	
SF	80.0	81.0	80.0	0.58	0.074	80.33	0.34	0.94	
SI	89.0	86.0	86.0	1.73	0.222	87.00	1.79	2.38	
SM	88.0	93.0	84.0	4.51	0.665	88.33	2.07	2.67	
SN	87.0	71.0	71.0	9.24	1.345	76.33	-0.52	0.07	
SR	84.0	82.0	84.0	1.15	0.148	83.33	0.99	1.59	
SS	71.0	82.0	81.0	6.08	0.812	78.00	-0.16	0.43	
ST									•
SV	78.0	85.0	76.0	4.73	0.665	79.67	0.20	0.79	
SX	83.0	85.0	86.0	1.53	0.222	84.67	1.28	1.88	
SZ	79.0	81.0	80.0	1.00	0.148	80.00	0.27	0.87	
T	75.0	70.0	69.0	3.21	0.443	71.33	-1.61	-1.01	
TB	114.0	122.0	113.0	4.93	0.665	116.33	8.14	8.73	×
TC	77.0	78.0	80.0	1.53	0.222	78.33	-0.09	0.51	
TD	84.0	79.0	79.0	2.89	0.369	80.67	0.41	1.01	
TE									•
TH	73.0	66.0	75.0	4.73	0.665	71.33	-1.61	-1.01	
TI	81.0	85.0	81.0	2.31	0.295	82.33	0.78	1.37	
TL	66.0	66.0	78.0	6.93	0.886	70.00	-1.89	-1.30	
TO	86.0	85.0	85.0	0.58	0.074	85.33	1.43	2.02	
TQ	81.0	77.0	85.0	4.00	0.591	81.00	0.49	1.08	
TR	72.0	66.0	81.0	7.55	1.205	73.00	-1.25	-0.65	
TS	77.0	84.0	81.0	3.51	0.517	80.67	0.41	1.01	
U	77.0	76.0	77.0	0.58	0.074	76.67	-0.45	0.14	
UE	71.0	69.0	73.0	2.00	0.295	71.00	-1.68	-1.08	
UM									•
UN	86.0	81.0	74.0	6.03	0.886	80.33	0.34	0.94	
UP	83.0	85.0	82.0	1.53	0.222	83.33	0.99	1.59	
UR	89.0	83.0	91.0	4.16	0.591	87.67	1.93	2.53	
UT									•
UW	81.0	77.0	77.0	2.31	0.295	78.33	-0.09	0.51	
UX									•
UY	84.0	82.0	75.0	4.73	0.665	80.33	0.34	0.94	
VA	87.0	87.0	87.0	0.00	0.000	87.00	1.79	2.38	
VC	81.0	83.0	78.0	2.52	0.369	80.67	0.41	1.01	
VE									•
VG	80.0	79.0	77.0	1.53	0.222	78.67	-0.02	0.58	
VH	74.0	80.0	77.0	3.00	0.443	77.00	-0.38	0.22	
VI	82.0	86.0	83.0	2.08	0.295	83.67	1.06	1.66	
VM	86.0	86.0	86.0	0.00	0.000	86.00	1.57	2.17	
VO	81.0	80.0	76.0	2.65	0.369	79.00	0.05	0.65	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VR									•
VS	90.0	89.0	80.0	5.51	0.738	86.33	1.64	2.24	
VT									•
VU									•
W	80.0	70.0	71.0	5.51	0.738	73.67	-1.10	-0.51	
WD	76.0	82.0	80.0	3.06	0.443	79.33	0.13	0.72	
WF	79.0	76.0	75.0	2.08	0.295	76.67	-0.45	0.14	
WI	53.0	64.0	80.0	13.58	2.892	65.67	-2.83	-2.24	
WJ	84.0	82.0	85.0	1.53	0.222	83.67	1.06	1.66	
WK	62.0	79.0	71.0	8.50	1.486	70.67	-1.75	-1.15	
X	95.0	87.0	80.0	7.51	1.205	87.33	1.86	2.45	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
28.00	×	BW	73.67		AU	77.33		JE
36.33	×	FZ	74.00		NZ	77.33		CA
37.00	×	BI	74.00		JI	77.33		BM
41.00	×	RF	74.00		FU	77.33		AK
65.33		DZ	74.00		AH	77.67		SC
65.67		WI	74.33		RV	77.67		I
66.67		JG	74.33		NK	77.67		EL
67.00		PQ	74.67		QW	77.67		DD
67.67		OM	74.67		QT	77.67		AP
68.67		RH	74.67		HP	77.67		AN
69.67		KL	74.67		EW	78.00		SS
69.67		AY	75.00		PI	78.00		OA
70.00		TL	75.00		DO	78.00		DT
70.00		K	75.33		PV	78.00		CO
70.67		WK	75.33		DE	78.33		UW
70.67		CK	75.33		AW	78.33		TC
71.00		UE	75.67		PB	78.67		VG
71.00		DL	75.67		KX	78.67		HX
71.00		AI	75.67		EA	79.00		VO
71.33		TH	76.00		S	79.00		FL
71.33		T	76.00		QX	79.00		EZ
71.33		OK	76.00		LF	79.33		WD
71.33		BL	76.33		SN	79.33		OZ
72.00		DG	76.33		NJ	79.33		NH
72.33		A	76.67		WF	79.33		M
73.00		TR	76.67		U	79.33		KH
73.00		QU	76.67		NP	79.33		J
73.00		LR	77.00		VH	79.33		E
73.33		GE	77.00		PW	79.33		D
73.67		W	77.33		RR	79.33		BO
73.67		DH	77.33		Q	79.33		AJ

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

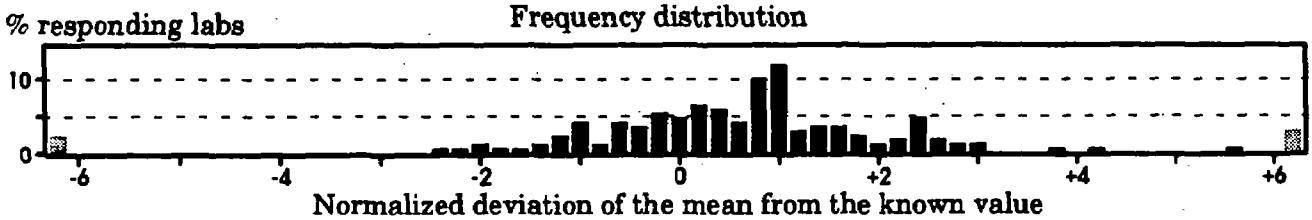
× ≡ Determined to be an outlier

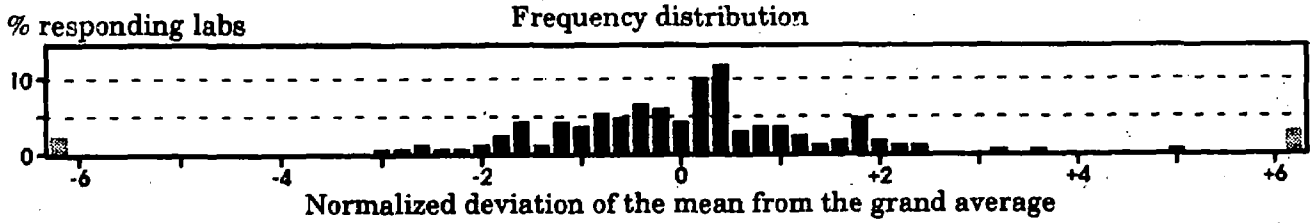
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Zinc-65

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
79.67		SV	81.00		CX	86.00		VM
79.67		RU	81.00		CP	86.33		VS
79.67		GL	81.33		N	86.33		AZ
79.67		AF	81.33		GI	86.67		O
80.00		SZ	81.33		CQ	86.67		FJ
80.00		DM	81.67		RO	87.00		VA
80.00		BC	81.67		LT	87.00		SI
80.33		UY	82.33		TI	87.00		CC
80.33		UN	82.33		CS	87.33		X
80.33		SF	82.33		CJ	87.33		MV
80.33		OL	82.67		R	87.33		CM
80.33		MQ	82.67		PM	87.67		UR
80.33		JS	82.67		HK	87.67		CE
80.33		HJ	83.00		HL	88.33		SM
80.67		VC	83.00		BB	89.33		GQ
80.67		TS	83.33		UP	89.33		AL
80.67		TD	83.33		SR	89.67		SD
80.67		RZ	83.67		WJ	89.67		L
80.67		QZ	83.67		VI	93.33	⇑	BK
80.67		MP	84.00		EB	95.00	⇑	P
80.67		IC	84.00		BH	102.00	×	ML
80.67		EX	84.33		C	109.00	×	BG
80.67		AE	84.67		SX	116.33	×	TB
81.00		TQ	85.33		TO	275.00	×	LE
81.00		HI	85.67		NO	688.67	×	JY
						811.33	×	BA





• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EXPOSURE RESEARCH LABORATORY
P.O. BOX 93478 • LAS VEGAS, NV 89193-3478

OFFICE OF
RESEARCH AND DEVELOPMENT

A note regarding the Cesium-134 portion of the June 9, 1995 Gamma in Water Performance Evaluation Study:

The difference between the grand average and the known value was significant for this study. The primary peak for Cs-134 (604.7) is subject to coincidence summing, resulting in a negative bias if quantified using commercial mixed standards. Efficiency factors based on these standards do not correctly quantify peaks subject to summing, and in general produce a negative bias as was observed. This bias will be minimized if the efficiency is calculated using a separate Cs-134 standard or a previous PE study. Please direct any questions to Steve Pia at 702 798-2102.

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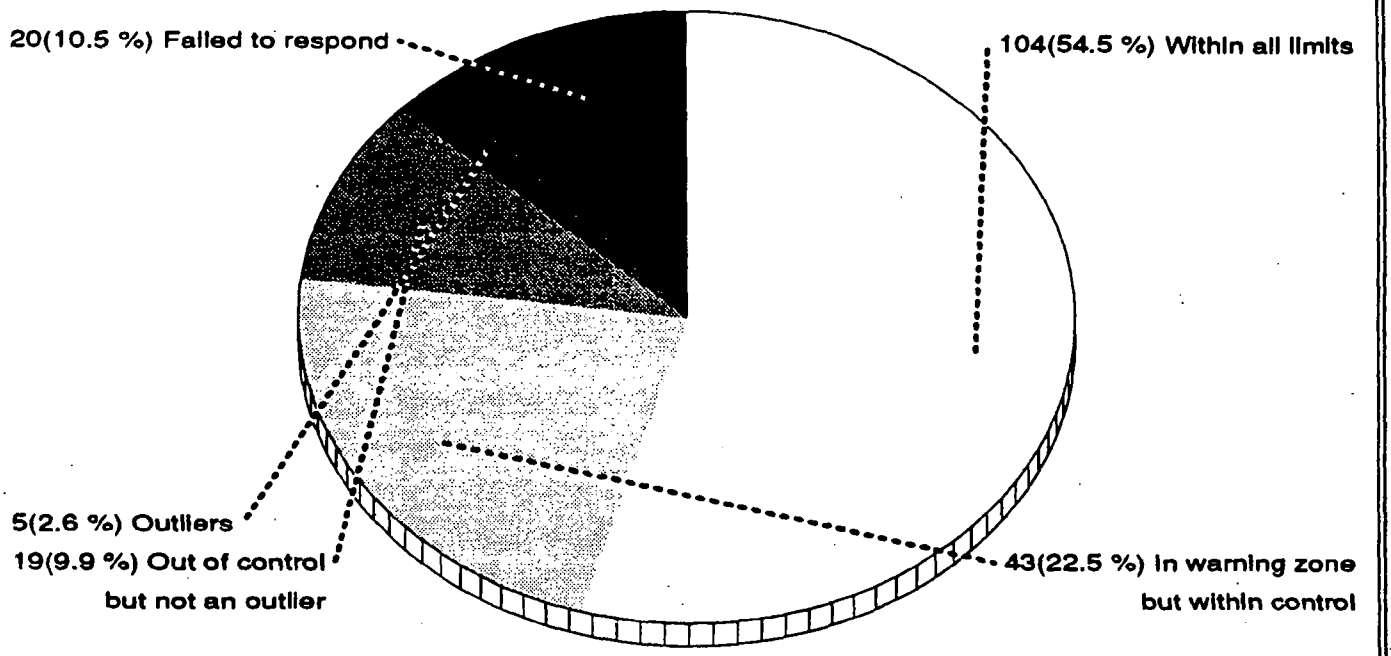
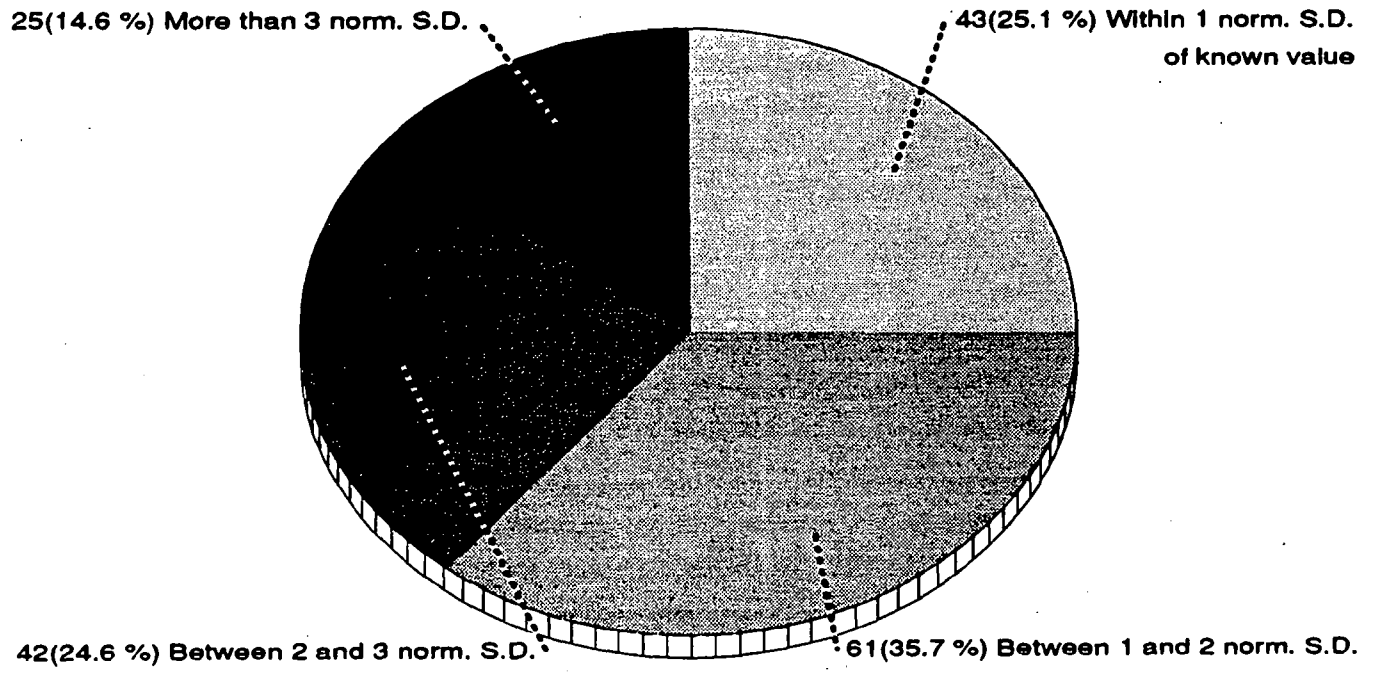
Cesium-134 Statistical Summary 191 Participants

The known value of this nuclide is **50.0 pCi/l** with an expected precision of **5.0**; the control limits are 41.3 to 58.7; the warning regions are 41.3 to 44.2 and 55.8 to 58.7



Statistic	Respondents	Non-outliers
Mean	47.37	**Grand Avg 45.65**
Std. Dev.	24.61	3.99
Variance	605.69	15.90
% Coef. of Var.	51.95	8.74
% deviation of mean from known value	-5.26	-8.71
Norm. dev. of mean from known value	-0.11	-1.09
Median	45.67	45.50
% deviation of median from known value	-8.67	-9.00
Norm. dev. of median from known value	-0.18	-1.13



CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	38.0	41.0	41.0	1.73	0.354	40.00	-1.96	-3.46	⇓
AE	50.0	50.0	43.0	4.04	0.827	47.67	0.70	-0.81	
AF	45.0	46.0	47.0	1.00	0.236	46.00	0.12	-1.39	
AH	42.0	43.0	42.0	0.58	0.118	42.33	-1.15	-2.66	
AI	42.0	42.0	42.0	0.00	0.000	42.00	-1.26	-2.77	
AJ	43.0	43.0	43.0	0.00	0.000	43.00	-0.92	-2.42	
AK	46.0	44.0	45.0	1.00	0.236	45.00	-0.22	-1.73	
AL	44.0	46.0	45.0	1.00	0.236	45.00	-0.22	-1.73	
AN	51.0	47.0	48.0	2.08	0.473	48.67	1.05	-0.46	
AP	45.0	48.0	50.0	2.52	0.591	47.67	0.70	-0.81	
AU	44.0	43.0	45.0	1.00	0.236	44.00	-0.57	-2.08	
AW	40.0	42.0	40.0	1.15	0.236	40.67	-1.73	-3.23	⇓
AY	49.0	47.0	48.0	1.00	0.236	48.00	0.82	-0.69	
AZ	55.0	61.0	59.0	3.06	0.709	58.33	4.39	2.89	
BA	49.0	47.0	48.0	1.00	0.236	48.00	0.82	-0.69	
BB	47.0	48.0	48.0	0.58	0.118	47.67	0.70	-0.81	
BC	43.0	42.0	43.0	0.58	0.118	42.67	-1.03	-2.54	
BG	61.0	48.0	68.0	10.15	3.596	59.00	4.63	3.12	⇑
BH	48.0	50.0	47.0	1.53	0.354	48.33	0.93	-0.58	
BI	70.0	69.0	59.0	6.08	1.570	66.00	7.05	5.54	×
BK	53.0	53.0	52.0	0.58	0.118	52.67	2.43	0.92	
BL	43.0	45.0	43.0	1.15	0.236	43.67	-0.69	-2.19	
BM	44.0	45.0	45.0	0.58	0.118	44.67	-0.34	-1.85	
BN									•
BO	48.0	46.0	48.0	1.15	0.236	47.33	0.58	-0.92	
BW	35.0	39.0	36.0	2.08	0.473	36.67	-3.11	-4.62	⇓
C	50.0	50.0	49.0	0.58	0.118	49.67	1.39	-0.12	
CA	47.0	45.0	46.0	1.00	0.236	46.00	0.12	-1.39	
CC	48.0	47.0	48.0	0.58	0.118	47.67	0.70	-0.81	
CE	50.0	49.0	49.0	0.58	0.118	49.33	1.28	-0.23	
CG	1.0	1.0	1.0	0.00	0.000	1.00	-15.47	-16.97	×
CJ	46.0	45.0	49.0	2.08	0.473	46.67	0.35	-1.15	
CK	45.0	44.0	44.0	0.58	0.118	44.33	-0.45	-1.96	
CM	50.0	48.0	46.0	2.00	0.473	48.00	0.82	-0.69	
CO	45.0	47.0	46.0	1.00	0.236	46.00	0.12	-1.39	
CP	46.0	47.0	47.0	0.58	0.118	46.67	0.35	-1.15	
CQ	45.0	48.0	50.0	2.52	0.591	47.67	0.70	-0.81	
CS	45.0	46.0	42.0	2.08	0.473	44.33	-0.45	-1.96	
CX	47.0	47.0	46.0	0.58	0.118	46.67	0.35	-1.15	
D	42.0	43.0	48.0	3.21	0.709	44.33	-0.45	-1.96	
DD	46.0	46.0	47.0	0.58	0.118	46.33	0.24	-1.27	
DE	45.0	45.0	44.0	0.58	0.118	44.67	-0.34	-1.85	
DG	45.0	46.0	44.0	1.00	0.236	45.00	-0.22	-1.73	
DH	42.0	43.0	43.0	0.58	0.118	42.67	-1.03	-2.54	
DL	47.0	45.0	45.0	1.15	0.236	45.67	0.01	-1.50	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	47.0	45.0	43.0	2.00	0.473	45.00	-0.22	-1.73	
DO	43.0	49.0	40.0	4.58	1.120	44.00	-0.57	-2.08	
DT	46.0	43.0	46.0	1.73	0.354	45.00	-0.22	-1.73	
DZ	36.0	40.0	38.0	2.00	0.473	38.00	-2.65	-4.16	⇓
E	46.0	47.0	46.0	0.58	0.118	46.33	0.24	-1.27	
EA	49.0	48.0	44.0	2.65	0.591	47.00	0.47	-1.04	
EB	42.0	42.0	42.0	0.00	0.000	42.00	-1.26	-2.77	
EL	49.0	44.0	47.0	2.52	0.591	46.67	0.35	-1.15	
EN									•
EW	47.0	46.0	47.0	0.58	0.118	46.67	0.35	-1.15	
EX	46.0	49.0	45.0	2.08	0.473	46.67	0.35	-1.15	
EZ	45.0	48.0	48.0	1.73	0.354	47.00	0.47	-1.04	
FJ	48.0	49.0	49.0	0.58	0.118	48.67	1.05	-0.46	
FK									•
FL	44.0	46.0	45.0	1.00	0.236	45.00	-0.22	-1.73	
FU	45.0	46.0	44.0	1.00	0.236	45.00	-0.22	-1.73	
FZ	25.0	24.0	24.0	0.58	0.118	24.33	-7.38	-8.89	×
GE	44.0	47.0	45.0	1.53	0.354	45.33	-0.11	-1.62	
GI	41.0	43.0	43.0	1.15	0.236	42.33	-1.15	-2.66	
GL	40.0	41.0	41.0	0.58	0.118	40.67	-1.73	-3.23	⇓
GQ	54.0	57.0	58.0	2.08	0.473	56.33	3.70	2.19	
HI	52.0	52.0	52.0	0.00	0.000	52.00	2.20	0.69	
HJ	48.0	52.0	48.0	2.31	0.473	49.33	1.28	-0.23	
HK	46.0	48.0	47.0	1.00	0.236	47.00	0.47	-1.04	
HL	46.0	46.0	46.0	0.00	0.000	46.00	0.12	-1.39	
HP	46.0	47.0	46.0	0.58	0.118	46.33	0.24	-1.27	
HX	43.0	42.0	44.0	1.00	0.236	43.00	-0.92	-2.42	
I	48.0	49.0	40.0	4.93	1.120	45.67	0.01	-1.50	
IC	55.0	53.0	51.0	2.00	0.473	53.00	2.55	1.04	
J	51.0	51.0	50.0	0.58	0.118	50.67	1.74	0.23	
JE	44.0	43.0	42.0	1.00	0.236	43.00	-0.92	-2.42	
JG	39.0	40.0	42.0	1.53	0.354	40.33	-1.84	-3.35	⇓
JI	44.0	43.0	45.0	1.00	0.236	44.00	-0.57	-2.08	
JS	49.0	47.0	49.0	1.15	0.236	48.33	0.93	-0.58	
JY	346.0	383.0	343.0	22.28	8.096	357.33	107.97	106.46	×
K	41.0	41.0	41.0	0.00	0.000	41.00	-1.61	-3.12	⇓
KH	41.0	39.0	40.0	1.00	0.236	40.00	-1.96	-3.46	⇓
KL	44.0	41.0	42.0	1.53	0.354	42.33	-1.15	-2.66	
KX	45.0	51.0	44.0	3.79	0.827	46.67	0.35	-1.15	
L	50.0	51.0	52.0	1.00	0.236	51.00	1.85	0.35	
LE	62.0	51.0	53.0	5.86	1.570	55.33	3.36	1.85	
LF	45.0	48.0	45.0	1.73	0.354	46.00	0.12	-1.39	
LR	54.0	52.0	49.0	2.52	0.591	51.67	2.09	0.58	
LT	49.0	46.0	49.0	1.73	0.354	48.00	0.82	-0.69	
M	43.0	42.0	43.0	0.58	0.118	42.67	-1.03	-2.54	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
MA									•
ML	53.0	54.0	52.0	1.00	0.236	53.00	2.55	1.04	
MP	46.0	48.0	47.0	1.00	0.236	47.00	0.47	-1.04	
MQ	45.0	41.0	46.0	2.65	0.591	44.00	-0.57	-2.08	
MV	50.0	51.0	50.0	0.58	0.118	50.33	1.62	0.12	
MY									•
N	48.0	47.0	44.0	2.08	0.473	46.33	0.24	-1.27	
NH	44.0	43.0	43.0	0.58	0.118	43.33	-0.80	-2.31	
NJ	42.0	44.0	43.0	1.00	0.236	43.00	-0.92	-2.42	
NK	41.0	35.0	39.0	3.06	0.709	38.33	-2.53	-4.04	⇓
NO	43.0	46.0	50.0	3.51	0.827	46.33	0.24	-1.27	
NP	42.0	43.0	41.0	1.00	0.236	42.00	-1.26	-2.77	
NZ	42.0	29.0	42.0	7.51	2.020	37.67	-2.76	-4.27	⇓
O	51.0	51.0	51.0	0.00	0.000	51.00	1.85	0.35	
OA	45.0	44.0	45.0	0.58	0.118	44.67	-0.34	-1.85	
OB									•
OK	42.0	44.0	41.0	1.53	0.354	42.33	-1.15	-2.66	
OL	57.0	53.0	50.0	3.51	0.827	53.33	2.66	1.15	
OM	42.0	42.0	42.0	0.00	0.000	42.00	-1.26	-2.77	
OZ	43.0	45.0	42.0	1.53	0.354	43.33	-0.80	-2.31	
P	52.0	53.0	53.0	0.58	0.118	52.67	2.43	0.92	
PB	45.0	45.0	45.0	0.00	0.000	45.00	-0.22	-1.73	
PE									•
PI	43.0	41.0	44.0	1.53	0.354	42.67	-1.03	-2.54	
PM	45.0	43.0	44.0	1.00	0.236	44.00	-0.57	-2.08	
PQ	44.0	37.0	39.0	3.61	0.827	40.00	-1.96	-3.46	⇓
PU									•
PV	34.0	40.0	39.0	3.21	0.709	37.67	-2.76	-4.27	⇓
PW	47.0	46.0	46.0	0.58	0.118	46.33	0.24	-1.27	
Q	43.0	43.0	46.0	1.73	0.354	44.00	-0.57	-2.08	
QJ									•
QP	52.0	46.0	46.0	3.46	0.709	48.00	0.82	-0.69	
QT	44.0	44.0	43.0	0.58	0.118	43.67	-0.69	-2.19	
QU	40.0	40.0	41.0	0.58	0.118	40.33	-1.84	-3.35	⇓
QW	41.0	38.0	39.0	1.53	0.354	39.33	-2.19	-3.70	⇓
QX	45.0	45.0	46.0	0.58	0.118	45.33	-0.11	-1.62	
QZ	42.0	42.0	41.0	0.58	0.118	41.67	-1.38	-2.89	
R	47.0	47.0	47.0	0.00	0.000	47.00	0.47	-1.04	
RF	48.0	48.0	48.0	0.00	0.000	48.00	0.82	-0.69	
RH	44.0	44.0	44.0	0.00	0.000	44.00	-0.57	-2.08	
RL									•
RO	45.0	44.0	46.0	1.00	0.236	45.00	-0.22	-1.73	
RR	44.0	42.0	42.0	1.15	0.236	42.67	-1.03	-2.54	
RU	50.0	50.0	43.0	4.04	0.827	47.67	0.70	-0.81	
RV	48.0	48.0	50.0	1.15	0.236	48.67	1.05	-0.46	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res: 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RX									•
RZ	46.0	46.0	46.0	0.00	0.000	46.00	0.12	-1.39	
S	45.0	45.0	45.0	0.00	0.000	45.00	-0.22	-1.73	
SC	41.0	47.0	45.0	3.06	0.709	44.33	-0.45	-1.96	
SD	47.0	47.0	50.0	1.73	0.354	48.00	0.82	-0.69	
SF	46.0	46.0	43.0	1.73	0.354	45.00	-0.22	-1.73	
SI	47.0	50.0	52.0	2.52	0.591	49.67	1.39	-0.12	
SM	53.0	49.0	48.0	2.65	0.591	50.00	1.51	0.00	
SN	50.0	52.0	50.0	1.15	0.236	50.67	1.74	0.23	
SR	48.0	46.0	46.0	1.15	0.236	46.67	0.35	-1.15	
SS	49.0	49.0	47.0	1.15	0.236	48.33	0.93	-0.58	
ST									•
SV	41.0	41.0	39.0	1.15	0.236	40.33	-1.84	-3.35	⇓
SX	43.0	43.0	42.0	0.58	0.118	42.67	-1.03	-2.54	
SZ	44.0	45.0	44.0	0.58	0.118	44.33	-0.45	-1.96	
T	45.0	45.0	47.0	1.15	0.236	45.67	0.01	-1.50	
TB	76.0	75.0	73.0	1.53	0.354	74.67	10.05	8.54	×
TC	47.0	40.0	45.0	3.61	0.827	44.00	-0.57	-2.08	
TD	45.0	48.0	44.0	2.08	0.473	45.67	0.01	-1.50	
TE									•
TH	43.0	44.0	44.0	0.58	0.118	43.67	-0.69	-2.19	
TI	48.0	48.0	47.0	0.58	0.118	47.67	0.70	-0.81	
TL	42.0	44.0	47.0	2.52	0.591	44.33	-0.45	-1.96	
TO	55.0	54.0	53.0	1.00	0.236	54.00	2.89	1.39	
TQ	44.0	44.0	44.0	0.00	0.000	44.00	-0.57	-2.08	
TR	33.0	34.0	34.0	0.58	0.118	33.67	-4.15	-5.66	⇓
TS	48.0	45.0	46.0	1.53	0.354	46.33	0.24	-1.27	
U	48.0	48.0	47.0	0.58	0.118	47.67	0.70	-0.81	
UE	49.0	51.0	49.0	1.15	0.236	49.67	1.39	-0.12	
UM									•
UN	46.0	39.0	51.0	6.03	1.795	45.33	-0.11	-1.62	
UP	44.0	44.0	42.0	1.15	0.236	43.33	-0.80	-2.31	
UR	52.0	53.0	53.0	0.58	0.118	52.67	2.43	0.92	
UT									•
UW	48.0	49.0	48.0	0.58	0.118	48.33	0.93	-0.58	
UX									•
UY	43.0	44.0	41.0	1.53	0.354	42.67	-1.03	-2.54	
VA	46.0	47.0	45.0	1.00	0.236	46.00	0.12	-1.39	
VC	49.0	46.0	47.0	1.53	0.354	47.33	0.58	-0.92	
VE									•
VG	44.0	43.0	43.0	0.58	0.118	43.33	-0.80	-2.31	
VH	41.0	41.0	43.0	1.15	0.236	41.67	-1.38	-2.89	
VI	39.0	39.0	37.0	1.15	0.236	38.33	-2.53	-4.04	⇓
VM	49.0	52.0	51.0	1.53	0.354	50.67	1.74	0.23	
VO	50.0	46.0	50.0	2.31	0.473	48.67	1.05	-0.46	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VR									•
VS	44.0	41.0	43.0	1.53	0.354	42.67	-1.03	-2.54	
VT									•
VU									•
W	43.0	43.0	43.0	0.00	0.000	43.00	-0.92	-2.42	
WD	42.0	44.0	41.0	1.53	0.354	42.33	-1.15	-2.66	
WF	44.0	41.0	39.0	2.52	0.591	41.33	-1.49	-3.00	
WI	39.0	41.0	38.0	1.53	0.354	39.33	-2.19	-3.70	⇓
WJ	46.0	45.0	47.0	1.00	0.236	46.00	0.12	-1.39	
WK	44.0	45.0	45.0	0.58	0.118	44.67	-0.34	-1.85	
X	50.0	49.0	48.0	1.00	0.236	49.00	1.16	-0.35	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00	×	CG	42.33		AH	44.33		SZ
24.33	×	FZ	42.67		VS	44.33		SC
33.67	⇓	TR	42.67		UY	44.33		D
36.67	⇓	BW	42.67		SX	44.33		CS
37.67	⇓	PV	42.67		RR	44.33		CK
37.67	⇓	NZ	42.67		PI	44.67		WK
38.00	⇓	DZ	42.67		M	44.67		OA
38.33	⇓	VI	42.67		DH	44.67		DE
38.33	⇓	NK	42.67		BC	44.67		BM
39.33	⇓	WI	43.00		W	45.00		SF
39.33	⇓	QW	43.00		NJ	45.00		S
40.00	⇓	PQ	43.00		JE	45.00		RO
40.00	⇓	KH	43.00		HX	45.00		PB
40.00	⇓	A	43.00		AJ	45.00		FU
40.33	⇓	SV	43.33		VG	45.00		FL
40.33	⇓	QU	43.33		UP	45.00		DT
40.33	⇓	JG	43.33		OZ	45.00		DM
40.67	⇓	GL	43.33		NH	45.00		DG
40.67	⇓	AW	43.67		TH	45.00		AL
41.00	⇓	K	43.67		QT	45.00		AK
41.33		WF	43.67		BL	45.33		UN
41.67		VH	44.00		TQ	45.33		QX
41.67		QZ	44.00		TC	45.33		GE
42.00		OM	44.00		RH	45.67		TD
42.00		NP	44.00		Q	45.67		T
42.00		EB	44.00		PM	45.67		I
42.00		AI	44.00		MQ	45.67		DL
42.33		WD	44.00		JI	46.00		WJ
42.33		OK	44.00		DO	46.00		VA
42.33		KL	44.00		AU	46.00		RZ
42.33		GI	44.33		TL	46.00		LF

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

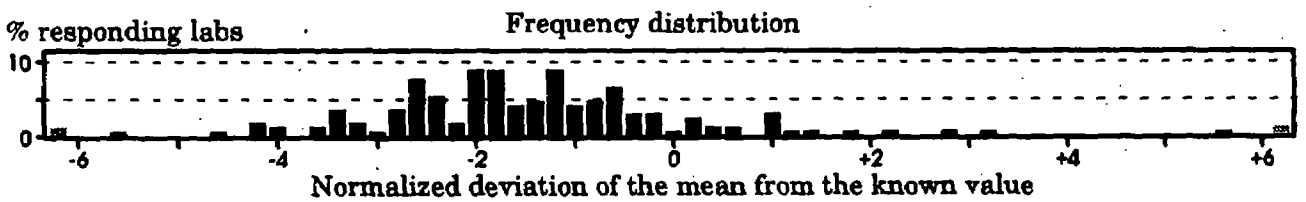
× ≡ Determined to be an outlier

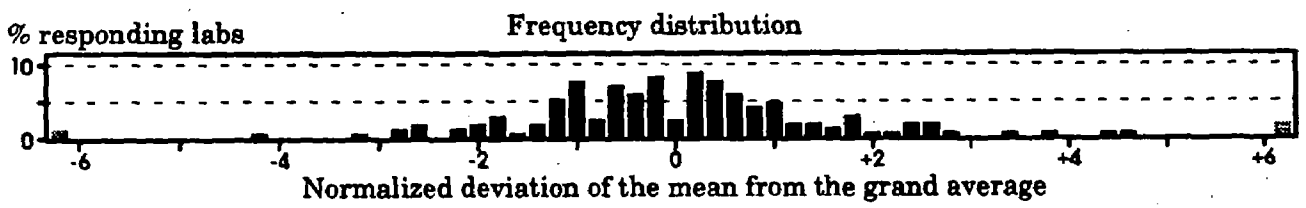
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
46.00		HL	47.67		U	49.67		UE
46.00		CO	47.67		TI	49.67		SI
46.00		CA	47.67		RU	49.67		C
46.00		AF	47.67		CQ	50.00		SM
46.33		TS	47.67		CC	50.33		MV
46.33		PW	47.67		BB	50.67		VM
46.33		NO	47.67		AP	50.67		SN
46.33		N	47.67		AE	50.67		J
46.33		HP	48.00		SD	51.00		O
46.33		E	48.00		RF	51.00		L
46.33		DD	48.00		QP	51.67		LR
46.67		SR	48.00		LT	52.00		HI
46.67		KX	48.00		CM	52.67		UR
46.67		EX	48.00		BA	52.67		P
46.67		EW	48.00		AY	52.67		BK
46.67		EL	48.33		UW	53.00		ML
46.67		CX	48.33		SS	53.00		IC
46.67		CP	48.33		JS	53.33		OL
46.67		CJ	48.33		BH	54.00		TO
47.00		R	48.67		VO	55.33		LE
47.00		MP	48.67		RV	56.33		GQ
47.00		HK	48.67		FJ	58.33		AZ
47.00		EZ	48.67		AN	59.00	⇑	BG
47.00		EA	49.00		X	66.00	×	BI
47.33		VC	49.33		HJ	74.67	×	TB
47.33		BO	49.33		CE	357.33	×	JY





• ≡ No data submitted
∅ ≡ Insufficient data

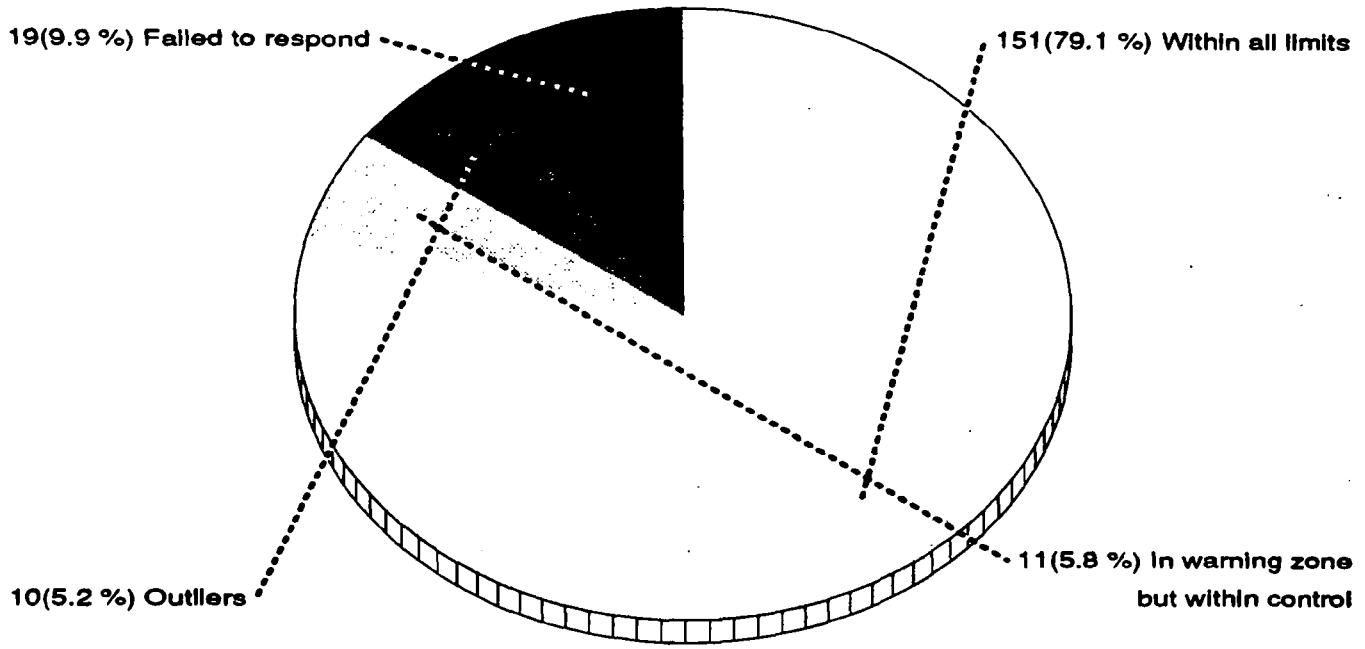
TAG SYMBOLS

× ≡ Determined to be an outlier

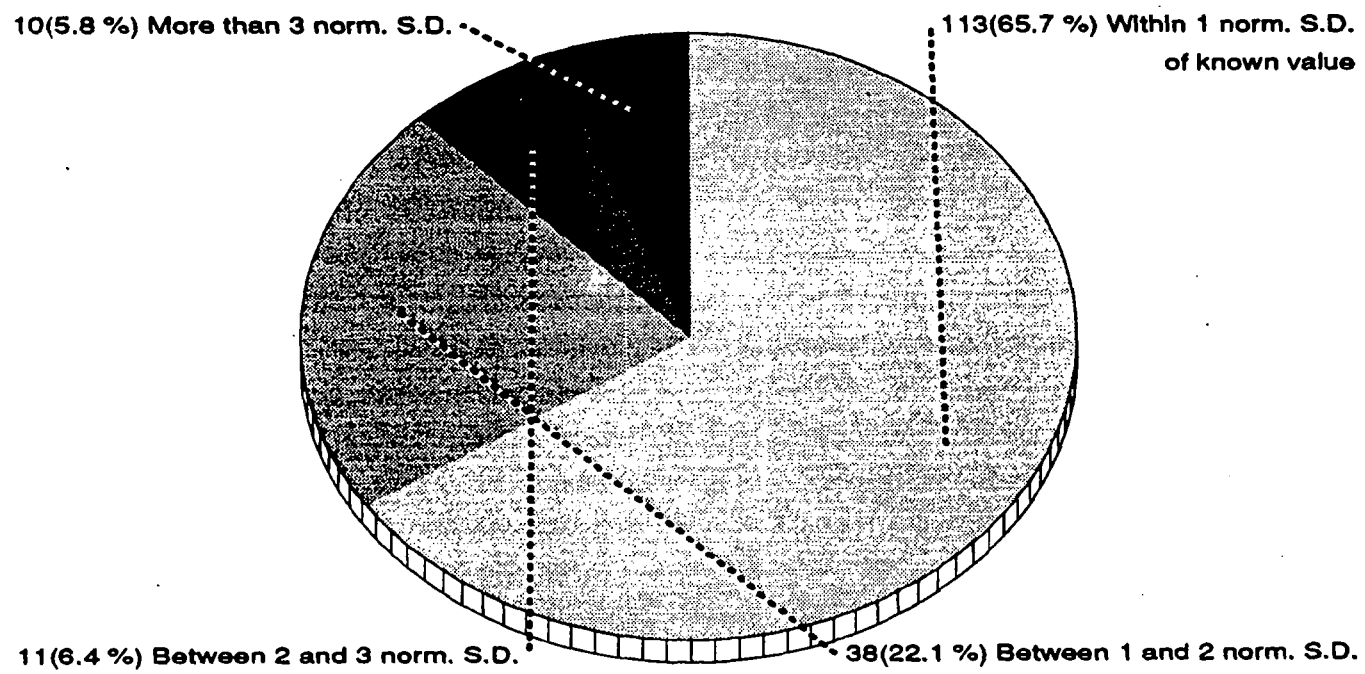
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137 Statistical Summary 191 Participants

The known value of this nuclide is **35.0 pCi/l** with an expected precision of **5.0**; the control limits are 26.3 to 43.7; the warning regions are 26.3 to 29.2 and 40.8 to 43.7



Statistic	Respondents	Non-outliers
Mean	38.14	**Grand Avg 35.49**
Std. Dev.	23.01	2.90
Variance	529.37	8.42
% Coef. of Var.	60.32	8.18
% deviation of mean from known value	8.98	1.40
Norm. dev. of mean from known value	0.14	0.17
Median	35.67	35.33
% deviation of median from known value	1.90	0.95
Norm. dev. of median from known value	0.03	0.11



CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	30.0	34.0	33.0	2.08	0.473	32.33	-1.09	-0.92	
AE	38.0	38.0	37.0	0.58	0.118	37.67	0.75	0.92	
AF	33.0	37.0	36.0	2.08	0.473	35.33	-0.05	0.12	
AH	33.0	34.0	34.0	0.58	0.118	33.67	-0.63	-0.46	
AI	32.0	31.0	32.0	0.58	0.118	31.67	-1.32	-1.15	
AJ	34.0	34.0	37.0	1.73	0.354	35.00	-0.17	0.00	
AK	36.0	36.0	35.0	0.58	0.118	35.67	0.06	0.23	
AL	26.0	22.0	23.0	2.08	0.473	23.67	-4.10	-3.93	×
AN	34.0	38.0	35.0	2.08	0.473	35.67	0.06	0.23	
AP	35.0	36.0	37.0	1.00	0.236	36.00	0.18	0.35	
AU	35.0	33.0	36.0	1.53	0.354	34.67	-0.29	-0.12	
AW	38.0	38.0	34.0	2.31	0.473	36.67	0.41	0.58	
AY	30.0	32.0	34.0	2.00	0.473	32.00	-1.21	-1.04	
AZ	41.0	34.0	43.0	4.73	1.120	39.33	1.33	1.50	
BA	29.0	31.0	31.0	1.15	0.236	30.33	-1.79	-1.62	
BB	35.0	34.0	35.0	0.58	0.118	34.67	-0.29	-0.12	
BC	34.0	35.0	35.0	0.58	0.118	34.67	-0.29	-0.12	
BG	40.0	31.0	24.0	8.02	2.695	31.67	-1.32	-1.15	
BH	33.0	39.0	38.0	3.21	0.709	36.67	0.41	0.58	
BI	25.0	31.0	37.0	6.00	1.795	31.00	-1.56	-1.39	
BK	43.0	43.0	42.0	0.58	0.118	42.67	2.49	2.66	
BL	34.0	34.0	34.0	0.00	0.000	34.00	-0.52	-0.35	
BM	35.0	36.0	35.0	0.58	0.118	35.33	-0.05	0.12	
BN									•
BO	35.0	34.0	36.0	1.00	0.236	35.00	-0.17	0.00	
BW	36.0	32.0	29.0	3.51	0.827	32.33	-1.09	-0.92	
C	56.0	53.0	61.0	4.04	0.945	56.67	7.34	7.51	×
CA	36.0	36.0	38.0	1.15	0.236	36.67	0.41	0.58	
CC	36.0	35.0	35.0	0.58	0.118	35.33	-0.05	0.12	
CE	41.0	40.0	38.0	1.53	0.354	39.67	1.45	1.62	
CG	68.0	53.0	45.0	11.68	4.271	55.33	6.87	7.04	×
CJ	37.0	37.0	39.0	1.15	0.236	37.67	0.75	0.92	
CK	38.0	32.0	31.0	3.79	0.827	33.67	-0.63	-0.46	
CM	38.0	36.0	33.0	2.52	0.591	35.67	0.06	0.23	
CO	40.0	41.0	38.0	1.53	0.354	39.67	1.45	1.62	
CP	35.0	34.0	35.0	0.58	0.118	34.67	-0.29	-0.12	
CQ	43.0	39.0	41.0	2.00	0.473	41.00	1.91	2.08	
CS	35.0	37.0	35.0	1.15	0.236	35.67	0.06	0.23	
CX	39.0	36.0	39.0	1.73	0.354	38.00	0.87	1.04	
D	34.0	34.0	36.0	1.15	0.236	34.67	-0.29	-0.12	
DD	36.0	36.0	36.0	0.00	0.000	36.00	0.18	0.35	
DE	34.0	34.0	34.0	0.00	0.000	34.00	-0.52	-0.35	
DG	44.0	49.0	45.0	2.65	0.591	46.00	3.64	3.81	×
DH	34.0	34.0	34.0	0.00	0.000	34.00	-0.52	-0.35	
DL	32.0	37.0	33.0	2.65	0.591	34.00	-0.52	-0.35	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	35.0	36.0	36.0	0.58	0.118	35.67	0.06	0.23	
DO	28.0	29.0	30.0	1.00	0.236	29.00	-2.25	-2.08	
DT	36.0	34.0	41.0	3.61	0.827	37.00	0.52	0.69	
DZ	43.0	38.0	41.0	2.52	0.591	40.67	1.79	1.96	
E	37.0	35.0	38.0	1.53	0.354	36.67	0.41	0.58	
EA	33.0	32.0	33.0	0.58	0.118	32.67	-0.98	-0.81	
EB	36.0	36.0	36.0	0.00	0.000	36.00	0.18	0.35	
EL	34.0	35.0	35.0	0.58	0.118	34.67	-0.29	-0.12	
EN									•
EW	35.0	34.0	34.0	0.58	0.118	34.33	-0.40	-0.23	
EX	36.0	33.0	34.0	1.53	0.354	34.33	-0.40	-0.23	
EZ	41.0	37.0	38.0	2.08	0.473	38.67	1.10	1.27	
FJ	37.0	33.0	37.0	2.31	0.473	35.67	0.06	0.23	
FK									•
FL	35.0	37.0	36.0	1.00	0.236	36.00	0.18	0.35	
FU	33.0	33.0	32.0	0.58	0.118	32.67	-0.98	-0.81	
FZ	18.0	17.0	17.0	0.58	0.118	17.33	-6.29	-6.12	×
GE	34.0	32.0	33.0	1.00	0.236	33.00	-0.86	-0.69	
GI	35.0	35.0	36.0	0.58	0.118	35.33	-0.05	0.12	
GL	36.0	35.0	33.0	1.53	0.354	34.67	-0.29	-0.12	
GQ	37.0	40.0	40.0	1.73	0.354	39.00	1.22	1.39	
HI	39.0	43.0	48.0	4.51	1.120	43.33	2.72	2.89	
HJ	35.0	33.0	34.0	1.00	0.236	34.00	-0.52	-0.35	
HK	38.0	36.0	35.0	1.53	0.354	36.33	0.29	0.46	
HL	37.0	37.0	37.0	0.00	0.000	37.00	0.52	0.69	
HP	39.0	37.0	37.0	1.15	0.236	37.67	0.75	0.92	
HX	35.0	35.0	36.0	0.58	0.118	35.33	-0.05	0.12	
I	32.0	34.0	37.0	2.52	0.591	34.33	-0.40	-0.23	
IC	39.0	38.0	38.0	0.58	0.118	38.33	0.99	1.15	
J	36.0	35.0	35.0	0.58	0.118	35.33	-0.05	0.12	
JE	34.0	34.0	34.0	0.00	0.000	34.00	-0.52	-0.35	
JG	32.0	35.0	33.0	1.53	0.354	33.33	-0.75	-0.58	
JI	35.0	37.0	33.0	2.00	0.473	35.00	-0.17	0.00	
JS	37.0	37.0	35.0	1.15	0.236	36.33	0.29	0.46	
JY	312.0	296.0	335.0	19.60	7.871	314.33	96.59	96.76	×
K	34.0	32.0	33.0	1.00	0.236	33.00	-0.86	-0.69	
KH	38.0	37.0	37.0	0.58	0.118	37.33	0.64	0.81	
KL	34.0	34.0	32.0	1.15	0.236	33.33	-0.75	-0.58	
KX	34.0	35.0	34.0	0.58	0.118	34.33	-0.40	-0.23	
L	39.0	39.0	39.0	0.00	0.000	39.00	1.22	1.39	
LE	56.0	45.0	42.0	7.37	2.245	47.67	4.22	4.39	×
LF	32.0	36.0	37.0	2.65	0.591	35.00	-0.17	0.00	
LR	36.0	35.0	37.0	1.00	0.236	36.00	0.18	0.35	
LT	38.0	35.0	38.0	1.73	0.354	37.00	0.52	0.69	
M	34.0	34.0	34.0	0.00	0.000	34.00	-0.52	-0.35	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

 CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
MA									•
ML	65.0	60.0	54.0	5.51	1.570	59.67	8.38	8.54	×
MP	37.0	35.0	37.0	1.15	0.236	36.33	0.29	0.46	
MQ	37.0	47.0	36.0	6.08	1.570	40.00	1.56	1.73	
MV	44.0	42.0	43.0	1.00	0.236	43.00	2.60	2.77	
MY									•
N	36.0	35.0	38.0	1.53	0.354	36.33	0.29	0.46	
NH	35.0	38.0	36.0	1.53	0.354	36.33	0.29	0.46	
NJ	33.0	35.0	34.0	1.00	0.236	34.00	-0.52	-0.35	
NK	26.0	33.0	33.0	4.04	0.827	30.67	-1.67	-1.50	
NO	35.0	36.0	38.0	1.53	0.354	36.33	0.29	0.46	
NP	34.0	33.0	32.0	1.00	0.236	33.00	-0.86	-0.69	
NZ	30.0	27.0	29.0	1.53	0.354	28.67	-2.36	-2.19	
O	39.0	39.0	40.0	0.58	0.118	39.33	1.33	1.50	
OA	33.0	33.0	36.0	1.73	0.354	34.00	-0.52	-0.35	
OB	33.0	34.0	32.0	1.00	0.236	33.00	-0.86	-0.69	
OK	28.0	27.0	26.0	1.00	0.236	27.00	-2.94	-2.77	
OL	32.0	38.0	34.0	3.06	0.709	34.67	-0.29	-0.12	
OM	36.0	36.0	35.0	0.58	0.118	35.67	0.06	0.23	
OZ	35.0	36.0	34.0	1.00	0.236	35.00	-0.17	0.00	
P	41.0	40.0	42.0	1.00	0.236	41.00	1.91	2.08	
PB	35.0	35.0	35.0	0.00	0.000	35.00	-0.17	0.00	
PE									•
PI	35.0	33.0	34.0	1.00	0.236	34.00	-0.52	-0.35	
PM	35.0	42.0	36.0	3.79	0.827	37.67	0.75	0.92	
PQ	30.0	33.0	30.0	1.73	0.354	31.00	-1.56	-1.39	
PU									•
PV	29.0	33.0	34.0	2.65	0.591	32.00	-1.21	-1.04	
PW	35.0	35.0	35.0	0.00	0.000	35.00	-0.17	0.00	
Q	34.0	35.0	36.0	1.00	0.236	35.00	-0.17	0.00	
QJ									•
QP	38.0	41.0	40.0	1.53	0.354	39.67	1.45	1.62	
QT	34.0	33.0	34.0	0.58	0.118	33.67	-0.63	-0.46	
QU	26.0	28.0	27.0	1.00	0.236	27.00	-2.94	-2.77	
QW	27.0	28.0	27.0	0.58	0.118	27.33	-2.83	-2.66	
QX	39.0	39.0	38.0	0.58	0.118	38.67	1.10	1.27	
QZ	34.0	35.0	34.0	0.58	0.118	34.33	-0.40	-0.23	
R	36.0	38.0	39.0	1.53	0.354	37.67	0.75	0.92	
RF	32.0	32.0	31.0	0.58	0.118	31.67	-1.32	-1.15	
RH	36.0	34.0	33.0	1.53	0.354	34.33	-0.40	-0.23	
RL									•
RO	36.0	36.0	36.0	0.00	0.000	36.00	0.18	0.35	
RR	35.0	33.0	35.0	1.15	0.236	34.33	-0.40	-0.23	
RU	39.0	41.0	34.0	3.61	0.827	38.00	0.87	1.04	
RV	42.0	46.0	34.0	6.11	1.795	40.67	1.79	1.96	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RX									•
RZ	33.0	31.0	32.0	1.00	0.236	32.00	-1.21	-1.04	
S	36.0	35.0	35.0	0.58	0.118	35.33	-0.05	0.12	
SC	32.0	37.0	37.0	2.89	0.591	35.33	-0.05	0.12	
SD	36.0	41.0	43.0	3.61	0.827	40.00	1.56	1.73	
SF	41.0	39.0	37.0	2.00	0.473	39.00	1.22	1.39	
SI	37.0	39.0	37.0	1.15	0.236	37.67	0.75	0.92	
SM	36.0	40.0	39.0	2.08	0.473	38.33	0.99	1.15	
SN	39.0	41.0	37.0	2.00	0.473	39.00	1.22	1.39	
SR	35.0	34.0	38.0	2.08	0.473	35.67	0.06	0.23	
SS	40.0	37.0	42.0	2.52	0.591	39.67	1.45	1.62	
ST									•
SV	35.0	37.0	39.0	2.00	0.473	37.00	0.52	0.69	
SX	33.0	32.0	33.0	0.58	0.118	32.67	-0.98	-0.81	
SZ	36.0	36.0	36.0	0.00	0.000	36.00	0.18	0.35	
T	36.0	36.0	36.0	0.00	0.000	36.00	0.18	0.35	
TB	58.0	53.0	53.0	2.89	0.591	54.67	6.64	6.81	×
TC	36.0	35.0	40.0	2.65	0.591	37.00	0.52	0.69	
TD	35.0	36.0	32.0	2.08	0.473	34.33	-0.40	-0.23	
TE									•
TH	34.0	34.0	35.0	0.58	0.118	34.33	-0.40	-0.23	
TI	36.0	36.0	37.0	0.58	0.118	36.33	0.29	0.46	
TL	26.0	27.0	34.0	4.36	0.945	29.00	-2.25	-2.08	
TO	38.0	38.0	38.0	0.00	0.000	38.00	0.87	1.04	
TQ	35.0	36.0	34.0	1.00	0.236	35.00	-0.17	0.00	
TR	33.0	36.0	38.0	2.52	0.591	35.67	0.06	0.23	
TS	36.0	32.0	38.0	3.06	0.709	35.33	-0.05	0.12	
U	36.0	35.0	34.0	1.00	0.236	35.00	-0.17	0.00	
UE	34.0	35.0	36.0	1.00	0.236	35.00	-0.17	0.00	
UM									•
UN	41.0	32.0	41.0	5.20	1.120	38.00	0.87	1.04	
UP	36.0	37.0	35.0	1.00	0.236	36.00	0.18	0.35	
UR	34.0	39.0	39.0	2.89	0.591	37.33	0.64	0.81	
UT									•
UW	33.0	36.0	36.0	1.73	0.354	35.00	-0.17	0.00	
UX									•
UY	30.0	31.0	33.0	1.53	0.354	31.33	-1.44	-1.27	
VA	34.0	35.0	38.0	2.08	0.473	35.67	0.06	0.23	
VC	37.0	38.0	38.0	0.58	0.118	37.67	0.75	0.92	
VE									•
VG	31.0	30.0	32.0	1.00	0.236	31.00	-1.56	-1.39	
VH	33.0	32.0	32.0	0.58	0.118	32.33	-1.09	-0.92	
VI	36.0	36.0	36.0	0.00	0.000	36.00	0.18	0.35	
VM	37.0	37.0	37.0	0.00	0.000	37.00	0.52	0.69	
VO	38.0	40.0	38.0	1.15	0.236	38.67	1.10	1.27	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VR									•
VS	44.0	41.0	37.0	3.51	0.827	40.67	1.79	1.96	
VT									•
VU									•
W	36.0	34.0	31.0	2.52	0.591	33.67	-0.63	-0.46	
WD	33.0	34.0	34.0	0.58	0.118	33.67	-0.63	-0.46	
WF	36.0	37.0	37.0	0.58	0.118	36.67	0.41	0.58	
WI	35.0	40.0	40.0	2.89	0.591	38.33	0.99	1.15	
WJ	35.0	38.0	35.0	1.73	0.354	36.00	0.18	0.35	
WK	140.0	132.0	136.0	4.00	0.945	136.00	34.82	34.99	×
X	39.0	41.0	36.0	2.52	0.591	38.67	1.10	1.27	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
17.33	×	FZ	33.33		JG	34.67		BB
23.67	×	AL	33.67		WD	34.67		AU
27.00		QU	33.67		W	35.00		UW
27.00		OK	33.67		QT	35.00		UE
27.33		QW	33.67		CK	35.00		U
28.67		NZ	33.67		AH	35.00		TQ
29.00		TL	34.00		PI	35.00		Q
29.00		DO	34.00		OA	35.00		PW
30.33		BA	34.00		NJ	35.00		PB
30.67		NK	34.00		M	35.00		OZ
31.00		VG	34.00		JE	35.00		LF
31.00		PQ	34.00		HJ	35.00		JI
31.00		BI	34.00		DL	35.00		BO
31.33		UY	34.00		DH	35.00		AJ
31.67		RF	34.00		DE	35.33		TS
31.67		BG	34.00		BL	35.33		SC
31.67		AI	34.33		TH	35.33		S
32.00		RZ	34.33		TD	35.33		J
32.00		PV	34.33		RR	35.33		HX
32.00		AY	34.33		RH	35.33		GI
32.33		VH	34.33		QZ	35.33		CC
32.33		BW	34.33		KX	35.33		BM
32.33		A	34.33		I	35.33		AF
32.67		SX	34.33		EX	35.67		VA
32.67		FU	34.33		EW	35.67		TR
32.67		EA	34.67		OL	35.67		SR
33.00		OB	34.67		GL	35.67		OM
33.00		NP	34.67		EL	35.67		FJ
33.00		K	34.67		D	35.67		DM
33.00		GE	34.67		CP	35.67		CS
33.33		KL	34.67		BC	35.67		CM

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∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

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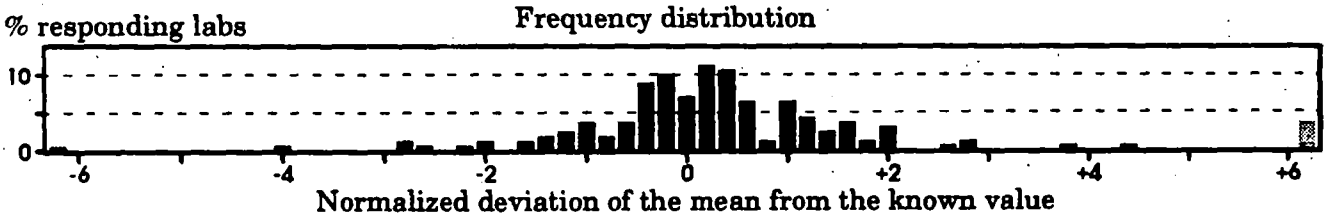
⇓ ≡ Below control limit

Cesium-137

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
35.67		AN	37.00		TC	39.00		SF
35.67		AK	37.00		SV	39.00		L
36.00		WJ	37.00		LT	39.00		GQ
36.00		VI	37.00		HL	39.33		O
36.00		UP	37.00		DT	39.33		AZ
36.00		T	37.33		UR	39.67		SS
36.00		SZ	37.33		KH	39.67		QP
36.00		RO	37.67		VC	39.67		CO
36.00		LR	37.67		SI	39.67		CE
36.00		FL	37.67		R	40.00		SD
36.00		EB	37.67		PM	40.00		MQ
36.00		DD	37.67		HP	40.67		VS
36.00		AP	37.67		CJ	40.67		RV
36.33		TI	37.67		AE	40.67		DZ
36.33		NO	38.00		UN	41.00		P
36.33		NH	38.00		TO	41.00		CQ
36.33		N	38.00		RU	42.67		BK
36.33		MP	38.00		CX	43.00		MV
36.33		JS	38.33		WI	43.33		HI
36.33		HK	38.33		SM	46.00	×	DG
36.67		WF	38.33		IC	47.67	×	LE
36.67		E	38.67		X	54.67	×	TB
36.67		CA	38.67		VO	55.33	×	CG
36.67		BH	38.67		QX	56.67	×	C
36.67		AW	38.67		EZ	59.67	×	ML
37.00		VM	39.00		SN	136.00	×	WK
						314.33	×	JY



• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

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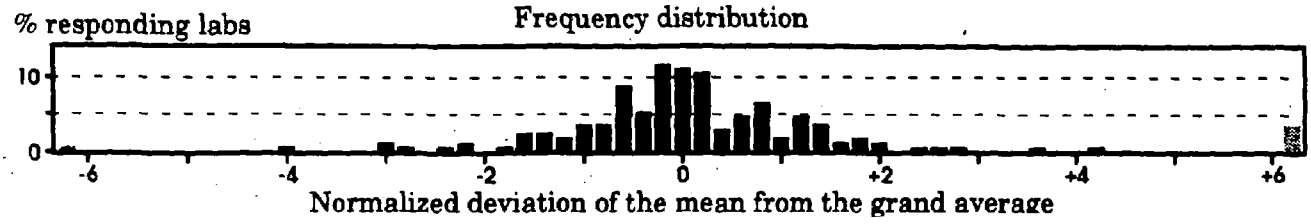
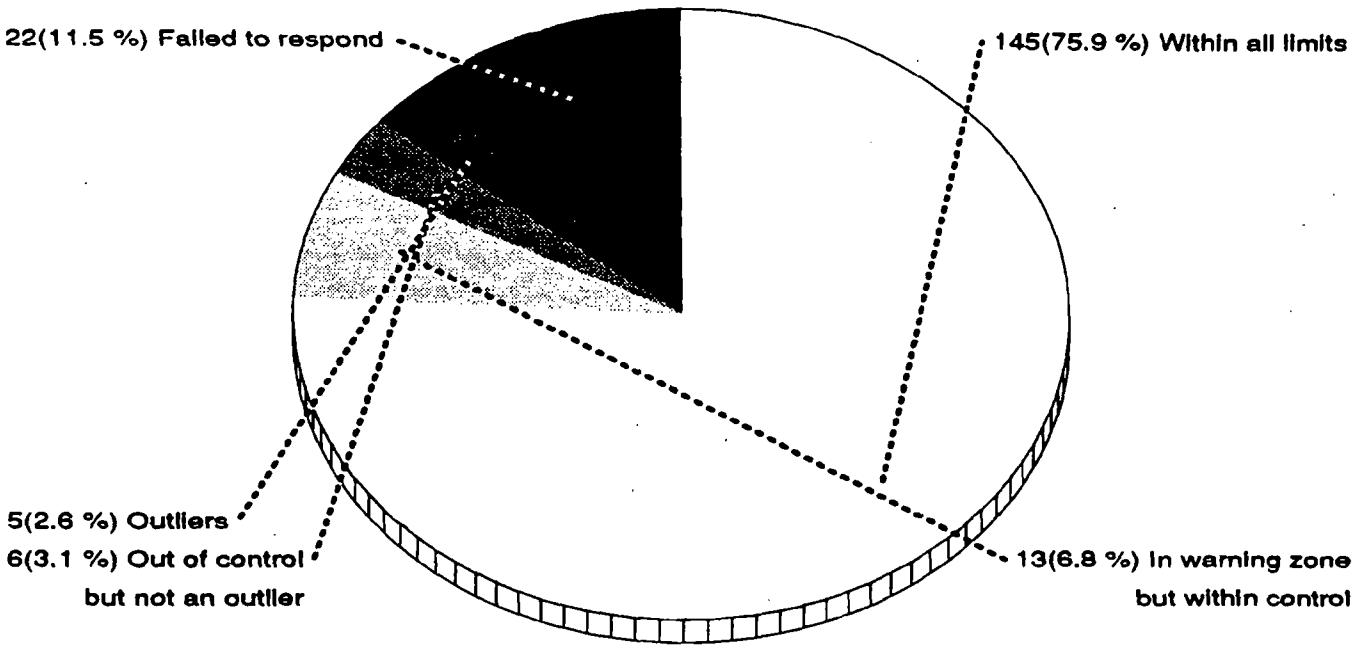
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

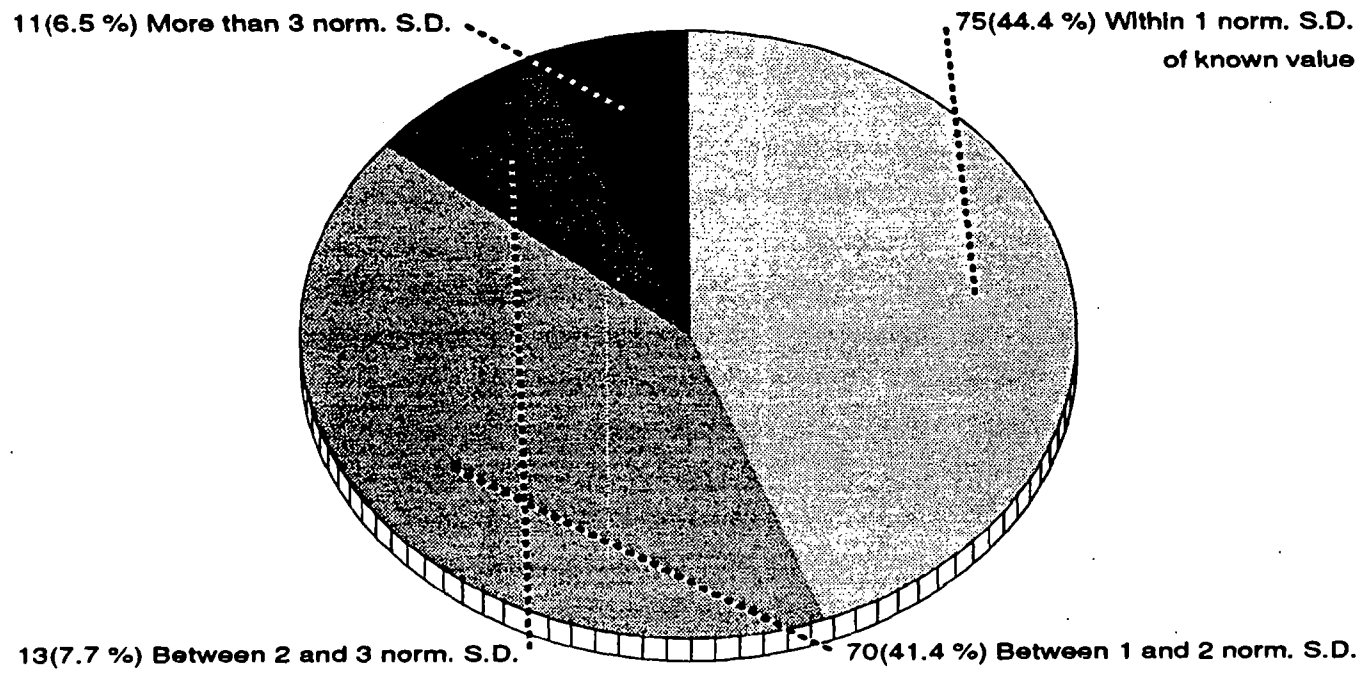

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Barium-133 Statistical Summary 191 Participants

The known value of this nuclide is **79.0 pCi/l** with an expected precision of **8.0**; the control limits are 65.1 to 92.9; the warning regions are 65.1 to 69.7 and 88.3 to 92.9



Statistic	Respondents	Non-outliers
Mean	79.52	**Grand Avg 76.16**
Std. Dev.	44.59	5.46
Variance	1988.16	29.77
% Coef. of Var.	56.07	7.16
% deviation of mean from known value	0.66	-3.59
Norm. dev. of mean from known value	0.01	-0.52
Median	75.67	75.67
% deviation of median from known value	-4.22	-4.22
Norm. dev. of median from known value	-0.07	-0.61



CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	68.0	74.0	71.0	3.00	0.443	71.00	-1.12	-1.73	
AE	88.0	84.0	79.0	4.51	0.665	83.67	1.63	1.01	
AF	80.0	82.0	80.0	1.15	0.148	80.67	0.98	0.36	
AH	74.0	74.0	71.0	1.73	0.222	73.00	-0.68	-1.30	
AI	73.0	72.0	72.0	0.58	0.074	72.33	-0.83	-1.44	
AJ	77.0	78.0	79.0	1.00	0.148	78.00	0.40	-0.22	
AK	76.0	74.0	73.0	1.53	0.222	74.33	-0.40	-1.01	
AL	83.0	78.0	79.0	2.65	0.369	80.00	0.83	0.22	
AN	79.0	80.0	89.0	5.51	0.738	82.67	1.41	0.79	
AP	71.0	72.0	73.0	1.00	0.148	72.00	-0.90	-1.52	
AU	72.0	83.0	76.0	5.57	0.812	77.00	0.18	-0.43	
AW	76.0	71.0	72.0	2.65	0.369	73.00	-0.68	-1.30	
AY	74.0	69.0	76.0	3.61	0.517	73.00	-0.68	-1.30	
AZ	84.0	82.0	82.0	1.15	0.148	82.67	1.41	0.79	
BA	77.0	79.0	80.0	1.53	0.222	78.67	0.54	-0.07	
BB	75.0	72.0	74.0	1.53	0.222	73.67	-0.54	-1.15	
BC	69.0	69.0	70.0	0.58	0.074	69.33	-1.48	-2.09	
BG	96.0	82.0	84.0	7.57	1.064	87.33	2.42	1.80	
BH	73.0	77.0	74.0	2.08	0.295	74.67	-0.32	-0.94	
BI	110.0	91.0	108.0	10.44	1.767	103.00	5.81	5.20	×
BK	80.0	80.0	80.0	0.00	0.000	80.00	0.83	0.22	
BL	78.0	75.0	75.0	1.73	0.222	76.00	-0.03	-0.65	
BM	86.0	80.0	80.0	3.46	0.443	82.00	1.26	0.65	
BN									•
BO	77.0	78.0	78.0	0.58	0.074	77.67	0.33	-0.29	
BW									•
C	87.0	83.0	81.0	3.06	0.443	83.67	1.63	1.01	
CA	82.0	81.0	79.0	1.53	0.222	80.67	0.98	0.36	
CC	75.0	70.0	67.0	4.04	0.591	70.67	-1.19	-1.80	
CE	86.0	80.0	84.0	3.06	0.443	83.33	1.55	0.94	
CG									•
CJ	72.0	76.0	75.0	2.08	0.295	74.33	-0.40	-1.01	
CK	70.0	68.0	69.0	1.00	0.148	69.00	-1.55	-2.17	
CM	77.0	78.0	85.0	4.36	0.591	80.00	0.83	0.22	
CO	82.0	69.0	76.0	6.51	0.960	75.67	-0.11	-0.72	
CP	81.0	82.0	80.0	1.00	0.148	81.00	1.05	0.43	
CQ	79.0	79.0	82.0	1.73	0.222	80.00	0.83	0.22	
CS	72.0	77.0	74.0	2.52	0.369	74.33	-0.40	-1.01	
CX	73.0	74.0	73.0	0.58	0.074	73.33	-0.61	-1.23	
D	73.0	73.0	77.0	2.31	0.295	74.33	-0.40	-1.01	
DD	82.0	84.0	78.0	3.06	0.443	81.33	1.12	0.51	
DE	74.0	75.0	75.0	0.58	0.074	74.67	-0.32	-0.94	
DG	76.0	75.0	77.0	1.00	0.148	76.00	-0.03	-0.65	
DH	72.0	72.0	72.0	0.00	0.000	72.00	-0.90	-1.52	
DL	84.0	76.0	82.0	4.16	0.591	80.67	0.98	0.36	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	74.0	82.0	74.0	4.62	0.591	76.67	0.11	-0.51	
DO	80.0	87.0	76.0	5.57	0.812	81.00	1.05	0.43	
DT	74.0	76.0	79.0	2.52	0.369	76.33	0.04	-0.58	
DZ	80.0	87.0	85.0	3.61	0.517	84.00	1.70	1.08	
E	76.0	74.0	75.0	1.00	0.148	75.00	-0.25	-0.87	
EA	82.0	79.0	78.0	2.08	0.295	79.67	0.76	0.14	
EB	71.0	72.0	72.0	0.58	0.074	71.67	-0.97	-1.59	
EL	74.0	86.0	76.0	6.43	0.886	78.67	0.54	-0.07	
EN									•
EW	73.0	72.0	74.0	1.00	0.148	73.00	-0.68	-1.30	
EX	71.0	73.0	71.0	1.15	0.148	71.67	-0.97	-1.59	
EZ	82.0	79.0	76.0	3.00	0.443	79.00	0.61	0.00	
FJ	79.0	75.0	77.0	2.00	0.295	77.00	0.18	-0.43	
FK									•
FL	83.0	76.0	83.0	4.04	0.517	80.67	0.98	0.36	
FU	77.0	75.0	73.0	2.00	0.295	75.00	-0.25	-0.87	
FZ	31.0	30.0	31.0	0.58	0.074	30.67	-9.85	-10.46	×
GE	81.0	84.0	82.0	1.53	0.222	82.33	1.34	0.72	
GI	72.0	77.0	74.0	2.52	0.369	74.33	-0.40	-1.01	
GL	72.0	76.0	75.0	2.08	0.295	74.33	-0.40	-1.01	
GQ	81.0	85.0	85.0	2.31	0.295	83.67	1.63	1.01	
HI	85.0	85.0	84.0	0.58	0.074	84.67	1.84	1.23	
HJ	78.0	73.0	71.0	3.61	0.517	74.00	-0.47	-1.08	
HK	75.0	74.0	73.0	1.00	0.148	74.00	-0.47	-1.08	
HL	76.0	76.0	76.0	0.00	0.000	76.00	-0.03	-0.65	
HP	78.0	79.0	84.0	3.21	0.443	80.33	0.90	0.29	
HX	71.0	74.0	74.0	1.73	0.222	73.00	-0.68	-1.30	
I	87.0	76.0	88.0	6.66	0.886	83.67	1.63	1.01	
IC	75.0	79.0	79.0	2.31	0.295	77.67	0.33	-0.29	
J	83.0	80.0	81.0	1.53	0.222	81.33	1.12	0.51	
JE	73.0	74.0	76.0	1.53	0.222	74.33	-0.40	-1.01	
JG	63.0	69.0	64.0	3.21	0.443	65.33	-2.34	-2.96	
JI	73.0	70.0	76.0	3.00	0.443	73.00	-0.68	-1.30	
JS	76.0	75.0	76.0	0.58	0.074	75.67	-0.11	-0.72	
JY	664.0	614.0	660.0	27.78	6.127	646.00	123.37	122.76	×
K	66.0	64.0	64.0	1.15	0.148	64.67	-2.49	-3.10	⇓
KH	72.0	71.0	74.0	1.53	0.222	72.33	-0.83	-1.44	
KL	75.0	74.0	75.0	0.58	0.074	74.67	-0.32	-0.94	
KX	79.0	78.0	74.0	2.65	0.369	77.00	0.18	-0.43	
L	84.0	83.0	86.0	1.53	0.222	84.33	1.77	1.15	
LE	92.0	82.0	91.0	5.51	0.738	88.33	2.64	2.02	
LF	82.0	78.0	79.0	2.08	0.295	79.67	0.76	0.14	
LR	74.0	72.0	75.0	1.53	0.222	73.67	-0.54	-1.15	
LT	86.0	80.0	86.0	3.46	0.443	84.00	1.70	1.08	
M	70.0	68.0	71.0	1.53	0.222	69.67	-1.41	-2.02	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
MA									•
ML	85.0	82.0	85.0	1.73	0.222	84.00	1.70	1.08	
MP	79.0	77.0	78.0	1.00	0.148	78.00	0.40	-0.22	
MQ	75.0	67.0	74.0	4.36	0.591	72.00	-0.90	-1.52	
MV	88.0	88.0	89.0	0.58	0.074	88.33	2.64	2.02	
MY									•
N	77.0	82.0	80.0	2.52	0.369	79.67	0.76	0.14	
NH	74.0	72.0	76.0	2.00	0.295	74.00	-0.47	-1.08	
NJ	64.0	76.0	74.0	6.43	0.886	71.33	-1.05	-1.66	
NK	63.0	68.0	71.0	4.04	0.591	67.33	-1.91	-2.53	
NO	73.0	79.0	83.0	5.03	0.738	78.33	0.47	-0.14	
NP	70.0	70.0	70.0	0.00	0.000	70.00	-1.33	-1.95	
NZ	59.0	66.0	63.0	3.51	0.517	62.67	-2.92	-3.54	⇓
O	81.0	81.0	81.0	0.00	0.000	81.00	1.05	0.43	
OA	79.0	74.0	77.0	2.52	0.369	76.67	0.11	-0.51	
OB									•
OK	82.0	80.0	85.0	2.52	0.369	82.33	1.34	0.72	
OL	70.0	82.0	66.0	8.33	1.345	72.67	-0.76	-1.37	
OM	72.0	74.0	76.0	2.00	0.295	74.00	-0.47	-1.08	
OZ	43.0	43.0	44.0	0.58	0.074	43.33	-7.11	-7.72	×
P	77.0	80.0	81.0	2.08	0.295	79.33	0.69	0.07	
PB	65.0	66.0	65.0	0.58	0.074	65.33	-2.34	-2.96	
PE									•
PI	70.0	70.0	71.0	0.58	0.074	70.33	-1.26	-1.88	
PM	73.0	70.0	72.0	1.53	0.222	71.67	-0.97	-1.59	
PQ	62.0	66.0	65.0	2.08	0.295	64.33	-2.56	-3.18	⇓
PU									•
PV	63.0	76.0	67.0	6.66	0.960	68.67	-1.62	-2.24	
PW	73.0	74.0	70.0	2.08	0.295	72.33	-0.83	-1.44	
Q	70.0	69.0	74.0	2.65	0.369	71.00	-1.12	-1.73	
QJ									•
QP	80.0	77.0	78.0	1.53	0.222	78.33	0.47	-0.14	
QT	75.0	74.0	73.0	1.00	0.148	74.00	-0.47	-1.08	
QU	85.0	86.0	84.0	1.00	0.148	85.00	1.91	1.30	
QW	87.0	85.0	87.0	1.15	0.148	86.33	2.20	1.59	
QX	76.0	78.0	76.0	1.15	0.148	76.67	0.11	-0.51	
QZ	74.0	70.0	74.0	2.31	0.295	72.67	-0.76	-1.37	
R	75.0	73.0	75.0	1.15	0.148	74.33	-0.40	-1.01	
RF	71.0	74.0	71.0	1.73	0.222	72.00	-0.90	-1.52	
RH	70.0	74.0	74.0	2.31	0.295	72.67	-0.76	-1.37	
RL									•
RO	74.0	70.0	71.0	2.08	0.295	71.67	-0.97	-1.59	
RR	67.0	74.0	68.0	3.79	0.517	69.67	-1.41	-2.02	
RU	84.0	78.0	75.0	4.58	0.665	79.00	0.61	0.00	
RV	83.0	87.0	78.0	4.51	0.665	82.67	1.41	0.79	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RX									•
RZ	69.0	70.0	70.0	0.58	0.074	69.67	-1.41	-2.02	
S	76.0	79.0	77.0	1.53	0.222	77.33	0.25	-0.36	
SC	73.0	72.0	72.0	0.58	0.074	72.33	-0.83	-1.44	
SD	72.0	74.0	76.0	2.00	0.295	74.00	-0.47	-1.08	
SF	76.0	79.0	85.0	4.58	0.665	80.00	0.83	0.22	
SI	79.0	76.0	77.0	1.53	0.222	77.33	0.25	-0.36	
SM	79.0	83.0	80.0	2.08	0.295	80.67	0.98	0.36	
SN	76.0	72.0	75.0	2.08	0.295	74.33	-0.40	-1.01	
SR	74.0	78.0	75.0	2.08	0.295	75.67	-0.11	-0.72	
SS	83.0	78.0	81.0	2.52	0.369	80.67	0.98	0.36	
ST									•
SV	80.0	79.0	79.0	0.58	0.074	79.33	0.69	0.07	
SX	82.0	81.0	82.0	0.58	0.074	81.67	1.19	0.58	
SZ	77.0	73.0	76.0	2.08	0.295	75.33	-0.18	-0.79	
T	75.0	78.0	83.0	4.04	0.591	78.67	0.54	-0.07	
TB	126.0	126.0	126.0	0.00	0.000	126.00	10.79	10.18	×
TC	80.0	79.0	82.0	1.53	0.222	80.33	0.90	0.29	
TD	72.0	77.0	70.0	3.61	0.517	73.00	-0.68	-1.30	
TE									•
TH	74.0	75.0	71.0	2.08	0.295	73.33	-0.61	-1.23	
TI	86.0	81.0	84.0	2.52	0.369	83.67	1.63	1.01	
TL	68.0	74.0	78.0	5.03	0.738	73.33	-0.61	-1.23	
TO	67.0	67.0	66.0	0.58	0.074	66.67	-2.06	-2.67	
TQ	77.0	70.0	75.0	3.61	0.517	74.00	-0.47	-1.08	
TR	76.0	73.0	72.0	2.08	0.295	73.67	-0.54	-1.15	
TS	59.0	62.0	67.0	4.04	0.591	62.67	-2.92	-3.54	⇓
U	76.0	75.0	76.0	0.58	0.074	75.67	-0.11	-0.72	
UE	78.0	78.0	75.0	1.73	0.222	77.00	0.18	-0.43	
UM									•
UN	62.0	73.0	62.0	6.35	0.812	65.67	-2.27	-2.89	
UP	82.0	82.0	81.0	0.58	0.074	81.67	1.19	0.58	
UR	88.0	82.0	87.0	3.21	0.443	85.67	2.06	1.44	
UT									•
UW	75.0	77.0	75.0	1.15	0.148	75.67	-0.11	-0.72	
UX									•
UY	73.0	79.0	73.0	3.46	0.443	75.00	-0.25	-0.87	
VA	85.0	83.0	84.0	1.00	0.148	84.00	1.70	1.08	
VC	74.0	75.0	77.0	1.53	0.222	75.33	-0.18	-0.79	
VE									•
VG	72.0	71.0	70.0	1.00	0.148	71.00	-1.12	-1.73	
VH	73.0	72.0	73.0	0.58	0.074	72.67	-0.76	-1.37	
VI	73.0	75.0	72.0	1.53	0.222	73.33	-0.61	-1.23	
VM	81.0	81.0	76.0	2.89	0.369	79.33	0.69	0.07	
VO	79.0	82.0	80.0	1.53	0.222	80.33	0.90	0.29	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 9-Jun-1995

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VR									•
VS	83.0	83.0	79.0	2.31	0.295	81.67	1.19	0.58	
VT									•
VU									•
W	75.0	78.0	79.0	2.08	0.295	77.33	0.25	-0.36	
WD	73.0	74.0	71.0	1.53	0.222	72.67	-0.76	-1.37	
WF	63.0	57.0	59.0	3.06	0.443	59.67	-3.57	-4.19	⇓
WI	64.0	63.0	65.0	1.00	0.148	64.00	-2.63	-3.25	⇓
WJ	87.0	85.0	82.0	2.52	0.369	84.67	1.84	1.23	
WK	73.0	80.0	77.0	3.51	0.517	76.67	0.11	-0.51	
X	80.0	78.0	83.0	2.52	0.369	80.33	0.90	0.29	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
30.67	×	FZ	72.00		MQ	74.00		HK
43.33	×	OZ	72.00		DH	74.00		HJ
59.67	⇓	WF	72.00		AP	74.33		SN
62.67	⇓	TS	72.33		SC	74.33		R
62.67	⇓	NZ	72.33		PW	74.33		JE
64.00	⇓	WI	72.33		KH	74.33		GL
64.33	⇓	PQ	72.33		AI	74.33		GI
64.67	⇓	K	72.67		WD	74.33		D
65.33		PB	72.67		VH	74.33		CS
65.33		JG	72.67		RH	74.33		CJ
65.67		UN	72.67		QZ	74.33		AK
66.67		TO	72.67		OL	74.67		KL
67.33		NK	73.00		TD	74.67		DE
68.67		PV	73.00		JI	74.67		BH
69.00		CK	73.00		HX	75.00		UY
69.33		BC	73.00		EW	75.00		FU
69.67		RZ	73.00		AY	75.00		E
69.67		RR	73.00		AW	75.33		VC
69.67		M	73.00		AH	75.33		SZ
70.00		NP	73.33		VI	75.67		UW
70.33		PI	73.33		TL	75.67		U
70.67		CC	73.33		TH	75.67		SR
71.00		VG	73.33		CX	75.67		JS
71.00		Q	73.67		TR	75.67		CO
71.00		A	73.67		LR	76.00		HL
71.33		NJ	73.67		BB	76.00		DG
71.67		RO	74.00		TQ	76.00		BL
71.67		PM	74.00		SD	76.33		DT
71.67		EX	74.00		QT	76.67		WK
71.67		EB	74.00		OM	76.67		QX
72.00		RF	74.00		NH	76.67		OA

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

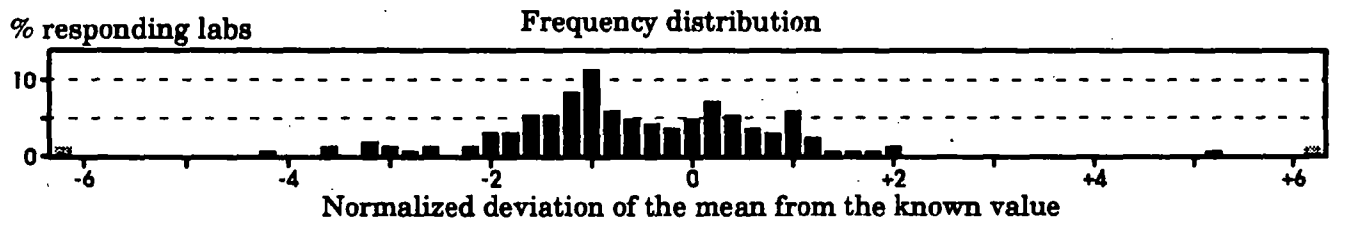
× ≡ Determined to be an outlier

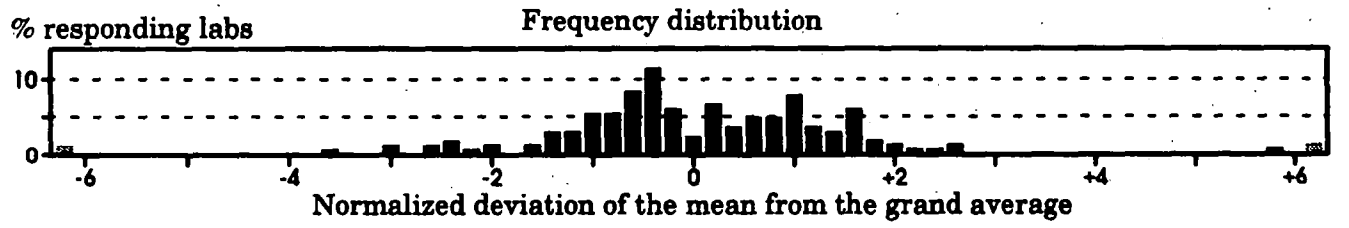
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
76.67		DM	80.00		SF	82.33		GE
77.00		UE	80.00		CQ	82.67		RV
77.00		KX	80.00		CM	82.67		AZ
77.00		FJ	80.00		BK	82.67		AN
77.00		AU	80.00		AL	83.33		CE
77.33		W	80.33		X	83.67		TI
77.33		SI	80.33		VO	83.67		I
77.33		S	80.33		TC	83.67		GQ
77.67		IC	80.33		HP	83.67		C
77.67		BO	80.67		SS	83.67		AE
78.00		MP	80.67		SM	84.00		VA
78.00		AJ	80.67		FL	84.00		ML
78.33		QP	80.67		DL	84.00		LT
78.33		NO	80.67		CA	84.00		DZ
78.67		T	80.67		AF	84.33		L
78.67		EL	81.00		O	84.67		WJ
78.67		BA	81.00		DO	84.67		HI
79.00		RU	81.00		CP	85.00		QU
79.00		EZ	81.33		J	85.67		UR
79.33		VM	81.33		DD	86.33		QW
79.33		SV	81.67		VS	87.33		BG
79.33		P	81.67		UP	88.33		MV
79.67		N	81.67		SX	88.33		LE
79.67		LF	82.00		BM	103.00	×	BI
79.67		EA	82.33		OK	126.00	×	TB
						646.00	×	JY





• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

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August 1995

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Uranium-Radium in Water Performance Evaluation Study

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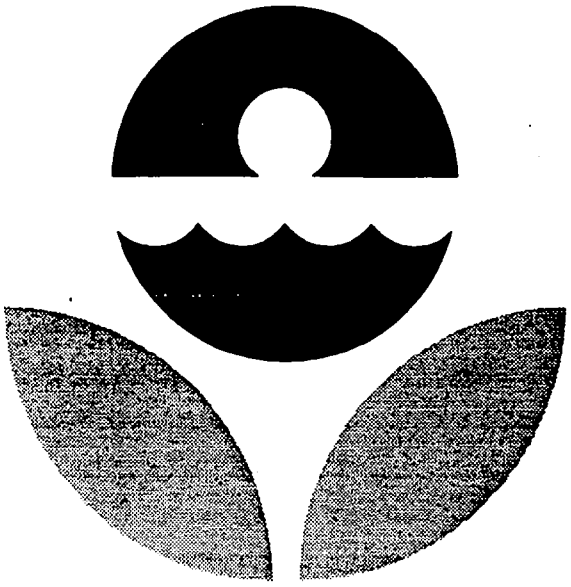
A Statistical Evaluation of the June 16, 1995 Data

0593RSD95 cov-137

Uranium-Radium in Water

Performance Evaluation Study

June 16, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Radiation Sciences Branch (CRD-LV) Performance Evaluation Study for ***Uranium-Radium in Water; June 16, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Program

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency It has been subject to the Agency's review and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

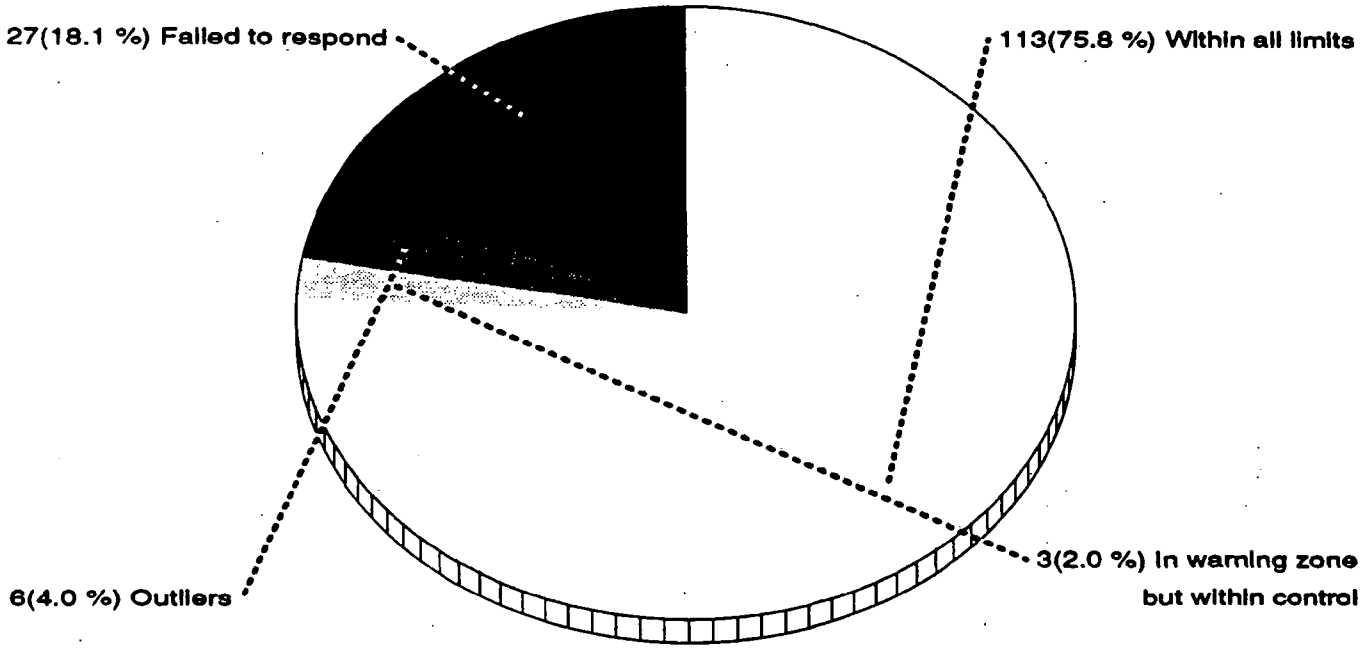
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

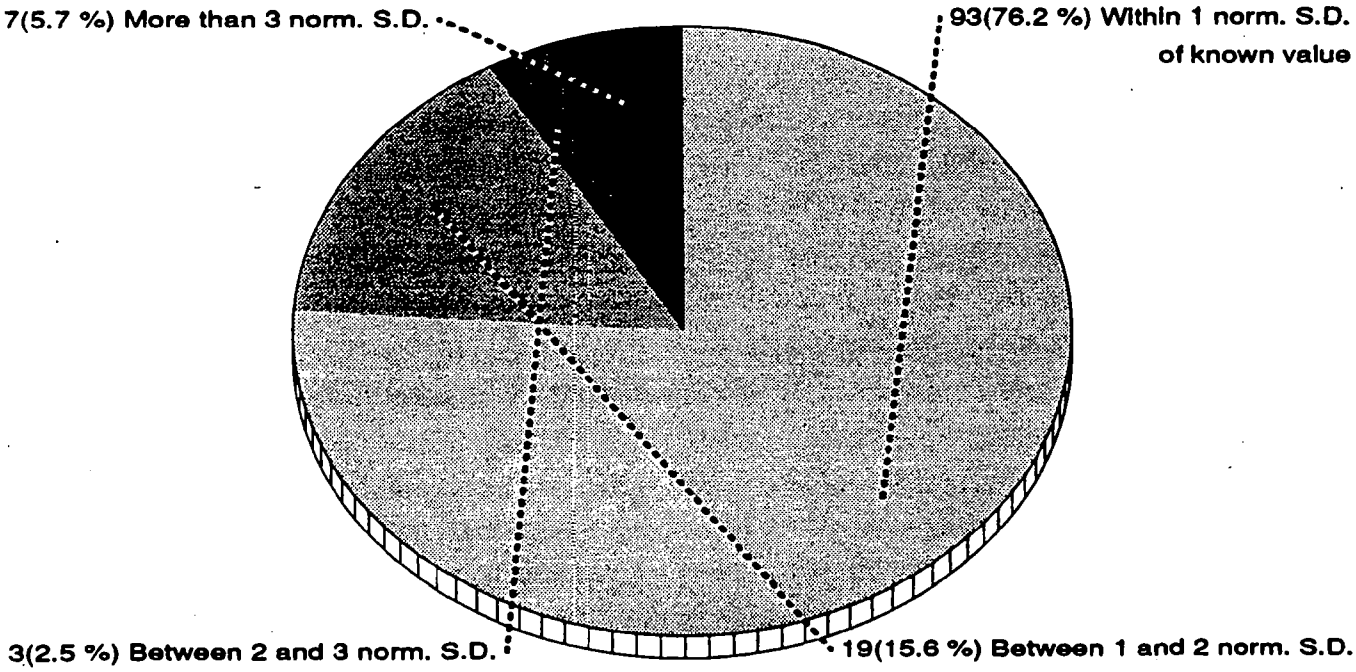
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, CRD-LV, 702/798-2104.

Uranium (Natural) Statistical Summary 149 Participants

The known value of this nuclide is **15.2 pCi/l** with an expected precision of **3.0**; the control limits are 10.0 to 20.4; the warning regions are 10.0 to 11.7 and 18.7 to 20.4



Statistic	Respondents	Non-outliers
Mean	15.59	**Grand Avg 14.62**
Std. Dev.	9.80	1.37
Variance	96.00	1.88
% Coef. of Var.	62.86	9.39
% deviation of mean from known value	2.55	-3.81
Norm. dev. of mean from known value	0.04	-0.42
Median	14.63	14.60
% deviation of median from known value	-3.73	-3.95
Norm. dev. of median from known value	-0.06	-0.44



 CRD-LV Performance Evaluation: Uranium-Radium in Water, 16-Jun-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	14.7	15.1	15.0	0.21	0.079	14.93	0.18	-0.15	
AE	15.6	15.2	15.9	0.35	0.138	15.57	0.55	0.21	
AF	16.7	16.1	15.9	0.42	0.158	16.23	0.93	0.60	
AH	14.0	13.9	14.3	0.21	0.079	14.07	-0.32	-0.65	
AI									•
AJ	11.4	14.2	12.8	1.40	0.551	12.80	-1.05	-1.39	
AK	14.4	13.5	13.0	0.71	0.276	13.63	-0.57	-0.90	
AL	10.5	14.2	12.9	1.88	0.728	12.53	-1.21	-1.54	
AP	18.3	18.2	18.3	0.06	0.020	18.27	2.11	1.77	
AR	12.2	12.9	12.6	0.35	0.138	12.57	-1.19	-1.52	
AU									•
AW	14.4	14.3	14.6	0.15	0.059	14.43	-0.11	-0.44	
AZ	15.7	15.3	15.1	0.31	0.118	15.37	0.43	0.10	
BA	15.6	14.8	14.1	0.75	0.295	14.83	0.12	-0.21	
BC	14.4	13.4	14.4	0.58	0.197	14.07	-0.32	-0.65	
BG	16.3	10.2	19.0	4.51	2.395	15.17	0.32	-0.02	
BG	15.4	15.0	15.7	0.35	0.138	15.37	0.43	0.10	
BG	12.4	13.2	13.1	0.44	0.158	12.90	-0.99	-1.33	
BH	14.0	15.0	15.0	0.58	0.197	14.67	0.03	-0.31	
BK	14.4	14.7	14.4	0.17	0.059	14.50	-0.07	-0.40	
BM	14.4	14.1	14.6	0.25	0.098	14.37	-0.15	-0.48	
BN	10.6	12.8	13.3	1.44	0.532	12.23	-1.38	-1.71	
BO	16.2	15.4	14.5	0.85	0.335	15.37	0.43	0.10	
C	13.4	13.1	16.1	1.65	0.591	14.20	-0.24	-0.58	
CA	13.7	14.3	13.8	0.32	0.118	13.93	-0.40	-0.73	
CE	15.9	16.1	16.1	0.12	0.039	16.03	0.82	0.48	
CG	11.5	12.0	12.0	0.29	0.098	11.83	-1.61	-1.94	
CJ	14.0	15.0	15.0	0.58	0.197	14.67	0.03	-0.31	
CK	17.5	17.9	17.4	0.26	0.098	17.60	1.72	1.39	
CM	14.2	14.7	15.0	0.40	0.158	14.63	0.01	-0.33	
CS	16.1	15.6	15.5	0.32	0.118	15.73	0.64	0.31	
CX	17.4	16.2	16.8	0.60	0.236	16.80	1.26	0.92	
D	15.0	15.5	14.9	0.32	0.118	15.13	0.30	-0.04	
DB	10.4	12.1	11.6	0.87	0.335	11.37	-1.88	-2.21	
DE	19.0	19.1	19.1	0.06	0.020	19.07	2.57	2.23	
DI	15.0	14.6	15.5	0.45	0.177	15.03	0.24	-0.10	
DO	15.4	14.8	15.1	0.30	0.118	15.10	0.28	-0.06	
DT	14.5	13.9	15.7	0.92	0.354	14.70	0.05	-0.29	
DZ	15.9	14.2	14.7	0.87	0.335	14.93	0.18	-0.15	
E	13.8	13.4	13.6	0.20	0.079	13.60	-0.59	-0.92	
EB	15.4	15.9	15.8	0.26	0.098	15.70	0.62	0.29	
EO	0.1	1.0	0.1	0.52	0.177	0.40	-8.21	-8.54	×
EP									•
ER	12.4	13.9	14.4	1.04	0.394	13.57	-0.61	-0.94	
FJ	12.5	12.2	13.2	0.51	0.197	12.63	-1.15	-1.48	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
FN	14.1	13.9	14.6	0.36	0.138	14.20	-0.24	-0.58	
FZ	14.1	15.8	14.3	0.93	0.335	14.73	0.07	-0.27	
GN	14.1	14.2	14.0	0.10	0.039	14.10	-0.30	-0.64	
GQ	15.0	14.9	14.1	0.49	0.177	14.67	0.03	-0.31	
HK	15.9	15.4	16.1	0.36	0.138	15.80	0.68	0.35	
HL	13.3	13.9	13.7	0.31	0.118	13.63	-0.57	-0.90	
HP	12.8	12.6	12.7	0.10	0.039	12.70	-1.11	-1.44	
I	14.9	15.2	15.4	0.25	0.098	15.17	0.32	-0.02	
ID	16.7	16.4	15.9	0.40	0.158	16.33	0.99	0.65	
J	14.8	15.2	14.6	0.31	0.118	14.87	0.14	-0.19	
JE	14.9	14.3	13.6	0.65	0.256	14.27	-0.20	-0.54	
JG									•
JK	14.9	14.0	15.0	0.55	0.197	14.63	0.01	-0.33	
JP	14.5	15.0	15.5	0.50	0.197	15.00	0.22	-0.12	
JS	13.2	13.8	13.6	0.31	0.118	13.53	-0.63	-0.96	
JX									•
JY	14.5	14.5	13.9	0.35	0.118	14.30	-0.19	-0.52	
K	18.9	18.5	16.5	1.29	0.473	17.97	1.93	1.60	
KH	14.6	14.6	14.8	0.12	0.039	14.67	0.03	-0.31	
KL									•
L	14.3	14.3	14.9	0.35	0.118	14.50	-0.07	-0.40	
LH	17.0	16.0	17.0	0.58	0.197	16.67	1.18	0.85	
LT	14.8	16.7	16.0	0.96	0.374	15.83	0.70	0.37	
LZ	15.5	15.8	15.5	0.17	0.059	15.60	0.57	0.23	
M									•
MX									•
MY									•
N	14.6	14.4	14.3	0.15	0.059	14.43	-0.11	-0.44	
NA	16.3	16.9	16.4	0.32	0.118	16.53	1.10	0.77	
NH	14.7	14.1	14.5	0.31	0.118	14.43	-0.11	-0.44	
NJ	14.0	14.0	14.0	0.00	0.000	14.00	-0.36	-0.69	
NK	14.1	15.4	13.8	0.85	0.315	14.43	-0.11	-0.44	
NO	14.7	14.9	15.4	0.36	0.138	15.00	0.22	-0.12	
NT	15.4	15.4	15.5	0.06	0.020	15.43	0.47	0.13	
OB	14.8	15.0	14.9	0.10	0.039	14.90	0.16	-0.17	
OF									•
OS	13.9	13.5	14.6	0.56	0.217	14.00	-0.36	-0.69	
OX									•
OY	12.4	12.9	12.6	0.25	0.098	12.63	-1.15	-1.48	
OZ	20.8	21.2	21.0	0.20	0.079	21.00	3.68	3.35	×
P	14.1	14.9	14.3	0.42	0.158	14.43	-0.11	-0.44	
PB	16.8	17.0	16.8	0.12	0.039	16.87	1.30	0.96	
PG									•
PQ	14.4	14.6	14.7	0.15	0.059	14.57	-0.03	-0.37	
PV	15.1	15.3	15.7	0.31	0.118	15.37	0.43	0.10	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
PW	12.4	15.1	12.0	1.69	0.610	13.17	-0.84	-1.17	
Q	15.0	15.5	16.6	0.82	0.315	15.70	0.62	0.29	
QJ	17.0	15.0	14.0	1.53	0.591	15.33	0.41	0.08	
QQ	14.8	14.2	15.5	0.65	0.256	14.83	0.12	-0.21	
QU	7.3	11.5	11.2	2.34	0.827	10.00	-2.67	-3.00	
QX	10.2	10.0	9.0	0.64	0.236	9.73	-2.82	-3.16	×
QZ	14.8	12.9	15.7	1.43	0.551	14.47	-0.09	-0.42	
R									•
RD	13.2	13.2	13.2	0.00	0.000	13.20	-0.82	-1.15	
RF	14.3	15.1	14.6	0.40	0.158	14.67	0.03	-0.31	
RG	14.8	14.7	14.5	0.15	0.059	14.67	0.03	-0.31	
RK	13.9	13.9	13.4	0.29	0.098	13.73	-0.51	-0.85	
RL									•
RP	14.7	13.8	14.4	0.46	0.177	14.30	-0.19	-0.52	
RR	15.7	15.8	14.6	0.67	0.236	15.37	0.43	0.10	
RV	14.2	14.4	14.0	0.20	0.079	14.20	-0.24	-0.58	
RW	13.9	13.6	13.5	0.21	0.079	13.67	-0.55	-0.89	
RX									•
RZ	12.5	14.4	16.0	1.75	0.689	14.30	-0.19	-0.52	
S	15.0	13.5	13.4	0.90	0.315	13.97	-0.38	-0.71	
SC	14.7	14.4	14.6	0.15	0.059	14.57	-0.03	-0.37	
SD	13.1	13.1	13.4	0.17	0.059	13.20	-0.82	-1.15	
SF	13.8	14.1	13.9	0.15	0.059	13.93	-0.40	-0.73	
SI	14.3	14.9	14.5	0.31	0.118	14.57	-0.03	-0.37	
SL	13.5	14.4	13.9	0.45	0.177	13.93	-0.40	-0.73	
SM	15.8	17.5	17.5	0.98	0.335	16.93	1.34	1.00	
SO	14.6	13.8	14.2	0.40	0.158	14.20	-0.24	-0.58	
SS	14.5	15.5	16.5	1.00	0.394	15.50	0.51	0.17	
ST	27.7	28.3	28.3	0.35	0.118	28.10	7.78	7.45	×
SX									•
SZ	12.9	13.4	12.7	0.36	0.138	13.00	-0.94	-1.27	
T	16.9	16.6	15.0	1.02	0.374	16.17	0.89	0.56	
TD	16.3	15.7	18.0	1.19	0.453	16.67	1.18	0.85	
TE									•
TH	16.2	14.1	14.5	1.12	0.413	14.93	0.18	-0.15	
TI	14.6	15.3	13.8	0.75	0.295	14.57	-0.03	-0.37	
TL	15.7	16.1	16.9	0.61	0.236	16.23	0.93	0.60	
TN									•
TQ									•
TS	13.5	14.2	14.0	0.36	0.138	13.90	-0.42	-0.75	
U	15.6	15.9	15.9	0.17	0.059	15.80	0.68	0.35	
UE									•
UN	13.1	13.4	13.6	0.25	0.098	13.37	-0.72	-1.06	
UP	14.0	15.4	16.0	1.03	0.394	15.13	0.30	-0.04	
UQ									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
UW	11.8	11.2	12.2	0.50	0.197	11.73	-1.67	-2.00	
UZ									•
VA	118.0	123.2	115.9	3.76	1.833	119.03	60.28	59.95	×
VG	14.2	14.1	14.6	0.26	0.098	14.30	-0.19	-0.52	
VH									•
VI	26.4	27.6	28.2	0.92	0.354	27.40	7.38	7.04	×
VT									•
VV									•
W	15.9	14.9	15.4	0.50	0.197	15.40	0.45	0.12	
WC									•
WG									•
WH	15.8	14.7	15.2	0.55	0.217	15.23	0.35	0.02	
WI	13.2	13.1	13.4	0.15	0.059	13.23	-0.80	-1.14	
X	13.2	13.0	14.6	0.87	0.315	13.60	-0.59	-0.92	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.40	×	EO	13.90		TS	14.57		TI
9.73	×	QX	13.93		SL	14.57		SI
10.00		QU	13.93		SF	14.57		SC
11.37		DB	13.93		CA	14.57		PQ
11.73		UW	13.97		S	14.63		JK
11.83		CG	14.00		OS	14.63		CM
12.23		BN	14.00		NJ	14.67		RG
12.53		AL	14.07		BC	14.67		RF
12.57		AR	14.07		AH	14.67		KH
12.63		OY	14.10		GN	14.67		GQ
12.63		FJ	14.20		RV	14.67		CJ
12.70		HP	14.20		SO	14.67		BH
12.80		AJ	14.20		FN	14.70		DT
12.90		BG	14.20		C	14.73		FZ
13.00		SZ	14.27		JE	14.83		QQ
13.17		PW	14.30		VG	14.83		BA
13.20		RD	14.30		RZ	14.87		J
13.20		SD	14.30		RP	14.90		OB
13.23		WI	14.30		JY	14.93		DZ
13.37		UN	14.37		BM	14.93		A
13.53		JS	14.43		P	14.93		TH
13.57		ER	14.43		NK	15.00		NO
13.60		X	14.43		NH	15.00		JP
13.60		E	14.43		N	15.03		DI
13.63		HL	14.43		AW	15.10		DO
13.63		AK	14.47		QZ	15.13		UP
13.67		RW	14.50		L	15.13		D
13.73		RK	14.50		BK	15.17		I

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

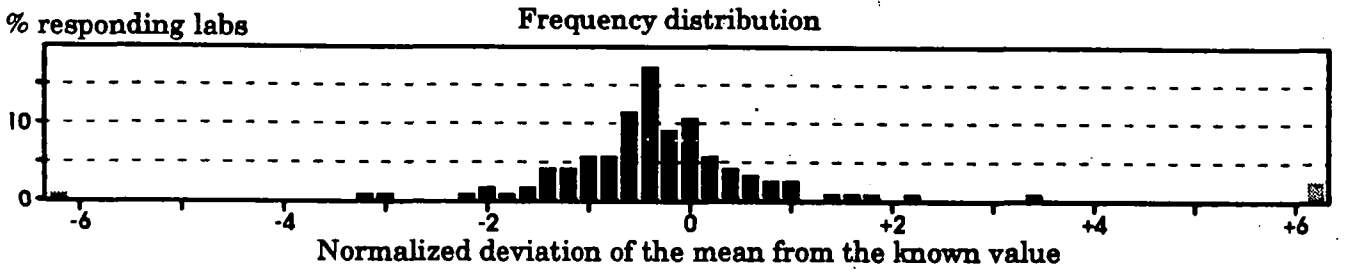
× ≡ Determined to be an outlier

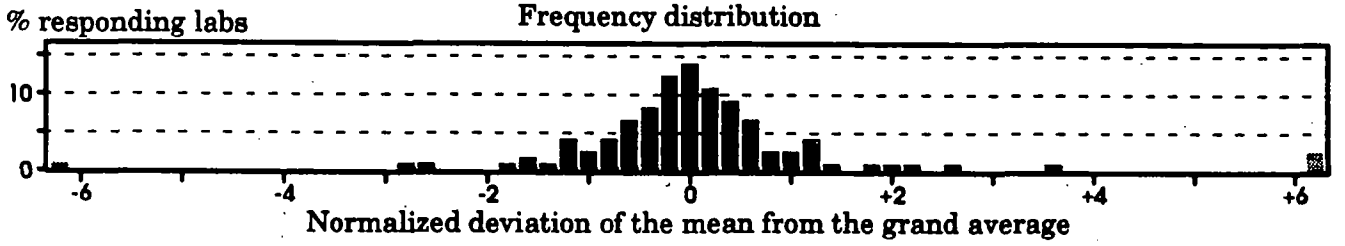
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
15.17		BG	15.60		LZ	16.67		TD
15.23		WH	15.70		EB	16.67		LH
15.33		QJ	15.70		Q	16.80		CX
15.37		BG	15.73		CS	16.87		PB
15.37		RR	15.80		U	16.93		SM
15.37		PV	15.80		HK	17.60		CK
15.37		BO	15.83		LT	17.97		K
15.37		AZ	16.03		CE	18.27		AP
15.40		W	16.17		T	19.07		DE
15.43		NT	16.23		TL	21.00	×	OZ
15.50		SS	16.23		AF	27.40	×	VI
15.57		AE	16.33		ID	28.10	×	ST
			16.53		NA	119.03	×	VA





• ≡ No data submitted
∅ ≡ Insufficient data

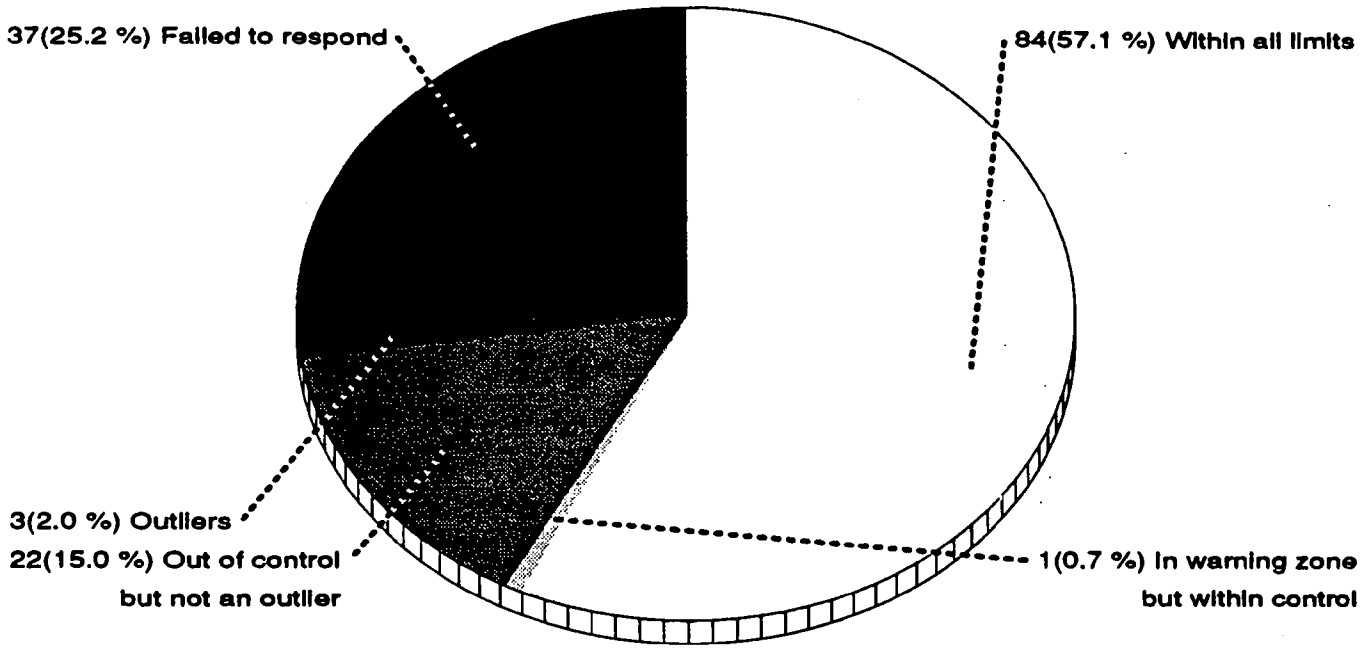
TAG SYMBOLS

× ≡ Determined to be an outlier

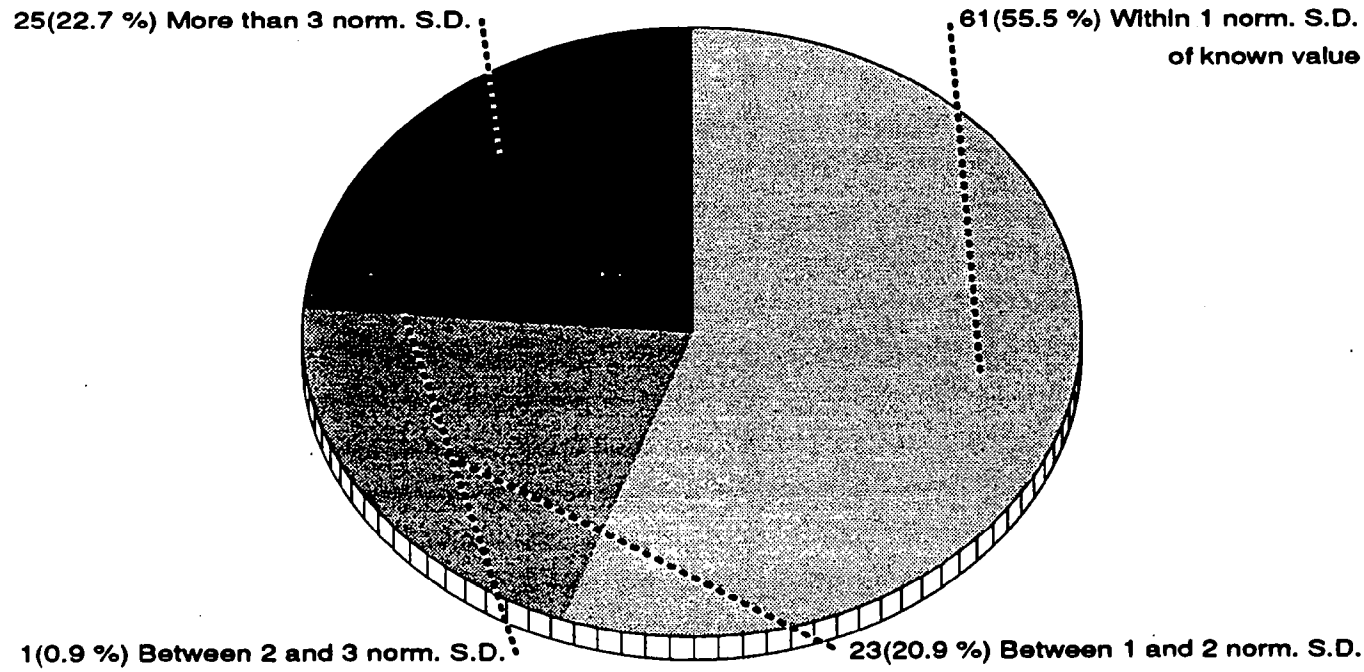
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 147 Participants

The known value of this nuclide is **14.8 pCi/l** with an expected precision of **2.2**; the control limits are 11.0 to 18.6; the warning regions are 11.0 to 12.3 and 17.3 to 18.6



Statistic	Respondents	Non-outliers
Mean	15.25	**Grand Avg 14.32**
Std. Dev.	6.93	2.44
Variance	48.07	5.97
% Coef. of Var.	45.47	17.07
% deviation of mean from known value	3.02	-3.28
Norm. dev. of mean from known value	0.06	-0.20
Median	14.38	14.37
% deviation of median from known value	-2.82	-2.93
Norm. dev. of median from known value	-0.06	-0.18



Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	14.6	13.1	14.8	0.93	0.456	14.17	-0.12	-0.50	
AE	14.5	14.7	14.9	0.20	0.107	14.70	0.30	-0.08	
AF	13.3	13.7	13.2	0.26	0.134	13.40	-0.72	-1.10	
AH	14.3	14.9	13.4	0.75	0.403	14.20	-0.09	-0.47	
AI									•
AJ	13.3	13.4	14.2	0.49	0.242	13.63	-0.54	-0.92	
AK	12.6	13.3	12.8	0.36	0.188	12.90	-1.11	-1.50	
AL	13.5	13.4	14.3	0.49	0.242	13.73	-0.46	-0.84	
AP	14.1	13.9	14.9	0.53	0.268	14.30	-0.01	-0.39	
AR									•
AU	13.5	13.1	13.9	0.40	0.215	13.50	-0.64	-1.02	
AW	13.3	13.6	13.0	0.30	0.161	13.30	-0.80	-1.18	
AZ	13.7	17.3	14.7	1.86	0.967	15.23	0.72	0.34	
BA	13.6	13.7	14.0	0.21	0.107	13.77	-0.43	-0.81	
BC	11.1	10.5	11.0	0.32	0.161	10.87	-2.72	-3.10	⇓
BG	91.0	71.0	66.0	13.23	11.880	76.00	48.56	48.18	×
BH	14.5	14.6	13.3	0.72	0.349	14.13	-0.14	-0.52	
BK	14.5	14.1	14.6	0.26	0.134	14.40	0.07	-0.31	
BM	15.2	11.8	12.7	1.76	0.913	13.23	-0.85	-1.23	
BN	19.9	19.8	20.8	0.55	0.268	20.17	4.61	4.23	⇑
BO	14.0	14.2	14.0	0.12	0.054	14.07	-0.20	-0.58	
C	15.7	15.0	14.2	0.75	0.403	14.97	0.51	0.13	
CA	14.8	14.9	14.3	0.32	0.161	14.67	0.28	-0.10	
CE	11.8	13.1	14.2	1.20	0.644	13.03	-1.01	-1.39	
CG	15.9	17.8	15.8	1.13	0.537	16.50	1.72	1.34	
CJ	15.0	15.0	15.0	0.00	0.000	15.00	0.54	0.16	
CK	12.8	13.0	12.8	0.12	0.054	12.87	-1.14	-1.52	
CM									•
CS	17.7	15.6	16.2	1.08	0.564	16.50	1.72	1.34	
CX									•
D									•
DB	13.4	12.6	12.6	0.46	0.215	12.87	-1.14	-1.52	
DE	14.6	14.6	14.6	0.00	0.000	14.60	0.22	-0.16	
DI									•
DO									•
DT	14.2	14.9	14.0	0.47	0.242	14.37	0.04	-0.34	
DZ	14.4	14.5	14.2	0.15	0.081	14.37	0.04	-0.34	
E	13.1	14.0	14.0	0.52	0.242	13.70	-0.48	-0.87	
EB	13.7	14.1	15.3	0.83	0.430	14.37	0.04	-0.34	
EO	14.8	15.2	15.3	0.26	0.134	15.10	0.62	0.24	
EP	13.9	13.8	13.4	0.26	0.134	13.70	-0.48	-0.87	
ER	14.5	15.0	14.9	0.26	0.134	14.80	0.38	0.00	
FJ									•
FN	18.8	20.0	20.8	1.01	0.537	19.87	4.37	3.99	⇑
FZ	19.0	18.4	23.1	2.56	1.499	20.17	4.61	4.23	⇑

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
GN	14.4	15.2	14.1	0.57	0.295	14.57	0.20	-0.18	
GQ	14.0	14.9	13.2	0.85	0.456	14.03	-0.22	-0.60	
HK	15.0	14.9	14.9	0.06	0.027	14.93	0.49	0.10	
HL	14.8	14.2	15.9	0.86	0.456	14.97	0.51	0.13	
HP	15.6	16.2	18.1	1.31	0.671	16.63	1.83	1.44	
I	20.3	17.0	14.2	3.05	2.215	17.17	2.24	1.86	
ID	13.0	15.1	12.7	1.31	0.644	13.60	-0.56	-0.94	
J	13.2	15.0	14.7	0.96	0.483	14.30	-0.01	-0.39	
JE	16.9	16.5	15.8	0.56	0.295	16.40	1.64	1.26	
JG	9.1	9.5	13.2	2.26	1.192	10.60	-2.93	-3.31	⇓
JK									•
JP									•
JS	12.9	17.8	20.4	3.81	2.931	17.03	2.14	1.76	
JX	15.6	15.2	15.4	0.20	0.107	15.40	0.85	0.47	
JY	13.5	16.4	11.9	2.28	1.397	13.93	-0.30	-0.68	
K									•
KH	14.6	14.2	14.8	0.31	0.161	14.53	0.17	-0.21	
KL	13.6	16.0	14.1	1.27	0.644	14.57	0.20	-0.18	
L	13.1	12.3	12.9	0.42	0.215	12.77	-1.22	-1.60	
LH									•
LT	9.6	9.8	11.6	1.10	0.537	10.33	-3.13	-3.52	⇓
LZ	14.5	14.5	14.5	0.00	0.000	14.50	0.15	-0.24	
M	15.6	17.9	14.9	1.57	0.805	16.13	1.43	1.05	
MX									•
MY									•
N	14.4	14.4	14.2	0.12	0.054	14.33	0.01	-0.37	
NA									•
NH	14.1	14.9	12.9	1.01	0.537	13.97	-0.27	-0.66	
NJ	15.0	17.0	17.0	1.15	0.537	16.33	1.59	1.21	
NK									•
NO	15.6	15.8	16.2	0.31	0.161	15.87	1.22	0.84	
NT	14.5	14.7	14.6	0.10	0.054	14.60	0.22	-0.16	
OB	16.5	15.5	15.7	0.53	0.268	15.90	1.25	0.87	
OF	7.8	7.8	8.9	0.64	0.295	8.17	-4.84	-5.22	⇓
OS									•
OX	14.9	14.8	15.0	0.10	0.054	14.90	0.46	0.08	
OY	11.7	10.6	10.0	0.86	0.456	10.77	-2.79	-3.18	⇓
OZ									•
P	19.9	17.5	19.4	1.27	0.644	18.93	3.64	3.25	⇑
PB	14.5	14.2	15.0	0.40	0.215	14.57	0.20	-0.18	
PG									•
PQ	8.9	9.3	10.2	0.67	0.349	9.47	-3.82	-4.20	⇓
PV	9.5	11.4	11.6	1.16	0.564	10.83	-2.74	-3.12	⇓
PW	15.2	17.2	15.3	1.13	0.537	15.90	1.25	0.87	
Q	14.3	15.7	16.3	1.03	0.537	15.43	0.88	0.50	

• ≡ No data submitted | **TAG SYMBOLS** | ⇑ ≡ Above control limit

∅ ≡ Insufficient data | × ≡ Determined to be an outlier | ⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
QJ	10.0	14.0	14.0	2.31	1.141	12.67	-1.30	-1.68	
QQ	17.1	17.1	16.3	0.46	0.215	16.83	1.98	1.60	
QU	9.5	12.4	10.8	1.45	0.779	10.90	-2.69	-3.07	⇓
QX	8.1	8.0	8.5	0.26	0.134	8.20	-4.81	-5.20	⇓
QZ	14.3	14.7	15.1	0.40	0.215	14.70	0.30	-0.08	
R	13.7	14.2	13.4	0.40	0.215	13.77	-0.43	-0.81	
RD	14.2	14.0	13.7	0.25	0.134	13.97	-0.27	-0.66	
RF	15.4	16.4	15.3	0.61	0.295	15.70	1.09	0.71	
RG									•
RK	15.3	18.8	14.7	2.21	1.192	16.27	1.54	1.15	
RL									•
RP									•
RR									•
RV	9.5	9.8	10.8	0.68	0.349	10.03	-3.37	-3.75	⇓
RW	15.3	15.8	14.6	0.60	0.322	15.23	0.72	0.34	
RX									•
RZ	15.1	15.0	16.0	0.55	0.268	15.37	0.83	0.45	
S	14.9	14.7	14.5	0.20	0.107	14.70	0.30	-0.08	
SC	17.5	15.6	16.9	0.97	0.510	16.67	1.85	1.47	
SD	12.5	11.7	11.8	0.44	0.215	12.00	-1.82	-2.20	
SF	13.1	14.7	14.6	0.90	0.430	14.13	-0.14	-0.52	
SI	8.6	10.0	8.2	0.95	0.483	8.93	-4.24	-4.62	⇓
SL									•
SM	9.4	12.0	9.8	1.40	0.698	10.40	-3.08	-3.46	⇓
SO	10.2	10.6	11.0	0.40	0.215	10.60	-2.93	-3.31	⇓
SS	12.9	13.6	14.9	1.01	0.537	13.80	-0.41	-0.79	
ST	29.2	28.7	29.2	0.29	0.134	29.03	11.59	11.21	×
SX									•
SZ	16.1	14.1	15.3	1.01	0.537	15.17	0.67	0.29	
T	14.7	14.8	15.3	0.32	0.161	14.93	0.49	0.10	
TD	21.1	23.5	21.4	1.31	0.644	22.00	6.05	5.67	⇑
TE									•
TH	16.1	15.8	15.9	0.15	0.081	15.93	1.27	0.89	
TI	14.1	13.2	14.0	0.49	0.242	13.77	-0.43	-0.81	
TL									•
TN	14.1	13.4	15.2	0.91	0.483	14.23	-0.06	-0.45	
TQ									•
TS									•
U	13.6	14.8	14.6	0.64	0.322	14.33	0.01	-0.37	
UE									•
UN	10.2	10.7	10.4	0.25	0.134	10.43	-3.06	-3.44	⇓
UP	19.5	19.7	19.3	0.20	0.107	19.50	4.08	3.70	⇑
UQ	15.6	14.9	14.9	0.40	0.188	15.13	0.64	0.26	
UW	13.4	13.9	12.2	0.87	0.456	13.17	-0.90	-1.29	
UZ									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VA	40.5	43.0	37.7	2.65	1.806	40.40	20.54	20.15	×
VG									•
VH	12.6	11.8	12.9	0.57	0.295	12.43	-1.48	-1.86	
VI	15.0	16.1	15.6	0.55	0.295	15.57	0.99	0.60	
VT	12.0	8.6	10.3	1.70	0.913	10.30	-3.16	-3.54	⇓
VV									•
W	14.0	14.1	15.4	0.78	0.376	14.50	0.15	-0.24	
WC	24.1	17.4	17.6	3.81	2.522	19.70	4.24	3.86	⇑
WG									•
WH									•
WI									•
X	13.9	14.5	14.4	0.32	0.161	14.27	-0.04	-0.42	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.17	⇓	OF	13.70		EP	14.57		KL
8.20	⇓	QX	13.70		E	14.57		GN
8.93	⇓	SI	13.73		AL	14.60		NT
9.47	⇓	PQ	13.77		TI	14.60		DE
10.03	⇓	RV	13.77		R	14.67		CA
10.30	⇓	VT	13.77		BA	14.70		S
10.33	⇓	LT	13.80		SS	14.70		AE
10.40	⇓	SM	13.93		JY	14.70		QZ
10.43	⇓	UN	13.97		RD	14.80		ER
10.60	⇓	SO	13.97		NH	14.90		OX
10.60	⇓	JG	14.03		GQ	14.93		T
10.77	⇓	OY	14.07		BO	14.93		HK
10.83	⇓	PV	14.13		SF	14.97		HL
10.87	⇓	BC	14.13		BH	14.97		C
10.90	⇓	QU	14.17		A	15.00		CJ
12.00		SD	14.20		AH	15.10		EO
12.43		VH	14.23		TN	15.13		UQ
12.67		QJ	14.27		X	15.17		SZ
12.77		L	14.30		J	15.23		RW
12.87		DB	14.30		AP	15.23		AZ
12.87		CK	14.33		U	15.37		RZ
12.90		AK	14.33		N	15.40		JX
13.03		CE	14.37		DZ	15.43		Q
13.17		UW	14.37		DT	15.57		VI
13.23		BM	14.37		EB	15.70		RF
13.30		AW	14.40		BK	15.87		NO
13.40		AF	14.50		W	15.90		PW
13.50		AU	14.50		LZ	15.90		OB
13.60		ID	14.53		KH	15.93		TH
13.63		AJ	14.57		PB	16.13		M

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

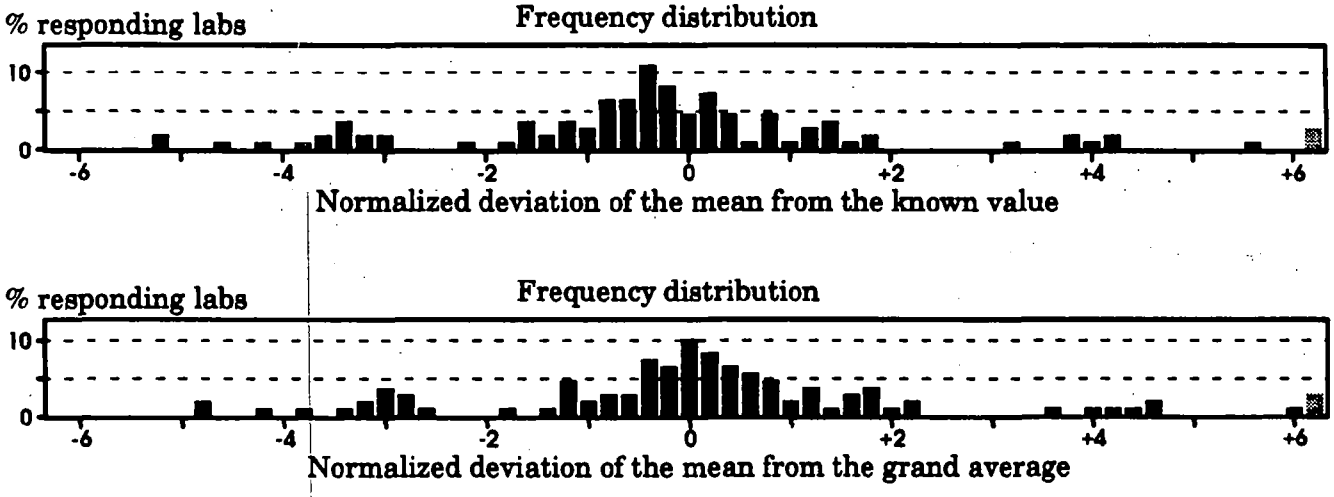
× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
16.27		RK	16.67		SC	19.87	⇑	FN
16.33		NJ	16.83		QQ	20.17	⇑	FZ
16.40		JE	17.03		JS	20.17	⇑	BN
16.50		CG	17.17		I	22.00	⇑	TD
16.50		CS	18.93	⇑	P	29.03	×	ST
16.63		HP	19.50	⇑	UP	40.40	×	VA
			19.70	⇑	WC	76.00	×	BG



• ≡ No data submitted
∅ ≡ Insufficient data

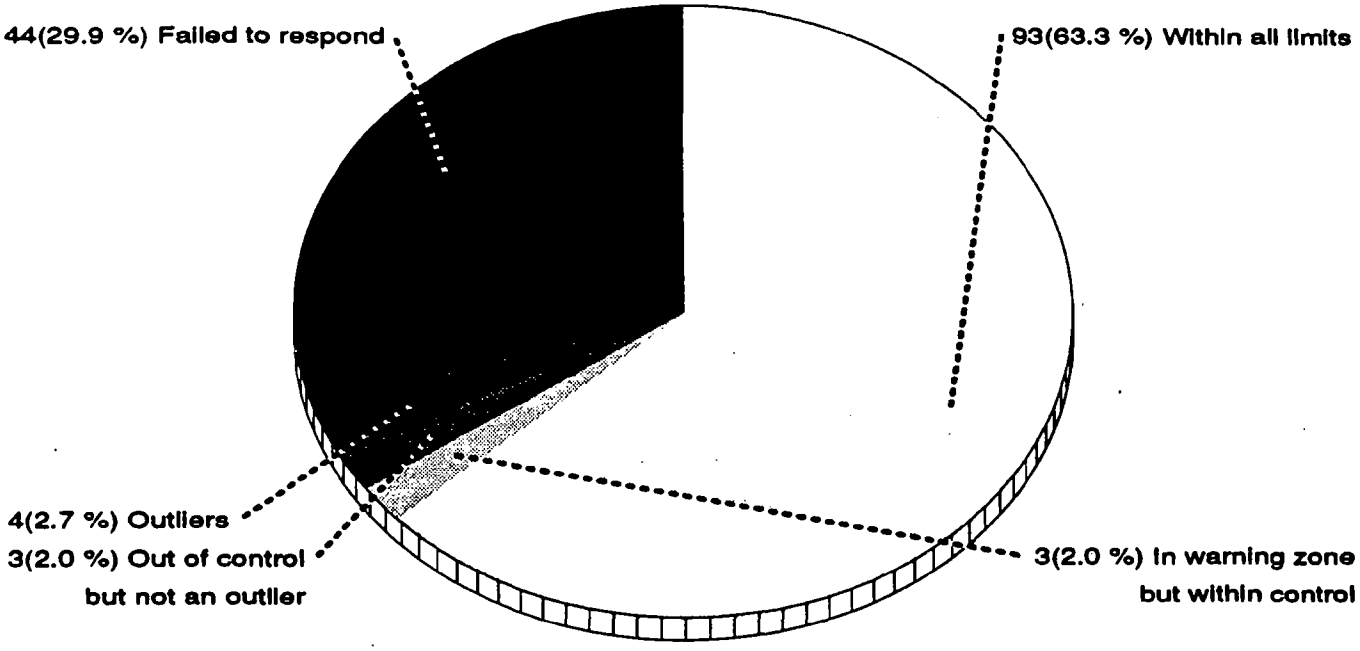
TAG SYMBOLS

× ≡ Determined to be an outlier

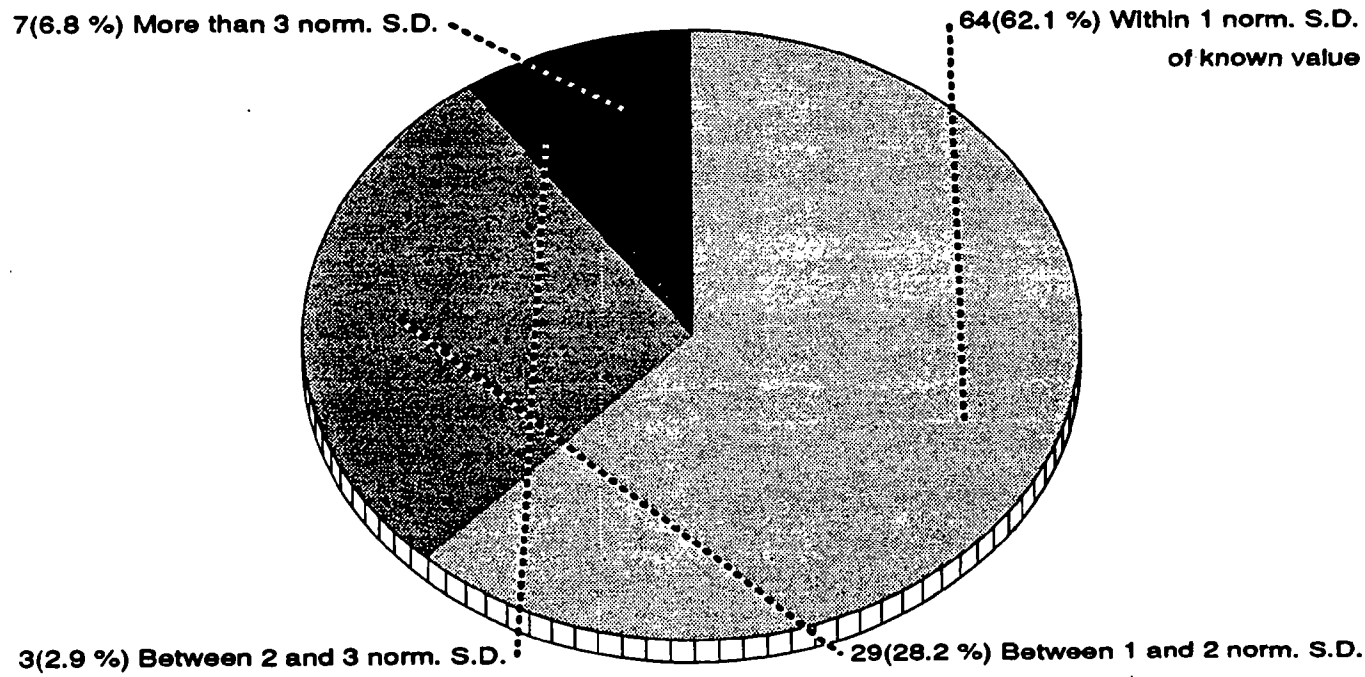
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 147 Participants

The known value of this nuclide is **15.0 pCi/l** with an expected precision of **3.8**; the control limits are 8.4 to 21.6; the warning regions are 8.4 to 10.6 and 19.4 to 21.6



Statistic	Respondents	Non-outliers
Mean	15.35	**Grand Avg 14.98**
Std. Dev.	4.17	2.59
Variance	17.43	6.69
% Coef. of Var.	27.19	17.27
% deviation of mean from known value	2.35	-0.16
Norm. dev. of mean from known value	0.08	-0.01
Median	15.07	15.03
% deviation of median from known value	0.44	0.22
Norm. dev. of median from known value	0.02	0.01



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	16.3	15.5	13.3	1.55	0.466	15.03	0.03	0.02	
AE	11.5	10.7	10.1	0.70	0.218	10.77	-1.92	-1.93	
AF	15.4	15.6	14.8	0.42	0.124	15.27	0.13	0.12	
AH	14.9	14.9	13.6	0.75	0.202	14.47	-0.23	-0.24	
AI	13.7	13.5	14.5	0.53	0.155	13.90	-0.49	-0.50	
AJ	21.1	17.2	14.5	3.32	1.049	17.60	1.20	1.19	
AK	13.6	12.7	12.1	0.75	0.233	12.80	-0.99	-1.00	
AL	12.4	14.8	13.1	1.23	0.373	13.43	-0.70	-0.71	
AP	5.8	7.6	8.2	1.25	0.373	7.20	-3.54	-3.56	⇓
AR									•
AU	2.1	2.1	2.5	0.23	0.062	2.23	-5.81	-5.82	×
AW	13.5	13.7	12.7	0.53	0.155	13.30	-0.76	-0.77	
AZ	15.4	16.0	15.1	0.46	0.140	15.50	0.24	0.23	
BA	11.8	12.5	10.4	1.07	0.326	11.57	-1.55	-1.56	
BC	19.1	16.4	18.0	1.36	0.420	17.83	1.30	1.29	
BG									•
BH	14.9	15.6	14.8	0.44	0.124	15.10	0.06	0.05	
BK	19.0	17.4	18.7	0.85	0.249	18.37	1.55	1.53	
BM	14.5	16.6	14.9	1.12	0.326	15.33	0.16	0.15	
BN									•
BO	14.2	13.9	14.1	0.15	0.047	14.07	-0.41	-0.43	
C	18.4	19.5	19.3	0.59	0.171	19.07	1.86	1.85	
CA	12.2	12.4	11.2	0.64	0.187	11.93	-1.39	-1.40	
CE	15.8	15.2	14.2	0.81	0.249	15.07	0.04	0.03	
CG	12.3	14.5	15.1	1.47	0.435	13.97	-0.46	-0.47	
CJ	14.0	14.0	14.0	0.00	0.000	14.00	-0.45	-0.46	
CK	11.5	14.0	13.1	1.27	0.389	12.87	-0.96	-0.97	
CM									•
CS	13.6	14.8	13.6	0.69	0.187	14.00	-0.45	-0.46	
CX									•
D									•
DB	14.9	15.9	15.6	0.51	0.155	15.47	0.22	0.21	
DE	17.7	17.7	17.7	0.00	0.000	17.70	1.24	1.23	
DI									•
DO									•
DT	19.2	18.4	18.7	0.40	0.124	18.77	1.73	1.72	
DZ	19.7	18.8	18.4	0.67	0.202	18.97	1.82	1.81	
E									•
EB	16.6	16.9	16.9	0.17	0.047	16.80	0.83	0.82	
EO	15.8	16.4	16.9	0.55	0.171	16.37	0.63	0.62	
EP	13.4	14.3	14.1	0.47	0.140	13.93	-0.48	-0.49	
ER									•
FJ									•
FN	15.0	14.5	13.8	0.60	0.187	14.43	-0.25	-0.26	
FZ	16.3	19.4	14.8	2.35	0.715	16.83	0.85	0.84	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
GN	22.6	23.2	23.2	0.35	0.093	23.00	3.66	3.65	⇑
GQ	15.9	16.0	17.9	1.13	0.311	16.60	0.74	0.73	
HK	15.2	13.2	13.6	1.06	0.311	14.00	-0.45	-0.46	
HL	15.9	16.2	15.4	0.40	0.124	15.83	0.39	0.38	
HP	12.0	10.4	11.7	0.85	0.249	11.37	-1.65	-1.66	
I	15.9	15.3	14.8	0.55	0.171	15.33	0.16	0.15	
ID	14.8	16.1	16.2	0.78	0.218	15.70	0.33	0.32	
J	15.1	15.4	14.3	0.57	0.171	14.93	-0.02	-0.03	
JE	20.7	19.9	19.6	0.57	0.171	20.07	2.32	2.31	
JG	12.1	11.4	8.6	1.85	0.544	10.70	-1.95	-1.96	
JK									•
JP									•
JS	17.8	15.3	14.4	1.76	0.528	15.83	0.39	0.38	
JX	11.0	11.8	12.0	0.53	0.155	11.60	-1.54	-1.55	
JY	11.4	13.0	11.1	1.02	0.295	11.83	-1.43	-1.44	
K									•
KH	15.2	14.6	15.0	0.31	0.093	14.93	-0.02	-0.03	
KL	17.7	19.4	17.0	1.23	0.373	18.03	1.39	1.38	
L	17.3	17.8	17.0	0.40	0.124	17.37	1.09	1.08	
LH									•
LT	9.8	11.2	8.1	1.55	0.482	9.70	-2.41	-2.42	
LZ									•
M	14.4	14.8	15.8	0.72	0.218	15.00	0.01	0.00	
MX									•
MY									•
N	14.4	16.6	13.7	1.51	0.451	14.90	-0.03	-0.05	
NA									•
NH	16.4	14.5	15.2	0.96	0.295	15.37	0.18	0.17	
NJ	15.0	16.0	17.0	1.00	0.311	16.00	0.47	0.46	
NK									•
NO	12.0	13.0	14.0	1.00	0.311	13.00	-0.90	-0.91	
NT	16.6	16.8	16.9	0.15	0.047	16.77	0.82	0.81	
OB									•
OF	14.5	15.3	15.3	0.46	0.124	15.03	0.03	0.02	
OS									•
OX	15.2	15.3	15.0	0.15	0.047	15.17	0.09	0.08	
OY	14.4	14.1	14.7	0.30	0.093	14.40	-0.26	-0.27	
OZ									•
P	11.7	11.4	11.3	0.21	0.062	11.47	-1.60	-1.61	
PB	15.6	15.8	16.0	0.20	0.062	15.80	0.38	0.36	
PG									•
PQ	13.8	12.0	10.2	1.80	0.560	12.00	-1.36	-1.37	
PV	9.1	9.7	13.1	2.16	0.622	10.63	-1.98	-1.99	
PW	15.6	15.2	15.1	0.26	0.078	15.30	0.15	0.14	
Q	14.3	16.1	15.8	0.96	0.280	15.40	0.19	0.18	

• ≡ No data submitted — **TAG SYMBOLS** — ⇑ ≡ Above control limit

∅ ≡ Insufficient data — × ≡ Determined to be an outlier — ⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
QJ	14.0	13.0	14.0	0.58	0.155	13.67	-0.60	-0.61	
QQ									•
QU	33.4	22.8	18.8	7.54	3.418	25.00	4.57	4.56	×
QX	11.4	12.2	12.3	0.49	0.140	11.97	-1.37	-1.38	
QZ	13.7	12.6	13.4	0.57	0.171	13.23	-0.79	-0.81	
R									•
RD	13.3	15.5	14.0	1.12	0.342	14.27	-0.32	-0.33	
RF	17.8	15.4	16.9	1.21	0.373	16.70	0.79	0.77	
RG									•
RK	36.1	39.2	40.6	2.30	0.699	38.63	10.78	10.77	×
RL									•
RP									•
RR									•
RV	15.2	14.6	14.5	0.38	0.109	14.77	-0.10	-0.11	
RW	16.0	16.2	14.3	1.04	0.295	15.50	0.24	0.23	
RX									•
RZ	15.6	14.7	16.8	1.05	0.326	15.70	0.33	0.32	
S	12.5	12.4	13.3	0.49	0.140	12.73	-1.02	-1.03	
SC	11.0	12.9	13.7	1.39	0.420	12.53	-1.11	-1.12	
SD	15.5	15.1	14.9	0.31	0.093	15.17	0.09	0.08	
SF	18.1	16.9	15.7	1.20	0.373	16.90	0.88	0.87	
SI	17.2	17.9	17.7	0.36	0.109	17.60	1.20	1.19	
SL									•
SM	14.3	13.3	14.1	0.53	0.155	13.90	-0.49	-0.50	
SO									•
SS	14.1	17.9	13.4	2.42	0.699	15.13	0.07	0.06	
ST	33.5	32.0	32.6	0.76	0.233	32.70	8.08	8.07	×
SX									•
SZ	13.5	16.3	13.6	1.59	0.435	14.47	-0.23	-0.24	
T	17.2	16.3	15.7	0.75	0.233	16.40	0.65	0.64	
TD	22.3	18.6	13.8	4.26	1.612	18.23	1.48	1.47	
TE									•
TH	17.0	15.3	18.0	1.37	0.420	16.77	0.82	0.81	
TI	16.3	18.7	19.1	1.51	0.435	18.03	1.39	1.38	
TL	10.2	10.9	11.8	0.80	0.249	10.97	-1.83	-1.84	
TN	19.4	18.4	17.0	1.21	0.373	18.27	1.50	1.49	
TQ									•
TS									•
U	15.4	12.5	12.0	1.84	0.528	13.30	-0.76	-0.77	
UE									•
UN	12.6	12.7	13.5	0.49	0.140	12.93	-0.93	-0.94	
UP	17.1	21.2	22.3	2.74	0.808	20.20	2.38	2.37	
UQ	17.2	16.2	16.4	0.53	0.155	16.60	0.74	0.73	
UW	12.6	14.2	13.6	0.81	0.249	13.47	-0.69	-0.70	
UZ									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VA	22.8	20.7	24.3	1.81	0.560	22.60	3.47	3.46	⇑
VG	11.8	12.4	11.9	0.32	0.093	12.03	-1.34	-1.35	
VH	15.2	14.6	13.8	0.70	0.218	14.53	-0.20	-0.21	
VI	15.4	16.3	15.9	0.45	0.140	15.87	0.41	0.40	
VT	13.5	13.7	13.6	0.10	0.031	13.60	-0.63	-0.64	
VV									•
W	16.1	14.7	16.6	0.98	0.295	15.80	0.38	0.36	
WC									•
WG									•
WH									•
WI									•
X	13.9	12.5	15.8	1.66	0.513	14.07	-0.41	-0.43	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.23	×	AU	13.90		AI	15.37		NH
7.20	⇓	AP	13.93		EP	15.40		Q
9.70		LT	13.97		CG	15.47		DB
10.63		PV	14.00		HK	15.50		RW
10.70		JG	14.00		CS	15.50		AZ
10.77		AE	14.00		CJ	15.70		RZ
10.97		TL	14.07		X	15.70		ID
11.37		HP	14.07		BO	15.80		W
11.47		P	14.27		RD	15.80		PB
11.57		BA	14.40		OY	15.83		JS
11.60		JX	14.43		FN	15.83		HL
11.83		JY	14.47		SZ	15.87		VI
11.93		CA	14.47		AH	16.00		NJ
11.97		QX	14.53		VH	16.37		EO
12.00		PQ	14.77		RV	16.40		T
12.03		VG	14.90		N	16.60		UQ
12.53		SC	14.93		KH	16.60		GQ
12.73		S	14.93		J	16.70		RF
12.80		AK	15.00		M	16.77		TH
12.87		CK	15.03		A	16.77		NT
12.93		UN	15.03		OF	16.80		EB
13.00		NO	15.07		CE	16.83		FZ
13.23		QZ	15.10		BH	16.90		SF
13.30		U	15.13		SS	17.37		L
13.30		AW	15.17		SD	17.60		SI
13.43		AL	15.17		OX	17.60		AJ
13.47		UW	15.27		AF	17.70		DE
13.60		VT	15.30		PW	17.83		BC
13.67		QJ	15.33		I	18.03		TI
13.90		SM	15.33		BM	18.03		KL

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

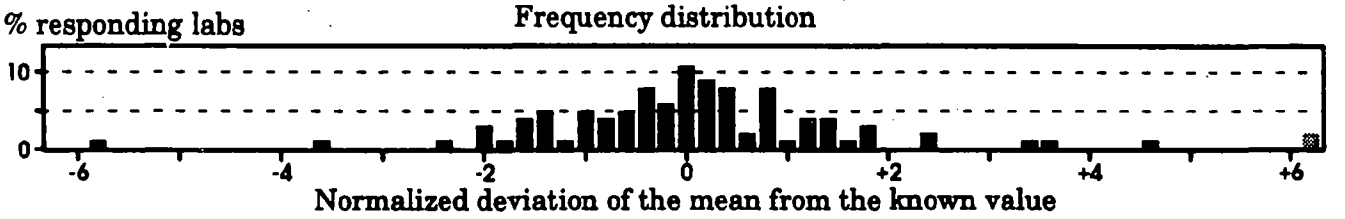
⇑ ≡ Above control limit

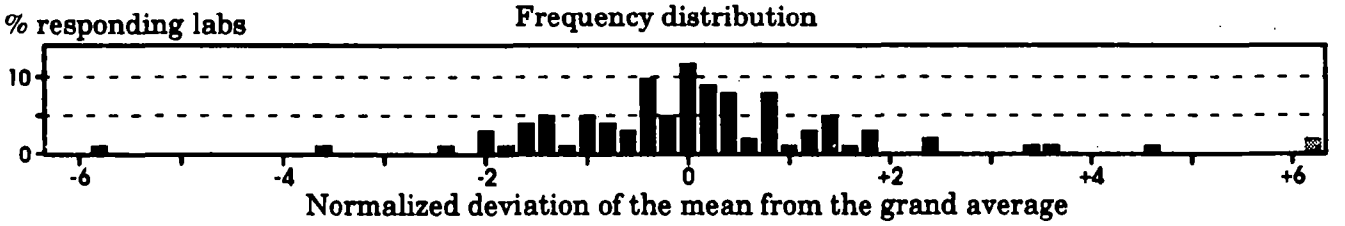
⇓ ≡ Below control limit

Radium-228

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
18.23		**TD**	18.97		**DZ**	22.60	⇑	**VA**
18.27		**TN**	19.07		**C**	23.00	⇑	**GN**
18.37		**BK**	20.07		**JE**	25.00	×	**QU**
18.77		**DT**	20.20		**UP**	32.70	×	**ST**
						38.63	×	**RK**





• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-96/012
February 1996

EPA

Strontium in Water Performance Evaluation Study

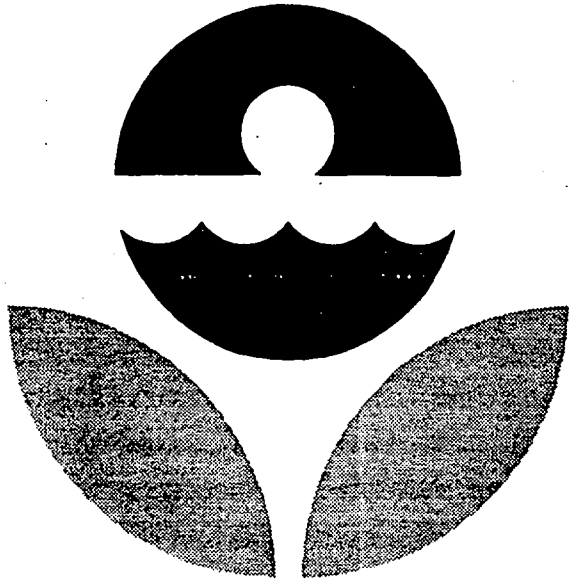
A Statistical Evaluation of the July 14, 1995 Data

023RSL96 cov-012

Strontium in Water

Performance Evaluation Study

July 14, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Analytical Sciences Branch (CRD-LV) Performance Evaluation Study for ***Strontium in Water; July 14, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by
the U.S. Environmental Protection Agency.
It has been subjected to the Agency's review,
and has been approved for publication as
an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

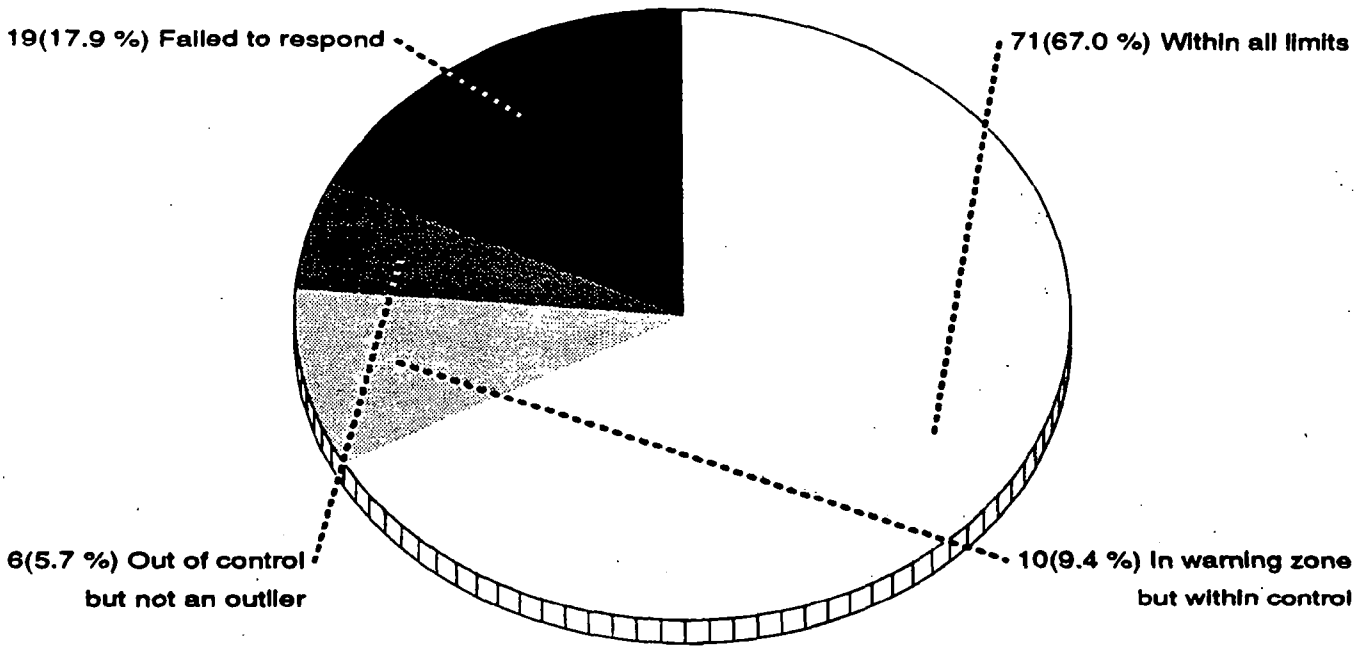
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

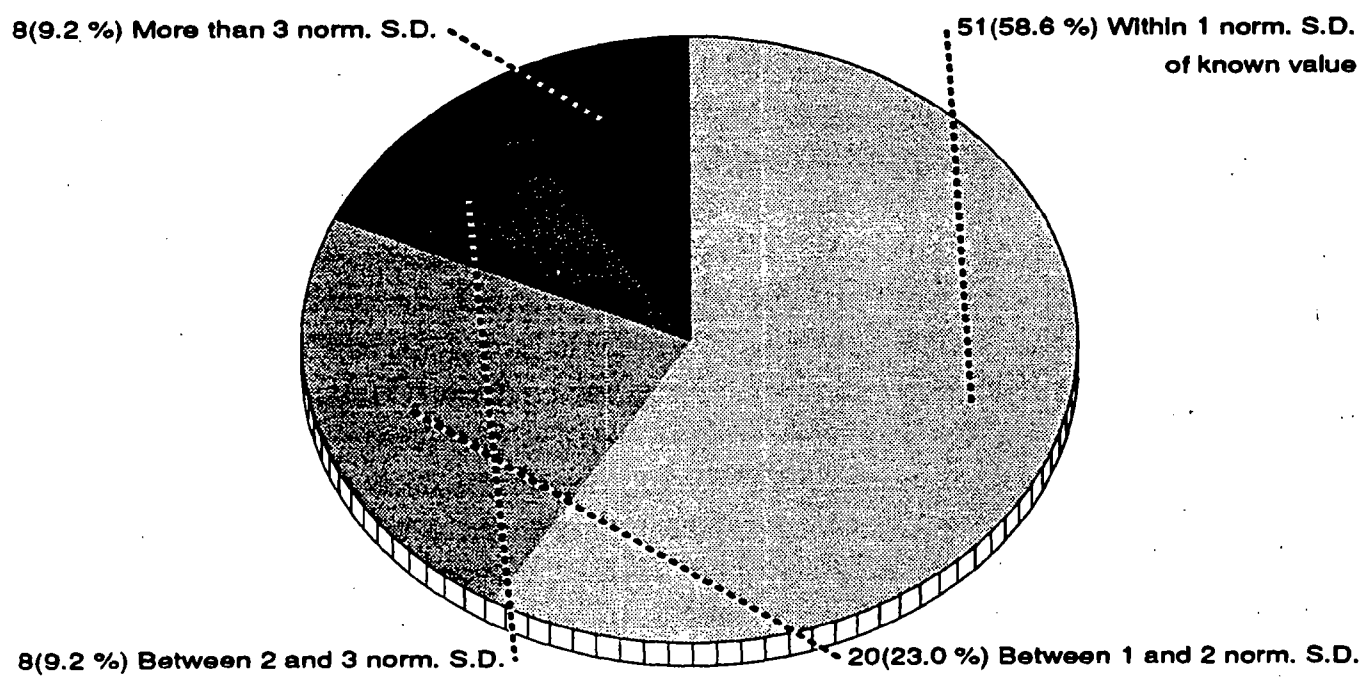
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, CRD-LV, 702/798-2141.

Strontium-89 Statistical Summary 106 Participants

The known value of this nuclide is **20.0 pCi/l** with an expected precision of **5.0**; the control limits are 11.3 to 28.7; the warning regions are 11.3 to 14.2 and 25.8 to 28.7



Statistic	Respondents	Non-outliers
Mean	18.07	**Grand Avg 18.07**
Std. Dev.	3.98	3.98
Variance	15.87	15.87
% Coef. of Var.	22.05	22.05
% deviation of mean from known value	-9.67	-9.67
Norm. dev. of mean from known value	-0.49	-0.49
Median	18.67	18.67
% deviation of median from known value	-6.67	-6.67
Norm. dev. of median from known value	-0.33	-0.33



CRD-LV Performance Evaluation: Strontium in Water, 14-Jul-1995

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	20.0	21.0	21.0	0.58	0.118	20.67	0.90	0.23	
AE	18.0	18.0	17.0	0.58	0.118	17.67	-0.14	-0.81	
AF	20.0	20.0	20.0	0.00	0.000	20.00	0.67	0.00	
AJ	21.0	15.0	13.0	4.16	0.945	16.33	-0.60	-1.27	
AK	12.0	11.0	11.0	0.58	0.118	11.33	-2.33	-3.00	
AL	18.0	22.0	23.0	2.65	0.591	21.00	1.02	0.35	
AU	21.0	23.0	22.0	1.00	0.236	22.00	1.36	0.69	
AW	22.0	19.0	17.0	2.52	0.591	19.33	0.44	-0.23	
AY									•
AZ	17.0	18.0	20.0	1.53	0.354	18.33	0.09	-0.58	
BA	23.0	21.0	22.0	1.00	0.236	22.00	1.36	0.69	
BB									•
BC	16.0	15.0	18.0	1.53	0.354	16.33	-0.60	-1.27	
BG	8.0								Ø
BH	18.0	16.0	17.0	1.00	0.236	17.00	-0.37	-1.04	
BL	21.0	21.0	21.0	0.00	0.000	21.00	1.02	0.35	
BM	9.0	11.0	10.0	1.00	0.236	10.00	-2.79	-3.46	⇓
BO	21.0	21.0	20.0	0.58	0.118	20.67	0.90	0.23	
C	20.0	21.0	21.0	0.58	0.118	20.67	0.90	0.23	
CA	23.0	23.0	25.0	1.15	0.236	23.67	1.94	1.27	
CE									•
CG	23.0	18.0	24.0	3.21	0.709	21.67	1.25	0.58	
CJ	18.0	20.0	17.0	1.53	0.354	18.33	0.09	-0.58	
CK	16.0	19.0	15.0	2.08	0.473	16.67	-0.48	-1.15	
CO	12.0	12.0	15.0	1.73	0.354	13.00	-1.75	-2.42	
CQ	14.0	15.0	16.0	1.00	0.236	15.00	-1.06	-1.73	
CS	17.0	17.0	16.0	0.58	0.118	16.67	-0.48	-1.15	
CX									•
D	14.0	14.0	14.0	0.00	0.000	14.00	-1.41	-2.08	
DD	16.0	14.0	18.0	2.00	0.473	16.00	-0.72	-1.39	
DE	20.0	20.0	21.0	0.58	0.118	20.33	0.79	0.12	
DG	11.0	11.0	11.0	0.00	0.000	11.00	-2.45	-3.12	⇓
DO	22.0	30.0	15.0	7.51	2.470	22.33	1.48	0.81	
DT	20.0	19.0	18.0	1.00	0.236	19.00	0.32	-0.35	
DZ	21.0	23.0	22.0	1.00	0.236	22.00	1.36	0.69	
E	20.0	18.0	20.0	1.15	0.236	19.33	0.44	-0.23	
EB	20.0	20.0	19.0	0.58	0.118	19.67	0.55	-0.12	
EL	18.0	18.0	18.0	0.00	0.000	18.00	-0.02	-0.69	
EX									•
FU	25.0	26.0	27.0	1.00	0.236	26.00	2.75	2.08	
FZ	17.0	15.0	16.0	1.00	0.236	16.00	-0.72	-1.39	
GQ	23.0	25.0	27.0	2.00	0.473	25.00	2.40	1.73	
HK	18.0	17.0	19.0	1.00	0.236	18.00	-0.02	-0.69	
HP	20.0	17.0	18.0	1.53	0.354	18.33	0.09	-0.58	
I	19.0	21.0	21.0	1.15	0.236	20.33	0.79	0.12	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
IC	19.0	18.0	18.0	0.58	0.118	18.33	0.09	-0.58	
J	21.0	20.0	20.0	0.58	0.118	20.33	0.79	0.12	
JE									•
JG									•
JS	18.0	22.0	16.0	3.06	0.709	18.67	0.21	-0.46	
JY									•
K	14.0	15.0	16.0	1.00	0.236	15.00	-1.06	-1.73	
KH	21.0	20.0	21.0	0.58	0.118	20.67	0.90	0.23	
KL	19.0	18.0	18.0	0.58	0.118	18.33	0.09	-0.58	
KX	18.0	17.0	18.0	0.58	0.118	17.67	-0.14	-0.81	
L	20.0	20.0	19.0	0.58	0.118	19.67	0.55	-0.12	
LT	28.0	25.0	26.0	1.53	0.354	26.33	2.86	2.19	
M	18.0	19.0	20.0	1.00	0.236	19.00	0.32	-0.35	
MQ	17.0	19.0	19.0	1.15	0.236	18.33	0.09	-0.58	
N	19.0	18.0	20.0	1.00	0.236	19.00	0.32	-0.35	
NJ	15.0	19.0	17.0	2.00	0.473	17.00	-0.37	-1.04	
NO	23.0	24.0	25.0	1.00	0.236	24.00	2.06	1.39	
NT	16.0	16.0	16.0	0.00	0.000	16.00	-0.72	-1.39	
OA	18.0	21.0	20.0	1.53	0.354	19.67	0.55	-0.12	
OL									•
PB	21.0	20.0	20.0	0.58	0.118	20.33	0.79	0.12	
PV	25.0	21.0	19.0	3.06	0.709	21.67	1.25	0.58	
Q	18.0	19.0	21.0	1.53	0.354	19.33	0.44	-0.23	
QJ									•
QU	15.0	15.0	15.0	0.00	0.000	15.00	-1.06	-1.73	
QW	16.0	17.0	18.0	1.00	0.236	17.00	-0.37	-1.04	
QZ	16.0	15.0	19.0	2.08	0.473	16.67	-0.48	-1.15	
R	11.0	6.0	7.0	2.65	0.591	8.00	-3.49	-4.16	⇓
RR	20.0	20.0	21.0	0.58	0.118	20.33	0.79	0.12	
RV									•
S	20.0	19.0	19.0	0.58	0.118	19.33	0.44	-0.23	
SC	15.0	16.0	18.0	1.53	0.354	16.33	-0.60	-1.27	
SD	20.0	22.0	19.0	1.53	0.354	20.33	0.79	0.12	
SF	20.0	16.0	15.0	2.65	0.591	17.00	-0.37	-1.04	
SI	8.0	8.0	9.0	0.58	0.118	8.33	-3.37	-4.04	⇓
SM	19.0	21.0	18.0	1.53	0.354	19.33	0.44	-0.23	
SS	18.0	17.0	19.0	1.00	0.236	18.00	-0.02	-0.69	
ST	19.0	18.0	21.0	1.53	0.354	19.33	0.44	-0.23	
SZ									•
T	19.0	17.0	19.0	1.15	0.236	18.33	0.09	-0.58	
TD	13.0	11.0	10.0	1.53	0.354	11.33	-2.33	-3.00	
TE									•
TH									•
TI	12.0	13.0	13.0	0.58	0.118	12.67	-1.87	-2.54	
TL	20.0	20.0	22.0	1.15	0.236	20.67	0.90	0.23	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Strontium in Water, 14-Jul-1995

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
TQ	17.0	18.0	22.0	2.65	0.591	19.00	0.32	-0.35	
U	20.0	18.0	19.0	1.00	0.236	19.00	0.32	-0.35	
UE	17.0	20.0	21.0	2.08	0.473	19.33	0.44	-0.23	
UN	12.0	13.0	10.0	1.53	0.354	11.67	-2.22	-2.89	
UP	13.0	15.0	16.0	1.53	0.354	14.67	-1.18	-1.85	
UW	18.0	17.0	18.0	0.58	0.118	17.67	-0.14	-0.81	
VA	10.0	11.0	10.0	0.58	0.118	10.33	-2.68	-3.35	⇓
VC									•
VG									•
VI	24.0	21.0	17.0	3.51	0.827	20.67	0.90	0.23	
VR									•
W	18.0	22.0	20.0	2.00	0.473	20.00	0.67	0.00	
WF	19.0	37.0	29.0	9.02	3.146	28.33	3.56	2.89	
WG									•
WI	12.0	14.0	9.0	2.52	0.591	11.67	-2.22	-2.89	
X	9.0	7.0	6.0	1.53	0.354	7.33	-3.72	-4.39	⇓

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
7.33	⇓	X	17.00		SF	19.33		S
8.00	⇓	R	17.00		QW	19.33		Q
8.33	⇓	SI	17.00		NJ	19.33		E
10.00	⇓	BM	17.00		BH	19.33		AW
10.33	⇓	VA	17.67		UW	19.67		OA
11.00	⇓	DG	17.67		KX	19.67		L
11.33		TD	17.67		AE	19.67		EB
11.33		AK	18.00		SS	20.00		W
11.67		WI	18.00		HK	20.00		AF
11.67		UN	18.00		EL	20.33		SD
12.67		TI	18.33		T	20.33		RR
13.00		CO	18.33		MQ	20.33		PB
14.00		D	18.33		KL	20.33		J
14.67		UP	18.33		IC	20.33		I
15.00		QU	18.33		HP	20.33		DE
15.00		K	18.33		CJ	20.67		VI
15.00		CQ	18.33		AZ	20.67		TL
16.00		NT	18.67		JS	20.67		KH
16.00		FZ	19.00		U	20.67		C
16.00		DD	19.00		TQ	20.67		BO
16.33		SC	19.00		N	20.67		A
16.33		BC	19.00		M	21.00		BL
16.33		AJ	19.00		DT	21.00		AL
16.67		QZ	19.33		UE	21.67		PV
16.67		CS	19.33		ST	21.67		CG
16.67		CK	19.33		SM	22.00		DZ

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

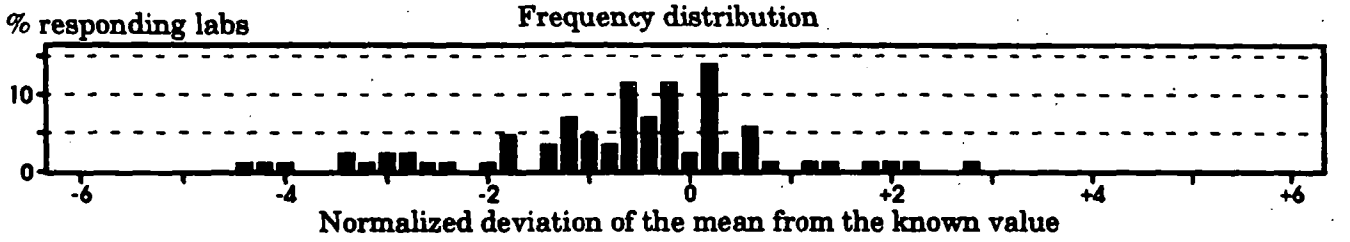
× ≡ Determined to be an outlier

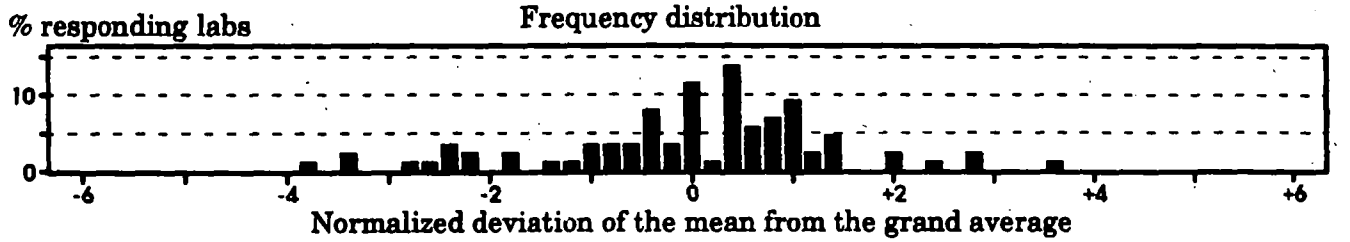
⇓ ≡ Below control limit

Strontium-89

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
22.00		BA	23.67		CA	26.00		FU
22.00		AU	24.00		NO	26.33		LT
22.33		DO	25.00		GQ	28.33		WF





• ≡ No data submitted
∅ ≡ Insufficient data

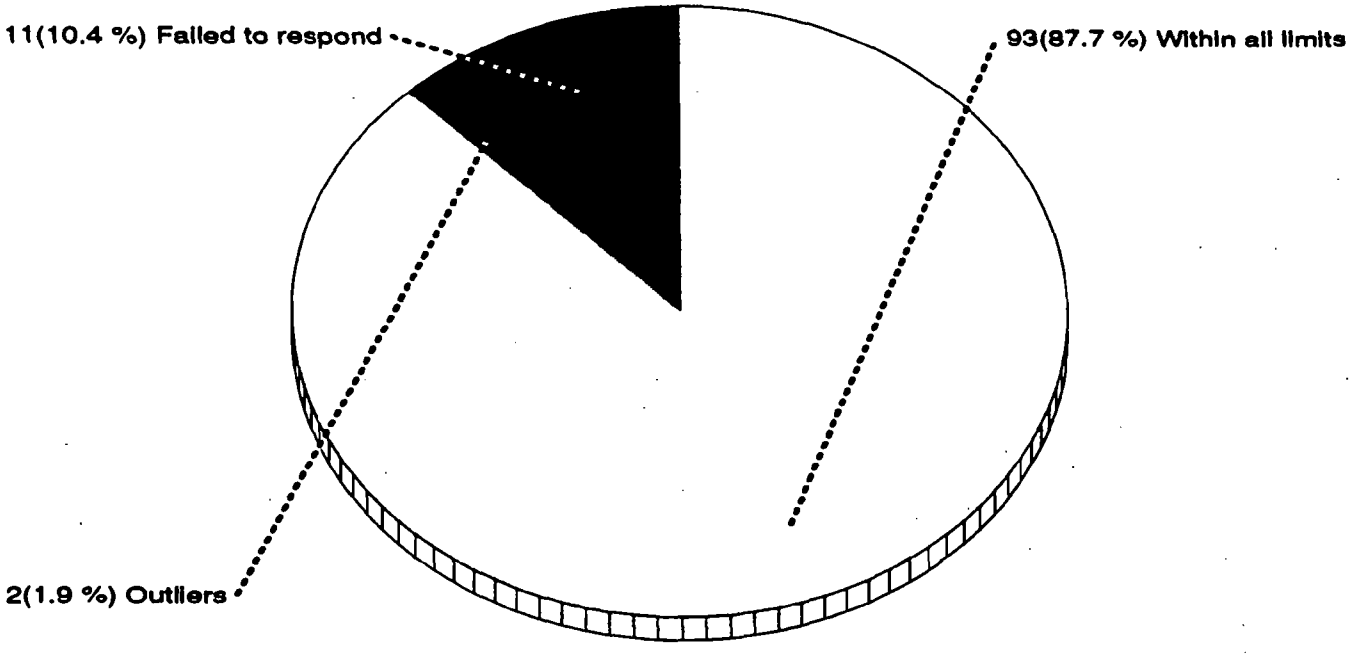
TAG SYMBOLS

× ≡ Determined to be an outlier

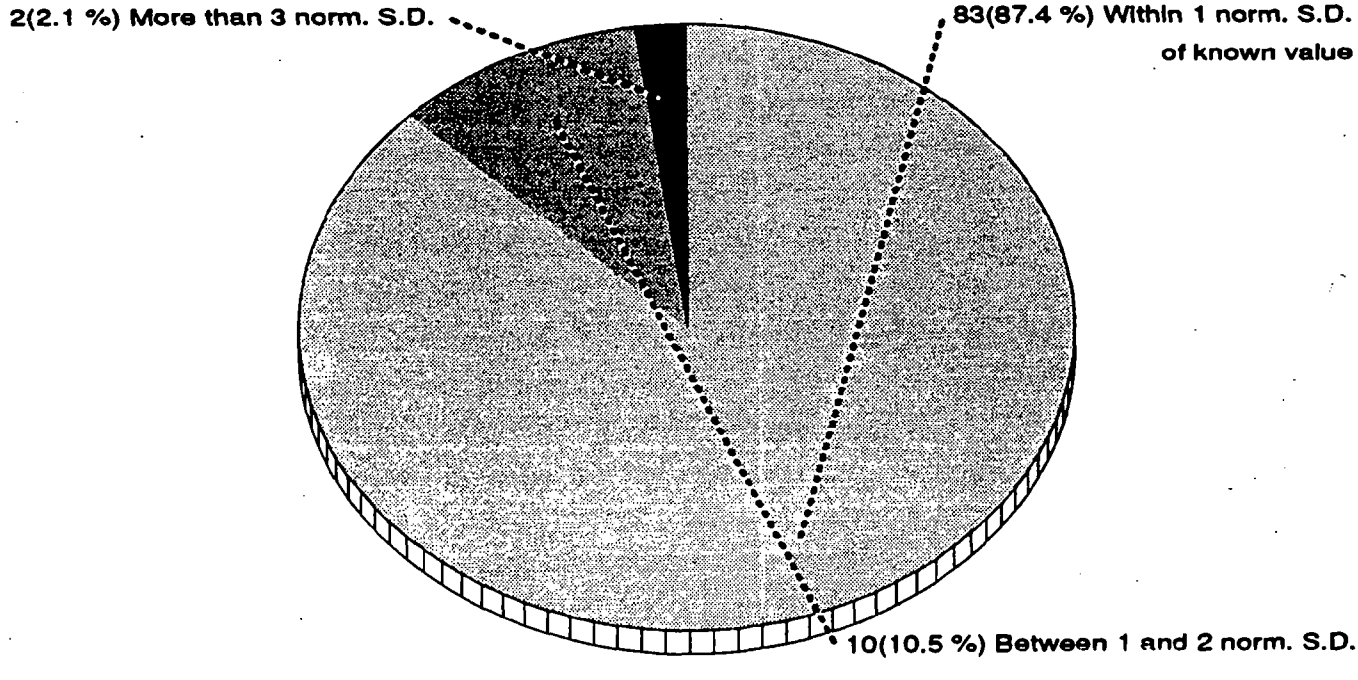
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90 Statistical Summary 106 Participants

The known value of this nuclide is **8.0 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 16.7; the warning regions are 0.0 to 2.2 and 13.8 to 16.7



Statistic	Respondents	Non-outliers
Mean	7.98	**Grand Avg 7.72**
Std. Dev.	2.42	1.67
Variance	5.85	2.80
% Coef. of Var.	30.30	21.68
% deviation of mean from known value	-0.26	-3.45
Norm. dev. of mean from known value	-0.01	-0.16
Median	7.67	7.67
% deviation of median from known value	-4.17	-4.17
Norm. dev. of median from known value	-0.14	-0.20



CRD-LV Performance Evaluation: Strontium in Water, 14-Jul-1995

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	7.0	8.0	8.0	0.58	0.118	7.67	-0.02	-0.12	
AE	6.0	6.0	7.0	0.58	0.118	6.33	-0.48	-0.58	
AF	7.0	8.0	7.0	0.58	0.118	7.33	-0.14	-0.23	
AJ	8.0	8.0	9.0	0.58	0.118	8.33	0.21	0.12	
AK	11.0	11.0	13.0	1.15	0.236	11.67	1.37	1.27	
AL	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
AU	6.0	7.0	6.0	0.58	0.118	6.33	-0.48	-0.58	
AW	8.0	8.0	10.0	1.15	0.236	8.67	0.33	0.23	
AY	6.0	7.0	6.0	0.58	0.118	6.33	-0.48	-0.58	
AZ	8.0	7.0	7.0	0.58	0.118	7.33	-0.14	-0.23	
BA	7.0	8.0	8.0	0.58	0.118	7.67	-0.02	-0.12	
BB	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
BC	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
BG	8.0	7.0	7.0	0.58	0.118	7.33	-0.14	-0.23	
BH	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
BL	9.0	8.0	9.0	0.58	0.118	8.67	0.33	0.23	
BM	4.0	4.0	4.0	0.00	0.000	4.00	-1.29	-1.39	
BO	6.0	6.0	7.0	0.58	0.118	6.33	-0.48	-0.58	
C	9.0	8.0	9.0	0.58	0.118	8.67	0.33	0.23	
CA	9.0	9.0	10.0	0.58	0.118	9.33	0.56	0.46	
CE	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
CG	7.0	9.0	7.0	1.15	0.236	7.67	-0.02	-0.12	
CJ	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
CK	10.0	10.0	8.0	1.15	0.236	9.33	0.56	0.46	
CO	7.0	7.0	6.0	0.58	0.118	6.67	-0.37	-0.46	
CQ	7.0	8.0	9.0	1.00	0.236	8.00	0.10	0.00	
CS	9.0	9.0	9.0	0.00	0.000	9.00	0.44	0.35	
CX									•
D	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
DD	8.0	9.0	7.0	1.00	0.236	8.00	0.10	0.00	
DE	9.0	10.0	10.0	0.58	0.118	9.67	0.67	0.58	
DG	6.0	6.0	6.0	0.00	0.000	6.00	-0.60	-0.69	
DO	7.0	6.0	7.0	0.58	0.118	6.67	-0.37	-0.46	
DT	6.0	7.0	6.0	0.58	0.118	6.33	-0.48	-0.58	
DZ	10.0	10.0	10.0	0.00	0.000	10.00	0.79	0.69	
E	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
EB	7.0	8.0	8.0	0.58	0.118	7.67	-0.02	-0.12	
EL	9.0	10.0	9.0	0.58	0.118	9.33	0.56	0.46	
EX									•
FU	5.0	6.0	7.0	1.00	0.236	6.00	-0.60	-0.69	
FZ	11.0	10.0	10.0	0.58	0.118	10.33	0.90	0.81	
GQ	12.0	13.0	13.0	0.58	0.118	12.67	1.71	1.62	
HK	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
HP	8.0	8.0	7.0	0.58	0.118	7.67	-0.02	-0.12	
I	8.0	6.0	7.0	1.00	0.236	7.00	-0.25	-0.35	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
IC	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
J	9.0	9.0	8.0	0.58	0.118	8.67	0.33	0.23	
JE									•
JG									•
JS	6.0	7.0	7.0	0.58	0.118	6.67	-0.37	-0.46	
JY	13.0	12.0	12.0	0.58	0.118	12.33	1.60	1.50	
K	8.0	5.0	8.0	1.73	0.354	7.00	-0.25	-0.35	
KH	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
KL	8.0	9.0	7.0	1.00	0.236	8.00	0.10	0.00	
KX	7.0	8.0	7.0	0.58	0.118	7.33	-0.14	-0.23	
L	7.0	8.0	8.0	0.58	0.118	7.67	-0.02	-0.12	
LT	3.0	4.0	4.0	0.58	0.118	3.67	-1.41	-1.50	
M	5.0	6.0	6.0	0.58	0.118	5.67	-0.71	-0.81	
MQ	9.0	8.0	8.0	0.58	0.118	8.33	0.21	0.12	
N	7.0	8.0	7.0	0.58	0.118	7.33	-0.14	-0.23	
NJ	9.0	7.0	8.0	1.00	0.236	8.00	0.10	0.00	
NO	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
NT	7.0	7.0	7.0	0.00	0.000	7.00	-0.25	-0.35	
OA	9.0	8.0	9.0	0.58	0.118	8.67	0.33	0.23	
OL									•
PB	10.0	9.0	10.0	0.58	0.118	9.67	0.67	0.58	
PV	4.0	6.0	6.0	1.15	0.236	5.33	-0.83	-0.92	
Q	10.0	10.0	10.0	0.00	0.000	10.00	0.79	0.69	
QJ	11.0	9.0	6.0	2.52	0.591	8.67	0.33	0.23	
QU	4.0	6.0	8.0	2.00	0.473	6.00	-0.60	-0.69	
QW	6.0	7.0	6.0	0.58	0.118	6.33	-0.48	-0.58	
QZ	6.0	6.0	6.0	0.00	0.000	6.00	-0.60	-0.69	
R	9.0	9.0	10.0	0.58	0.118	9.33	0.56	0.46	
RR	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
RV									•
S	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
SC	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
SD	7.0	5.0	6.0	1.00	0.236	6.00	-0.60	-0.69	
SF	10.0	11.0	10.0	0.58	0.118	10.33	0.90	0.81	
SI	4.0	4.0	4.0	0.00	0.000	4.00	-1.29	-1.39	
SM	7.0	7.0	8.0	0.58	0.118	7.33	-0.14	-0.23	
SS	9.0	8.0	8.0	0.58	0.118	8.33	0.21	0.12	
ST	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
SZ	10.0	11.0	10.0	0.58	0.118	10.33	0.90	0.81	
T	7.0	8.0	6.0	1.00	0.236	7.00	-0.25	-0.35	
TD	3.0	5.0	7.0	2.00	0.473	5.00	-0.94	-1.04	
TE									•
TH	20.0	22.0	22.0	1.15	0.236	21.33	4.71	4.62	×
TI	9.0	8.0	8.0	0.58	0.118	8.33	0.21	0.12	
TL	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Strontium in Water, 14-Jul-1995

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
TQ	9.0	7.0	8.0	1.00	0.236	8.00	0.10	0.00	
U	7.0	8.0	8.0	0.58	0.118	7.67	-0.02	-0.12	
UE	8.0	8.0	7.0	0.58	0.118	7.67	-0.02	-0.12	
UN	4.0	6.0	4.0	1.15	0.236	4.67	-1.06	-1.15	
UP	8.0	9.0	8.0	0.58	0.118	8.33	0.21	0.12	
UW	8.0	7.0	7.0	0.58	0.118	7.33	-0.14	-0.23	
VA	10.0	10.0	10.0	0.00	0.000	10.00	0.79	0.69	
VC									•
VG									•
VI	10.0	11.0	13.0	1.53	0.354	11.33	1.25	1.15	
VR									•
W	7.0	6.0	7.0	0.58	0.118	6.67	-0.37	-0.46	
WF	8.0	8.0	8.0	0.00	0.000	8.00	0.10	0.00	
WG									•
WI	4.0	5.0	4.0	0.58	0.118	4.33	-1.17	-1.27	
X	17.0	19.0	19.0	1.15	0.236	18.33	3.68	3.58	×

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.67		LT	7.00		KH	8.00		SC
4.00		SI	7.00		K	8.00		S
4.00		BM	7.00		IC	8.00		RR
4.33		WI	7.00		I	8.00		NJ
4.67		UN	7.00		CE	8.00		KL
5.00		TD	7.00		BC	8.00		HK
5.33		PV	7.00		AL	8.00		E
5.67		M	7.33		UW	8.00		DD
6.00		SD	7.33		SM	8.00		D
6.00		QZ	7.33		N	8.00		CQ
6.00		QU	7.33		KX	8.00		CJ
6.00		FU	7.33		BG	8.00		BH
6.00		DG	7.33		AZ	8.00		BB
6.33		QW	7.33		AF	8.33		UP
6.33		DT	7.67		UE	8.33		TI
6.33		BO	7.67		U	8.33		SS
6.33		AY	7.67		L	8.33		MQ
6.33		AU	7.67		HP	8.33		AJ
6.33		AE	7.67		EB	8.67		QJ
6.67		W	7.67		CG	8.67		OA
6.67		JS	7.67		BA	8.67		J
6.67		DO	7.67		A	8.67		C
6.67		CO	8.00		WF	8.67		BL
7.00		T	8.00		TQ	8.67		AW
7.00		NT	8.00		TL	9.00		CS
7.00		NO	8.00		ST	9.33		R

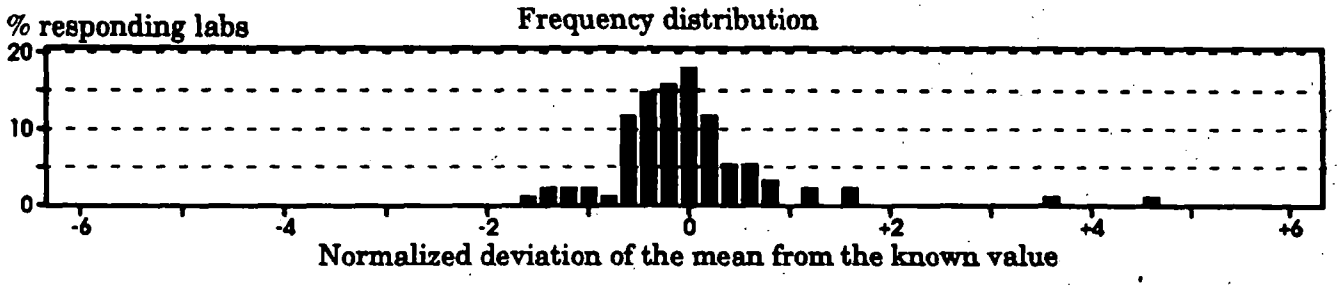
TAG SYMBOLS

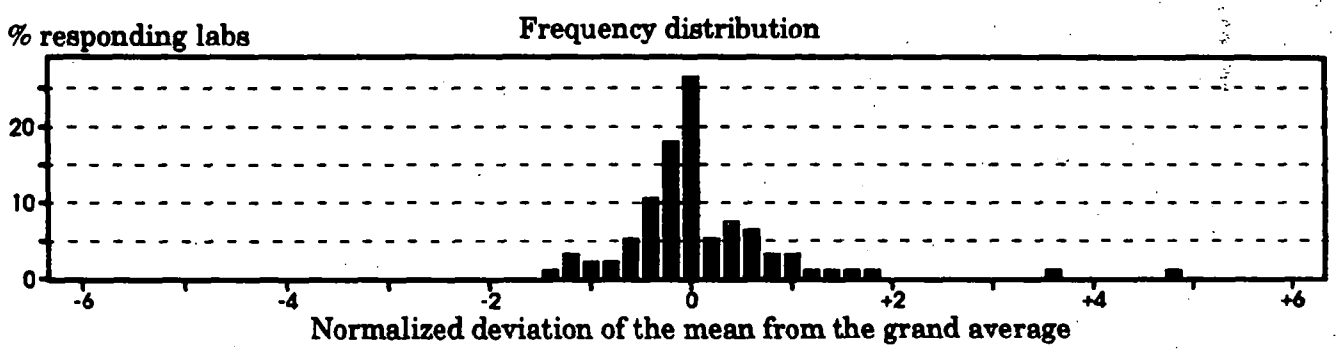
• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.33		EL	10.00		VA	11.33		VI
9.33		CK	10.00		Q	11.67		AK
9.33		CA	10.00		DZ	12.33		JY
9.67		PB	10.33		SZ	12.67		GQ
9.67		DE	10.33		SF	18.33	×	X
			10.33		FZ	21.33	×	TH





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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-95/143
September 1995

EPA

Gross Alpha-Beta in Water Performance Evaluation Study

A Statistical Evaluation of the July 21, 1995 Data

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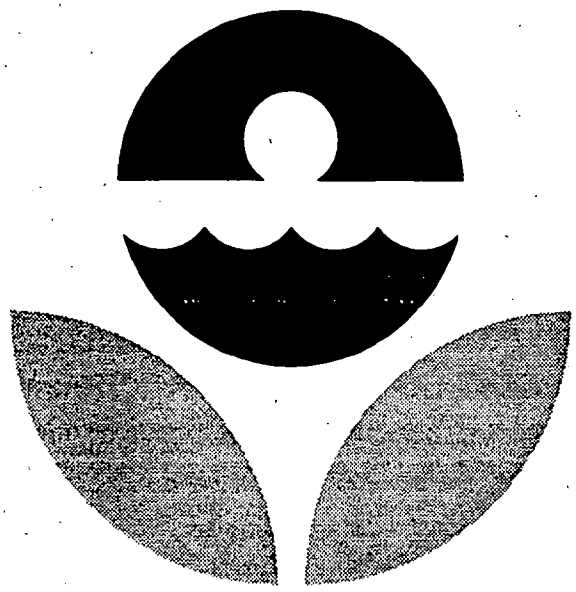
Gross Alpha-Beta in Water

Performance Evaluation Study

July 21, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Radiation Sciences Branch (CRD-LV) Performance Evaluation Study for ***Gross Alpha-Beta in Water; July 21, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Program

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

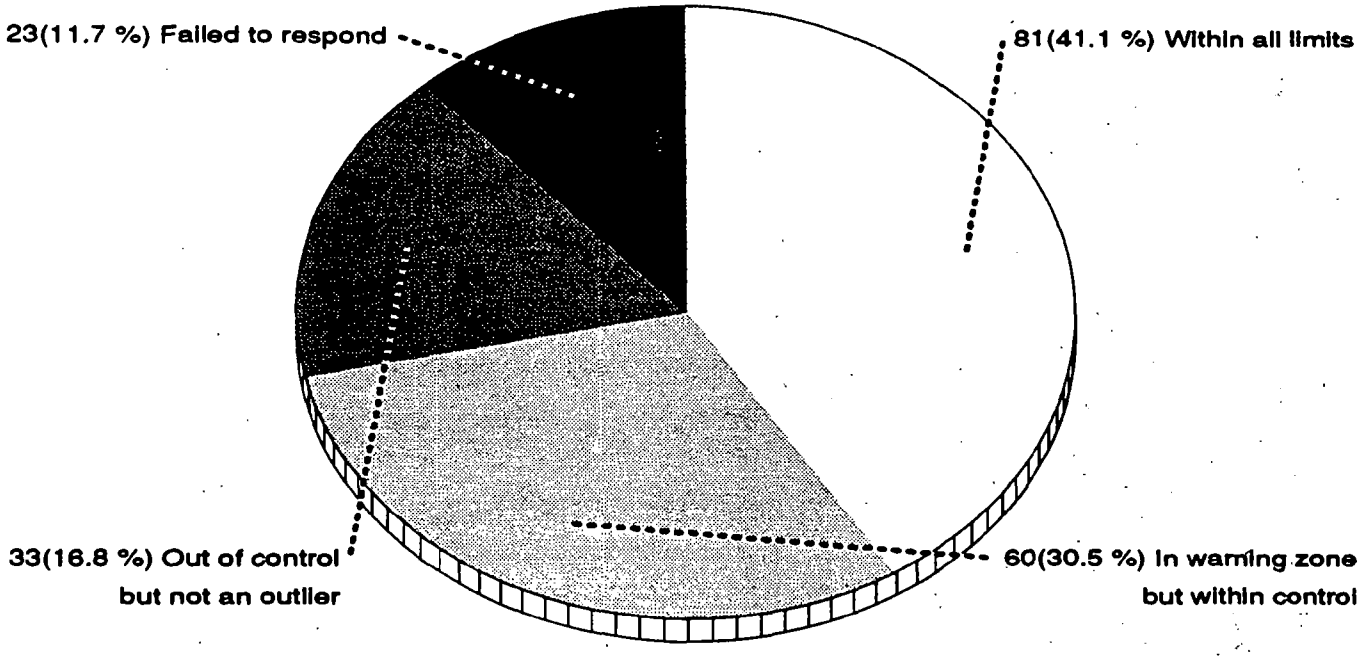
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

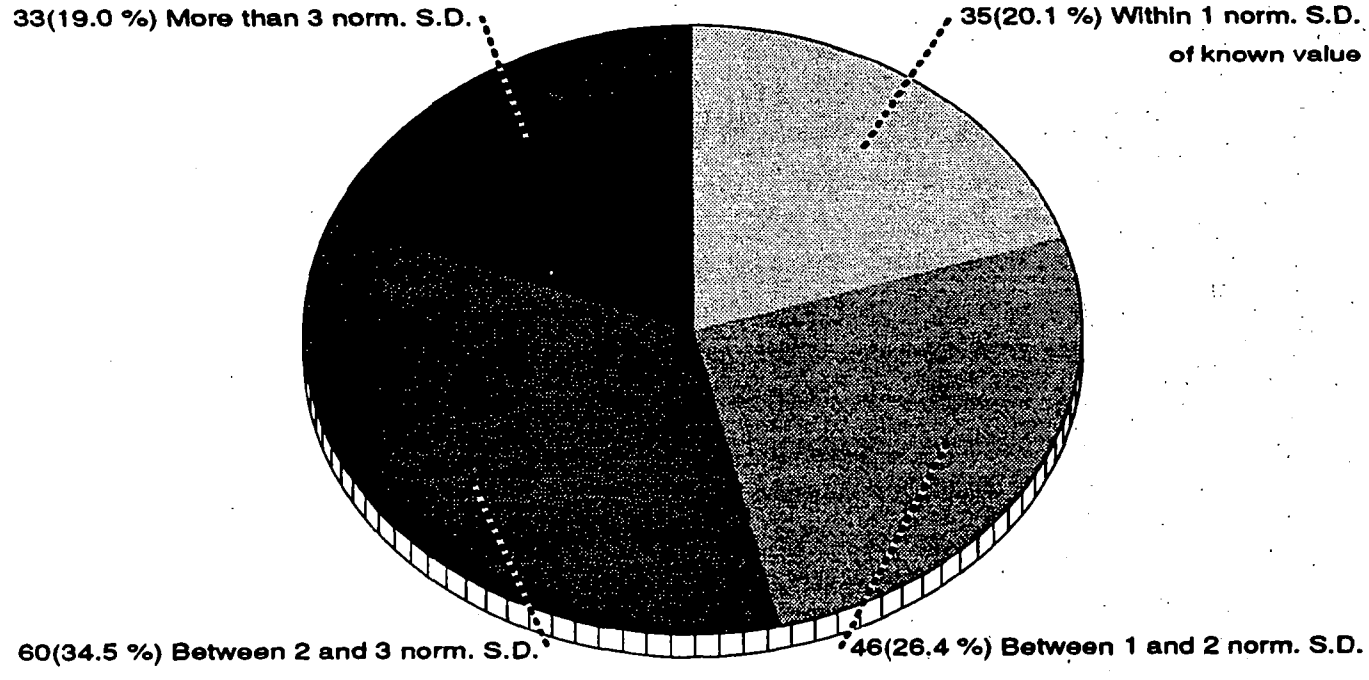
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, CRD-LV, 702/798-2104.

Gross Alpha Statistical Summary 197 Participants

The known value of this nuclide is **27.5 pCi/l** with an expected precision of **6.9**; the control limits are 15.5 to 39.5; the warning regions are 15.5 to 19.5 and 35.5 to 39.5



Statistic	Respondents	Non-outliers
Mean	19.75	**Grand Avg 19.75**
Std. Dev.	5.46	5.46
Variance	29.76	29.76
% Coef. of Var.	27.62	27.62
% deviation of mean from known value	-28.17	-28.17
Norm. dev. of mean from known value	-1.42	-1.42
Median	19.32	19.32
% deviation of median from known value	-29.76	-29.76
Norm. dev. of median from known value	-1.50	-1.50



CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 21-Jul-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	21.5	24.7	24.4	1.77	0.274	23.53	0.95	-1.00	
AE	34.0	31.4	32.2	1.33	0.223	32.53	3.21	1.26	
AF	16.1	15.5	15.7	0.31	0.051	15.77	-1.00	-2.95	
AH									•
AJ	17.4	18.6	18.7	0.72	0.111	18.23	-0.38	-2.33	
AK	15.3	15.9	16.2	0.46	0.077	15.80	-0.99	-2.94	
AL	22.9	21.6	20.2	1.35	0.231	21.57	0.45	-1.49	
AN	29.8	27.9	29.5	1.02	0.163	29.07	2.34	0.39	
AP	21.2	23.6	19.0	2.30	0.394	21.27	0.38	-1.56	
AR	31.9	34.7	26.4	4.22	0.711	31.00	2.82	0.88	
AU	17.0	14.0	16.0	1.53	0.257	15.67	-1.03	-2.97	
AW	18.6	19.4	20.2	0.80	0.137	19.40	-0.09	-2.03	
AZ	27.7	24.3	26.3	1.71	0.291	26.10	1.59	-0.35	
BA	17.6	17.2	18.8	0.83	0.137	17.87	-0.47	-2.42	
BB	16.4	17.9	16.0	1.00	0.163	16.77	-0.75	-2.69	
BC	20.7	14.7	16.0	3.16	0.514	17.13	-0.66	-2.60	
BG	16.0	15.0	15.0	0.58	0.086	15.33	-1.11	-3.05	⇓
BH	19.8	22.0	20.7	1.11	0.188	20.83	0.27	-1.67	
BI	17.0	15.0	17.0	1.15	0.171	16.33	-0.86	-2.80	
BK	20.2	20.6	20.4	0.20	0.034	20.40	0.16	-1.78	
BL	35.8	36.6	31.2	2.91	0.462	34.53	3.71	1.77	
BM	26.7	26.3	25.2	0.78	0.128	26.07	1.58	-0.36	
BN	25.9	26.4	26.6	0.36	0.060	26.30	1.64	-0.30	
BO	25.7	22.5	20.7	2.53	0.428	22.97	0.81	-1.14	
C	19.4	18.3	19.9	0.82	0.137	19.20	-0.14	-2.08	
CA	18.8	14.0	16.4	2.40	0.411	16.40	-0.84	-2.79	
CE	19.5	18.8	22.3	1.85	0.300	20.20	0.11	-1.83	
CG	15.3	19.7	21.7	3.27	0.548	18.90	-0.21	-2.16	
CJ	17.0	18.0	20.0	1.53	0.257	18.33	-0.36	-2.30	
CK	24.6	25.1	21.2	2.12	0.334	23.63	0.97	-0.97	
CO	18.1	14.5	14.2	2.17	0.334	15.60	-1.04	-2.99	
CP	15.0	13.0	16.0	1.53	0.257	14.67	-1.28	-3.22	⇓
CQ	17.0	15.2	16.2	0.90	0.154	16.13	-0.91	-2.85	
CS	27.0	30.9	28.1	2.01	0.334	28.67	2.24	0.29	
CX	25.0	9.7	24.4	8.67	1.590	19.70	-0.01	-1.96	
D	20.6	18.6	19.0	1.06	0.171	19.40	-0.09	-2.03	
DB	23.3	23.5	24.0	0.36	0.060	23.60	0.97	-0.98	
DD	16.9	15.8	20.2	2.29	0.377	17.63	-0.53	-2.48	
DE	20.1	20.2	20.3	0.10	0.017	20.20	0.11	-1.83	
DH	17.3	18.4	16.6	0.91	0.154	17.43	-0.58	-2.53	
DI	22.6	21.7	21.8	0.49	0.077	22.03	0.57	-1.37	
DM									•
DO	17.0	19.0	25.0	4.16	0.685	20.33	0.15	-1.80	
DR	21.0	16.0	17.0	2.65	0.428	18.00	-0.44	-2.38	
DS	12.8	12.5	12.4	0.21	0.034	12.57	-1.80	-3.75	⇓

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DT	19.6	20.4	21.9	1.17	0.197	20.63	0.22	-1.72	
DZ	19.1	19.7	18.4	0.65	0.111	19.07	-0.17	-2.12	
E	20.7	20.2	21.4	0.60	0.103	20.77	0.25	-1.69	
EB	24.2	24.4	25.7	0.81	0.128	24.77	1.26	-0.69	
EL	14.4	14.1	13.2	0.62	0.103	13.90	-1.47	-3.41	⇓
EN	13.3	10.9	14.6	1.88	0.317	12.93	-1.71	-3.66	⇓
EO	16.0	17.0	17.0	0.58	0.086	16.67	-0.78	-2.72	
ER	22.5	23.3	21.8	0.75	0.128	22.53	0.70	-1.25	
EV	18.6	16.6	16.2	1.29	0.205	17.13	-0.66	-2.60	
EW	24.6	23.2	24.3	0.74	0.120	24.03	1.07	-0.87	
EX									•
FF	20.0	20.0	19.0	0.58	0.086	19.67	-0.02	-1.97	
FJ	26.6	25.3	23.1	1.77	0.300	25.00	1.32	-0.63	
FL	23.0	13.0	14.0	5.51	0.856	16.67	-0.78	-2.72	
FN	15.3	14.6	16.9	1.18	0.197	15.60	-1.04	-2.99	
FZ	13.0	15.0	15.0	1.15	0.171	14.33	-1.36	-3.31	⇓
GE									•
GQ	22.3	22.3	21.7	0.35	0.051	22.10	0.59	-1.36	
GT	14.3	14.6	11.8	1.54	0.240	13.57	-1.55	-3.50	⇓
GZ	26.5	25.6	25.3	0.62	0.103	25.80	1.52	-0.43	
HI	19.0	18.0	16.0	1.53	0.257	17.67	-0.52	-2.47	
HK	20.1	18.6	19.9	0.81	0.128	19.53	-0.06	-2.00	
HL	16.9	13.0	12.8	2.31	0.351	14.23	-1.39	-3.33	⇓
HP	23.0	17.9	15.3	3.92	0.659	18.73	-0.26	-2.20	
I	24.2	24.7	25.6	0.71	0.120	24.83	1.27	-0.67	
IC	19.9	20.1	19.1	0.53	0.086	19.70	-0.01	-1.96	
ID	17.1	15.4	16.8	0.91	0.146	16.43	-0.83	-2.78	
J	31.9	30.0	26.6	2.69	0.454	29.50	2.45	0.50	
JE									•
JG	17.0	18.3	18.5	0.81	0.128	17.93	-0.46	-2.40	
JM	12.0	13.0	13.0	0.58	0.086	12.67	-1.78	-3.72	⇓
JN	17.3	20.0	18.5	1.35	0.231	18.60	-0.29	-2.23	
JP	17.6	17.2	16.1	0.78	0.128	16.97	-0.70	-2.64	
JQ	21.4	24.8	22.9	1.70	0.291	23.03	0.82	-1.12	
JS	20.9	18.1	18.9	1.44	0.240	19.30	-0.11	-2.06	
JY									•
K	19.9	14.5	20.1	3.18	0.479	18.17	-0.40	-2.34	
KC									•
KE	23.1	25.0	24.3	0.96	0.163	24.13	1.10	-0.85	
KH	28.0	31.7	28.7	1.97	0.317	29.47	2.44	0.49	
KT	22.0	22.0	21.0	0.58	0.086	21.67	0.48	-1.46	
KX	18.0	19.0	17.0	1.00	0.171	18.00	-0.44	-2.38	
L	10.6	11.6	11.4	0.53	0.086	11.20	-2.15	-4.09	⇓
LF	14.0	13.0	10.0	2.08	0.342	12.33	-1.86	-3.81	⇓
LL	27.6	32.1	26.3	3.04	0.497	28.67	2.24	0.29	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 21-Jul-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR	7.2	7.8	5.9	0.97	0.163	6.97	-3.21	-5.15	⇓
LT	15.6	12.8	13.5	1.46	0.240	13.97	-1.45	-3.40	⇓
M	38.0	35.0	42.0	3.51	0.599	38.33	4.66	2.72	
MA									•
MF	26.5	27.0	26.2	0.40	0.068	26.57	1.71	-0.23	
MQ	24.0	22.0	26.0	2.00	0.342	24.00	1.07	-0.88	
MV	17.9	15.0	14.0	2.03	0.334	15.63	-1.03	-2.98	
MX	28.0	32.7	27.5	2.87	0.445	29.40	2.42	0.48	
MY									•
N	24.0	28.0	32.0	4.00	0.685	28.00	2.07	0.13	
NA	18.6	20.9	21.1	1.39	0.214	20.20	0.11	-1.83	
NB	11.2	12.6	12.0	0.70	0.120	11.93	-1.96	-3.91	⇓
NE									•
NJ	14.7	13.1	13.9	0.80	0.137	13.90	-1.47	-3.41	⇓
NK									•
NO	17.1	18.8	18.6	0.93	0.146	18.17	-0.40	-2.34	
NP	28.9	30.9	30.6	1.08	0.171	30.13	2.61	0.66	
NT	18.4	18.1	17.8	0.30	0.051	18.10	-0.42	-2.36	
O	26.0	24.8	24.5	0.79	0.128	25.10	1.34	-0.60	
OA	21.0	23.0	19.0	2.00	0.342	21.00	0.31	-1.63	
OB	23.4	23.6	22.6	0.53	0.086	23.20	0.86	-1.08	
OF	22.2	17.4	13.7	4.26	0.728	17.77	-0.50	-2.44	
OS	19.0	18.0	21.0	1.53	0.257	19.33	-0.11	-2.05	
OX	27.1	21.9	17.0	5.05	0.865	22.00	0.56	-1.38	
OY	28.8	33.7	33.2	2.70	0.419	31.90	3.05	1.10	
OZ	18.3	20.4	20.6	1.27	0.197	19.77	0.00	-1.94	
P	32.1	33.9	34.2	1.14	0.180	33.40	3.43	1.48	
PB	20.4	21.8	20.1	0.91	0.146	20.77	0.25	-1.69	
PG	25.8	22.8	25.3	1.61	0.257	24.63	1.22	-0.72	
PM	13.0	12.0	12.0	0.58	0.086	12.33	-1.86	-3.81	⇓
PQ	19.5	21.8	23.1	1.82	0.308	21.47	0.43	-1.51	
PR	32.0	30.0	27.0	2.52	0.428	29.67	2.49	0.54	
PV	13.1	23.1	19.9	5.11	0.856	18.70	-0.26	-2.21	
Q	15.8	13.5	18.5	2.50	0.428	15.93	-0.96	-2.90	
QC	15.9	13.5	12.1	1.92	0.325	13.83	-1.49	-3.43	⇓
QP	15.8	15.6	17.6	1.10	0.171	16.33	-0.86	-2.80	
QQ	20.2	20.3	20.2	0.06	0.009	20.23	0.12	-1.82	
QT	19.1	21.1	24.9	2.95	0.497	21.70	0.49	-1.46	
QU	13.6	15.0	16.4	1.40	0.240	15.00	-1.19	-3.14	⇓
QW	22.4	19.0	25.8	3.40	0.582	22.40	0.66	-1.28	
QX	19.3	19.6	20.9	0.85	0.137	19.93	0.04	-1.90	
QZ	23.5	26.1	22.1	2.03	0.342	23.90	1.04	-0.90	
R	21.8	23.7	24.5	1.39	0.231	23.33	0.90	-1.05	
RB	13.6	11.8	12.6	0.90	0.154	12.67	-1.78	-3.72	⇓
RD	21.0	19.0	14.0	3.61	0.599	18.00	-0.44	-2.38	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE	22.0	23.5	20.2	1.65	0.282	21.90	0.54	-1.41	
RG	18.7	18.2	20.9	1.44	0.231	19.27	-0.12	-2.07	
RH									•
RI	17.2	16.3	20.8	2.38	0.385	18.10	-0.42	-2.36	
RJ									•
RR	30.0	27.0	27.0	1.73	0.257	28.00	2.07	0.13	
RU									•
RV	15.0	18.0	17.0	1.53	0.257	16.67	-0.78	-2.72	
RW	19.1	19.6	19.4	0.25	0.043	19.37	-0.10	-2.04	
RZ	25.8	23.4	25.0	1.22	0.205	24.73	1.25	-0.69	
S	17.8	22.7	20.6	2.46	0.419	20.37	0.15	-1.79	
SC	17.9	16.3	20.1	1.91	0.325	18.10	-0.42	-2.36	
SD	22.5	24.7	21.8	1.51	0.248	23.00	0.81	-1.13	
SF	19.6	19.7	19.8	0.10	0.017	19.70	-0.01	-1.96	
SI	20.4	27.1	23.1	3.37	0.574	23.53	0.95	-1.00	
SL	21.9	20.5	22.3	0.95	0.154	21.57	0.45	-1.49	
SM	29.3	29.5	28.9	0.31	0.051	29.23	2.38	0.44	
SN	11.5	6.2	10.7	2.86	0.454	9.47	-2.58	-4.53	⇓
SO	22.3	21.7	21.5	0.42	0.068	21.83	0.52	-1.42	
SR	25.0	34.0	31.0	4.58	0.770	30.00	2.57	0.63	
SS	25.2	19.5	20.5	3.04	0.488	21.73	0.50	-1.45	
SU	17.5	16.9	18.3	0.70	0.120	17.57	-0.55	-2.49	
SX	23.4	22.7	21.3	1.07	0.180	22.47	0.68	-1.26	
SZ									•
T	11.6	9.0	10.6	1.31	0.223	10.40	-2.35	-4.29	⇓
TC									•
TD	24.3	21.1	22.1	1.64	0.274	22.50	0.69	-1.26	
TE									•
TG	15.7	16.6	10.6	3.24	0.514	14.30	-1.37	-3.31	⇓
TH	11.3	9.9	8.3	1.50	0.257	9.83	-2.49	-4.43	⇓
TI	14.6	14.2	15.0	0.40	0.068	14.60	-1.29	-3.24	⇓
TL	22.5	24.1	27.7	2.66	0.445	24.77	1.26	-0.69	
TN	12.7	18.8	17.3	3.18	0.522	16.27	-0.88	-2.82	
TO	16.0	17.1	17.4	0.74	0.120	16.83	-0.73	-2.68	
TQ	14.1	12.7	13.4	0.70	0.120	13.40	-1.60	-3.54	⇓
TW	18.8	16.3	21.1	2.40	0.411	18.73	-0.26	-2.20	
TY	11.9	12.2	11.8	0.21	0.034	11.97	-1.95	-3.90	⇓
U	21.9	21.5	16.2	3.18	0.488	19.87	0.03	-1.92	
UA	10.1	11.6	10.9	0.75	0.128	10.87	-2.23	-4.18	⇓
UE	15.0	17.3	14.6	1.46	0.231	15.63	-1.03	-2.98	
UN	15.5	19.3	17.7	1.91	0.325	17.50	-0.57	-2.51	
UP	16.5	22.2	19.8	2.86	0.488	19.50	-0.06	-2.01	
UQ	22.6	22.8	20.5	1.27	0.197	21.97	0.56	-1.39	
UW	26.2	22.8	23.0	1.91	0.291	24.00	1.07	-0.88	
UY									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 21-Jul-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VA	22.8	19.5	13.5	4.71	0.796	18.60	-0.29	-2.23	
VC									•
VG	15.8	15.4	16.8	0.72	0.120	16.00	-0.94	-2.89	
VH	14.3	15.3	17.3	1.53	0.257	15.63	-1.03	-2.98	
VI	16.3	12.0	11.8	2.54	0.385	13.37	-1.60	-3.55	⇓
VJ	16.0	17.4	16.0	0.81	0.120	16.47	-0.83	-2.77	
VO									•
VT	18.6	16.4	17.5	1.10	0.188	17.50	-0.57	-2.51	
W	24.9	29.4	22.5	3.50	0.591	25.60	1.47	-0.48	
WD									•
WE	12.0	12.3	11.3	0.51	0.086	11.87	-1.98	-3.92	⇓
WF	13.2	11.0	12.1	1.10	0.188	12.10	-1.92	-3.87	⇓
WH	10.6	8.4	9.7	1.11	0.188	9.57	-2.56	-4.50	⇓
WJ									•
WK									•
WN	12.0	11.4	11.9	0.32	0.051	11.77	-2.01	-3.95	⇓
X	16.0	13.9	14.0	1.18	0.180	14.63	-1.29	-3.23	⇓

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.97	⇓	LR	14.23	⇓	HL	16.67		RV
9.47	⇓	SN	14.30	⇓	TG	16.67		FL
9.57	⇓	WH	14.33	⇓	FZ	16.67		EO
9.83	⇓	TH	14.60	⇓	TI	16.77		BB
10.40	⇓	T	14.63	⇓	X	16.83		TO
10.87	⇓	UA	14.67	⇓	CP	16.97		JP
11.20	⇓	L	15.00	⇓	QU	17.13		EV
11.77	⇓	WN	15.33	⇓	BG	17.13		BC
11.87	⇓	WE	15.60		FN	17.43		DH
11.93	⇓	NB	15.60		CO	17.50		VT
11.97	⇓	TY	15.63		VH	17.50		UN
12.10	⇓	WF	15.63		UE	17.57		SU
12.33	⇓	PM	15.63		MV	17.63		DD
12.33	⇓	LF	15.67		AU	17.67		HI
12.57	⇓	DS	15.77		AF	17.77		OF
12.67	⇓	RB	15.80		AK	17.87		BA
12.67	⇓	JM	15.93		Q	17.93		JG
12.93	⇓	EN	16.00		VG	18.00		RD
13.37	⇓	VI	16.13		CQ	18.00		KX
13.40	⇓	TQ	16.27		TN	18.00		DR
13.57	⇓	GT	16.33		QP	18.10		SC
13.83	⇓	QC	16.33		BI	18.10		RI
13.90	⇓	NJ	16.40		CA	18.10		NT
13.90	⇓	EL	16.43		ID	18.17		NO
13.97	⇓	LT	16.47		VJ	18.17		K

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

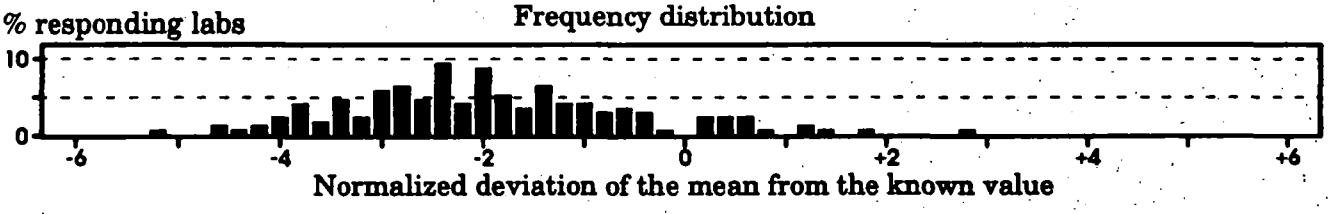
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
18.23		AJ	20.77		PB	24.03		EW
18.33		CJ	20.77		E	24.13		KE
18.60		VA	20.83		BH	24.63		FG
18.60		JN	21.00		OA	24.73		RZ
18.70		PV	21.27		AP	24.77		TL
18.73		TW	21.47		PQ	24.77		EB
18.73		HP	21.57		SL	24.83		I
18.90		CG	21.57		AL	25.00		FJ
19.07		DZ	21.67		KT	25.10		O
19.20		C	21.70		QT	25.60		W
19.27		RG	21.73		SS	25.80		GZ
19.30		JS	21.83		SO	26.07		BM
19.33		OS	21.90		RE	26.10		AZ
19.37		RW	21.97		UQ	26.30		BN
19.40		D	22.00		OX	26.57		MF
19.40		AW	22.03		DI	28.00		RR
19.50		UP	22.10		GQ	28.00		N
19.53		HK	22.40		QW	28.67		LL
19.67		FF	22.47		SX	28.67		CS
19.70		CX	22.50		TD	29.07		AN
19.70		SF	22.53		ER	29.23		SM
19.70		IC	22.97		BO	29.40		MX
19.77		OZ	23.00		SD	29.47		KH
19.87		U	23.03		JQ	29.50		J
19.93		QX	23.20		OB	29.67		PR
20.20		CE	23.33		R	30.00		SR
20.20		NA	23.53		SI	30.13		NP
20.20		DE	23.53		A	31.00		AR
20.23		QQ	23.60		DB	31.90		OY
20.33		DO	23.63		CK	32.53		AE
20.37		S	23.90		QZ	33.40		P
20.40		BK	24.00		UW	34.53		BL
20.63		DT	24.00		MQ	38.33		M



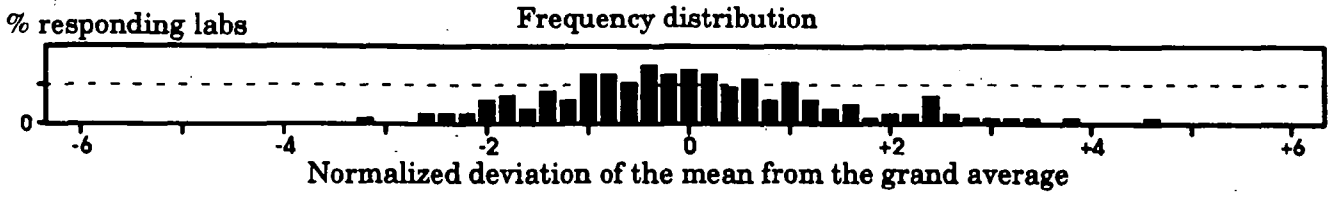
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

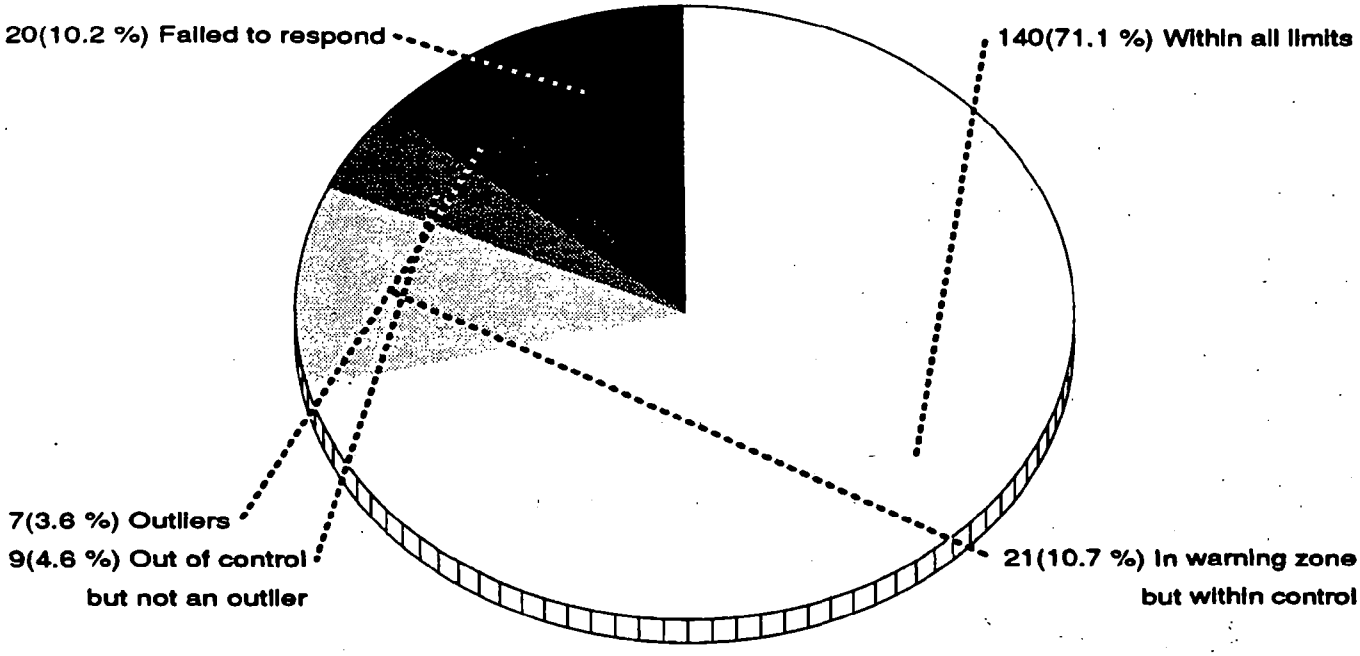
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

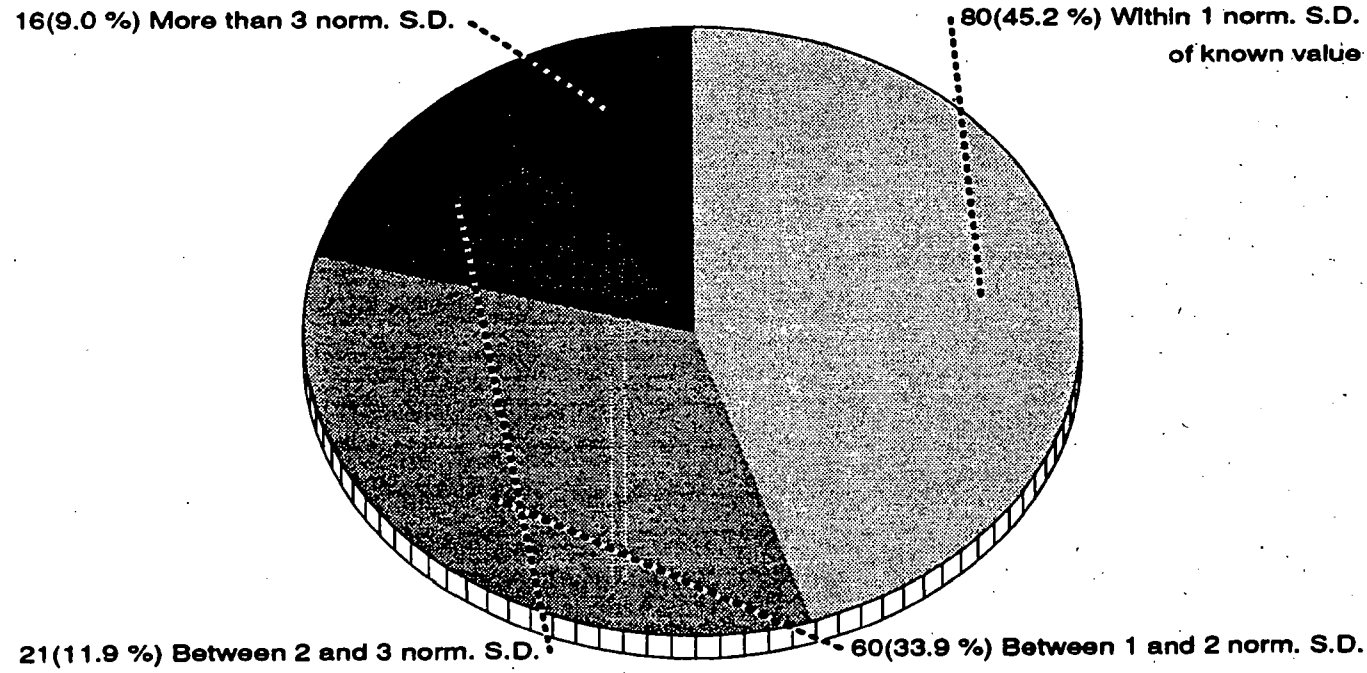

% responding labs
Frequency distribution
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Gross Beta Statistical Summary 197 Participants

The known value of this nuclide is **19.4 pCi/l** with an expected precision of **5.0**; the control limits are 10.7 to 28.1; the warning regions are 10.7 to 13.6 and 25.2 to 28.1



Statistic	Respondents	Non-outliers
Mean	31.17	**Grand Avg 21.67**
Std. Dev.	105.86	3.88
Variance	11206.04	15.08
% Coef. of Var.	339.67	17.92
% deviation of mean from known value	60.65	11.68
Norm. dev. of mean from known value	0.11	0.58
Median	21.87	21.70
% deviation of median from known value	12.71	11.86
Norm. dev. of median from known value	0.02	0.59



CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 21-Jul-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	21.6	23.6	22.7	1.00	0.236	22.63	0.33	1.12	
AE	13.0	13.3	13.8	0.40	0.095	13.37	-2.88	-2.09	
AF	22.2	25.9	24.9	1.91	0.437	24.33	0.92	1.71	
AH	21.0	22.0	21.8	0.53	0.118	21.60	-0.02	0.76	
AJ	21.4	26.5	24.6	2.58	0.602	24.17	0.87	1.65	
AK	20.5	20.0	20.4	0.26	0.059	20.30	-0.47	0.31	
AL	21.9	18.8	18.1	2.02	0.449	19.60	-0.72	0.07	
AN	15.9	15.4	16.7	0.66	0.154	16.00	-1.96	-1.18	
AP	20.9	21.5	22.2	0.65	0.154	21.53	-0.05	0.74	
AR	35.2	33.0	29.6	2.82	0.662	32.60	3.79	4.57	⇑
AU	20.0	21.0	22.0	1.00	0.236	21.00	-0.23	0.55	
AW	27.1	26.5	25.1	1.03	0.236	26.23	1.58	2.37	
AZ	14.9	15.1	17.2	1.27	0.272	15.73	-2.06	-1.27	
BA	20.3	20.7	19.3	0.72	0.165	20.10	-0.54	0.24	
BB	23.2	23.2	21.3	1.10	0.224	22.57	0.31	1.10	
BC	16.1	20.0	19.4	2.10	0.461	18.50	-1.10	-0.31	
BG	17.0	18.0	17.0	0.58	0.118	17.33	-1.50	-0.72	
BH	20.7	21.2	22.4	0.87	0.201	21.43	-0.08	0.70	
BI	24.0	24.0	24.0	0.00	0.000	24.00	0.81	1.59	
BK	23.8	24.1	25.3	0.79	0.177	24.40	0.95	1.73	
BL	23.2	22.1	20.3	1.46	0.343	21.87	0.07	0.85	
BM	27.2	27.5	25.6	1.02	0.224	26.77	1.77	2.55	
BN	20.7	21.8	22.1	0.74	0.165	21.53	-0.05	0.74	
BO	23.1	19.1	20.3	2.05	0.473	20.83	-0.29	0.50	
C	21.8	21.6	22.4	0.42	0.095	21.93	0.09	0.88	
CA	16.1	17.9	16.4	0.96	0.213	16.80	-1.69	-0.90	
CE	22.2	21.9	21.4	0.40	0.095	21.83	0.06	0.84	
CG	20.1	14.2	18.2	3.01	0.697	17.50	-1.44	-0.66	
CJ	21.0	18.0	19.0	1.53	0.354	19.33	-0.81	-0.02	
CK	25.2	25.4	27.2	1.10	0.236	25.93	1.48	2.26	
CO	16.1	18.9	16.3	1.56	0.331	17.10	-1.58	-0.80	
CP	28.0	27.0	27.0	0.58	0.118	27.33	1.96	2.75	
CQ	25.4	23.0	21.4	2.01	0.473	23.27	0.55	1.34	
CS	24.7	23.8	20.9	1.99	0.449	23.13	0.51	1.29	
CX	29.7	19.9	20.5	5.49	1.300	23.37	0.59	1.37	
D	23.8	25.8	24.0	1.10	0.236	24.53	0.99	1.78	
DB	23.7	23.2	23.2	0.29	0.059	23.37	0.59	1.37	
DD	25.5	25.0	22.5	1.61	0.354	24.33	0.92	1.71	
DE	16.1	16.2	16.3	0.10	0.024	16.20	-1.89	-1.11	
DH	21.9	22.8	21.4	0.71	0.165	22.03	0.13	0.91	
DI	30.7	31.7	32.3	0.81	0.189	31.57	3.43	4.21	⇑
DM	19.9	27.7	22.5	3.97	0.921	23.37	0.59	1.37	
DO	23.0	20.0	21.0	1.53	0.354	21.33	-0.12	0.67	
DR	21.0	24.0	22.0	1.53	0.354	22.33	0.23	1.02	
DS	19.4	19.0	18.4	0.50	0.118	18.93	-0.95	-0.16	

TAG SYMBOLS

• = No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DT	23.0	22.9	22.1	0.49	0.106	22.67	0.35	1.13	
DZ	19.7	20.8	21.0	0.70	0.154	20.50	-0.40	0.38	
E	25.3	25.9	23.4	1.31	0.295	24.87	1.11	1.89	
EB	21.5	22.4	24.7	1.65	0.378	22.87	0.42	1.20	
EL	20.8	20.8	20.4	0.23	0.047	20.67	-0.35	0.44	
EN	25.2	25.4	29.3	2.31	0.484	26.63	1.72	2.51	
EO	24.0	26.0	23.0	1.53	0.354	24.33	0.92	1.71	
ER									•
EV	24.4	22.4	19.8	2.31	0.543	22.20	0.18	0.97	
EW	24.6	23.2	24.3	0.74	0.165	24.03	0.82	1.61	
EX									•
FF	23.0	22.0	23.0	0.58	0.118	22.67	0.35	1.13	
FJ	35.4	40.1	31.7	4.21	0.992	35.73	4.87	5.66	×
FL	13.0	24.0	16.0	5.69	1.570	17.67	-1.39	-0.60	
FN	35.0	36.3	40.2	2.71	0.614	37.17	5.37	6.15	×
FZ	19.0	18.0	21.0	1.53	0.354	19.33	-0.81	-0.02	
GE	22.0	22.0	23.0	0.58	0.118	22.33	0.23	1.02	
GQ	19.3	19.5	19.6	0.15	0.035	19.47	-0.76	0.02	
GT	20.0	15.6	18.5	2.24	0.520	18.03	-1.26	-0.47	
GZ	16.6	28.4	22.0	5.91	1.750	22.33	0.23	1.02	
HI	27.0	22.0	26.0	2.65	0.591	25.00	1.15	1.94	
HK	22.0	25.0	25.0	1.73	0.354	24.00	0.81	1.59	
HL	20.4	19.9	22.8	1.55	0.343	21.03	-0.22	0.57	
HP	17.3	18.2	18.3	0.55	0.118	17.93	-1.29	-0.51	
I	27.4	24.2	24.3	1.82	0.378	25.30	1.26	2.04	
IC	24.7	23.7	24.6	0.55	0.118	24.33	0.92	1.71	
ID	24.0	23.3	22.7	0.65	0.154	23.33	0.58	1.36	
J	20.6	20.4	20.7	0.15	0.035	20.57	-0.38	0.40	
JE									•
JG	21.9	20.7	20.0	0.96	0.224	20.87	-0.28	0.51	
JM	20.0	23.0	24.0	2.08	0.473	22.33	0.23	1.02	
JN	20.5	21.6	23.0	1.25	0.295	21.70	0.01	0.80	
JP	20.2	18.8	16.7	1.76	0.413	18.57	-1.07	-0.29	
JQ	20.3	24.5	23.2	2.15	0.496	22.67	0.35	1.13	
JS	20.5	22.1	21.9	0.87	0.189	21.50	-0.06	0.73	
JY									•
K	26.2	24.0	25.1	1.10	0.260	25.10	1.19	1.97	
KC									•
KE	26.2	24.6	25.5	0.80	0.189	25.43	1.30	2.09	
KH	24.2	20.9	22.2	1.66	0.390	22.43	0.27	1.05	
KT	12.0	10.0	8.0	2.00	0.473	10.00	-4.04	-3.26	⇓
KX	23.0	20.0	21.0	1.53	0.354	21.33	-0.12	0.67	
L	27.6	27.6	27.3	0.17	0.035	27.50	2.02	2.81	
LF	21.0	17.0	24.0	3.51	0.827	20.67	-0.35	0.44	
LL	22.2	20.4	19.2	1.51	0.354	20.60	-0.37	0.42	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

 CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 21-Jul-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	21.1	18.8	21.9	1.61	0.366	20.60	-0.37	0.42	
LT	23.4	26.0	24.6	1.30	0.307	24.67	1.04	1.82	
M	18.0	15.0	21.0	3.00	0.709	18.00	-1.27	-0.48	
MA	12.0	15.0	15.0	1.73	0.354	14.00	-2.66	-1.87	
MF	21.5	20.6	22.9	1.16	0.272	21.67	0.00	0.79	
MQ	13.0	15.0	16.0	1.53	0.354	14.67	-2.42	-1.64	
MV	22.7	21.7	17.7	2.65	0.591	20.70	-0.33	0.45	
MX	1650.1	1210.7	1402.2	220.30	97.967	1421.00	484.74	485.53	×
MY									•
N	21.0	19.0	20.0	1.00	0.236	20.00	-0.58	0.21	
NA	26.0	24.5	22.6	1.70	0.402	24.37	0.94	1.72	
NB	91.7	98.2	95.0	3.25	0.768	94.97	25.39	26.18	×
NE									•
NJ	29.7	29.6	29.5	0.10	0.024	29.60	2.75	3.53	⇑
NK									•
NO	19.7	23.1	25.7	3.01	0.709	22.83	0.40	1.19	
NP	35.6	42.4	31.8	5.37	1.480	36.60	5.17	5.96	×
NT	21.9	21.1	21.5	0.40	0.095	21.50	-0.06	0.73	
O	20.8	22.3	20.5	0.96	0.213	21.20	-0.16	0.62	
OA	23.0	20.0	22.0	1.53	0.354	21.67	0.00	0.79	
OB	26.2	22.4	22.4	2.19	0.449	23.67	0.69	1.48	
OF	15.5	19.4	18.7	2.08	0.461	17.87	-1.32	-0.53	
OS	22.0	23.0	23.0	0.58	0.118	22.67	0.35	1.13	
OX	19.6	20.0	20.2	0.31	0.071	19.93	-0.60	0.18	
OY	16.0	21.6	20.0	2.88	0.662	19.20	-0.85	-0.07	
OZ	13.4	17.7	15.9	2.16	0.508	15.67	-2.08	-1.29	
P	22.8	22.8	21.0	1.04	0.213	22.20	0.18	0.97	
PB	20.8	20.2	21.8	0.81	0.189	20.93	-0.25	0.53	
PG	24.4	21.2	23.6	1.67	0.378	23.07	0.48	1.27	
PM	22.0	23.0	23.0	0.58	0.118	22.67	0.35	1.13	
PQ	21.6	21.6	20.0	0.92	0.189	21.07	-0.21	0.58	
PR	24.0	22.0	22.0	1.15	0.236	22.67	0.35	1.13	
PV	25.5	21.4	26.5	2.70	0.602	24.47	0.97	1.76	
Q	18.0	21.6	23.4	2.75	0.638	21.00	-0.23	0.55	
QC	16.9	16.5	16.7	0.20	0.047	16.70	-1.72	-0.94	
QP	19.0	18.0	17.5	0.76	0.177	18.17	-1.21	-0.43	
QQ	24.6	24.7	24.7	0.06	0.012	24.67	1.04	1.82	
QT	22.6	19.9	27.4	3.80	0.886	23.30	0.57	1.35	
QU	17.2	20.0	22.8	2.80	0.662	20.00	-0.58	0.21	
QW	38.2	41.7	40.9	1.83	0.413	40.27	6.44	7.23	×
QX	27.4	27.4	27.4	0.01	0.000	27.40	1.99	2.77	
QZ	20.8	21.0	20.5	0.25	0.059	20.77	-0.31	0.47	
R	21.0	24.0	25.8	2.42	0.567	23.60	0.67	1.45	
RB	16.2	17.0	16.5	0.40	0.095	16.57	-1.77	-0.98	
RD	24.0	17.0	22.0	3.61	0.827	21.00	-0.23	0.55	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RE	24.8	28.2	27.9	1.88	0.402	26.97	1.84	2.62	
RG	19.0	19.3	20.7	0.91	0.201	19.67	-0.69	0.09	
RH									•
RI	24.3	27.9	22.1	2.93	0.685	24.77	1.07	1.86	
RJ									•
RR	30.6	29.4	30.6	0.69	0.142	30.20	2.96	3.74	⇑
RU									•
RV	28.0	29.0	27.0	1.00	0.236	28.00	2.19	2.98	
RW	25.7	21.0	23.4	2.35	0.555	23.37	0.59	1.37	
RZ	26.3	27.2	26.1	0.59	0.130	26.53	1.69	2.47	
S	23.3	24.6	22.7	0.97	0.224	23.53	0.65	1.43	
SC	16.3	21.9	22.7	3.49	0.756	20.30	-0.47	0.31	
SD	14.4	14.7	12.8	1.02	0.224	13.97	-2.67	-1.88	
SF	17.0	19.4	19.6	1.45	0.307	18.67	-1.04	-0.25	
SI	17.7	17.9	18.1	0.20	0.047	17.90	-1.30	-0.52	
SL	24.5	25.7	23.5	1.10	0.260	24.57	1.00	1.79	
SM	24.4	23.2	23.3	0.67	0.142	23.63	0.68	1.47	
SN	22.9	15.9	19.9	3.51	0.827	19.57	-0.73	0.06	
SO	19.7	19.4	19.5	0.15	0.035	19.53	-0.74	0.05	
SR	24.0	27.0	25.0	1.53	0.354	25.33	1.27	2.06	
SS	21.9	19.8	21.5	1.12	0.248	21.07	-0.21	0.58	
SU	17.9	19.1	18.2	0.62	0.142	18.40	-1.13	-0.35	
SX	29.3	29.0	28.2	0.57	0.130	28.83	2.48	3.27	⇑
SZ									•
T	21.9	18.9	21.3	1.59	0.354	20.70	-0.33	0.45	
TC									•
TD	9.9	12.3	13.5	1.83	0.425	11.90	-3.38	-2.60	
TE									•
TG	24.0	26.0	21.5	2.25	0.532	23.83	0.75	1.54	
TH	19.6	18.0	18.2	0.87	0.189	18.60	-1.06	-0.28	
TI	23.8	24.3	23.3	0.50	0.118	23.80	0.74	1.52	
TL	20.5	21.6	23.2	1.36	0.319	21.77	0.03	0.82	
TN	26.6	26.9	27.0	0.21	0.047	26.83	1.79	2.57	
TO	36.2	31.6	26.3	4.95	1.323	31.37	3.36	4.15	⇑
TQ	18.3	13.4	15.9	2.45	0.579	15.87	-2.01	-1.22	
TW	10.5	10.3	15.8	3.12	0.650	12.20	-3.28	-2.49	
TY	21.0	21.5	22.6	0.82	0.189	21.70	0.01	0.80	
U	23.6	22.8	22.7	0.49	0.106	23.03	0.47	1.26	
UA	15.0	16.0	17.0	1.00	0.236	16.00	-1.96	-1.18	
UE	21.7	22.2	22.1	0.26	0.059	22.00	0.12	0.90	
UN	34.8	23.0	24.3	6.47	1.750	27.37	1.97	2.76	
UP	23.1	18.8	23.9	2.74	0.602	21.93	0.09	0.88	
UQ	20.8	23.0	20.4	1.40	0.307	21.40	-0.09	0.69	
UW	28.6	20.2	26.4	4.36	0.992	25.07	1.18	1.96	
UY	20.4	20.1	21.4	0.68	0.154	20.63	-0.36	0.43	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 21-Jul-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VA	22.0	20.5	17.9	2.07	0.484	20.13	-0.53	0.25	
VC									•
VG	17.9	18.3	18.9	0.50	0.118	18.37	-1.14	-0.36	
VH	31.4	27.1	26.1	2.82	0.626	28.20	2.26	3.05	⇑
VI	12.3	12.4	12.8	0.26	0.059	12.50	-3.18	-2.39	
VJ	26.9	27.0	22.3	2.69	0.555	25.40	1.29	2.08	
VO									•
VT	26.4	27.0	26.7	0.30	0.071	26.70	1.74	2.53	
W	21.7	21.5	19.3	1.33	0.284	20.83	-0.29	0.50	
WD									•
WE	22.3	21.7	20.0	1.19	0.272	21.33	-0.12	0.67	
WF	170.0	169.3	162.2	4.32	0.921	167.17	50.40	51.19	×
WH	10.7	9.3	9.9	0.70	0.165	9.97	-4.05	-3.27	⇓
WJ									•
WK									•
WN									•
X	17.8	17.9	17.3	0.32	0.071	17.67	-1.39	-0.60	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.97	⇓	WH	17.93		HP	20.30		AK
10.00	⇓	KT	18.00		M	20.50		DZ
11.90		TD	18.03		GT	20.57		J
12.20		TW	18.17		QP	20.60		LR
12.50		VI	18.37		VG	20.60		LL
13.37		AE	18.40		SU	20.63		UY
13.97		SD	18.50		BC	20.67		LF
14.00		MA	18.57		JP	20.67		EL
14.67		MQ	18.60		TH	20.70		T
15.67		OZ	18.67		SF	20.70		MV
15.73		AZ	18.93		DS	20.77		QZ
15.87		TQ	19.20		OY	20.83		W
16.00		UA	19.33		FZ	20.83		BO
16.00		AN	19.33		CJ	20.87		JG
16.20		DE	19.47		GQ	20.93		PB
16.57		RB	19.53		SO	21.00		RD
16.70		QC	19.57		SN	21.00		Q
16.80		CA	19.60		AL	21.00		AU
17.10		CO	19.67		RG	21.03		HL
17.33		BG	19.93		OX	21.07		SS
17.50		CG	20.00		QU	21.07		PQ
17.67		X	20.00		N	21.20		O
17.67		FL	20.10		BA	21.33		WE
17.87		OF	20.13		VA	21.33		KX
17.90		SI	20.30		SC	21.33		DO

TAG SYMBOLS

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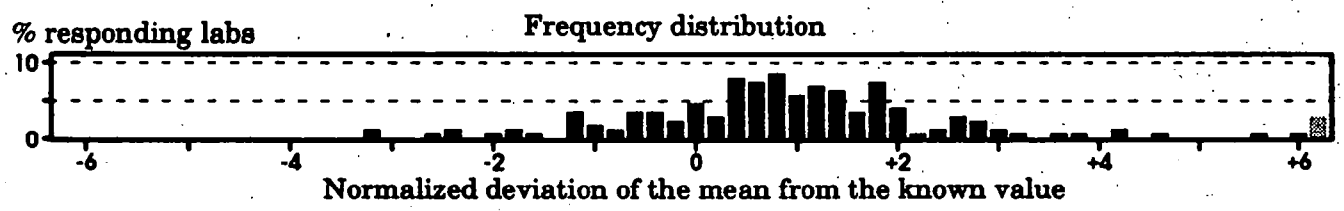
Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
21.40		UQ	22.87		EB	25.00		HI
21.43		BH	23.03		U	25.07		UW
21.50		NT	23.07		PG	25.10		K
21.50		JS	23.13		CS	25.30		I
21.53		BN	23.27		CQ	25.33		SR
21.53		AP	23.30		QT	25.40		VJ
21.60		AH	23.33		ID	25.43		KE
21.67		OA	23.37		RW	25.93		CK
21.67		MF	23.37		DM	26.23		AW
21.70		TY	23.37		CX	26.53		RZ
21.70		JN	23.37		DB	26.63		EN
21.77		TL	23.53		S	26.70		VT
21.83		CE	23.60		R	26.77		BM
21.87		BL	23.63		SM	26.83		TN
21.93		UP	23.67		OB	26.97		RE
21.93		C	23.80		TI	27.33		CP
22.00		UE	23.83		TG	27.37		UN
22.03		DH	24.00		HK	27.40		QX
22.20		P	24.00		BI	27.50		L
22.20		EV	24.03		EW	28.00		RV
22.33		JM	24.17		AJ	28.20	⇑	VH
22.33		GZ	24.33		IC	28.83	⇑	SX
22.33		GE	24.33		EO	29.60	⇑	NJ
22.33		DR	24.33		DD	30.20	⇑	RR
22.43		KH	24.33		AF	31.37	⇑	TO
22.57		BB	24.37		NA	31.57	⇑	DI
22.63		A	24.40		BK	32.60	⇑	AR
22.67		PR	24.47		PV	35.73	×	FJ
22.67		PM	24.53		D	36.60	×	NP
22.67		OS	24.57		SL	37.17	×	FN
22.67		JQ	24.67		QQ	40.27	×	QW
22.67		FF	24.67		LT	94.97	×	NB
22.67		DT	24.77		RI	167.17	×	WF
22.83		NO	24.87		E	1421.00	×	MX



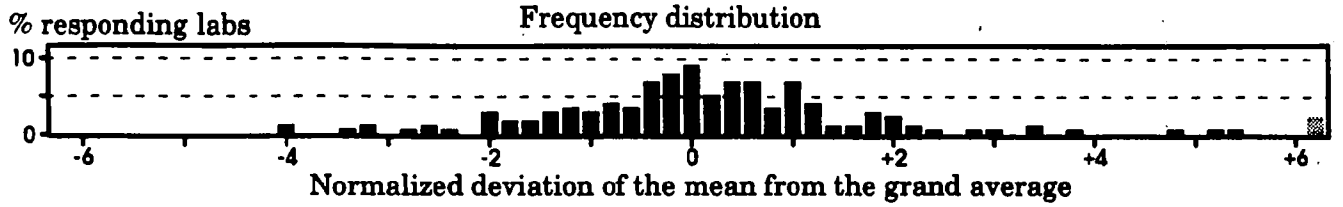
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta


% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

United States
Environmental Protection
Agency

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Tritium in Water Performance Evaluation Study

A Statistical Evaluation of the August 4, 1995 Data

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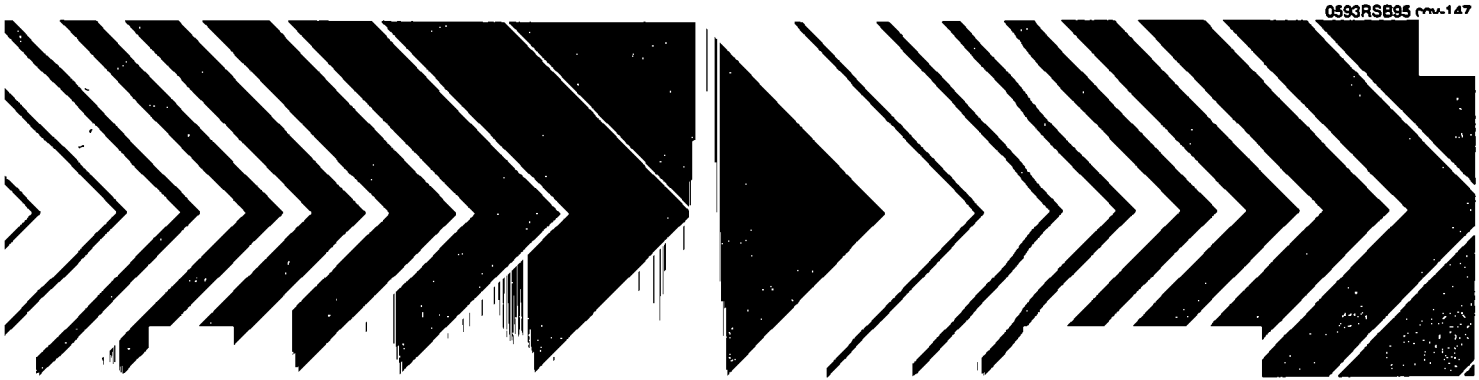
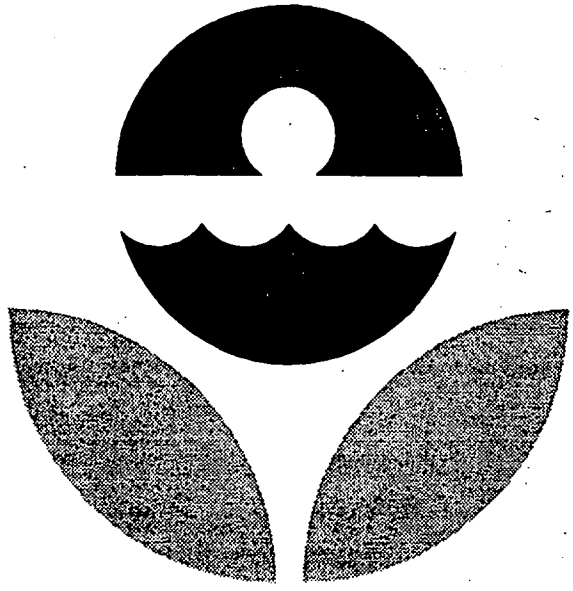


Tritium in Water

Performance Evaluation Study

August 4, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Radiation Sciences Branch (CRD-LV) Performance Evaluation Study for ***Tritium in Water; August 4, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Chemist
Radioanalysis Program

Enclosure

NOTICE

This material has been funded wholly by the U.S. Environmental Protection Agency. It has been subject to the Agency's review, and has been approved for publication as an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

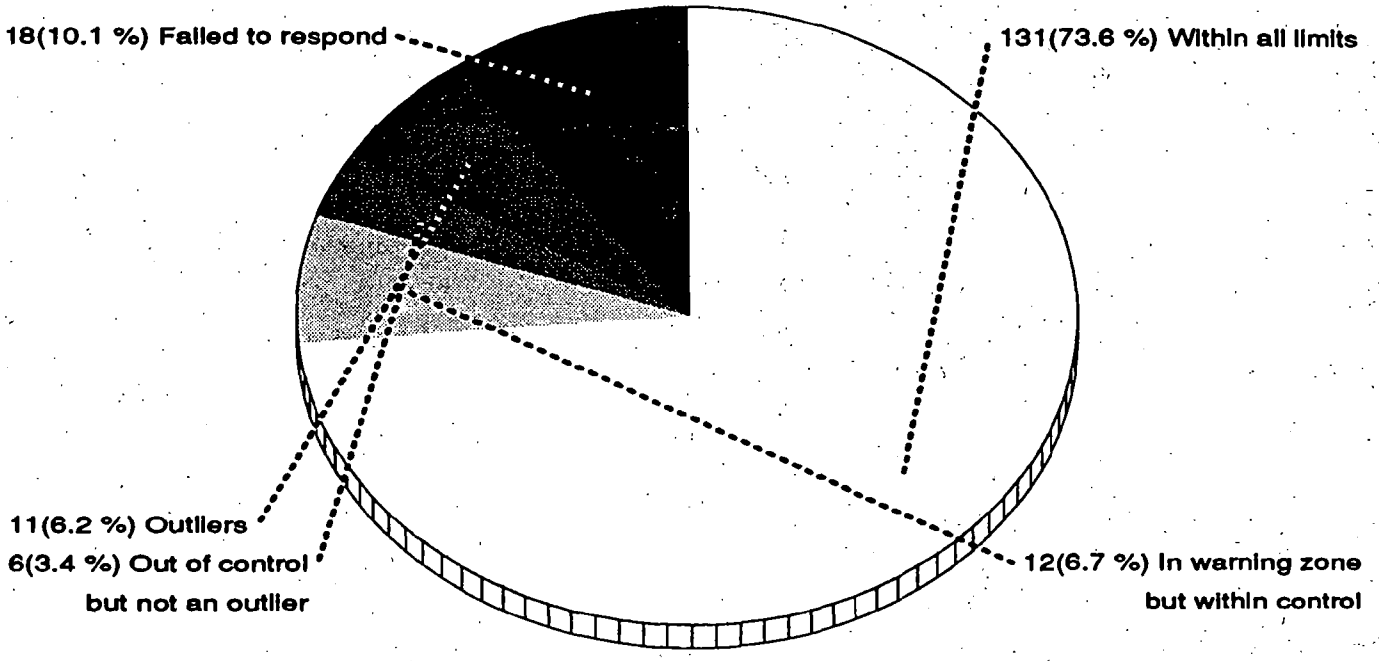
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

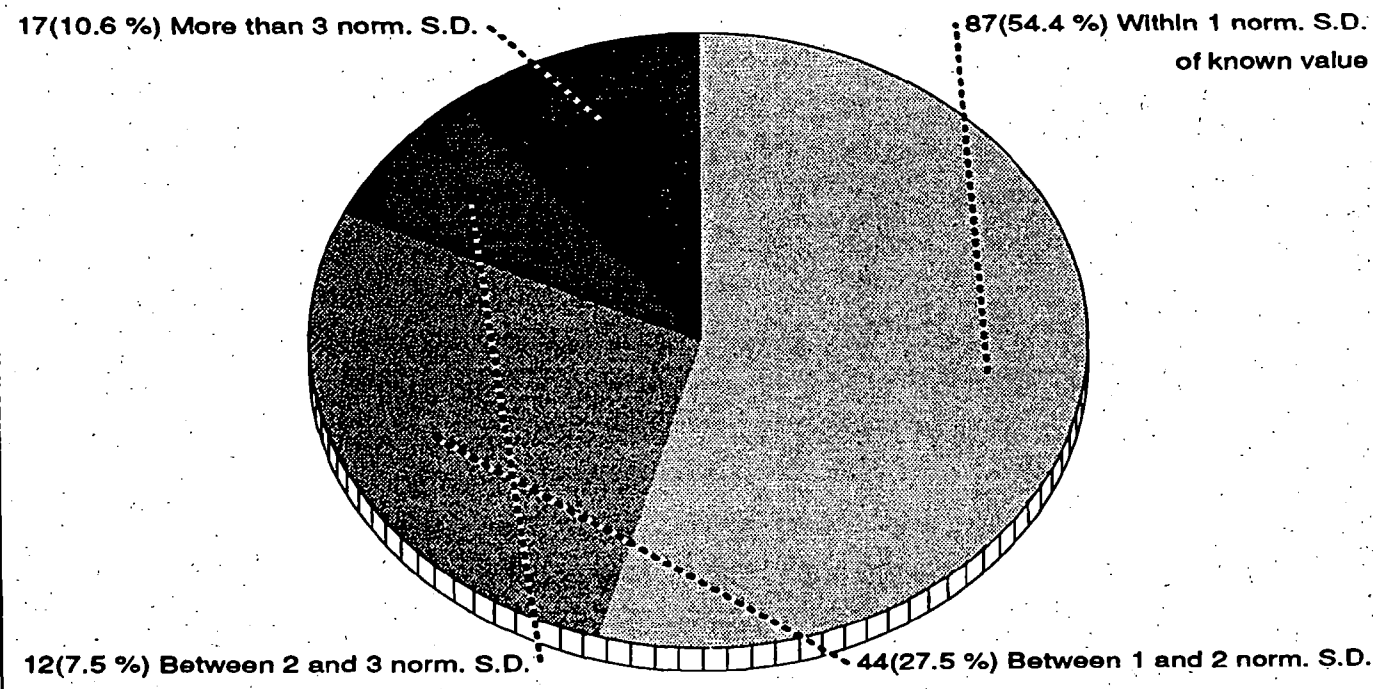
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from George Dilbeck, CRD-LV, 702/798-2104.

Tritium Statistical Summary 178 Participants

The known value of this nuclide is **4872.0 pCi/l** with an expected precision of **487.0**; the control limits are 4027.1 to 5716.9; the warning regions are 4027.1 to 4308.3 and 5435.7 to 5716.9



Statistic	Respondents	Non-outliers
Mean	4892.32	**Grand Avg 4788.09**
Std. Dev.	1949.41	374.05
Variance	3800194.25	139910.75
% Coef. of Var.	39.85	7.81
% deviation of mean from known value	0.42	-1.72
Norm. dev. of mean from known value	0.01	-0.22
Median	4780.17	4780.33
% deviation of median from known value	-1.88	-1.88
Norm. dev. of median from known value	-0.05	-0.25



CRD-LV Performance Evaluation: Tritium in Water, 4-Aug-1995

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	4860.0	5030.0	4960.0	85.45	0.206	4950.00	0.58	0.28	
AE	4917.0	4964.0	4957.0	25.34	0.057	4946.00	0.56	0.26	
AF	5150.0	4974.0	4958.0	106.54	0.233	5027.33	0.85	0.55	
AH	4560.0	4540.0	4470.0	47.26	0.109	4523.33	-0.94	-1.24	
AI									•
AJ	4885.0	4906.0	4803.0	54.44	0.125	4864.67	0.27	-0.03	
AK	5145.0	5155.0	5160.0	7.57	0.018	5153.33	1.30	1.00	
AP	4684.0	4499.0	4565.0	93.76	0.224	4582.67	-0.73	-1.03	
AU	4900.0	4900.0	5000.0	57.74	0.121	4933.33	0.52	0.22	
AW	4587.0	4581.0	4552.0	18.74	0.042	4573.33	-0.76	-1.06	
AY	4835.0	4613.0	4618.0	126.76	0.269	4688.67	-0.35	-0.65	
AZ	4457.0	4824.0	4547.0	191.28	0.445	4609.33	-0.64	-0.93	
BA	5238.0	5176.0	5429.0	131.87	0.307	5281.00	1.75	1.45	
BB	4815.0	4965.0	5000.0	98.27	0.224	4926.67	0.49	0.19	
BC	4826.0	4908.0	5075.0	126.90	0.302	4936.33	0.53	0.23	
BG									•
BL	4808.0	4764.0	4668.0	71.59	0.170	4746.67	-0.15	-0.45	
BM									•
BO	4590.0	4580.0	4600.0	10.00	0.024	4590.00	-0.70	-1.00	
BW									•
C	4027.0	4285.0	4700.0	339.54	0.816	4337.33	-1.60	-1.90	
CA	4830.0	4735.0	4756.0	49.92	0.115	4773.67	-0.05	-0.35	
CE	4860.0	4980.0	4760.0	110.15	0.267	4866.67	0.28	-0.02	
CG	3893.0	3502.0	3802.0	204.60	0.474	3732.33	-3.75	-4.05	⇓
CJ	4700.0	4900.0	5000.0	152.75	0.364	4866.67	0.28	-0.02	
CK	5062.0	5052.0	4918.0	80.41	0.175	5010.67	0.79	0.49	
CO	4570.0	4760.0	4660.0	95.04	0.230	4663.33	-0.44	-0.74	
CP	4750.0	4720.0	4410.0	188.24	0.412	4626.67	-0.57	-0.87	
CQ	4860.0	4440.0	4440.0	242.49	0.509	4580.00	-0.74	-1.04	
CS	4500.0	4770.0	4800.0	165.23	0.364	4690.00	-0.35	-0.65	
CX	5110.0	4980.0	5510.0	276.22	0.643	5200.00	1.46	1.17	
D	4707.0	4564.0	4773.0	106.84	0.253	4681.33	-0.38	-0.68	
DD	4970.0	4920.0	4880.0	45.11	0.109	4923.33	0.48	0.18	
DE	4891.0	4894.0	4918.0	14.78	0.033	4901.00	0.40	0.10	
DG	4480.0	4570.0	4760.0	142.95	0.340	4603.33	-0.66	-0.96	
DH	4859.0	5084.0	5034.0	118.15	0.273	4992.33	0.73	0.43	
DI	4584.0	4509.0	4670.0	80.56	0.195	4587.67	-0.71	-1.01	
DL	4889.0	4865.0	5095.0	126.43	0.279	4949.67	0.57	0.28	
DM	4850.0	4820.0	4800.0	25.21	0.061	4823.33	0.13	-0.17	
DR	4824.0	4800.0	4814.0	12.14	0.029	4812.67	0.09	-0.21	
DT									•
E	5269.0	5296.0	5141.0	82.80	0.188	5235.33	1.59	1.29	
EA	4855.0	4794.0	4855.0	35.23	0.074	4834.67	0.17	-0.13	
EB	4700.0	4940.0	4760.0	124.90	0.291	4800.00	0.04	-0.26	
EL	5071.0	5038.0	5354.0	173.70	0.383	5154.33	1.30	1.00	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
EN	4828.0	4406.0	4797.0	235.20	0.512	4677.00	-0.40	-0.69	
EW	4414.0	4998.0	4977.0	331.28	0.708	4796.33	0.03	-0.27	
EX	5037.0	4888.0	4969.0	74.59	0.181	4964.67	0.63	0.33	
FJ									•
FL	4860.0	4873.0	4637.0	132.66	0.286	4790.00	0.01	-0.29	
FU	5470.0	5984.0	5219.0	389.96	0.928	5557.67	2.74	2.44	
FZ	2700.0	2300.0	2700.0	230.94	0.485	2566.67	-7.90	-8.20	×
GE	4867.0	4819.0	5120.0	161.71	0.365	4935.33	0.52	0.23	
GQ	4180.0	4210.0	4260.0	40.41	0.097	4216.67	-2.03	-2.33	
HI	4544.0	4416.0	4474.0	64.09	0.155	4478.00	-1.10	-1.40	
HJ	5640.0	5710.0	5550.0	80.21	0.194	5633.33	3.01	2.71	
HK									•
HP	4860.0	5040.0	5150.0	146.41	0.352	5016.67	0.81	0.51	
HR	5113.0	5086.0	5113.0	15.62	0.033	5104.00	1.12	0.83	
I	4819.0	4709.0	4639.0	90.74	0.218	4722.33	-0.23	-0.53	
IC	4926.0	4836.0	4778.0	74.57	0.180	4846.67	0.21	-0.09	
J	4815.0	4910.0	4821.0	53.21	0.115	4848.67	0.22	-0.08	
JE	5236.0	4744.0	4990.0	246.00	0.597	4990.00	0.72	0.42	
JI	4560.0	4700.0	4880.0	160.42	0.388	4713.33	-0.27	-0.56	
JK	4985.0	4878.0	4918.0	54.06	0.130	4927.00	0.49	0.20	
JM	4252.0	4386.0	4443.0	98.05	0.232	4360.33	-1.52	-1.82	
JP	4767.0	4733.0	4771.0	20.84	0.046	4757.00	-0.11	-0.41	
JR	3206.0	3218.0	3201.0	8.77	0.021	3208.33	-5.62	-5.92	×
JS	4930.0	5110.0	5130.0	110.16	0.243	5056.67	0.96	0.66	
JY	4820.0	5130.0	4800.0	185.03	0.400	4916.67	0.46	0.16	
K	4138.0	3912.0	3912.0	130.48	0.274	3987.33	-2.85	-3.15	⇓
KH	4798.0	4805.0	4738.0	36.82	0.081	4780.33	-0.03	-0.33	
KX	4770.0	4670.0	4590.0	90.18	0.218	4676.67	-0.40	-0.69	
L	4135.0	4135.0	4248.0	65.25	0.137	4172.67	-2.19	-2.49	
LE	4630.0	4540.0	4540.0	51.96	0.109	4570.00	-0.78	-1.07	
LF	4900.0	5000.0	4900.0	57.74	0.121	4933.33	0.52	0.22	
LR	4710.0	4565.0	4639.0	72.51	0.176	4638.00	-0.53	-0.83	
LT	4704.0	5093.0	3902.0	607.32	1.847	4566.33	-0.79	-1.09	
M	4800.0	4700.0	4900.0	100.00	0.243	4800.00	0.04	-0.26	
MA	4461.0	4498.0	4661.0	106.41	0.243	4540.00	-0.88	-1.18	
ML	6525.0	6825.0	6748.0	155.82	0.364	6699.33	6.80	6.50	×
MQ	4660.0	4420.0	4510.0	121.24	0.291	4530.00	-0.92	-1.22	
MT	4864.0	4757.0	4746.0	65.20	0.143	4789.00	0.00	-0.30	
MV	3896.0	4216.0	4059.0	160.01	0.388	4057.00	-2.60	-2.90	
N	4657.0	4586.0	4663.0	42.84	0.093	4635.33	-0.54	-0.84	
NB	7.0	9.0	10.0	1.53	0.004	8.67	-17.00	-17.30	×
NH	4520.0	4605.0	4689.0	84.51	0.205	4604.67	-0.65	-0.95	
NJ	4595.0	4567.0	4608.0	20.98	0.050	4590.00	-0.70	-1.00	
NO	3177.0	3360.0	3643.0	234.78	0.565	3393.33	-4.96	-5.26	×
NP	5242.0	5516.0	4949.0	283.56	0.688	5235.67	1.59	1.29	

• ≡ No data submitted

TAG SYMBOLS

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⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Tritium in Water, 4-Aug-1995

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
O	4699.0	4744.0	4528.0	113.96	0.262	4657.00	-0.47	-0.76	
OA	4200.0	4500.0	5200.0	513.16	1.405	4633.33	-0.55	-0.85	
OK	5246.0	5111.0	5364.0	126.60	0.307	5240.33	1.61	1.31	
OL	5426.0	4547.0	4769.0	457.09	1.126	4914.00	0.45	0.15	
OX	4878.0	4710.0	4748.0	88.10	0.204	4778.67	-0.03	-0.33	
PB	4924.0	4865.0	4932.0	36.59	0.081	4907.00	0.42	0.12	
PE	4392.0	4259.0	4568.0	155.00	0.375	4406.33	-1.36	-1.66	
PI									•
PJ									•
PM	4821.0	4893.0	4826.0	40.22	0.087	4846.67	0.21	-0.09	
PQ	4679.0	5032.0	4606.0	227.82	0.517	4772.33	-0.06	-0.35	
PV	5881.0	5598.0	4760.0	582.95	1.685	5413.00	2.22	1.92	
Q	4727.0	4542.0	4574.0	98.87	0.224	4614.33	-0.62	-0.92	
QC	4655.0	4875.0	4758.0	110.08	0.267	4762.67	-0.09	-0.39	
QD	4962.0	4934.0	5019.0	43.31	0.103	4971.67	0.65	0.35	
QI									•
QJ	4800.0	4800.0	4600.0	115.47	0.243	4733.33	-0.19	-0.49	
QM	3741.0	3842.0	3821.0	53.30	0.122	3801.33	-3.51	-3.81	⇓
QP	5654.0	5708.0	5740.0	43.49	0.104	5700.67	3.25	2.95	
QQ	5037.0	5191.0	5345.0	154.00	0.374	5191.00	1.43	1.13	
QT	5367.0	5237.0	5365.0	74.47	0.158	5323.00	1.90	1.60	
QU	4162.0	4577.0	4761.0	306.84	0.727	4500.00	-1.02	-1.32	
QW	4436.0	4456.0	4665.0	126.83	0.278	4519.00	-0.96	-1.26	
QX	5887.0	5708.0	5900.0	107.29	0.233	5831.67	3.71	3.41	⇑
QZ	4736.0	4686.0	4858.0	88.48	0.209	4760.00	-0.10	-0.40	
R									•
RB	4520.0	4054.0	4059.0	267.61	0.565	4211.00	-2.05	-2.35	
RH	3949.0	4042.0	4025.0	49.53	0.113	4005.33	-2.78	-3.08	⇓
RL									•
RO	5251.0	4624.0	5161.0	339.02	0.760	5012.00	0.80	0.50	
RR	4650.0	4670.0	4640.0	15.28	0.036	4653.33	-0.48	-0.78	
RU	4468.0	4523.0	4468.0	31.75	0.067	4486.33	-1.07	-1.37	
RV									•
RX	4033.0	4225.0	4321.0	146.64	0.349	4193.00	-2.12	-2.41	
S	4800.0	4861.0	4869.0	37.73	0.084	4843.33	0.20	-0.10	
SC	4133.0	4460.0	4356.0	167.07	0.397	4316.33	-1.68	-1.98	
SD	4875.0	4629.0	4752.0	123.00	0.298	4752.00	-0.13	-0.43	
SF	4527.0	4670.0	4773.0	123.54	0.298	4656.67	-0.47	-0.77	
SI	4420.0	4450.0	4510.0	45.83	0.109	4460.00	-1.17	-1.47	
SM	5110.0	4640.0	4560.0	297.16	0.667	4770.00	-0.06	-0.36	
SN	4506.0	4455.0	4476.0	25.62	0.062	4479.00	-1.10	-1.40	
SS	5034.0	5026.0	4982.0	28.04	0.063	5014.00	0.80	0.51	
ST	4920.0	4850.0	4870.0	36.06	0.085	4880.00	0.33	0.03	
SU	48.0	48.0	47.0	0.58	0.001	47.67	-16.86	-17.16	×
SZ	4683.0	4628.0	4729.0	50.58	0.122	4680.00	-0.38	-0.68	

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⇓ ≡ Below control limit

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
T	4500.0	4500.0	4500.0	0.00	0.000	4500.00	-1.02	-1.32	
TC	5126.0	5339.0	5596.0	235.35	0.570	5353.67	2.01	1.71	
TD	24300.0	23300.0	31100.0	4244.21	17.115	26233.33	76.27	75.97	×
TE									•
TF	12920.0	11300.0	12300.0	817.39	2.838	12173.33	26.27	25.97	×
TG	5136.0	5445.0	5242.0	157.02	0.375	5274.33	1.73	1.43	
TH	3951.0	4189.0	4174.0	133.29	0.289	4104.67	-2.43	-2.73	
TI	5230.0	5560.0	4980.0	290.92	0.703	5256.67	1.67	1.37	
TL	3863.0	3343.0	3528.0	263.58	0.631	3578.00	-4.30	-4.60	⇓
TN	5092.0	5134.0	5000.0	68.55	0.163	5075.33	1.02	0.72	
TQ	5390.0	5120.0	5660.0	270.00	0.655	5390.00	2.14	1.84	
TW									•
TX	5185.0	5110.0	5118.0	41.18	0.091	5137.67	1.24	0.94	
U	4850.0	4860.0	4630.0	130.00	0.279	4780.00	-0.03	-0.33	
UC	6096.0	6265.0	5927.0	169.00	0.410	6096.00	4.65	4.35	×
UE	4320.0	4330.0	4300.0	15.28	0.036	4316.67	-1.68	-1.98	
UK	5010.0	5060.0	5040.0	25.21	0.061	5036.67	0.88	0.59	
UN	5925.0	4932.0	5120.0	527.48	1.389	5325.67	1.91	1.61	
UO	4698.0	4892.0	5374.0	348.07	0.820	4988.00	0.71	0.41	
UP	5067.0	3855.0	4489.0	606.22	1.895	4470.33	-1.13	-1.43	
UT									•
UW	5325.0	5420.0	5428.0	57.29	0.125	5391.00	2.14	1.85	
UX	4948.0	4708.0	4883.0	124.13	0.291	4846.33	0.21	-0.09	
UY	4436.0	4476.0	4483.0	25.35	0.057	4465.00	-1.15	-1.45	
VA	5358.0	4673.0	4281.0	545.10	1.583	4770.67	-0.06	-0.36	
VC	5082.0	5035.0	5032.0	28.07	0.061	5049.67	0.93	0.63	
VE	5260.0	4660.0	4840.0	307.90	0.728	4920.00	0.47	0.17	
VG	4650.0	4570.0	4610.0	40.00	0.097	4610.00	-0.63	-0.93	
VI	6640.0	7900.0	5730.0	1089.69	4.108	6756.67	7.00	6.70	×
VM	5126.0	5079.0	5034.0	46.00	0.112	5079.67	1.04	0.74	
VN									•
VP	4620.0	5070.0	4880.0	225.91	0.546	4856.67	0.24	-0.05	
VR	5532.0	4683.0	4767.0	467.81	1.057	4994.00	0.73	0.43	
VW	4392.0	5135.0	4595.0	384.03	0.901	4707.33	-0.29	-0.59	
VZ	4682.0	4553.0	4424.0	129.00	0.313	4553.00	-0.84	-1.13	
W	4391.0	4004.0	4163.0	194.53	0.469	4186.00	-2.14	-2.44	
WD	2141.0	2115.0	2232.0	61.44	0.142	2162.67	-9.34	-9.64	×
WF	4325.0	4257.0	4236.0	46.53	0.108	4272.67	-1.83	-2.13	
WH	5351.0	5604.0	5241.0	186.13	0.440	5398.67	2.17	1.87	
WI									•
WJ	4696.0	4714.0	4545.0	92.81	0.205	4651.67	-0.49	-0.78	
WL	6010.0	5930.0	4010.0	1132.31	3.716	5316.67	1.88	1.58	
X	5599.0	5967.0	5488.0	250.73	0.581	5684.67	3.19	2.89	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Tritium

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.67	×	NB	4590.00		BO	4834.67		EA
47.67	×	SU	4603.33		DG	4843.33		S
2162.67	×	WD	4604.67		NH	4846.33		UX
2566.67	×	FZ	4609.33		AZ	4846.67		PM
3208.33	×	JR	4610.00		VG	4846.67		IC
3393.33	×	NO	4614.33		Q	4848.67		J
3578.00	⇓	TL	4626.67		CP	4856.67		VP
3732.33	⇓	CG	4633.33		OA	4864.67		AJ
3801.33	⇓	QM	4635.33		N	4866.67		CJ
3987.33	⇓	K	4638.00		LR	4866.67		CE
4005.33	⇓	RH	4651.67		WJ	4880.00		ST
4057.00		MV	4653.33		RR	4901.00		DE
4104.67		TH	4656.67		SF	4907.00		PB
4172.67		L	4657.00		O	4914.00		OL
4186.00		W	4663.33		CO	4916.67		JY
4193.00		RX	4676.67		KX	4920.00		VE
4211.00		RB	4677.00		EN	4923.33		DD
4216.67		GQ	4680.00		SZ	4926.67		BB
4272.67		WF	4681.33		D	4927.00		JK
4316.33		SC	4688.67		AY	4933.33		LF
4316.67		UE	4690.00		CS	4933.33		AU
4337.33		C	4707.33		VW	4935.33		GE
4360.33		JM	4713.33		JI	4936.33		BC
4406.33		PE	4722.33		I	4946.00		AE
4460.00		SI	4733.33		QJ	4949.67		DL
4465.00		UY	4746.67		BL	4950.00		A
4470.33		UP	4752.00		SD	4964.67		EX
4478.00		HI	4757.00		JP	4971.67		QD
4479.00		SN	4760.00		QZ	4988.00		UO
4486.33		RU	4762.67		QC	4990.00		JE
4500.00		T	4770.00		SM	4992.33		DH
4500.00		QU	4770.67		VA	4994.00		VR
4519.00		QW	4772.33		PQ	5010.67		CK
4523.33		AH	4773.67		CA	5012.00		RO
4530.00		MQ	4778.67		OX	5014.00		SS
4540.00		MA	4780.00		U	5016.67		HP
4553.00		VZ	4780.33		KH	5027.33		AF
4566.33		LT	4789.00		MT	5036.67		UK
4570.00		LE	4790.00		FL	5049.67		VC
4573.33		AW	4796.33		EW	5056.67		JS
4580.00		CQ	4800.00		M	5075.33		TN
4582.67		AP	4800.00		EB	5079.67		VM
4587.67		DI	4812.67		DR	5104.00		HR
4590.00		NJ	4823.33		DM	5137.67		TX

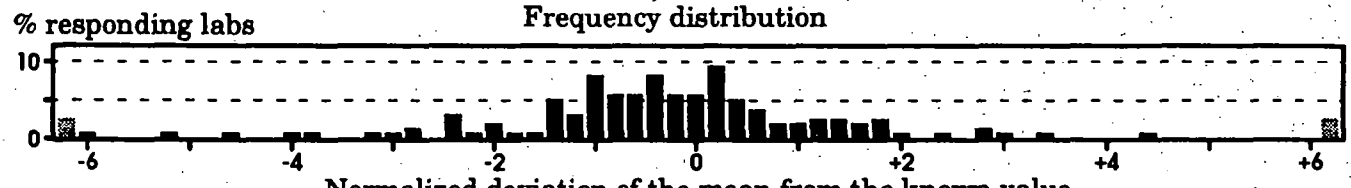
TAG SYMBOLS

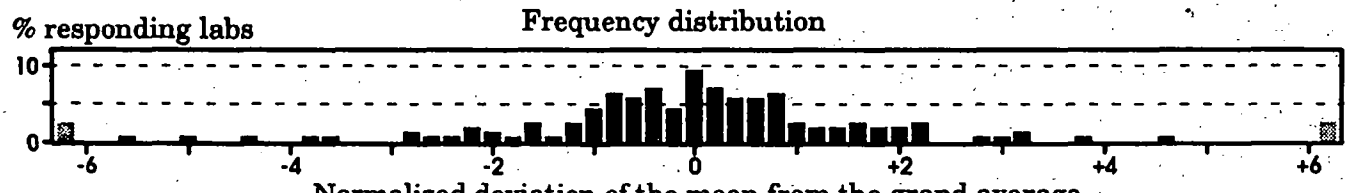
• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Tritium

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5153.33		AK	5281.00		BA	5557.67		FU
5154.33		EL	5316.67		WL	5633.33		HJ
5191.00		QQ	5323.00		QT	5684.67		X
5200.00		CX	5325.67		UN	5700.67		QP
5235.33		E	5353.67		TC	5831.67	⇑	QX
5235.67		NP	5390.00		TQ	6096.00	×	UC
5240.33		OK	5391.00		UW	6699.33	×	ML
5256.67		TI	5398.67		WH	6756.67	×	VI
5274.33		TG	5413.00		PV	12173.33	×	TF
						26233.33	×	TD





• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

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⇑ ≡ Above control limit
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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-96/047A
April 1996

EPA

Blind-A Performance Evaluation Study

A Statistical Evaluation of the October 17, 1995 Data

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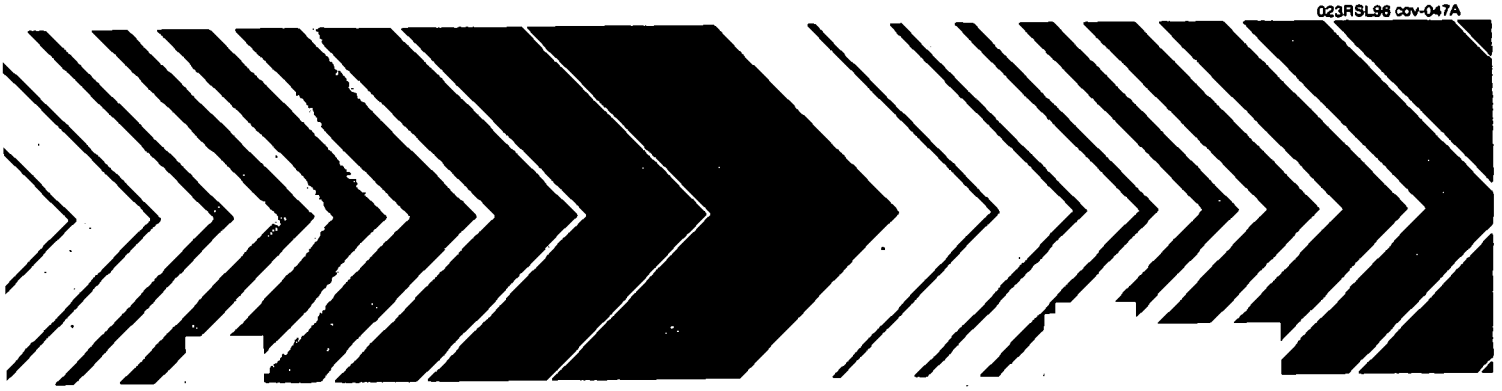
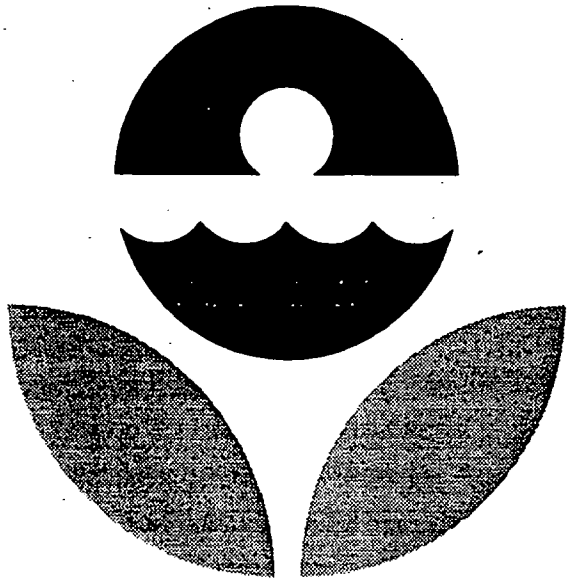


Blind-A

Performance Evaluation Study

October 17, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Analytical Sciences Branch (CRD-LV) Performance Evaluation Study for ***Blind-A; October 17, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by
the U.S. Environmental Protection Agency.
It has been subjected to the Agency's review,
and has been approved for publication as
an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

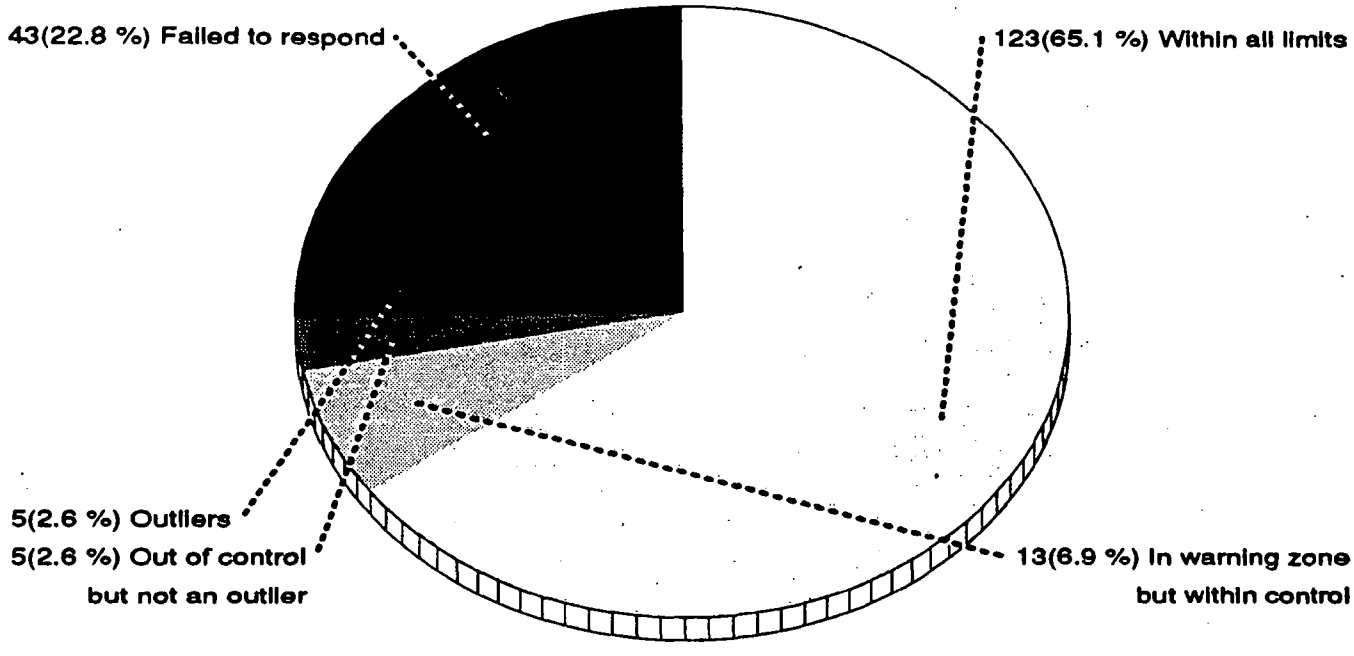
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

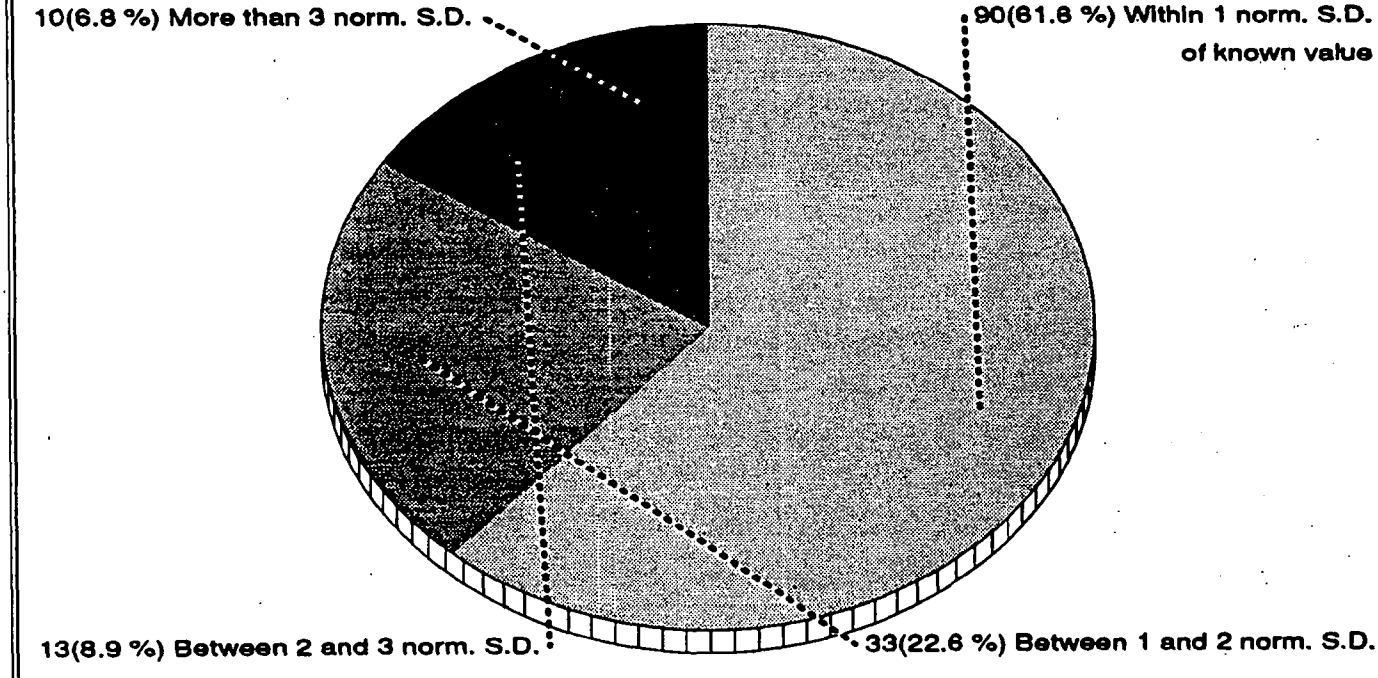
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, CRD-LV, 702/798-2141.

Gross Alpha Statistical Summary 189 Participants

The known value of this nuclide is **99.4 pCi/l** with an expected precision of **24.9**; the control limits are 56.2 to 142.6; the warning regions are 56.2 to 70.6 and 128.2 to 142.6



Statistic	Respondents	Non-outliers
Mean	102.50	**Grand Avg 101.68**
Std. Dev.	25.09	17.82
Variance	629.57	317.69
% Coef. of Var.	24.48	17.53
% deviation of mean from known value	3.12	2.30
Norm. dev. of mean from known value	0.12	0.13
Median	101.72	101.67
% deviation of median from known value	2.33	2.28
Norm. dev. of median from known value	0.09	0.13



Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	106.6	103.0	93.0	7.05	0.323	100.87	-0.06	0.10	
AE	72.6	72.2	72.2	0.23	0.009	72.33	-2.04	-1.88	
AF	105.2	107.1	102.4	2.36	0.111	104.90	0.22	0.38	
AH	83.1	73.5	81.1	5.06	0.228	79.23	-1.56	-1.40	
AI									•
AJ	99.7	86.9	105.6	9.56	0.444	97.40	-0.30	-0.14	
AK	109.1	99.6	109.0	5.46	0.225	105.90	0.29	0.45	
AL	118.9	113.9	122.8	4.46	0.211	118.53	1.17	1.33	
AP	98.0	102.6	104.7	3.43	0.159	101.77	0.01	0.16	
AR	109.4	88.4	83.6	13.72	0.612	93.80	-0.55	-0.39	
AU	144.8	140.7	145.3	2.52	0.109	143.60	2.92	3.07	⇑
AW	110.8	109.5	111.4	0.97	0.045	110.57	0.62	0.78	
AZ	23.4	25.1	22.9	1.15	0.052	23.80	-5.42	-5.26	×
BA	95.3	95.1	89.9	3.06	0.128	93.43	-0.57	-0.42	
BB	113.1	101.8	107.5	5.65	0.268	107.47	0.40	0.56	
BC	102.2	102.2	103.9	0.98	0.040	102.77	0.08	0.23	
BG	198.0	191.5	185.0	6.50	0.308	191.50	6.25	6.41	×
BH	94.6	99.6	96.3	2.54	0.119	96.83	-0.34	-0.18	
BK	144.0	133.0	105.0	20.11	0.925	127.33	1.78	1.94	
BL									•
BM	100.9	103.1	99.3	1.91	0.090	101.10	-0.04	0.12	
BN	122.3	134.4	139.1	8.67	0.399	131.93	2.10	2.26	
BO	94.0	88.5	105.5	8.67	0.403	96.00	-0.40	-0.24	
BS	98.6	97.1	97.0	0.90	0.038	97.57	-0.29	-0.13	
BW									•
C	109.2	102.0	94.4	7.40	0.351	101.87	0.01	0.17	
CA	99.1	124.9	98.0	15.22	0.638	107.33	0.39	0.55	
CE	99.5	101.4	91.2	5.42	0.242	97.37	-0.30	-0.14	
CG	101.6	102.5	103.7	1.05	0.050	102.60	0.06	0.22	
CJ	91.0	100.0	93.0	4.73	0.213	94.67	-0.49	-0.33	
CK	106.0	105.0	110.0	2.65	0.119	107.00	0.37	0.53	
CM									•
CO	2.5	2.5	2.6	0.06	0.002	2.53	-6.90	-6.74	×
CP									•
CQ	94.8	87.4	99.3	6.01	0.282	93.83	-0.55	-0.39	
CS	108.8	103.8	112.5	4.37	0.206	108.37	0.46	0.62	
CX	95.9	96.3	97.5	0.83	0.038	96.57	-0.36	-0.20	
D	102.0	100.0	103.0	1.53	0.071	101.67	0.00	0.16	
DB	96.0	100.0	100.0	2.31	0.095	98.67	-0.21	-0.05	
DD	107.6	106.0	103.2	2.23	0.104	105.60	0.27	0.43	
DE	133.0	133.0	133.0	0.00	0.000	133.00	2.18	2.34	
DG	74.8	66.3	64.4	5.54	0.247	68.50	-2.31	-2.15	
DI	93.9	108.0	90.8	9.17	0.408	97.57	-0.29	-0.13	
DL									•
DM									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DO									•
DS	96.6	95.7	94.1	1.27	0.059	95.47	-0.43	-0.27	
DT	105.0	108.0	102.0	3.00	0.142	105.00	0.23	0.39	
DZ	92.4	95.0	94.1	1.32	0.062	93.83	-0.55	-0.39	
E	112.1	112.2	109.8	1.36	0.057	111.37	0.67	0.83	
EB	103.7	105.4	105.0	0.89	0.040	104.70	0.21	0.37	
EL									•
EO	88.0	96.0	88.0	4.62	0.190	90.67	-0.77	-0.61	
ER	115.0	111.0	112.0	2.08	0.095	112.67	0.76	0.92	
EV	93.3	101.9	113.5	10.14	0.479	102.90	0.08	0.24	
EX									•
FF									•
FJ	87.7	85.8	85.3	1.27	0.057	86.27	-1.07	-0.91	
FL	91.0	93.0	94.0	1.53	0.071	92.67	-0.63	-0.47	
FN	120.0	116.0	128.0	6.11	0.285	121.33	1.37	1.53	
FU	104.3	95.4	101.9	4.60	0.211	100.53	-0.08	0.08	
FZ	118.0	111.0	118.0	4.04	0.166	115.67	0.97	1.13	
GE									•
GI									•
GQ	61.2	60.4	60.8	0.40	0.019	60.80	-2.84	-2.69	
GT	295.1	176.2	230.0	59.54	4.468	233.77	9.19	9.35	×
GZ	99.0	101.9	102.8	1.99	0.090	101.23	-0.03	0.13	
HI	98.0	100.0	97.0	1.53	0.071	98.33	-0.23	-0.07	
HK	115.9	118.3	117.4	1.21	0.057	117.20	1.08	1.24	
HL	100.4	100.4	100.4	0.03	0.000	100.40	-0.09	0.07	
HP	84.9	76.4	79.4	4.31	0.202	80.23	-1.49	-1.33	
HX									•
I	101.0	105.1	108.7	3.85	0.183	104.93	0.23	0.38	
IC	107.5	98.2	110.6	6.45	0.294	105.43	0.26	0.42	
ID	95.8	105.6	122.5	13.51	0.633	107.97	0.44	0.60	
J	114.6	113.7	100.8	7.72	0.327	109.70	0.56	0.72	
JE	93.0	79.3	82.0	7.26	0.325	84.77	-1.18	-1.02	
JG	104.4	104.8	107.9	1.92	0.083	105.70	0.28	0.44	
JN	96.6	115.9	110.6	9.97	0.458	107.70	0.42	0.58	
JQ	154.1	158.2	154.0	2.40	0.100	155.43	3.74	3.90	⇑
JS	97.0	99.7	98.4	1.35	0.064	98.37	-0.23	-0.07	
JX									•
JY	81.9	96.2	78.3	9.47	0.425	85.47	-1.13	-0.97	
K	129.5	132.7	129.5	1.85	0.076	130.57	2.01	2.17	
KE	173.7	173.1	180.7	4.23	0.180	175.83	5.16	5.32	×
KT									•
KX	126.0	127.0	136.0	5.51	0.237	129.67	1.95	2.11	
L	112.6	113.7	113.4	0.57	0.026	113.23	0.80	0.96	
LF	110.0	100.0	100.0	5.77	0.237	103.33	0.11	0.27	
LL									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR	99.0	83.0	102.0	10.21	0.451	94.67	-0.49	-0.33	
LT	91.9	101.0	100.0	4.99	0.216	97.63	-0.28	-0.12	
M	119.0	127.0	128.0	4.93	0.213	124.67	1.60	1.76	
MA									•
MF	125.0	128.0	131.0	3.00	0.142	128.00	1.83	1.99	
MP									•
MQ	81.0	84.0	90.0	4.58	0.213	85.00	-1.16	-1.00	
MV	84.0	82.0	86.0	2.00	0.095	84.00	-1.23	-1.07	
MY	82.1	71.9	71.4	6.04	0.254	75.13	-1.85	-1.69	
N									•
NA	87.5	106.6	86.5	11.33	0.477	93.53	-0.57	-0.41	
NH									•
NJ	89.7	95.7	93.2	3.01	0.142	92.87	-0.61	-0.45	
NK	115.0	113.0	111.0	2.00	0.095	113.00	0.79	0.95	
NO	111.0	114.0	119.0	4.04	0.190	114.67	0.90	1.06	
NT	96.4	94.2	95.9	1.15	0.052	95.50	-0.43	-0.27	
O	124.3	128.0	135.2	5.54	0.259	129.17	1.91	2.07	
OF	143.0	124.0	117.0	13.45	0.617	128.00	1.83	1.99	
OS	93.7	92.1	91.2	1.27	0.059	92.33	-0.65	-0.49	
OX	105.7	105.0	96.0	5.41	0.230	102.23	0.04	0.20	
OY	151.0	147.0	143.0	4.00	0.190	147.00	3.15	3.31	⇑
OZ									•
P	87.6	113.6	95.9	13.28	0.617	99.03	-0.18	-0.03	
PA	65.2	71.4	66.3	3.31	0.147	67.63	-2.37	-2.21	
PB	107.1	102.1	107.7	3.07	0.133	105.63	0.27	0.43	
PG	137.1	125.0	110.0	13.58	0.643	124.03	1.55	1.71	
PI									•
PM	83.9	96.6	93.7	6.65	0.301	91.40	-0.72	-0.56	
PQ	84.3	75.2	85.1	5.50	0.235	81.53	-1.40	-1.24	
PR	85.0	86.4	91.7	3.53	0.159	87.70	-0.97	-0.81	
PV	127.4	112.4	109.8	9.50	0.417	116.53	1.03	1.19	
PW									•
Q	108.6	108.9	109.8	0.62	0.028	109.10	0.52	0.67	
QC									•
QJ	92.0	93.0	92.0	0.58	0.024	92.33	-0.65	-0.49	
QP	118.9	119.5	123.9	2.73	0.119	120.77	1.33	1.49	
QQ	138.4	137.2	126.9	6.32	0.273	134.17	2.26	2.42	
QT	100.2	106.2	101.6	3.14	0.142	102.67	0.07	0.23	
QU	65.0	65.6	61.6	2.16	0.095	64.07	-2.62	-2.46	
QW	92.9	83.5	83.8	5.34	0.223	86.73	-1.04	-0.88	
QX	86.0	85.8	86.8	0.53	0.024	86.20	-1.08	-0.92	
QZ	97.6	109.8	108.1	6.61	0.289	105.17	0.24	0.40	
RD	147.1	135.9	149.1	7.11	0.313	144.03	2.95	3.10	⇑
RF									•
RG	112.0	108.0	119.0	5.57	0.261	113.00	0.79	0.95	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RK	71.4	80.8	80.0	5.21	0.223	77.40	-1.69	-1.53	
RP									•
RR									•
RU	45.9	40.4	45.5	3.07	0.130	43.93	-4.02	-3.86	⇓
RV									•
RZ	101.4	105.0	102.3	1.87	0.085	102.90	0.08	0.24	
S	114.7	117.6	106.3	5.87	0.268	112.87	0.78	0.94	
SC	105.7	102.4	111.8	4.77	0.223	106.63	0.34	0.50	
SD	104.0	100.5	103.8	1.97	0.083	102.77	0.08	0.23	
SF	104.4	105.1	101.0	2.19	0.097	103.50	0.13	0.29	
SI	94.8	92.4	101.0	4.44	0.204	96.07	-0.39	-0.23	
SL	127.0	140.0	137.0	6.81	0.308	134.67	2.29	2.45	
SM	91.1	103.8	89.4	7.87	0.342	94.77	-0.48	-0.32	
SN	81.6	81.5	90.6	5.23	0.216	84.57	-1.19	-1.03	
SO	86.5	88.1	93.0	3.39	0.154	89.20	-0.87	-0.71	
SR	101.1	116.5	131.9	15.40	0.731	116.50	1.03	1.19	
SS	113.0	112.8	117.6	2.72	0.114	114.47	0.89	1.05	
ST									•
SX	105.0	105.6	97.6	4.46	0.190	102.73	0.07	0.23	
SZ	80.0	75.2	81.8	3.41	0.157	79.00	-1.58	-1.42	
T	102.4	86.1	90.7	8.40	0.387	93.07	-0.60	-0.44	
TD	88.6	105.4	120.2	15.81	0.750	104.73	0.21	0.37	
TG	56.8	72.1	62.1	7.77	0.363	63.67	-2.64	-2.49	
TH	105.7	100.7	97.9	3.95	0.185	101.43	-0.02	0.14	
TI									•
TJ									•
TL	102.1	62.5	89.1	20.19	0.939	84.57	-1.19	-1.03	
TN	127.2	89.2	93.0	20.93	0.901	103.13	0.10	0.26	
TQ	102.0	106.0	87.4	9.79	0.441	98.47	-0.22	-0.06	
TS	121.6	123.6	120.3	1.66	0.078	121.83	1.40	1.56	
TY	85.1	82.9	84.7	1.17	0.052	84.23	-1.21	-1.05	
U	84.0	87.0	85.1	1.52	0.071	85.37	-1.13	-0.98	
UA	129.0	130.0	132.0	1.53	0.071	130.33	1.99	2.15	
UE									•
UK									•
UN	76.5	80.4	72.7	3.85	0.183	76.53	-1.75	-1.59	
UP	100.8	108.6	101.1	4.42	0.185	103.50	0.13	0.29	
UQ									•
UW	98.0	94.7	90.3	3.86	0.183	94.33	-0.51	-0.35	
UY									•
VA									•
VC									•
VG									•
VH	77.5	68.1	70.3	4.92	0.223	71.97	-2.07	-1.91	
VI	95.3	118.0	77.4	20.35	0.963	96.90	-0.33	-0.17	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VJ									•
VM									•
VO	88.3	82.5	75.2	6.56	0.311	82.00	-1.37	-1.21	
VT									•
W	124.0	116.0	118.0	4.16	0.190	119.33	1.23	1.39	
WE	102.1	95.6	90.4	5.86	0.278	96.03	-0.39	-0.23	
WF	81.4	87.3	92.0	5.31	0.251	86.90	-1.03	-0.87	
WO									•
X	102.8	123.5	122.6	11.70	0.491	116.30	1.02	1.18	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.53	×	CO	91.40		PM	100.40		HL
23.80	×	AZ	92.33		QJ	100.53		FU
43.93	⇓	RU	92.33		OS	100.87		A
60.80		GQ	92.67		FL	101.10		BM
63.67		TG	92.87		NJ	101.23		GZ
64.07		QU	93.07		T	101.43		TH
67.63		PA	93.43		BA	101.67		D
68.50		DG	93.53		NA	101.77		AP
71.97		VH	93.80		AR	101.87		C
72.33		AE	93.83		DZ	102.23		OX
75.13		MY	93.83		CQ	102.60		CG
76.53		UN	94.33		UW	102.67		QT
77.40		RK	94.67		LR	102.73		SX
79.00		SZ	94.67		CJ	102.77		BC
79.23		AH	94.77		SM	102.77		SD
80.23		HP	95.47		DS	102.90		RZ
81.53		PQ	95.50		NT	102.90		EV
82.00		VO	96.00		BO	103.13		TN
84.00		MV	96.03		WE	103.33		LF
84.23		TY	96.07		SI	103.50		UP
84.57		TL	96.57		CX	103.50		SF
84.57		SN	96.83		BH	104.70		EB
84.77		JE	96.90		VI	104.73		TD
85.00		MQ	97.37		CE	104.90		AF
85.37		U	97.40		AJ	104.93		I
85.47		JY	97.57		DI	105.00		DT
86.20		QX	97.57		BS	105.17		QZ
86.27		FJ	97.63		LT	105.43		IC
86.73		QW	98.33		HI	105.60		DD
86.90		WF	98.37		JS	105.63		PB
87.70		PR	98.47		TQ	105.70		JG
89.20		SO	98.67		DB	105.90		AK
90.67		EO	99.03		P	106.63		SC

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

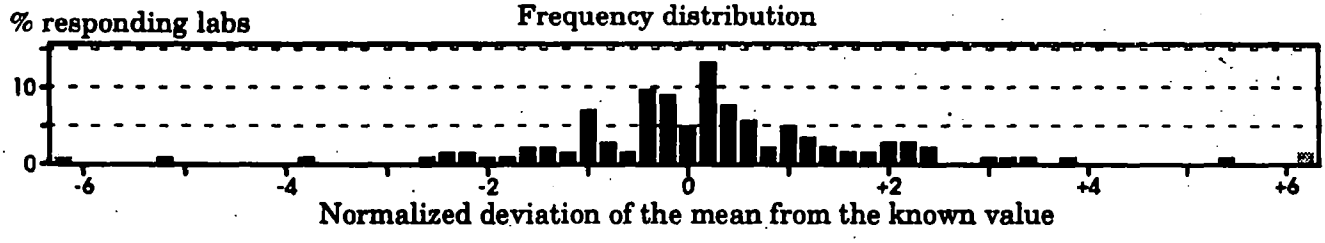
× ≡ Determined to be an outlier

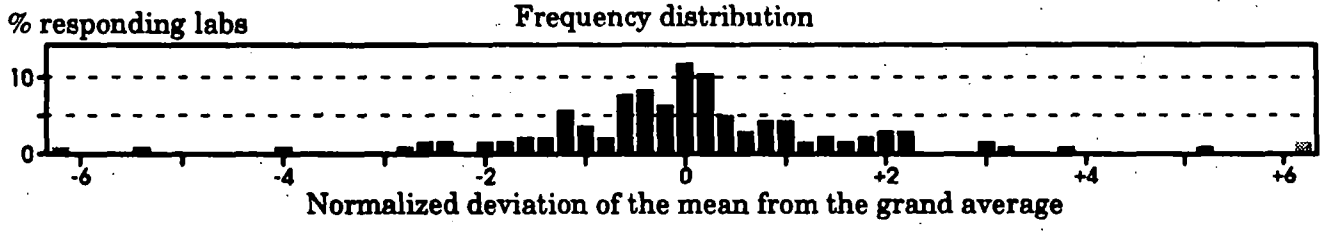
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
107.00		CK	114.47		SS	128.00		MF
107.33		CA	114.67		NO	129.17		O
107.47		BB	115.67		FZ	129.67		KX
107.70		JN	116.30		X	130.33		UA
107.97		ID	116.50		SR	130.57		K
108.37		CS	116.53		PV	131.93		BN
109.10		Q	117.20		HK	133.00		DE
109.70		J	118.53		AL	134.17		QQ
110.57		AW	119.33		W	134.67		SL
111.37		E	120.77		QP	143.60	⇑	AU
112.67		ER	121.33		FN	144.03	⇑	RD
112.87		S	121.83		TS	147.00	⇑	OY
113.00		RG	124.03		PG	155.43	⇑	JQ
113.00		NK	124.67		M	175.83	×	KE
113.23		L	127.33		BK	191.50	×	BG
			128.00		OF	233.77	×	GT





• ≡ No data submitted
∅ ≡ Insufficient data

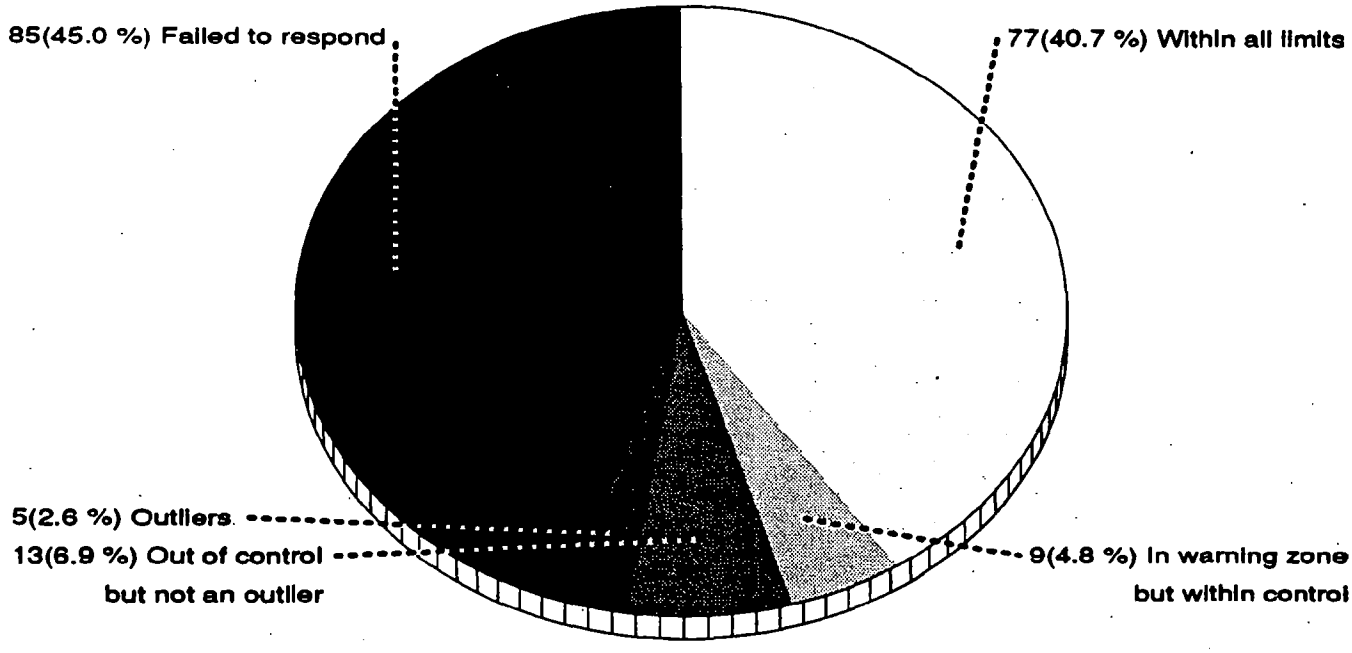
TAG SYMBOLS

× ≡ Determined to be an outlier

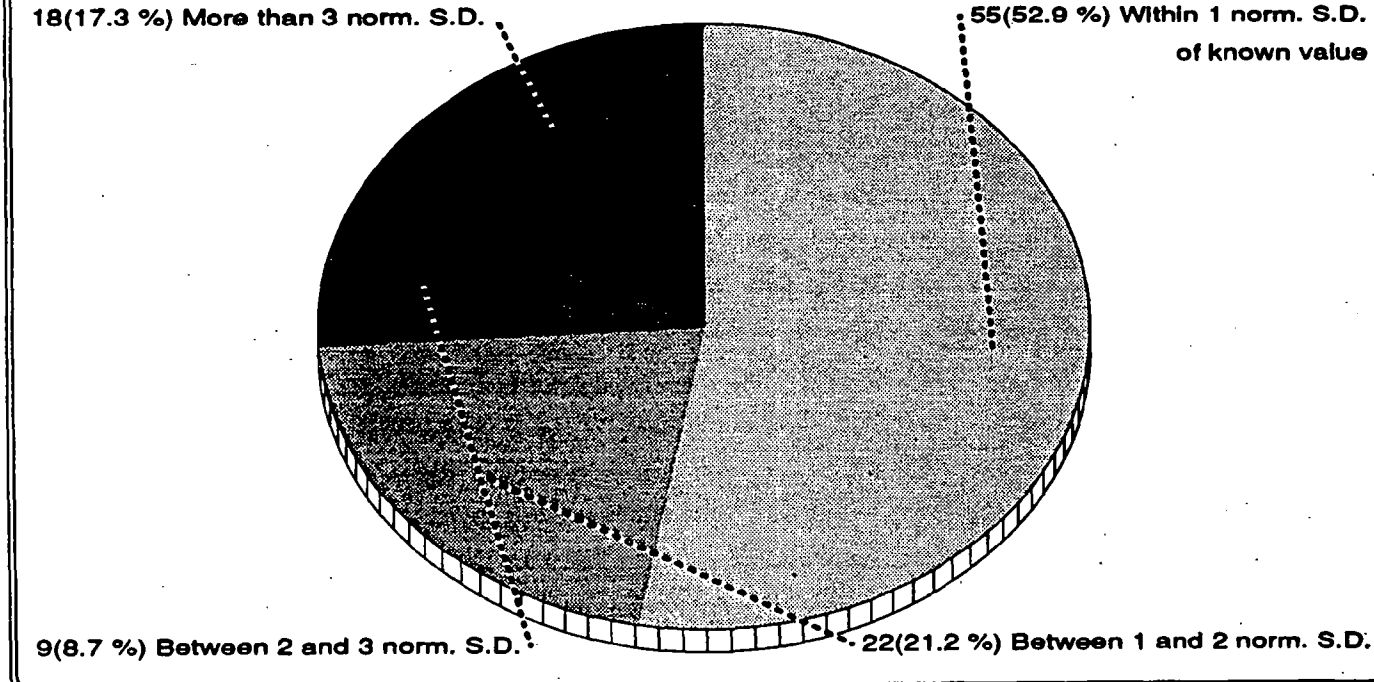
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 189 Participants

The known value of this nuclide is **24.8 pCi/l** with an expected precision of **3.7**; the control limits are 18.4 to 31.2; the warning regions are 18.4 to 20.5 and 29.1 to 31.2



Statistic	Respondents	Non-outliers
Mean	25.63	**Grand Avg 23.27**
Std. Dev.	23.62	3.78
Variance	558.12	14.27
% Coef. of Var.	92.18	16.23
% deviation of mean from known value	3.35	-6.16
Norm. dev. of mean from known value	0.04	-0.40
Median	24.07	24.03
% deviation of median from known value	-2.96	-3.09
Norm. dev. of median from known value	-0.03	-0.20



CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	23.4	24.4	24.3	0.55	0.160	24.03	0.36	-0.36	
AE	23.3	23.6	24.0	0.35	0.112	23.63	0.17	-0.55	
AF	24.7	23.7	23.9	0.53	0.160	24.10	0.39	-0.33	
AH	27.3	26.7	26.7	0.35	0.096	26.90	1.70	0.98	
AI									•
AJ									•
AK	22.2	20.6	22.2	0.92	0.255	21.67	-0.75	-1.47	
AL	24.2	23.4	25.3	0.95	0.303	24.30	0.48	-0.23	
AP	26.4	26.9	27.7	0.66	0.208	27.00	1.74	1.03	
AR									•
AU	21.0	21.0	21.6	0.35	0.096	21.20	-0.97	-1.69	
AW	20.7	20.8	22.7	1.13	0.319	21.40	-0.88	-1.59	
AZ	23.6	26.7	29.2	2.81	0.894	26.50	1.51	0.80	
BA	18.6	18.2	17.6	0.50	0.160	18.13	-2.41	-3.12	⇓
BB									•
BC	26.3	25.5	27.6	1.06	0.335	26.47	1.50	0.78	
BG	24.0	45.0	44.0	11.85	5.481	37.67	6.74	6.02	×
BH	20.5	24.4	21.8	1.99	0.623	22.23	-0.49	-1.20	
BK	23.6	23.7	23.6	0.06	0.016	23.63	0.17	-0.55	
BL									•
BM	22.5	21.8	22.4	0.38	0.112	22.23	-0.49	-1.20	
BN	25.1	26.5	24.9	0.87	0.255	25.50	1.04	0.33	
BO	24.4	23.4	22.7	0.85	0.271	23.50	0.11	-0.61	
BS									•
BW									•
C	23.4	24.9	26.0	1.31	0.415	24.77	0.70	-0.02	
CA	24.8	24.3	24.3	0.29	0.080	24.47	0.56	-0.16	
CE	19.9	23.8	20.7	2.06	0.623	21.47	-0.85	-1.56	
CG	23.4	22.6	25.3	1.39	0.431	23.77	0.23	-0.48	
CJ	24.0	25.0	25.0	0.58	0.160	24.67	0.65	-0.06	
CK	18.9	18.0	22.9	2.61	0.782	19.93	-1.56	-2.28	
CM									•
CO									•
CP									•
CQ									•
CS	26.2	25.4	24.9	0.66	0.208	25.50	1.04	0.33	
CX									•
D									•
DB	21.9	22.8	22.0	0.49	0.144	22.23	-0.49	-1.20	
DD									•
DE	24.7	24.7	24.7	0.01	0.000	24.70	0.67	-0.05	
DG									•
DI									•
DL									•
DM									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DO									•
DS									•
DT	23.4	25.4	24.4	1.00	0.319	24.40	0.53	-0.19	
DZ	25.7	27.5	27.1	0.95	0.287	26.77	1.64	0.92	
E	20.0	20.0	20.4	0.23	0.064	20.13	-1.47	-2.18	
EB	24.3	24.6	25.0	0.35	0.112	24.63	0.64	-0.08	
EL	26.9	25.1	26.0	0.90	0.287	26.00	1.28	0.56	
EO	25.4	25.4	22.5	1.67	0.463	24.43	0.54	-0.17	
ER	24.3	24.0	24.8	0.40	0.128	24.37	0.51	-0.20	
EV									•
EX									•
FF									•
FJ									•
FL									•
FN	21.5	19.5	19.9	1.06	0.319	20.30	-1.39	-2.11	
FU									•
FZ	32.0	33.0	32.0	0.58	0.160	32.33	4.24	3.53	⇑
GE									•
GI									•
GQ	20.4	19.7	19.0	0.70	0.223	19.70	-1.67	-2.39	
GT									•
GZ									•
HI									•
HK	26.0	25.3	26.8	0.75	0.239	26.03	1.29	0.58	
HL	21.6	21.6	21.6	0.01	0.000	21.60	-0.78	-1.50	
HP	26.7	23.9	26.0	1.46	0.447	25.53	1.06	0.34	
HX									•
I	24.8	24.1	24.6	0.36	0.112	24.50	0.57	-0.14	
IC									•
ID	14.9	16.5	15.4	0.82	0.255	15.60	-3.59	-4.31	⇓
J	22.2	24.5	24.6	1.36	0.383	23.77	0.23	-0.48	
JE	27.6	32.6	23.9	4.37	1.741	28.03	2.23	1.51	
JG	16.8	18.9	18.4	1.10	0.335	18.03	-2.45	-3.17	⇓
JN									•
JQ									•
JS	23.2	21.0	22.3	1.11	0.351	22.17	-0.52	-1.23	
JX	23.0	24.2	25.2	1.10	0.351	24.13	0.40	-0.31	
JY	24.4	28.0	29.2	2.50	0.766	27.20	1.84	1.12	
K	21.7	20.3	21.0	0.70	0.223	21.00	-1.06	-1.78	
KE									•
KT									•
KX									•
L	24.5	24.3	24.9	0.31	0.096	24.57	0.61	-0.11	
LF									•
LL									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR	268.0	252.0	257.0	8.19	3.960	259.00	110.35	109.63	×
LT	19.0	28.1	24.3	4.57	1.862	23.80	0.25	-0.47	
M	22.9	20.8	20.4	1.34	0.399	21.37	-0.89	-1.61	
MA									•
MF									•
MP									•
MQ									•
MV									•
MY									•
N									•
NA									•
NH	28.6	26.7	25.0	1.80	0.575	26.77	1.64	0.92	
NJ	28.0	32.0	26.0	3.06	0.958	28.67	2.53	1.81	
NK									•
NO	29.9	30.1	31.7	0.99	0.287	30.57	3.41	2.70	
NT	24.8	24.9	24.9	0.06	0.016	24.87	0.75	0.03	
O									•
OF	19.5	16.5	14.3	2.61	0.830	16.77	-3.05	-3.76	⇓
OS									•
OX	25.3	25.4	25.7	0.21	0.064	25.47	1.03	0.31	
OY	16.0	15.2	15.0	0.53	0.160	15.40	-3.69	-4.40	⇓
OZ									•
P	33.0	32.8	31.5	0.81	0.239	32.43	4.29	3.57	⇑
PA									•
PB	24.6	24.4	24.9	0.25	0.080	24.63	0.64	-0.08	
PG	20.3	20.7	19.0	0.89	0.271	20.00	-1.53	-2.25	
PI									•
PM									•
PQ	8.0	9.3	10.0	1.01	0.319	9.10	-6.63	-7.35	×
PR									•
PV	22.1	26.8	23.2	2.46	0.750	24.03	0.36	-0.36	
PW	24.2	21.8	23.2	1.21	0.383	23.07	-0.10	-0.81	
Q	32.0	27.2	31.1	2.55	0.766	30.10	3.20	2.48	
QC									•
QJ	16.6	14.3	16.5	1.30	0.367	15.80	-3.50	-4.21	⇓
QP									•
QQ	12.8	13.9	12.4	0.78	0.239	13.03	-4.79	-5.51	⇓
QT	14.9	15.6	15.9	0.51	0.160	15.47	-3.65	-4.37	⇓
QU	24.6	25.0	25.0	0.23	0.064	24.87	0.75	0.03	
QW									•
QX	15.2	16.6	16.1	0.71	0.223	15.97	-3.42	-4.14	⇓
QZ	23.4	22.7	23.2	0.36	0.112	23.10	-0.08	-0.80	
RD	19.2	21.2	21.4	1.22	0.351	20.60	-1.25	-1.97	
RF	24.0	26.0	24.0	1.15	0.319	24.67	0.65	-0.06	
RG									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RK	26.4	24.9	24.1	1.17	0.367	25.13	0.87	0.16	
RP									•
RR									•
RU	24.4	21.8	20.0	2.21	0.702	22.07	-0.56	-1.28	
RV									•
RZ	23.8	21.8	23.5	1.08	0.319	23.03	-0.11	-0.83	
S	25.0	24.9	25.0	0.06	0.016	24.97	0.79	0.08	
SC	23.2	24.4	25.7	1.25	0.399	24.43	0.54	-0.17	
SD	21.0	20.0	21.2	0.64	0.192	20.73	-1.19	-1.90	
SF	21.2	24.3	19.3	2.52	0.798	21.60	-0.78	-1.50	
SI	11.7	7.3	10.6	2.29	0.702	9.87	-6.28	-6.99	×
SL									•
SM	23.7	25.7	22.7	1.53	0.479	24.03	0.36	-0.36	
SN									•
SO	23.6	23.7	24.5	0.49	0.144	23.93	0.31	-0.41	
SR									•
SS	21.7	22.9	24.0	1.15	0.367	22.87	-0.19	-0.91	
ST									•
SX	24.4	22.1	23.8	1.19	0.367	23.43	0.08	-0.64	
SZ	24.0	25.3	23.4	0.97	0.303	24.23	0.45	-0.27	
T	25.0	25.1	25.7	0.38	0.112	25.27	0.93	0.22	
TD	58.1	48.2	31.3	13.55	7.244	45.87	10.58	9.86	×
TG									•
TH									•
TI	23.7	23.9	26.9	1.79	0.511	24.83	0.73	0.02	
TJ									•
TL	22.9	6.3	5.2	9.92	4.477	11.47	-5.53	-6.24	⇓
TN	18.2	20.1	22.9	2.36	0.750	20.40	-1.34	-2.06	
TQ	24.7	28.5	27.4	1.96	0.607	26.87	1.68	0.97	
TS	29.7	31.8	29.5	1.27	0.367	30.33	3.31	2.59	
TY									•
U	26.4	25.7	26.5	0.44	0.128	26.20	1.37	0.66	
UA									•
UE									•
UK									•
UN	15.2	14.5	12.9	1.18	0.367	14.20	-4.25	-4.96	⇓
UP	21.9	26.8	24.4	2.45	0.782	24.37	0.51	-0.20	
UQ	24.7	25.8	24.5	0.70	0.208	25.00	0.81	0.09	
UW	24.9	23.9	24.6	0.51	0.160	24.47	0.56	-0.16	
UY									•
VA									•
VC									•
VG									•
VH	22.7	18.2	21.6	2.35	0.718	20.83	-1.14	-1.86	
VI	22.6	20.3	21.4	1.15	0.367	21.43	-0.86	-1.58	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VJ									•
VM									•
VO									•
VT									•
W	21.1	23.6	23.0	1.31	0.399	22.57	-0.33	-1.05	
WE									•
WF									•
WO									•
X	23.1	27.9	23.1	2.77	0.766	24.70	0.67	-0.05	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.10	×	PQ	22.23		DB	24.63		EB
9.87	×	SI	22.23		BM	24.67		RF
11.47	⇓	TL	22.23		BH	24.67		CJ
13.03	⇓	QQ	22.57		W	24.70		X
14.20	⇓	UN	22.87		SS	24.70		DE
15.40	⇓	OY	23.03		RZ	24.77		C
15.47	⇓	QT	23.07		PW	24.83		TI
15.60	⇓	ID	23.10		QZ	24.87		QU
15.80	⇓	QJ	23.43		SX	24.87		NT
15.97	⇓	QX	23.50		BO	24.97		S
16.77	⇓	OF	23.63		BK	25.00		UQ
18.03	⇓	JG	23.63		AE	25.13		RK
18.13	⇓	BA	23.77		J	25.27		T
19.70		GQ	23.77		CG	25.47		OX
19.93		CK	23.80		LT	25.50		CS
20.00		PG	23.93		SO	25.50		BN
20.13		E	24.03		PV	25.53		HP
20.30		FN	24.03		A	26.00		EL
20.40		TN	24.03		SM	26.03		HK
20.60		RD	24.10		AF	26.20		U
20.73		SD	24.13		JX	26.47		BC
20.83		VH	24.23		SZ	26.50		AZ
21.00		K	24.30		AL	26.77		NH
21.20		AU	24.37		UP	26.77		DZ
21.37		M	24.37		ER	26.87		TQ
21.40		AW	24.40		DT	26.90		AH
21.43		VI	24.43		SC	27.00		AP
21.47		CE	24.43		EO	27.20		JY
21.60		SF	24.47		UW	28.03		JE
21.60		HL	24.47		CA	28.67		NJ
21.67		AK	24.50		I	30.10		Q
22.07		RU	24.57		L	30.33		TS
22.17		JS	24.63		PB	30.57		NO

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

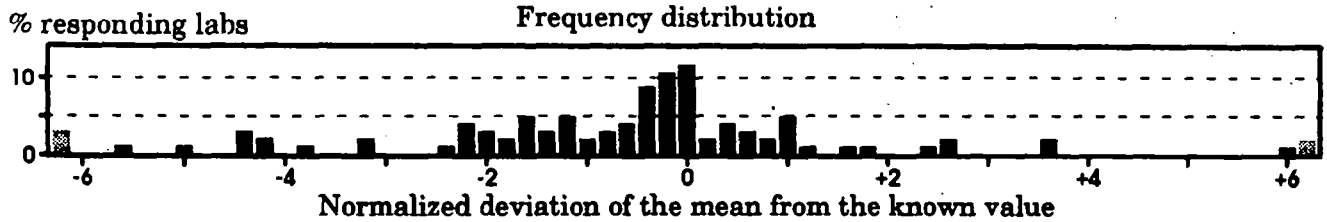
× ≡ Determined to be an outlier

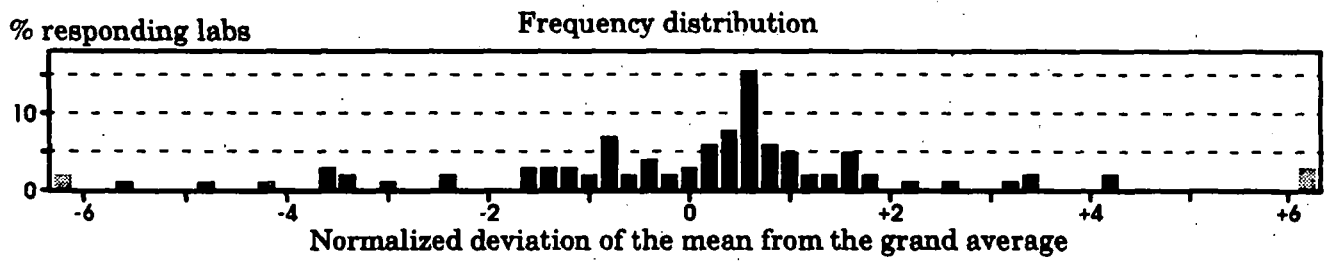
⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
32.33	⇑	**FZ**	32.43	⇑	**P**	45.87	×	**TD**
			37.67	×	**BG**	259.00	×	**LR**





• ≡ No data submitted
∅ ≡ Insufficient data

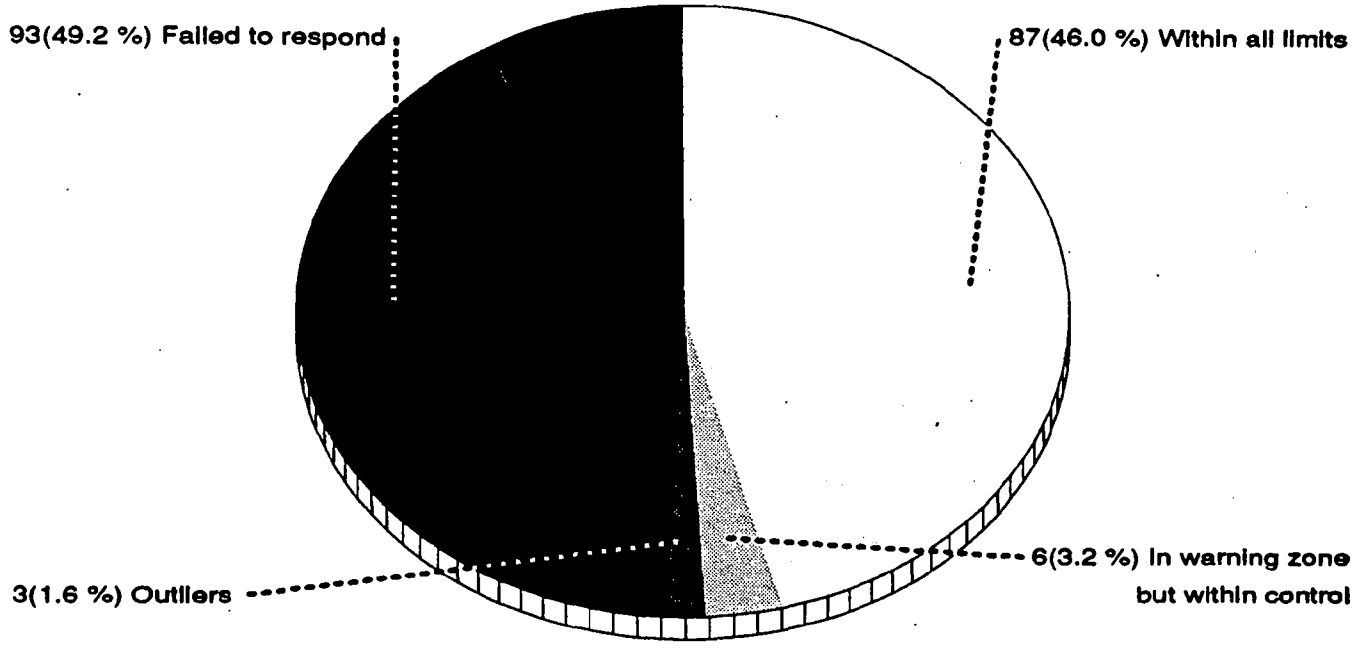
TAG SYMBOLS

× ≡ Determined to be an outlier

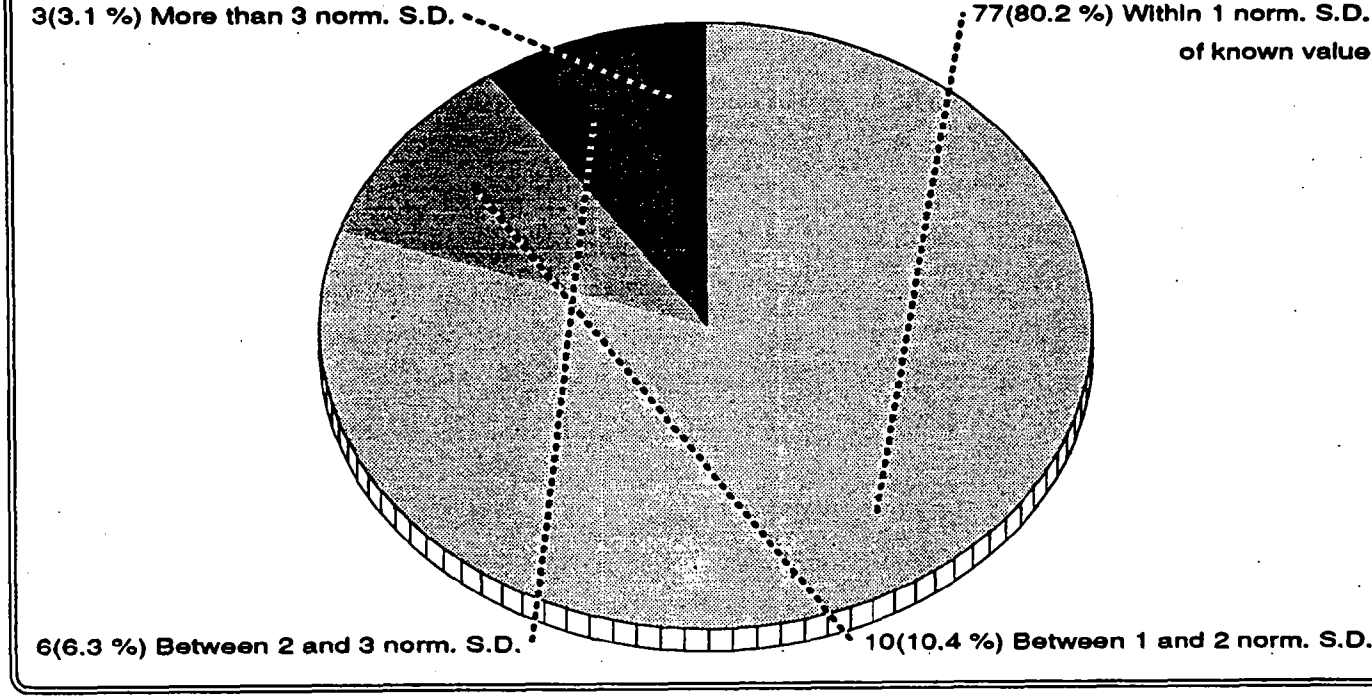
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 189 Participants

The known value of this nuclide is **20.7 pCi/l** with an expected precision of **5.2**; the control limits are 11.7 to 29.7; the warning regions are 11.7 to 14.7 and 26.7 to 29.7



Statistic	Respondents	Non-outliers
Mean	20.17	**Grand Avg 20.31**
Std. Dev.	3.59	2.75
Variance	12.92	7.56
% Coef. of Var.	17.82	13.54
% deviation of mean from known value	-2.56	-1.88
Norm. dev. of mean from known value	-0.15	-0.14
Median	20.53	20.60
% deviation of median from known value	-0.81	-0.48
Norm. dev. of median from known value	-0.05	-0.04



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	20.6	17.8	18.8	1.42	0.318	19.07	-0.41	-0.54	
AE	17.6	19.2	19.9	1.18	0.261	18.90	-0.47	-0.60	
AF	22.7	22.1	22.4	0.30	0.068	22.40	0.70	0.57	
AH	20.2	21.7	20.8	0.75	0.170	20.90	0.20	0.07	
AI									•
AJ									•
AK	22.6	20.4	20.0	1.40	0.295	21.00	0.23	0.10	
AL	18.8	22.9	19.0	2.31	0.466	20.23	-0.03	-0.16	
AP	16.1	18.8	21.1	2.50	0.568	18.67	-0.55	-0.68	
AR									•
AU	3.2	3.7	3.4	0.25	0.057	3.43	-5.62	-5.75	×
AW	16.0	15.9	15.8	0.10	0.023	15.90	-1.47	-1.60	
AZ	24.3	20.4	22.7	1.96	0.443	22.47	0.72	0.59	
BA	21.4	21.6	21.7	0.15	0.034	21.57	0.42	0.29	
BB									•
BC	18.2	17.4	16.9	0.66	0.148	17.50	-0.94	-1.07	
BG									•
BH	21.1	18.3	18.3	1.62	0.318	19.23	-0.36	-0.49	
BK	19.7	19.4	18.7	0.51	0.114	19.27	-0.35	-0.48	
BL									•
BM	18.5	20.0	19.0	0.76	0.170	19.17	-0.38	-0.51	
BN									•
BO	18.6	18.7	20.6	1.13	0.227	19.30	-0.34	-0.47	
BS									•
BW									•
C	21.4	21.0	19.8	0.83	0.182	20.73	0.14	0.01	
CA	20.9	20.7	18.7	1.22	0.250	20.10	-0.07	-0.20	
CE	17.4	18.9	19.5	1.08	0.239	18.60	-0.57	-0.70	
CG	18.8	17.7	21.5	1.96	0.432	19.33	-0.33	-0.46	
CJ	20.0	20.0	19.0	0.58	0.114	19.67	-0.21	-0.34	
CK	20.4	17.4	22.3	2.47	0.557	20.03	-0.09	-0.22	
CM									•
CO									•
CP									•
CQ									•
CS	14.4	14.0	14.6	0.31	0.068	14.33	-1.99	-2.12	
CX									•
D									•
DB	20.5	22.8	23.4	1.53	0.329	22.23	0.64	0.51	
DD									•
DE	22.8	22.8	22.9	0.06	0.011	22.83	0.84	0.71	
DG									•
DI									•
DL									•
DM									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DO									•
DS									•
DT	22.6	21.3	19.8	1.40	0.318	21.23	0.31	0.18	
DZ	21.8	20.8	20.7	0.61	0.125	21.10	0.26	0.13	
E									•
EB	18.4	17.5	18.3	0.49	0.102	18.07	-0.75	-0.88	
EL	21.5	21.3	20.5	0.53	0.114	21.10	0.26	0.13	
EO	20.6	19.7	20.9	0.62	0.136	20.40	0.03	-0.10	
ER									•
EV									•
EX									•
FF									•
FJ									•
FL									•
FN	22.3	24.0	20.4	1.80	0.409	22.23	0.64	0.51	
FU									•
FZ	10.0	14.0	8.8	2.72	0.591	10.93	-3.12	-3.25	×
GE									•
GI									•
GQ	12.3	11.3	12.3	0.58	0.114	11.97	-2.78	-2.91	
GT									•
GZ									•
HI									•
HK	20.3	20.8	20.2	0.32	0.068	20.43	0.04	-0.09	
HL	20.8	20.8	20.8	0.00	0.000	20.80	0.16	0.03	
HP	19.9	17.2	17.6	1.46	0.307	18.23	-0.69	-0.82	
HX									•
I	18.8	17.4	19.9	1.25	0.284	18.70	-0.54	-0.67	
IC									•
ID	27.4	27.8	25.4	1.29	0.273	26.87	2.18	2.05	
J	21.1	19.9	19.1	1.01	0.227	20.03	-0.09	-0.22	
JE	24.2	28.6	26.2	2.20	0.500	26.33	2.01	1.88	
JG	24.9	27.1	20.0	3.63	0.806	24.00	1.23	1.10	
JN									•
JQ									•
JS	20.8	20.7	20.4	0.21	0.045	20.63	0.11	-0.02	
JX	20.6	20.1	21.6	0.76	0.170	20.77	0.15	0.02	
JY	24.7	20.5	22.6	2.10	0.477	22.60	0.76	0.63	
K	17.0	18.6	18.5	0.90	0.182	18.03	-0.76	-0.89	
KE									•
KT									•
KX									•
L	19.9	21.0	21.3	0.74	0.159	20.73	0.14	0.01	
LF									•
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR	37.0	31.0	31.0	3.46	0.682	33.00	4.23	4.10	×
LT	19.9	18.0	20.9	1.47	0.329	19.60	-0.24	-0.37	
M	24.0	23.0	22.0	1.00	0.227	23.00	0.90	0.77	
MA									•
MF									•
MP									•
MQ									•
MV									•
MY									•
N									•
NA									•
NH	17.2	16.2							Ø
NJ	22.0	21.0	20.0	1.00	0.227	21.00	0.23	0.10	
NK									•
NO	19.0	21.0	23.0	2.00	0.454	21.00	0.23	0.10	
NT	20.5	21.3	22.4	0.95	0.216	21.40	0.36	0.23	
O									•
OF	28.0	22.0	19.8	4.24	0.931	23.27	0.98	0.85	
OS									•
OX	21.4	21.2	20.8	0.31	0.068	21.13	0.27	0.14	
OY	20.0	21.0	22.0	1.00	0.227	21.00	0.23	0.10	
OZ									•
P	13.5	10.3	12.2	1.61	0.363	12.00	-2.77	-2.90	
PA									•
PB	20.1	20.8	20.5	0.35	0.080	20.47	0.05	-0.08	
PG									•
PI									•
PM									•
PQ	19.7	18.4	21.4	1.50	0.341	19.83	-0.16	-0.29	
PR									•
PV	20.7	17.8	26.2	4.27	0.954	21.57	0.42	0.29	
PW	20.9	21.2	20.6	0.30	0.068	20.90	0.20	0.07	
Q	24.0	23.4	19.1	2.67	0.557	22.17	0.62	0.49	
QC									•
QJ	23.6	19.7	25.1	2.79	0.613	22.80	0.83	0.70	
QP									•
QQ									•
QT	19.7	21.7	19.2	1.32	0.284	20.20	-0.04	-0.17	
QU	21.3	20.0	22.6	1.30	0.295	21.30	0.33	0.20	
QW									•
QX	19.7	19.9	19.6	0.15	0.034	19.73	-0.19	-0.32	
QZ	18.7	18.6	18.1	0.32	0.068	18.47	-0.61	-0.74	
RD	16.5	18.1	18.5	1.06	0.227	17.70	-0.87	-1.00	
RF	21.0	20.0	22.0	1.00	0.227	21.00	0.23	0.10	
RG									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RK	15.7	17.9	16.0	1.19	0.250	16.53	-1.26	-1.39	
RP									•
RR									•
RU	20.7	20.9	20.2	0.36	0.080	20.60	0.10	-0.03	
RV									•
RZ	22.6	21.9	23.0	0.56	0.125	22.50	0.73	0.60	
S	19.3	21.8	19.1	1.50	0.307	20.07	-0.08	-0.21	
SC	18.1	15.9	15.9	1.27	0.250	16.63	-1.23	-1.35	
SD	24.2	24.9	25.1	0.47	0.102	24.73	1.47	1.34	
SF	19.6	24.7	19.7	2.92	0.579	21.33	0.34	0.21	
SI	14.5	14.4	18.4	2.28	0.454	15.77	-1.51	-1.64	
SL									•
SM	23.4	21.2	21.5	1.19	0.250	22.03	0.57	0.44	
SN									•
SO									•
SR									•
SS	20.7	19.0	20.0	0.85	0.193	19.90	-0.14	-0.27	
ST									•
SX	20.5	23.2	21.8	1.35	0.307	21.83	0.51	0.38	
SZ	23.1	24.5	20.0	2.30	0.511	22.53	0.74	0.61	
T	22.4	22.7	21.5	0.62	0.136	22.20	0.63	0.50	
TD	24.2	29.5	25.9	2.71	0.602	26.53	2.07	1.94	
TG									•
TH									•
TI	27.3	27.1	29.9	1.56	0.318	28.10	2.59	2.46	
TJ									•
TL	20.0	19.9	21.5	0.90	0.182	20.47	0.05	-0.08	
TN	20.5	18.9	16.9	1.80	0.409	18.77	-0.51	-0.64	
TQ	22.0	24.4	24.2	1.33	0.273	23.53	1.07	0.94	
TS	16.3	17.0	13.3	1.97	0.420	15.53	-1.59	-1.72	
TY									•
U	19.6	17.7	16.0	1.80	0.409	17.77	-0.85	-0.98	
UA									•
UE									•
UK									•
UN	12.6	13.0	13.3	0.35	0.080	12.97	-2.45	-2.58	
UP	22.3	20.0	20.8	1.17	0.261	21.03	0.24	0.11	
UQ	19.7	19.4	20.7	0.68	0.148	19.93	-0.13	-0.26	
UW	20.6	20.9	19.5	0.74	0.159	20.33	0.01	-0.12	
UY									•
VA									•
VC									•
VG									•
VH	19.6	23.3	20.1	2.01	0.420	21.00	0.23	0.10	
VI	21.3	19.6	20.0	0.89	0.193	20.30	0.00	-0.13	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VJ									•
VM									•
VO									•
VT									•
W	21.8	21.6	19.7	1.16	0.239	21.03	0.24	0.11	
WE									•
WF									•
WO									•
X	19.4	14.1	19.8	3.18	0.647	17.77	-0.85	-0.98	

Data sorted by Laboratory Average

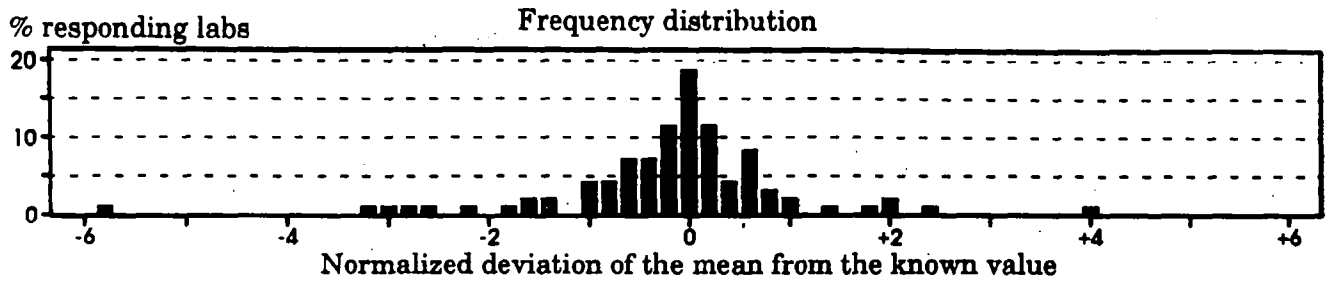
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.43	×	AU	19.73		QX	21.10		EL
10.93	×	FZ	19.83		PQ	21.10		DZ
11.97		GQ	19.90		SS	21.13		OX
12.00		P	19.93		UQ	21.23		DT
12.97		UN	20.03		CK	21.30		QU
14.33		CS	20.03		J	21.33		SF
15.53		TS	20.07		S	21.40		NT
15.77		SI	20.10		CA	21.57		PV
15.90		AW	20.20		QT	21.57		BA
16.53		RK	20.23		AL	21.83		SX
16.63		SC	20.30		VI	22.03		SM
17.50		BC	20.33		UW	22.17		Q
17.70		RD	20.40		EO	22.20		T
17.77		X	20.43		HK	22.23		FN
17.77		U	20.47		TL	22.23		DB
18.03		K	20.47		PB	22.40		AF
18.07		EB	20.60		RU	22.47		AZ
18.23		HP	20.63		JS	22.50		RZ
18.47		QZ	20.73		L	22.53		SZ
18.60		CE	20.73		C	22.60		JY
18.67		AP	20.77		JX	22.80		QJ
18.70		I	20.80		HL	22.83		DE
18.77		TN	20.90		PW	23.00		M
18.90		AE	20.90		AH	23.27		OF
19.07		A	21.00		VH	23.53		TQ
19.17		BM	21.00		RF	24.00		JG
19.23		BH	21.00		OY	24.73		SD
19.27		BK	21.00		NO	26.33		JE
19.30		BO	21.00		NJ	26.53		TD
19.33		CG	21.00		AK	26.87		ID
19.60		LT	21.03		UP	28.10		TI
19.67		CJ	21.03		W	33.00	×	LR

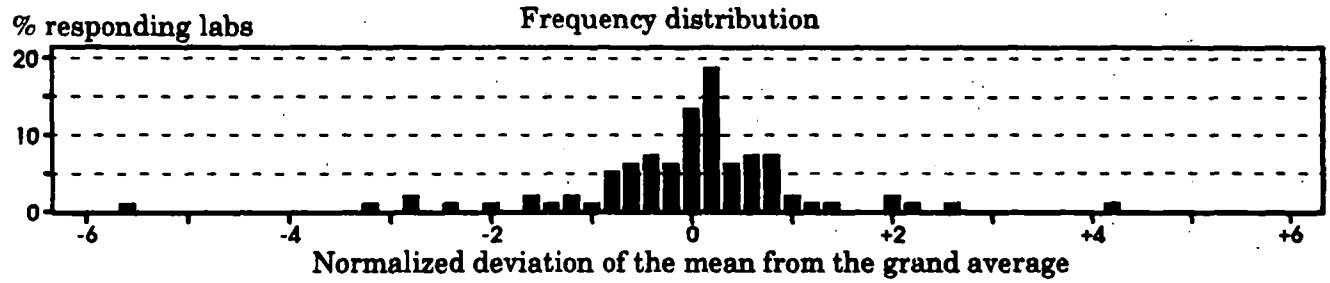
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

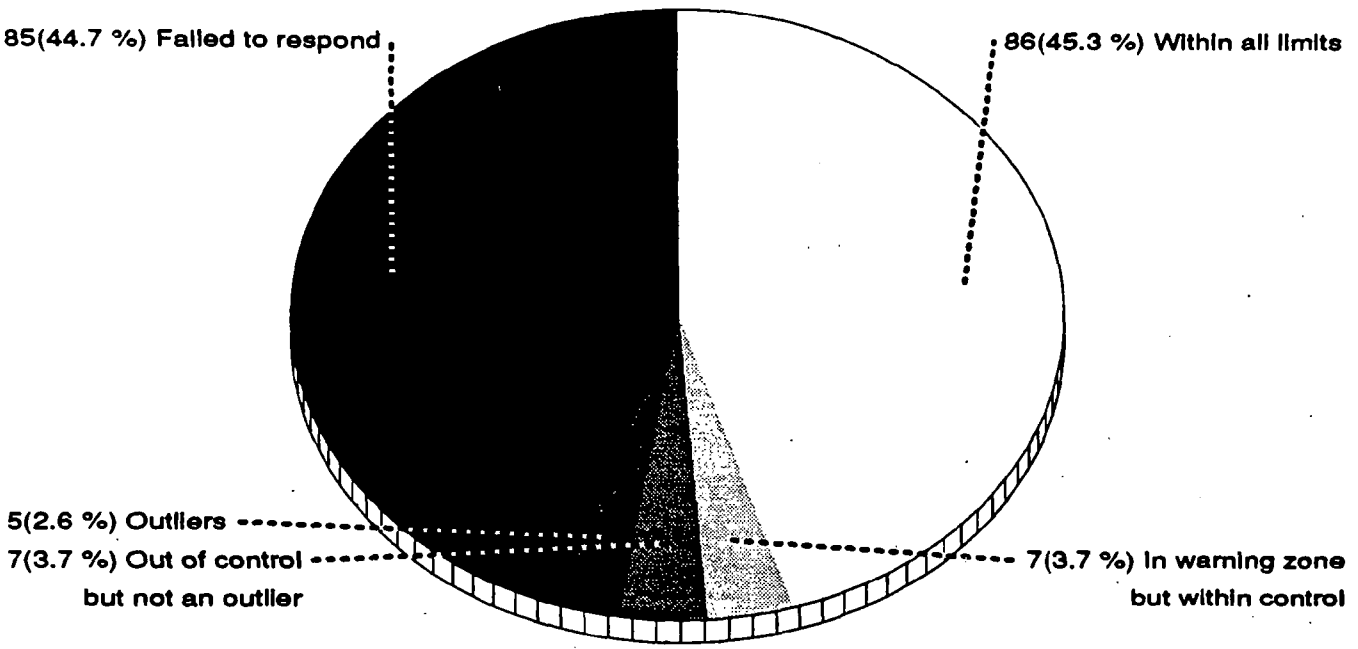
Radium-228


% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the known value

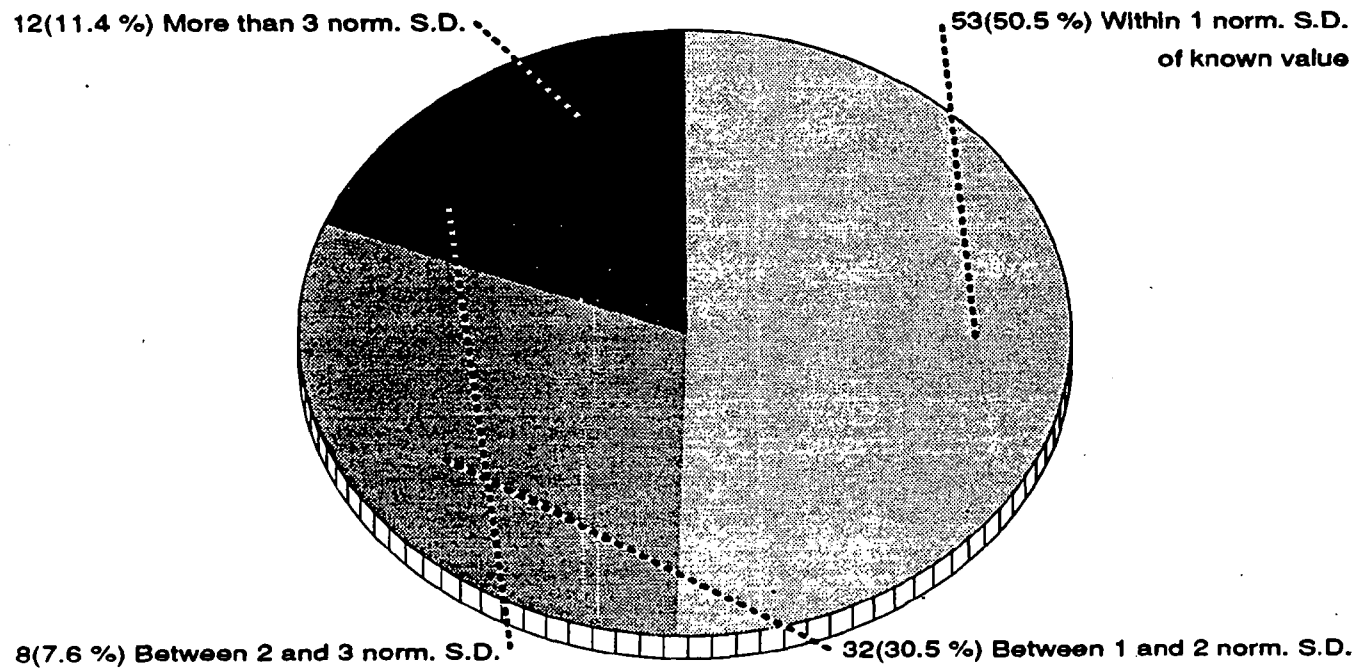

% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Uranium (Natural) Statistical Summary 190 Participants

The known value of this nuclide is **27.0 pCi/l** with an expected precision of **3.0**; the control limits are 21.8 to 32.2; the warning regions are 21.8 to 23.5 and 30.5 to 32.2



Statistic	Respondents	Non-outliers
Mean	26.18	**Grand Avg 26.33**
Std. Dev.	4.16	2.52
Variance	17.29	6.35
% Coef. of Var.	15.89	9.57
% deviation of mean from known value	-3.05	-2.47
Norm. dev. of mean from known value	-0.20	-0.26
Median	26.47	26.50
% deviation of median from known value	-1.98	-1.85
Norm. dev. of median from known value	-0.13	-0.20



CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	25.6	24.4	25.0	0.60	0.236	25.00	-0.77	-1.15	
AE	28.3	29.9	29.5	0.83	0.315	29.23	1.67	1.29	
AF	30.7	31.4	29.7	0.85	0.335	30.60	2.46	2.08	
AH	25.9	21.1	26.9	3.10	1.270	24.63	-0.98	-1.37	
AI									•
AJ									•
AK	26.2	27.5	28.8	1.30	0.512	27.50	0.67	0.29	
AL	22.1	30.1	29.1	4.36	2.095	27.10	0.44	0.06	
AP									•
AR	22.3	21.7	21.1	0.60	0.236	21.70	-2.67	-3.06	⇓
AU									•
AW	25.1	24.6	24.7	0.26	0.098	24.80	-0.89	-1.27	
AZ	27.6	28.7	29.3	0.86	0.335	28.53	1.27	0.89	
BA	29.4	25.9	26.2	1.94	0.689	27.17	0.48	0.10	
BB	22.5	25.2	21.9	1.76	0.650	23.20	-1.81	-2.19	
BC	27.2	26.8	27.1	0.21	0.079	27.03	0.40	0.02	
BG	24.0	25.5	22.4	1.55	0.610	23.97	-1.37	-1.75	
BG	28.4	28.8	29.1	0.35	0.138	28.77	1.41	1.02	
BH	30.9	31.5	27.9	1.93	0.709	30.10	2.17	1.79	
BK	26.7	25.5	25.8	0.62	0.236	26.00	-0.19	-0.58	
BL									•
BM	27.9	27.3	27.6	0.30	0.118	27.60	0.73	0.35	
BN	23.9	26.6	26.0	1.42	0.532	25.50	-0.48	-0.87	
BO	24.9	24.2	29.9	3.11	1.233	26.33	0.00	-0.38	
BS									•
BW									•
C	28.2	26.6	24.0	2.12	0.827	26.27	-0.04	-0.42	
CA	26.2	24.7	26.4	0.93	0.335	25.77	-0.33	-0.71	
CE	27.0	26.7	27.1	0.21	0.079	26.93	0.35	-0.04	
CG	23.8	24.3	24.9	0.55	0.217	24.33	-1.15	-1.54	
CJ	23.0	24.0	24.0	0.58	0.197	23.67	-1.54	-1.92	
CK	32.4	27.9	29.0	2.35	0.886	29.77	1.98	1.60	
CM									•
CO	5.0	5.0	5.1	0.06	0.020	5.03	-12.30	-12.68	×
CP									•
CQ									•
CS	42.1	42.9	42.6	0.40	0.158	42.53	9.35	8.97	×
CX	30.6	29.2	29.5	0.74	0.276	29.77	1.98	1.60	
D									•
DB	22.4	23.7	24.5	1.06	0.413	23.53	-1.62	-2.00	
DD									•
DE	24.9	24.9	24.9	0.01	0.000	24.90	-0.83	-1.21	
DG									•
DI	25.7	26.9	24.4	1.25	0.492	25.67	-0.38	-0.77	
DL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM									•
DO	25.2	25.3	24.6	0.38	0.138	25.03	-0.75	-1.14	
DS									•
DT	25.7	24.0	24.1	0.95	0.335	24.60	-1.00	-1.39	
DZ	33.3	32.0	34.9	1.45	0.571	33.40	4.08	3.70	⇑
E	24.2	24.2	23.3	0.52	0.177	23.90	-1.40	-1.79	
EB	27.7	27.2	27.2	0.29	0.098	27.37	0.60	0.21	
EL	26.4	27.3	25.7	0.80	0.315	26.47	0.08	-0.31	
EO									•
ER	24.3	23.4	24.7	0.67	0.256	24.13	-1.27	-1.66	
EV									•
EX									•
FF									•
FJ									•
FL									•
FN	22.4	22.0	22.7	0.35	0.138	22.37	-2.29	-2.68	
FU									•
FZ	28.0	34.0	27.0	3.79	1.720	29.67	1.92	1.54	
GE									•
GI									•
GQ	25.2	26.3	27.5	1.15	0.453	26.33	0.00	-0.38	
GT									•
GZ									•
HI									•
HK	21.0	24.7	23.4	1.88	0.728	23.03	-1.91	-2.29	
HL	30.4	30.4	30.4	0.01	0.000	30.40	2.35	1.96	
HP	27.7	27.6	26.6	0.61	0.217	27.30	0.56	0.17	
HX									•
I	33.3	30.6	33.4	1.59	0.551	32.43	3.52	3.14	⇑
IC									•
ID	25.0	27.1	24.6	1.34	0.492	25.57	-0.44	-0.83	
J	27.3	27.6	27.3	0.17	0.059	27.40	0.62	0.23	
JE	25.6	25.7	30.0	2.51	0.866	27.10	0.44	0.06	
JG									•
JN	23.5	23.5	23.8	0.17	0.059	23.60	-1.58	-1.96	
JQ									•
JS	27.1	27.0	27.1	0.06	0.020	27.07	0.42	0.04	
JX									•
JY	25.2	28.2	27.1	1.52	0.591	26.83	0.29	-0.10	
K	26.5	26.9	28.2	0.89	0.335	27.20	0.50	0.12	
KE									•
KT	20.0	21.0	20.0	0.58	0.197	20.33	-3.46	-3.85	⇓
KX									•
L	28.5	28.0	27.1	0.71	0.276	27.87	0.89	0.50	
LF									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LL									•
LR									•
LT									•
M									•
MA									•
MF									•
MP									•
MQ									•
MV									•
MY									•
N									•
NA	22.8	25.5	27.6	2.41	0.945	25.30	-0.60	-0.98	
NH	28.1	28.7	27.7	0.50	0.197	28.17	1.06	0.67	
NJ	26.0	28.0	28.0	1.15	0.394	27.33	0.58	0.19	
NK	27.4	25.0	28.7	1.88	0.728	27.03	0.40	0.02	
NO	27.0	28.0	29.0	1.00	0.394	28.00	0.96	0.58	
NT	25.5	26.3	27.1	0.80	0.315	26.30	-0.02	-0.40	
O									•
OF									•
OS	27.8	25.2	27.8	1.50	0.512	26.93	0.35	-0.04	
OX									•
OY	21.3	23.2	23.0	1.04	0.374	22.50	-2.21	-2.60	
OZ									•
P	26.8	26.8	26.5	0.17	0.059	26.70	0.21	-0.17	
PA									•
PB	30.8	29.5	30.3	0.66	0.256	30.20	2.23	1.85	
PG	26.7	27.1	27.0	0.21	0.079	26.93	0.35	-0.04	
PI									•
PM									•
PQ	27.5	27.4	27.8	0.21	0.079	27.57	0.71	0.33	
PR									•
PV	24.5	25.1	25.7	0.60	0.236	25.10	-0.71	-1.10	
PW	23.8	19.2	22.9	2.44	0.906	21.97	-2.52	-2.91	
Q	28.6	29.5	30.2	0.80	0.315	29.43	1.79	1.40	
QC									•
QJ	25.0	25.6	21.4	2.27	0.827	24.00	-1.35	-1.73	
QP									•
QQ	26.9	26.9	26.8	0.06	0.020	26.87	0.31	-0.08	
QT									•
QU	20.1	22.3	19.0	1.68	0.650	20.47	-3.39	-3.77	⇓
QW									•
QX	14.7	15.9	15.8	0.67	0.236	15.47	-6.27	-6.66	×
QZ	25.7	26.4	26.3	0.38	0.138	26.13	-0.12	-0.50	
RD	24.9	24.4	25.3	0.45	0.177	24.87	-0.85	-1.23	
RF									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RG	26.8	25.5	25.6	0.72	0.256	25.97	-0.21	-0.60	
RK	13.1	13.3	12.9	0.20	0.079	13.10	-7.64	-8.03	×
RP	26.4	26.4	26.2	0.12	0.039	26.33	0.00	-0.38	
RR									•
RU									•
RV									•
RZ	23.8	24.2	24.4	0.31	0.118	24.13	-1.27	-1.66	
S	23.9	23.3	24.4	0.55	0.217	23.87	-1.42	-1.81	
SC	25.2	27.0	25.1	1.07	0.374	25.77	-0.33	-0.71	
SD	29.2	30.6	32.5	1.66	0.650	30.77	2.56	2.17	
SF	26.9	27.2	27.3	0.21	0.079	27.13	0.46	0.08	
SI	28.1	28.8	29.8	0.85	0.335	28.90	1.48	1.10	
SL	26.9	26.8	25.9	0.55	0.197	26.53	0.12	-0.27	
SM	28.6	27.0	26.9	0.95	0.335	27.50	0.67	0.29	
SN									•
SO	24.9	27.5	25.4	1.38	0.512	25.93	-0.23	-0.62	
SR									•
SS	23.3	23.0	26.5	1.94	0.689	24.27	-1.19	-1.58	
ST									•
SX	29.3	30.3	30.9	0.81	0.315	30.17	2.21	1.83	
SZ	25.6	25.5	25.4	0.10	0.039	25.50	-0.48	-0.87	
T	27.0	28.9	28.4	0.98	0.374	28.10	1.02	0.64	
TD	20.2	23.3	20.3	1.76	0.610	21.27	-2.93	-3.31	⇓
TG									•
TH									•
TI	26.1	26.1	27.7	0.92	0.315	26.63	0.17	-0.21	
TJ									•
TL	33.8	56.8	26.7	15.73	10.384	39.10	7.37	6.99	×
TN									•
TQ	25.6	25.0	26.1	0.55	0.217	25.57	-0.44	-0.83	
TS	23.1	23.6	24.3	0.60	0.236	23.67	-1.54	-1.92	
TY									•
U	28.6	28.7	28.8	0.10	0.039	28.70	1.37	0.98	
UA									•
UE									•
UK									•
UN	24.7	24.6	26.2	0.90	0.315	25.17	-0.67	-1.06	
UP	18.0	20.0	21.8	1.90	0.748	19.93	-3.69	-4.08	⇓
UQ									•
UW	27.4	28.3	28.5	0.59	0.217	28.07	1.00	0.62	
UY									•
VA									•
VC									•
VG									•
VH	28.1	29.7	30.0	1.02	0.374	29.27	1.69	1.31	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-A, 17-Oct-1995

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VI	27.8	27.3	26.9	0.45	0.177	27.33	0.58	0.19	
VJ									•
VM									•
VO	26.3	27.4	26.1	0.70	0.256	26.60	0.15	-0.23	
VT									•
W	26.0	25.9	25.0	0.55	0.197	25.63	-0.40	-0.79	
WE									•
WF									•
WO									•
X	28.1	32.4	23.6	4.40	2.395	28.03	0.98	0.60	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.03	×	CO	25.10		PV	27.07		JS
13.10	×	RK	25.17		UN	27.10		JE
15.47	×	QX	25.30		NA	27.10		AL
19.93	⇓	UP	25.50		SZ	27.13		SF
20.33	⇓	KT	25.50		BN	27.17		BA
20.47	⇓	QU	25.57		TQ	27.20		K
21.27	⇓	TD	25.57		ID	27.30		HP
21.70	⇓	AR	25.63		W	27.33		VI
21.97		PW	25.67		DI	27.33		NJ
22.37		FN	25.77		SC	27.37		EB
22.50		OY	25.77		CA	27.40		J
23.03		HK	25.93		SO	27.50		SM
23.20		BB	25.97		RG	27.50		AK
23.53		DB	26.00		BK	27.57		PQ
23.60		JN	26.13		QZ	27.60		BM
23.67		TS	26.27		C	27.87		L
23.67		CJ	26.30		NT	28.00		NO
23.87		S	26.33		RP	28.03		X
23.90		E	26.33		GQ	28.07		UW
23.97		BG	26.33		BO	28.10		T
24.00		QJ	26.47		EL	28.17		NH
24.13		RZ	26.53		SL	28.53		AZ
24.13		ER	26.60		VO	28.70		U
24.27		SS	26.63		TI	28.77		BG
24.33		CG	26.70		P	28.90		SI
24.60		DT	26.83		JY	29.23		AE
24.63		AH	26.87		QQ	29.27		VH
24.80		AW	26.93		PG	29.43		Q
24.87		RD	26.93		OS	29.67		FZ
24.90		DE	26.93		CE	29.77		CX
25.00		A	27.03		NK	29.77		CK
25.03		DO	27.03		BC	30.10		BH

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

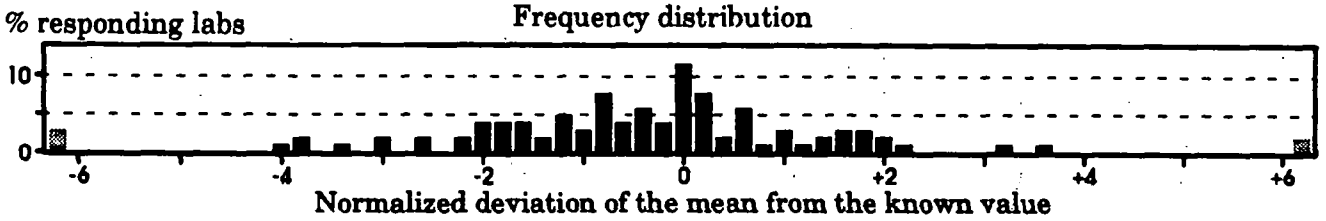
⇑ ≡ Above control limit

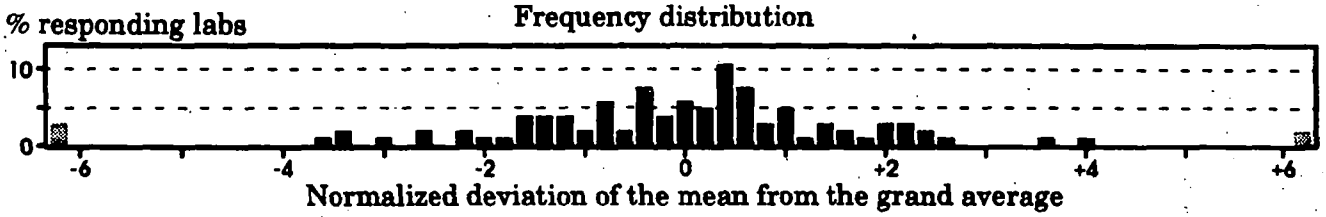
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
30.17		SX	30.60		AF	33.40	⇑	DZ
30.20		PB	30.77		SD	39.10	×	TL
30.40		HL	32.43	⇑	I	42.53	×	CS





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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-96/047B
April 1996

EPA

Blind-B Performance Evaluation Study

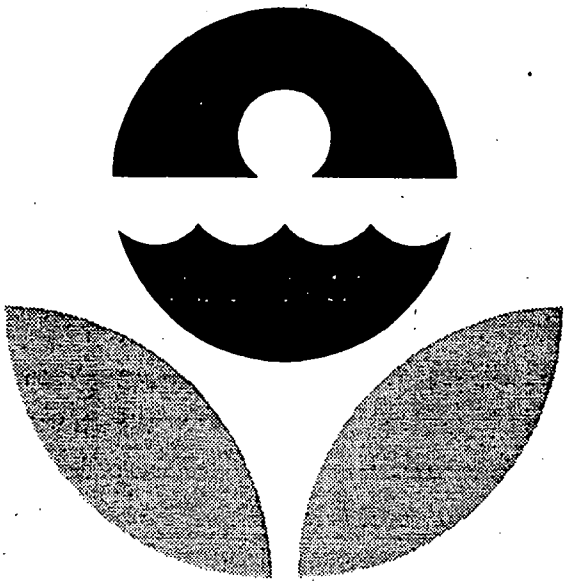
A Statistical Evaluation of the October 17, 1995 Data

023RSL96 cov-047B

Blind-B

Performance Evaluation Study

October 17, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Analytical Sciences Branch (CRD-LV) Performance Evaluation Study for ***Blind-B; October 17, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivit Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141

Sincerely,

George Dilbeck
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by
the U.S. Environmental Protection Agency.
It has been subjected to the Agency's review,
and has been approved for publication as
an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

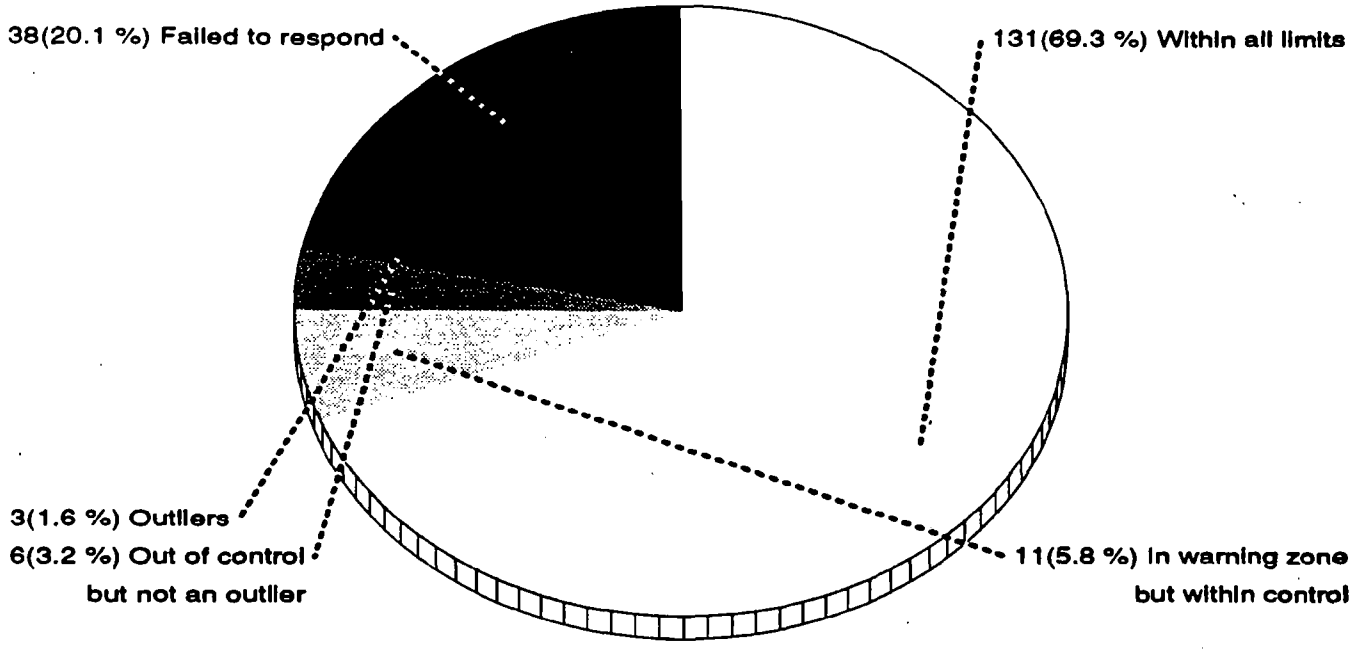
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

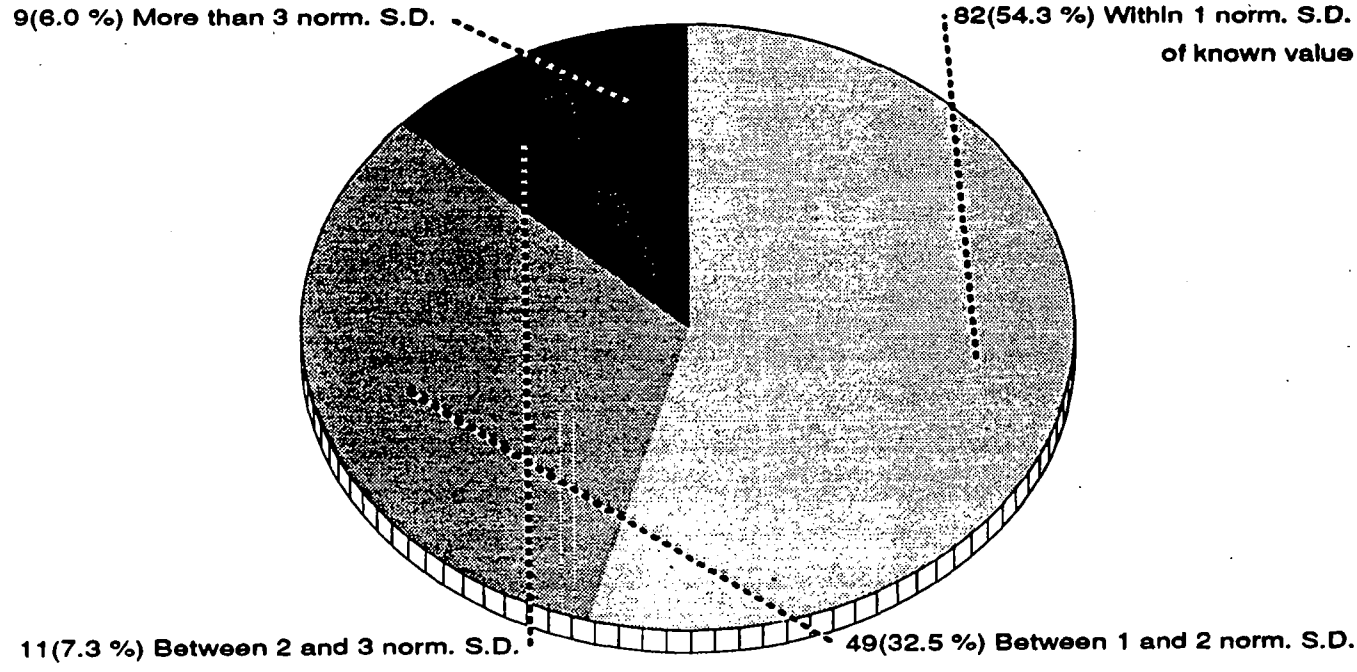
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, CRD-LV, 702/798-2141.

Gross Beta Statistical Summary 189 Participants

The known value of this nuclide is **123.5 pCi/l** with an expected precision of **18.5**; the control limits are 91.4 to 155.6; the warning regions are 91.4 to 102.1 and 144.9 to 155.6



Statistic	Respondents	Non-outliers
Mean	124.75	**Grand Avg 123.94**
Std. Dev.	34.02	14.60
Variance	1157.21	213.06
% Coef. of Var.	27.27	11.78
% deviation of mean from known value	1.01	0.36
Norm. dev. of mean from known value	0.04	0.03
Median	123.97	123.98
% deviation of median from known value	0.38	0.39
Norm. dev. of median from known value	0.01	0.03



CRD-LV Performance Evaluation: Blind-B, 17-Oct-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	127.3	128.1	127.3	0.46	0.026	127.57	0.34	0.38	
AE	103.3	102.0	102.4	0.67	0.042	102.57	-2.00	-1.96	
AF	135.5	125.0	128.6	5.34	0.335	129.70	0.54	0.58	
AH	122.0	134.0	121.0	7.23	0.415	125.67	0.16	0.20	
AI									•
AJ	106.7	102.2	98.6	4.06	0.259	102.50	-2.01	-1.97	
AK	117.2	104.7	110.5	6.26	0.399	110.80	-1.23	-1.19	
AL	124.3	127.9	119.8	4.06	0.259	124.00	0.01	0.05	
AP	126.8	124.6	126.6	1.22	0.070	126.00	0.19	0.23	
AR	127.0	132.0	120.0	6.03	0.383	126.33	0.22	0.27	
AU	145.6	141.8	144.4	1.94	0.121	143.93	1.87	1.91	
AW	132.0	136.9	131.8	2.89	0.163	133.57	0.90	0.94	
AZ	107.0	104.0	101.0	3.00	0.192	104.00	-1.87	-1.83	
BA	133.2	130.4	138.9	4.33	0.271	134.17	0.96	1.00	
BB	106.1	114.7	110.4	4.30	0.275	110.40	-1.27	-1.23	
BC	106.3	105.8	110.6	2.64	0.153	107.57	-1.53	-1.49	
BG	145.0	134.0	145.0	6.35	0.351	141.33	1.63	1.67	
BH	118.7	120.1	127.4	4.67	0.278	122.07	-0.18	-0.13	
BK	137.0	140.0	138.0	1.53	0.096	138.33	1.35	1.39	
BL									•
BM	125.8	127.3	129.6	1.91	0.121	127.57	0.34	0.38	
BN	123.6	120.8	117.2	3.21	0.204	120.53	-0.32	-0.28	
BO	110.5	105.1	114.2	4.58	0.291	109.93	-1.31	-1.27	
BS	131.2	138.5	135.1	3.65	0.233	134.93	1.03	1.07	
BW									•
C	122.6	123.5	125.6	1.54	0.096	123.90	0.00	0.04	
CA	112.9	114.2	119.2	3.33	0.201	115.43	-0.80	-0.76	
CE	125.5	138.3	128.1	6.77	0.409	130.63	0.63	0.67	
CG	125.7	119.3	126.4	3.91	0.227	123.80	-0.01	0.03	
CJ	120.0	120.0	120.0	0.00	0.000	120.00	-0.37	-0.33	
CK	134.0	139.0	146.0	6.03	0.383	139.67	1.47	1.51	
CM									•
CO	1.0	1.0	1.0	0.00	0.000	1.00	-11.51	-11.47	×
CP									•
CQ	119.0	117.0	109.0	5.29	0.319	115.00	-0.84	-0.80	
CS	133.8	115.6	122.5	9.19	0.581	123.97	0.00	0.04	
CX	113.0	128.0	115.0	8.14	0.479	118.67	-0.49	-0.45	
D	125.0	125.0	119.0	3.46	0.192	123.00	-0.09	-0.05	
DB	125.0	121.0	127.0	3.06	0.192	124.33	0.04	0.08	
DD	119.6	130.1	127.1	5.41	0.335	125.60	0.16	0.20	
DE	110.9	111.0	111.0	0.06	0.003	110.97	-1.21	-1.17	
DG	104.0	104.0	119.0	8.66	0.479	109.00	-1.40	-1.36	
DI	86.9	88.5	85.4	1.55	0.099	86.93	-3.46	-3.42	⇓
DL	120.0	125.0	102.0	12.10	0.734	115.67	-0.77	-0.73	
DM	151.0	161.0	140.0	10.50	0.670	150.67	2.50	2.54	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DO									•
DS	112.0	107.0	111.0	2.65	0.160	110.00	-1.31	-1.26	
DT	140.0	141.0	137.0	2.08	0.128	139.33	1.44	1.48	
DZ	130.9	132.7	139.6	4.59	0.278	134.40	0.98	1.02	
E	127.2	129.5	125.1	2.20	0.140	127.27	0.31	0.35	
EB	130.2	130.0	131.2	0.64	0.038	130.47	0.61	0.65	
EL									•
EO	127.0	121.0	110.0	8.62	0.543	119.33	-0.43	-0.39	
ER									•
EV	139.1	141.7	134.6	3.59	0.227	138.47	1.36	1.40	
EX									•
FF									•
FJ	26.0	25.0	25.8	0.53	0.032	25.60	-9.21	-9.17	×
FL	107.0	105.0	106.0	1.00	0.064	106.00	-1.68	-1.64	
FN									•
FU	103.2	104.6	102.3	1.16	0.073	103.37	-1.93	-1.88	
FZ	96.0	93.0	99.0	3.00	0.192	96.00	-2.62	-2.57	
GE	121.0	126.0	104.0	11.53	0.702	117.00	-0.65	-0.61	
GI									•
GQ	128.0	127.0	131.0	2.08	0.128	128.67	0.44	0.48	
GT	461.9	447.9	490.7	21.82	1.698	466.83	32.10	32.14	×
GZ	159.5	162.9	163.6	2.19	0.131	162.00	3.56	3.60	⇑
HI	110.0	120.0	120.0	5.77	0.319	116.67	-0.68	-0.64	
HK	136.6	136.1	135.6	0.50	0.032	136.10	1.14	1.18	
HL	110.0	110.0	110.0	0.00	0.000	110.00	-1.31	-1.26	
HP	116.0	126.0	120.0	5.03	0.319	120.67	-0.31	-0.27	
HX									•
I	154.1	147.5	162.4	7.47	0.476	154.67	2.88	2.92	
IC	113.7	114.5	111.8	1.39	0.086	113.33	-0.99	-0.95	
ID	120.1	113.6	123.3	4.94	0.310	119.00	-0.46	-0.42	
J	123.8	122.3	120.6	1.60	0.102	122.23	-0.16	-0.12	
JE	120.6	139.1	135.0	9.72	0.591	131.57	0.71	0.76	
JG	146.6	146.1	143.8	1.49	0.089	145.50	2.02	2.06	
JN	112.6	113.4	106.1	4.00	0.233	110.70	-1.24	-1.20	
JQ	169.0	162.9	162.3	3.71	0.214	164.73	3.82	3.86	⇑
JS	160.8	164.6	168.2	3.70	0.236	164.53	3.80	3.84	⇑
JX									•
JY	105.0	94.9	88.4	8.36	0.530	96.10	-2.61	-2.57	
K	94.3	94.3	100.5	3.58	0.198	96.37	-2.58	-2.54	
KE	112.8	113.7	121.0	4.50	0.262	115.83	-0.76	-0.72	
KT	150.0	161.0	162.0	6.66	0.383	157.67	3.16	3.20	⇑
KX	128.0	132.0	127.0	2.65	0.160	129.00	0.47	0.51	
L	140.0	135.7	141.6	3.05	0.188	139.10	1.42	1.46	
LF	110.0	130.0	120.0	10.00	0.639	120.00	-0.37	-0.33	
LL									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

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⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	124.0	105.0	113.0	9.54	0.607	114.00	-0.93	-0.89	
LT	119.0	122.0	124.0	2.52	0.160	121.67	-0.21	-0.17	
M	117.0	119.0	119.0	1.15	0.064	118.33	-0.52	-0.48	
MA	122.0	107.0	92.0	15.00	0.958	107.00	-1.59	-1.54	
MF	107.5	106.3	108.1	0.92	0.057	107.30	-1.56	-1.52	
MP									•
MQ	135.0	137.0	136.0	1.00	0.064	136.00	1.13	1.17	
MV	143.0	134.0	142.0	4.93	0.287	139.67	1.47	1.51	
MY	112.3	111.9	96.0	9.30	0.520	106.73	-1.61	-1.57	
N									•
NA	150.5	145.1	124.7	13.61	0.824	140.10	1.51	1.55	
NH	123.0	105.0	134.0	14.64	0.926	120.67	-0.31	-0.27	
NJ	126.8	122.2	118.9	3.97	0.252	122.63	-0.12	-0.08	
NK	146.0	141.0	142.0	2.65	0.160	143.00	1.78	1.83	
NO	112.0	119.0	122.0	5.13	0.319	117.67	-0.59	-0.55	
NT	126.5	126.7	126.6	0.11	0.006	126.60	0.25	0.29	
O	117.2	119.0	116.9	1.14	0.067	117.70	-0.58	-0.54	
OF	144.0	139.0	125.0	9.85	0.607	136.00	1.13	1.17	
OS	146.2	142.0	145.0	2.16	0.134	144.40	1.92	1.96	
OX	134.2	135.8	131.2	2.33	0.147	133.73	0.92	0.96	
OY	104.0	104.0	104.0	0.00	0.000	104.00	-1.87	-1.83	
OZ									•
P	141.9	144.0	143.8	1.16	0.067	143.23	1.81	1.85	
PA	140.3	132.9	132.8	4.30	0.239	135.33	1.07	1.11	
PB	127.4	129.6	128.8	1.11	0.070	128.60	0.44	0.48	
PG	131.0	128.9	130.7	1.14	0.067	130.20	0.59	0.63	
PI									•
PM	124.0	136.8	126.3	6.82	0.409	129.03	0.48	0.52	
PQ	135.7	126.2	134.0	5.07	0.303	131.97	0.75	0.79	
PR	98.6	97.4	96.2	1.20	0.077	97.40	-2.48	-2.44	
PV	114.4	130.9	127.3	8.68	0.527	124.20	0.02	0.07	
PW									•
Q	134.6	130.1	136.4	3.25	0.201	133.70	0.91	0.95	
QC									•
QJ	121.0	130.0	133.0	6.24	0.383	128.00	0.38	0.42	
QP	106.4	117.6	125.7	9.69	0.616	116.57	-0.69	-0.65	
QQ	117.9	118.5	119.9	1.03	0.064	118.77	-0.48	-0.44	
QT	112.8	134.1	122.1	10.68	0.680	123.00	-0.09	-0.05	
QU	115.9	115.5	109.2	3.76	0.214	113.53	-0.97	-0.93	
QW	125.4	123.5	123.1	1.23	0.073	124.00	0.01	0.05	
QX	126.8	125.7	122.4	2.29	0.140	124.97	0.10	0.14	
QZ	118.4	119.1	118.3	0.43	0.026	118.60	-0.50	-0.46	
RD	125.5	122.3	128.6	3.15	0.201	125.47	0.14	0.18	
RF									•
RG	136.0	126.0	133.0	5.13	0.319	131.67	0.72	0.76	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RK	104.8	105.9	89.7	9.05	0.517	100.13	-2.23	-2.19	
RP									•
RR									•
RU	130.0	111.0	117.0	9.71	0.607	119.33	-0.43	-0.39	
RV									•
RZ	132.8	126.5	127.4	3.41	0.201	128.90	0.46	0.51	
S	128.4	128.4	114.8	7.85	0.434	123.87	-0.01	0.03	
SC	123.1	128.0	128.4	2.95	0.169	126.50	0.24	0.28	
SD	124.1	126.6	127.7	1.85	0.115	126.13	0.21	0.25	
SF	136.6	138.4	137.4	0.90	0.057	137.47	1.27	1.31	
SI	111.0	106.0	111.0	2.89	0.160	109.33	-1.37	-1.33	
SL	118.0	123.0	120.0	2.52	0.160	120.33	-0.34	-0.30	
SM	100.0	94.6	113.7	9.85	0.610	102.77	-1.98	-1.94	
SN	126.8	119.9	119.6	4.07	0.230	122.10	-0.17	-0.13	
SO	125.4	119.1	118.0	3.99	0.236	120.83	-0.29	-0.25	
SR	114.0	106.7	104.8	4.86	0.294	108.50	-1.45	-1.40	
SS	109.3	106.6	104.7	2.31	0.147	106.87	-1.60	-1.56	
ST									•
SX	130.4	135.2	125.9	4.65	0.297	130.50	0.61	0.66	
SZ	109.1	112.5	118.1	4 54	0.287	113.23	-1.00	-0.96	
T	127.0	124.9	119.4	3.92	0.243	123.77	-0.02	0.02	
TD	117.0	130.0	134.0	8.89	0.543	127.00	0.29	0.33	
TG	92.9	88.6	91.1	2.16	0.137	90.87	-3.10	-3.06	⇓
TH	135.8	136.8	137.2	0.72	0.045	136.60	1.19	1.23	
TI									•
TJ									•
TL	133.5	134.1	128.7	2.96	0.172	132.10	0.76	0.81	
TN	131.4	139.3	129.2	5.31	0.322	133.30	0.88	0.92	
TQ	116.0	116.0	124.0	4.62	0.255	118.67	-0.49	-0.45	
TS	137.6	148.4	146.5	5.77	0.345	144.17	1.89	1.93	
TY	121.0	118.0	119.0	1.53	0.096	119.33	-0.43	-0.39	
U	121.0	111.7	126.2	7.35	0.463	119.63	-0.40	-0.36	
UA	101.0	103.0	100.0	1.53	0.096	101.33	-2.12	-2.08	
UE									•
UK									•
UN	142.0	135.0	144.0	4.73	0.287	140.33	1.53	1.58	
UP	133.2	131.8	127.1	3.20	0.195	130.70	0.63	0.67	
UQ									•
UW	136.1	137.2	139.2	1.57	0.099	137.50	1.27	1.31	
UY	127.2	129.2	122.1	3.66	0.227	126.17	0.21	0.25	
VA									•
VC									•
VG									•
VH	101.1	97.9	111.9	7.34	0.447	103.63	-1.90	-1.86	
VI	99.0	90.0	102.0	6.24	0.383	97.00	-2.52	-2.48	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VJ									•
VM									•
VO	130.0	142.0	154.0	12.00	0.766	142.00	1.69	1.73	
VT									•
W	125.0	123.0	127.0	2.00	0.128	125.00	0.10	0.14	
WE	141.2	140.0	130.7	5.75	0.335	137.30	1.25	1.29	
WF	136.0	143.0	148.0	6.03	0.383	142.33	1.72	1.76	
WO									•
X	158.7	134.3	143.2	12.35	0.779	145.40	2.01	2.05	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00	×	CO	110.97		DE	122.10		SN
25.60	×	FJ	113.23		SZ	122.23		J
86.93	⇓	DI	113.33		IC	122.63		NJ
90.87	⇓	TG	113.53		QU	123.00		QT
96.00		FZ	114.00		LR	123.00		D
96.10		JY	115.00		CQ	123.77		T
96.37		K	115.43		CA	123.80		CG
97.00		VI	115.67		DL	123.87		S
97.40		PR	115.83		KE	123.90		C
100.13		RK	116.57		QP	123.97		CS
101.33		UA	116.67		HI	124.00		QW
102.50		AJ	117.00		GE	124.00		AL
102.57		AE	117.67		NO	124.20		PV
102.77		SM	117.70		O	124.33		DB
103.37		FU	118.33		M	124.97		QX
103.63		VH	118.60		QZ	125.00		W
104.00		OY	118.67		TQ	125.47		RD
104.00		AZ	118.67		CX	125.60		DD
106.00		FL	118.77		QQ	125.67		AH
106.73		MY	119.00		ID	126.00		AP
106.87		SS	119.33		TY	126.13		SD
107.00		MA	119.33		RU	126.17		UY
107.30		MF	119.33		EO	126.33		AR
107.57		BC	119.63		U	126.50		SC
108.50		SR	120.00		LF	126.60		NT
109.00		DG	120.00		CJ	127.00		TD
109.33		SI	120.33		SL	127.27		E
109.93		BO	120.53		BN	127.57		BM
110.00		HL	120.67		NH	127.57		A
110.00		DS	120.67		HP	128.00		QJ
110.40		BB	120.83		SO	128.60		PB
110.70		JN	121.67		LT	128.67		GQ
110.80		AK	122.07		BH	128.90		RZ

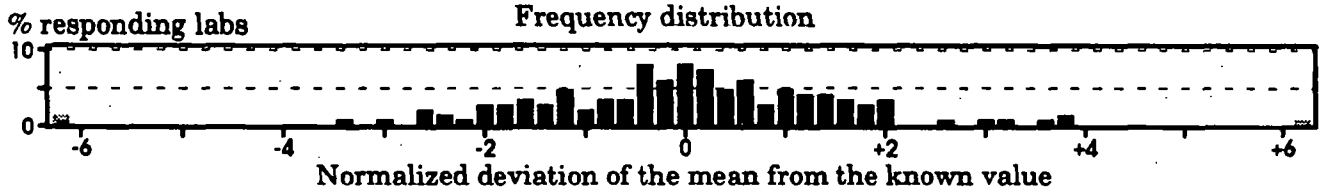
TAG SYMBOLS

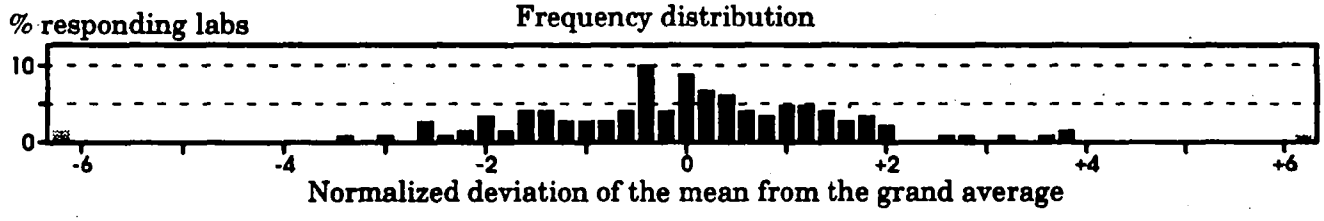
• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
129.00		KX	134.40		DZ	140.33		UN
129.03		PM	134.93		BS	141.33		BG
129.70		AF	135.33		PA	142.00		VO
130.20		PG	136.00		OF	142.33		WF
130.47		EB	136.00		MQ	143.00		NK
130.50		SX	136.10		HK	143.23		P
130.63		CE	136.60		TH	143.93		AU
130.70		UP	137.30		WE	144.17		TS
131.57		JE	137.47		SF	144.40		OS
131.67		RG	137.50		UW	145.40		X
131.97		PQ	138.33		BK	145.50		JG
132.10		TL	138.47		EV	150.67		DM
133.30		TN	139.10		L	154.67		I
133.57		AW	139.33		DT	157.67	⇑	KT
133.70		Q	139.67		MV	162.00	⇑	GZ
133.73		OX	139.67		CK	164.53	⇑	JS
134.17		BA	140.10		NA	164.73	⇑	JQ
						466.83	×	GT





• ≡ No data submitted
∅ ≡ Insufficient data

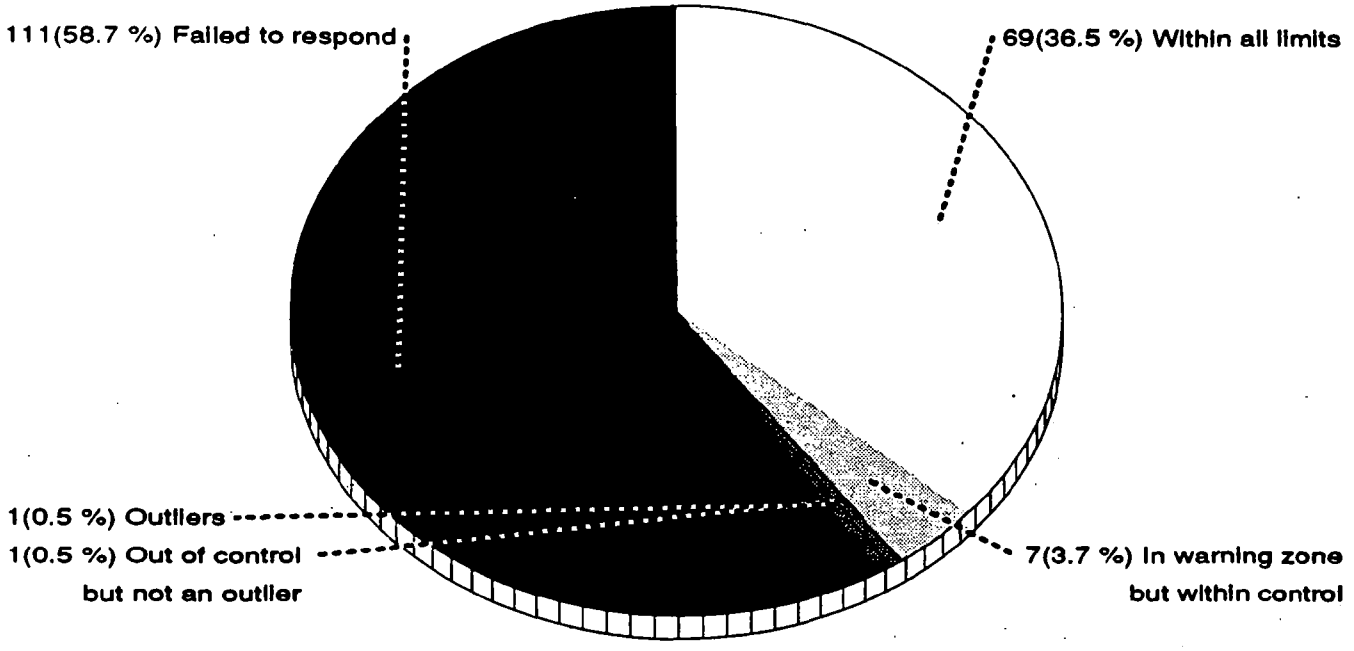
TAG SYMBOLS

× ≡ Determined to be an outlier

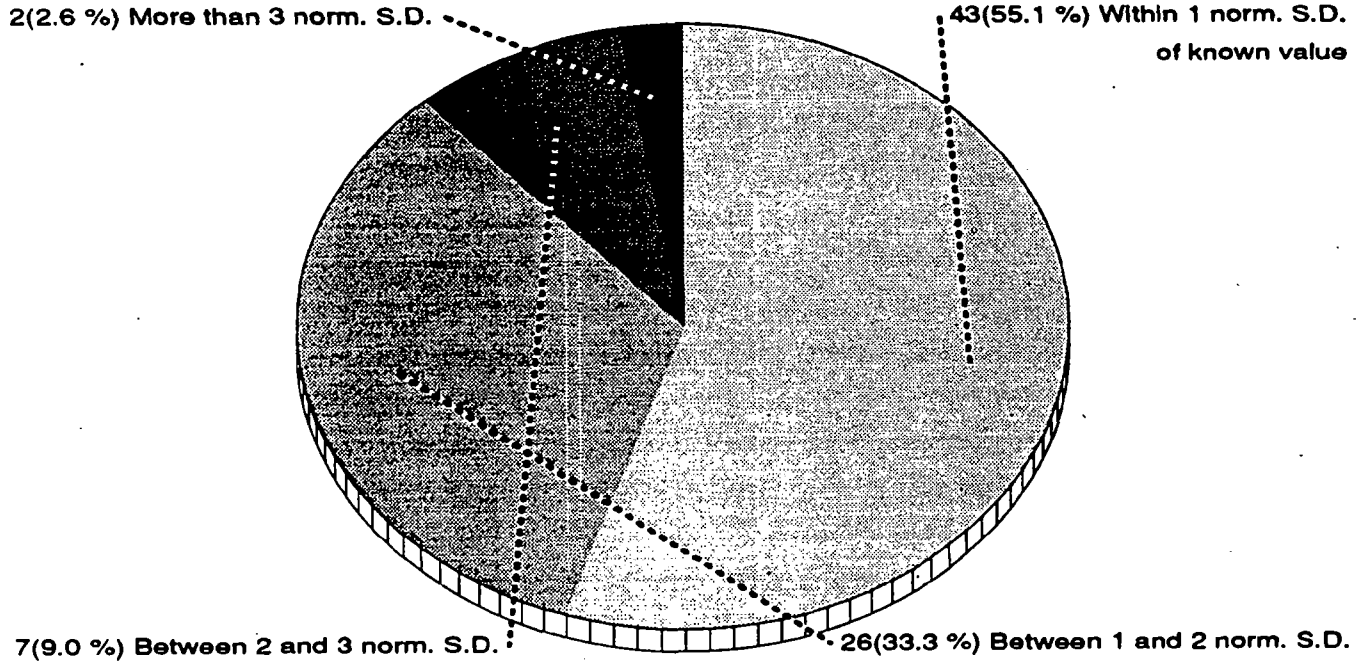
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89 Statistical Summary 189 Participants

The known value of this nuclide is **20.0 pCi/l** with an expected precision of **5.0**; the control limits are 11.3 to 28.7; the warning regions are 11.3 to 14.2 and 25.8 to 28.7



Statistic	Respondents	Non-outliers
Mean	19.87	**Grand Avg 19.58**
Std. Dev.	4.37	3.58
Variance	19.10	12.82
% Coef. of Var.	22.00	18.29
% deviation of mean from known value	-0.66	-2.10
Norm. dev. of mean from known value	-0.03	-0.12
Median	19.67	19.67
% deviation of median from known value	-1.67	-1.67
Norm. dev. of median from known value	-0.08	-0.09



Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	20.0	20.0	19.0	0.58	0.118	19.67	0.03	-0.12	
AE	24.0	24.0	27.0	1.73	0.354	25.00	1.88	1.73	
AF	22.0	19.0	19.0	1.73	0.354	20.00	0.15	0.00	
AH									•
AI									•
AJ	21.0	21.0	17.0	2.31	0.473	19.67	0.03	-0.12	
AK	15.0	17.0	15.0	1.15	0.236	15.67	-1.36	-1.50	
AL	18.0	21.0	22.0	2.08	0.473	20.33	0.26	0.12	
AP									•
AR									•
AU	41.0	42.0	43.0	1.00	0.236	42.00	7.77	7.62	×
AW	18.0	17.0	18.0	0.58	0.118	17.67	-0.66	-0.81	
AZ	20.0	21.0	22.0	1.00	0.236	21.00	0.49	0.35	
BA	25.0	21.0	23.0	2.00	0.473	23.00	1.18	1.04	
BB									•
BC	18.0	16.0	16.0	1.15	0.236	16.67	-1.01	-1.15	
BG									•
BH	26.0	26.0	24.0	1.15	0.236	25.33	1.99	1.85	
BK									•
BL	24.0	21.0	20.0	2.08	0.473	21.67	0.72	0.58	
BM	24.0	25.0	28.0	2.08	0.473	25.67	2.11	1.96	
BN									•
BO	21.0	20.0	20.0	0.58	0.118	20.33	0.26	0.12	
BS									•
BW									•
C	20.0	22.0	20.0	1.15	0.236	20.67	0.38	0.23	
CA	20.0	17.0	20.0	1.73	0.354	19.00	-0.20	-0.35	
CE									•
CG	22.0	22.0	20.0	1.15	0.236	21.33	0.61	0.46	
CJ	20.0	22.0	20.0	1.15	0.236	20.67	0.38	0.23	
CK	17.0	18.0	18.0	0.58	0.118	17.67	-0.66	-0.81	
CM									•
CO									•
CP	28.0	31.0	32.0	2.08	0.473	30.33	3.73	3.58	⇑
CQ	18.0	18.0	17.0	0.58	0.118	17.67	-0.66	-0.81	
CS	18.0	18.0	18.0	0.00	0.000	18.00	-0.55	-0.69	
CX	21.0	27.0	22.0	3.21	0.709	23.33	1.30	1.15	
D									•
DB									•
DD	21.0	21.0	21.0	0.00	0.000	21.00	0.49	0.35	
DE	22.0	22.0	23.0	0.58	0.118	22.33	0.95	0.81	
DG	21.0	24.0	21.0	1.73	0.354	22.00	0.84	0.69	
DI									•
DL									•
DM									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DO	19.0	18.0	21.0	1.53	0.354	19.33	-0.09	-0.23	
DS									•
DT	18.0	19.0	19.0	0.58	0.118	18.67	-0.32	-0.46	
DZ	21.0	21.0	20.0	0.58	0.118	20.67	0.38	0.23	
E	18.0	18.0	21.0	1.73	0.354	19.00	-0.20	-0.35	
EB	20.0	25.0	17.0	4.04	0.945	20.67	0.38	0.23	
EL	23.0	24.0	23.0	0.58	0.118	23.33	1.30	1.15	
EO									•
ER									•
EV									•
EX									•
FF									•
FJ									•
FL									•
FN									•
FU	21.0	21.0	21.0	0.00	0.000	21.00	0.49	0.35	
FZ	18.0	18.0	20.0	1.15	0.236	18.67	-0.32	-0.46	
GE									•
GI									•
GQ	18.0	17.0	18.0	0.58	0.118	17.67	-0.66	-0.81	
GT									•
GZ									•
HI									•
HK	17.0	16.0	16.0	0.58	0.118	16.33	-1.12	-1.27	
HL									•
HP	22.0	26.0	25.0	2.08	0.473	24.33	1.65	1.50	
HX									•
I	20.0	21.0	21.0	0.58	0.118	20.67	0.38	0.23	
IC	19.0	18.0	18.0	0.58	0.118	18.33	-0.43	-0.58	
ID									•
J	20.0	21.0	21.0	0.58	0.118	20.67	0.38	0.23	
JE	14.0	14.0	13.0	0.58	0.118	13.67	-2.05	-2.19	
JG									•
JN									•
JQ									•
JS	20.0	24.0	25.0	2.65	0.591	23.00	1.18	1.04	
JX									•
JY	17.0	18.0	19.0	1.00	0.236	18.00	-0.55	-0.69	
K	26.0	23.0	24.0	1.53	0.354	24.33	1.65	1.50	
KE									•
KT									•
KX	16.0	18.0	13.0	2.52	0.591	15.67	-1.36	-1.50	
L	22.0	19.0	21.0	1.53	0.354	20.67	0.38	0.23	
LF									•
LL									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
LR									•
LT	22.0	21.0	24.0	1.53	0.354	22.33	0.95	0.81	
M	17.0	18.0	19.0	1.00	0.236	18.00	-0.55	-0.69	
MA									•
MF									•
MP									•
MQ	23.0	18.0	18.0	2.89	0.591	19.67	0.03	-0.12	
MV									•
MY									•
N									•
NA									•
NH									•
NJ	29.0	28.0	26.0	1.53	0.354	27.67	2.80	2.66	
NK									•
NO									•
NT	19.0	20.0	22.0	1.53	0.354	20.33	0.26	0.12	
O									•
OF									•
OS									•
OX									•
OY									•
OZ									•
P									•
PA									•
PB	20.0	19.0	20.0	0.58	0.118	19.67	0.03	-0.12	
PG									•
PI									•
PM									•
PQ									•
PR									•
PV	15.0	11.0	14.0	2.08	0.473	13.33	-2.16	-2.31	
PW									•
Q	19.0	20.0	23.0	2.08	0.473	20.67	0.38	0.23	
QC									•
QJ									•
QP									•
QQ									•
QT									•
QU	14.0	16.0	15.0	1.00	0.236	15.00	-1.59	-1.73	
QW	14.0	16.0	14.0	1.15	0.236	14.67	-1.70	-1.85	
QX									•
QZ	19.0	17.0	19.0	1.15	0.236	18.33	-0.43	-0.58	
RD									•
RF									•
RG									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RK									•
RP									•
RR									•
RU									•
RV									•
RZ									•
S	19.0	18.0	18.0	0.58	0.118	18.33	-0.43	-0.58	
SC	23.0	25.0	23.0	1.15	0.236	23.67	1.42	1.27	
SD	13.0	17.0	13.0	2.31	0.473	14.33	-1.82	-1.96	
SF	15.0	16.0	20.0	2.65	0.591	17.00	-0.89	-1.04	
SI	19.0	20.0	21.0	1.00	0.236	20.00	0.15	0.00	
SL									•
SM	28.0	26.0	24.0	2.00	0.473	26.00	2.22	2.08	
SN									•
SO									•
SR									•
SS	16.0	14.0	17.0	1.53	0.354	15.67	-1.36	-1.50	
ST									•
SX									•
SZ									•
T	21.0	20.0	21.0	0.58	0.118	20.67	0.38	0.23	
TD	22.0	25.0	34.0	6.24	1.795	27.00	2.57	2.42	
TG									•
TH									•
TI	16.0	17.0	17.0	0.58	0.118	16.67	-1.01	-1.15	
TJ									•
TL	19.0	20.0	20.0	0.58	0.118	19.67	0.03	-0.12	
TN									•
TQ	15.0	14.0	15.0	0.58	0.118	14.67	-1.70	-1.85	
TS									•
TY									•
U	16.0	17.0	18.0	1.00	0.236	17.00	-0.89	-1.04	
UA									•
UE									•
UK									•
UN	16.0	16.0	13.0	1.73	0.354	15.00	-1.59	-1.73	
UP	15.0	14.0	15.0	0.58	0.118	14.67	-1.70	-1.85	
UQ									•
UW	17.0	18.0	16.0	1.00	0.236	17.00	-0.89	-1.04	
UY									•
VA									•
VC									•
VG									•
VH									•
VI	19.0	8.0	11.0	5.69	1.570	12.67	-2.39	-2.54	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 17-Oct-1995

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VJ									•
VM									•
VO									•
VT									•
W	16.0	19.0	20.0	2.08	0.473	18.33	-0.43	-0.58	
WE									•
WF	14.0	16.0	16.0	1.15	0.236	15.33	-1.47	-1.62	
WO									•
X	16.0	15.0	11.0	2.65	0.591	14.00	-1.93	-2.08	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
12.67		VI	18.00		CS	20.67		DZ
13.33		PV	18.33		W	20.67		CJ
13.67		JE	18.33		S	20.67		C
14.00		X	18.33		QZ	21.00		FU
14.33		SD	18.33		IC	21.00		DD
14.67		UP	18.67		FZ	21.00		AZ
14.67		TQ	18.67		DT	21.33		CG
14.67		QW	19.00		E	21.67		BL
15.00		UN	19.00		CA	22.00		DG
15.00		QU	19.33		DO	22.33		LT
15.33		WF	19.67		TL	22.33		DE
15.67		SS	19.67		PB	23.00		JS
15.67		KX	19.67		MQ	23.00		BA
15.67		AK	19.67		AJ	23.33		EL
16.33		HK	19.67		A	23.33		CX
16.67		TI	20.00		SI	23.67		SC
16.67		BC	20.00		AF	24.33		K
17.00		UW	20.33		NT	24.33		HP
17.00		U	20.33		BO	25.00		AE
17.00		SF	20.33		AL	25.33		BH
17.67		GQ	20.67		T	25.67		BM
17.67		CQ	20.67		Q	26.00		SM
17.67		CK	20.67		L	27.00		TD
17.67		AW	20.67		J	27.67		NJ
18.00		M	20.67		I	30.33	⇑	CP
18.00		JY	20.67		EB	42.00	×	AU

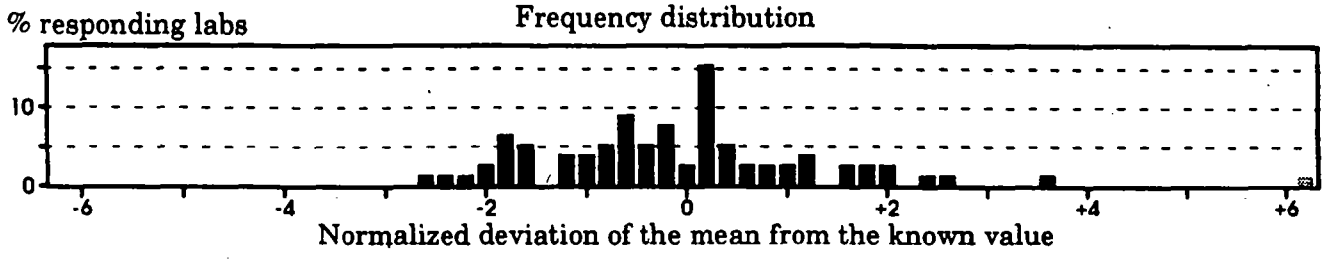
• ≡ No data submitted
∅ ≡ Insufficient data

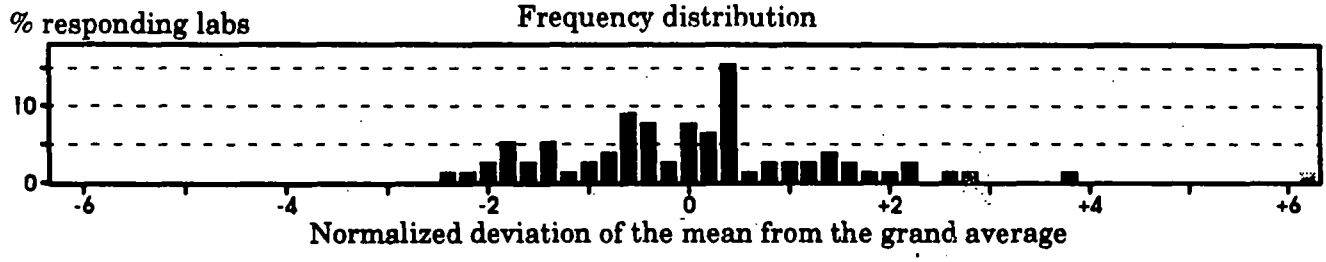
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

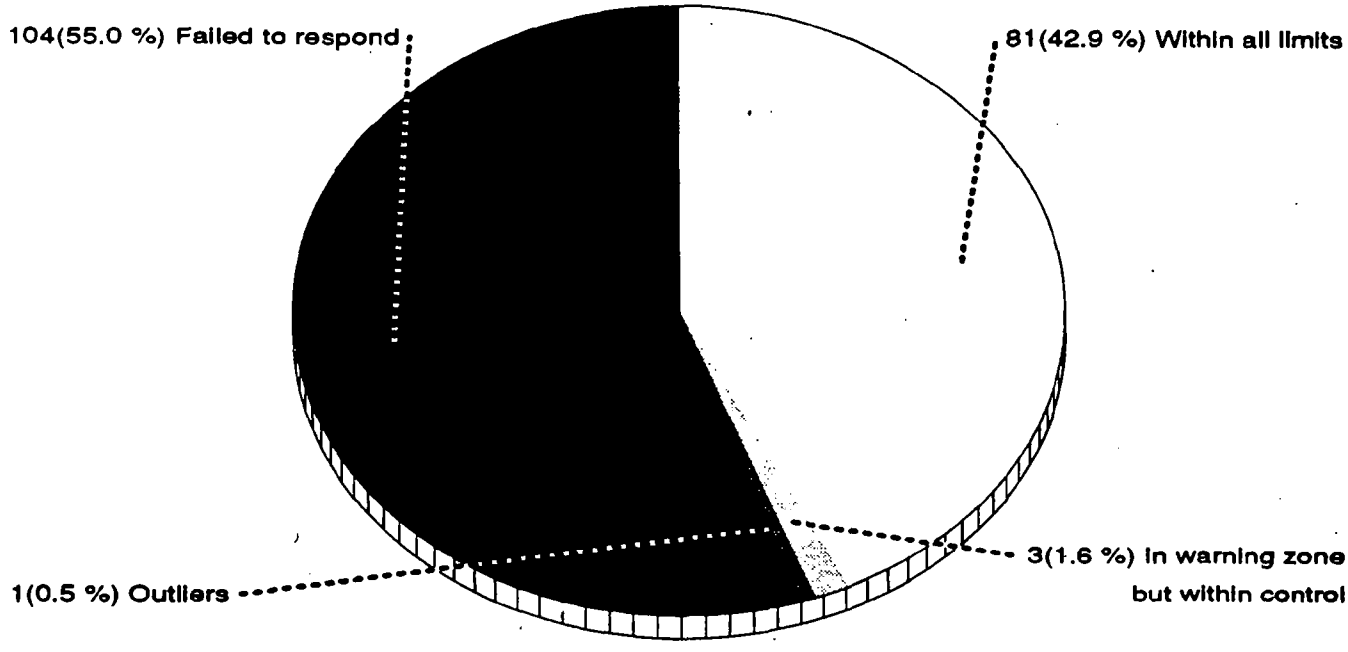
Strontium-89



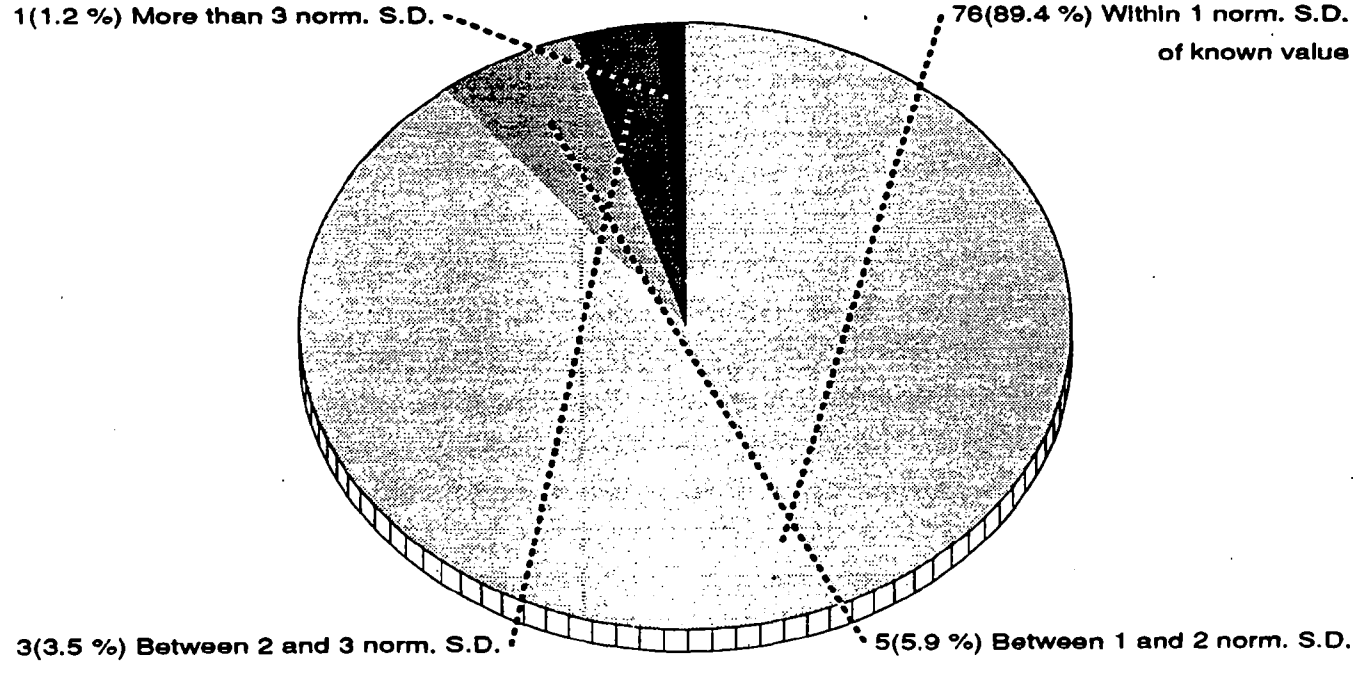


Strontium-90 Statistical Summary 189 Participants

The known value of this nuclide is **10.0 pCi/l** with an expected precision of **5.0**; the control limits are 1.3 to 18.7; the warning regions are 1.3 to 4.2 and 15.8 to 18.7



Statistic	Respondents	Non-outliers
Mean	10.33	**Grand Avg 10.18**
Std. Dev.	2.40	1.97
Variance	5.77	3.88
% Coef. of Var.	23.25	19.35
% deviation of mean from known value	3.33	1.83
Norm. dev. of mean from known value	0.14	0.09
Median	10.00	10.00
% deviation of median from known value	0.00	0.00
Norm. dev. of median from known value	0.00	0.00



Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	9.0	9.0	9.0	0.00	0.000	9.00	-0.41	-0.35	
AE	13.0	15.0	16.0	1.53	0.354	14.67	1.55	1.62	
AF	9.0	9.0	9.0	0.00	0.000	9.00	-0.41	-0.35	
AH									•
AI									•
AJ	8.0	8.0	10.0	1.15	0.236	8.67	-0.53	-0.46	
AK	12.0	12.0	13.0	0.58	0.118	12.33	0.75	0.81	
AL	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
AP									•
AR									•
AU	17.0	13.0	19.0	3.06	0.709	16.33	2.13	2.19	
AW	12.0	13.0	14.0	1.00	0.236	13.00	0.98	1.04	
AZ	11.0	11.0	11.0	0.00	0.000	11.00	0.28	0.35	
BA	10.0	10.0	9.0	0.58	0.118	9.67	-0.18	-0.12	
BB	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
BC	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
BG	10.0	8.0	11.0	1.53	0.354	9.67	-0.18	-0.12	
BH	9.0	10.0	10.0	0.58	0.118	9.67	-0.18	-0.12	
BK									•
BL	7.0	8.0	8.0	0.58	0.118	7.67	-0.87	-0.81	
BM	9.0	9.0	11.0	1.15	0.236	9.67	-0.18	-0.12	
BN									•
BO	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
BS									•
BW									•
C	10.0	11.0	10.0	0.58	0.118	10.33	0.05	0.12	
CA	11.0	11.0	10.0	0.58	0.118	10.67	0.17	0.23	
CE	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
CG	12.0	11.0	12.0	0.58	0.118	11.67	0.51	0.58	
CJ	9.0	9.0	10.0	0.58	0.118	9.33	-0.29	-0.23	
CK	13.0	12.0	13.0	0.58	0.118	12.67	0.86	0.92	
CM									•
CO	9.0	11.0	11.0	1.15	0.236	10.33	0.05	0.12	
CP	9.0	9.0	8.0	0.58	0.118	8.67	-0.53	-0.46	
CQ	9.0	10.0	11.0	1.00	0.236	10.00	-0.06	0.00	
CS	23.0	24.0	22.0	1.00	0.236	23.00	4.44	4.50	×
CX	11.0	8.0	11.0	1.73	0.354	10.00	-0.06	0.00	
D									•
DB									•
DD	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
DE	10.0	11.0	11.0	0.58	0.118	10.67	0.17	0.23	
DG	8.0	9.0	8.0	0.58	0.118	8.33	-0.64	-0.58	
DI									•
DL									•
DM									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DO	9.0	9.0	8.0	0.58	0.118	8.67	-0.53	-0.46	
DS									•
DT	12.0	10.0	10.0	1.15	0.236	10.67	0.17	0.23	
DZ	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
E	12.0	13.0	13.0	0.58	0.118	12.67	0.86	0.92	
EB	10.0	8.0	10.0	1.15	0.236	9.33	-0.29	-0.23	
EL	11.0	9.0	9.0	1.15	0.236	9.67	-0.18	-0.12	
EO									•
ER									•
EV									•
EX									•
FF									•
FJ									•
FL									•
FN									•
FU	9.0	9.0	9.0	0.00	0.000	9.00	-0.41	-0.35	
FZ	8.0	9.0	9.0	0.58	0.118	8.67	-0.53	-0.46	
GE									•
GI									•
GQ	8.0	8.0	8.0	0.00	0.000	8.00	-0.76	-0.69	
GT									•
GZ									•
HI									•
HK	9.0	9.0	9.0	0.00	0.000	9.00	-0.41	-0.35	
HL									•
HP	12.0	10.0	11.0	1.00	0.236	11.00	0.28	0.35	
HX									•
I	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
IC	8.0	10.0	10.0	1.15	0.236	9.33	-0.29	-0.23	
ID									•
J	12.0	11.0	11.0	0.58	0.118	11.33	0.40	0.46	
JE	6.0	8.0	9.0	1.53	0.354	7.67	-0.87	-0.81	
JG									•
JN									•
JQ									•
JS	9.0	8.0	9.0	0.58	0.118	8.67	-0.53	-0.46	
JX									•
JY	10.0	10.0	11.0	0.58	0.118	10.33	0.05	0.12	
K	9.0	10.0	10.0	0.58	0.118	9.67	-0.18	-0.12	
KE									•
KT									•
KX	9.0	10.0	11.0	1.00	0.236	10.00	-0.06	0.00	
L	9.0	9.0	9.0	0.00	0.000	9.00	-0.41	-0.35	
LF									•
LL									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR									•
LT	12.0	13.0	11.0	1.00	0.236	12.00	0.63	0.69	
M	15.0	15.0	18.0	1.73	0.354	16.00	2.02	2.08	
MA									•
MF									•
MP									•
MQ	7.0	10.0	10.0	1.73	0.354	9.00	-0.41	-0.35	
MV									•
MY									•
N									•
NA									•
NH									•
NJ	7.0	8.0	8.0	0.58	0.118	7.67	-0.87	-0.81	
NK									•
NO									•
NT	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
O									•
OF									•
OS									•
OX									•
OY									•
OZ									•
P									•
PA									•
PB	10.0	11.0	10.0	0.58	0.118	10.33	0.05	0.12	
PG									•
PI									•
PM									•
PQ									•
PR									•
PV	4.0	6.0	8.0	2.00	0.473	6.00	-1.45	-1.39	
PW									•
Q	11.0	11.0	12.0	0.58	0.118	11.33	0.40	0.46	
QC									•
QJ	9.0	8.0	9.0	0.58	0.118	8.67	-0.53	-0.46	
QP									•
QQ									•
QT									•
QU	9.0	8.0	8.0	0.58	0.118	8.33	-0.64	-0.58	
QW	9.0	8.0	8.0	0.58	0.118	8.33	-0.64	-0.58	
QX									•
QZ	7.0	8.0	8.0	0.58	0.118	7.67	-0.87	-0.81	
RD									•
RF									•
RG									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
RK									•
RP									•
RR									•
RU									•
RV									•
RZ									•
S	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
SC	12.0	12.0	11.0	0.58	0.118	11.67	0.51	0.58	
SD	10.0	8.0	10.0	1.15	0.236	9.33	-0.29	-0.23	
SF	15.0	15.0	13.0	1.15	0.236	14.33	1.44	1.50	
SI	9.0	9.0	8.0	0.58	0.118	8.67	-0.53	-0.46	
SL									•
SM	11.0	11.0	12.0	0.58	0.118	11.33	0.40	0.46	
SN									•
SO									•
SR									•
SS	11.0	12.0	11.0	0.58	0.118	11.33	0.40	0.46	
ST									•
SX									•
SZ	10.0	11.0	11.0	0.58	0.118	10.67	0.17	0.23	
T	10.0	9.0	9.0	0.58	0.118	9.33	-0.29	-0.23	
TD	10.0	11.0	8.0	1.53	0.354	9.67	-0.18	-0.12	
TG									•
TH									•
TI	9.0	10.0	9.0	0.58	0.118	9.33	-0.29	-0.23	
TJ									•
TL	12.0	10.0	11.0	1.00	0.236	11.00	0.28	0.35	
TN									•
TQ	9.0	9.0	9.0	0.00	0.000	9.00	-0.41	-0.35	
TS									•
TY									•
U	10.0	10.0	9.0	0.58	0.118	9.67	-0.18	-0.12	
UA									•
UE									•
UK									•
UN	11.0	10.0	11.0	0.58	0.118	10.67	0.17	0.23	
UP	10.0	10.0	10.0	0.00	0.000	10.00	-0.06	0.00	
UQ									•
UW	8.0	10.0	9.0	1.00	0.236	9.00	-0.41	-0.35	
UY									•
VA									•
VC									•
VG									•
VH									•
VI	8.0	9.0	7.0	1.00	0.236	8.00	-0.76	-0.69	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VJ									•
VM									•
VO	8.0	12.0	9.0	2.08	0.473	9.67	-0.18	-0.12	
VT									•
W	10.0	9.0	9.0	0.58	0.118	9.33	-0.29	-0.23	
WE									•
WF	18.0	17.0	17.0	0.58	0.118	17.33	2.48	2.54	
WO									•
X	14.0	14.0	17.0	1.73	0.354	15.00	1.67	1.73	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.00		PV	9.33		SD	10.33		JY
7.67		QZ	9.33		IC	10.33		CO
7.67		NJ	9.33		EB	10.33		C
7.67		JE	9.33		CJ	10.67		UN
7.67		BL	9.67		VO	10.67		SZ
8.00		VI	9.67		U	10.67		DT
8.00		GQ	9.67		TD	10.67		DE
8.33		QW	9.67		K	10.67		CA
8.33		QU	9.67		EL	11.00		TL
8.33		DG	9.67		BM	11.00		HP
8.67		SI	9.67		BH	11.00		AZ
8.67		QJ	9.67		BG	11.33		SS
8.67		JS	9.67		BA	11.33		SM
8.67		FZ	10.00		UP	11.33		Q
8.67		DO	10.00		S	11.33		J
8.67		CP	10.00		NT	11.67		SC
8.67		AJ	10.00		KX	11.67		CG
9.00		UW	10.00		I	12.00		LT
9.00		TQ	10.00		DZ	12.33		AK
9.00		MQ	10.00		DD	12.67		E
9.00		L	10.00		CX	12.67		CK
9.00		HK	10.00		CQ	13.00		AW
9.00		FU	10.00		CE	14.33		SF
9.00		AF	10.00		BO	14.67		AE
9.00		A	10.00		BC	15.00		X
9.33		W	10.00		BB	16.00		M
9.33		TI	10.00		AL	16.33		AU
9.33		T	10.33		PB	17.33		WF
						23.00	×	CS

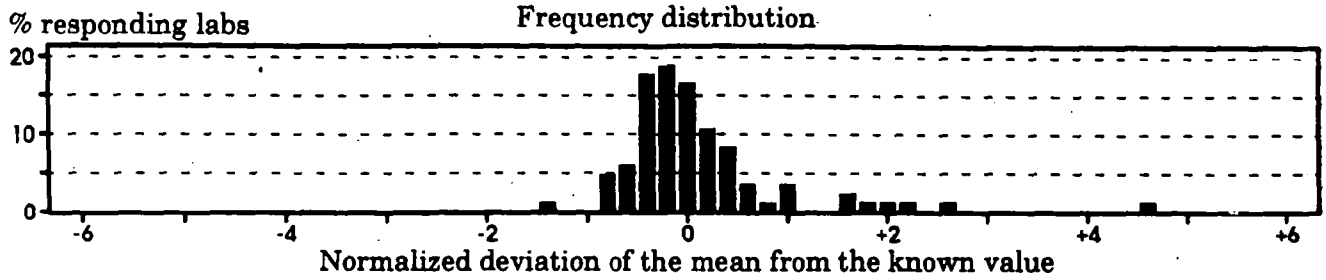
• ≡ No data submitted
∅ ≡ Insufficient data

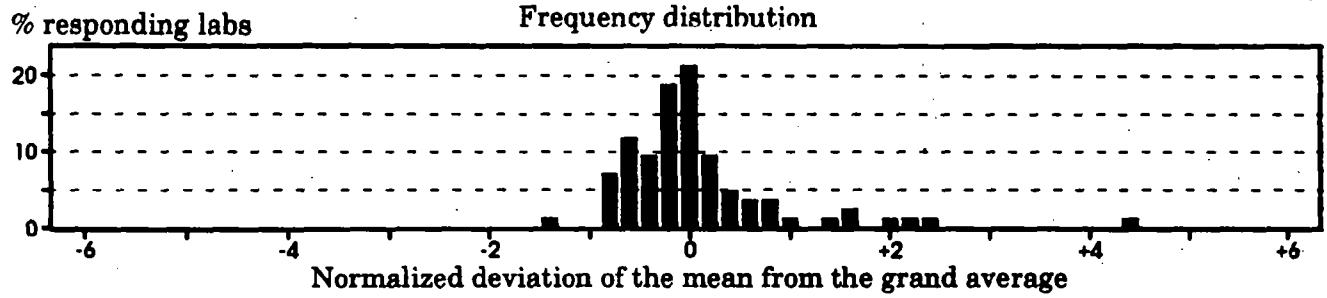
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

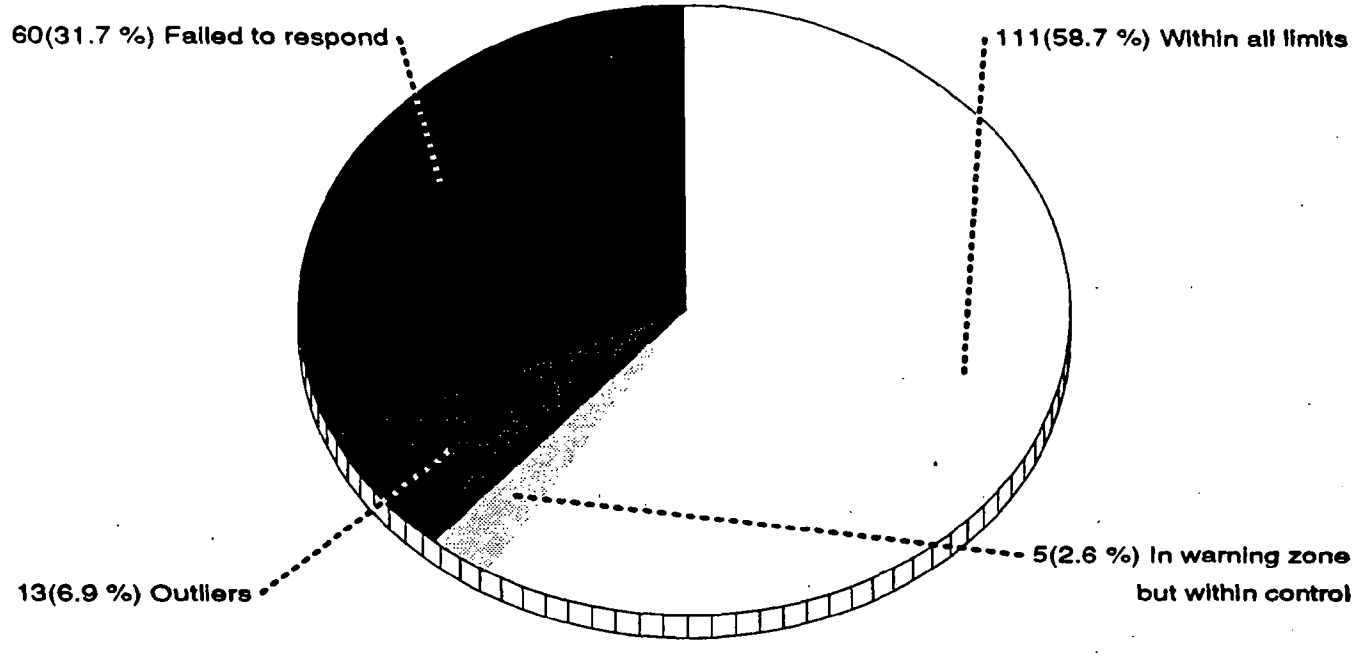
Strontium-90



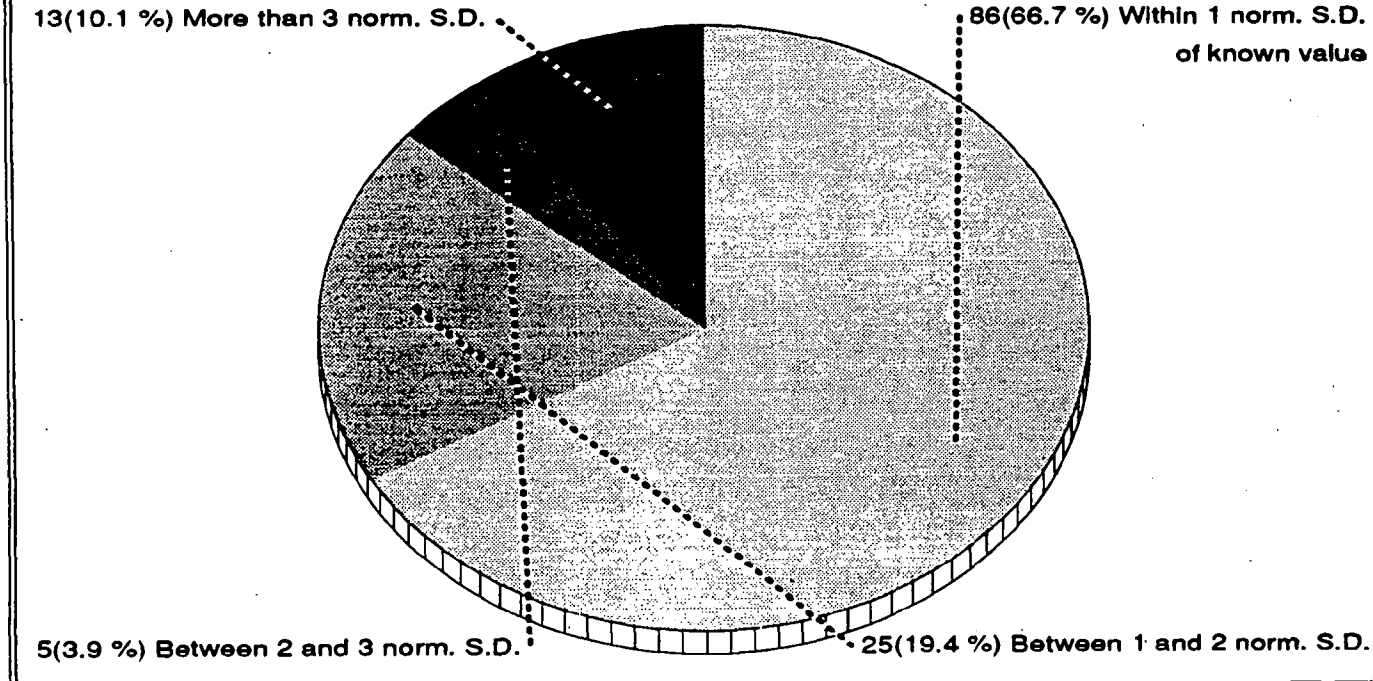


Cobalt-60 Statistical Summary 189 Participants

The known value of this nuclide is **49.0 pCi/l** with an expected precision of **5.0**; the control limits are 40.3 to 57.7; the warning regions are 40.3 to 43.2 and 54.8 to 57.7



Statistic	Respondents	Non-outliers
Mean	49.96	**Grand Avg 49.26**
Std. Dev.	9.73	2.75
Variance	94.67	7.59
% Coef. of Var.	19.48	5.59
% deviation of mean from known value	1.96	0.53
Norm. dev. of mean from known value	0.10	0.09
Median	49.67	49.67
% deviation of median from known value	1.36	1.36
Norm. dev. of median from known value	0.07	0.24



Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	42.0	45.0	44.0	1.53	0.354	43.67	-1.94	-1.85	
AE	47.0	51.0	46.0	2.65	0.591	48.00	-0.44	-0.35	
AF	47.0	46.0	49.0	1.53	0.354	47.33	-0.67	-0.58	
AH	46.0	44.0	44.0	1.15	0.236	44.67	-1.59	-1.50	
AI									•
AJ	49.0	50.0	50.0	0.58	0.118	49.67	0.14	0.23	
AK	48.0	48.0	48.0	0.00	0.000	48.00	-0.44	-0.35	
AL	51.0	45.0	50.0	3.21	0.709	48.67	-0.21	-0.12	
AP	48.0	49.0	50.0	1.00	0.236	49.00	-0.09	0.00	
AR									•
AU	49.0	51.0	51.0	1.15	0.236	50.33	0.37	0.46	
AW	49.0	48.0	47.0	1.00	0.236	48.00	-0.44	-0.35	
AZ	46.0	45.0	52.0	3.79	0.827	47.67	-0.55	-0.46	
BA	55.0	49.0	51.0	3.06	0.709	51.67	0.83	0.92	
BB	51.0	49.0	50.0	1.00	0.236	50.00	0.26	0.35	
BC	47.0	47.0	46.0	0.58	0.118	46.67	-0.90	-0.81	
BG	67.0	85.0	65.0	11.02	3.596	72.33	7.99	8.08	×
BH	52.0	51.0	54.0	1.53	0.354	52.33	1.06	1.15	
BK	52.0	52.0	52.0	0.00	0.000	52.00	0.95	1.04	
BL	49.0	51.0	49.0	1.15	0.236	49.67	0.14	0.23	
BM	50.0	49.0	52.0	1.53	0.354	50.33	0.37	0.46	
BN	48.0	47.0	49.0	1.00	0.236	48.00	-0.44	-0.35	
BO	48.0	51.0	50.0	1.53	0.354	49.67	0.14	0.23	
BS									•
BW									•
C	51.0	50.0	50.0	0.58	0.118	50.33	0.37	0.46	
CA	51.0	51.0	49.0	1.15	0.236	50.33	0.37	0.46	
CE	54.0	55.0	54.0	0.58	0.118	54.33	1.76	1.85	
CG									•
CJ	50.0	56.0	55.0	3.21	0.709	53.67	1.53	1.62	
CK	51.0	51.0	53.0	1.15	0.236	51.67	0.83	0.92	
CM	54.0	53.0	58.0	2.65	0.591	55.00	1.99	2.08	
CO	50.0	52.0	54.0	2.00	0.473	52.00	0.95	1.04	
CP	52.0	51.0	47.0	2.65	0.591	50.00	0.26	0.35	
CQ	49.0	50.0	52.0	1.53	0.354	50.33	0.37	0.46	
CS	59.0	60.0	58.0	1.00	0.236	59.00	3.37	3.46	×
CX	49.0	48.0	49.0	0.58	0.118	48.67	-0.21	-0.12	
D									•
DB									•
DD	47.0	47.0	47.0	0.00	0.000	47.00	-0.78	-0.69	
DE	46.0	47.0	48.0	1.00	0.236	47.00	-0.78	-0.69	
DG	49.0	52.0	52.0	1.73	0.354	51.00	0.60	0.69	
DI									•
DL	47.0	52.0	48.0	2.65	0.591	49.00	-0.09	0.00	
DM	48.0	48.0	49.0	0.58	0.118	48.33	-0.32	-0.23	

• ≡ No data submitted — **TAG SYMBOLS** — ⇑ ≡ Above control limit

Ø ≡ Insufficient data — × ≡ Determined to be an outlier — ⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DO	51.0	52.0	56.0	2.65	0.591	53.00	1.30	1.39	
DS									•
DT	48.0	48.0	48.0	0.00	0.000	48.00	-0.44	-0.35	
DZ	42.0	43.0	41.0	1.00	0.236	42.00	-2.52	-2.42	
E	46.0	48.0	48.0	1.15	0.236	47.33	-0.67	-0.58	
EB	52.0	51.0	51.0	0.58	0.118	51.33	0.72	0.81	
EL	47.0	47.0	48.0	0.58	0.118	47.33	-0.67	-0.58	
EO									•
ER									•
EV									•
EX	55.0	59.0	57.0	2.00	0.473	57.00	2.68	2.77	
FF									•
FJ	52.0	49.0	55.0	3.00	0.709	52.00	0.95	1.04	
FL	49.0	49.0	53.0	2.31	0.473	50.33	0.37	0.46	
FN									•
FU	50.0	51.0	49.0	1.00	0.236	50.00	0.26	0.35	
FZ	53.0	52.0	53.0	0.58	0.118	52.67	1.18	1.27	
GE	53.0	48.0	59.0	5.51	1.570	53.33	1.41	1.50	
GI	44.0	49.0	48.0	2.65	0.591	47.00	-0.78	-0.69	
GQ	48.0	48.0	48.0	0.00	0.000	48.00	-0.44	-0.35	
GT									•
GZ									•
HI	34.0	38.0	42.0	4.00	0.945	38.00	-3.90	-3.81	×
HK	51.0	49.0	50.0	1.00	0.236	50.00	0.26	0.35	
HL	49.0	49.0	49.0	0.00	0.000	49.00	-0.09	0.00	
HP	45.0	44.0	44.0	0.58	0.118	44.33	-1.71	-1.62	
HX	84.0	84.0	84.0	0.00	0.000	84.00	12.03	12.12	×
I	52.0	49.0	48.0	2.08	0.473	49.67	0.14	0.23	
IC	50.0	49.0	53.0	2.08	0.473	50.67	0.49	0.58	
ID									•
J	49.0	51.0	50.0	1.00	0.236	50.00	0.26	0.35	
JE	45.0	48.0	47.0	1.53	0.354	46.67	-0.90	-0.81	
JG	49.0	47.0	52.0	2.52	0.591	49.33	0.02	0.12	
JN									•
JQ									•
JS	50.0	51.0	51.0	0.58	0.118	50.67	0.49	0.58	
JX									•
JY	52.0	52.0	51.0	0.58	0.118	51.67	0.83	0.92	
K	47.0	43.0	45.0	2.00	0.473	45.00	-1.48	-1.39	
KE									•
KT									•
KX	50.0	49.0	51.0	1.00	0.236	50.00	0.26	0.35	
L	54.0	55.0	54.0	0.58	0.118	54.33	1.76	1.85	
LF	51.0	50.0	47.0	2.08	0.473	49.33	0.02	0.12	
LL									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 17-Oct-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	37.0	53.0	50.0	8.50	2.695	46.67	-0.90	-0.81	
LT	49.0	49.0	51.0	1.15	0.236	49.67	0.14	0.23	
M	48.0	48.0	51.0	1.73	0.354	49.00	-0.09	0.00	
MA	48.0	52.0	47.0	2.65	0.591	49.00	-0.09	0.00	
MF									•
MP	50.0	52.0	49.0	1.53	0.354	50.33	0.37	0.46	
MQ	54.0	47.0	45.0	4.73	1.120	48.67	-0.21	-0.12	
MV	21.0	19.0	25.0	3.06	0.709	21.67	-9.56	-9.47	×
MY	60.0	59.0	60.0	0.58	0.118	59.67	3.60	3.70	×
N									•
NA									•
NH									•
NJ	46.0	48.0	46.0	1.15	0.236	46.67	-0.90	-0.81	
NK	42.0	38.0	42.0	2.31	0.473	40.67	-2.98	-2.89	
NO	52.0	53.0	54.0	1.00	0.236	53.00	1.30	1.39	
NT									•
O	52.0	52.0	50.0	1.15	0.236	51.33	0.72	0.81	
OF									•
OS									•
OX									•
OY									•
OZ									•
P	36.0	39.0	32.0	3.51	0.827	35.67	-4.71	-4.62	×
PA									•
PB	48.0	49.0	48.0	0.58	0.118	48.33	-0.32	-0.23	
PG									•
PI	53.0	48.0	53.0	2.89	0.591	51.33	0.72	0.81	
PM	52.0	54.0	55.0	1.53	0.354	53.67	1.53	1.62	
PQ	51.0	51.0	50.0	0.58	0.118	50.67	0.49	0.58	
PR									•
PV	48.0	51.0	45.0	3.00	0.709	48.00	-0.44	-0.35	
PW	48.0	49.0	48.0	0.58	0.118	48.33	-0.32	-0.23	
Q	48.0	48.0	48.0	0.00	0.000	48.00	-0.44	-0.35	
QC									•
QJ	2.0	2.0	2.0	0.00	0.000	2.00	-16.37	-16.28	×
QP	48.0	47.0	46.0	1.00	0.236	47.00	-0.78	-0.69	
QQ									•
QT	48.0	46.0	47.0	1.00	0.236	47.00	-0.78	-0.69	
QU	50.0	52.0	54.0	2.00	0.473	52.00	0.95	1.04	
QW	53.0	52.0	51.0	1.00	0.236	52.00	0.95	1.04	
QX	52.0	50.0	50.0	1.15	0.236	50.67	0.49	0.58	
QZ	46.0	45.0	45.0	0.58	0.118	45.33	-1.36	-1.27	
RD									•
RF	47.0	46.0	45.0	1.00	0.236	46.00	-1.13	-1.04	
RG									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RK	36.0	35.0	36.0	0.58	0.118	35.67	-4.71	-4.62	×
RP									•
RR									•
RU	48.0	49.0	48.0	0.58	0.118	48.33	-0.32	-0.23	
RV									•
RZ	49.0	50.0	49.0	0.58	0.118	49.33	0.02	0.12	
S	48.0	49.0	48.0	0.58	0.118	48.33	-0.32	-0.23	
SC	44.0	46.0	45.0	1.00	0.236	45.00	-1.48	-1.39	
SD	43.0	43.0	44.0	0.58	0.118	43.33	-2.05	-1.96	
SF	52.0	50.0	49.0	1.53	0.354	50.33	0.37	0.46	
SI	52.0	50.0	50.0	1.15	0.236	50.67	0.49	0.58	
SL									•
SM	48.0	48.0	48.0	0.00	0.000	48.00	-0.44	-0.35	
SN	45.0	48.0	47.0	1.53	0.354	46.67	-0.90	-0.81	
SO									•
SR	50.0	47.0	49.0	1.53	0.354	48.67	-0.21	-0.12	
SS	54.0	55.0	54.0	0.58	0.118	54.33	1.76	1.85	
ST									•
SX	48.0	49.0	52.0	2.08	0.473	49.67	0.14	0.23	
SZ	49.0	47.0	48.0	1.00	0.236	48.00	-0.44	-0.35	
T	45.0	49.0	47.0	2.00	0.473	47.00	-0.78	-0.69	
TD	64.0	63.0	61.0	1.53	0.354	62.67	4.64	4.73	×
TG									•
TH	117.0	114.0	115.0	1.53	0.354	115.33	22.89	22.98	×
TI	50.0	50.0	50.0	0.00	0.000	50.00	0.26	0.35	
TJ									•
TL	41.0	40.0	46.0	3.21	0.709	42.33	-2.40	-2.31	
TN									•
TQ	45.0	48.0	43.0	2.52	0.591	45.33	-1.36	-1.27	
TS	50.0	52.0	52.0	1.15	0.236	51.33	0.72	0.81	
TY									•
U	50.0	50.0	51.0	0.58	0.118	50.33	0.37	0.46	
UA									•
UE									•
UK	63.0	95.0	94.0	18.19	6.296	84.00	12.03	12.12	×
UN	53.0	50.0	50.0	1.73	0.354	51.00	0.60	0.69	
UP	46.0	54.0	50.0	4.00	0.945	50.00	0.26	0.35	
UQ									•
UW	53.0	54.0	52.0	1.00	0.236	53.00	1.30	1.39	
UY	46.0	52.0	55.0	4.58	1.120	51.00	0.60	0.69	
VA									•
VC									•
VG									•
VH	47.0	48.0	48.0	0.58	0.118	47.67	-0.55	-0.46	
VI	50.0	51.0	50.0	0.58	0.118	50.33	0.37	0.46	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 17-Oct-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VJ									•
VM	51.0	50.0	50.0	0.58	0.118	50.33	0.37	0.46	
VO	53.0	48.0	51.0	2.52	0.591	50.67	0.49	0.58	
VT									•
W	48.0	48.0	44.0	2.31	0.473	46.67	-0.90	-0.81	
WE									•
WF	49.0	50.0	49.0	0.58	0.118	49.33	0.02	0.12	
WO									•
X	58.0	62.0	61.0	2.08	0.473	60.33	3.84	3.93	×

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.00	×	QJ	47.67		AZ	49.67		BL
21.67	×	MV	48.00		SZ	49.67		AJ
35.67	×	RK	48.00		SM	50.00		UP
35.67	×	P	48.00		Q	50.00		TI
38.00	×	HI	48.00		PV	50.00		KX
40.67		NK	48.00		GQ	50.00		J
42.00		DZ	48.00		DT	50.00		HK
42.33		TL	48.00		BN	50.00		FU
43.33		SD	48.00		AW	50.00		CP
43.67		A	48.00		AK	50.00		BB
44.33		HP	48.00		AE	50.33		VM
44.67		AH	48.33		S	50.33		VI
45.00		SC	48.33		RU	50.33		U
45.00		K	48.33		PW	50.33		SF
45.33		TQ	48.33		PB	50.33		MP
45.33		QZ	48.33		DM	50.33		FL
46.00		RF	48.67		SR	50.33		CQ
46.67		W	48.67		MQ	50.33		CA
46.67		SN	48.67		CX	50.33		C
46.67		NJ	48.67		AL	50.33		BM
46.67		LR	49.00		MA	50.33		AU
46.67		JE	49.00		M	50.67		VO
46.67		BC	49.00		HL	50.67		SI
47.00		T	49.00		DL	50.67		QX
47.00		QT	49.00		AP	50.67		PQ
47.00		QP	49.33		WF	50.67		JS
47.00		GI	49.33		RZ	50.67		IC
47.00		DE	49.33		LF	51.00		UY
47.00		DD	49.33		JG	51.00		UN
47.33		EL	49.67		SX	51.00		DG
47.33		E	49.67		LT	51.33		TS
47.33		AF	49.67		I	51.33		PI
47.67		VH	49.67		BO	51.33		O

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

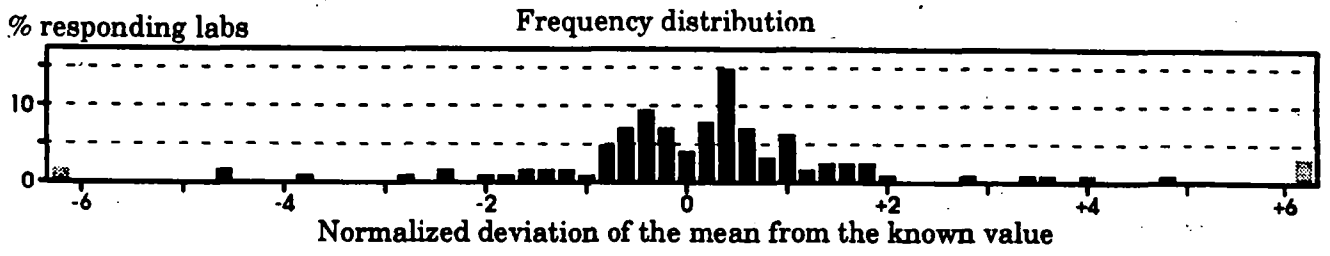
× ≡ Determined to be an outlier

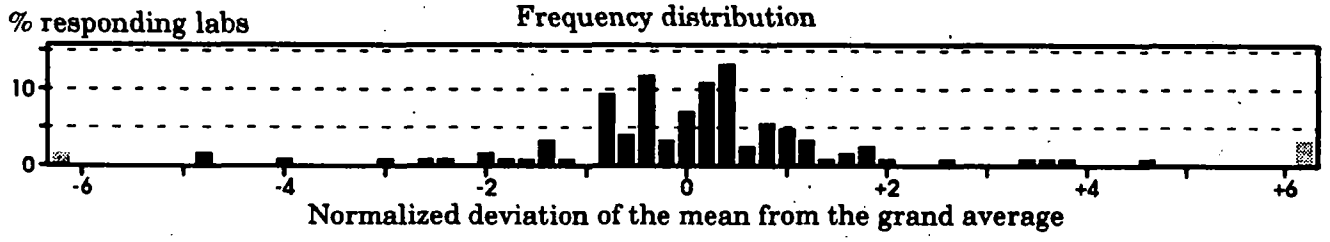
⇓ ≡ Below control limit

Cobalt-60

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
51.33		EB	52.67		FZ	55.00		CM
51.67		JY	53.00		UW	57.00		EX
51.67		CK	53.00		NO	59.00	×	CS
51.67		BA	53.00		DO	59.67	×	MY
52.00		QW	53.33		GE	60.33	×	X
52.00		QU	53.67		PM	62.67	×	TD
52.00		FJ	53.67		CJ	72.33	×	BG
52.00		CO	54.33		SS	84.00	×	UK
52.00		BK	54.33		L	84.00	×	HX
52.33		BH	54.33		CE	115.33	×	TH





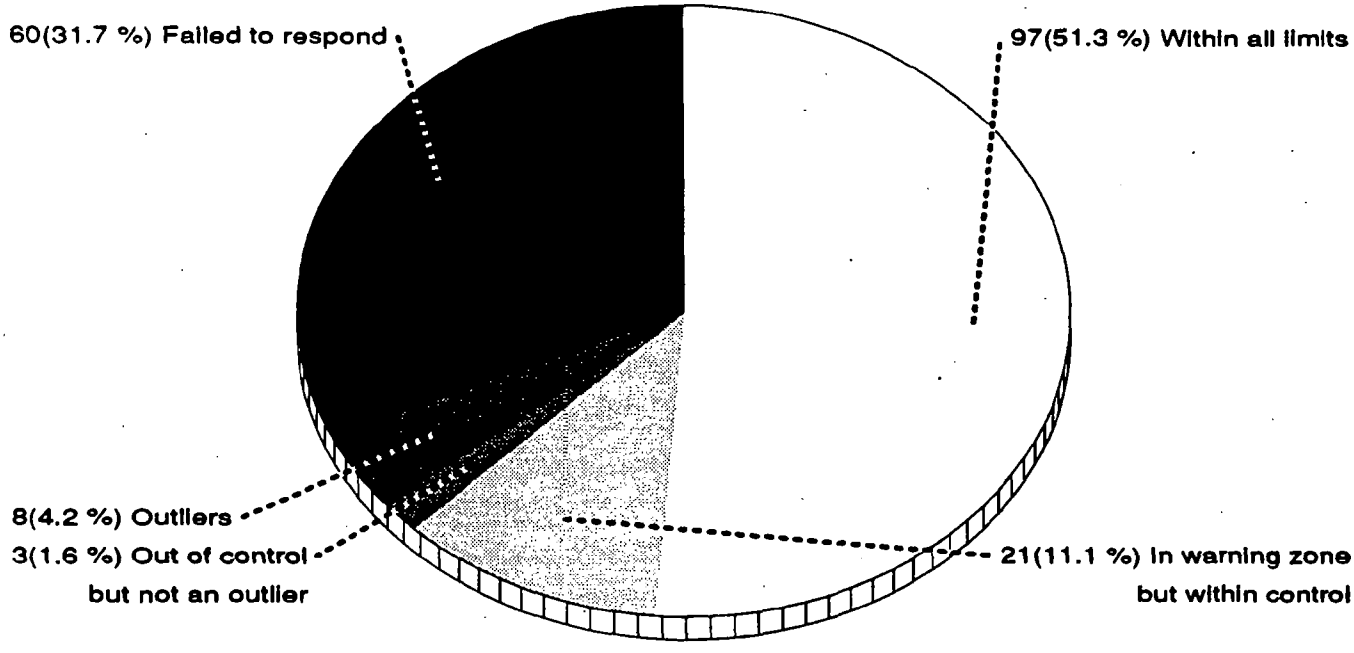
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

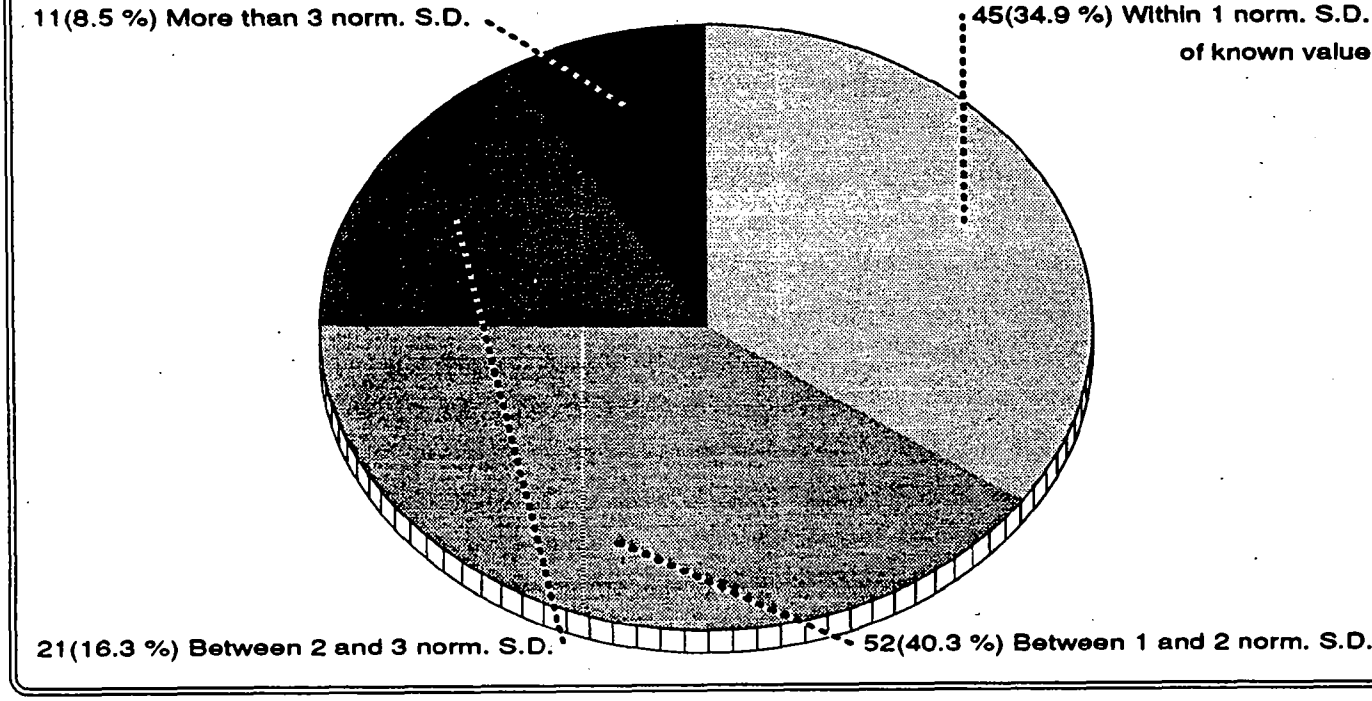
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134 Statistical Summary 189 Participants

The known value of this nuclide is **40.0 pCi/l** with an expected precision of **5.0**; the control limits are 31.3 to 48.7; the warning regions are 31.3 to 34.2 and 45.8 to 48.7



Statistic	Respondents	Non-outliers
Mean	36.57	**Grand Avg 36.71**
Std. Dev.	7.10	3.06
Variance	50.45	9.38
% Coef. of Var.	19.42	8.34
% deviation of mean from known value	-8.59	-8.22
Norm. dev. of mean from known value	-0.48	-1.07
Median	36.67	36.67
% deviation of median from known value	-8.33	-8.33
Norm. dev. of median from known value	-0.47	-1.09



Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	31.0	33.0	32.0	1.00	0.236	32.00	-1.63	-2.77	
AE	36.0	36.0	38.0	1.15	0.236	36.67	-0.02	-1.15	
AF	32.0	35.0	34.0	1.53	0.354	33.67	-1.05	-2.19	
AH	36.0	34.0	35.0	1.00	0.236	35.00	-0.59	-1.73	
AI									•
AJ	35.0	34.0	34.0	0.58	0.118	34.33	-0.82	-1.96	
AK	36.0	36.0	36.0	0.00	0.000	36.00	-0.25	-1.39	
AL	43.0	41.0	40.0	1.53	0.354	41.33	1.60	0.46	
AP	37.0	37.0	40.0	1.73	0.354	38.00	0.45	-0.69	
AR									•
AU	36.0	39.0	35.0	2.08	0.473	36.67	-0.02	-1.15	
AW	34.0	33.0	35.0	1.00	0.236	34.00	-0.94	-2.08	
AZ	51.0	40.0	50.0	6.08	1.570	47.00	3.56	2.42	
BA	39.0	39.0	40.0	0.58	0.118	39.33	0.91	-0.23	
BB	38.0	39.0	39.0	0.58	0.118	38.67	0.68	-0.46	
BC	34.0	35.0	36.0	1.00	0.236	35.00	-0.59	-1.73	
BG	30.0	30.0	35.0	2.89	0.591	31.67	-1.75	-2.89	
BH	35.0	33.0	36.0	1.53	0.354	34.67	-0.71	-1.85	
BK	44.0	44.0	44.0	0.00	0.000	44.00	2.53	1.39	
BL	38.0	37.0	38.0	0.58	0.118	37.67	0.33	-0.81	
BM	38.0	35.0	35.0	1.73	0.354	36.00	-0.25	-1.39	
BN	35.0	36.0	36.0	0.58	0.118	35.67	-0.36	-1.50	
BO	33.0	36.0	37.0	2.08	0.473	35.33	-0.48	-1.62	
BS									•
BW									•
C	38.0	37.0	38.0	0.58	0.118	37.67	0.33	-0.81	
CA	37.0	35.0	37.0	1.15	0.236	36.33	-0.13	-1.27	
CE	37.0	38.0	39.0	1.00	0.236	38.00	0.45	-0.69	
CG									•
CJ	33.0	32.0	38.0	3.21	0.709	34.33	-0.82	-1.96	
CK	35.0	35.0	32.0	1.73	0.354	34.00	-0.94	-2.08	
CM	36.0	39.0	41.0	2.52	0.591	38.67	0.68	-0.46	
CO	40.0	38.0	34.0	3.06	0.709	37.33	0.22	-0.92	
CP	41.0	37.0	35.0	3.06	0.709	37.67	0.33	-0.81	
CQ	34.0	35.0	36.0	1.00	0.236	35.00	-0.59	-1.73	
CS	45.0	46.0	46.0	0.58	0.118	45.67	3.10	1.96	
CX	39.0	38.0	39.0	0.58	0.118	38.67	0.68	-0.46	
D									•
DB									•
DD	37.0	36.0	38.0	1.00	0.236	37.00	0.10	-1.04	
DE	35.0	35.0	35.0	0.00	0.000	35.00	-0.59	-1.73	
DG	36.0	35.0	33.0	1.53	0.354	34.67	-0.71	-1.85	
DI									•
DL	41.0	37.0	37.0	2.31	0.473	38.33	0.56	-0.58	
DM	37.0	38.0	35.0	1.53	0.354	36.67	-0.02	-1.15	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DO	30.0	35.0	35.0	2.89	0.591	33.33	-1.17	-2.31	
DS									•
DT	39.0	35.0	36.0	2.08	0.473	36.67	-0.02	-1.15	
DZ	43.0	32.0	30.0	7.00	2.020	35.00	-0.59	-1.73	
E	38.0	37.0	34.0	2.08	0.473	36.33	-0.13	-1.27	
EB	37.0	37.0	37.0	0.00	0.000	37.00	0.10	-1.04	
EL	36.0	39.0	37.0	1.53	0.354	37.33	0.22	-0.92	
EO									•
ER									•
EV									•
EX	37.0	42.0	41.0	2.65	0.591	40.00	1.14	0.00	
FF									•
FJ	39.0	39.0	37.0	1.15	0.236	38.33	0.56	-0.58	
FL	37.0	41.0	39.0	2.00	0.473	39.00	0.79	-0.35	
FN									•
FU	38.0	39.0	37.0	1.00	0.236	38.00	0.45	-0.69	
FZ	37.0	41.0	43.0	3.06	0.709	40.33	1.25	0.12	
GE	34.0	35.0	36.0	1.00	0.236	35.00	-0.59	-1.73	
GI	32.0	36.0	34.0	2.00	0.473	34.00	-0.94	-2.08	
GQ	38.0	37.0	39.0	1.00	0.236	38.00	0.45	-0.69	
GT									•
GZ									•
HI	22.0	23.0	24.0	1.00	0.236	23.00	-4.75	-5.89	×
HK	36.0	37.0	37.0	0.58	0.118	36.67	-0.02	-1.15	
HL	40.0	40.0	40.0	0.00	0.000	40.00	1.14	0.00	
HP	38.0	37.0	38.0	0.58	0.118	37.67	0.33	-0.81	
HX	65.0	62.0	64.0	1.53	0.354	63.67	9.34	8.20	×
I	42.0	39.0	36.0	3.00	0.709	39.00	0.79	-0.35	
IC	41.0	41.0	47.0	3.46	0.709	43.00	2.18	1.04	
ID									•
J	38.0	38.0	37.0	0.58	0.118	37.67	0.33	-0.81	
JE	33.0	34.0	35.0	1.00	0.236	34.00	-0.94	-2.08	
JG	33.0	33.0	29.0	2.31	0.473	31.67	-1.75	-2.89	
JN									•
JQ									•
JS	38.0	39.0	38.0	0.58	0.118	38.33	0.56	-0.58	
JX									•
JY	37.0	37.0	36.0	0.58	0.118	36.67	-0.02	-1.15	
K	43.0	40.0	42.0	1.53	0.354	41.67	1.72	0.58	
KE									•
KT									•
KX	37.0	37.0	39.0	1.15	0.236	37.67	0.33	-0.81	
L	40.0	40.0	42.0	1.15	0.236	40.67	1.37	0.23	
LF	33.0	34.0	33.0	0.58	0.118	33.33	-1.17	-2.31	
LL									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	37.0	31.0	40.0	4.58	1.120	36.00	-0.25	-1.39	
LT	36.0	37.0	38.0	1.00	0.236	37.00	0.10	-1.04	
M	38.0	39.0	37.0	1.00	0.236	38.00	0.45	-0.69	
MA	32.0	36.0	36.0	2.31	0.473	34.67	-0.71	-1.85	
MF									•
MP	35.0	35.0	36.0	0.58	0.118	35.33	-0.48	-1.62	
MQ	44.0	37.0	34.0	5.13	1.345	38.33	0.56	-0.58	
MV	11.0	10.0	14.0	2.08	0.473	11.67	-8.68	-9.81	×
MY	30.0	31.0	30.0	0.58	0.118	30.33	-2.21	-3.35	⇓
N									•
NA									•
NH									•
NJ	33.0	33.0	33.0	0.00	0.000	33.00	-1.29	-2.42	
NK	31.0	30.0	31.0	0.58	0.118	30.67	-2.09	-3.23	⇓
NO	36.0	37.0	38.0	1.00	0.236	37.00	0.10	-1.04	
NT									•
O	36.0	36.0	36.0	0.00	0.000	36.00	-0.25	-1.39	
OF									•
OS									•
OX									•
OY									•
OZ									•
P	20.0	25.0	20.0	2.89	0.591	21.67	-5.21	-6.35	×
PA									•
PB	22.0	22.0	21.0	0.58	0.118	21.67	-5.21	-6.35	×
PG									•
PI	38.0	38.0	39.0	0.58	0.118	38.33	0.56	-0.58	
PM	36.0	36.0	39.0	1.73	0.354	37.00	0.10	-1.04	
PQ	34.0	35.0	34.0	0.58	0.118	34.33	-0.82	-1.96	
PR									•
PV	37.0	36.0	30.0	3.79	0.827	34.33	-0.82	-1.96	
PW	35.0	37.0	37.0	1.15	0.236	36.33	-0.13	-1.27	
Q	38.0	36.0	36.0	1.15	0.236	36.67	-0.02	-1.15	
QC									•
QJ	1.0	1.0	1.0	0.00	0.000	1.00	-12.37	-13.51	×
QP	46.0	39.0	41.0	3.61	0.827	42.00	1.83	0.69	
QQ									•
QT	35.0	36.0	35.0	0.58	0.118	35.33	-0.48	-1.62	
QU	35.0	34.0	36.0	1.00	0.236	35.00	-0.59	-1.73	
QW	31.0	35.0	33.0	2.00	0.473	33.00	-1.29	-2.42	
QX	34.0	36.0	38.0	2.00	0.473	36.00	-0.25	-1.39	
QZ	33.0	31.0	31.0	1.15	0.236	31.67	-1.75	-2.89	
RD									•
RF	40.0	39.0	38.0	1.00	0.236	39.00	0.79	-0.35	
RG									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RK	28.0	28.0	27.0	0.58	0.118	27.67	-3.13	-4.27	⇓
RP									•
RR									•
RU	35.0	34.0	35.0	0.58	0.118	34.67	-0.71	-1.85	
RV									•
RZ	38.0	39.0	39.0	0.58	0.118	38.67	0.68	-0.46	
S	37.0	38.0	39.0	1.00	0.236	38.00	0.45	-0.69	
SC	33.0	34.0	35.0	1.00	0.236	34.00	-0.94	-2.08	
SD	34.0	35.0	34.0	0.58	0.118	34.33	-0.82	-1.96	
SF	39.0	37.0	37.0	1.15	0.236	37.67	0.33	-0.81	
SI	37.0	38.0	40.0	1.53	0.354	38.33	0.56	-0.58	
SL									•
SM	36.0	39.0	36.0	1.73	0.354	37.00	0.10	-1.04	
SN	36.0	37.0	37.0	0.58	0.118	36.67	-0.02	-1.15	
SO									•
SR	38.0	37.0	33.0	2.65	0.591	36.00	-0.25	-1.39	
SS	42.0	41.0	40.0	1.00	0.236	41.00	1.49	0.35	
ST									•
SX	33.0	34.0	35.0	1.00	0.236	34.00	-0.94	-2.08	
SZ	35.0	35.0	35.0	0.00	0.000	35.00	-0.59	-1.73	
T	38.0	39.0	35.0	2.08	0.473	37.33	0.22	-0.92	
TD	46.0	44.0	45.0	1.00	0.236	45.00	2.87	1.73	
TG									•
TH	80.0	79.0	78.0	1.00	0.236	79.00	14.65	13.51	×
TI	38.0	36.0	37.0	1.00	0.236	37.00	0.10	-1.04	
TJ									•
TL	33.0	28.0	37.0	4.51	1.120	32.67	-1.40	-2.54	
TN									•
TQ	33.0	36.0	33.0	1.73	0.354	34.00	-0.94	-2.08	
TS	40.0	40.0	41.0	0.58	0.118	40.33	1.25	0.12	
TY									•
U	40.0	39.0	38.0	1.00	0.236	39.00	0.79	-0.35	
UA									•
UE									•
UK	62.0	52.0	46.0	8.08	2.695	53.33	5.76	4.62	×
UN	37.0	37.0	36.0	0.58	0.118	36.67	-0.02	-1.15	
UP	32.0	40.0	36.0	4.00	0.945	36.00	-0.25	-1.39	
UQ									•
UW	41.0	39.0	41.0	1.15	0.236	40.33	1.25	0.12	
UY	36.0	39.0	40.0	2.08	0.473	38.33	0.56	-0.58	
VA									•
VC									•
VG									•
VH	32.0	34.0	36.0	2.00	0.473	34.00	-0.94	-2.08	
VI	31.0	34.0	31.0	1.73	0.354	32.00	-1.63	-2.77	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VJ									•
VM	39.0	38.0	40.0	1.00	0.236	39.00	0.79	-0.35	
VO	38.0	39.0	35.0	2.08	0.473	37.33	0.22	-0.92	
VT									•
W	35.0	36.0	35.0	0.58	0.118	35.33	-0.48	-1.62	
WE									•
WF	34.0	34.0	34.0	0.00	0.000	34.00	-0.94	-2.08	
WO									•
X	46.0	40.0	38.0	4.16	0.945	41.33	1.60	0.46	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00	×	QJ	34.67		RU	36.67		DM
11.67	×	MV	34.67		MA	36.67		AU
21.67	×	PB	34.67		DG	36.67		AE
21.67	×	P	34.67		BH	37.00		TI
23.00	×	HI	35.00		SZ	37.00		SM
27.67	⇓	RK	35.00		QU	37.00		PM
30.33	⇓	MY	35.00		GE	37.00		NO
30.67	⇓	NK	35.00		DZ	37.00		LT
31.67		QZ	35.00		DE	37.00		EB
31.67		JG	35.00		CQ	37.00		DD
31.67		BG	35.00		BC	37.33		VO
32.00		VI	35.00		AH	37.33		T
32.00		A	35.33		W	37.33		EL
32.67		TL	35.33		QT	37.33		CO
33.00		QW	35.33		MP	37.67		SF
33.00		NJ	35.33		BO	37.67		KX
33.33		LF	35.67		BN	37.67		J
33.33		DO	36.00		UP	37.67		HP
33.67		AF	36.00		SR	37.67		CP
34.00		WF	36.00		QX	37.67		C
34.00		VH	36.00		O	37.67		BL
34.00		TQ	36.00		LR	38.00		S
34.00		SX	36.00		BM	38.00		M
34.00		SC	36.00		AK	38.00		GQ
34.00		JE	36.33		PW	38.00		FU
34.00		GI	36.33		E	38.00		CE
34.00		CK	36.33		CA	38.00		AP
34.00		AW	36.67		UN	38.33		UY
34.33		SD	36.67		SN	38.33		SI
34.33		PV	36.67		Q	38.33		PI
34.33		PQ	36.67		JY	38.33		MQ
34.33		CJ	36.67		HK	38.33		JS
34.33		AJ	36.67		DT	38.33		FJ

• ≡ No data submitted
∅ ≡ Insufficient data

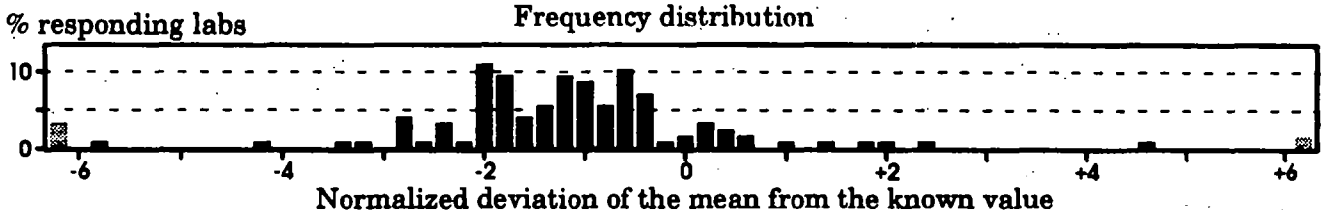
TAG SYMBOLS
× ≡ Determined to be an outlier

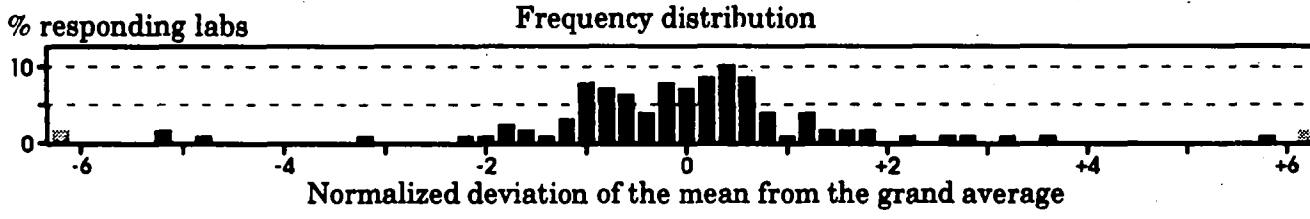
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
38.33		DL	39.33		BA	41.67		K
38.67		RZ	40.00		HL	42.00		QP
38.67		CX	40.00		EX	43.00		IC
38.67		CM	40.33		UW	44.00		BK
38.67		BB	40.33		TS	45.00		TD
39.00		VM	40.33		FZ	45.67		CS
39.00		U	40.67		L	47.00		AZ
39.00		RF	41.00		SS	53.33	×	UK
39.00		I	41.33		X	63.67	×	HX
39.00		FL	41.33		AL	79.00	×	TH





• ≡ No data submitted
∅ ≡ Insufficient data

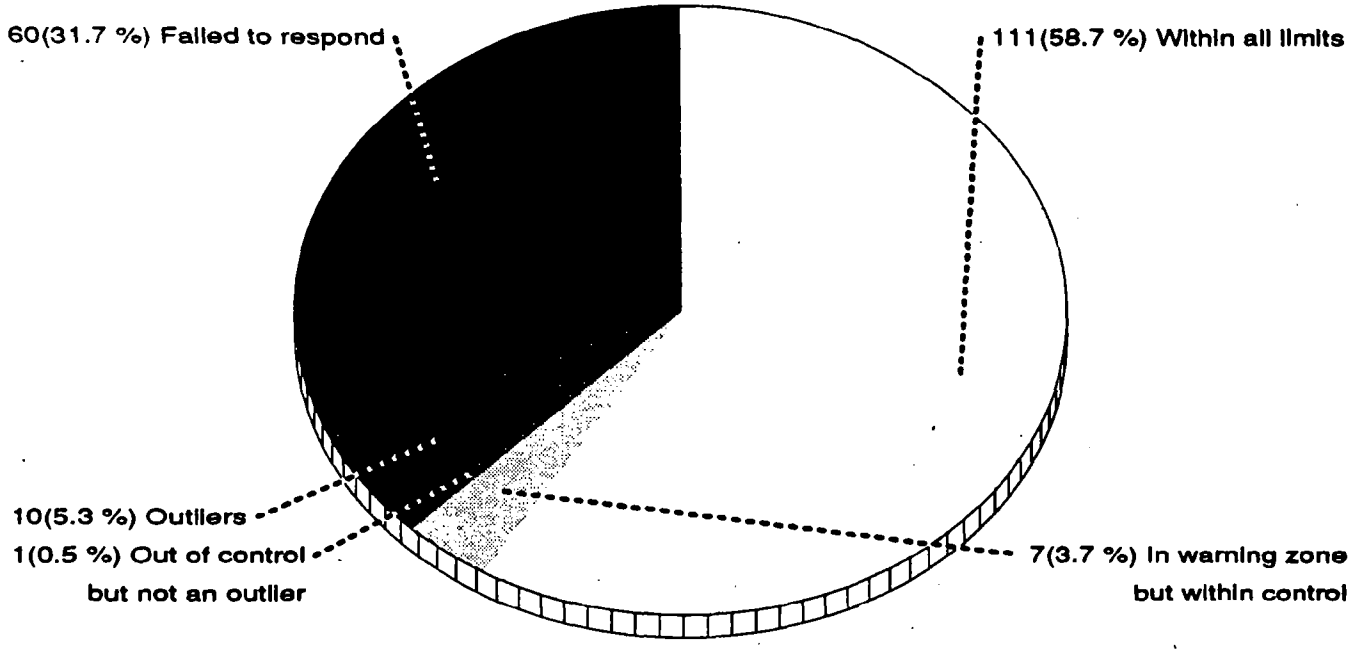
TAG SYMBOLS

× ≡ Determined to be an outlier

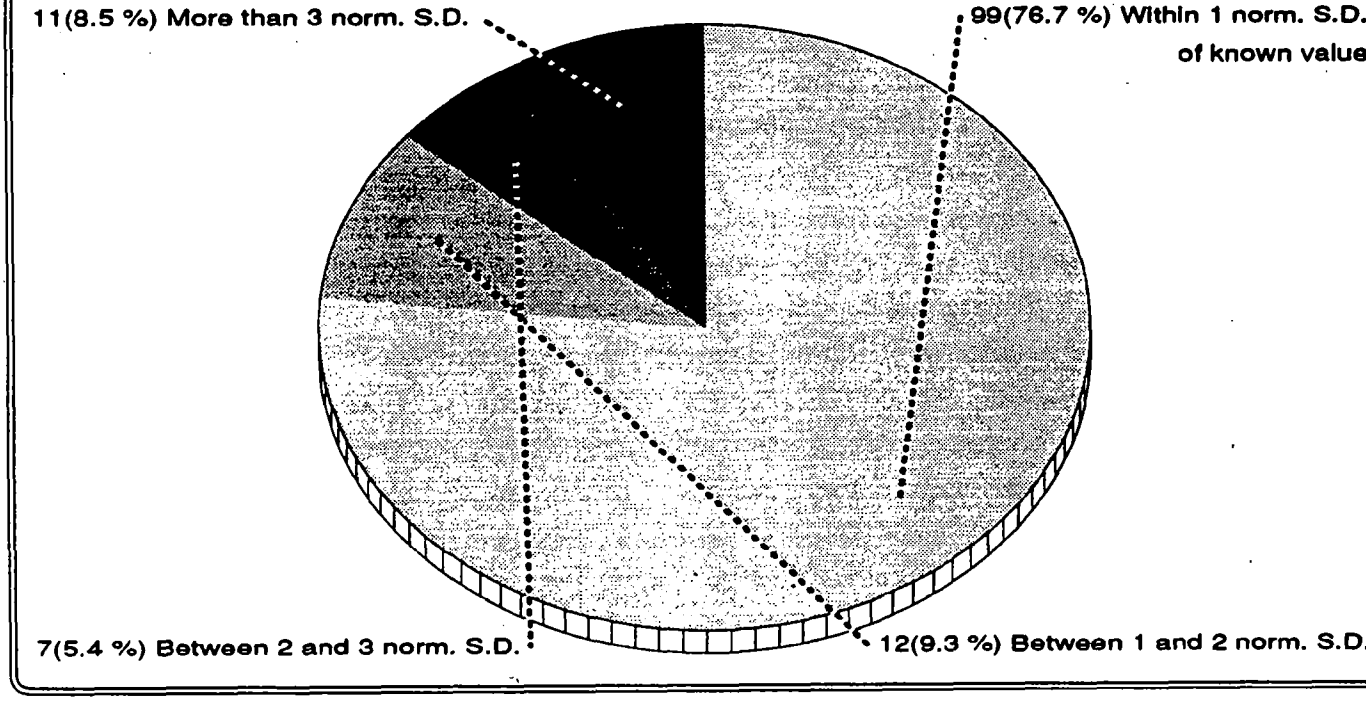
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137 Statistical Summary 189 Participants

The known value of this nuclide is **30.0 pCi/l** with an expected precision of **5.0**; the control limits are 21.3 to 38.7; the warning regions are 21.3 to 24.2 and 35.8 to 38.7



Statistic	Respondents	Non-outliers
Mean	31.12	**Grand Avg 30.84**
Std. Dev.	6.28	2.52
Variance	39.47	6.35
% Coef. of Var.	20.19	8.17
% deviation of mean from known value	3.75	2.81
Norm. dev. of mean from known value	0.18	0.33
Median	30.67	30.67
% deviation of median from known value	2.22	2.22
Norm. dev. of median from known value	0.11	0.26



CRD-LV Performance Evaluation: Blind-B, 17-Oct-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	28.0	28.0	27.0	0.58	0.118	27.67	-1.10	-0.81	
AE	31.0	30.0	30.0	0.58	0.118	30.33	-0.18	0.12	
AF	32.0	26.0	27.0	3.21	0.709	28.33	-0.87	-0.58	
AH	32.0	29.0	30.0	1.53	0.354	30.33	-0.18	0.12	
AI									•
AJ	30.0	30.0	30.0	0.00	0.000	30.00	-0.29	0.00	
AK	30.0	30.0	30.0	0.00	0.000	30.00	-0.29	0.00	
AL	28.0	34.0	32.0	3.06	0.709	31.33	0.17	0.46	
AP	32.0	30.0	29.0	1.53	0.354	30.33	-0.18	0.12	
AR									•
AU	33.0	31.0	29.0	2.00	0.473	31.00	0.05	0.35	
AW	31.0	27.0	32.0	2.65	0.591	30.00	-0.29	0.00	
AZ	34.0	32.0	31.0	1.53	0.354	32.33	0.52	0.81	
BA	25.0	28.0	29.0	2.08	0.473	27.33	-1.22	-0.92	
BB	32.0	29.0	31.0	1.53	0.354	30.67	-0.06	0.23	
BC	31.0	30.0	29.0	1.00	0.236	30.00	-0.29	0.00	
BG	16.0	21.0	14.0	3.61	0.827	17.00	-4.80	-4.50	×
BH	34.0	32.0	32.0	1.15	0.236	32.67	0.63	0.92	
BK	38.0	38.0	38.0	0.00	0.000	38.00	2.48	2.77	
BL	31.0	30.0	30.0	0.58	0.118	30.33	-0.18	0.12	
BM	32.0	29.0	28.0	2.08	0.473	29.67	-0.41	-0.12	
BN	28.0	31.0	32.0	2.08	0.473	30.33	-0.18	0.12	
BO	29.0	31.0	29.0	1.15	0.236	29.67	-0.41	-0.12	
BS									•
BW									•
C	31.0	32.0	31.0	0.58	0.118	31.33	0.17	0.46	
CA	31.0	30.0	33.0	1.53	0.354	31.33	0.17	0.46	
CE	32.0	30.0	34.0	2.00	0.473	32.00	0.40	0.69	
CG									•
CJ	35.0	35.0	35.0	0.00	0.000	35.00	1.44	1.73	
CK	33.0	33.0	27.0	3.46	0.709	31.00	0.05	0.35	
CM	30.0	30.0	32.0	1.15	0.236	30.67	-0.06	0.23	
CO	28.0	31.0	34.0	3.00	0.709	31.00	0.05	0.35	
CP	31.0	29.0	30.0	1.00	0.236	30.00	-0.29	0.00	
CQ	32.0	32.0	34.0	1.15	0.236	32.67	0.63	0.92	
CS	39.0	38.0	40.0	1.00	0.236	39.00	2.83	3.12	⇑
CX	29.0	33.0	33.0	2.31	0.473	31.67	0.29	0.58	
D									•
DB									•
DD	31.0	30.0	32.0	1.00	0.236	31.00	0.05	0.35	
DE	29.0	30.0	30.0	0.58	0.118	29.67	-0.41	-0.12	
DG	35.0	35.0	33.0	1.15	0.236	34.33	1.21	1.50	
DI									•
DL	27.0	31.0	28.0	2.08	0.473	28.67	-0.75	-0.46	
DM	31.0	31.0	29.0	1.15	0.236	30.33	-0.18	0.12	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DO	34.0	32.0	29.0	2.52	0.591	31.67	0.29	0.58	
DS									•
DT	36.0	32.0	34.0	2.00	0.473	34.00	1.09	1.39	
DZ	35.0	32.0	31.0	2.08	0.473	32.67	0.63	0.92	
E	31.0	32.0	27.0	2.65	0.591	30.00	-0.29	0.00	
EB	33.0	32.0	32.0	0.58	0.118	32.33	0.52	0.81	
EL	31.0	31.0	28.0	1.73	0.354	30.00	-0.29	0.00	
EO									•
ER									•
EV									•
EX	29.0	35.0	30.0	3.21	0.709	31.33	0.17	0.46	
FF									•
FJ	30.0	33.0	31.0	1.53	0.354	31.33	0.17	0.46	
FL	32.0	32.0	34.0	1.15	0.236	32.67	0.63	0.92	
FN									•
FU	28.0	32.0	30.0	2.00	0.473	30.00	-0.29	0.00	
FZ	30.0	33.0	33.0	1.73	0.354	32.00	0.40	0.69	
GE	30.0	33.0	42.0	6.24	1.795	35.00	1.44	1.73	
GI	27.0	30.0	30.0	1.73	0.354	29.00	-0.64	-0.35	
GQ	30.0	31.0	29.0	1.00	0.236	30.00	-0.29	0.00	
GT									•
GZ									•
HI	22.0	23.0	21.0	1.00	0.236	22.00	-3.06	-2.77	
HK	33.0	32.0	32.0	0.58	0.118	32.33	0.52	0.81	
HL	33.0	33.0	33.0	0.00	0.000	33.00	0.75	1.04	
HP	31.0	32.0	32.0	0.58	0.118	31.67	0.29	0.58	
HX	52.0	51.0	53.0	1.00	0.236	52.00	7.33	7.62	×
I	29.0	33.0	31.0	2.00	0.473	31.00	0.05	0.35	
IC	32.0	31.0	31.0	0.58	0.118	31.33	0.17	0.46	
ID									•
J	30.0	30.0	30.0	0.00	0.000	30.00	-0.29	0.00	
JE	28.0	30.0	29.0	1.00	0.236	29.00	-0.64	-0.35	
JG	38.0	34.0	39.0	2.65	0.591	37.00	2.13	2.42	
JN									•
JQ									•
JS	29.0	30.0	31.0	1.00	0.236	30.00	-0.29	0.00	
JX									•
JY	32.0	31.0	31.0	0.58	0.118	31.33	0.17	0.46	
K	34.0	33.0	32.0	1.00	0.236	33.00	0.75	1.04	
KE									•
KT									•
KX	28.0	31.0	28.0	1.73	0.354	29.00	-0.64	-0.35	
L	34.0	34.0	35.0	0.58	0.118	34.33	1.21	1.50	
LF	28.0	28.0	31.0	1.73	0.354	29.00	-0.64	-0.35	
LL									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Blind-B, 17-Oct-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LR	27.0	31.0	33.0	3.06	0.709	30.33	-0.18	0.12	
LT	30.0	29.0	33.0	2.08	0.473	30.67	-0.06	0.23	
M	28.0	30.0	30.0	1.15	0.236	29.33	-0.52	-0.23	
MA	30.0	26.0	31.0	2.65	0.591	29.00	-0.64	-0.35	
MF									•
MP	30.0	30.0	31.0	0.58	0.118	30.33	-0.18	0.12	
MQ	34.0	31.0	30.0	2.08	0.473	31.67	0.29	0.58	
MV	10.0	9.0	14.0	2.65	0.591	11.00	-6.87	-6.58	×
MY	41.0	40.0	41.0	0.58	0.118	40.67	3.40	3.70	×
N									•
NA									•
NH									•
NJ	29.0	28.0	28.0	0.58	0.118	28.33	-0.87	-0.58	
NK	24.0	22.0	25.0	1.53	0.354	23.67	-2.49	-2.19	
NO	33.0	34.0	35.0	1.00	0.236	34.00	1.09	1.39	
NT									•
O	31.0	31.0	31.0	0.00	0.000	31.00	0.05	0.35	
OF									•
OS									•
OX									•
OY									•
OZ									•
P	17.0	19.0	20.0	1.53	0.354	18.67	-4.22	-3.93	×
PA									•
PB	28.0	28.0	32.0	2.31	0.473	29.33	-0.52	-0.23	
PG									•
PI	34.0	33.0	33.0	0.58	0.118	33.33	0.86	1.15	
PM	27.0	32.0	36.0	4.51	1.120	31.67	0.29	0.58	
PQ	31.0	30.0	30.0	0.58	0.118	30.33	-0.18	0.12	
PR									•
PV	28.0	29.0	27.0	1.00	0.236	28.00	-0.98	-0.69	
PW	30.0	31.0	31.0	0.58	0.118	30.67	-0.06	0.23	
Q	28.0	29.0	32.0	2.08	0.473	29.67	-0.41	-0.12	
QC									•
QJ	1.0	1.0	1.0	0.00	0.000	1.00	-10.34	-10.05	×
QP	28.0	34.0	31.0	3.00	0.709	31.00	0.05	0.35	
QQ									•
QT	29.0	30.0	29.0	0.58	0.118	29.33	-0.52	-0.23	
QU	33.0	33.0	32.0	0.58	0.118	32.67	0.63	0.92	
QW	33.0	32.0	32.0	0.58	0.118	32.33	0.52	0.81	
QX	36.0	31.0	34.0	2.52	0.591	33.67	0.98	1.27	
QZ	28.0	27.0	28.0	0.58	0.118	27.67	-1.10	-0.81	
RD									•
RF	28.0	28.0	29.0	0.58	0.118	28.33	-0.87	-0.58	
RG									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RK	21.0	22.0	22.0	0.58	0.118	21.67	-3.18	-2.89	
RP									•
RR									•
RU	29.0	30.0	29.0	0.58	0.118	29.33	-0.52	-0.23	
RV									•
RZ	29.0	29.0	30.0	0.58	0.118	29.33	-0.52	-0.23	
S	29.0	31.0	31.0	1.15	0.236	30.33	-0.18	0.12	
SC	30.0	29.0	29.0	0.58	0.118	29.33	-0.52	-0.23	
SD	32.0	29.0	30.0	1.53	0.354	30.33	-0.18	0.12	
SF	29.0	30.0	32.0	1.53	0.354	30.33	-0.18	0.12	
SI	30.0	31.0	31.0	0.58	0.118	30.67	-0.06	0.23	
SL									•
SM	34.0	31.0	32.0	1.53	0.354	32.33	0.52	0.81	
SN	30.0	33.0	32.0	1.53	0.354	31.67	0.29	0.58	
SO									•
SR	32.0	31.0	29.0	1.53	0.354	30.67	-0.06	0.23	
SS	34.0	32.0	33.0	1.00	0.236	33.00	0.75	1.04	
ST									•
SX	27.0	27.0	28.0	0.58	0.118	27.33	-1.22	-0.92	
SZ	31.0	30.0	30.0	0.58	0.118	30.33	-0.18	0.12	
T	29.0	28.0	28.0	0.58	0.118	28.33	-0.87	-0.58	
TD	37.0	35.0	38.0	1.53	0.354	36.67	2.02	2.31	
TG									•
TH	71.0	68.0	70.0	1.53	0.354	69.67	13.45	13.74	×
TI	41.0	32.0	36.0	4.51	1.120	36.33	1.90	2.19	
TJ									•
TL	37.0	46.0	41.0	4.51	1.120	41.33	3.63	3.93	×
TN									•
TQ	27.0	29.0	30.0	1.53	0.354	28.67	-0.75	-0.46	
TS	29.0	31.0	29.0	1.15	0.236	29.67	-0.41	-0.12	
TY									•
U	33.0	32.0	32.0	0.58	0.118	32.33	0.52	0.81	
UA									•
UE									•
UK	36.0	56.0	37.0	11.27	3.596	43.00	4.21	4.50	×
UN	31.0	31.0	31.0	0.00	0.000	31.00	0.05	0.35	
UP	30.0	35.0	33.0	2.52	0.591	32.67	0.63	0.92	
UQ									•
UW	28.0	29.0	29.0	0.58	0.118	28.67	-0.75	-0.46	
UY	35.0	36.0	34.0	1.00	0.236	35.00	1.44	1.73	
VA									•
VC									•
VG									•
VH	30.0	28.0	29.0	1.00	0.236	29.00	-0.64	-0.35	
VI	30.0	30.0	30.0	0.00	0.000	30.00	-0.29	0.00	

• ≡ No data submitted — **TAG SYMBOLS** — ⇑ ≡ Above control limit

∅ ≡ Insufficient data — × ≡ Determined to be an outlier — ⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VJ									•
VM	31.0	29.0	30.0	1.00	0.236	30.00	-0.29	0.00	
VO	33.0	32.0	32.0	0.58	0.118	32.33	0.52	0.81	
VT									•
W	29.0	32.0	31.0	1.53	0.354	30.67	-0.06	0.23	
WE									•
WF	53.0	48.0	50.0	2.52	0.591	50.33	6.75	7.04	×
WO									•
X	31.0	31.0	28.0	1.73	0.354	30.00	-0.29	0.00	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00	×	QJ	29.67		DE	30.67		PW
11.00	×	MV	29.67		BO	30.67		LT
17.00	×	BG	29.67		BM	30.67		CM
18.67	×	P	30.00		X	30.67		BB
21.67		RK	30.00		VM	31.00		UN
22.00		HI	30.00		VI	31.00		QP
23.67		NK	30.00		JS	31.00		O
27.33		SX	30.00		J	31.00		I
27.33		BA	30.00		GQ	31.00		DD
27.67		QZ	30.00		FU	31.00		CO
27.67		A	30.00		EL	31.00		CK
28.00		PV	30.00		E	31.00		AU
28.33		T	30.00		CP	31.33		JY
28.33		RF	30.00		BC	31.33		IC
28.33		NJ	30.00		AW	31.33		FJ
28.33		AF	30.00		AK	31.33		EX
28.67		UW	30.00		AJ	31.33		CA
28.67		TQ	30.33		SZ	31.33		C
28.67		DL	30.33		SF	31.33		AL
29.00		VH	30.33		SD	31.67		SN
29.00		MA	30.33		S	31.67		PM
29.00		LF	30.33		PQ	31.67		MQ
29.00		KX	30.33		MP	31.67		HP
29.00		JE	30.33		LR	31.67		DO
29.00		GI	30.33		DM	31.67		CX
29.33		SC	30.33		BN	32.00		FZ
29.33		RZ	30.33		BL	32.00		CE
29.33		RU	30.33		AP	32.33		VO
29.33		QT	30.33		AH	32.33		U
29.33		PB	30.33		AE	32.33		SM
29.33		M	30.67		W	32.33		QW
29.67		TS	30.67		SR	32.33		HK
29.67		Q	30.67		SI	32.33		EB

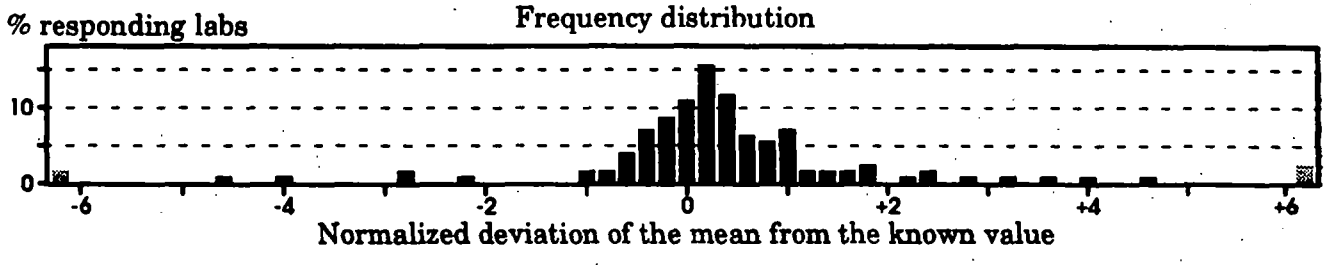
TAG SYMBOLS

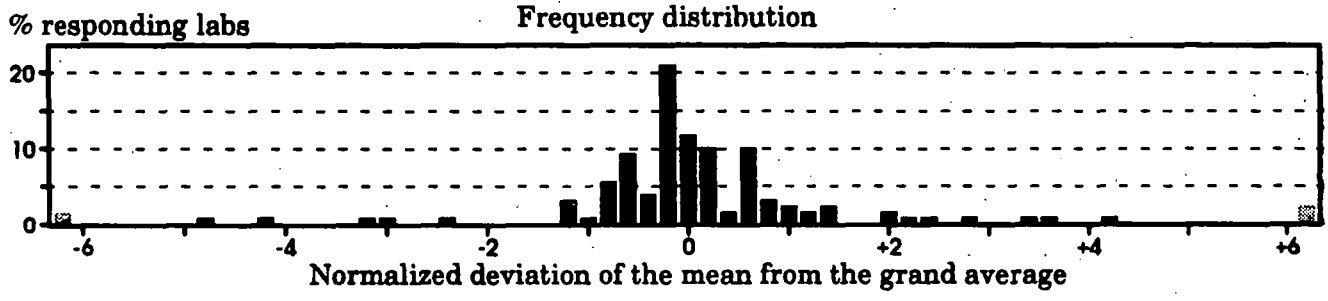
• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
32.33		AZ	33.33		PI	36.67		TD
32.67		UP	33.67		QX	37.00		JG
32.67		QU	34.00		NO	38.00		BK
32.67		FL	34.00		DT	39.00	⇑	CS
32.67		DZ	34.33		L	40.67	×	MY
32.67		CQ	34.33		DG	41.33	×	TL
32.67		BH	35.00		UY	43.00	×	UK
33.00		SS	35.00		GE	50.33	×	WF
33.00		K	35.00		CJ	52.00	×	HX
33.00		HL	36.33		TI	69.67	×	TH





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TAG SYMBOLS

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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

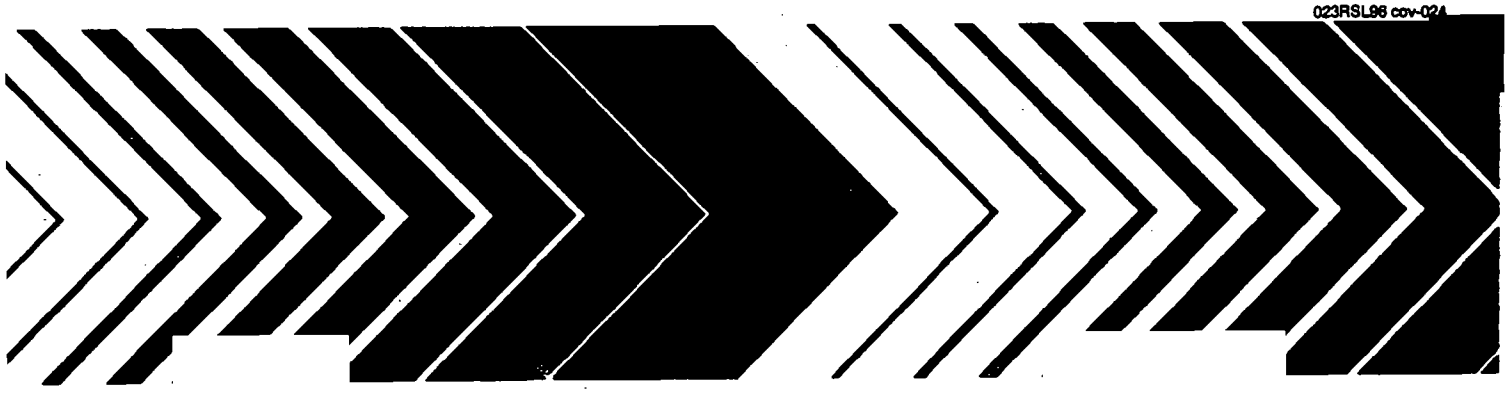
EPA/600/R-96/024
February 1996

EPA

Gross Alpha-Beta in Water Performance Evaluation Study

A Statistical Evaluation of the October 27, 1995 Data

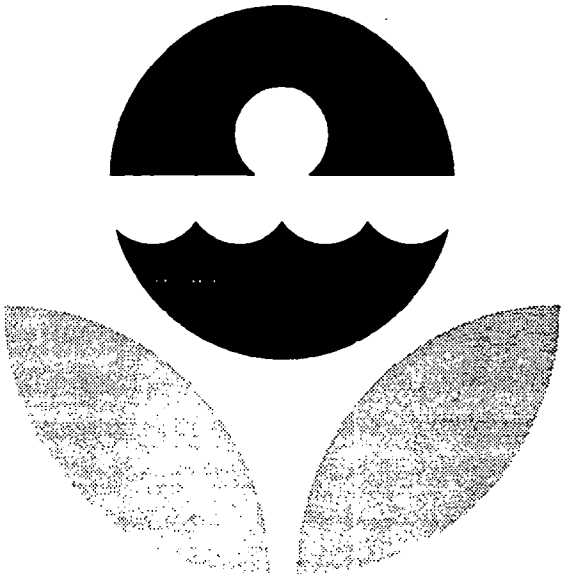
023RSL96 cov-024



Gross Alpha-Beta in Water

Performance Evaluation Study

October 27, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Analytical Sciences Branch (CRD-LV) Performance Evaluation Study for ***Gross Alpha-Beta in Water; October 27, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by
the U.S. Environmental Protection Agency.
It has been subjected to the Agency's review,
and has been approved for publication as
an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, CRD-LV, 702/798-2141.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EXPOSURE RESEARCH LABORATORY
P.O. BOX 93478 • LAS VEGAS, NV 89193-3478

OFFICE OF
RESEARCH AND DEVELOPMENT

A note regarding the Gross Alpha portion of the October 27, 1995 Gross Alpha-Beta in Water Performance Evaluation Study:

Both the July 1995 and October 1995 Gross Alpha-Beta in Water Performance Evaluation (PE) Studies showed a significant difference between the grand average and the known value for the gross alpha. This strongly implies there is bias in the method. Our research indicates that matrix differences between the salt solids used to prepare the calibration curve and the salts in the sample are the source of the bias.

The attached figure illustrates the changes in efficiency due to salt composition and nuclide energy. The bottom curve was prepared with serial dilutions of laboratory tap water. Laboratory tap water is also used to add variable amounts of dissolved solids to the PE gross alpha/beta study samples. The second curve was prepared with serial dilutions of sodium sulfate solution. The top curve was prepared the same way as the second curve except that Am-241 was used as the alpha emitter. All the usual precautions apply. The curves reflect the efficiencies for our counter; the curves in the figure are illustrative only; and lastly, results for your laboratory may be different than shown in the figure.

At zero mass all the curves converge to the extent that the bias would not be noticeable in a PE study. As the mass of solids increases, the difference between the two Th-230 curves becomes pronounced. For sample masses between 30 and 40 mg, typical range for a 200 mL sample of the July 1995 or October 1995 study, the difference is between 50 to 70 percent.

To address the bias, we are recommending the procedure used in our laboratory. To a volume of sample equal to that used for analysis (100-150 mL) add 120 pCi of Th-230. Acidify the sample with 20-40 mL of concentrated nitric acid and evaporate by the procedure attached to the PE study report sheet. The volume of PE sample provided is sufficient to prepare triplicate 150 mL samples and duplicate spiked samples. Count the spikes until approximately 1600 counts above background are acquired to a maximum of 200 minutes. Background in this case will be that of the PE samples. Subtract the average count rate of the triplicate samples from the average count rate of the spikes and calculate the efficiency. Use this efficiency to calculate the concentration of gross alpha in the PE sample.

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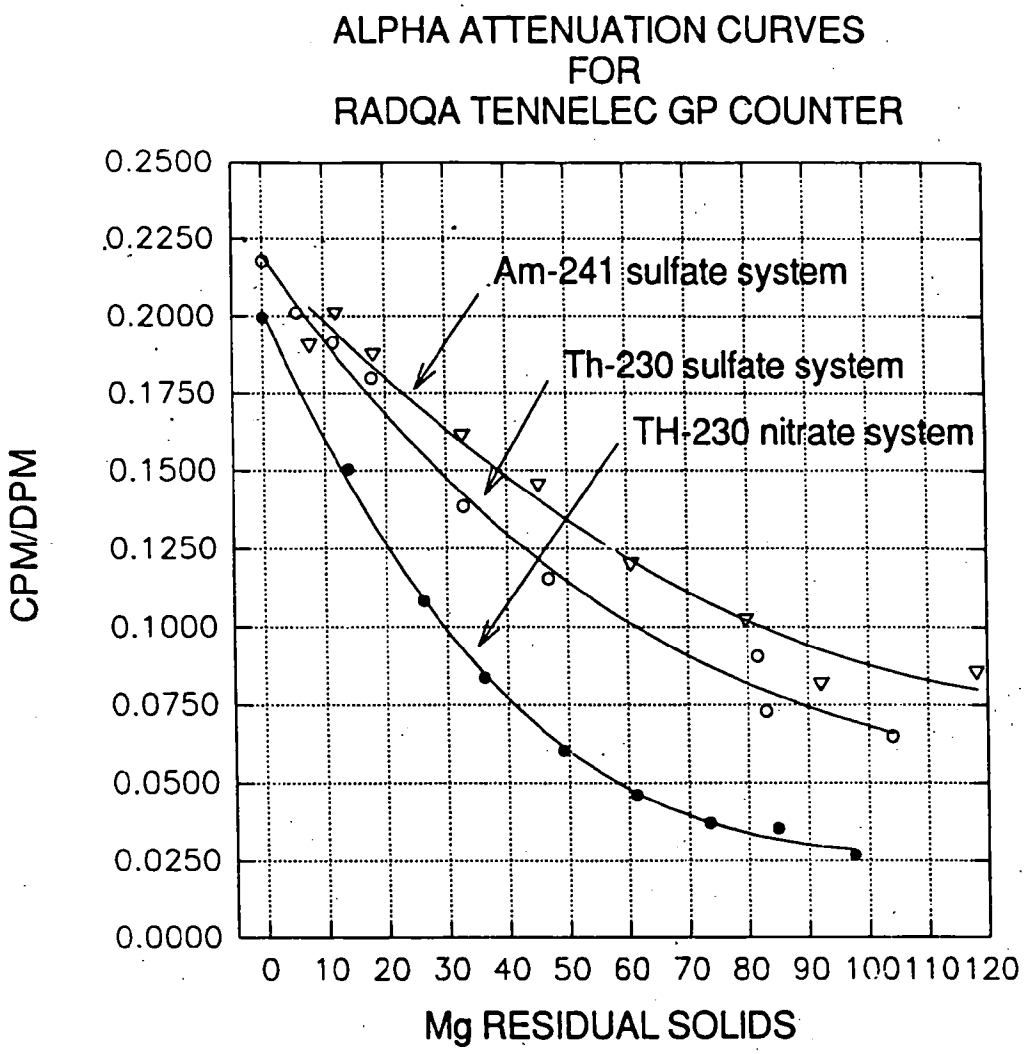
An alternate procedure. After counting the triplicates, redissolve/reslurry the solids of two of the samples in the planchet with dilute nitric acid (3-6M). Add the spike, mix well, redry and count the spikes. This technique, though simple on the surface, requires sufficient care so as not to lose sample volume, and that the Th-230 is thoroughly incorporated into the dissolved salts. We recommend this only for laboratories with a high degree of confidence in the analyst's ability to prepare the spikes by this technique.

You may use more or less spiked activity if you choose. The recommended activity of the spike and the maximum count time were determined to provide 5 percent precision at 95 percent confidence for the spike at an efficiency as low as 3 percent. For higher efficiencies the count time will be much shorter than 200 minutes. Additionally, we recommend several practice runs to gain experience with the technique you choose.

So, why not send out our laboratory tap water and have the participating laboratories prepare a curve? The tap water supplied to our laboratory varies in dissolved salt composition. This was observed during our verification of the July 1995 PE sample. Our QC samples showed a 40 percent bias when samples and spikes were quantified using a calibration curve. Repeat measurements demonstrated the bias was consistent and not due to analyst error. Therefore, preparing a curve with water from our laboratory does not guarantee that the bias will be eliminated.

Collectively these procedures are single point calibration techniques and are not prohibited by the approved methods. The curve concept was introduced in recognition of the variable dissolved solids of water in given geographical areas.

If you have any questions or comments please call Stephen Pia at 702 798-2102.

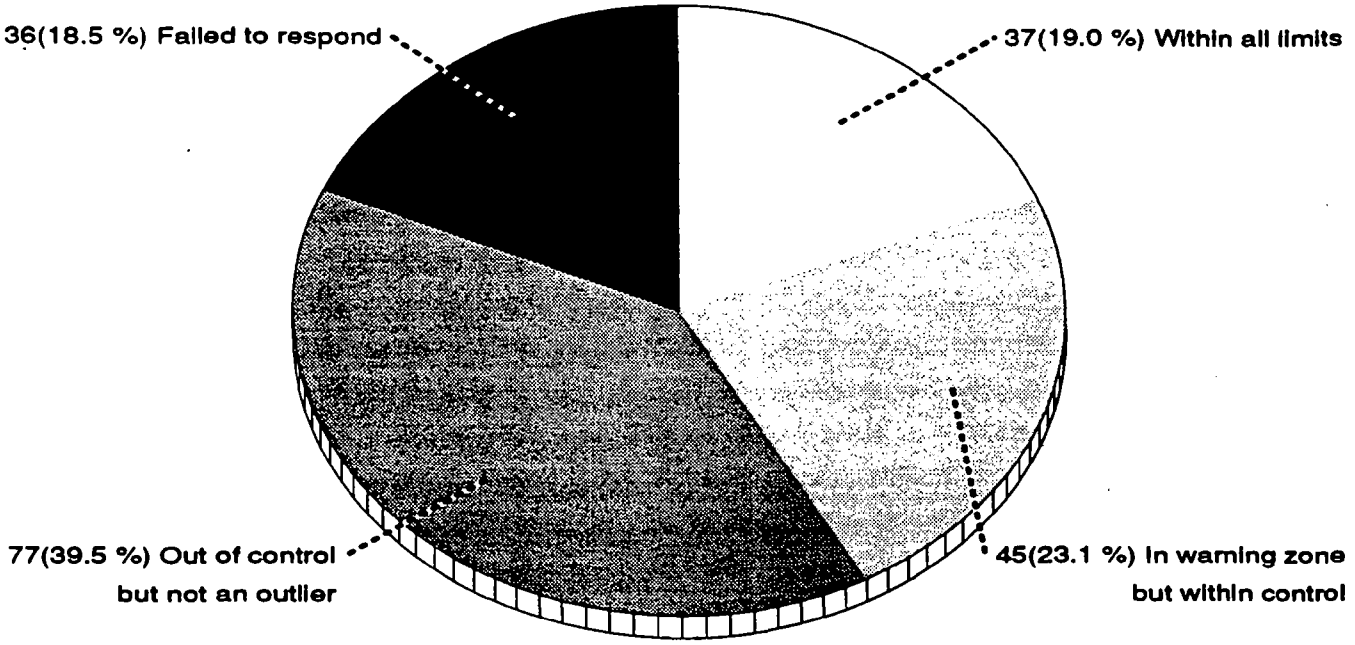


EQUATION: $Y = A_0 + A_1X + A_2X^2 + A_3X^3$

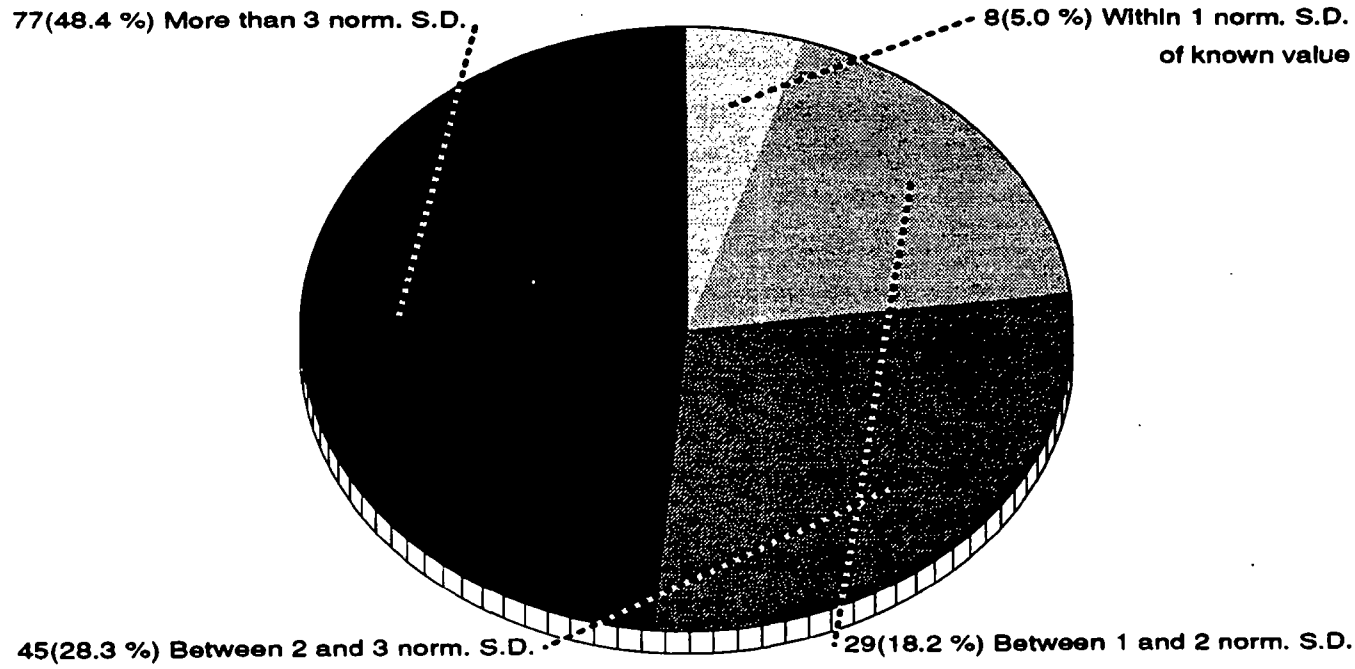
	Th-230 sulfate	Th-230 nitrate
A_0	0.2199	0.2016
A_1	-2.914E-3	-4.495E-3
A_2	1.8422E-5	3.918E-5
A_3	-4.4449E-8	-1.154E-7

Gross Alpha Statistical Summary 195 Participants

The known value of this nuclide is **51.2 pCi/l** with an expected precision of **12.8**; the control limits are 29.0 to 73.4; the warning regions are 29.0 to 36.4 and 66.0 to 73.4



Statistic	Respondents	Non-outliers
Mean	29.99	**Grand Avg 29.99**
Std. Dev.	8.68	8.68
Variance	75.27	75.27
% Coef. of Var.	28.93	28.93
% deviation of mean from known value	-41.43	-41.43
Norm. dev. of mean from known value	-2.45	-2.45
Median	29.67	29.67
% deviation of median from known value	-42.06	-42.06
Norm. dev. of median from known value	-2.48	-2.48



 CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Oct-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	41.0	36.8	44.5	3.86	0.355	40.77	1.46	-1.41	
AE	22.6	19.0	20.0	1.86	0.166	20.53	-1.28	-4.15	⇓
AF	20.8	21.5	24.4	1.91	0.166	22.23	-1.05	-3.92	⇓
AH	23.8	26.0	23.6	1.33	0.111	24.47	-0.75	-3.62	⇓
AJ									•
AK	27.4	28.5	33.1	3.02	0.263	29.67	-0.04	-2.91	
AL	35.9	37.3	43.2	3.87	0.337	38.80	1.19	-1.68	
AN	22.7	17.4	23.9	3.46	0.300	21.33	-1.17	-4.04	⇓
AP	36.3	34.5	39.2	2.37	0.217	36.67	0.90	-1.97	
AR	42.0	39.0	40.0	1.53	0.138	40.33	1.40	-1.47	
AU	35.8	28.4	28.6	4.22	0.341	30.93	0.13	-2.74	
AW	37.8	37.5	39.5	1.08	0.092	38.27	1.12	-1.75	
AZ	4.8	5.3	4.5	0.40	0.037	4.87	-3.40	-6.27	⇓
BA	25.4	22.1	21.8	2.00	0.166	23.10	-0.93	-3.80	⇓
BB									•
BC	37.5	36.7	35.6	0.95	0.088	36.60	0.89	-1.98	
BG	28.0	26.0	26.0	1.15	0.092	26.67	-0.45	-3.32	⇓
BH	27.8	25.2	28.4	1.70	0.148	27.13	-0.39	-3.26	⇓
BI	26.0	22.0	22.0	2.31	0.185	23.33	-0.90	-3.77	⇓
BK	32.9	34.9	33.6	1.01	0.092	33.80	0.52	-2.35	
BL	58.1	43.1	59.0	8.93	0.734	53.40	3.17	0.30	
BM	41.6	33.0	33.6	4.80	0.397	36.07	0.82	-2.05	
BN	20.4	18.9	21.7	1.40	0.129	20.33	-1.31	-4.18	⇓
BO	30.4	31.4	32.2	0.90	0.083	31.33	0.18	-2.69	
BS	25.8	26.1	22.3	2.11	0.175	24.73	-0.71	-3.58	⇓
C	39.3	36.5	37.7	1.40	0.129	37.83	1.06	-1.81	
CA	35.2	35.1	40.4	3.03	0.245	36.90	0.94	-1.94	
CE	28.5	25.2	33.9	4.39	0.401	29.20	-0.11	-2.98	
CG	22.2	25.9	26.4	2.29	0.194	24.83	-0.70	-3.57	⇓
CJ	37.0	40.0	34.0	3.00	0.277	37.00	0.95	-1.92	
CK	35.1	30.3	33.4	2.43	0.222	32.93	0.40	-2.47	
CO	26.5	18.8	33.0	7.11	0.655	26.10	-0.53	-3.40	⇓
CP	23.0	18.0	21.0	2.52	0.231	20.67	-1.26	-4.13	⇓
CQ	25.7	26.3	22.7	1.93	0.166	24.90	-0.69	-3.56	⇓
CS	40.5	39.3	37.9	1.30	0.120	39.23	1.25	-1.62	
CX									•
D									•
DB	35.0	33.0	34.6	1.06	0.092	34.20	0.57	-2.30	
DD	33.9	31.3	35.6	2.17	0.198	33.60	0.49	-2.38	
DE	46.8	46.9	47.0	0.10	0.009	46.90	2.29	-0.58	
DH	23.0	20.3	21.8	1.35	0.125	21.70	-1.12	-3.99	⇓
DI	25.1	25.8	19.5	3.45	0.291	23.47	-0.88	-3.75	⇓
DM									•
DO	59.0	51.0	60.0	4.93	0.415	56.67	3.61	0.74	
DR									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DS	18.6	15.7	20.7	2.51	0.231	18.33	-1.58	-4.45	⇓
DT	37.3	35.0	35.8	1.17	0.106	36.03	0.82	-2.05	
DZ	34.0	38.1	36.1	2.05	0.189	36.07	0.82	-2.05	
E	30.0	35.5	39.2	4.63	0.425	34.90	0.66	-2.21	
EB	37.5	40.3	43.0	2.75	0.254	40.27	1.39	-1.48	
EL	25.0	19.8	18.4	3.48	0.305	21.07	-1.21	-4.08	⇓
EO	21.0	29.0	27.0	4.16	0.369	25.67	-0.58	-3.46	⇓
ER	33.8	35.3	34.2	0.78	0.069	34.43	0.60	-2.27	
EV	23.5	23.2	23.4	0.15	0.014	23.37	-0.90	-3.77	⇓
EW									•
EX									•
FF	26.0	27.0	32.0	3.21	0.277	28.33	-0.22	-3.09	⇓
FJ									•
FL									•
FN	32.0	29.0	34.0	2.52	0.231	31.67	0.23	-2.64	
FZ	23.6	25.8	33.4	5.14	0.452	27.60	-0.32	-3.19	⇓
GE									•
GQ									•
GT									•
GZ	46.2	37.6	39.4	4.54	0.397	41.07	1.50	-1.37	
HI	18.0	23.0	20.0	2.52	0.231	20.33	-1.31	-4.18	⇓
HK	24.6	23.1	25.0	1.00	0.088	24.23	-0.78	-3.65	⇓
HL	22.7	22.7	22.7	0.01	0.000	22.70	-0.99	-3.86	⇓
HP	35.8	30.1	29.2	3.58	0.305	31.70	0.23	-2.64	
I	29.4	44.1	29.0	8.60	0.697	34.17	0.57	-2.30	
IC	18.6	21.7	19.6	1.58	0.143	19.97	-1.36	-4.23	⇓
ID	23.6	22.9	20.3	1.74	0.152	22.27	-1.04	-3.92	⇓
J	49.5	48.9	54.2	2.90	0.245	50.87	2.83	-0.05	
JE									•
JG	23.2	22.8	22.5	0.35	0.032	22.83	-0.97	-3.84	⇓
JM	25.0	27.3	28.5	1.78	0.162	26.93	-0.41	-3.28	⇓
JN	33.8	42.7	36.6	4.55	0.411	37.70	1.04	-1.83	
JP	30.6	30.5	29.3	0.72	0.060	30.13	0.02	-2.85	
JQ	37.7	40.8	43.8	3.05	0.281	40.77	1.46	-1.41	
JS	29.1	29.8	33.3	2.25	0.194	30.73	0.10	-2.77	
JY									•
K	24.4	31.6	29.0	3.65	0.332	28.33	-0.22	-3.09	⇓
KE	31.0	42.1	35.8	5.57	0.512	36.30	0.85	-2.02	
KH	40.5	38.0	39.0	1.26	0.115	39.17	1.24	-1.63	
KT	36.0	38.0	40.0	2.00	0.185	38.00	1.08	-1.79	
KX	20.0	24.0	22.0	2.00	0.185	22.00	-1.08	-3.95	⇓
L	40.0	39.8	46.8	3.98	0.323	42.20	1.65	-1.22	
LF	32.0	32.0	32.0	0.00	0.000	32.00	0.27	-2.60	
LL									•
LR	11.6	10.6	12.9	1.15	0.106	11.70	-2.47	-5.35	⇓

• ≡ No data submitted — **TAG SYMBOLS** — ⇑ ≡ Above control limit

∅ ≡ Insufficient data — × ≡ Determined to be an outlier — ⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Oct-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LT	21.1	26.8	22.0	3.06	0.263	23.30	-0.90	-3.78	⇓
M	19.0	22.0	18.0	2.08	0.185	19.67	-1.40	-4.27	⇓
MA									•
MF	34.7	35.3	33.7	0.81	0.074	34.57	0.62	-2.25	
MQ	31.0	34.0	36.0	2.52	0.231	33.67	0.50	-2.37	
MV	41.0	42.0	40.0	1.00	0.092	41.00	1.49	-1.38	
MX	14.9	15.7	17.9	1.55	0.138	16.17	-1.87	-4.74	⇓
MY									•
N									•
NA	38.7	36.6	40.8	2.10	0.194	38.70	1.18	-1.69	
NB	18.6	15.2	14.0	2.39	0.212	15.93	-1.90	-4.77	⇓
NJ	21.0	21.0	22.0	0.58	0.046	21.33	-1.17	-4.04	⇓
NK	27.2	31.3	26.1	2.74	0.240	28.20	-0.24	-3.11	⇓
NO	27.0	28.0	29.0	1.00	0.092	28.00	-0.27	-3.14	⇓
NP	33.3	46.6	30.3	8.68	0.752	36.73	0.91	-1.96	
NT	25.3	27.9	26.6	1.30	0.120	26.60	-0.46	-3.33	⇓
O	37.6	41.3	40.5	1.95	0.171	39.80	1.33	-1.54	
OA	23.0	27.0	28.0	2.65	0.231	26.00	-0.54	-3.41	⇓
OB									•
OF	29.0	29.0	33.0	2.31	0.185	30.33	0.05	-2.82	
OS	32.0	30.0	33.0	1.53	0.138	31.67	0.23	-2.64	
OX	22.1	23.5	26.2	2.08	0.189	23.93	-0.82	-3.69	⇓
OY	33.0	34.0	32.0	1.00	0.092	33.00	0.41	-2.46	
OZ	25.1	21.4	23.6	1.86	0.171	23.37	-0.90	-3.77	⇓
P	37.5	33.0	36.5	2.36	0.208	35.67	0.77	-2.10	
PB	50.5	48.6	47.8	1.39	0.125	48.97	2.57	-0.30	
PG	39.1	39.1	39.3	0.12	0.009	39.17	1.24	-1.63	
PM	44.5	42.2	38.7	2.92	0.268	41.80	1.60	-1.27	
PQ	29.0	35.9	26.5	4.87	0.434	30.47	0.07	-2.81	
PR	52.7	49.6	53.2	1.95	0.166	51.83	2.96	0.09	
PV	38.0	26.7	37.0	6.26	0.521	33.90	0.53	-2.34	
Q	21.2	18.9	17.6	1.82	0.166	19.23	-1.46	-4.33	⇓
QC	23.3	26.9	20.6	3.16	0.291	23.60	-0.86	-3.73	⇓
QM									•
QP	33.0	35.0	26.0	4.73	0.415	31.33	0.18	-2.69	
QQ	37.6	35.7	38.3	1.35	0.120	37.20	0.98	-1.89	
QT	39.5	33.3	31.0	4.40	0.392	34.60	0.62	-2.25	
QU	18.7	18.5	18.5	0.12	0.009	18.57	-1.55	-4.42	⇓
QW	17.2	19.1	18.3	0.95	0.088	18.20	-1.59	-4.47	⇓
QX	20.8	20.2	19.6	0.60	0.055	20.20	-1.32	-4.19	⇓
QZ	28.9	33.4	31.7	2.27	0.208	31.33	0.18	-2.69	
R	26.2	23.6	24.9	1.30	0.120	24.90	-0.69	-3.56	⇓
RB	26.9	23.3	20.6	3.16	0.291	23.60	-0.86	-3.73	⇓
RD	35.5	34.6	36.2	0.80	0.074	35.43	0.74	-2.13	
RG	27.9	28.8	27.0	0.90	0.083	27.90	-0.28	-3.15	⇓

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RI	28.3	27.1	24.5	1.94	0.175	26.63	-0.45	-3.32	⇓
RR	30.0	34.0	30.0	2.31	0.185	31.33	0.18	-2.69	
RU									•
RV	27.6	31.0	28.6	1.75	0.157	29.07	-0.12	-3.00	
RW	26.6	27.4	27.0	0.40	0.037	27.00	-0.40	-3.27	⇓
RZ	43.4	44.3	42.0	1.16	0.106	43.23	1.79	-1.08	
S	34.8	36.3	35.9	0.78	0.069	35.67	0.77	-2.10	
SC	25.6	24.6	29.0	2.31	0.203	26.40	-0.49	-3.36	⇓
SD	25.9	25.1	26.3	0.61	0.055	25.77	-0.57	-3.44	⇓
SF	33.2	35.3	37.1	1.95	0.180	35.20	0.71	-2.17	
SG									•
SI	24.5	25.1	27.9	1.81	0.157	25.83	-0.56	-3.43	⇓
SL	35.0	38.6	36.5	1.81	0.166	36.70	0.91	-1.96	
SM	25.7	27.0	25.5	0.81	0.069	26.07	-0.53	-3.40	⇓
SN	24.1	22.2	26.7	2.26	0.208	24.33	-0.76	-3.64	⇓
SO	35.3	33.8	34.4	0.75	0.069	34.50	0.61	-2.26	
SR	33.8	39.7	36.9	2.95	0.272	36.80	0.92	-1.95	
SS	21.0	18.7	22.8	2.06	0.189	20.83	-1.24	-4.11	⇓
ST	30.4	27.0	27.1	1.93	0.157	28.17	-0.25	-3.12	⇓
SU									•
SX	35.4	41.3	37.3	3.01	0.272	38.00	1.08	-1.79	
SZ	34.0	34.5	29.7	2.64	0.222	32.73	0.37	-2.50	
T	28.3	30.1	27.9	1.17	0.102	28.77	-0.17	-3.04	⇓
TD	46.3	42.2	47.4	2.74	0.240	45.30	2.07	-0.80	
TG	20.0	20.5	20.2	0.25	0.023	20.23	-1.32	-4.19	⇓
TH	33.3	37.1	36.6	2.06	0.175	35.67	0.77	-2.10	
TI	22.5	29.6	27.7	3.68	0.328	26.60	-0.46	-3.33	⇓
TJ									•
TL	37.4	33.8	26.9	5.34	0.485	32.70	0.37	-2.50	
TN	20.5	20.9	18.2	1.46	0.125	19.87	-1.37	-4.24	⇓
TO									•
TQ	34.1	35.2	34.6	0.55	0.051	34.63	0.63	-2.24	
TW									•
TY	34.3	20.4	22.8	7.43	0.641	25.83	-0.56	-3.43	⇓
U	33.1	31.3	31.0	1.14	0.097	31.80	0.25	-2.63	
UA									•
UE									•
UN	24.3	24.4	24.3	0.06	0.005	24.33	-0.76	-3.64	⇓
UP	46.7	39.8	48.9	4.75	0.420	45.13	2.05	-0.82	
UQ	30.0	31.0	28.0	1.53	0.138	29.67	-0.04	-2.91	
UW	33.4	32.8	28.2	2.84	0.240	31.47	0.20	-2.67	
UY									•
VA									•
VC	7.9	8.7	9.0	0.57	0.051	8.53	-2.90	-5.77	⇓
VG									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Oct-1995

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VH	21.4	23.6	22.4	1.10	0.102	22.47	-1.02	-3.89	⇓
VI	22.0	23.9	18.2	2.90	0.263	21.37	-1.17	-4.04	⇓
VJ	14.7	19.9	19.2	2.82	0.240	17.93	-1.63	-4.50	⇓
VO	30.1	26.6	26.7	1.99	0.162	27.80	-0.30	-3.17	⇓
VT									•
W	48.4	41.0	39.1	4.91	0.429	42.83	1.74	-1.13	
WD									•
WE	29.3	11.7	9.1	10.99	0.932	16.70	-1.80	-4.67	⇓
WF	16.0	18.0	22.0	3.06	0.277	18.67	-1.53	-4.40	⇓
WH									•
WJ	22.6	24.9	22.3	1.42	0.120	23.27	-0.91	-3.78	⇓
WK	25.4	30.0	30.9	2.95	0.254	28.77	-0.17	-3.04	⇓
WN									•
WO	29.4	34.8	28.0	3.59	0.314	30.73	0.10	-2.77	
X	17.9	15.5	18.4	1.55	0.134	17.27	-1.72	-4.59	⇓

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
4.87	⇓	AZ	21.70	⇓	DH	25.83	⇓	TY
8.53	⇓	VC	22.00	⇓	KX	25.83	⇓	SI
11.70	⇓	LR	22.23	⇓	AF	26.00	⇓	OA
15.93	⇓	NB	22.27	⇓	ID	26.07	⇓	SM
16.17	⇓	MX	22.47	⇓	VH	26.10	⇓	CO
16.70	⇓	WE	22.70	⇓	HL	26.40	⇓	SC
17.27	⇓	X	22.83	⇓	JG	26.60	⇓	TI
17.93	⇓	VJ	23.10	⇓	BA	26.60	⇓	NT
18.20	⇓	QW	23.27	⇓	WJ	26.63	⇓	RI
18.33	⇓	DS	23.30	⇓	LT	26.67	⇓	BG
18.57	⇓	QU	23.33	⇓	BI	26.93	⇓	JM
18.67	⇓	WF	23.37	⇓	OZ	27.00	⇓	RW
19.23	⇓	Q	23.37	⇓	EV	27.13	⇓	BH
19.67	⇓	M	23.47	⇓	DI	27.60	⇓	FZ
19.87	⇓	TN	23.60	⇓	RB	27.80	⇓	VO
19.97	⇓	IC	23.60	⇓	QC	27.90	⇓	RG
20.20	⇓	QX	23.93	⇓	OX	28.00	⇓	NO
20.23	⇓	TG	24.23	⇓	HK	28.17	⇓	ST
20.33	⇓	HI	24.33	⇓	UN	28.20	⇓	NK
20.33	⇓	BN	24.33	⇓	SN	28.33	⇓	K
20.53	⇓	AE	24.47	⇓	AH	28.33	⇓	FF
20.67	⇓	CP	24.73	⇓	BS	28.77	⇓	WK
20.83	⇓	SS	24.83	⇓	CG	28.77	⇓	T
21.07	⇓	EL	24.90	⇓	R	29.07		RV
21.33	⇓	NJ	24.90	⇓	CQ	29.20		CE
21.33	⇓	AN	25.67	⇓	EO	29.67		UQ
21.37	⇓	VI	25.77	⇓	SD	29.67		AK

• ≡ No data submitted
∅ ≡ Insufficient data

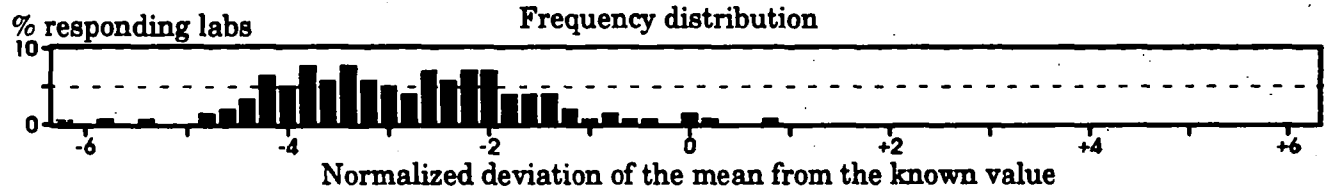
TAG SYMBOLS
× ≡ Determined to be an outlier

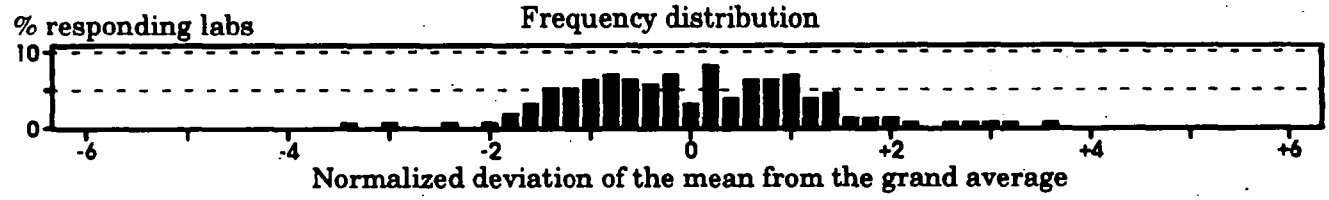
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
30.13		JP	34.43		ER	38.00		KT
30.33		OF	34.50		SO	38.27		AW
30.47		PQ	34.57		MF	38.70		NA
30.73		WO	34.60		QT	38.80		AL
30.73		JS	34.63		TQ	39.17		PG
30.93		AU	34.90		E	39.17		KH
31.33		RR	35.20		SF	39.23		CS
31.33		QZ	35.43		RD	39.80		O
31.33		QP	35.67		TH	40.27		EB
31.33		BO	35.67		S	40.33		AR
31.47		UW	35.67		P	40.77		JQ
31.67		OS	36.03		DT	40.77		A
31.67		FN	36.07		DZ	41.00		MV
31.70		HP	36.07		BM	41.07		GZ
31.80		U	36.30		KE	41.80		PM
32.00		LF	36.60		BC	42.20		L
32.70		TL	36.67		AP	42.83		W
32.73		SZ	36.70		SL	43.23		RZ
32.93		CK	36.73		NP	45.13		UP
33.00		OY	36.80		SR	45.30		TD
33.60		DD	36.90		CA	46.90		DE
33.67		MQ	37.00		CJ	48.97		PB
33.80		BK	37.20		QQ	50.87		J
33.90		PV	37.70		JN	51.83		PR
34.17		I	37.83		C	53.40		BL
34.20		DB	38.00		SX	56.67		DO





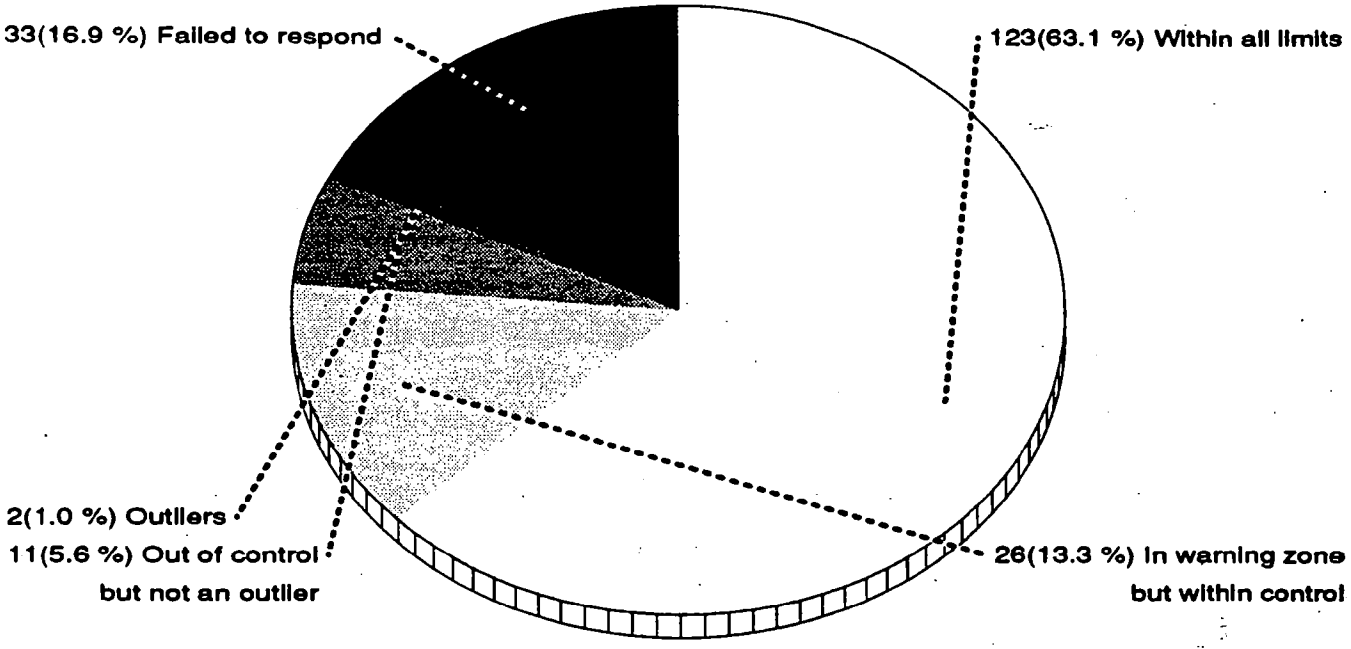
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

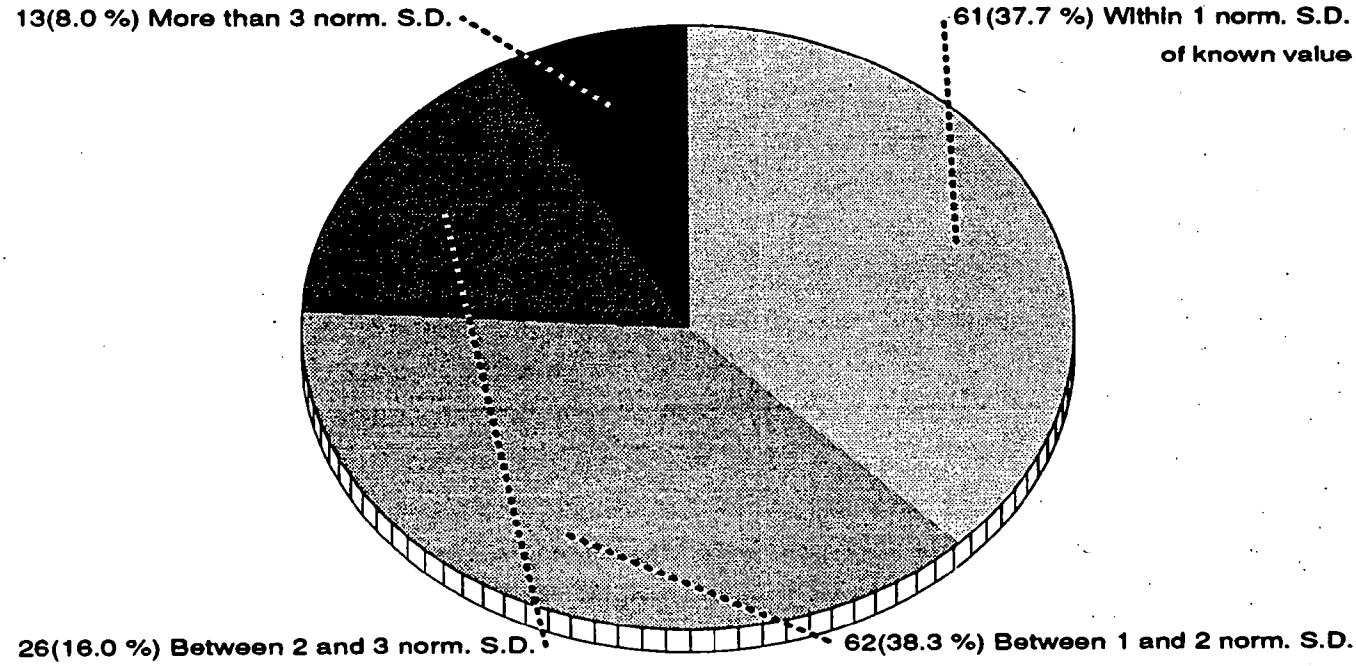
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta Statistical Summary 195 Participants

The known value of this nuclide is **24.8 pCi/l** with an expected precision of **5.0**; the control limits are 16.1 to 33.5; the warning regions are 16.1 to 19.0 and 30.6 to 33.5



Statistic	Respondents	Non-outliers
Mean	27.16	**Grand Avg 27.09**
Std. Dev.	5.16	4.43
Variance	26.67	19.58
% Coef. of Var.	19.01	16.34
% deviation of mean from known value	9.53	9.23
Norm. dev. of mean from known value	0.46	0.52
Median	27.50	27.50
% deviation of median from known value	10.89	10.89
Norm. dev. of median from known value	0.52	0.61



CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Oct-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	27.6	28.1	25.2	1.55	0.343	26.97	-0.04	0.75	
AE	25.7	22.0	24.3	1.87	0.437	24.00	-1.07	-0.28	
AF	28.7	23.6	25.1	2.62	0.602	25.80	-0.45	0.35	
AH	30.4	28.7	28.1	1.19	0.272	29.07	0.68	1.48	
AJ									•
AK	29.4	33.9	30.1	2.42	0.532	31.13	1.40	2.19	
AL	27.2	28.6	26.7	0.98	0.224	27.50	0.14	0.94	
AN	34.1	35.4	32.8	1.30	0.307	34.10	2.43	3.22	⇑
AP	25.5	24.9	23.8	0.86	0.201	24.73	-0.82	-0.02	
AR	29.0	31.0	30.0	1.00	0.236	30.00	1.01	1.80	
AU	31.6	31.3	31.7	0.21	0.047	31.53	1.54	2.33	
AW	31.0	31.3	31.6	0.30	0.071	31.30	1.46	2.25	
AZ	20.4	18.4	13.8	3.38	0.780	17.53	-3.31	-2.52	
BA	27.9	32.5	26.1	3.30	0.756	28.83	0.60	1.40	
BB									•
BC	19.6	22.1	19.9	1.37	0.295	20.53	-2.27	-1.48	
BG	27.0	27.0	27.0	0.00	0.000	27.00	-0.03	0.76	
BH	26.9	26.4	27.8	0.71	0.165	27.03	-0.02	0.77	
BI	42.0	38.0	36.0	3.06	0.709	38.67	4.01	4.80	⇑
BK	30.5	30.7	32.0	0.81	0.177	31.07	1.38	2.17	
BL	26.1	28.0	30.2	2.05	0.484	28.10	0.35	1.14	
BM	30.4	30.7	30.2	0.25	0.059	30.43	1.16	1.95	
BN	23.7	25.3	27.5	1.91	0.449	25.50	-0.55	0.24	
BO	22.5	25.3	26.4	2.01	0.461	24.73	-0.82	-0.02	
BS	30.9	30.3	29.9	0.50	0.118	30.37	1.14	1.93	
C	22.2	24.3	22.4	1.16	0.248	22.97	-1.43	-0.64	
CA	26.1	23.2	23.6	1.57	0.343	24.30	-0.97	-0.17	
CE	27.5	26.0	25.2	1.17	0.272	26.23	-0.30	0.50	
CG	21.8	23.9	21.0	1.50	0.343	22.23	-1.68	-0.89	
CJ	25.0	27.0	24.0	1.53	0.354	25.33	-0.61	0.18	
CK	28.1	31.9	31.8	2.17	0.449	30.60	1.22	2.01	
CO	16.8	20.2	20.6	2.09	0.449	19.20	-2.73	-1.94	
CP	31.0	27.0	29.0	2.00	0.473	29.00	0.66	1.45	
CQ	27.0	28.0	29.0	1.00	0.236	28.00	0.32	1.11	
CS	24.0	27.0	24.2	1.68	0.354	25.07	-0.70	0.09	
CX									•
D									•
DB	29.5	26.8	27.3	1.44	0.319	27.87	0.27	1.06	
DD	31.3	29.1	29.7	1.14	0.260	30.03	1.02	1.81	
DE	25.3	25.4	25.4	0.06	0.012	25.37	-0.60	0.20	
DH	28.7	28.6	27.8	0.49	0.106	28.37	0.44	1.24	
DI	20.5	20.8	21.4	0.46	0.106	20.90	-2.14	-1.35	
DM	29.6	27.6	30.6	1.53	0.354	29.27	0.75	1.55	
DO	26.0	18.0	26.0	4.62	0.945	23.33	-1.30	-0.51	
DR									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DS	23.2	20.8	33.4	6.69	1.930	25.80	-0.45	0.35	
DT	29.7	30.4	28.6	0.91	0.213	29.57	0.86	1.65	
DZ	25.0	26.9	23.5	1.70	0.402	25.13	-0.68	0.12	
E	30.1	30.2	29.5	0.38	0.083	29.93	0.99	1.78	
EB	30.5	30.8	29.5	0.68	0.154	30.27	1.10	1.89	
EL	27.0	28.3	28.4	0.78	0.165	27.90	0.28	1.07	
EO	29.0	29.0	30.0	0.58	0.118	29.33	0.78	1.57	
ER									•
EV	26.9	27.1	27.7	0.42	0.095	27.23	0.05	0.84	
EW	31.5	27.1	30.6	2.32	0.520	29.73	0.92	1.71	
EX									•
FF	27.0	26.0	26.0	0.58	0.118	26.33	-0.26	0.53	
FJ									•
FL									•
FN	31.0	30.0	28.0	1.53	0.354	29.67	0.89	1.69	
FZ	24.8	19.2	25.4	3.42	0.732	23.13	-1.37	-0.58	
GE	28.0	28.0	26.0	1.15	0.236	27.33	0.08	0.88	
GQ									•
GT									•
GZ									•
HI	24.0	22.0	26.0	2.00	0.473	24.00	-1.07	-0.28	
HK	30.1	31.6	31.4	0.81	0.177	31.03	1.37	2.16	
HL	29.0	29.0	29.0	0.00	0.000	29.00	0.66	1.45	
HP	35.4	33.6	36.6	1.51	0.354	35.20	2.81	3.60	⇑
I	33.4	31.0	33.2	1.33	0.284	32.53	1.89	2.68	
IC	26.0	28.9	27.1	1.46	0.343	27.33	0.08	0.88	
ID	28.9	26.9	25.7	1.62	0.378	27.17	0.03	0.82	
J	25.6	25.3	26.3	0.51	0.118	25.73	-0.47	0.32	
JE									•
JG	29.9	28.9	29.7	0.53	0.118	29.50	0.83	1.63	
JM	38.1	35.3	36.1	1.44	0.331	36.50	3.26	4.05	⇑
JN	25.5	29.0	29.1	2.05	0.425	27.87	0.27	1.06	
JP	26.0	26.2	26.5	0.25	0.059	26.23	-0.30	0.50	
JQ	15.1	19.2	40.1	13.41	4.721	24.80	-0.79	0.00	
JS	25.6	27.0	25.2	0.95	0.213	25.93	-0.40	0.39	
JY									•
K	27.3	28.8	25.9	1.45	0.343	27.33	0.08	0.88	
KE	24.0	27.3	23.6	2.03	0.437	24.97	-0.74	0.06	
KH	30.0	28.0	29.0	1.00	0.236	29.00	0.66	1.45	
KT	24.0	28.0	30.0	3.06	0.709	27.33	0.08	0.88	
KX	31.0	28.0	30.0	1.53	0.354	29.67	0.89	1.69	
L	25.1	25.3	24.7	0.31	0.071	25.03	-0.71	0.08	
LF	30.0	27.0	29.0	1.53	0.354	28.67	0.55	1.34	
LL									•
LR	23.3	13.7	13.0	5.76	1.413	16.67	-3.61	-2.82	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

13 / 16 CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Oct-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
LT	25.0	34.0	32.3	4.78	1.120	30.43	1.16	1.95	
M	9.6	8.6	10.6	1.00	0.236	9.60	-6.06	-5.27	×
MA	19.0	24.4	18.7	3.21	0.673	20.70	-2.21	-1.42	
MF	23.7	24.4	24.2	0.36	0.083	24.10	-1.04	-0.24	
MQ	36.0	28.0	30.0	4.16	0.945	31.33	1.47	2.26	
MV	28.0	32.0	30.0	2.00	0.473	30.00	1.01	1.80	
MX	19.9	16.3	18.9	1.86	0.425	18.37	-3.02	-2.23	
MY									•
N									•
NA	28.7	28.2	29.1	0.45	0.106	28.67	0.55	1.34	
NB	23.2	20.1	16.5	3.35	0.791	19.93	-2.48	-1.69	
NJ	22.6	21.0	20.0	1.31	0.307	21.20	-2.04	-1.25	
NK	32.6	33.8	33.5	0.62	0.142	33.30	2.15	2.94	
NO	24.0	25.0	26.0	1.00	0.236	25.00	-0.72	0.07	
NP	15.0	7.7	17.5	5.09	1.300	13.40	-4.74	-3.95	⇓
NT	28.9	29.2	29.1	0.15	0.035	29.07	0.68	1.48	
O	26.0	28.2	27.1	1.10	0.260	27.10	0.00	0.80	
OA	29.0	28.0	27.0	1.00	0.236	28.00	0.32	1.11	
OB									•
OF	24.0	23.0	23.0	0.58	0.118	23.33	-1.30	-0.51	
OS	30.0	31.0	29.0	1.00	0.236	30.00	1.01	1.80	
OX	28.9	27.9	31.1	1.64	0.378	29.30	0.77	1.56	
OY	20.0	19.0	19.0	0.58	0.118	19.33	-2.69	-1.89	
OZ	31.7	29.6	25.6	3.10	0.721	28.97	0.65	1.44	
P	30.4	28.0	33.8	2.91	0.685	30.73	1.26	2.06	
PB	25.7	26.1	26.9	0.61	0.142	26.23	-0.30	0.50	
PG	25.6	24.4	27.2	1.40	0.331	25.73	-0.47	0.32	
PM	27.8	31.3	26.9	2.32	0.520	28.67	0.55	1.34	
PQ	25.7	25.4	28.1	1.48	0.319	26.40	-0.24	0.55	
PR	32.0	30.5	29.7	1.17	0.272	30.73	1.26	2.06	
PV	29.5	19.5	22.9	5.08	1.345	23.97	-1.08	-0.29	
Q	30.2	31.5	30.2	0.75	0.154	30.63	1.23	2.02	
QC	23.6	24.1	25.7	1.10	0.248	24.47	-0.91	-0.12	
QM									•
QP	28.0	30.0	30.0	1.15	0.236	29.33	0.78	1.57	
QQ	30.6	29.1	31.3	1.12	0.260	30.33	1.12	1.92	
QT	24.9	47.1	26.5	12.38	4.091	32.83	1.99	2.78	
QU	21.3	20.0	18.7	1.30	0.307	20.00	-2.46	-1.66	
QW	20.2	18.4	18.6	0.99	0.213	19.07	-2.78	-1.99	
QX	27.6	28.0	26.9	0.56	0.130	27.50	0.14	0.94	
QZ	24.5	25.3	24.5	0.46	0.095	24.77	-0.80	-0.01	
R	38.1	27.8	33.0	5.15	1.413	32.97	2.04	2.83	
RB	25.7	24.1	23.6	1.10	0.248	24.47	-0.91	-0.12	
RD	31.6	29.8	31.3	0.96	0.213	30.90	1.32	2.11	
RG	31.0	31.8	31.2	0.42	0.095	31.33	1.47	2.26	

• ≡ No data submitted — **TAG SYMBOLS** — ⇑ ≡ Above control limit

∅ ≡ Insufficient data — × ≡ Determined to be an outlier — ⇓ ≡ Below control limit

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RI	30.3	29.4	27.3	1.54	0.354	29.00	0.66	1.45	
RR	30.0	28.0	27.0	1.53	0.354	28.33	0.43	1.22	
RU									•
RV	34.6	34.3	33.9	0.35	0.083	34.27	2.49	3.28	⇑
RW	16.6	19.8	18.2	1.60	0.378	18.20	-3.08	-2.29	
RZ	36.0	35.3	29.8	3.40	0.732	33.70	2.29	3.08	⇑
S	29.1	29.4	30.0	0.46	0.106	29.50	0.83	1.63	
SC	27.5	24.8	27.5	1.56	0.319	26.60	-0.17	0.62	
SD	16.7	14.4	18.7	2.15	0.508	16.60	-3.63	-2.84	
SF	29.3	29.0	30.8	0.96	0.213	29.70	0.90	1.70	
SG									•
SI	21.1	20.0	23.6	1.84	0.425	21.57	-1.91	-1.12	
SL	31.0	30.0	29.0	1.00	0.236	30.00	1.01	1.80	
SM	24.6	28.6	24.1	2.47	0.532	25.77	-0.46	0.33	
SN	27.3	27.9	26.7	0.60	0.142	27.30	0.07	0.87	
SO	26.7	28.8	29.6	1.50	0.343	28.37	0.44	1.24	
SR	28.5	34.4	31.4	2.95	0.697	31.43	1.50	2.30	
SS	24.9	23.0	22.0	1.47	0.343	23.30	-1.31	-0.52	
ST	25.7	27.9	28.0	1.30	0.272	27.20	0.04	0.83	
SU									•
SX	25.0	28.7	23.7	2.59	0.591	25.80	-0.45	0.35	
SZ	22.9	28.1	24.8	2.63	0.614	25.27	-0.63	0.16	
T	26.0	24.7	26.6	0.97	0.224	25.77	-0.46	0.33	
TD	15.8	16.8	19.2	1.75	0.402	17.27	-3.40	-2.61	
TG	18.2	20.6	18.7	1.27	0.284	19.17	-2.74	-1.95	
TH	21.2	28.9	23.5	3.95	0.910	24.53	-0.89	-0.09	
TI	30.2	29.6	29.5	0.38	0.083	29.77	0.93	1.72	
TJ									•
TL	36.9	36.2	33.2	1.97	0.437	35.43	2.89	3.68	⇑
TN	33.0	28.6	32.7	2.46	0.520	31.43	1.50	2.30	
TO									•
TQ	22.3	22.5	23.7	0.76	0.165	22.83	-1.47	-0.68	
TW									•
TY	30.7	31.0	27.7	1.82	0.390	29.80	0.94	1.73	
U	31.9	30.8	30.3	0.82	0.189	31.00	1.35	2.15	
UA									•
UE									•
UN	28.5	27.2	24.4	2.10	0.484	26.70	-0.13	0.66	
UP	35.8	39.5	29.8	4.90	1.278	35.03	2.75	3.54	⇑
UQ	28.0	29.0	29.0	0.58	0.118	28.67	0.55	1.34	
UW	29.5	29.9	29.5	0.23	0.047	29.63	0.88	1.67	
UY	26.5	26.7	25.6	0.59	0.130	26.27	-0.29	0.51	
VA									•
VC	18.9	18.2	20.3	1.07	0.248	19.13	-2.76	-1.96	
VG									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

15 / 16 CRD-LV Performance Evaluation: Gross Alpha-Beta in Water, 27-Oct-1995

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VH	27.9	26.5	22.7	2.69	0.614	25.70	-0.48	0.31	
VI	16.2	16.8	15.7	0.55	0.130	16.23	-3.76	-2.97	
VJ	22.9	23.4	22.4	0.50	0.118	22.90	-1.45	-0.66	
VO	35.7	32.1	34.5	1.83	0.425	34.10	2.43	3.22	⇑
VT									•
W	26.4	25.4	30.7	2.82	0.626	27.50	0.14	0.94	
WD									•
WE	23.4	38.9	26.0	8.30	2.583	29.43	0.81	1.61	
WF	29.0	29.0	27.0	1.15	0.236	28.33	0.43	1.22	
WH									•
WJ	31.7	42.2	33.5	5.62	1.458	35.80	3.02	3.81	⇑
WK	53.0	52.0	65.0	7.23	2.020	56.67	10.25	11.04	×
WN									•
WO	17.6	24.0	19.0	3.36	0.756	20.20	-2.39	-1.59	
X	29.0	29.8	32.2	1.67	0.378	30.33	1.12	1.92	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.60	×	M	23.30		SS	25.77		T
13.40	⇓	NP	23.33		OF	25.77		SM
16.23		VI	23.33		DO	25.80		SX
16.60		SD	23.97		PV	25.80		DS
16.67		LR	24.00		HI	25.80		AF
17.27		TD	24.00		AE	25.93		JS
17.53		AZ	24.10		MF	26.23		PB
18.20		RW	24.30		CA	26.23		JP
18.37		MX	24.47		RB	26.23		CE
19.07		QW	24.47		QC	26.27		UY
19.13		VC	24.53		TH	26.33		FF
19.17		TG	24.73		BO	26.40		PQ
19.20		CO	24.73		AP	26.60		SC
19.33		OY	24.77		QZ	26.70		UN
19.93		NB	24.80		JQ	26.97		A
20.00		QU	24.97		KE	27.00		BG
20.20		WO	25.00		NO	27.03		BH
20.53		BC	25.03		L	27.10		O
20.70		MA	25.07		CS	27.17		ID
20.90		DI	25.13		DZ	27.20		ST
21.20		NJ	25.27		SZ	27.23		EV
21.57		SI	25.33		CJ	27.30		SN
22.23		CG	25.37		DE	27.33		KT
22.83		TQ	25.50		BN	27.33		K
22.90		VJ	25.70		VH	27.33		IC
22.97		C	25.73		J	27.33		GE
23.13		FZ	25.73		PG	27.50		W

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

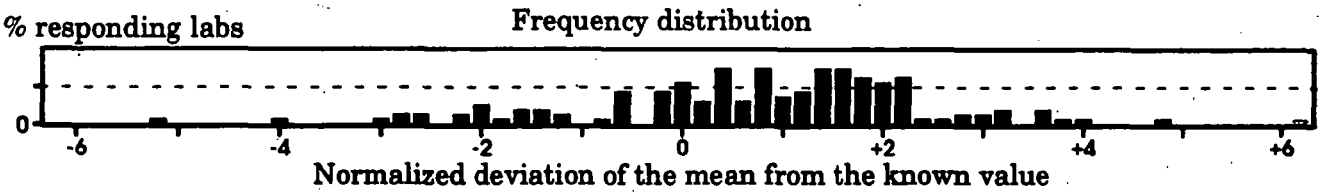
⇑ ≡ Above control limit

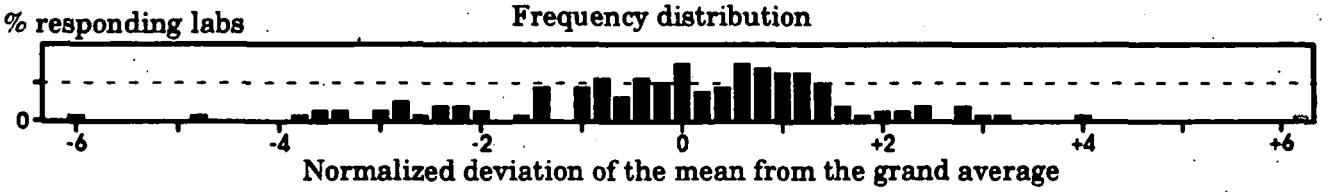
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
27.50		QX	29.33		EO	30.73		PR
27.50		AL	29.43		WE	30.90		RD
27.87		JN	29.50		S	31.00		U
27.87		DB	29.50		JG	31.03		HK
27.90		EL	29.57		DT	31.07		BK
28.00		OA	29.63		UW	31.13		AK
28.00		CQ	29.67		KX	31.30		AW
28.10		BL	29.67		FN	31.33		RG
28.33		WF	29.70		SF	31.33		MQ
28.33		RR	29.73		EW	31.43		TN
28.37		SO	29.77		TI	31.43		SR
28.37		DH	29.80		TY	31.53		AU
28.67		UQ	29.93		E	32.53		I
28.67		PM	30.00		SL	32.83		QT
28.67		NA	30.00		OS	32.97		R
28.67		LF	30.00		MV	33.30		NK
28.83		BA	30.00		AR	33.70	⇑	RZ
28.97		OZ	30.03		DD	34.10	⇑	VO
29.00		RI	30.27		EB	34.10	⇑	AN
29.00		KH	30.33		X	34.27	⇑	RV
29.00		HL	30.33		QQ	35.03	⇑	UP
29.00		CP	30.37		BS	35.20	⇑	HP
29.07		NT	30.43		LT	35.43	⇑	TL
29.07		AH	30.43		BM	35.80	⇑	WJ
29.27		DM	30.60		CK	36.50	⇑	JM
29.30		OX	30.63		Q	38.67	⇑	BI
29.33		QP	30.73		P	56.67	×	WK





• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-96/023
February 1996

EPA

Gamma in Water Performance Evaluation Study

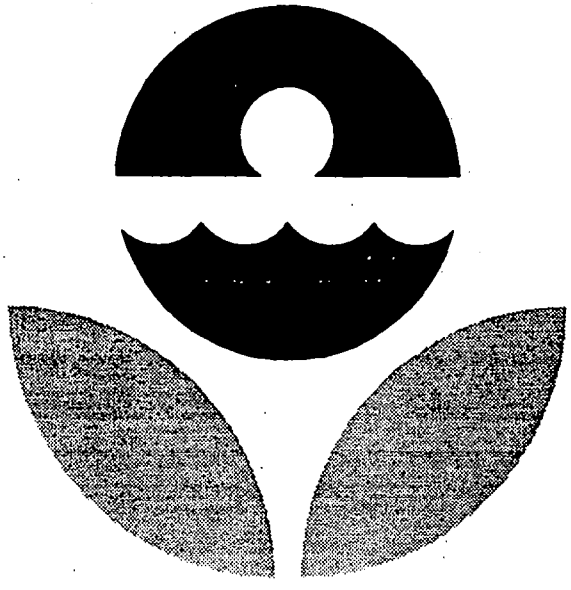
A Statistical Evaluation of the November 3, 1995 Data

023RSL96 cov-023

Gamma in Water

Performance Evaluation Study

November 3, 1995



Environmental Protection Agency

National Exposure Research Laboratory

Characterization Research Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
CHARACTERIZATION RESEARCH DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Analytical Sciences Branch (CRD-LV) Performance Evaluation Study for ***Gamma in Water; November 3, 1995.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by CRD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact George Dilbeck at 702/798-2104 or Patricia Honsa at 702/798-2141.

Sincerely,

George Dilbeck

George Dilbeck
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by
the U.S. Environmental Protection Agency.
It has been subjected to the Agency's review
and has been approved for publication as
an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

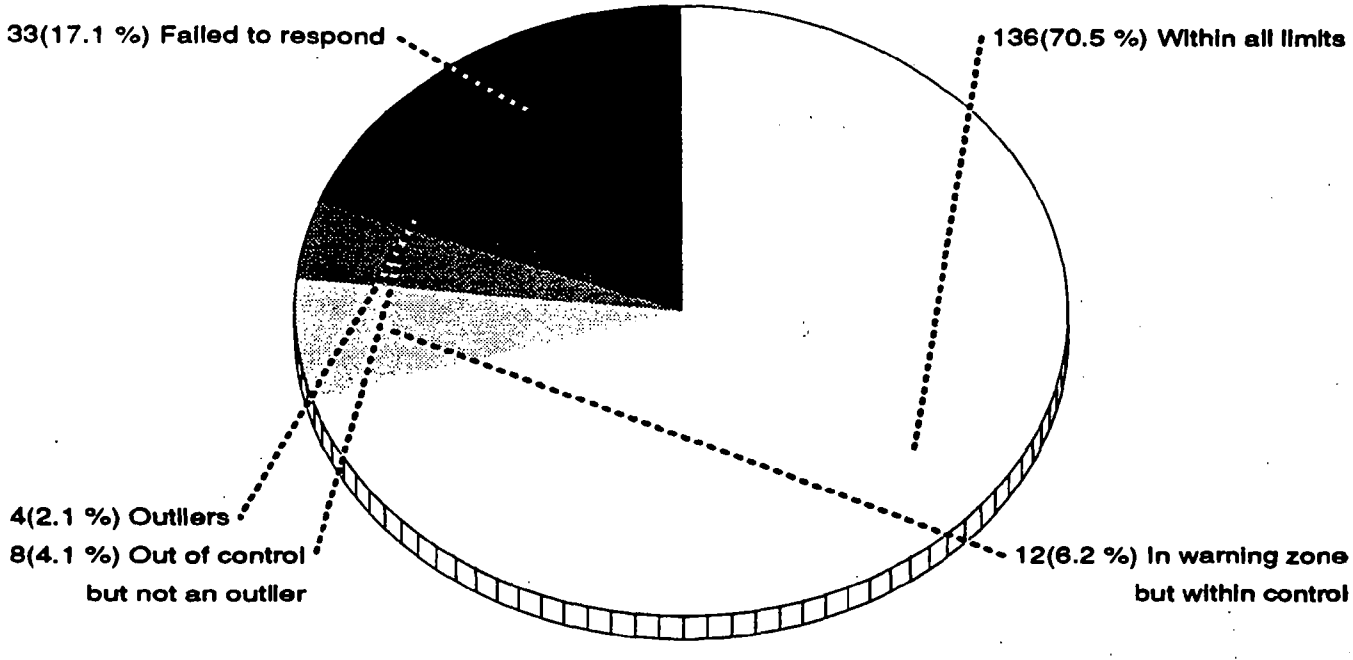
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

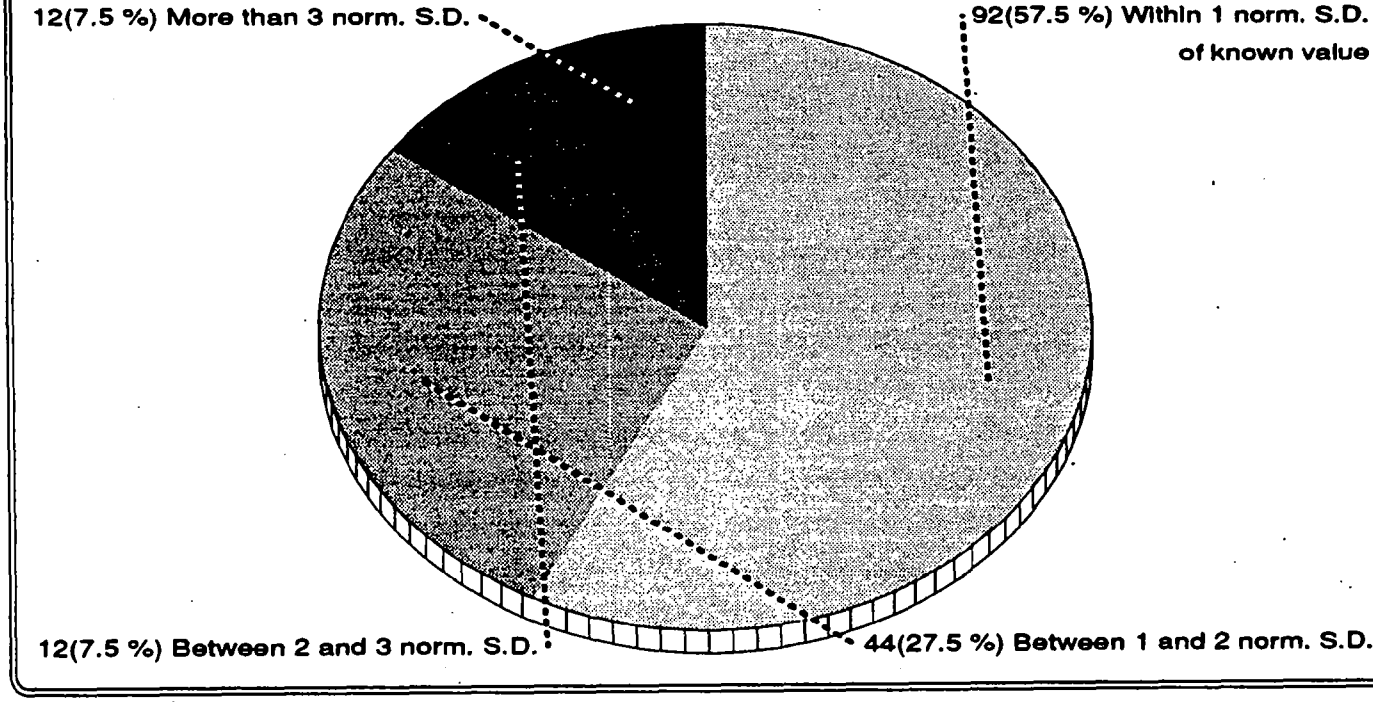
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, CRD-LV, 702/798-2141.

Cobalt-60 Statistical Summary 193 Participants

The known value of this nuclide is **60.0 pCi/l** with an expected precision of **5.0**; the control limits are 51.3 to 68.7; the warning regions are 51.3 to 54.2 and 65.8 to 68.7



Statistic	Respondents	Non-outliers
Mean	65.31	**Grand Avg 59.65**
Std. Dev.	47.67	4.05
Variance	2272.59	16.44
% Coef. of Var.	72.99	6.80
% deviation of mean from known value	8.85	-0.58
Norm. dev. of mean from known value	0.11	-0.09
Median	59.67	59.67
% deviation of median from known value	-0.56	-0.56
Norm. dev. of median from known value	-0.01	-0.08



CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	54.0	52.0	50.0	2.00	0.473	52.00	-2.65	-2.77	
AE	61.0	62.0	61.0	0.58	0.118	61.33	0.58	0.46	
AF	61.0	59.0	59.0	1.15	0.236	59.67	0.01	-0.12	
AH	57.0	53.0	55.0	2.00	0.473	55.00	-1.61	-1.73	
AI									•
AJ	61.0	58.0	60.0	1.53	0.354	59.67	0.01	-0.12	
AK	62.0	58.0	59.0	2.08	0.473	59.67	0.01	-0.12	
AL	52.0	52.0	55.0	1.73	0.354	53.00	-2.30	-2.42	
AN	63.0	62.0	57.0	3.21	0.709	60.67	0.35	0.23	
AP	61.0	60.0	61.0	0.58	0.118	60.67	0.35	0.23	
AU	58.0	58.0	58.0	0.00	0.000	58.00	-0.57	-0.69	
AW	58.0	57.0	59.0	1.00	0.236	58.00	-0.57	-0.69	
AY	65.0	64.0	66.0	1.00	0.236	65.00	1.85	1.73	
AZ	67.0	52.0	52.0	8.66	2.470	57.00	-0.92	-1.04	
BA	68.0	67.0	63.0	2.65	0.591	66.00	2.20	2.08	
BB	61.0	61.0	61.0	0.00	0.000	61.00	0.47	0.35	
BC	57.0	56.0	58.0	1.00	0.236	57.00	-0.92	-1.04	
BG	90.0	46.0	72.0	22.12	8.996	69.33	3.35	3.23	⇑
BH	62.0	63.0	61.0	1.00	0.236	62.00	0.81	0.69	
BI									•
BK	64.0	62.0	63.0	1.00	0.236	63.00	1.16	1.04	
BL	63.0	58.0	59.0	2.65	0.591	60.00	0.12	0.00	
BM	58.0	61.0	62.0	2.08	0.473	60.33	0.24	0.12	
BN	60.0	57.0	59.0	1.53	0.354	58.67	-0.34	-0.46	
BO	58.0	60.0	55.0	2.52	0.591	57.67	-0.69	-0.81	
BW									•
C	56.0	55.0	56.0	0.58	0.118	55.67	-1.38	-1.50	
CA	62.0	59.0	65.0	3.00	0.709	62.00	0.81	0.69	
CC	58.0	59.0	59.0	0.58	0.118	58.67	-0.34	-0.46	
CE	64.0	63.0	62.0	1.00	0.236	63.00	1.16	1.04	
CG									•
CJ	51.0	58.0	65.0	7.00	2.245	58.00	-0.57	-0.69	
CK	64.0	62.0	62.0	1.15	0.236	62.67	1.05	0.92	
CM	61.0	62.0	56.0	3.21	0.709	59.67	0.01	-0.12	
CO									•
CP	51.0	60.0	56.0	4.51	1.120	55.67	-1.38	-1.50	
CQ	60.0	66.0	60.0	3.46	0.709	62.00	0.81	0.69	
CS	71.0	72.0	73.0	1.00	0.236	72.00	4.28	4.16	⇑
CX	58.0	61.0	61.0	1.73	0.354	60.00	0.12	0.00	
D									•
DD	60.0	58.0	59.0	1.00	0.236	59.00	-0.23	-0.35	
DE	57.0	58.0	58.0	0.58	0.118	57.67	-0.69	-0.81	
DG	63.0	63.0	62.0	0.58	0.118	62.67	1.05	0.92	
DH	61.0	62.0	60.0	1.00	0.236	61.00	0.47	0.35	
DL	63.0	62.0	61.0	1.00	0.236	62.00	0.81	0.69	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM	54.0	55.0	55.0	0.58	0.118	54.67	-1.73	-1.85	
DO	59.0	64.0	65.0	3.21	0.709	62.67	1.05	0.92	
DR									•
DT	56.0	57.0	60.0	2.08	0.473	57.67	-0.69	-0.81	
DZ	58.0	62.0	59.0	2.08	0.473	59.67	0.01	-0.12	
E	58.0	58.0	59.0	0.58	0.118	58.33	-0.46	-0.58	
EA	60.0	61.0	60.0	0.58	0.118	60.33	0.24	0.12	
EB	55.0	55.0	56.0	0.58	0.118	55.33	-1.50	-1.62	
EL	58.0	58.0	61.0	1.73	0.354	59.00	-0.23	-0.35	
EW									•
EX	66.0	67.0	71.0	2.65	0.591	68.00	2.89	2.77	
EZ	56.0	59.0	62.0	3.00	0.709	59.00	-0.23	-0.35	
FJ	61.0	62.0	61.0	0.58	0.118	61.33	0.58	0.46	
FK									•
FL	62.0	67.0	61.0	3.21	0.709	63.33	1.28	1.15	
FU									•
FZ	53.0	57.0	54.0	2.08	0.473	54.67	-1.73	-1.85	
GE	63.0	58.0	58.0	2.89	0.591	59.67	0.01	-0.12	
GI	53.0	57.0	57.0	2.31	0.473	55.67	-1.38	-1.50	
GL	59.0	59.0	58.0	0.58	0.118	58.67	-0.34	-0.46	
GQ	55.0	55.0	58.0	1.73	0.354	56.00	-1.26	-1.39	
HI	69.0	67.0	72.0	2.52	0.591	69.33	3.35	3.23	⇑
HJ	57.0	63.0	64.0	3.79	0.827	61.33	0.58	0.46	
HK	61.0	59.0	59.0	1.15	0.236	59.67	0.01	-0.12	
HL	61.0	61.0	61.0	0.00	0.000	61.00	0.47	0.35	
HP	59.0	57.0	57.0	1.15	0.236	57.67	-0.69	-0.81	
HX	59.0	57.0	55.0	2.00	0.473	57.00	-0.92	-1.04	
I	54.0	62.0	65.0	5.69	1.570	60.33	0.24	0.12	
IC	59.0	58.0	59.0	0.58	0.118	58.67	-0.34	-0.46	
J	60.0	60.0	59.0	0.58	0.118	59.67	0.01	-0.12	
JE	60.0	61.0	60.0	0.58	0.118	60.33	0.24	0.12	
JG	62.0	57.0	60.0	2.52	0.591	59.67	0.01	-0.12	
JI									•
JS	61.0	62.0	63.0	1.00	0.236	62.00	0.81	0.69	
JY	69.0	67.0	60.0	4.73	1.120	65.33	1.97	1.85	
K	54.0	55.0	56.0	1.00	0.236	55.00	-1.61	-1.73	
KH	67.0	59.0	67.0	4.62	0.945	64.33	1.62	1.50	
KL	55.0	60.0	58.0	2.52	0.591	57.67	-0.69	-0.81	
KX	56.0	61.0	58.0	2.52	0.591	58.33	-0.46	-0.58	
L	65.0	64.0	63.0	1.00	0.236	64.00	1.51	1.39	
LE	61.0	59.0	56.0	2.52	0.591	58.67	-0.34	-0.46	
LF	60.0	53.0	59.0	3.79	0.827	57.33	-0.80	-0.92	
LR	64.0	60.0	59.0	2.65	0.591	61.00	0.47	0.35	
LT	60.0	59.0	62.0	1.53	0.354	60.33	0.24	0.12	
M	59.0	59.0	55.0	2.31	0.473	57.67	-0.69	-0.81	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
MA	61.0	61.0	60.0	0.58	0.118	60.67	0.35	0.23	
ML									•
MP	63.0	62.0	62.0	0.58	0.118	62.33	0.93	0.81	
MQ	58.0	54.0	62.0	4.00	0.945	58.00	-0.57	-0.69	
MV									•
MX	66.0	63.0	57.0	4.58	1.120	62.00	0.81	0.69	
MY									•
N	62.0	67.0	65.0	2.52	0.591	64.67	1.74	1.62	
NH	56.0	56.0	56.0	0.00	0.000	56.00	-1.26	-1.39	
NJ	54.0	56.0	59.0	2.52	0.591	56.33	-1.15	-1.27	
NK									•
NO	62.0	63.0	65.0	1.53	0.354	63.33	1.28	1.15	
NP									•
NZ									•
O	64.0	64.0	63.0	0.58	0.118	63.67	1.39	1.27	
OA	60.0	59.0	58.0	1.00	0.236	59.00	-0.23	-0.35	
OB	47.0	47.0	47.0	0.00	0.000	47.00	-4.38	-4.50	⇓
OK									•
OL	72.0	73.0	65.0	4.36	0.945	70.00	3.59	3.46	⇑
OM	64.0	65.0	66.0	1.00	0.236	65.00	1.85	1.73	
OZ									•
P									•
PB	50.0	49.0	50.0	0.58	0.118	49.67	-3.46	-3.58	⇓
PE	70.0	70.0	60.0	5.77	1.345	66.67	2.43	2.31	
PI	59.0	58.0	58.0	0.58	0.118	58.33	-0.46	-0.58	
PM	67.0	63.0	61.0	3.06	0.709	63.67	1.39	1.27	
PQ	59.0	59.0	56.0	1.73	0.354	58.00	-0.57	-0.69	
PU	67.0	60.0	68.0	4.36	0.945	65.00	1.85	1.73	
PV	57.0	60.0	61.0	2.08	0.473	59.33	-0.11	-0.23	
PW	58.0	59.0	57.0	1.00	0.236	58.00	-0.57	-0.69	
Q	54.0	56.0	56.0	1.15	0.236	55.33	-1.50	-1.62	
QJ	59.0	60.0	59.0	0.58	0.118	59.33	-0.11	-0.23	
QM									•
QP	64.0	59.0	57.0	3.61	0.827	60.00	0.12	0.00	
QT	54.0	57.0	58.0	2.08	0.473	56.33	-1.15	-1.27	
QU	61.0	63.0	64.0	1.53	0.354	62.67	1.05	0.92	
QW	61.0	61.0	63.0	1.15	0.236	61.67	0.70	0.58	
QX	57.0	58.0	60.0	1.53	0.354	58.33	-0.46	-0.58	
QZ	60.0	60.0	58.0	1.15	0.236	59.33	-0.11	-0.23	
R	61.0	59.0	61.0	1.15	0.236	60.33	0.24	0.12	
RF	55.0	57.0	56.0	1.00	0.236	56.00	-1.26	-1.39	
RH	50.0	52.0	53.0	1.53	0.354	51.67	-2.77	-2.89	
RL									•
RO	59.0	63.0	59.0	2.31	0.473	60.33	0.24	0.12	
RR	59.0	59.0	60.0	0.58	0.118	59.33	-0.11	-0.23	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RU	57.0	59.0	61.0	2.00	0.473	59.00	-0.23	-0.35	
RV	55.0	60.0	60.0	2.89	0.591	58.33	-0.46	-0.58	
RX	61.0	62.0	59.0	1.53	0.354	60.67	0.35	0.23	
RZ	60.0	64.0	63.0	2.08	0.473	62.33	0.93	0.81	
S	59.0	59.0	59.0	0.00	0.000	59.00	-0.23	-0.35	
SC	54.0	56.0	53.0	1.53	0.354	54.33	-1.84	-1.96	
SD	55.0	55.0	53.0	1.15	0.236	54.33	-1.84	-1.96	
SF	60.0	56.0	57.0	2.08	0.473	57.67	-0.69	-0.81	
SI	61.0	62.0	60.0	1.00	0.236	61.00	0.47	0.35	
SM	59.0	63.0	64.0	2.65	0.591	62.00	0.81	0.69	
SN	56.0	56.0	52.0	2.31	0.473	54.67	-1.73	-1.85	
SR	60.0	60.0	59.0	0.58	0.118	59.67	0.01	-0.12	
SS	62.0	61.0	61.0	0.58	0.118	61.33	0.58	0.46	
ST									•
SV	63.0	63.0	66.0	1.73	0.354	64.00	1.51	1.39	
SX	62.0	59.0	62.0	1.73	0.354	61.00	0.47	0.35	
SZ	60.0	59.0	60.0	0.58	0.118	59.67	0.01	-0.12	
T	56.0	52.0	58.0	3.06	0.709	55.33	-1.50	-1.62	
TB									•
TC	50.0	56.0	53.0	3.00	0.709	53.00	-2.30	-2.42	
TD	61.0	61.0	59.0	1.15	0.236	60.33	0.24	0.12	
TH	59.0	60.0	60.0	0.58	0.118	59.67	0.01	-0.12	
TI	60.0	58.0	59.0	1.00	0.236	59.00	-0.23	-0.35	
TL	54.0	51.0	54.0	1.73	0.354	53.00	-2.30	-2.42	
TO									•
TQ	58.0	52.0	57.0	3.21	0.709	55.67	-1.38	-1.50	
TR	68.0	70.0	64.0	3.06	0.709	67.33	2.66	2.54	
TS									•
U	62.0	63.0	64.0	1.00	0.236	63.00	1.16	1.04	
UE									•
UM									•
UN	62.0	65.0	63.0	1.53	0.354	63.33	1.28	1.15	
UP	60.0	61.0	59.0	1.00	0.236	60.00	0.12	0.00	
UR	84.0	89.0	83.0	3.21	0.709	85.33	8.90	8.78	×
UT	56.0	56.0	56.0	0.00	0.000	56.00	-1.26	-1.39	
UW	61.0	60.0	62.0	1.00	0.236	61.00	0.47	0.35	
UX	55.0	53.0	54.0	1.00	0.236	54.00	-1.96	-2.08	
UY	58.0	64.0	61.0	3.00	0.709	61.00	0.47	0.35	
VA	53.0	55.0	52.0	1.53	0.354	53.33	-2.19	-2.31	
VC									•
VE	54.0	58.0	55.0	2.08	0.473	55.67	-1.38	-1.50	
VG									•
VH	52.0	52.0	53.0	0.58	0.118	52.33	-2.53	-2.66	
VI	62.0	59.0	61.0	1.53	0.354	60.67	0.35	0.23	
VM	60.0	67.0	65.0	3.61	0.827	64.00	1.51	1.39	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VO	57.0	65.0	67.0	5.29	1.345	63.00	1.16	1.04	
VR									•
VS	65.0	61.0	63.0	2.00	0.473	63.00	1.16	1.04	
VT									•
W	61.0	58.0	60.0	1.53	0.354	59.67	0.01	-0.12	
WD	60.0	59.0	59.0	0.58	0.118	59.33	-0.11	-0.23	
WF	64.0	64.0	64.0	0.00	0.000	64.00	1.51	1.39	
WI									•
WJ	527.0	517.0	534.0	8.54	2.921	526.00	161.55	161.43	×
WK	51.0	55.0	33.0	11.72	4.046	46.33	-4.61	-4.73	⇓
WL	440.0	440.0	440.0	0.00	0.000	440.00	131.76	131.64	×
WO	91.0	91.0	97.0	3.46	0.709	93.00	11.55	11.43	×
X	68.0	70.0	70.0	1.15	0.236	69.33	3.35	3.23	⇑

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
46.33	⇓	WK	56.00		GQ	58.67		BN
47.00	⇓	OB	56.33		QT	59.00		TI
49.67	⇓	PB	56.33		NJ	59.00		S
51.67		RH	57.00		HX	59.00		RU
52.00		A	57.00		BC	59.00		OA
52.33		VH	57.00		AZ	59.00		EZ
53.00		TL	57.33		LF	59.00		EL
53.00		TC	57.67		SF	59.00		DD
53.00		AL	57.67		M	59.33		WD
53.33		VA	57.67		KL	59.33		RR
54.00		UX	57.67		HP	59.33		QZ
54.33		SD	57.67		DT	59.33		QJ
54.33		SC	57.67		DE	59.33		PV
54.67		SN	57.67		BO	59.67		W
54.67		FZ	58.00		PW	59.67		TH
54.67		DM	58.00		PQ	59.67		SZ
55.00		K	58.00		MQ	59.67		SR
55.00		AH	58.00		CJ	59.67		JG
55.33		T	58.00		AW	59.67		J
55.33		Q	58.00		AU	59.67		HK
55.33		EB	58.33		RV	59.67		GE
55.67		VE	58.33		QX	59.67		DZ
55.67		TQ	58.33		PI	59.67		CM
55.67		GI	58.33		KX	59.67		AK
55.67		CP	58.33		E	59.67		AJ
55.67		C	58.67		LE	59.67		AF
56.00		UT	58.67		IC	60.00		UP
56.00		RF	58.67		GL	60.00		QP
56.00		NH	58.67		CC	60.00		CX

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

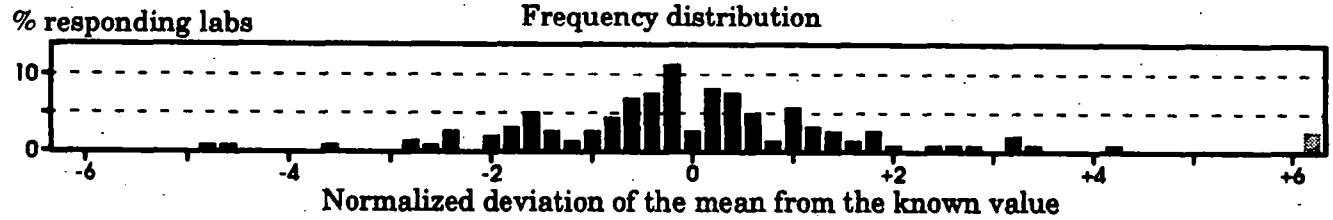
× ≡ Determined to be an outlier

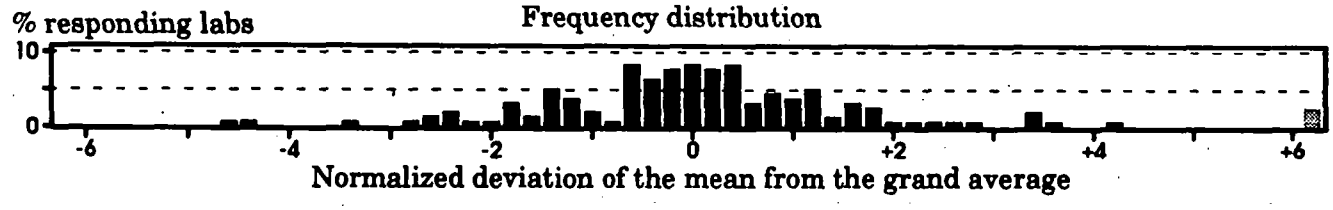
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cobalt-60

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
60.00		BL	61.33		FJ	63.67		PM
60.33		TD	61.33		AE	63.67		O
60.33		RO	61.67		QW	64.00		WF
60.33		R	62.00		SM	64.00		VM
60.33		LT	62.00		MX	64.00		SV
60.33		JE	62.00		JS	64.00		L
60.33		I	62.00		DL	64.33		KH
60.33		EA	62.00		CQ	64.67		N
60.33		BM	62.00		CA	65.00		PU
60.67		VI	62.00		BH	65.00		OM
60.67		RX	62.33		RZ	65.00		AY
60.67		MA	62.33		MP	65.33		JY
60.67		AP	62.67		QU	66.00		BA
60.67		AN	62.67		DO	66.67		PE
61.00		UY	62.67		DG	67.33		TR
61.00		UW	62.67		CK	68.00		EX
61.00		SX	63.00		VS	69.33	⇑	X
61.00		SI	63.00		VO	69.33	⇑	HI
61.00		LR	63.00		U	69.33	⇑	BG
61.00		HL	63.00		CE	70.00	⇑	OL
61.00		DH	63.00		BK	72.00	⇑	CS
61.00		BB	63.33		UN	85.33	×	UR
61.33		SS	63.33		NO	93.00	×	WO
61.33		HJ	63.33		FL	440.00	×	WL
						526.00	×	WJ





• ≡ No data submitted
Ø ≡ Insufficient data

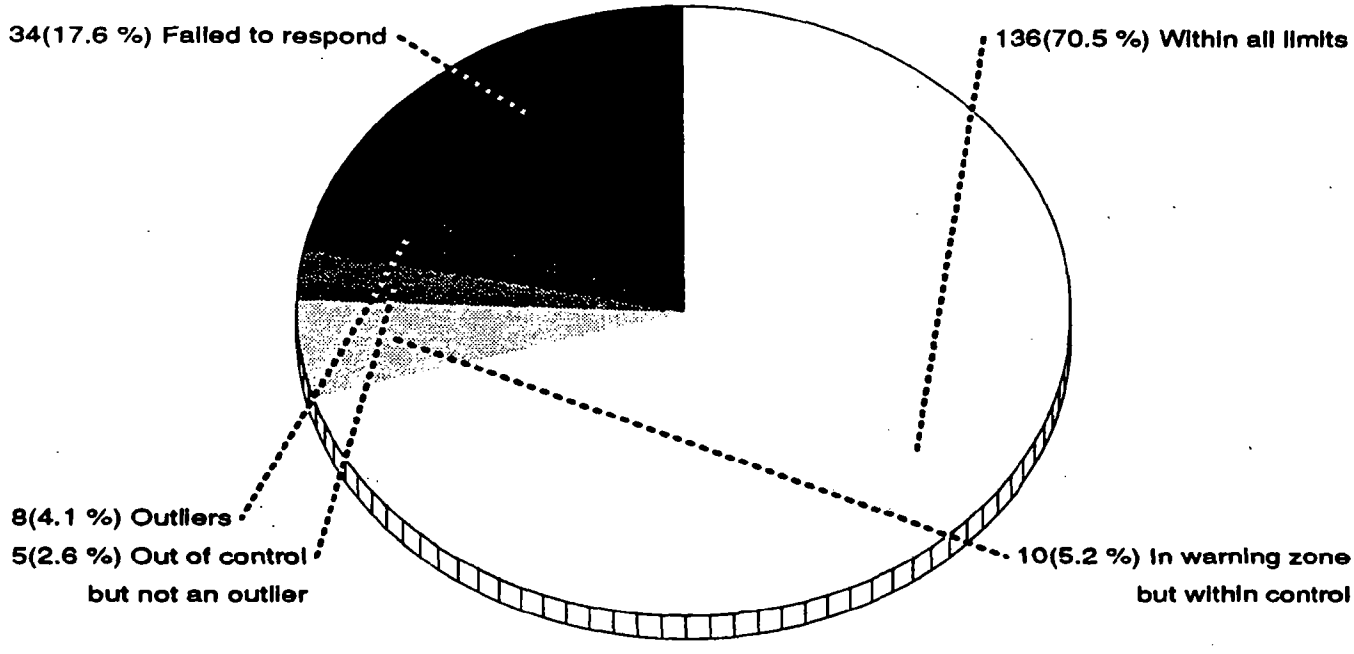
TAG SYMBOLS

× ≡ Determined to be an outlier

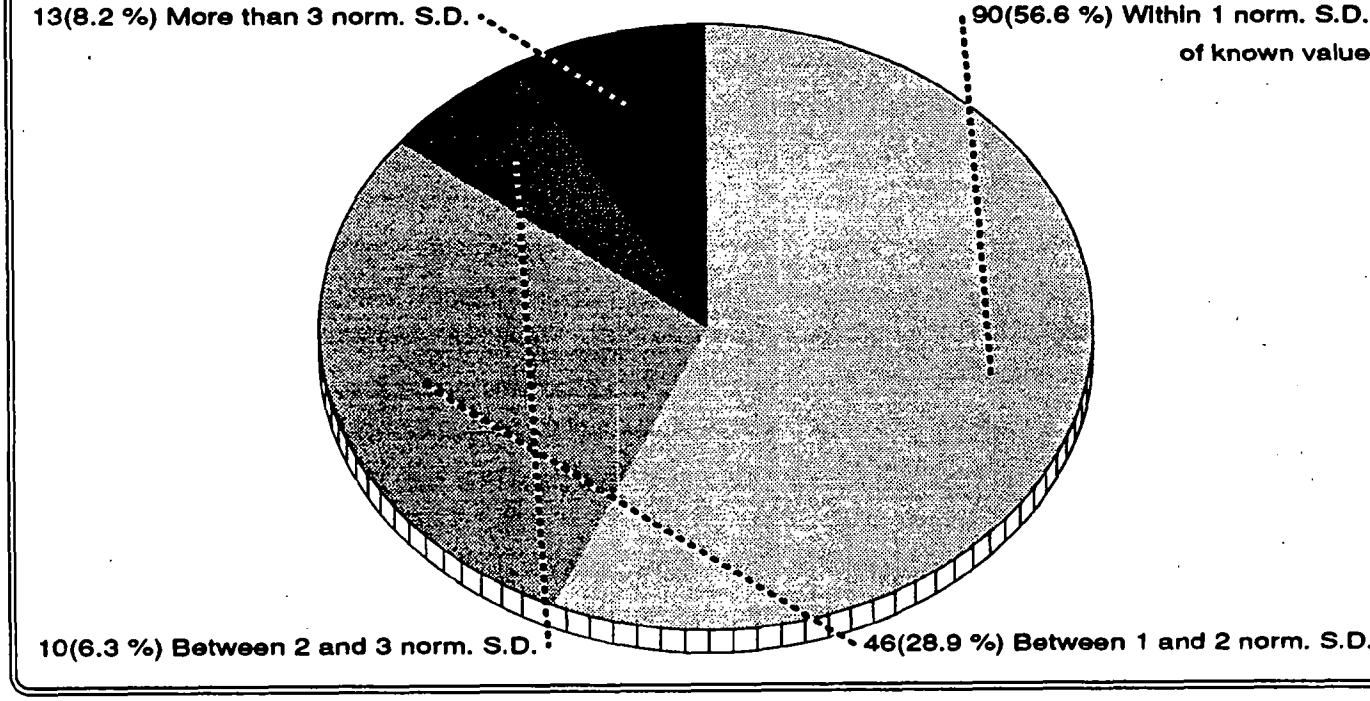
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Zinc-65 Statistical Summary 193 Participants

The known value of this nuclide is **125.0 pCi/l** with an expected precision of **13.0**; the control limits are 102.4 to 147.6; the warning regions are 102.4 to 110.0 and 140.0 to 147.6



Statistic	Respondents	Non-outliers
Mean	149.68	**Grand Avg 128.89**
Std. Dev.	144.90	8.98
Variance	20996.19	80.58
% Coef. of Var.	96.81	6.96
% deviation of mean from known value	19.74	3.11
Norm. dev. of mean from known value	0.17	0.43
Median	129.67	129.33
% deviation of median from known value	3.73	3.47
Norm. dev. of median from known value	0.03	0.48



CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	113.0	110.0	113.0	1.73	0.136	112.00	-2.25	-1.73	
AE	126.0	128.0	133.0	3.61	0.318	129.00	0.01	0.53	
AF	116.0	127.0	123.0	5.57	0.500	122.00	-0.92	-0.40	
AH	129.0	135.0	130.0	3.21	0.273	131.33	0.33	0.84	
AI									•
AJ	136.0	129.0	134.0	3.61	0.318	133.00	0.55	1.07	
AK	128.0	128.0	127.0	0.58	0.045	127.67	-0.16	0.36	
AL	137.0	129.0	123.0	7.02	0.636	129.67	0.10	0.62	
AN	126.0	127.0	130.0	2.08	0.182	127.67	-0.16	0.36	
AP	135.0	135.0	140.0	2.89	0.227	136.67	1.04	1.55	
AU	120.0	130.0	120.0	5.77	0.454	123.33	-0.74	-0.22	
AW	118.0	124.0	124.0	3.46	0.273	122.00	-0.92	-0.40	
AY	144.0	145.0	145.0	0.58	0.045	144.67	2.10	2.62	
AZ	150.0	137.0	147.0	6.81	0.591	144.67	2.10	2.62	
BA	1330.0	1360.0	1270.0	45.83	6.884	1320.00	158.70	159.22	×
BB	135.0	137.0	136.0	1.00	0.091	136.00	0.95	1.47	
BC	131.0	123.0	127.0	4.00	0.363	127.00	-0.25	0.27	
BG	136.0	146.0	119.0	13.65	1.432	133.67	0.64	1.15	
BH	139.0	142.0	141.0	1.53	0.136	140.67	1.57	2.09	
BI									•
BK	146.0	146.0	148.0	1.15	0.091	146.67	2.37	2.89	
BL	128.0	131.0	128.0	1.73	0.136	129.00	0.01	0.53	
BM	132.0	126.0	124.0	4.16	0.363	127.33	-0.21	0.31	
BN	125.0	127.0	129.0	2.00	0.182	127.00	-0.25	0.27	
BO	128.0	126.0	134.0	4.16	0.363	129.33	0.06	0.58	
BW									•
C	106.0	110.0	114.0	4.00	0.363	110.00	-2.52	-2.00	
CA	127.0	129.0	126.0	1.53	0.136	127.33	-0.21	0.31	
CC	130.0	131.0	131.0	0.58	0.045	130.67	0.24	0.75	
CE	131.0	132.0	125.0	3.79	0.318	129.33	0.06	0.58	
CG									•
CJ	111.0	134.0	149.0	19.14	2.384	131.33	0.33	0.84	
CK	130.0	130.0	120.0	5.77	0.454	126.67	-0.30	0.22	
CM	128.0	120.0	136.0	8.00	0.727	128.00	-0.12	0.40	
CO									•
CP	141.0	131.0	126.0	7.64	0.682	132.67	0.50	1.02	
CQ	137.0	148.0	137.0	6.35	0.500	140.67	1.57	2.09	
CS	159.0	164.0	165.0	3.21	0.273	162.67	4.50	5.02	×
CX	132.0	131.0	131.0	0.58	0.045	131.33	0.33	0.84	
D									•
DD	135.0	129.0	131.0	3.06	0.273	131.67	0.37	0.89	
DE	121.0	122.0	122.0	0.58	0.045	121.67	-0.96	-0.44	
DG	122.0	126.0	109.0	8.89	0.772	119.00	-1.32	-0.80	
DH	119.0	120.0	123.0	2.08	0.182	120.67	-1.10	-0.58	
DL	148.0	143.0	139.0	4.51	0.409	143.33	1.92	2.44	

TAG SYMBOLS

• ≡ No data submitted

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
DM	117.0	122.0	122.0	2.89	0.227	120.33	-1.14	-0.62	
DO	129.0	134.0	132.0	2.52	0.227	131.67	0.37	0.89	
DR									•
DT	118.0	148.0	131.0	15.04	1.692	132.33	0.46	0.98	
DZ	115.0	116.0	109.0	3.79	0.318	113.33	-2.07	-1.55	
E	135.0	121.0	135.0	8.08	0.636	130.33	0.19	0.71	
EA	125.0	126.0	126.0	0.58	0.045	125.67	-0.43	0.09	
EB	131.0	132.0	130.0	1.00	0.091	131.00	0.28	0.80	
EL	128.0	126.0	127.0	1.00	0.091	127.00	-0.25	0.27	
EW									•
EX	111.0	98.0	89.0	11.06	1.000	99.33	-3.94	-3.42	⇓
EZ	125.0	121.0	123.0	2.00	0.182	123.00	-0.78	-0.27	
FJ	139.0	140.0	137.0	1.53	0.136	138.67	1.30	1.82	
FK									•
FL	140.0	131.0	127.0	6.66	0.591	132.67	0.50	1.02	
FU									•
FZ	120.0	120.0	120.0	0.00	0.000	120.00	-1.18	-0.67	
GE	122.0	134.0	134.0	6.93	0.545	130.00	0.15	0.67	
GI	118.0	131.0	133.0	8.14	0.682	127.33	-0.21	0.31	
GL	124.0	128.0	124.0	2.31	0.182	125.33	-0.47	0.04	
GQ	118.0	117.0	119.0	1.00	0.091	118.00	-1.45	-0.93	
HI	145.0	152.0	158.0	6.51	0.591	151.67	3.03	3.55	⇑
HJ	124.0	129.0	131.0	3.61	0.318	128.00	-0.12	0.40	
HK	133.0	126.0	131.0	3.61	0.318	130.00	0.15	0.67	
HL	137.0	137.0	137.0	0.00	0.000	137.00	1.08	1.60	
HP	125.0	130.0	133.0	4.04	0.363	129.33	0.06	0.58	
HX	128.0	130.0	127.0	1.53	0.136	128.33	-0.07	0.44	
I	124.0	137.0	126.0	7.00	0.591	129.00	0.01	0.53	
IC	135.0	129.0	138.0	4.58	0.409	134.00	0.68	1.20	
J	132.0	132.0	131.0	0.58	0.045	131.67	0.37	0.89	
JE	134.0	131.0	130.0	2.08	0.182	131.67	0.37	0.89	
JG	110.0	110.0	111.0	0.58	0.045	110.33	-2.47	-1.95	
JI									•
JS	133.0	130.0	140.0	5.13	0.454	134.33	0.73	1.24	
JY	119.0	147.0	129.0	14.19	1.518	131.67	0.37	0.89	
K	117.0	117.0	120.0	1.73	0.136	118.00	-1.45	-0.93	
KH	157.0	145.0	152.0	6.03	0.545	151.33	2.99	3.51	⇑
KL	121.0	131.0	122.0	5.51	0.454	124.67	-0.56	-0.04	
KX	121.0	129.0	123.0	4.16	0.363	124.33	-0.61	-0.09	
L	139.0	142.0	141.0	1.53	0.136	140.67	1.57	2.09	
LE	455.0	470.0	443.0	13.53	1.432	456.00	43.58	44.10	×
LF	130.0	130.0	140.0	5.77	0.454	133.33	0.59	1.11	
LR	174.0	175.0	164.0	6.08	0.500	171.00	5.61	6.13	×
LT	135.0	127.0	140.0	6.56	0.591	134.00	0.68	1.20	
M	138.0	135.0	126.0	6.24	0.545	133.00	0.55	1.07	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
MA	131.0	140.0	132.0	4.93	0.409	134.33	0.73	1.24	
ML									•
MP	152.0	153.0	154.0	1.00	0.091	153.00	3.21	3.73	⇑
MQ	119.0	130.0	130.0	6.35	0.500	126.33	-0.34	0.18	
MV									•
MX	140.0	139.0	136.0	2.08	0.182	138.33	1.26	1.78	
MY									•
N	121.0	124.0	132.0	5.69	0.500	125.67	-0.43	0.09	
NH	133.0	133.0	132.0	0.58	0.045	132.67	0.50	1.02	
NJ	124.0	124.0	120.0	2.31	0.182	122.67	-0.83	-0.31	
NK									•
NO	131.0	135.0	136.0	2.65	0.227	134.00	0.68	1.20	
NP									•
NZ									•
O	140.0	140.0	139.0	0.58	0.045	139.67	1.44	1.95	
OA	129.0	129.0	129.0	0.00	0.000	129.00	0.01	0.53	
OB									•
OK									•
OL	162.0	163.0	146.0	9.54	0.772	157.00	3.75	4.26	⇑
OM	118.0	119.0	117.0	1.00	0.091	118.00	-1.45	-0.93	
OZ									•
P									•
PB	99.0	102.0	107.0	4.04	0.363	102.67	-3.49	-2.98	
PE	132.0	125.0	131.0	3.79	0.318	129.33	0.06	0.58	
PI	122.0	122.0	126.0	2.31	0.182	123.33	-0.74	-0.22	
PM	131.0	129.0	126.0	2.52	0.227	128.67	-0.03	0.49	
PQ	134.0	136.0	124.0	6.43	0.545	131.33	0.33	0.84	
PU	125.0	128.0	132.0	3.51	0.318	128.33	-0.07	0.44	
PV	129.0	139.0	144.0	7.64	0.682	137.33	1.12	1.64	
PW	126.0	130.0	134.0	4.00	0.363	130.00	0.15	0.67	
Q	124.0	128.0	132.0	4.00	0.363	128.00	-0.12	0.40	
QJ	130.0	130.0	140.0	5.77	0.454	133.33	0.59	1.11	
QM									•
QP	149.0	110.0	103.0	24.79	3.076	120.67	-1.10	-0.58	
QT	122.0	128.0	118.0	5.03	0.454	122.67	-0.83	-0.31	
QU	130.0	132.0	132.0	1.15	0.091	131.33	0.33	0.84	
QW	126.0	131.0	135.0	4.51	0.409	130.67	0.24	0.75	
QX	116.0	110.0	124.0	7.02	0.636	116.67	-1.63	-1.11	
QZ	131.0	131.0	134.0	1.73	0.136	132.00	0.41	0.93	
R	135.0	130.0	139.0	4.51	0.409	134.67	0.77	1.29	
RF	126.0	131.0	122.0	4.51	0.409	126.33	-0.34	0.18	
RH	115.0	120.0	114.0	3.21	0.273	116.33	-1.67	-1.15	
RL									•
RO	135.0	137.0	143.0	4.16	0.363	138.33	1.26	1.78	
RR	129.0	138.0	132.0	4.58	0.409	133.00	0.55	1.07	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RU	130.0	130.0	129.0	0.58	0.045	129.67	0.10	0.62	
RV	125.0	125.0	116.0	5.20	0.409	122.00	-0.92	-0.40	
RX	130.0	112.0	121.0	9.00	0.818	121.00	-1.05	-0.53	
RZ	123.0	123.0	128.0	2.89	0.227	124.67	-0.56	-0.04	
S	127.0	127.0	128.0	0.58	0.045	127.33	-0.21	0.31	
SC	132.0	127.0	127.0	2.89	0.227	128.67	-0.03	0.49	
SD	125.0	132.0	112.0	10.15	0.909	123.00	-0.78	-0.27	
SF	128.0	145.0	134.0	8.62	0.772	135.67	0.90	1.42	
SI	138.0	136.0	143.0	3.61	0.318	139.00	1.35	1.87	
SM	129.0	137.0	132.0	4.04	0.363	132.67	0.50	1.02	
SN	129.0	130.0	130.0	0.58	0.045	129.67	0.10	0.62	
SR	133.0	131.0	129.0	2.00	0.182	131.00	0.28	0.80	
SS	135.0	129.0	134.0	3.21	0.273	132.67	0.50	1.02	
ST									•
SV	148.0	124.0	135.0	12.01	1.172	135.67	0.90	1.42	
SX	136.0	134.0	135.0	1.00	0.091	135.00	0.81	1.33	
SZ	134.0	125.0	124.0	5.51	0.454	127.67	-0.16	0.36	
T	123.0	122.0	124.0	1.00	0.091	123.00	-0.78	-0.27	
TB									•
TC	99.0	108.0	104.0	4.51	0.409	103.67	-3.36	-2.84	
TD	129.0	141.0	140.0	6.66	0.545	136.67	1.04	1.55	
TH	127.0	128.0	128.0	0.58	0.045	127.67	-0.16	0.36	
TI	137.0	134.0	135.0	1.53	0.136	135.33	0.86	1.38	
TL	95.0	121.0	120.0	14.73	1.345	112.00	-2.25	-1.73	
TO									•
TQ	124.0	132.0	122.0	5.29	0.454	126.00	-0.38	0.13	
TR	126.0	126.0	120.0	3.46	0.273	124.00	-0.65	-0.13	
TS									•
U	130.0	130.0	133.0	1.73	0.136	131.00	0.28	0.80	
UE									•
UM									•
UN	129.0	137.0	137.0	4.62	0.363	134.33	0.73	1.24	
UP	135.0	133.0	137.0	2.00	0.182	135.00	0.81	1.33	
UR	35.0	34.0	38.0	2.08	0.182	35.67	-12.42	-11.90	×
UT	35.0	35.0	35.0	0.00	0.000	35.00	-12.51	-11.99	×
UW	131.0	116.0	121.0	7.64	0.682	122.67	-0.83	-0.31	
UX	124.0	119.0	114.0	5.00	0.454	119.00	-1.32	-0.80	
UY	132.0	127.0	136.0	4.51	0.409	131.67	0.37	0.89	
VA	129.0	117.0	132.0	7.94	0.682	126.00	-0.38	0.13	
VC									•
VE	139.0	131.0	136.0	4.04	0.363	135.33	0.86	1.38	
VG									•
VH	136.0	133.0	133.0	1.73	0.136	134.00	0.68	1.20	
VI	139.0	133.0	143.0	5.03	0.454	138.33	1.26	1.78	
VM	115.0	115.0	125.0	5.77	0.454	118.33	-1.41	-0.89	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VO	132.0	128.0	142.0	7.21	0.636	134.00	0.68	1.20	
VR									•
VS	124.0	129.0	133.0	4.51	0.409	128.67	-0.03	0.49	
VT									•
W	131.0	132.0	127.0	2.65	0.227	130.00	0.15	0.67	
WD	140.0	133.0	128.0	6.03	0.545	133.67	0.64	1.15	
WF	125.0	125.0	125.0	0.00	0.000	125.00	-0.52	0.00	
WI									•
WJ	1189.0	1190.0	1195.0	3.21	0.273	1191.33	141.55	142.07	×
WK	104.0	126.0	112.0	11.14	1.000	114.00	-1.98	-1.47	
WL	928.0	1000.0	967.0	36.04	5.326	965.00	111.40	111.92	×
WO	104.0	112.0	104.0	4.62	0.363	106.67	-2.96	-2.44	
X	120.0	117.0	118.0	1.53	0.136	118.33	-1.41	-0.89	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
35.00	×	UT	122.00		AF	127.67		TH
35.67	×	UR	122.67		UW	127.67		SZ
99.33	⇓	EX	122.67		QT	127.67		AN
102.67		PB	122.67		NJ	127.67		AK
103.67		TC	123.00		T	128.00		Q
106.67		WO	123.00		SD	128.00		HJ
110.00		C	123.00		EZ	128.00		CM
110.33		JG	123.33		PI	128.33		PU
112.00		TL	123.33		AU	128.33		HX
112.00		A	124.00		TR	128.67		VS
113.33		DZ	124.33		KX	128.67		SC
114.00		WK	124.67		RZ	128.67		PM
116.33		RH	124.67		KL	129.00		OA
116.67		QX	125.00		WF	129.00		I
118.00		OM	125.33		GL	129.00		BL
118.00		K	125.67		N	129.00		AE
118.00		GQ	125.67		EA	129.33		PE
118.33		X	126.00		VA	129.33		HP
118.33		VM	126.00		TQ	129.33		CE
119.00		UX	126.33		RF	129.33		BO
119.00		DG	126.33		MQ	129.67		SN
120.00		FZ	126.67		CK	129.67		RU
120.33		DM	127.00		EL	129.67		AL
120.67		QP	127.00		BN	130.00		W
120.67		DH	127.00		BC	130.00		PW
121.00		RX	127.33		S	130.00		HK
121.67		DE	127.33		GI	130.00		GE
122.00		RV	127.33		CA	130.33		E
122.00		AW	127.33		BM	130.67		QW

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

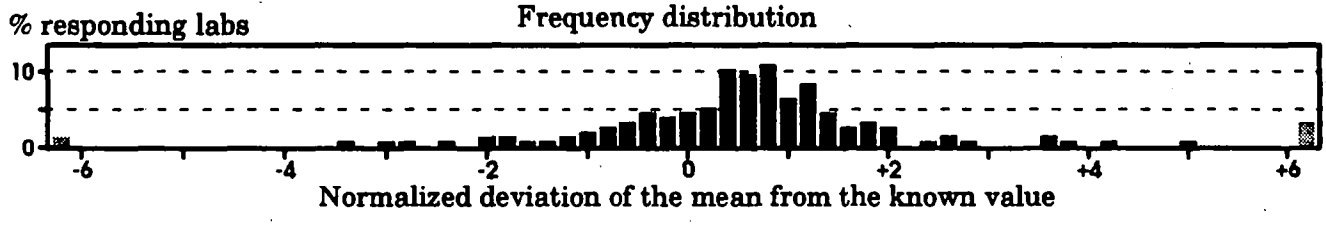
× ≡ Determined to be an outlier

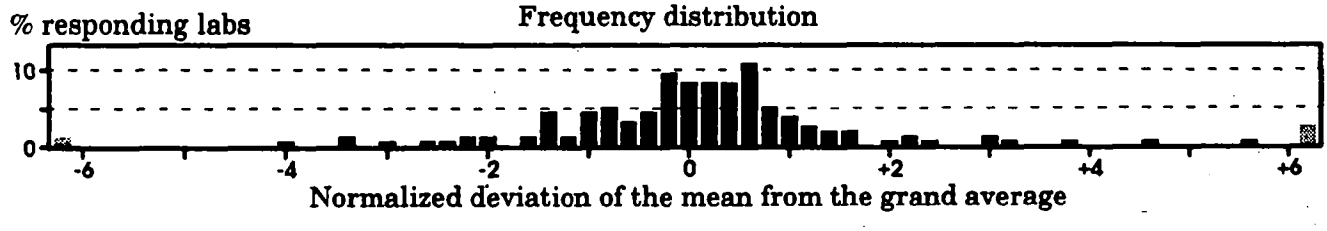
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Zinc-65

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
130.67		CC	133.00		AJ	137.33		PV
131.00		U	133.33		QJ	138.33		VI
131.00		SR	133.33		LF	138.33		RO
131.00		EB	133.67		WD	138.33		MX
131.33		QU	133.67		BG	138.67		FJ
131.33		PQ	134.00		VO	139.00		SI
131.33		CX	134.00		VH	139.67		O
131.33		CJ	134.00		NO	140.67		L
131.33		AH	134.00		LT	140.67		CQ
131.67		UY	134.00		IC	140.67		BH
131.67		JY	134.33		UN	143.33		DL
131.67		JE	134.33		MA	144.67		AZ
131.67		J	134.33		JS	144.67		AY
131.67		DO	134.67		R	146.67		BK
131.67		DD	135.00		UP	151.33	⇑	KH
132.00		QZ	135.00		SX	151.67	⇑	HI
132.33		DT	135.33		VE	153.00	⇑	MP
132.67		SS	135.33		TI	157.00	⇑	OL
132.67		SM	135.67		SV	162.67	×	CS
132.67		NH	135.67		SF	171.00	×	LR
132.67		FL	136.00		BB	456.00	×	LE
132.67		CP	136.67		TD	965.00	×	WL
133.00		RR	136.67		AP	1191.33	×	WJ
133.00		M	137.00		HL	1320.00	×	BA





• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EXPOSURE RESEARCH LABORATORY
P.O. BOX 93478 • LAS VEGAS, NV 89193-3478

OFFICE OF
RESEARCH AND DEVELOPMENT

A note regarding the Cesium-134 portion of the November 3, 1995 Gamma in Water Performance Evaluation Study:

The difference between the grand average and the known value was significant for this study. The primary peak for Cs-134 (604.7) is subject to coincidence summing, resulting in a negative bias if quantified using commercial mixed standards. Efficiency factors based on these standards do not correctly quantify peaks subject to summing, and in general produce a negative bias as was observed. This bias will be minimized if the efficiency is calculated using a separate Cs-134 standard or a previous PE study. Please direct any questions to Steve Pia at 702 798-2102.

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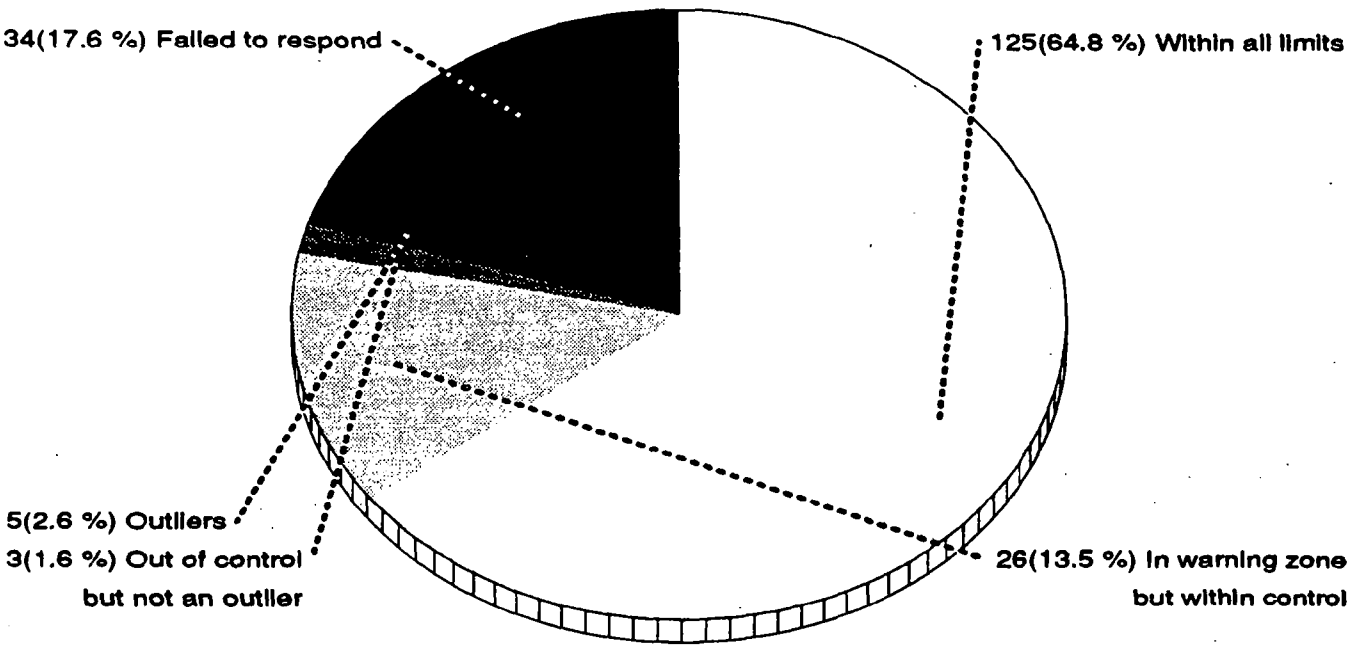
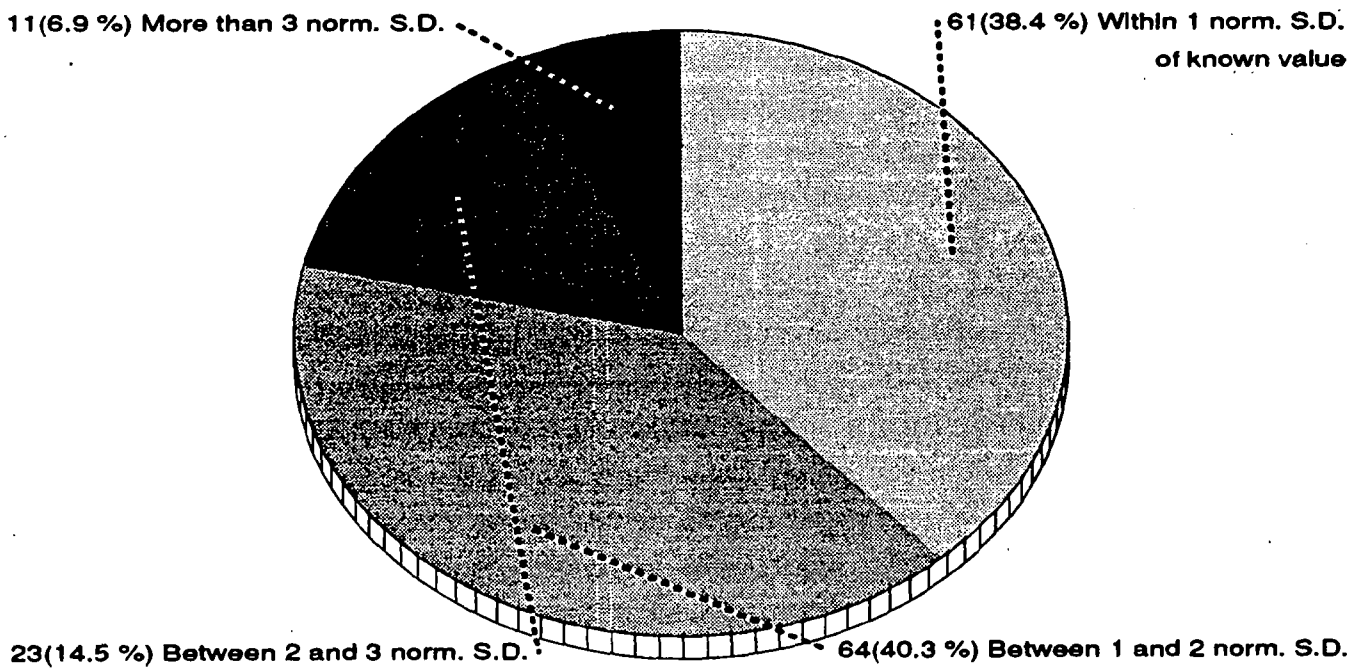
Cesium-134 Statistical Summary 193 Participants

The known value of this nuclide is **40.0 pCi/l** with an expected precision of **5.0**; the control limits are 31.3 to 48.7; the warning regions are 31.3 to 34.2 and 45.8 to 48.7



Statistic	Respondents	Non-outliers
Mean	40.64	**Grand Avg 36.85**
Std. Dev.	28.74	3.03
Variance	826.15	9.19
% Coef. of Var.	70.73	8.23
% deviation of mean from known value	1.59	-7.86
Norm. dev. of mean from known value	0.02	-1.04
Median	37.00	36.67
% deviation of median from known value	-7.50	-8.33
Norm. dev. of median from known value	-0.10	-1.10



CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	31.0	32.0	30.0	1.00	0.236	31.00	-2.03	-3.12	⇓
AE	35.0	38.0	38.0	1.73	0.354	37.00	0.05	-1.04	
AF	34.0	33.0	32.0	1.00	0.236	33.00	-1.34	-2.42	
AH	36.0	35.0	35.0	0.58	0.118	35.33	-0.53	-1.62	
AI									•
AJ	33.0	33.0	35.0	1.15	0.236	33.67	-1.10	-2.19	
AK	36.0	36.0	36.0	0.00	0.000	36.00	-0.30	-1.39	
AL	41.0	40.0	49.0	4.93	1.120	43.33	2.24	1.15	
AN	32.0	36.0	34.0	2.00	0.473	34.00	-0.99	-2.08	
AP	39.0	38.0	37.0	1.00	0.236	38.00	0.40	-0.69	
AU	39.0	35.0	38.0	2.08	0.473	37.33	0.17	-0.92	
AW	34.0	34.0	30.0	2.31	0.473	32.67	-1.45	-2.54	
AY	37.0	36.0	36.0	0.58	0.118	36.33	-0.18	-1.27	
AZ	50.0	40.0	47.0	5.13	1.345	45.67	3.05	1.96	
BA	38.0	41.0	41.0	1.73	0.354	40.00	1.09	0.00	
BB	40.0	38.0	39.0	1.00	0.236	39.00	0.74	-0.35	
BC	35.0	33.0	34.0	1.00	0.236	34.00	-0.99	-2.08	
BG	40.0	25.0	24.0	8.96	2.695	29.67	-2.49	-3.58	⇓
BH	33.0	37.0	35.0	2.00	0.473	35.00	-0.64	-1.73	
BI									•
BK	43.0	44.0	44.0	0.58	0.118	43.67	2.36	1.27	
BL	36.0	39.0	37.0	1.53	0.354	37.33	0.17	-0.92	
BM	38.0	37.0	36.0	1.00	0.236	37.00	0.05	-1.04	
BN	34.0	36.0	35.0	1.00	0.236	35.00	-0.64	-1.73	
BO	36.0	37.0	35.0	1.00	0.236	36.00	-0.30	-1.39	
BW									•
C	36.0	37.0	36.0	0.58	0.118	36.33	-0.18	-1.27	
CA	37.0	38.0	38.0	0.58	0.118	37.67	0.28	-0.81	
CC	34.0	35.0	36.0	1.00	0.236	35.00	-0.64	-1.73	
CE	38.0	37.0	39.0	1.00	0.236	38.00	0.40	-0.69	
CG									•
CJ	34.0	38.0	37.0	2.08	0.473	36.33	-0.18	-1.27	
CK	33.0	33.0	33.0	0.00	0.000	33.00	-1.34	-2.42	
CM	34.0	35.0	33.0	1.00	0.236	34.00	-0.99	-2.08	
CO									•
CP	38.0	33.0	35.0	2.52	0.591	35.33	-0.53	-1.62	
CQ	35.0	39.0	42.0	3.51	0.827	38.67	0.63	-0.46	
CS	42.0	43.0	42.0	0.58	0.118	42.33	1.90	0.81	
CX	38.0	37.0	40.0	1.53	0.354	38.33	0.51	-0.58	
D									•
DD	37.0	38.0	37.0	0.58	0.118	37.33	0.17	-0.92	
DE	35.0	36.0	36.0	0.58	0.118	35.67	-0.41	-1.50	
DG	34.0	36.0	33.0	1.53	0.354	34.33	-0.87	-1.96	
DH	40.0	40.0	39.0	0.58	0.118	39.67	0.97	-0.12	
DL	35.0	38.0	37.0	1.53	0.354	36.67	-0.07	-1.15	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	36.0	35.0	35.0	0.58	0.118	35.33	-0.53	-1.62	
DO	35.0	36.0	38.0	1.53	0.354	36.33	-0.18	-1.27	
DR									•
DT	33.0	40.0	37.0	3.51	0.827	36.67	-0.07	-1.15	
DZ	44.0	45.0	42.0	1.53	0.354	43.67	2.36	1.27	
E	39.0	37.0	40.0	1.53	0.354	38.67	0.63	-0.46	
EA	40.0	40.0	40.0	0.00	0.000	40.00	1.09	0.00	
EB	33.0	32.0	32.0	0.58	0.118	32.33	-1.57	-2.66	
EL	37.0	36.0	36.0	0.58	0.118	36.33	-0.18	-1.27	
EW									•
EX	34.0	44.0	42.0	5.29	1.345	40.00	1.09	0.00	
EZ	40.0	37.0	37.0	1.73	0.354	38.00	0.40	-0.69	
FJ	36.0	38.0	39.0	1.53	0.354	37.67	0.28	-0.81	
FK									•
FL	40.0	41.0	40.0	0.58	0.118	40.33	1.20	0.12	
FU									•
FZ	36.0	35.0	36.0	0.58	0.118	35.67	-0.41	-1.50	
GE	36.0	36.0	35.0	0.58	0.118	35.67	-0.41	-1.50	
GI	31.0	34.0	35.0	2.08	0.473	33.33	-1.22	-2.31	
GL	31.0	31.0	34.0	1.73	0.354	32.00	-1.68	-2.77	
GQ	38.0	38.0	37.0	0.58	0.118	37.67	0.28	-0.81	
HI	44.0	44.0	42.0	1.15	0.236	43.33	2.24	1.15	
HJ	41.0	33.0	36.0	4.04	0.945	36.67	-0.07	-1.15	
HK	37.0	37.0	37.0	0.00	0.000	37.00	0.05	-1.04	
HL	39.0	39.0	39.0	0.00	0.000	39.00	0.74	-0.35	
HP	41.0	38.0	37.0	2.08	0.473	38.67	0.63	-0.46	
HX	36.0	34.0	34.0	1.15	0.236	34.67	-0.76	-1.85	
I	35.0	37.0	37.0	1.15	0.236	36.33	-0.18	-1.27	
IC	39.0	37.0	42.0	2.52	0.591	39.33	0.86	-0.23	
J	38.0	37.0	37.0	0.58	0.118	37.33	0.17	-0.92	
JE	36.0	36.0	35.0	0.58	0.118	35.67	-0.41	-1.50	
JG	33.0	30.0	31.0	1.53	0.354	31.33	-1.91	-3.00	
JI									•
JS	38.0	38.0	38.0	0.00	0.000	38.00	0.40	-0.69	
JY	47.0	42.0	39.0	4.04	0.945	42.67	2.01	0.92	
K	40.0	42.0	44.0	2.00	0.473	42.00	1.78	0.69	
KH	41.0	42.0	40.0	1.00	0.236	41.00	1.44	0.35	
KL	36.0	36.0	38.0	1.15	0.236	36.67	-0.07	-1.15	
KX	37.0	40.0	38.0	1.53	0.354	38.33	0.51	-0.58	
L	39.0	40.0	40.0	0.58	0.118	39.67	0.97	-0.12	
LE	40.0	38.0	35.0	2.52	0.591	37.67	0.28	-0.81	
LF	37.0	37.0	33.0	2.31	0.473	35.67	-0.41	-1.50	
LR	72.0	74.0	61.0	7.00	2.020	69.00	11.14	10.05	×
LT	36.0	38.0	38.0	1.15	0.236	37.33	0.17	-0.92	
M	37.0	37.0	36.0	0.58	0.118	36.67	-0.07	-1.15	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
MA	38.0	36.0	36.0	1.15	0.236	36.67	-0.07	-1.15	
ML	•								
MP	47.0	43.0	46.0	2.08	0.473	45.33	2.94	1.85	
MQ	30.0	36.0	36.0	3.46	0.709	34.00	-0.99	-2.08	
MV	•								
MX	39.0	41.0	41.0	1.15	0.236	40.33	1.20	0.12	
MY	•								
N	36.0	39.0	37.0	1.53	0.354	37.33	0.17	-0.92	
NH	35.0	35.0	34.0	0.58	0.118	34.67	-0.76	-1.85	
NJ	32.0	35.0	33.0	1.53	0.354	33.33	-1.22	-2.31	
NK	•								
NO	39.0	40.0	40.0	0.58	0.118	39.67	0.97	-0.12	
NP	•								
NZ	•								
O	39.0	39.0	40.0	0.58	0.118	39.33	0.86	-0.23	
OA	36.0	35.0	36.0	0.58	0.118	35.67	-0.41	-1.50	
OB	•								
OK	•								
OL	51.0	31.0	40.0	10.02	3.596	40.67	1.32	0.23	
OM	41.0	36.0	35.0	3.21	0.709	37.33	0.17	-0.92	
OZ	•								
P	•								
PB	39.0	40.0	42.0	1.53	0.354	40.33	1.20	0.12	
PE	39.0	39.0	34.0	2.89	0.591	37.33	0.17	-0.92	
PI	34.0	35.0	36.0	1.00	0.236	35.00	-0.64	-1.73	
PM	36.0	34.0	37.0	1.53	0.354	35.67	-0.41	-1.50	
PQ	33.0	34.0	32.0	1.00	0.236	33.00	-1.34	-2.42	
PU	32.0	33.0	34.0	1.00	0.236	33.00	-1.34	-2.42	
PV	34.0	33.0	34.0	0.58	0.118	33.67	-1.10	-2.19	
PW	37.0	36.0	38.0	1.00	0.236	37.00	0.05	-1.04	
Q	37.0	37.0	38.0	0.58	0.118	37.33	0.17	-0.92	
QJ	34.0	36.0	35.0	1.00	0.236	35.00	-0.64	-1.73	
QM	•								
QP	48.0	46.0	30.0	9.87	3.146	41.33	1.55	0.46	
QT	35.0	35.0	35.0	0.00	0.000	35.00	-0.64	-1.73	
QU	40.0	41.0	42.0	1.00	0.236	41.00	1.44	0.35	
QW	41.0	38.0	38.0	1.73	0.354	39.00	0.74	-0.35	
QX	37.0	39.0	39.0	1.15	0.236	38.33	0.51	-0.58	
QZ	36.0	33.0	36.0	1.73	0.354	35.00	-0.64	-1.73	
R	37.0	38.0	37.0	0.58	0.118	37.33	0.17	-0.92	
RF	40.0	38.0	40.0	1.15	0.236	39.33	0.86	-0.23	
RH	33.0	37.0	37.0	2.31	0.473	35.67	-0.41	-1.50	
RL	•								
RO	36.0	36.0	36.0	0.00	0.000	36.00	-0.30	-1.39	
RR	37.0	36.0	38.0	1.00	0.236	37.00	0.05	-1.04	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RU	35.0	36.0	34.0	1.00	0.236	35.00	-0.64	-1.73	
RV	37.0	40.0	38.0	1.53	0.354	38.33	0.51	-0.58	
RX	40.0	39.0	41.0	1.00	0.236	40.00	1.09	0.00	
RZ	38.0	38.0	38.0	0.00	0.000	38.00	0.40	-0.69	
S	38.0	39.0	39.0	0.58	0.118	38.67	0.63	-0.46	
SC	35.0	31.0	31.0	2.31	0.473	32.33	-1.57	-2.66	
SD	35.0	35.0	33.0	1.15	0.236	34.33	-0.87	-1.96	
SF	34.0	36.0	39.0	2.52	0.591	36.33	-0.18	-1.27	
SI	37.0	39.0	39.0	1.15	0.236	38.33	0.51	-0.58	
SM	37.0	38.0	37.0	0.58	0.118	37.33	0.17	-0.92	
SN	36.0	38.0	37.0	1.00	0.236	37.00	0.05	-1.04	
SR	38.0	36.0	37.0	1.00	0.236	37.00	0.05	-1.04	
SS	40.0	39.0	39.0	0.58	0.118	39.33	0.86	-0.23	
ST									•
SV	36.0	35.0	31.0	2.65	0.591	34.00	-0.99	-2.08	
SX	37.0	34.0	33.0	2.08	0.473	34.67	-0.76	-1.85	
SZ	34.0	36.0	36.0	1.15	0.236	35.33	-0.53	-1.62	
T	35.0	37.0	39.0	2.00	0.473	37.00	0.05	-1.04	
TB									•
TC	26.0	31.0	29.0	2.52	0.591	28.67	-2.84	-3.93	⇓
TD	36.0	36.0	35.0	0.58	0.118	35.67	-0.41	-1.50	
TH	40.0	39.0	38.0	1.00	0.236	39.00	0.74	-0.35	
TI	39.0	37.0	38.0	1.00	0.236	38.00	0.40	-0.69	
TL	36.0	34.0	39.0	2.52	0.591	36.33	-0.18	-1.27	
TO									•
TQ	34.0	31.0	33.0	1.53	0.354	32.67	-1.45	-2.54	
TR	33.0	33.0	33.0	0.00	0.000	33.00	-1.34	-2.42	
TS									•
U	41.0	40.0	42.0	1.00	0.236	41.00	1.44	0.35	
UE									•
UM									•
UN	36.0	37.0	39.0	1.53	0.354	37.33	0.17	-0.92	
UP	36.0	36.0	35.0	0.58	0.118	35.67	-0.41	-1.50	
UR	63.0	61.0	61.0	1.15	0.236	61.67	8.60	7.51	×
UT	41.0	41.0	41.0	0.00	0.000	41.00	1.44	0.35	
UW	41.0	42.0	40.0	1.00	0.236	41.00	1.44	0.35	
UX	30.0	32.0	32.0	1.15	0.236	31.33	-1.91	-3.00	
UY	34.0	36.0	36.0	1.15	0.236	35.33	-0.53	-1.62	
VA	36.0	33.0	32.0	2.08	0.473	33.67	-1.10	-2.19	
VC									•
VE	35.0	34.0	36.0	1.00	0.236	35.00	-0.64	-1.73	
VG									•
VH	35.0	34.0	33.0	1.00	0.236	34.00	-0.99	-2.08	
VI	32.0	30.0	32.0	1.15	0.236	31.33	-1.91	-3.00	
VM	44.0	48.0	40.0	4.00	0.945	44.00	2.48	1.39	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
VO	41.0	39.0	32.0	4.73	1.120	37.33	0.17	-0.92	
VR									•
VS	35.0	38.0	37.0	1.53	0.354	36.67	-0.07	-1.15	
VT									•
W	36.0	34.0	35.0	1.00	0.236	35.00	-0.64	-1.73	
WD	38.0	38.0	36.0	1.15	0.236	37.33	0.17	-0.92	
WF	34.0	34.0	34.0	0.00	0.000	34.00	-0.99	-2.08	
WI									•
WJ	326.0	326.0	325.0	0.58	0.118	325.67	100.05	98.96	x
WK	28.0	40.0	32.0	6.11	1.795	33.33	-1.22	-2.31	
WL	274.0	220.0	248.0	27.01	11.246	247.33	72.91	71.82	x
WO	81.0	81.0	84.0	1.73	0.354	82.00	15.64	14.55	x
X	34.0	35.0	36.0	1.00	0.236	35.00	-0.64	-1.73	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
28.67	⇓	TC	34.33		SD	35.67		FZ
29.67	⇓	BG	34.33		DG	35.67		DE
31.00	⇓	A	34.67		SX	36.00		RO
31.33		VI	34.67		NH	36.00		BO
31.33		UX	34.67		HX	36.00		AK
31.33		JG	35.00		X	36.33		TL
32.00		GL	35.00		W	36.33		SF
32.33		SC	35.00		VE	36.33		I
32.33		EB	35.00		RU	36.33		EL
32.67		TQ	35.00		QZ	36.33		DO
32.67		AW	35.00		QT	36.33		CJ
33.00		TR	35.00		QJ	36.33		C
33.00		PU	35.00		PI	36.33		AY
33.00		PQ	35.00		CC	36.67		VS
33.00		CK	35.00		BN	36.67		MA
33.00		AF	35.00		BH	36.67		M
33.33		WK	35.33		UY	36.67		KL
33.33		NJ	35.33		SZ	36.67		HJ
33.33		GI	35.33		DM	36.67		DT
33.67		VA	35.33		CP	36.67		DL
33.67		PV	35.33		AH	37.00		T
33.67		AJ	35.67		UP	37.00		SR
34.00		WF	35.67		TD	37.00		SN
34.00		VH	35.67		RH	37.00		RR
34.00		SV	35.67		PM	37.00		PW
34.00		MQ	35.67		OA	37.00		HK
34.00		CM	35.67		LF	37.00		BM
34.00		BC	35.67		JE	37.00		AE
34.00		AN	35.67		GE	37.33		WD

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

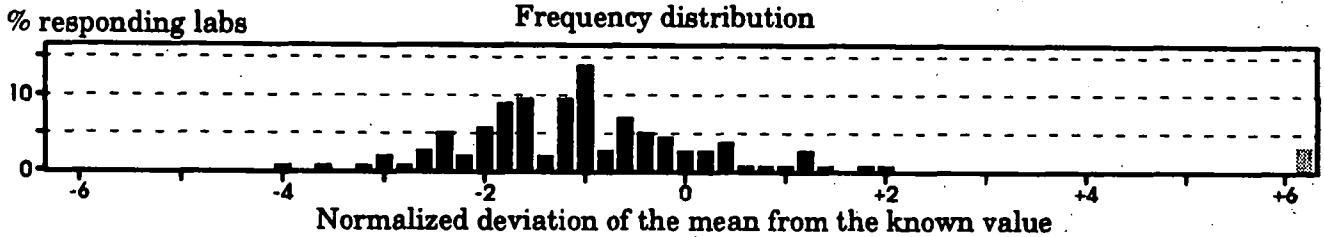
⇑ ≡ Above control limit

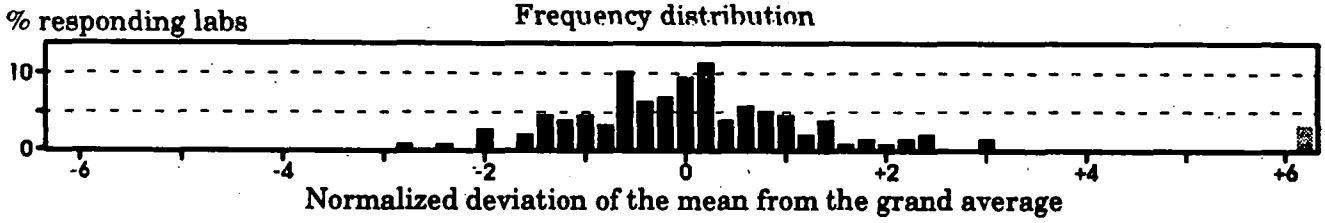
⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
37.33		VO	38.33		RV	40.33		MX
37.33		UN	38.33		QX	40.33		FL
37.33		SM	38.33		KX	40.67		OL
37.33		R	38.33		CX	41.00		UW
37.33		Q	38.67		S	41.00		UT
37.33		PE	38.67		HP	41.00		U
37.33		OM	38.67		E	41.00		QU
37.33		N	38.67		CQ	41.00		KH
37.33		LT	39.00		TH	41.33		QP
37.33		J	39.00		QW	42.00		K
37.33		DD	39.00		HL	42.33		CS
37.33		BL	39.00		BB	42.67		JY
37.33		AU	39.33		SS	43.33		HI
37.67		LE	39.33		RF	43.33		AL
37.67		GQ	39.33		O	43.67		DZ
37.67		FJ	39.33		IC	43.67		BK
37.67		CA	39.67		NO	44.00		VM
38.00		TI	39.67		L	45.33		MP
38.00		RZ	39.67		DH	45.67		AZ
38.00		JS	40.00		RX	61.67	×	UR
38.00		EZ	40.00		EX	69.00	×	LR
38.00		CE	40.00		EA	82.00	×	WO
38.00		AP	40.00		BA	247.33	×	WL
38.33		SI	40.33		PB	325.67	×	WJ





• ≡ No data submitted
Ø ≡ Insufficient data

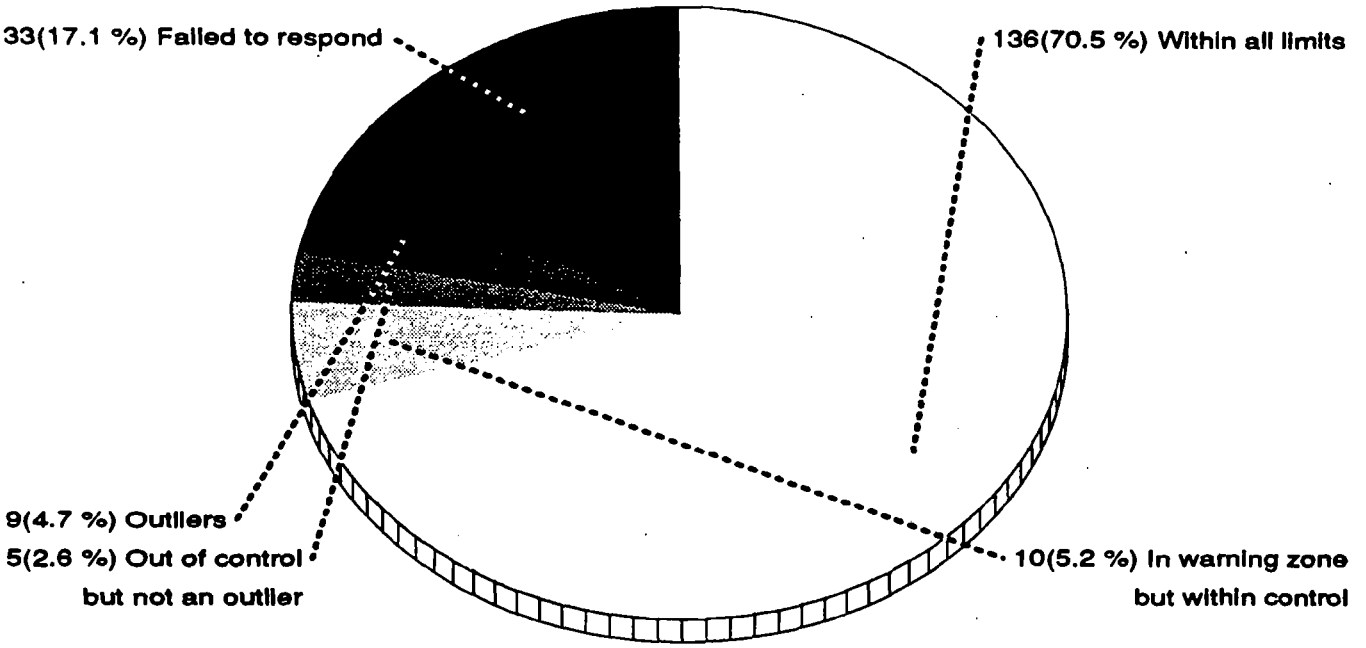
TAG SYMBOLS

× ≡ Determined to be an outlier

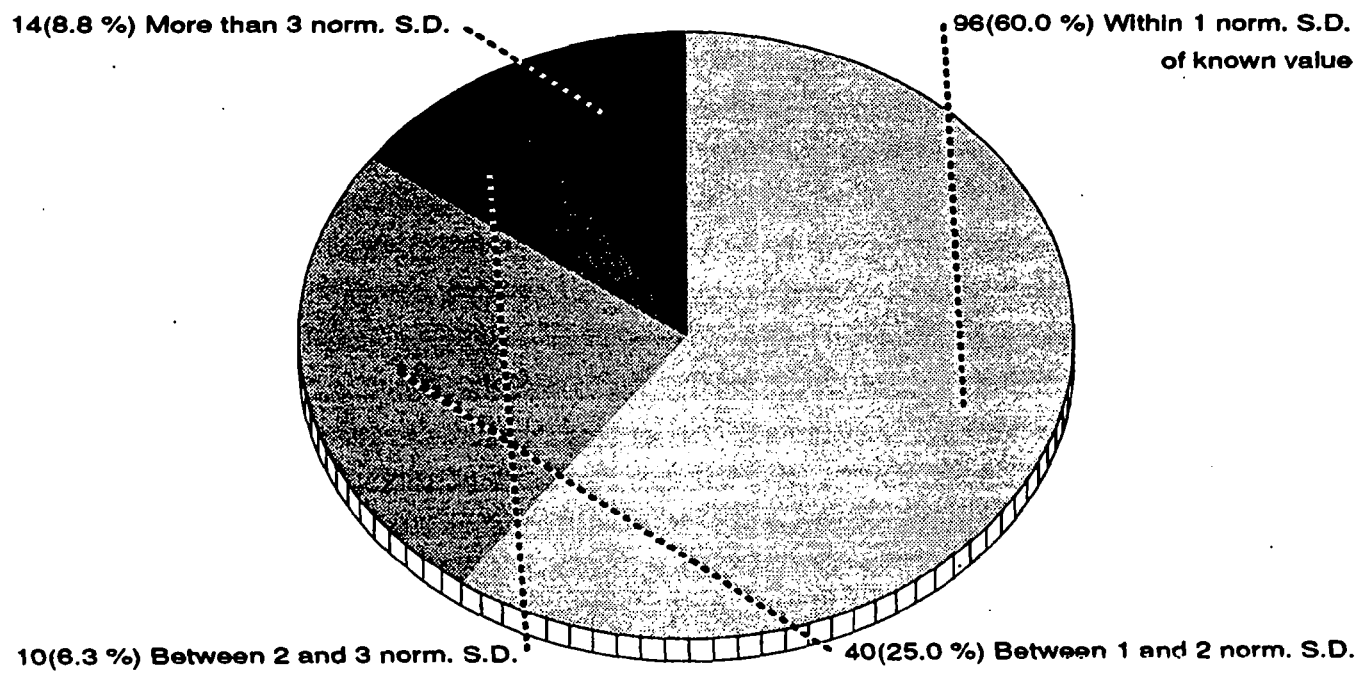
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137 Statistical Summary 193 Participants

The known value of this nuclide is **49.0 pCi/l** with an expected precision of **5.0**; the control limits are 40.3 to 57.7; the warning regions are 40.3 to 43.2 and 54.8 to 57.7



Statistic	Respondents	Non-outliers
Mean	66.29	**Grand Avg 50.81**
Std. Dev.	140.10	3.13
Variance	19627.35	9.82
% Coef. of Var.	211.33	6.17
% deviation of mean from known value	35.29	3.69
Norm. dev. of mean from known value	0.12	0.58
Median	50.67	50.67
% deviation of median from known value	3.40	3.40
Norm. dev. of median from known value	0.01	0.53



CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	43.0	44.0	43.0	0.58	0.118	43.33	-2.59	-1.96	
AE	49.0	50.0	53.0	2.08	0.473	50.67	-0.05	0.58	
AF	51.0	49.0	52.0	1.53	0.354	50.67	-0.05	0.58	
AH	52.0	53.0	52.0	0.58	0.118	52.33	0.53	1.15	
AI									•
AJ	50.0	50.0	50.0	0.00	0.000	50.00	-0.28	0.35	
AK	50.0	50.0	50.0	0.00	0.000	50.00	-0.28	0.35	
AL	51.0	50.0	40.0	6.08	1.570	47.00	-1.32	-0.69	
AN	50.0	49.0	50.0	0.58	0.118	49.67	-0.39	0.23	
AP	52.0	51.0	52.0	0.58	0.118	51.67	0.30	0.92	
AU	48.0	48.0	50.0	1.15	0.236	48.67	-0.74	-0.12	
AW	51.0	49.0	49.0	1.15	0.236	49.67	-0.39	0.23	
AY	57.0	57.0	58.0	0.58	0.118	57.33	2.26	2.89	
AZ	52.0	46.0	44.0	4.16	0.945	47.33	-1.20	-0.58	
BA	49.0	48.0	44.0	2.65	0.591	47.00	-1.32	-0.69	
BB	50.0	50.0	50.0	0.00	0.000	50.00	-0.28	0.35	
BC	52.0	52.0	51.0	0.58	0.118	51.67	0.30	0.92	
BG	67.0	48.0	52.0	10.02	3.371	55.67	1.68	2.31	
BH	53.0	53.0	53.0	0.00	0.000	53.00	0.76	1.39	
BI									•
BK	64.0	65.0	64.0	0.58	0.118	64.33	4.69	5.31	×
BL	50.0	51.0	49.0	1.00	0.236	50.00	-0.28	0.35	
BM	52.0	50.0	52.0	1.15	0.236	51.33	0.18	0.81	
BN	52.0	51.0	51.0	0.58	0.118	51.33	0.18	0.81	
BO	48.0	51.0	51.0	1.73	0.354	50.00	-0.28	0.35	
BW									•
C	44.0	46.0	47.0	1.53	0.354	45.67	-1.78	-1.15	
CA	54.0	50.0	51.0	2.08	0.473	51.67	0.30	0.92	
CC	49.0	48.0	48.0	0.58	0.118	48.33	-0.86	-0.23	
CE	55.0	53.0	55.0	1.15	0.236	54.33	1.22	1.85	
CG									•
CJ	45.0	53.0	53.0	4.62	0.945	50.33	-0.16	0.46	
CK	48.0	53.0	44.0	4.51	1.120	48.33	-0.86	-0.23	
CM	50.0	52.0	51.0	1.00	0.236	51.00	0.07	0.69	
CO									•
CP	56.0	51.0	47.0	4.51	1.120	51.33	0.18	0.81	
CQ	53.0	54.0	51.0	1.53	0.354	52.67	0.64	1.27	
CS	62.0	61.0	63.0	1.00	0.236	62.00	3.88	4.50	×
CX	51.0	52.0	53.0	1.00	0.236	52.00	0.41	1.04	
D									•
DD	53.0	52.0	54.0	1.00	0.236	53.00	0.76	1.39	
DE	50.0	50.0	50.0	0.00	0.000	50.00	-0.28	0.35	
DG	56.0	58.0	60.0	2.00	0.473	58.00	2.49	3.12	⇑
DH	50.0	50.0	50.0	0.00	0.000	50.00	-0.28	0.35	
DL	54.0	42.0	48.0	6.00	1.795	48.00	-0.97	-0.35	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	45.0	46.0	48.0	1.53	0.354	46.33	-1.55	-0.92	
DO	49.0	55.0	58.0	4.58	1.120	54.00	1.11	1.73	
DR									•
DT	49.0	48.0	53.0	2.65	0.591	50.00	-0.28	0.35	
DZ	54.0	54.0	49.0	2.89	0.591	52.33	0.53	1.15	
E	57.0	51.0	55.0	3.06	0.709	54.33	1.22	1.85	
EA	51.0	50.0	51.0	0.58	0.118	50.67	-0.05	0.58	
EB	50.0	49.0	48.0	1.00	0.236	49.00	-0.63	0.00	
EL	50.0	50.0	52.0	1.15	0.236	50.67	-0.05	0.58	
EW									•
EX	52.0	54.0	51.0	1.53	0.354	52.33	0.53	1.15	
EZ	42.0	51.0	50.0	4.93	1.120	47.67	-1.09	-0.46	
FJ	51.0	51.0	49.0	1.15	0.236	50.33	-0.16	0.46	
FK									•
FL	54.0	53.0	51.0	1.53	0.354	52.67	0.64	1.27	
FU									•
FZ	45.0	49.0	50.0	2.65	0.591	48.00	-0.97	-0.35	
GE	55.0	51.0	48.0	3.51	0.827	51.33	0.18	0.81	
GI	44.0	49.0	48.0	2.65	0.591	47.00	-1.32	-0.69	
GL	47.0	50.0	50.0	1.73	0.354	49.00	-0.63	0.00	
GQ	52.0	52.0	51.0	0.58	0.118	51.67	0.30	0.92	
HI	56.0	59.0	57.0	1.53	0.354	57.33	2.26	2.89	
HJ	54.0	49.0	48.0	3.21	0.709	50.33	-0.16	0.46	
HK	52.0	54.0	51.0	1.53	0.354	52.33	0.53	1.15	
HL	55.0	55.0	55.0	0.00	0.000	55.00	1.45	2.08	
HP	52.0	53.0	53.0	0.58	0.118	52.67	0.64	1.27	
HX	50.0	50.0	49.0	0.58	0.118	49.67	-0.39	0.23	
I	51.0	48.0	43.0	4.04	0.945	47.33	-1.20	-0.58	
IC	52.0	51.0	52.0	0.58	0.118	51.67	0.30	0.92	
J	50.0	50.0	49.0	0.58	0.118	49.67	-0.39	0.23	
JE	53.0	53.0	51.0	1.15	0.236	52.33	0.53	1.15	
JG	51.0	55.0	56.0	2.65	0.591	54.00	1.11	1.73	
JI									•
JS	54.0	50.0	54.0	2.31	0.473	52.67	0.64	1.27	
JY	51.0	58.0	52.0	3.79	0.827	53.67	0.99	1.62	
K	53.0	51.0	53.0	1.15	0.236	52.33	0.53	1.15	
KH	59.0	62.0	58.0	2.08	0.473	59.67	3.07	3.70	⇑
KL	51.0	49.0	50.0	1.00	0.236	50.00	-0.28	0.35	
KX	49.0	52.0	48.0	2.08	0.473	49.67	-0.39	0.23	
L	54.0	57.0	58.0	2.08	0.473	56.33	1.91	2.54	
LE	57.0	55.0	54.0	1.53	0.354	55.33	1.57	2.19	
LF	48.0	51.0	49.0	1.53	0.354	49.33	-0.51	0.12	
LR	52.0	50.0	50.0	1.15	0.236	50.67	-0.05	0.58	
LT	52.0	52.0	54.0	1.15	0.236	52.67	0.64	1.27	
M	51.0	49.0	46.0	2.52	0.591	48.67	-0.74	-0.12	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
MA	52.0	54.0	52.0	1.15	0.236	52.67	0.64	1.27	
ML									•
MP	52.0	55.0	53.0	1.53	0.354	53.33	0.88	1.50	
MQ	50.0	51.0	53.0	1.53	0.354	51.33	0.18	0.81	
MV									•
MX	52.0	55.0	54.0	1.53	0.354	53.67	0.99	1.62	
MY									•
N	54.0	48.0	51.0	3.00	0.709	51.00	0.07	0.69	
NH	51.0	51.0	50.0	0.58	0.118	50.67	-0.05	0.58	
NJ	49.0	48.0	49.0	0.58	0.118	48.67	-0.74	-0.12	
NK									•
NO	51.0	52.0	54.0	1.53	0.354	52.33	0.53	1.15	
NP									•
NZ									•
O	56.0	56.0	55.0	0.58	0.118	55.67	1.68	2.31	
OA	49.0	48.0	46.0	1.53	0.354	47.67	-1.09	-0.46	
OB	54.0	55.0	55.0	0.58	0.118	54.67	1.34	1.96	
OK									•
OL	49.0	55.0	51.0	3.06	0.709	51.67	0.30	0.92	
OM	51.0	49.0	51.0	1.15	0.236	50.33	-0.16	0.46	
OZ									•
P									•
PB	45.0	45.0	45.0	0.00	0.000	45.00	-2.01	-1.39	
PE	54.0	57.0	57.0	1.73	0.354	56.00	1.80	2.42	
PI	51.0	50.0	50.0	0.58	0.118	50.33	-0.16	0.46	
PM	50.0	55.0	52.0	2.52	0.591	52.33	0.53	1.15	
PQ	49.0	51.0	48.0	1.53	0.354	49.33	-0.51	0.12	
PU	56.0	57.0	57.0	0.58	0.118	56.67	2.03	2.66	
PV	45.0	50.0	47.0	2.52	0.591	47.33	-1.20	-0.58	
PW	51.0	51.0	49.0	1.15	0.236	50.33	-0.16	0.46	
Q	47.0	47.0	48.0	0.58	0.118	47.33	-1.20	-0.58	
QJ	50.0	51.0	54.0	2.08	0.473	51.67	0.30	0.92	
QM									•
QP	59.0	50.0	46.0	6.66	2.020	51.67	0.30	0.92	
QT	49.0	48.0	44.0	2.65	0.591	47.00	-1.32	-0.69	
QU	52.0	52.0	53.0	0.58	0.118	52.33	0.53	1.15	
QW	54.0	51.0	50.0	2.08	0.473	51.67	0.30	0.92	
QX	59.0	62.0	62.0	1.73	0.354	61.00	3.53	4.16	⇑
QZ	51.0	49.0	52.0	1.53	0.354	50.67	-0.05	0.58	
R	53.0	56.0	53.0	1.73	0.354	54.00	1.11	1.73	
RF	45.0	47.0	45.0	1.15	0.236	45.67	-1.78	-1.15	
RH	46.0	48.0	47.0	1.00	0.236	47.00	-1.32	-0.69	
RL									•
RO	51.0	49.0	53.0	2.00	0.473	51.00	0.07	0.69	
RR	47.0	46.0	49.0	1.53	0.354	47.33	-1.20	-0.58	

TAG SYMBOLS

• ≡ No data submitted
⇑ ≡ Above control limit
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇓ ≡ Below control limit

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RU	48.0	49.0	48.0	0.58	0.118	48.33	-0.86	-0.23	
RV	50.0	46.0	55.0	4.51	1.120	50.33	-0.16	0.46	
RX	52.0	53.0	50.0	1.53	0.354	51.67	0.30	0.92	
RZ	49.0	50.0	50.0	0.58	0.118	49.67	-0.39	0.23	
S	50.0	47.0	49.0	1.53	0.354	48.67	-0.74	-0.12	
SC	44.0	47.0	50.0	3.00	0.709	47.00	-1.32	-0.69	
SD	53.0	53.0	49.0	2.31	0.473	51.67	0.30	0.92	
SF	53.0	53.0	50.0	1.73	0.354	52.00	0.41	1.04	
SI	52.0	50.0	49.0	1.53	0.354	50.33	-0.16	0.46	
SM	50.0	55.0	54.0	2.65	0.591	53.00	0.76	1.39	
SN	50.0	51.0	51.0	0.58	0.118	50.67	-0.05	0.58	
SR	50.0	50.0	49.0	0.58	0.118	49.67	-0.39	0.23	
SS	53.0	54.0	54.0	0.58	0.118	53.67	0.99	1.62	
ST	•								
SV	47.0	46.0	52.0	3.21	0.709	48.33	-0.86	-0.23	
SX	45.0	44.0	44.0	0.58	0.118	44.33	-2.24	-1.62	
SZ	51.0	52.0	52.0	0.58	0.118	51.67	0.30	0.92	
T	49.0	50.0	48.0	1.00	0.236	49.00	-0.63	0.00	
TB	•								
TC	53.0	46.0	50.0	3.51	0.827	49.67	-0.39	0.23	
TD	45.0	52.0	51.0	3.79	0.827	49.33	-0.51	0.12	
TH	50.0	51.0	51.0	0.58	0.118	50.67	-0.05	0.58	
TI	64.0	52.0	58.0	6.00	1.795	58.00	2.49	3.12	⇑
TL	44.0	49.0	53.0	4.51	1.120	48.67	-0.74	-0.12	
TO	•								
TQ	45.0	50.0	46.0	2.65	0.591	47.00	-1.32	-0.69	
TR	46.0	43.0	44.0	1.53	0.354	44.33	-2.24	-1.62	
TS	•								
U	53.0	53.0	53.0	0.00	0.000	53.00	0.76	1.39	
UE	•								
UM	•								
UN	53.0	55.0	56.0	1.53	0.354	54.67	1.34	1.96	
UP	50.0	50.0	50.0	0.00	0.000	50.00	-0.28	0.35	
UR	117.0	124.0	121.0	3.51	0.827	120.67	24.20	24.83	×
UT	1.0	1.0	1.0	0.00	0.000	1.00	-17.25	-16.63	×
UW	49.0	47.0	46.0	1.53	0.354	47.33	-1.20	-0.58	
UX	46.0	46.0	47.0	0.58	0.118	46.33	-1.55	-0.92	
UY	49.0	50.0	53.0	2.08	0.473	50.67	-0.05	0.58	
VA	48.0	45.0	44.0	2.08	0.473	45.67	-1.78	-1.15	
VC	•								
VE	38.0	45.0	42.0	3.51	0.827	41.67	-3.17	-2.54	
VG	•								
VH	48.0	45.0	52.0	3.51	0.827	48.33	-0.86	-0.23	
VI	54.0	51.0	48.0	3.00	0.709	51.00	0.07	0.69	
VM	51.0	52.0	50.0	1.00	0.236	51.00	0.07	0.69	

• ≡ No data submitted | **TAG SYMBOLS** | ⇑ ≡ Above control limit

∅ ≡ Insufficient data | × ≡ Determined to be an outlier | ⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VO	52.0	53.0	53.0	0.58	0.118	52.67	0.64	1.27	
VR									•
VS	48.0	53.0	49.0	2.65	0.591	50.00	-0.28	0.35	
VT									•
W	53.0	50.0	52.0	1.53	0.354	51.67	0.30	0.92	
WD	49.0	48.0	50.0	1.00	0.236	49.00	-0.63	0.00	
WF	90.0	90.0	90.0	0.00	0.000	90.00	13.58	14.20	×
WI									•
WJ	440.0	432.0	439.0	4.36	0.945	437.00	133.78	134.41	×
WK	1743.0	1752.0	1793.0	26.65	10.346	1762.67	593.01	593.63	×
WL	334.0	286.0	312.0	24.03	9.896	310.67	90.02	90.64	×
WO	91.0	77.0	93.0	8.72	2.695	87.00	12.54	13.16	×
X	59.0	56.0	59.0	1.73	0.354	58.00	2.49	3.12	⇑

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00	×	UT	48.33		SV	50.00		DE
41.67		VE	48.33		RU	50.00		BO
43.33		A	48.33		CK	50.00		BL
44.33		TR	48.33		CC	50.00		BB
44.33		SX	48.67		TL	50.00		AK
45.00		PB	48.67		S	50.00		AJ
45.67		VA	48.67		NJ	50.33		SI
45.67		RF	48.67		M	50.33		RV
45.67		C	48.67		AU	50.33		PW
46.33		UX	49.00		WD	50.33		PI
46.33		DM	49.00		T	50.33		OM
47.00		TQ	49.00		GL	50.33		HJ
47.00		SC	49.00		EB	50.33		FJ
47.00		RH	49.33		TD	50.33		CJ
47.00		QT	49.33		PQ	50.67		UY
47.00		GI	49.33		LF	50.67		TH
47.00		BA	49.67		TC	50.67		SN
47.00		AL	49.67		SR	50.67		QZ
47.33		UW	49.67		RZ	50.67		NH
47.33		RR	49.67		KX	50.67		LR
47.33		Q	49.67		J	50.67		EL
47.33		PV	49.67		HX	50.67		EA
47.33		I	49.67		AW	50.67		AF
47.33		AZ	49.67		AN	50.67		AE
47.67		OA	50.00		VS	51.00		VM
47.67		EZ	50.00		UP	51.00		VI
48.00		FZ	50.00		KL	51.00		RO
48.00		DL	50.00		DT	51.00		N
48.33		VH	50.00		DH	51.00		CM

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

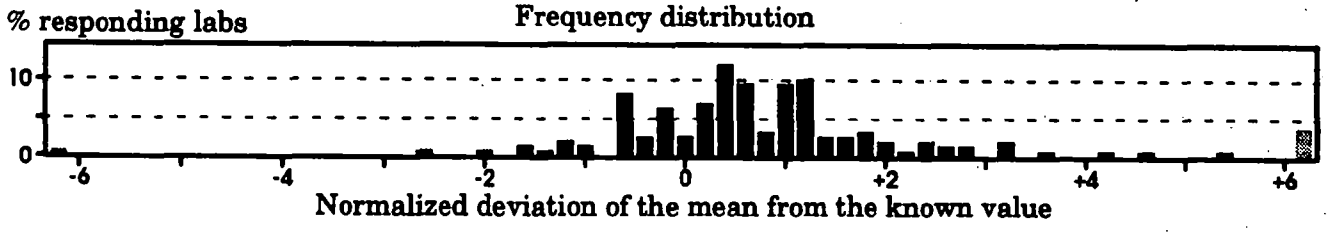
× ≡ Determined to be an outlier

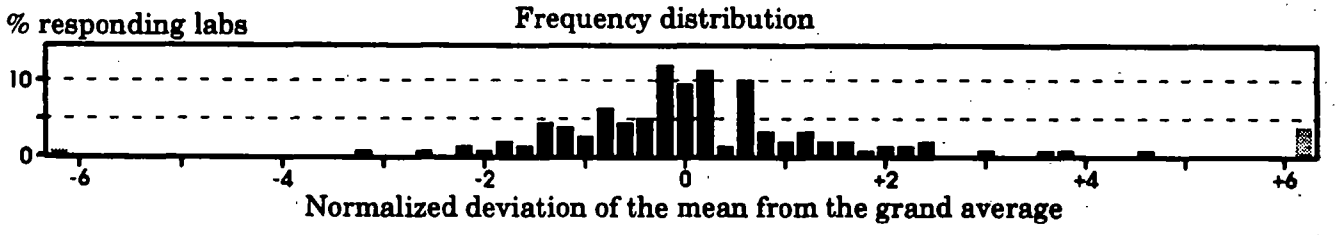
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
51.33		MQ	52.33		JE	54.33		CE
51.33		GE	52.33		HK	54.67		UN
51.33		CP	52.33		EX	54.67		OB
51.33		BN	52.33		DZ	55.00		HL
51.33		BM	52.33		AH	55.33		LE
51.67		W	52.67		VO	55.67		O
51.67		SZ	52.67		MA	55.67		BG
51.67		SD	52.67		LT	56.00		PE
51.67		RX	52.67		JS	56.33		L
51.67		QW	52.67		HP	56.67		PU
51.67		QP	52.67		FL	57.33		HI
51.67		QJ	52.67		CQ	57.33		AY
51.67		OL	53.00		U	58.00	⇑	X
51.67		IC	53.00		SM	58.00	⇑	TI
51.67		GQ	53.00		DD	58.00	⇑	DG
51.67		CA	53.00		BH	59.67	⇑	KH
51.67		BC	53.33		MP	61.00	⇑	QX
51.67		AP	53.67		SS	62.00	×	CS
52.00		SF	53.67		MX	64.33	×	BK
52.00		CX	53.67		JY	87.00	×	WO
52.33		QU	54.00		R	90.00	×	WF
52.33		PM	54.00		JG	120.67	×	UR
52.33		NO	54.00		DO	310.67	×	WL
52.33		K	54.33		E	437.00	×	WJ
						1762.67	×	WK





• ≡ No data submitted
∅ ≡ Insufficient data

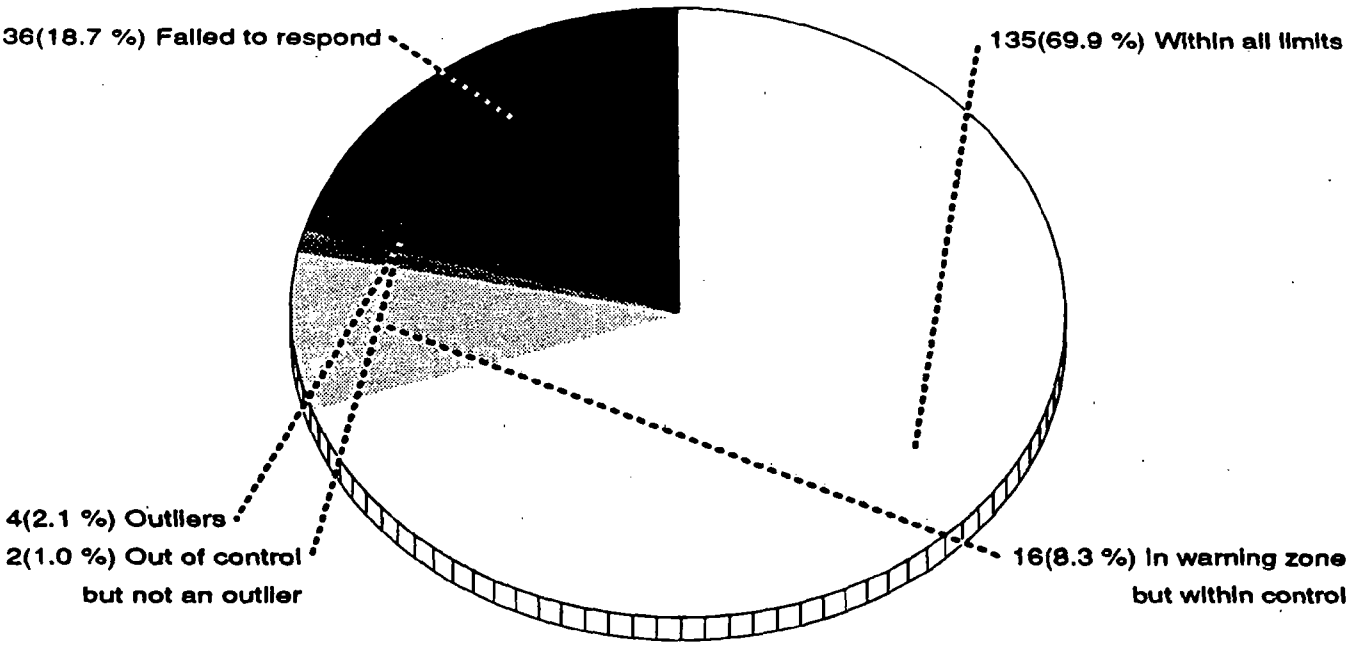
TAG SYMBOLS

× ≡ Determined to be an outlier

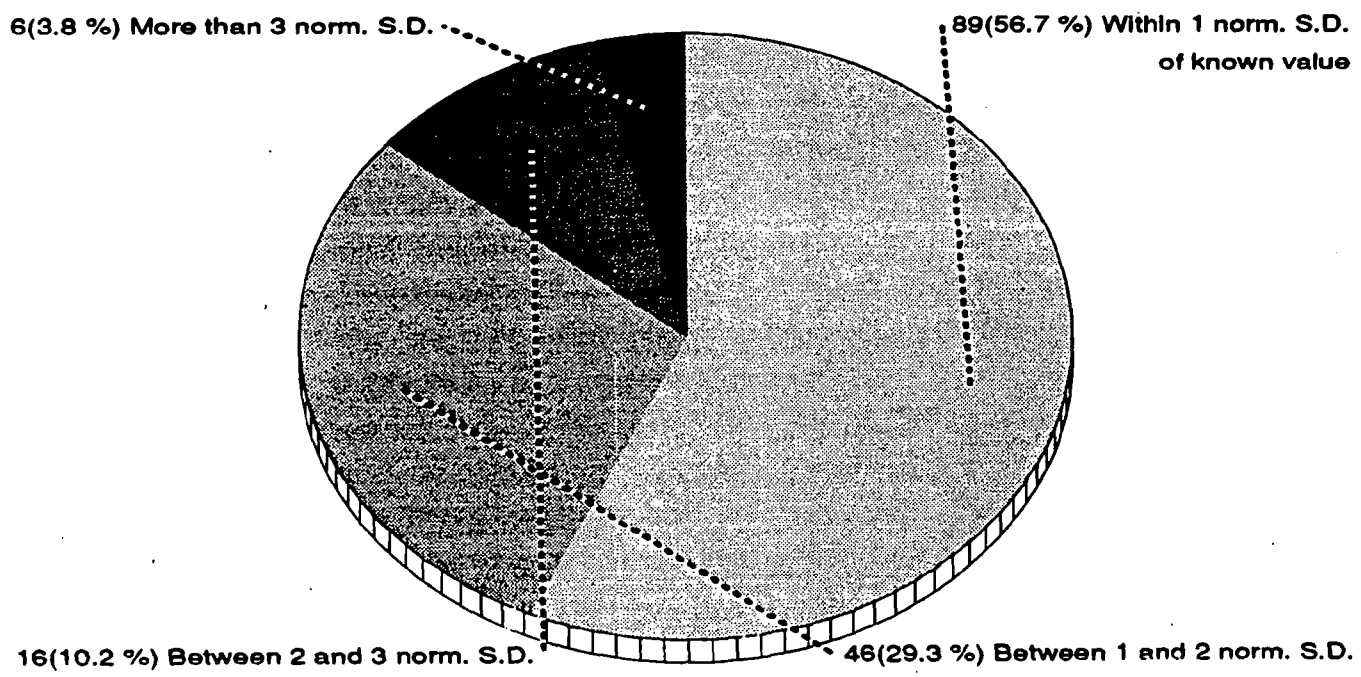
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133 Statistical Summary 193 Participants

The known value of this nuclide is **99.0 pCi/l** with an expected precision of **10.0**; the control limits are 81.7 to 116.3; the warning regions are 81.7 to 87.4 and 110.6 to 116.3



Statistic	Respondents	Non-outliers
Mean	103.69	**Grand Avg 95.64**
Std. Dev.	78.47	6.59
Variance	6157.64	43.47
% Coef. of Var.	75.68	6.89
% deviation of mean from known value	4.74	-3.40
Norm. dev. of mean from known value	0.06	-0.51
Median	96.00	96.00
% deviation of median from known value	-3.03	-3.03
Norm. dev. of median from known value	-0.04	-0.46



CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	89.0	85.0	76.0	6.66	0.768	83.33	-2.13	-2.71	
AE	96.0	99.0	101.0	2.52	0.295	98.67	0.52	-0.06	
AF	93.0	97.0	93.0	2.31	0.236	94.33	-0.23	-0.81	
AH	99.0	98.0	100.0	1.00	0.118	99.00	0.58	0.00	
AI									•
AJ	96.0	99.0	96.0	1.73	0.177	97.00	0.24	-0.35	
AK	90.0	92.0	89.0	1.53	0.177	90.33	-0.92	-1.50	
AL	97.0	108.0	99.0	5.86	0.650	101.33	0.99	0.40	
AN	92.0	106.0	92.0	8.08	0.827	96.67	0.18	-0.40	
AP	94.0	90.0	91.0	2.08	0.236	91.67	-0.69	-1.27	
AU	92.0	98.0	99.0	3.79	0.413	96.33	0.12	-0.46	
AW	90.0	90.0	86.0	2.31	0.236	88.67	-1.21	-1.79	
AY	103.0	102.0	104.0	1.00	0.118	103.00	1.28	0.69	
AZ	113.0	101.0	95.0	9.17	1.120	103.00	1.28	0.69	
BA	106.0	100.0	103.0	3.00	0.354	103.00	1.28	0.69	
BB	86.0	94.0	90.0	4.00	0.473	90.00	-0.98	-1.56	
BC	85.0	86.0	86.0	0.58	0.059	85.67	-1.73	-2.31	
BG	97.0	96.0	84.0	7.23	0.768	92.33	-0.57	-1.15	
BH	92.0	92.0	93.0	0.58	0.059	92.33	-0.57	-1.15	
BI									•
BK	111.0	112.0	112.0	0.58	0.059	111.67	2.78	2.19	
BL	99.0	100.0	100.0	0.58	0.059	99.67	0.70	0.12	
BM	99.0	99.0	99.0	0.00	0.000	99.00	0.58	0.00	
BN	89.0	89.0	92.0	1.73	0.177	90.00	-0.98	-1.56	
BO	93.0	96.0	95.0	1.53	0.177	94.67	-0.17	-0.75	
BW									•
C	95.0	91.0	91.0	2.31	0.236	92.33	-0.57	-1.15	
CA	103.0	97.0	98.0	3.21	0.354	99.33	0.64	0.06	
CC	89.0	88.0	87.0	1.00	0.118	88.00	-1.32	-1.91	
CE	104.0	102.0	93.0	5.86	0.650	99.67	0.70	0.12	
CG									•
CJ	94.0	92.0	88.0	3.06	0.354	91.33	-0.75	-1.33	
CK	86.0	86.0	88.0	1.15	0.118	86.67	-1.55	-2.14	
CM	101.0	101.0	96.0	2.89	0.295	99.33	0.64	0.06	
CO									•
CP	95.0	107.0	98.0	6.24	0.709	100.00	0.76	0.17	
CQ	101.0	97.0	100.0	2.08	0.236	99.33	0.64	0.06	
CS	105.0	106.0	105.0	0.58	0.059	105.33	1.68	1.10	
CX	86.0	87.0	90.0	2.08	0.236	87.67	-1.38	-1.96	
D									•
DD	102.0	102.0	102.0	0.00	0.000	102.00	1.10	0.52	
DE	91.0	92.0	92.0	0.58	0.059	91.67	-0.69	-1.27	
DG	92.0	95.0	90.0	2.52	0.295	92.33	-0.57	-1.15	
DH	94.0	95.0	95.0	0.58	0.059	94.67	-0.17	-0.75	
DL	105.0	100.0	105.0	2.89	0.295	103.33	1.33	0.75	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
DM	86.0	86.0	89.0	1.73	0.177	87.00	-1.50	-2.08	
DO	99.0	99.0	111.0	6.93	0.709	103.00	1.28	0.69	
DR	•								
DT	89.0	91.0	102.0	7.00	0.768	94.00	-0.28	-0.87	
DZ	101.0	102.0	99.0	1.53	0.177	100.67	0.87	0.29	
E	95.0	94.0	94.0	0.58	0.059	94.33	-0.23	-0.81	
EA	98.0	98.0	98.0	0.00	0.000	98.00	0.41	-0.17	
EB	84.0	85.0	87.0	1.53	0.177	85.33	-1.78	-2.37	
EL	94.0	94.0	95.0	0.58	0.059	94.33	-0.23	-0.81	
EW	•								
EX	97.0	101.0	100.0	2.08	0.236	99.33	0.64	0.06	
EZ	111.0	105.0	109.0	3.06	0.354	108.33	2.20	1.62	
FJ	97.0	100.0	101.0	2.08	0.236	99.33	0.64	0.06	
FK	•								
FL	109.0	115.0	99.0	8.08	0.945	107.67	2.08	1.50	
FU	•								
FZ	95.0	96.0	91.0	2.65	0.295	94.00	-0.28	-0.87	
GE	97.0	92.0	97.0	2.89	0.295	95.33	-0.05	-0.64	
GI	85.0	94.0	95.0	5.51	0.591	91.33	-0.75	-1.33	
GL	94.0	87.0	92.0	3.61	0.413	91.00	-0.80	-1.39	
GQ	96.0	96.0	96.0	0.00	0.000	96.00	0.06	-0.52	
HI	100.0	112.0	116.0	8.33	0.945	109.33	2.37	1.79	
HJ	99.0	97.0	94.0	2.52	0.295	96.67	0.18	-0.40	
HK	92.0	91.0	90.0	1.00	0.118	91.00	-0.80	-1.39	
HL	100.0	100.0	100.0	0.00	0.000	100.00	0.76	0.17	
HP	101.0	94.0	94.0	4.04	0.413	96.33	0.12	-0.46	
HX	96.0	92.0	93.0	2.08	0.236	93.67	-0.34	-0.92	
I	85.0	95.0	86.0	5.51	0.591	88.67	-1.21	-1.79	
IC	96.0	106.0	99.0	5.13	0.591	100.33	0.81	0.23	
J	105.0	101.0	102.0	2.08	0.236	102.67	1.22	0.64	
JE	94.0	95.0	95.0	0.58	0.059	94.67	-0.17	-0.75	
JG	78.0	79.0	82.0	2.08	0.236	79.67	-2.77	-3.35	⇓
JI	•								
JS	98.0	97.0	97.0	0.58	0.059	97.33	0.29	-0.29	
JY	97.0	101.0	98.0	2.08	0.236	98.67	0.52	-0.06	
K	92.0	94.0	95.0	1.53	0.177	93.67	-0.34	-0.92	
KH	106.0	104.0	104.0	1.15	0.118	104.67	1.56	0.98	
KL	100.0	100.0	99.0	0.58	0.059	99.67	0.70	0.12	
KX	100.0	107.0	102.0	3.61	0.413	103.00	1.28	0.69	
L	106.0	104.0	102.0	2.00	0.236	104.00	1.45	0.87	
LE	93.0	101.0	97.0	4.00	0.473	97.00	0.24	-0.35	
LF	93.0	95.0	96.0	1.53	0.177	94.67	-0.17	-0.75	
LR	116.0	112.0	109.0	3.51	0.413	112.33	2.89	2.31	
LT	101.0	100.0	96.0	2.65	0.295	99.00	0.58	0.00	
M	85.0	85.0	90.0	2.89	0.295	86.67	-1.55	-2.14	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
MA	106.0	101.0	101.0	2.89	0.295	102.67	1.22	0.64	
ML	•								
MP	107.0	109.0	108.0	1.00	0.118	108.00	2.14	1.56	
MQ	•								
MV	•								
MX	99.0	103.0	101.0	2.00	0.236	101.00	0.93	0.35	
MY	•								
N	101.0	100.0	102.0	1.00	0.118	101.00	0.93	0.35	
NH	93.0	93.0	94.0	0.58	0.059	93.33	-0.40	-0.98	
NJ	86.0	83.0	89.0	3.00	0.354	86.00	-1.67	-2.25	
NK	•								
NO	87.0	89.0	90.0	1.53	0.177	88.67	-1.21	-1.79	
NP	•								
NZ	•								
O	100.0	99.0	101.0	1.00	0.118	100.00	0.76	0.17	
OA	100.0	97.0	99.0	1.53	0.177	98.67	0.52	-0.06	
OB	•								
OK	•								
OL	104.0	98.0	87.0	8.62	1.008	96.33	0.12	-0.46	
OM	95.0	95.0	90.0	2.89	0.295	93.33	-0.40	-0.98	
OZ	•								
P	•								
PB	84.0	85.0	86.0	1.00	0.118	85.00	-1.84	-2.42	
PE	104.0	104.0	103.0	0.58	0.059	103.67	1.39	0.81	
PI	90.0	90.0	86.0	2.31	0.236	88.67	-1.21	-1.79	
PM	89.0	99.0	89.0	5.77	0.591	92.33	-0.57	-1.15	
PQ	97.0	99.0	92.0	3.61	0.413	96.00	0.06	-0.52	
PU	•								
PV	80.0	92.0	85.0	6.03	0.709	85.67	-1.73	-2.31	
PW	92.0	93.0	96.0	2.08	0.236	93.67	-0.34	-0.92	
Q	89.0	92.0	87.0	2.52	0.295	89.33	-1.09	-1.67	
QJ	100.0	100.0	100.0	0.00	0.000	100.00	0.76	0.17	
QM	•								
QP	95.0	87.0	106.0	9.54	1.233	96.00	0.06	-0.52	
QT	92.0	95.0	97.0	2.52	0.295	94.67	-0.17	-0.75	
QU	100.0	100.0	99.0	0.58	0.059	99.67	0.70	0.12	
QW	99.0	100.0	98.0	1.00	0.118	99.00	0.58	0.00	
QX	102.0	105.0	101.0	2.08	0.236	102.67	1.22	0.64	
QZ	93.0	94.0	95.0	1.00	0.118	94.00	-0.28	-0.87	
R	92.0	93.0	93.0	0.58	0.059	92.67	-0.51	-1.10	
RF	95.0	89.0	90.0	3.21	0.354	91.33	-0.75	-1.33	
RH	88.0	89.0	92.0	2.08	0.236	89.67	-1.03	-1.62	
RL	•								
RO	94.0	86.0	89.0	4.04	0.473	89.67	-1.03	-1.62	
RR	92.0	89.0	91.0	1.53	0.177	90.67	-0.86	-1.44	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
RU	98.0	96.0	93.0	2.52	0.295	95.67	0.01	-0.58	
RV	110.0	103.0	103.0	4.04	0.413	105.33	1.68	1.10	
RX	98.0	110.0	106.0	6.11	0.709	104.67	1.56	0.98	
RZ	95.0	96.0	97.0	1.00	0.118	96.00	0.06	-0.52	
S	97.0	98.0	98.0	0.58	0.059	97.67	0.35	-0.23	
SC	86.0	87.0	90.0	2.08	0.236	87.67	-1.38	-1.96	
SD	88.0	87.0	81.0	3.79	0.413	85.33	-1.78	-2.37	
SF	99.0	98.0	100.0	1.00	0.118	99.00	0.58	0.00	
SI	95.0	92.0	91.0	2.08	0.236	92.67	-0.51	-1.10	
SM	98.0	105.0	99.0	3.79	0.413	100.67	0.87	0.29	
SN	92.0	92.0	91.0	0.58	0.059	91.67	-0.69	-1.27	
SR	97.0	91.0	93.0	3.06	0.354	93.67	-0.34	-0.92	
SS	107.0	106.0	106.0	0.58	0.059	106.33	1.85	1.27	
ST									•
SV	98.0	98.0	105.0	4.04	0.413	100.33	0.81	0.23	
SX	101.0	97.0	103.0	3.06	0.354	100.33	0.81	0.23	
SZ	92.0	95.0	93.0	1.53	0.177	93.33	-0.40	-0.98	
T	94.0	97.0	97.0	1.73	0.177	96.00	0.06	-0.52	
TB									•
TC	98.0	78.0	88.0	10.00	1.345	88.00	-1.32	-1.91	
TD	92.0	87.0	86.0	3.21	0.354	88.33	-1.26	-1.85	
TH	96.0	98.0	97.0	1.00	0.118	97.00	0.24	-0.35	
TI	101.0	98.0	100.0	1.53	0.177	99.67	0.70	0.12	
TL	93.0	92.0	90.0	1.53	0.177	91.67	-0.69	-1.27	
TO									•
TQ	90.0	88.0	91.0	1.53	0.177	89.67	-1.03	-1.62	
TR	92.0	93.0	96.0	2.08	0.236	93.67	-0.34	-0.92	
TS									•
U	95.0	95.0	98.0	1.73	0.177	96.00	0.06	-0.52	
UE									•
UM									•
UN	87.0	86.0	92.0	3.21	0.354	88.33	-1.26	-1.85	
UP	91.0	93.0	90.0	1.53	0.177	91.33	-0.75	-1.33	
UR	61.0	70.0	55.0	7.55	0.886	62.00	-5.83	-6.41	×
UT	32.0	32.0	32.0	0.00	0.000	32.00	-11.02	-11.60	×
UW	101.0	103.0	99.0	2.00	0.236	101.00	0.93	0.35	
UX	82.0	83.0	82.0	0.58	0.059	82.33	-2.30	-2.89	
UY	106.0	99.0	101.0	3.61	0.413	102.00	1.10	0.52	
VA	94.0	84.0	87.0	5.13	0.591	88.33	-1.26	-1.85	
VC									•
VE	95.0	91.0	92.0	2.08	0.236	92.67	-0.51	-1.10	
VG									•
VH	86.0	83.0	87.0	2.08	0.236	85.33	-1.78	-2.37	
VI	93.0	88.0	88.0	2.89	0.295	89.67	-1.03	-1.62	
VM	96.0	97.0	98.0	1.00	0.118	97.00	0.24	-0.35	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

CRD-LV Performance Evaluation: Gamma in Water, 3-Nov-1995

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
VO	97.0	98.0	109.0	6.66	0.709	101.33	0.99	0.40	
VR									•
VS	98.0	99.0	101.0	1.53	0.177	99.33	0.64	0.06	
VT									•
W	99.0	96.0	94.0	2.52	0.295	96.33	0.12	-0.46	
WD	103.0	101.0	95.0	4.16	0.473	99.67	0.70	0.12	
WF	77.0	77.0	77.0	0.00	0.000	77.00	-3.23	-3.81	⇓
WI									•
WJ	896.0	900.0	912.0	8.33	0.945	902.67	139.78	139.20	×
WK	89.0	88.0	87.0	1.00	0.118	88.00	-1.32	-1.91	
WL	751.0	544.0	656.0	103.62	22.384	650.33	96.08	95.49	×
WO	115.0	118.0	113.0	2.52	0.295	115.33	3.41	2.83	
X	82.0	93.0	84.0	5.86	0.650	86.33	-1.61	-2.19	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
32.00	×	UT	89.33		Q	93.33		NH
62.00	×	UR	89.67		VI	93.67		TR
77.00	⇓	WF	89.67		TQ	93.67		SR
79.67	⇓	JG	89.67		RO	93.67		PW
82.33		UX	89.67		RH	93.67		K
83.33		A	90.00		BN	93.67		HX
85.00		PB	90.00		BB	94.00		QZ
85.33		VH	90.33		AK	94.00		FZ
85.33		SD	90.67		RR	94.00		DT
85.33		EB	91.00		HK	94.33		EL
85.67		PV	91.00		GL	94.33		E
85.67		BC	91.33		UP	94.33		AF
86.00		NJ	91.33		RF	94.67		QT
86.33		X	91.33		GI	94.67		LF
86.67		M	91.33		CJ	94.67		JE
86.67		CK	91.67		TL	94.67		DH
87.00		DM	91.67		SN	94.67		BO
87.67		SC	91.67		DE	95.33		GE
87.67		CX	91.67		AP	95.67		RU
88.00		WK	92.33		PM	96.00		U
88.00		TC	92.33		DG	96.00		T
88.00		CC	92.33		C	96.00		RZ
88.33		VA	92.33		BH	96.00		QP
88.33		UN	92.33		BG	96.00		PQ
88.33		TD	92.67		VE	96.00		GQ
88.67		PI	92.67		SI	96.33		W
88.67		NO	92.67		R	96.33		OL
88.67		I	93.33		SZ	96.33		HP
88.67		AW	93.33		OM	96.33		AU

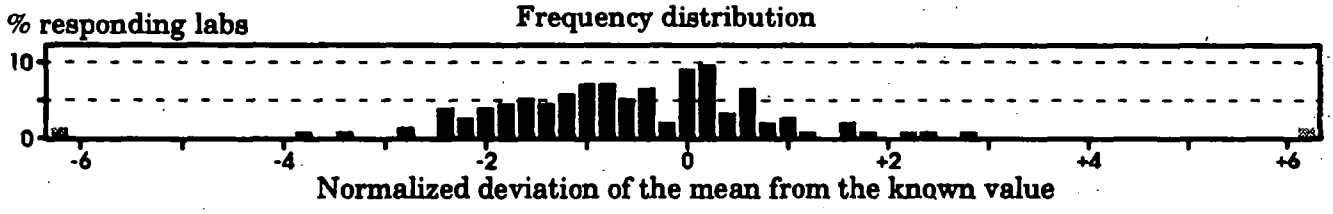
TAG SYMBOLS

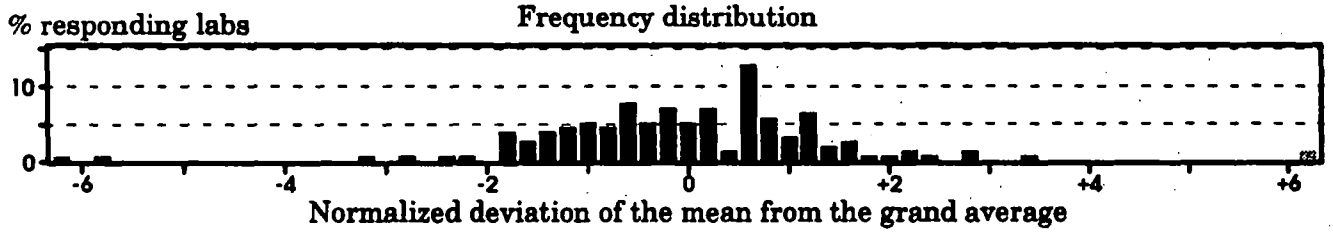
• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
96.67		HJ	99.67		WD	102.67		MA
96.67		AN	99.67		TI	102.67		J
97.00		VM	99.67		QU	103.00		KX
97.00		TH	99.67		KL	103.00		DO
97.00		LE	99.67		CE	103.00		BA
97.00		AJ	99.67		BL	103.00		AZ
97.33		JS	100.00		QJ	103.00		AY
97.67		S	100.00		O	103.33		DL
98.00		EA	100.00		HL	103.67		PE
98.67		OA	100.00		CP	104.00		L
98.67		JY	100.33		SX	104.67		RX
98.67		AE	100.33		SV	104.67		KH
99.00		SF	100.33		IC	105.33		RV
99.00		QW	100.67		SM	105.33		CS
99.00		LT	100.67		DZ	106.33		SS
99.00		BM	101.00		UW	107.67		FL
99.00		AH	101.00		N	108.00		MP
99.33		VS	101.00		MX	108.33		EZ
99.33		FJ	101.33		VO	109.33		HI
99.33		EX	101.33		AL	111.67		BK
99.33		CQ	102.00		UY	112.33		LR
99.33		CM	102.00		DD	115.33		WO
99.33		CA	102.67		QX	650.33	×	WL
						902.67	×	WJ





• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit