United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-99/076
August 1999

EPA

Results from EPA's Drinking Water Radiochemistry Performance Evaluation Studies for Calendar Year 1998

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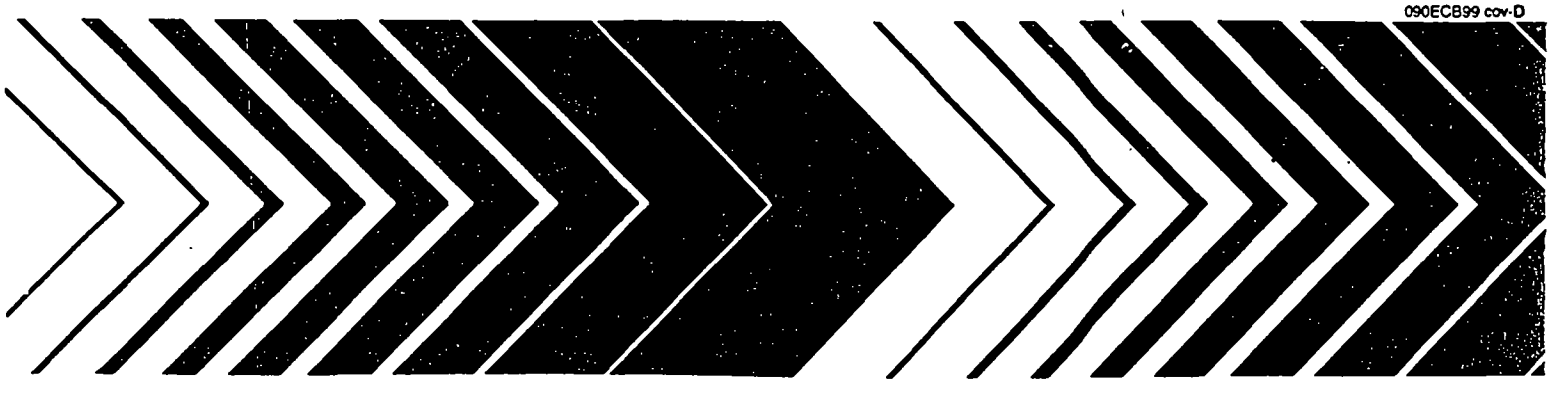

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16. Abstract

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.

17. Key Words and Document Analysis		
a. Descriptors: PE Studies, PE, radiochemistry, gross alpha, gross beta, strontium, tritium, plutonium, uranium, radium, gamma, mixed gamma, blind, iodine, air filter, radioactivity	b Identifiers/Open-ended Terms	c COSATI
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5. Title

Results from EPA's Drinking Water Radiochemistry Performance Evaluation Studies for Calendar Year 1998

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

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

N/A

8. OMIS Task No., GPRA ID (eg, CB0101), AFG, and APM	9. Project Officer Name, Telephone No. and Contract/IAG, CAG #
Project # J0477	S. Pia, 702/798-2102

10. Contract/IAG/Assistance Agreement No.

N/A

11. Product Type

- ☐ Peer Reviewed Journal Article (See block 12)
- X Published Report
- ☐ 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 _____

(Identify product type. Use block 12 if needed)

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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RB

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15. Comments or Keywords

16a. Product's Peer Review Category

(Refereed papers are usually Category 3; abstracts, EPA reports and non-refereed products are usually Category 4.)

- ☐ 1. Major sci. & tech. work product (AA signs in 18)
- ☐ 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 Jul. 99

Christian G. Daughton, Chief, Environmental Chemistry Branch Date

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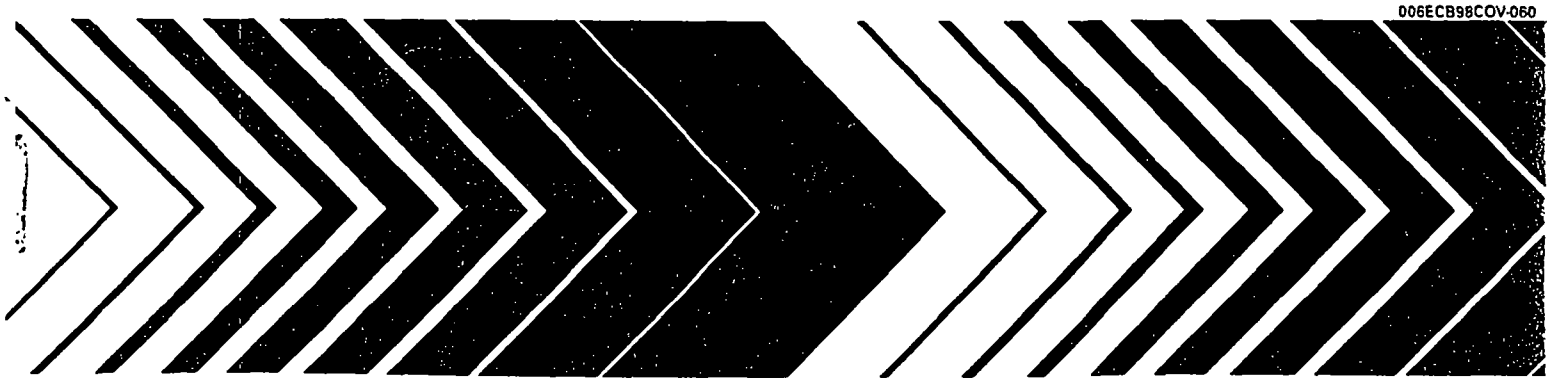
Washington, DC 20460

EPA/600/R-98/060
May 1998

EPA

Strontium in Water Performance Evaluation Study

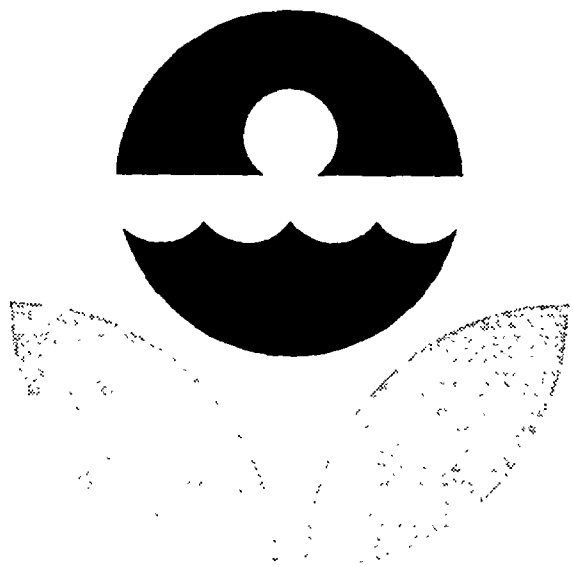
A Statistical Evaluation of the January 16, 1998 Data



Strontium in Water

Performance Evaluation Study

January 16, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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ENVIRONMENTAL SCIENCES DIVISION-LAS VEGAS
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LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Strontium in Water; January 16, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

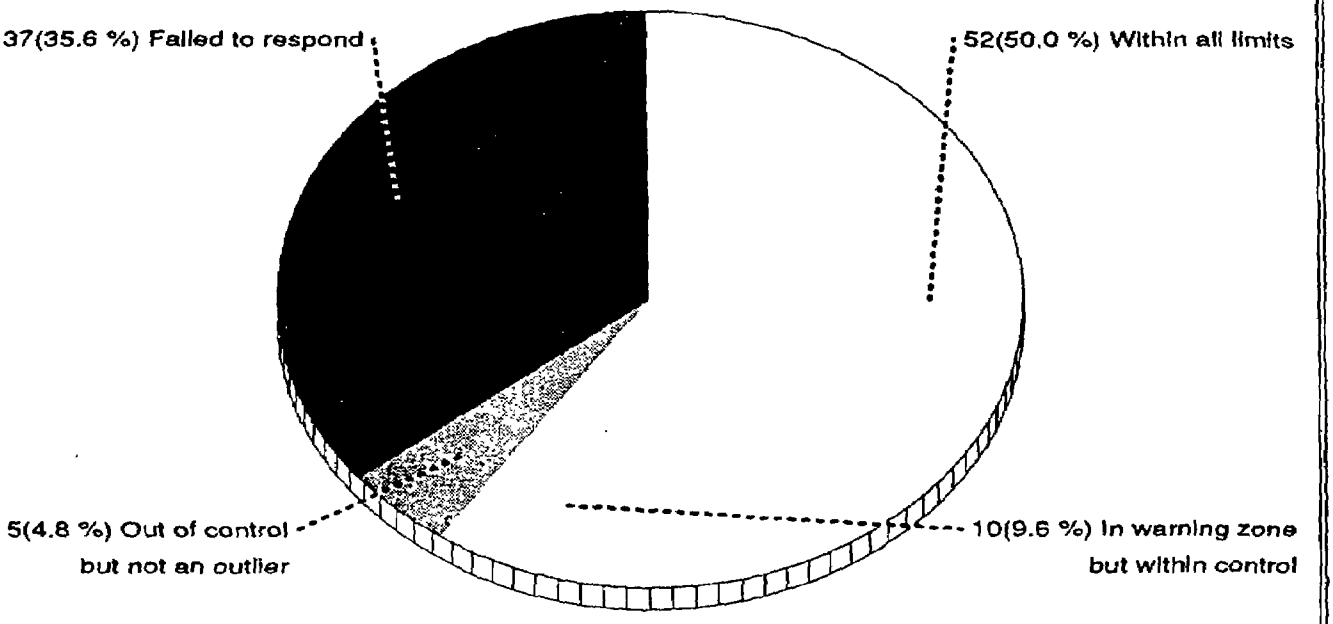
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

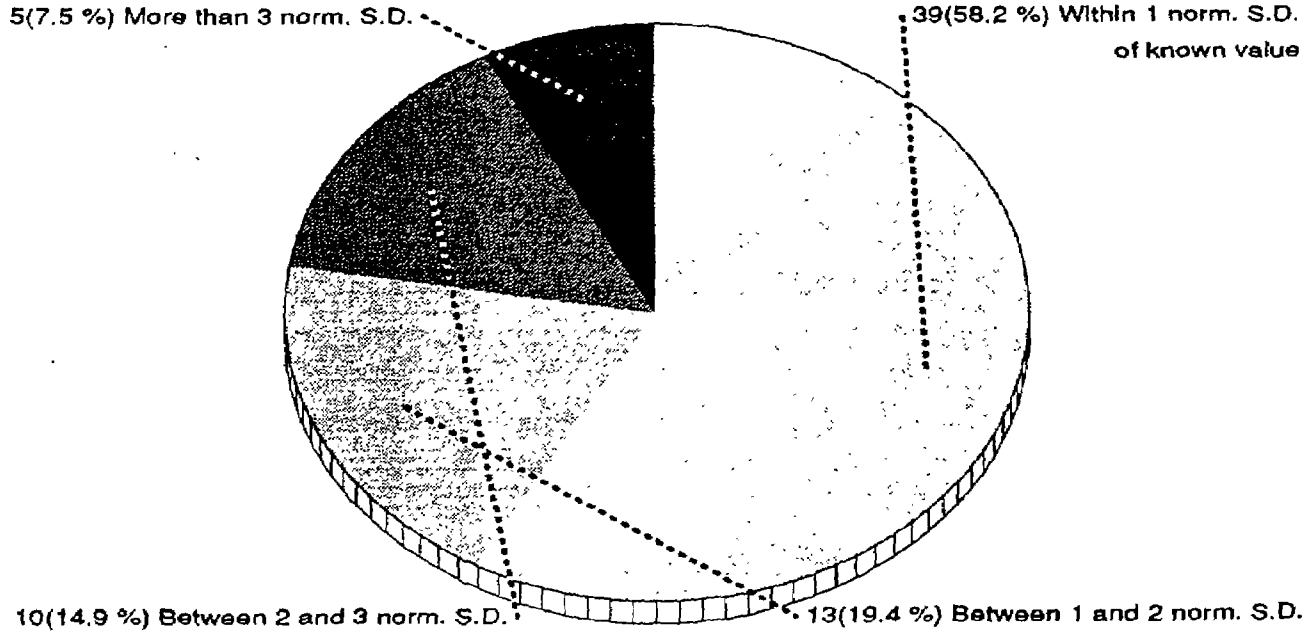
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Strontium-89 Statistical Summary 104 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	9.33	**Grand Avg 9.33**
Std. Dev.	4.70	4.70
Variance	22.13	22.13
% Coef. of Var.	50.41	50.41
% deviation of mean from known value	16.67	16.67
Norm. dev. of mean from known value	0.28	0.28
Median	8.33	8.33
% deviation of median from known value	4.17	4.17
Norm. dev. of median from known value	0.07	0.07



ESD-LV Performance Evaluation: Strontium in Water, 16-Jan-1998

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	9.0	9.0	9.0	0.00	0.000	9.00	-0.12	0.35	
AE	9.0	11.0	11.0	1.15	0.236	10.33	0.35	0.81	
AF	11.0	10.0	12.0	1.00	0.236	11.00	0.58	1.04	
AJ	15.0	12.0	15.0	1.73	0.354	14.00	1.62	2.08	
AK	5.0	6.0	5.0	0.58	0.118	5.33	-1.39	-0.92	
AL	10.0	12.0	12.0	1.15	0.236	11.33	0.69	1.15	
AU	20.0	24.0	24.0	2.31	0.473	22.67	4.62	5.08	⇑
AW	7.0	8.0	9.0	1.00	0.236	8.00	-0.46	0.00	
AY									•
AZ	13.0	14.0	16.0	1.53	0.354	14.33	1.73	2.19	
BA	17.0	15.0	16.0	1.00	0.236	16.00	2.31	2.77	
BB									•
BC	6.0	7.0	7.0	0.58	0.118	6.67	-0.92	-0.46	
BG									•
BH	11.0	7.0	10.0	2.08	0.473	9.33	0.00	0.46	
BL	8.0	13.0	9.0	2.65	0.591	10.00	0.23	0.69	
BM	11.0	12.0	10.0	1.00	0.236	11.00	0.58	1.04	
BO	13.0	10.0	12.0	1.53	0.354	11.67	0.81	1.27	
C	6.0	7.0	6.0	0.58	0.118	6.33	-1.04	-0.58	
CA	6.0	5.0	7.0	1.00	0.236	6.00	-1.15	-0.69	
CC									•
CE									•
CJ	6.0	3.0	6.0	1.73	0.354	5.00	-1.50	-1.04	
CO									•
CP									•
CS	9.0	8.0	6.0	1.53	0.354	7.67	-0.58	-0.12	
CX	16.0	29.0	10.0	9.71	3.371	18.33	3.12	3.58	⇑
D	15.0	12.0	16.0	2.08	0.473	14.33	1.73	2.19	
DD	3.0	3.0	3.0	0.00	0.000	3.00	-2.19	-1.73	
DE	8.0	8.0	9.0	0.58	0.118	8.33	-0.35	0.12	
DO	8.0	9.0	15.0	3.79	0.827	10.67	0.46	0.92	
DT	8.0	8.0	7.0	0.58	0.118	7.67	-0.58	-0.12	
DZ									•
E	4.0	6.0	4.0	1.15	0.236	4.67	-1.62	-1.15	
EB	6.0	4.0	7.0	1.53	0.354	5.67	-1.27	-0.81	
EL	0.0	0.0	0.0	0.00	0.000	0.00	-3.23	-2.77	
FE	9.0	9.0	8.0	0.58	0.118	8.67	-0.23	0.23	
GQ	16.0	16.0	15.0	0.58	0.118	15.67	2.19	2.66	
HK	9.0	9.0	8.0	0.58	0.118	8.67	-0.23	0.23	
HP	5.0	4.0	2.0	1.53	0.354	3.67	-1.96	-1.50	
I	21.0	22.0	18.0	2.08	0.473	20.33	3.81	4.27	⇑
J									•
JE	9.0	7.0	8.0	1.00	0.236	8.00	-0.46	0.00	
JS	5.0	5.0	6.0	0.58	0.118	5.33	-1.39	-0.92	
JY	7.0	7.0	12.0	2.89	0.591	8.67	-0.23	0.23	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ 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)	(known)	Tag
K	4.0	5.0	11.0	3.79	0.827	6.67	-0.92	-0.46	
KH	8.0	5.0	6.0	1.53	0.354	6.33	-1.04	-0.58	
KL	7.0	4.0	4.0	1.73	0.354	5.00	-1.50	-1.04	
L	13.0	11.0	9.0	2.00	0.473	11.00	0.58	1.04	
LE									•
LF	9.0	8.0	8.0	0.58	0.118	8.33	-0.35	0.12	
LT	15.0	15.0	17.0	1.15	0.236	15.67	2.19	2.66	
M	8.0	8.0	9.0	0.58	0.118	8.33	-0.35	0.12	
N	7.0	8.0	9.0	1.00	0.236	8.00	-0.46	0.00	
NJ	8.0	11.0	10.0	1.53	0.354	9.67	0.12	0.58	
NO									•
OA	11.0	11.0	14.0	1.73	0.354	12.00	0.92	1.39	
PB									•
Q	9.0	10.0	11.0	1.00	0.236	10.00	0.23	0.69	
QM	8.0	11.0	13.0	2.52	0.591	10.67	0.46	0.92	
QU	7.0	8.0	7.0	0.58	0.118	7.33	-0.69	-0.23	
QW	7.0	8.0	8.0	0.58	0.118	7.67	-0.58	-0.12	
QZ	15.0	10.0	16.0	3.21	0.709	13.67	1.50	1.96	
R	6.0	6.0	6.0	0.00	0.000	6.00	-1.15	-0.69	
RK									•
RR	9.0	9.0	10.0	0.58	0.118	9.33	0.00	0.46	
S	6.0	6.0	7.0	0.58	0.118	6.33	-1.04	-0.58	
SC									•
SD	14.0	15.0	16.0	1.00	0.236	15.00	1.96	2.42	
SF									•
SI	6.0	3.0	3.0	1.73	0.354	4.00	-1.85	-1.39	
SL									•
SM	8.0	7.0	4.0	2.08	0.473	6.33	-1.04	-0.58	
SS	0.0	0.0	0.0	0.00	0.000	0.00	-3.23	-2.77	
SZ									•
T	6.0	8.0	7.0	1.00	0.236	7.00	-0.81	-0.35	
TD	10.0	5.0	8.0	2.52	0.591	7.67	-0.58	-0.12	
TF									•
TL									•
TQ	1.0	1.0	2.0	0.58	0.118	1.33	-2.77	-2.31	
U									•
UM									•
UP	6.0	10.0	7.0	2.08	0.473	7.67	-0.58	-0.12	
VA									•
VC									•
VH									•
VI									•
W	11.0	6.0	10.0	2.65	0.591	9.00	-0.12	0.35	
WG									•
WI									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Strontium in Water, 16-Jan-1998

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
WJ									•
WO									•
WR									•
WS									•
WV									•
X	23.0	22.0	21.0	1.00	0.236	22.00	4.39	4.85	⇑
XI									•
XK									•
XL	7.0	7.0	7.0	0.00	0.000	7.00	-0.81	-0.35	
XM	10.0	12.0	9.0	1.53	0.354	10.33	0.35	0.81	
XO									•
XQ									•
XR									•
Y	22.0	21.0	13.0	4.93	1.120	18.67	3.23	3.70	⇑

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.00		**SS**	7.33		**QU**	10.33		**XM**
0.00		**EL**	7.67		**UP**	10.33		**AE**
1.33		**TQ**	7.67		**TD**	10.67		**QM**
3.00		**DD**	7.67		**QW**	10.67		**DO**
3.67		**HP**	7.67		**DT**	11.00		**L**
4.00		**SI**	7.67		**CS**	11.00		**BM**
4.67		**E**	8.00		**N**	11.00		**AF**
5.00		**KL**	8.00		**JE**	11.33		**AL**
5.00		**CJ**	8.00		**AW**	11.67		**BO**
5.33		**JS**	8.33		**M**	12.00		**OA**
5.33		**AK**	8.33		**LF**	13.67		**QZ**
5.67		**EB**	8.33		**DE**	14.00		**AJ**
6.00		**R**	8.67		**JY**	14.33		**D**
6.00		**CA**	8.67		**HK**	14.33		**AZ**
6.33		**SM**	8.67		**FE**	15.00		**SD**
6.33		**S**	9.00		**W**	15.67		**LT**
6.33		**KH**	9.00		**A**	15.67		**GQ**
6.33		**C**	9.33		**RR**	16.00		**BA**
6.67		**K**	9.33		**BH**	18.33	⇑	**CX**
6.67		**BC**	9.67		**NJ**	18.67	⇑	**Y**
7.00		**XL**	10.00		**Q**	20.33	⇑	**I**
7.00		**T**	10.00		**BL**	22.00	⇑	**X**
						22.67	⇑	**AU**

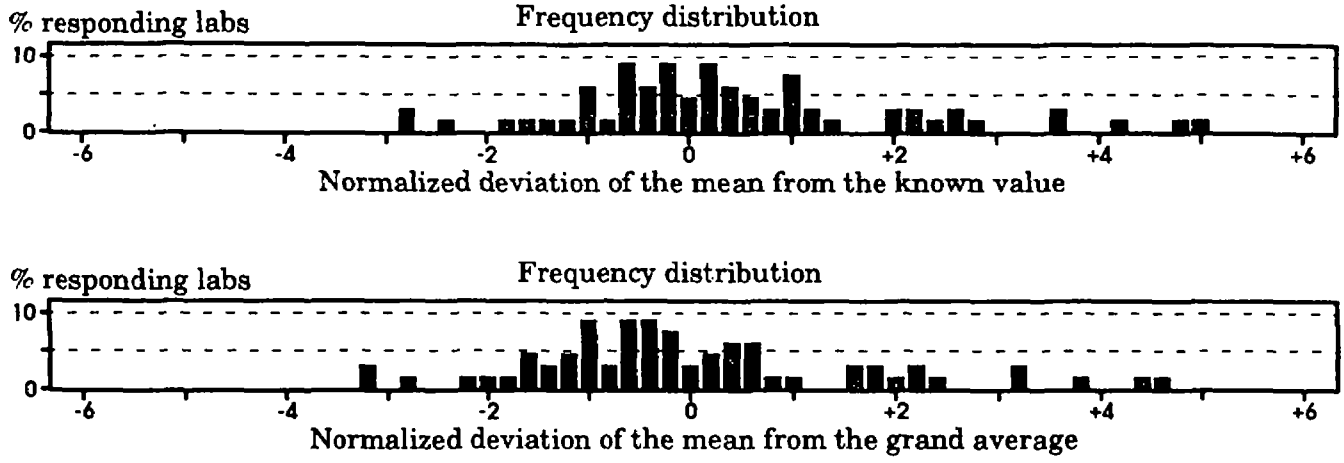
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

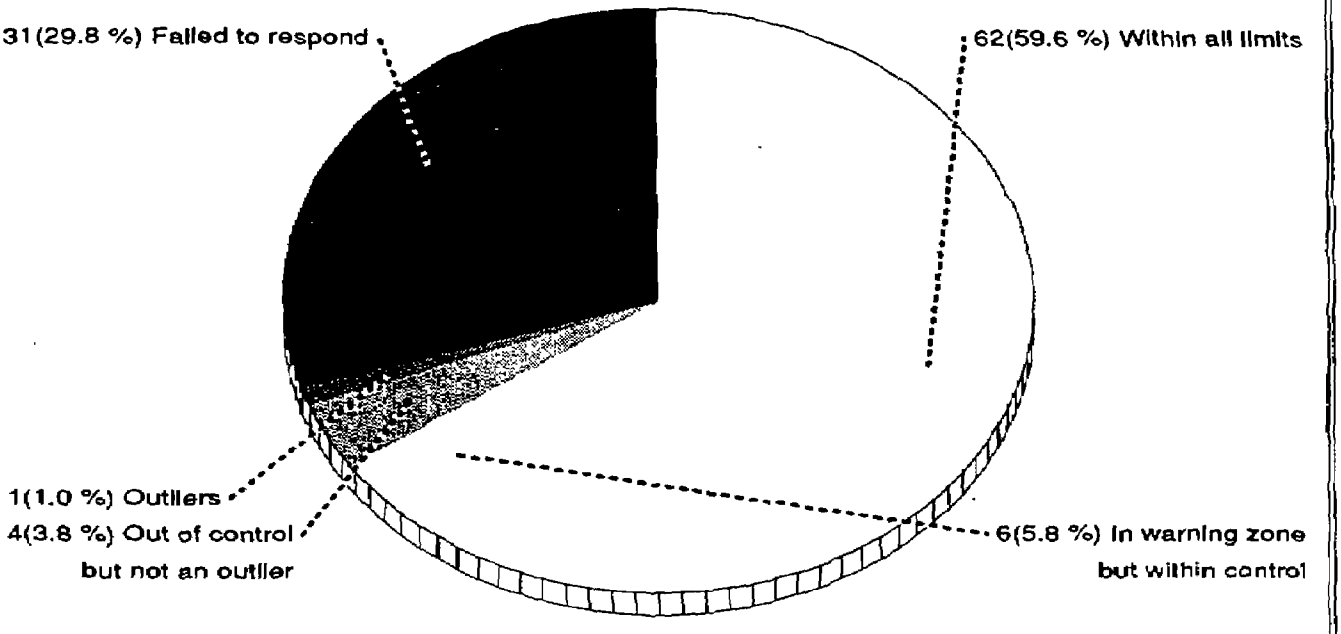
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

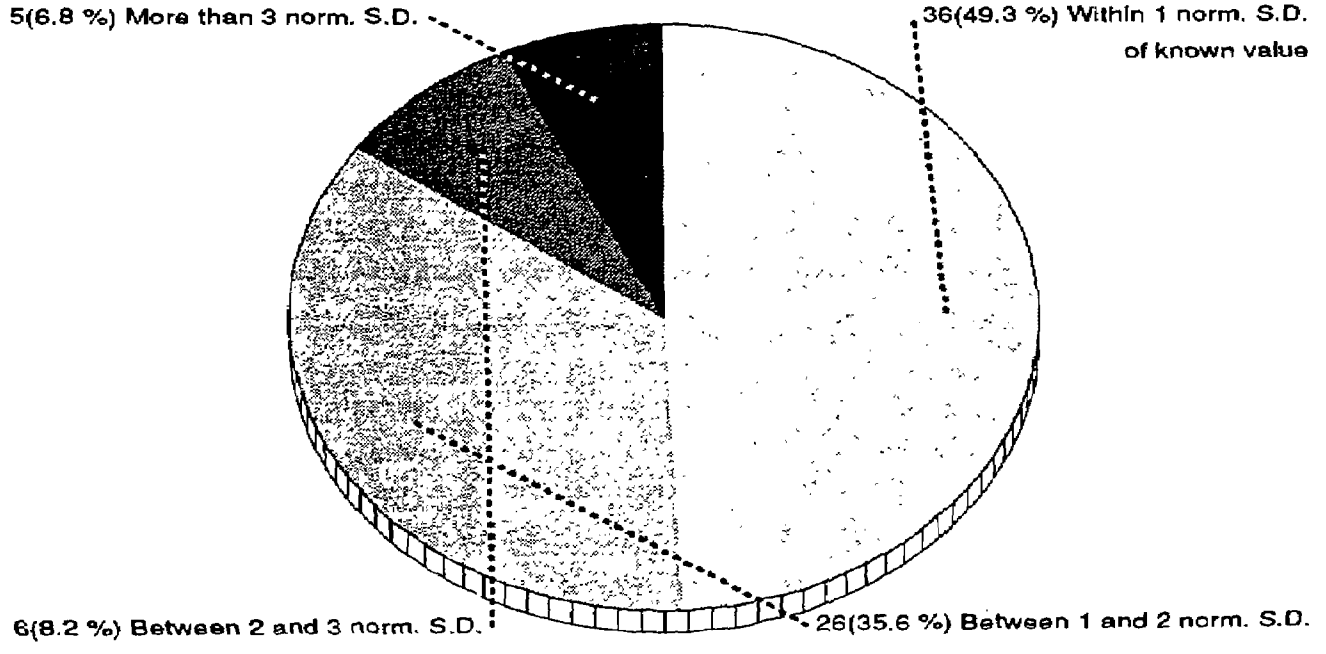


Strontium-90 Statistical Summary 104 Participants

The known value of this nuclide is 32.0 pCi/l with an expected precision of 5.0; the control limits are 23.3 to 40.7; the warning regions are 23.3 to 26.2 and 37.8 to 40.7



Statistic	Respondents	Non-outliers
Mean	29.69	**Grand Avg 29.51**
Std. Dev.	3.70	3.39
Variance	13.71	11.50
% Coef. of Var.	12.47	11.49
% deviation of mean from known value	-7.22	-7.78
Norm. dev. of mean from known value	-0.62	-0.73
Median	30.00	29.83
% deviation of median from known value	-6.25	-6.77
Norm. dev. of median from known value	-0.54	-0.64



ESD-LV Performance Evaluation: Strontium in Water, 16-Jan-1998

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	31.0	31.0	30.0	0.58	0.118	30.67	0.40	-0.46	
AE	29.0	27.0	28.0	1.00	0.236	28.00	-0.52	-1.39	
AF	32.0	32.0	28.0	2.31	0.473	30.67	0.40	-0.46	
AJ	29.0	29.0	27.0	1.15	0.236	28.33	-0.41	-1.27	
AK	30.0	30.0	30.0	0.00	0.000	30.00	0.17	-0.69	
AL	28.0	30.0	28.0	1.15	0.236	28.67	-0.29	-1.15	
AU	27.0	24.0	25.0	1.53	0.354	25.33	-1.45	-2.31	
AW	30.0	30.0	30.0	0.00	0.000	30.00	0.17	-0.69	
AY									•
AZ	30.0	30.0	30.0	0.00	0.000	30.00	0.17	-0.69	
BA	26.0	24.0	24.0	1.15	0.236	24.67	-1.68	-2.54	
BB	28.0	24.0	25.0	2.08	0.473	25.67	-1.33	-2.19	
BC	29.0	29.0	29.0	0.00	0.000	29.00	-0.18	-1.04	
BG									•
BH	33.0	30.0	31.0	1.53	0.354	31.33	0.63	-0.23	
BL	32.0	29.0	29.0	1.73	0.354	30.00	0.17	-0.69	
BM	29.0	28.0	30.0	1.00	0.236	29.00	-0.18	-1.04	
BO	27.0	29.0	27.0	1.15	0.236	27.67	-0.64	-1.50	
C	31.0	34.0	33.0	1.53	0.354	32.67	1.09	0.23	
CA	26.0	28.0	28.0	1.15	0.236	27.33	-0.75	-1.62	
CC									•
CE	31.0	31.0	29.0	1.15	0.236	30.33	0.29	-0.58	
CJ	32.0	32.0	31.0	0.58	0.118	31.67	0.75	-0.12	
CO	29.0	27.0	29.0	1.15	0.236	28.33	-0.41	-1.27	
CP									•
CS	30.0	33.0	34.0	2.08	0.473	32.33	0.98	0.12	
CX	22.0	20.0	25.0	2.52	0.591	22.33	-2.49	-3.35	⇓
D	30.0	33.0	30.0	1.73	0.354	31.00	0.52	-0.35	
DD	33.0	36.0	31.0	2.52	0.591	33.33	1.32	0.46	
DE	32.0	33.0	33.0	0.58	0.118	32.67	1.09	0.23	
DO	30.0	29.0	26.0	2.08	0.473	28.33	-0.41	-1.27	
DT	30.0	30.0	30.0	0.00	0.000	30.00	0.17	-0.69	
DZ	38.0	39.0	38.0	0.58	0.118	38.33	3.06	2.19	
E	32.0	32.0	33.0	0.58	0.118	32.33	0.98	0.12	
EB	27.0	28.0	27.0	0.58	0.118	27.33	-0.75	-1.62	
EL	28.0	29.0	28.0	0.58	0.118	28.33	-0.41	-1.27	
FE	33.0	33.0	32.0	0.58	0.118	32.67	1.09	0.23	
GQ	33.0	33.0	32.0	0.58	0.118	32.67	1.09	0.23	
HK	32.0	30.0	31.0	1.00	0.236	31.00	0.52	-0.35	
HP	31.0	35.0	34.0	2.08	0.473	33.33	1.32	0.46	
I	28.0	26.0	28.0	1.15	0.236	27.33	-0.75	-1.62	
J									•
JE	33.0	34.0	34.0	0.58	0.118	33.67	1.44	0.58	
JS	30.0	32.0	30.0	1.15	0.236	30.67	0.40	-0.46	
JY	30.0	29.0	24.0	3.21	0.709	27.67	-0.64	-1.50	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ 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
K	31.0	29.0	28.0	1.53	0.354	29.33	-0.06	-0.92	
KH	32.0	35.0	31.0	2.08	0.473	32.67	1.09	0.23	
KL	33.0	36.0	36.0	1.73	0.354	35.00	1.90	1.04	
L	29.0	30.0	31.0	1.00	0.236	30.00	0.17	-0.69	
LE									•
LF	35.0	33.0	35.0	1.15	0.236	34.33	1.67	0.81	
LT	24.0	26.0	24.0	1.15	0.236	24.67	-1.68	-2.54	
M	28.0	28.0	29.0	0.58	0.118	28.33	-0.41	-1.27	
N	34.0	34.0	33.0	0.58	0.118	33.67	1.44	0.58	
NJ	29.0	27.0	28.0	1.00	0.236	28.00	-0.52	-1.39	
NO									•
OA	28.0	26.0	26.0	1.15	0.236	26.67	-0.98	-1.85	
PB									•
Q	30.0	34.0	35.0	2.65	0.591	33.00	1.21	0.35	
QM	24.0	19.0	18.0	3.21	0.709	20.33	-3.18	-4.04	⇓
QU	20.0	21.0	22.0	1.00	0.236	21.00	-2.95	-3.81	⇓
QW	24.0	21.0	21.0	1.73	0.354	22.00	-2.60	-3.46	⇓
QZ	28.0	30.0	27.0	1.53	0.354	28.33	-0.41	-1.27	
R	27.0	27.0	28.0	0.58	0.118	27.33	-0.75	-1.62	
RK									•
RR	31.0	29.0	30.0	1.00	0.236	30.00	0.17	-0.69	
S	31.0	31.0	31.0	0.00	0.000	31.00	0.52	-0.35	
SC									•
SD	31.0	29.0	32.0	1.53	0.354	30.67	0.40	-0.46	
SF									•
SI	29.0	29.0	27.0	1.15	0.236	28.33	-0.41	-1.27	
SL									•
SM	25.0	31.0	29.0	3.06	0.709	28.33	-0.41	-1.27	
SS	35.0	35.0	34.0	0.58	0.118	34.67	1.79	0.92	
SZ	36.0	36.0	36.0	0.00	0.000	36.00	2.25	1.39	
T	29.0	26.0	27.0	1.53	0.354	27.33	-0.75	-1.62	
TD	27.0	28.0	28.0	0.58	0.118	27.67	-0.64	-1.50	
TF									•
TL									•
TQ	27.0	27.0	28.0	0.58	0.118	27.33	-0.75	-1.62	
U									•
UM									•
UP	43.0	42.0	43.0	0.58	0.118	42.67	4.56	3.70	×
VA									•
VC									•
VH									•
VI									•
W	30.0	32.0	31.0	1.00	0.236	31.00	0.52	-0.35	
WG									•
WI									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Strontium in Water, 16-Jan-1998

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
WJ									•
WO									•
WR	26.0	28.0	28.0	1.15	0.236	27.33	-0.75	-1.62	
WS									•
WV									•
X	22.0	24.0	26.0	2.00	0.473	24.00	-1.91	-2.77	
XI									•
XK									•
XL	29.0	29.0	31.0	1.15	0.236	29.67	0.05	-0.81	
XM	33.0	32.0	32.0	0.58	0.118	32.33	0.98	0.12	
XO									•
XQ									•
XR									•
Y	32.0	28.0	29.0	2.08	0.473	29.67	0.05	-0.81	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
20.33	⇓	**QM**	28.33		**QZ**	31.00		**W**
21.00	⇓	**QU**	28.33		**M**	31.00		**S**
22.00	⇓	**QW**	28.33		**EL**	31.00		**HK**
22.33	⇓	**CX**	28.33		**DO**	31.00		**D**
24.00		**X**	28.33		**CO**	31.33		**BH**
24.67		**LT**	28.33		**AJ**	31.67		**CJ**
24.67		**BA**	28.67		**AL**	32.33		**XM**
25.33		**AU**	29.00		**BM**	32.33		**E**
25.67		**BB**	29.00		**BC**	32.33		**CS**
26.67		**OA**	29.33		**K**	32.67		**KH**
27.33		**WR**	29.67		**Y**	32.67		**GQ**
27.33		**TQ**	29.67		**XL**	32.67		**FE**
27.33		**T**	30.00		**RR**	32.67		**DE**
27.33		**R**	30.00		**L**	32.67		**C**
27.33		**I**	30.00		**DT**	33.00		**Q**
27.33		**EB**	30.00		**BL**	33.33		**HP**
27.33		**CA**	30.00		**AZ**	33.33		**DD**
27.67		**TD**	30.00		**AW**	33.67		**N**
27.67		**JY**	30.00		**AK**	33.67		**JE**
27.67		**BO**	30.33		**CE**	34.33		**LF**
28.00		**NJ**	30.67		**SD**	34.67		**SS**
28.00		**AE**	30.67		**JS**	35.00		**KL**
28.33		**SM**	30.67		**AF**	36.00		**SZ**
28.33		**SI**	30.67		**A**	38.33		**DZ**
						42.67	×	**UP**

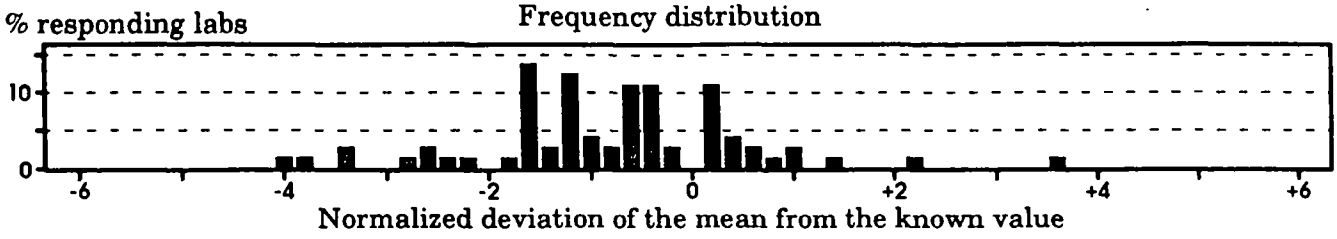
• ≡ No data submitted
∅ ≡ Insufficient data

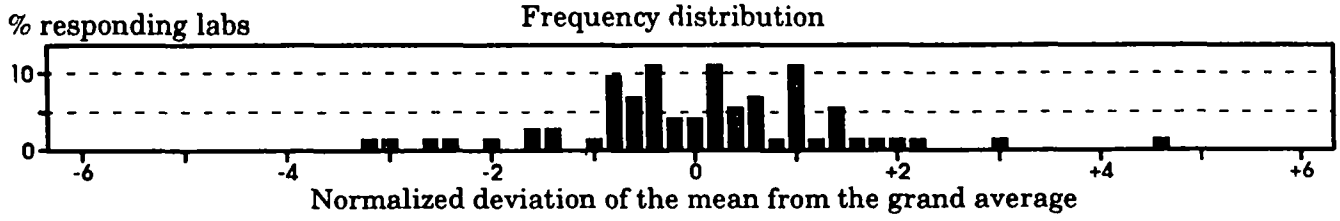
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90





United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-98/063
May 1998

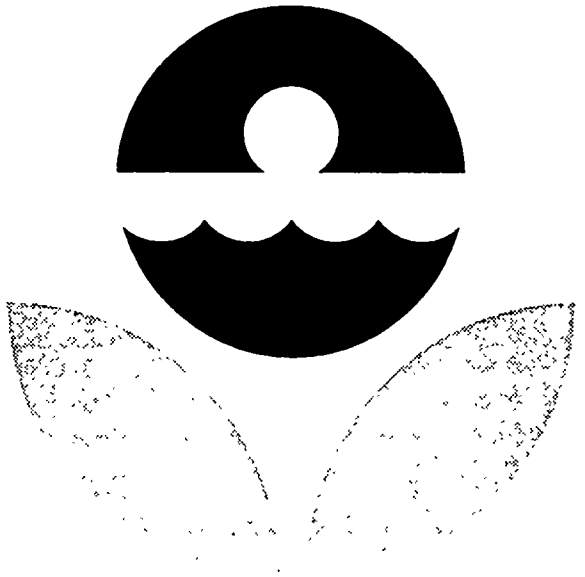
EPA

Gross Alpha-Beta in Water Performance Evaluation Study

A Statistical Evaluation of the January 30, 1998 Data

006ECB98COV-063

Gross Alpha-Beta in Water
Performance Evaluation Study
January 30, 1998



Environmental Protection Agency
National Exposure Research Laboratory
Environmental Sciences Division
Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Gross Alpha-Beta in Water; January 30, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

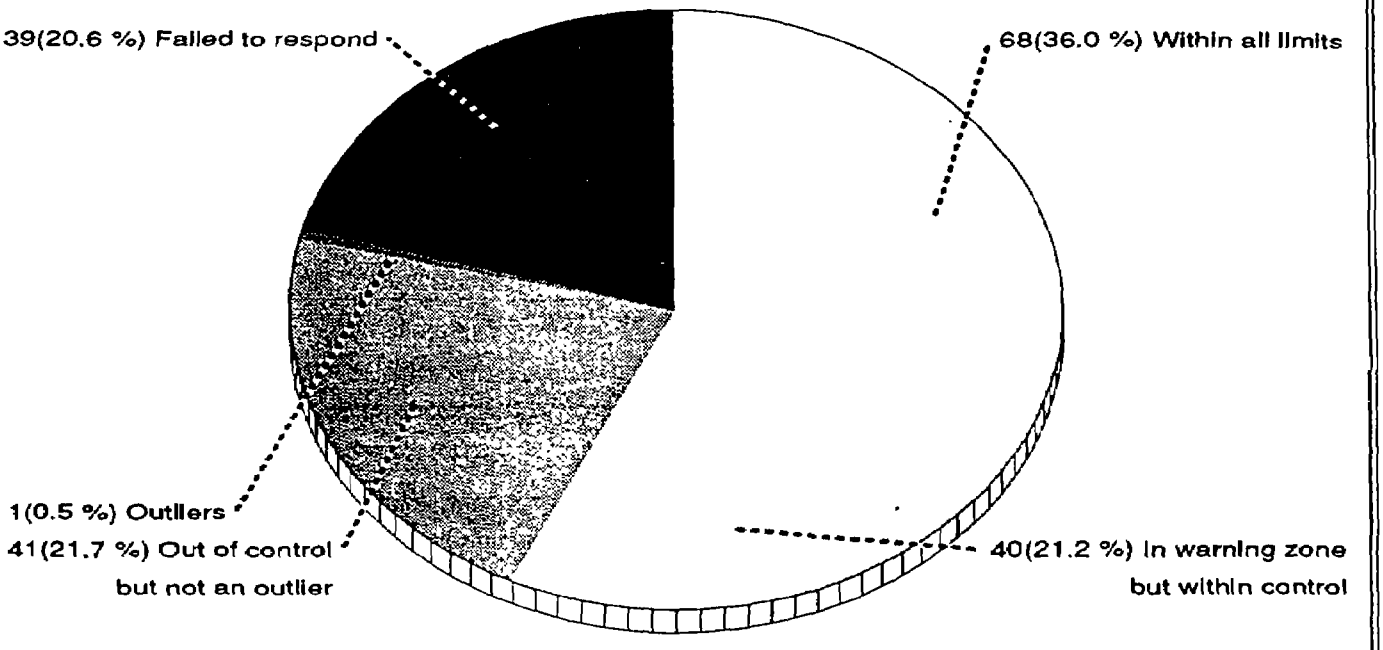
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

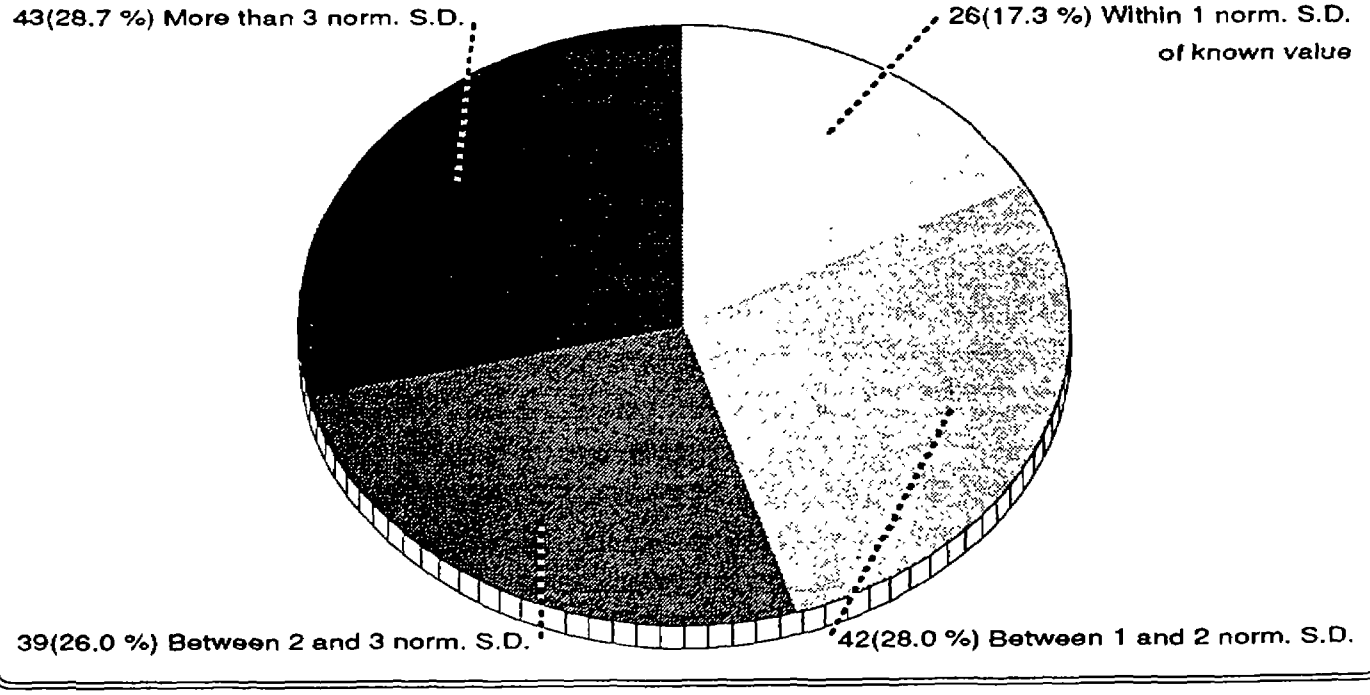
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Alpha Statistical Summary 189 Participants

The known value of this nuclide is **30.5 pCi/l** with an expected precision of **7.6**; the control limits are 17.3 to 43.7; the warning regions are 17.3 to 21.7 and 39.3 to 43.7



Statistic	Respondents	Non-outliers
Mean	21.52	**Grand Avg 21.36**
Std. Dev.	6.28	5.99
Variance	39.42	35.94
% Coef. of Var.	29.17	28.06
% deviation of mean from known value	-29.44	-29.95
Norm. dev. of mean from known value	-1.43	-1.52
Median	21.25	21.23
% deviation of median from known value	-30.33	-30.38
Norm. dev. of median from known value	-1.47	-1.55



ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 30-Jan-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	21.8	25.2	19.2	3.01	0.466	22.07	0.16	-1.92	
AE	20.5	21.5	19.6	0.95	0.148	20.53	-0.19	-2.27	
AF	21.2	18.1	24.1	3.00	0.466	21.13	-0.05	-2.13	
AH	17.9	18.4	17.3	0.55	0.085	17.87	-0.80	-2.88	
AJ	18.4	20.3	18.7	1.02	0.148	19.13	-0.51	-2.59	
AK	17.8	18.6	19.0	0.61	0.093	18.47	-0.66	-2.74	
AL	28.4	28.2	29.1	0.47	0.070	28.57	1.64	-0.44	
AP									•
AR	21.3	21.3	19.3	1.15	0.155	20.63	-0.17	-2.25	
AU	36.4	34.0	35.3	1.20	0.187	35.23	3.16	1.08	
AW	24.1	24.3	26.8	1.50	0.210	25.07	0.84	-1.24	
AZ	22.5	25.0	23.8	1.25	0.194	23.77	0.55	-1.53	
BA	23.8	24.9	25.9	1.05	0.163	24.87	0.80	-1.28	
BB									•
BC	25.1	28.3	25.6	1.72	0.249	26.33	1.13	-0.95	
BG									•
BH	26.5	20.9	24.1	2.81	0.435	23.83	0.56	-1.52	
BK	21.7	22.2	22.0	0.25	0.039	21.97	0.14	-1.94	
BL	30.5	28.7	32.2	1.75	0.272	30.47	2.07	-0.01	
BM	25.5	25.0	26.3	0.66	0.101	25.60	0.97	-1.12	
BN	9.7	9.0	11.2	1.12	0.171	9.97	-2.60	-4.68	⇓
BO	17.0	18.3	15.8	1.25	0.194	17.03	-0.99	-3.07	⇓
BS	23.6	26.3	27.1	1.83	0.272	25.67	0.98	-1.10	
C	28.5	27.5	25.8	1.36	0.210	27.27	1.35	-0.74	
CA	32.8	28.6	32.1	2.25	0.326	31.17	2.23	0.15	
CC									•
CE	22.9	20.0	24.0	2.07	0.311	22.30	0.21	-1.87	
CJ	35.0	34.0	30.0	2.65	0.389	33.00	2.65	0.57	
CO	11.9	18.2	19.0	3.89	0.552	16.37	-1.14	-3.22	⇓
CP	15.0	14.0	13.0	1.00	0.155	14.00	-1.68	-3.76	⇓
CS									•
CX	17.9	18.6	18.0	0.38	0.054	18.17	-0.73	-2.81	
D	22.5	26.6	27.0	2.49	0.350	25.37	0.91	-1.17	
D*	27.4	32.3	31.3	2.59	0.381	30.33	2.04	-0.04	
DB	25.6	26.1	27.0	0.71	0.109	26.23	1.11	-0.97	
DD	16.7	18.8	19.3	1.38	0.202	18.27	-0.71	-2.79	
DE	21.9	21.9	22.0	0.06	0.008	21.93	0.13	-1.95	
DH	14.2	13.6	13.4	0.42	0.062	13.73	-1.74	-3.82	⇓
DO	26.0	23.0	29.0	3.00	0.466	26.00	1.06	-1.03	
DR	4.2	5.7	5.8	0.90	0.124	5.23	-3.68	-5.76	⇓
DT	20.8	19.7	18.6	1.10	0.171	19.70	-0.38	-2.46	
DZ	21.4	19.2	23.8	2.30	0.358	21.47	0.02	-2.06	
E									•
EB	30.5	29.9	28.9	0.81	0.124	29.77	1.91	-0.17	
EL	11.5	7.6	10.2	1.99	0.303	9.77	-2.64	-4.73	⇓

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ 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)	Normalized deviation (known)	Tag
EO	15.0	15.0	17.0	1.15	0.155	15.67	-1.30	-3.38	⇓
ER	21.2	21.9	21.0	0.47	0.070	21.37	0.00	-2.08	
EV	14.1	14.1	16.8	1.56	0.210	15.00	-1.45	-3.53	⇓
EW									•
EX	17.0	14.2	15.0	1.44	0.218	15.40	-1.36	-3.44	⇓
FE	16.0	18.8	19.7	1.93	0.288	18.17	-0.73	-2.81	
FF	23.5	21.2	20.6	1.53	0.225	21.77	0.09	-1.99	
FJ									•
FL	11.5	12.5	14.0	1.26	0.194	12.67	-1.98	-4.06	⇓
FN	18.0	16.0	18.0	1.15	0.155	17.33	-0.92	-3.00	
GQ	27.3	26.4	24.6	1.37	0.210	26.10	1.08	-1.00	
GZ									•
HE									•
HI	12.8	13.5	16.5	1.97	0.288	14.27	-1.62	-3.70	⇓
HK	16.2	14.6	14.4	0.99	0.140	15.07	-1.44	-3.52	⇓
HL	16.7	20.0	17.7	1.69	0.256	18.13	-0.74	-2.82	
HP	11.3	13.5	13.1	1.17	0.171	12.63	-1.99	-4.07	⇓
I	15.7	17.1	17.8	1.07	0.163	16.87	-1.03	-3.11	⇓
ID	18.8	14.7	13.5	2.78	0.412	15.67	-1.30	-3.38	⇓
IU									•
J	30.0	32.1	32.6	1.38	0.202	31.57	2.33	0.24	
JE	13.7	13.9	10.8	1.73	0.241	12.80	-1.95	-4.03	⇓
JG	16.1	15.6	13.3	1.49	0.218	15.00	-1.45	-3.53	⇓
JM	24.7	25.3	19.7	3.07	0.435	23.23	0.43	-1.66	
JN	23.2	23.3	22.8	0.26	0.039	23.10	0.40	-1.69	
JP	22.7	21.1	23.6	1.27	0.194	22.47	0.25	-1.83	
JQ	20.2	23.6	23.7	1.99	0.272	22.50	0.26	-1.82	
JS	24.7	22.1	23.3	1.30	0.202	23.37	0.46	-1.63	
JY	25.5	23.4	27.2	1.90	0.295	25.37	0.91	-1.17	
K	30.4	28.9	26.7	1.86	0.288	28.67	1.66	-0.42	
KE	20.4	19.3	22.7	1.73	0.264	20.80	-0.13	-2.21	
KH	17.5	13.2	17.0	2.35	0.334	15.90	-1.25	-3.33	⇓
KT	28.0	30.0	31.0	1.53	0.233	29.67	1.89	-0.19	
KX	13.0	13.0	13.0	0.00	0.000	13.00	-1.91	-3.99	⇓
L	19.3	18.9	21.1	1.17	0.171	19.77	-0.36	-2.45	
LE									•
LF	24.0	19.0	20.0	2.65	0.389	21.00	-0.08	-2.17	
LL	21.9	21.4	23.8	1.27	0.187	22.37	0.23	-1.85	
LR	9.2	8.2	8.5	0.51	0.078	8.63	-2.90	-4.98	⇓
LT	13.7	18.4	15.6	2.36	0.365	15.90	-1.25	-3.33	⇓
M	17.2	21.8	17.9	2.48	0.358	18.97	-0.55	-2.63	
MF	19.9	19.0	21.0	1.00	0.155	19.97	-0.32	-2.40	
MV	22.3	23.0	16.1	3.80	0.536	20.47	-0.20	-2.29	
MX									•
N	23.1	21.7	22.4	0.70	0.109	22.40	0.24	-1.85	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 30-Jan-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NA	15.6	16.0	14.5	0.78	0.117	15.37	-1.37	-3.45	⇓
NB	10.6	12.1	16.1	2.84	0.427	12.93	-1.92	-4.00	⇓
NH	12.5	15.0	17.5	2.50	0.389	15.00	-1.45	-3.53	⇓
NJ	17.0	14.0	17.0	1.73	0.233	16.00	-1.22	-3.30	⇓
NK									•
NO									•
NP	15.2	16.3	18.5	1.68	0.256	16.67	-1.07	-3.15	⇓
O	25.2	27.4	25.7	1.15	0.171	26.10	1.08	-1.00	
OA									•
OB	26.3	23.8	28.7	2.45	0.381	26.27	1.12	-0.96	
OF	15.0	15.1	15.4	0.21	0.031	15.17	-1.41	-3.49	⇓
OS	22.0	21.0	22.0	0.58	0.078	21.67	0.07	-2.01	
OT									•
OY									•
P	14.6	15.7	19.2	2.40	0.358	16.50	-1.11	-3.19	⇓
PA									•
PB	21.5	21.3	21.7	0.20	0.031	21.50	0.03	-2.05	
PD									•
PG	21.4	23.1	25.1	1.85	0.288	23.20	0.42	-1.66	
PM	22.5	21.4	23.0	0.82	0.124	22.30	0.21	-1.87	
Q	18.0	17.1	16.7	0.67	0.101	17.27	-0.93	-3.02	⇓
QM	20.6	23.1	17.7	2.70	0.420	20.47	-0.20	-2.29	
QP	29.6	28.4	27.8	0.92	0.140	28.60	1.65	-0.43	
QQ	17.0	23.1	13.3	4.95	0.762	17.80	-0.81	-2.89	
QT	24.2	22.1	21.4	1.46	0.218	22.57	0.27	-1.81	
QU	23.1	25.9	28.4	2.65	0.412	25.80	1.01	-1.07	
QW	24.4	29.9	29.4	3.04	0.427	27.90	1.49	-0.59	
QX	14.7	15.1	14.2	0.45	0.070	14.67	-1.53	-3.61	⇓
QZ	31.1	24.8	25.2	3.53	0.490	27.03	1.29	-0.79	
R	11.2	8.1	10.0	1.56	0.241	9.77	-2.64	-4.73	⇓
RB	26.2	26.7	33.4	4.02	0.560	28.77	1.69	-0.40	
RD	27.9	25.9	25.7	1.22	0.171	26.50	1.17	-0.91	
RG	16.0	17.0	16.7	0.51	0.078	16.57	-1.09	-3.18	⇓
RI	22.5	23.2	17.8	2.94	0.420	21.17	-0.05	-2.13	
RK									•
RR	25.0	29.0	28.0	2.08	0.311	27.33	1.36	-0.72	
RZ	24.7	23.0	23.2	0.93	0.132	23.63	0.52	-1.56	
S	30.1	32.6	28.9	1.89	0.288	30.53	2.09	0.01	
SC									•
SD	22.7	24.7	25.7	1.53	0.233	24.37	0.68	-1.40	
SF	17.6	17.1	23.5	3.56	0.497	19.40	-0.45	-2.53	
SG	52.7	37.1	45.2	7.80	1.405	45.00	5.39	3.30	×
SI	20.9	21.1	18.8	1.27	0.179	20.27	-0.25	-2.33	
SL	26.8	23.1	26.7	2.11	0.288	25.53	0.95	-1.13	
SM	19.7	18.2	20.0	0.96	0.140	19.30	-0.47	-2.55	

• ≡ 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
SN	18.4	20.1	17.4	1.37	0.210	18.63	-0.62	-2.70	
SO	17.4	16.7	14.7	1.40	0.210	16.27	-1.16	-3.24	⇓
SR	18.4	22.4	22.7	2.40	0.334	21.17	-0.05	-2.13	
SS	20.9	25.1	22.4	2.13	0.326	22.80	0.33	-1.75	
SU	15.8	17.2	15.8	0.81	0.109	16.27	-1.16	-3.24	⇓
SV	22.2	20.0	21.5	1.12	0.171	21.23	-0.03	-2.11	
SX	14.3	15.0	15.7	0.70	0.109	15.00	-1.45	-3.53	⇓
SZ	13.0	18.4	15.7	2.70	0.420	15.70	-1.29	-3.37	⇓
T	23.1	24.9	26.3	1.60	0.249	24.77	0.78	-1.31	
TD	19.2	21.4	25.3	3.09	0.474	21.97	0.14	-1.94	
TL									•
TN	22.5	20.8	24.3	1.75	0.272	22.53	0.27	-1.82	
TQ	17.8	15.4	15.7	1.31	0.187	16.30	-1.15	-3.24	⇓
TW	21.3	18.7	23.8	2.55	0.396	21.27	-0.02	-2.10	
TX									•
TY	17.7	20.8	18.8	1.57	0.241	19.10	-0.52	-2.60	
U	27.9	27.7	25.5	1.33	0.187	27.03	1.29	-0.79	
UA									•
UM									•
UP	27.2	25.2	27.9	1.40	0.210	26.77	1.23	-0.85	
UQ	22.2	23.2	22.2	0.58	0.078	22.53	0.27	-1.82	
UY									•
VA									•
VC									•
VH	28.3	30.0	26.3	1.85	0.288	28.20	1.56	-0.52	
VI	22.2	21.5	17.1	2.76	0.396	20.27	-0.25	-2.33	
VJ	17.1	17.1	19.2	1.21	0.163	17.80	-0.81	-2.89	
VO	23.8	19.9	15.6	4.10	0.637	19.77	-0.36	-2.45	
VT	22.4	22.9	21.7	0.60	0.093	22.33	0.22	-1.86	
W									•
WE	17.9	17.6	13.3	2.57	0.358	16.27	-1.16	-3.24	⇓
WH	20.0	21.3	19.2	1.06	0.163	20.17	-0.27	-2.35	
WJ									•
WN	38.4	43.5	45.0	3.46	0.513	42.30	4.77	2.69	
WO	21.4	21.6	15.7	3.35	0.459	19.57	-0.41	-2.49	
WP	19.8	37.7	24.7	9.25	1.745	27.40	1.38	-0.71	
WR	21.4	22.0	27.8	3.53	0.497	23.73	0.54	-1.54	
WS									•
WU									•
WW	14.7	12.5	15.5	1.55	0.233	14.23	-1.63	-3.71	⇓
WX									•
X	22.7	20.1	24.9	2.40	0.373	22.57	0.27	-1.81	
XB									•
XC									•
XD									•

• ≡ No data submitted

Ø ≡ Insufficient data

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⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 30-Jan-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
XF	36.7	34.8	40.0	2.63	0.404	37.17	3.60	1.52	
XI	20.0	16.0	19.0	2.08	0.311	18.33	-0.69	-2.77	
XJ	15.7	15.7	16.9	0.69	0.093	16.10	-1.20	-3.28	⇓
XK									•
XL	27.7	28.2	26.7	0.76	0.117	27.53	1.41	-0.68	
XM	25.6	23.3	25.3	1.25	0.179	24.73	0.77	-1.31	
XN	43.6	37.4	35.2	4.36	0.653	38.73	3.96	1.88	
XO									•
XQ	20.7	52.0	22.1	17.68	3.729	31.60	2.33	0.25	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.23	⇓	**DR**	16.30	⇓	**TQ**	20.47		**MV**
8.63	⇓	**LR**	16.37	⇓	**CO**	20.53		**AE**
9.77	⇓	**EL**	16.50	⇓	**P**	20.63		**AR**
9.77	⇓	**R**	16.57	⇓	**RG**	20.80		**KE**
9.97	⇓	**BN**	16.67	⇓	**NP**	21.00		**LF**
12.63	⇓	**HP**	16.87	⇓	**I**	21.13		**AF**
12.67	⇓	**FL**	17.03	⇓	**BO**	21.17		**SR**
12.80	⇓	**JE**	17.27	⇓	**Q**	21.17		**RI**
12.93	⇓	**NB**	17.33		**FN**	21.23		**SV**
13.00	⇓	**KX**	17.80		**VJ**	21.27		**TW**
13.73	⇓	**DH**	17.80		**QQ**	21.37		**ER**
14.00	⇓	**CP**	17.87		**AH**	21.47		**DZ**
14.23	⇓	**WW**	18.13		**HL**	21.50		**PB**
14.27	⇓	**HI**	18.17		**FE**	21.67		**OS**
14.67	⇓	**QX**	18.17		**CX**	21.77		**FF**
15.00	⇓	**SX**	18.27		**DD**	21.93		**DE**
15.00	⇓	**NH**	18.33		**XI**	21.97		**TD**
15.00	⇓	**JG**	18.47		**AK**	21.97		**BK**
15.00	⇓	**EV**	18.63		**SN**	22.07		**A**
15.07	⇓	**HK**	18.97		**M**	22.30		**PM**
15.17	⇓	**OF**	19.10		**TY**	22.30		**CE**
15.37	⇓	**NA**	19.13		**AJ**	22.33		**VT**
15.40	⇓	**EX**	19.30		**SM**	22.37		**LL**
15.67	⇓	**ID**	19.40		**SF**	22.40		**N**
15.67	⇓	**EO**	19.57		**WO**	22.47		**JP**
15.70	⇓	**SZ**	19.70		**DT**	22.50		**JQ**
15.90	⇓	**LT**	19.77		**VO**	22.53		**TN**
15.90	⇓	**KH**	19.77		**L**	22.53		**UQ**
16.00	⇓	**NJ**	19.97		**MF**	22.57		**X**
16.10	⇓	**XJ**	20.17		**WH**	22.57		**QT**
16.27	⇓	**WE**	20.27		**SI**	22.80		**SS**
16.27	⇓	**SO**	20.27		**VI**	23.10		**JN**
16.27	⇓	**SU**	20.47		**QM**	23.20		**PG**

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

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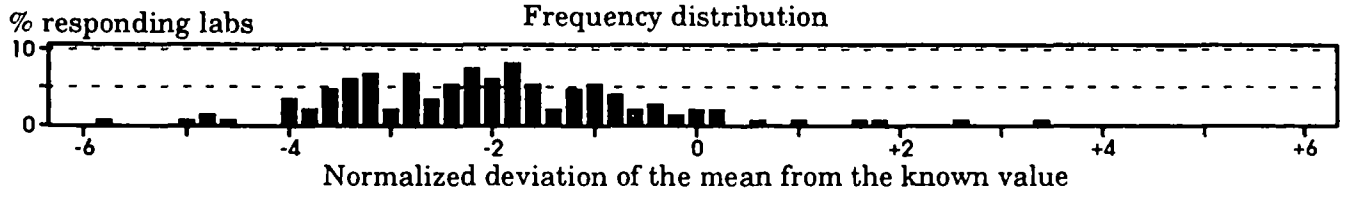
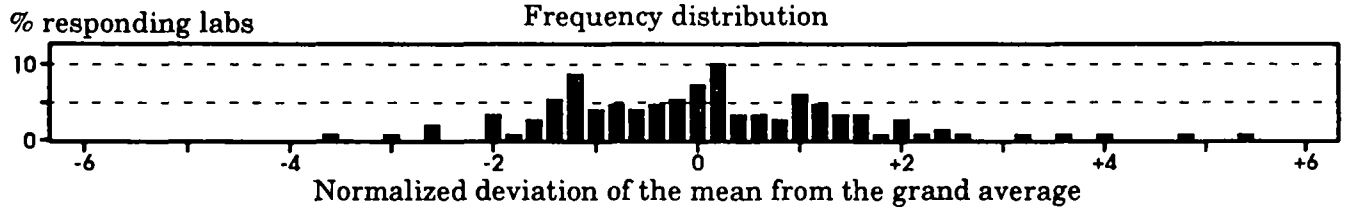
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
23.23		JM	26.00		DO	28.60		QP
23.37		JS	26.10		O	28.67		K
23.63		RZ	26.10		GQ	28.77		RB
23.73		WR	26.23		DB	29.67		KT
23.77		AZ	26.27		OB	29.77		EB
23.83		BH	26.33		BC	30.33		D*
24.37		SD	26.50		RD	30.47		BL
24.73		XM	26.77		UP	30.53		S
24.77		T	27.03		U	31.17		CA
24.87		BA	27.03		QZ	31.57		J
25.07		AW	27.27		C	31.60		XQ
25.37		JY	27.33		RR	33.00		CJ
25.37		D	27.40		WP	35.23		AU
25.53		SL	27.53		XL	37.17		XF
25.60		BM	27.90		QW	38.73		XN
25.67		BS	28.20		VH	42.30		WN
25.80		QU	28.57		AL	45.00	×	SG





• ≡ No data submitted
∅ ≡ Insufficient data

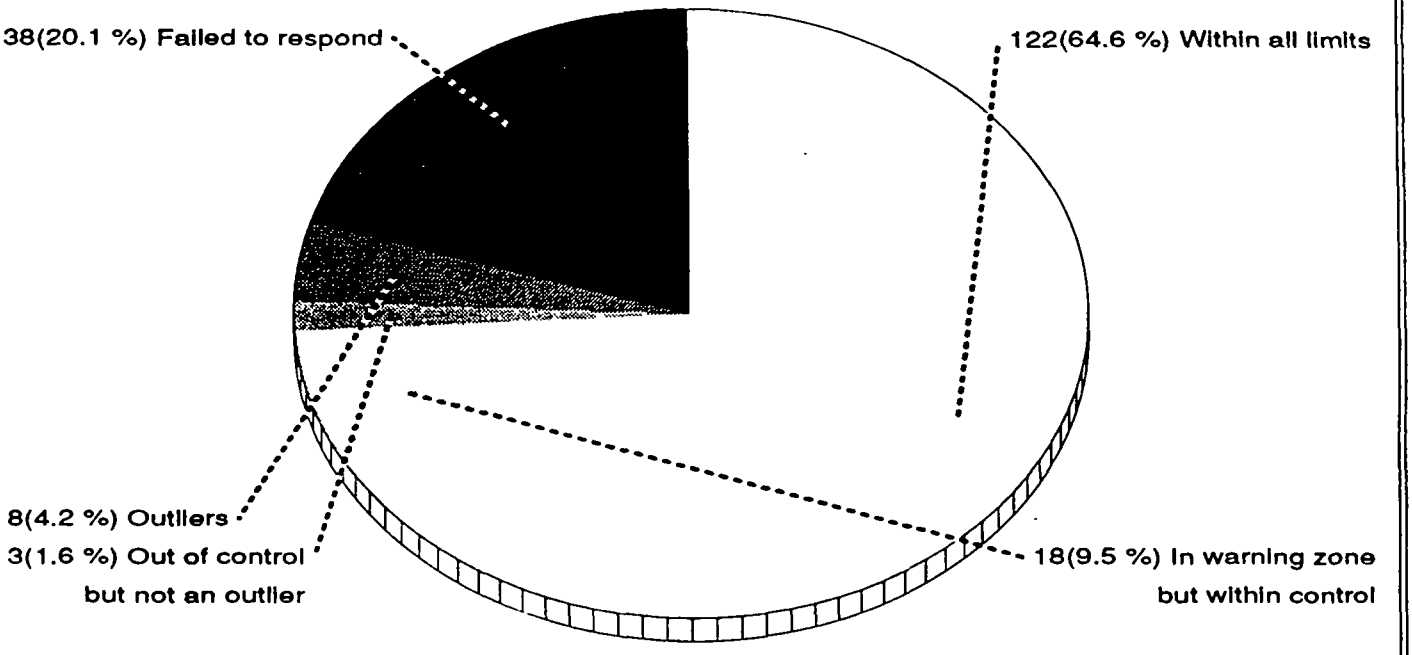
TAG SYMBOLS

× ≡ Determined to be an outlier

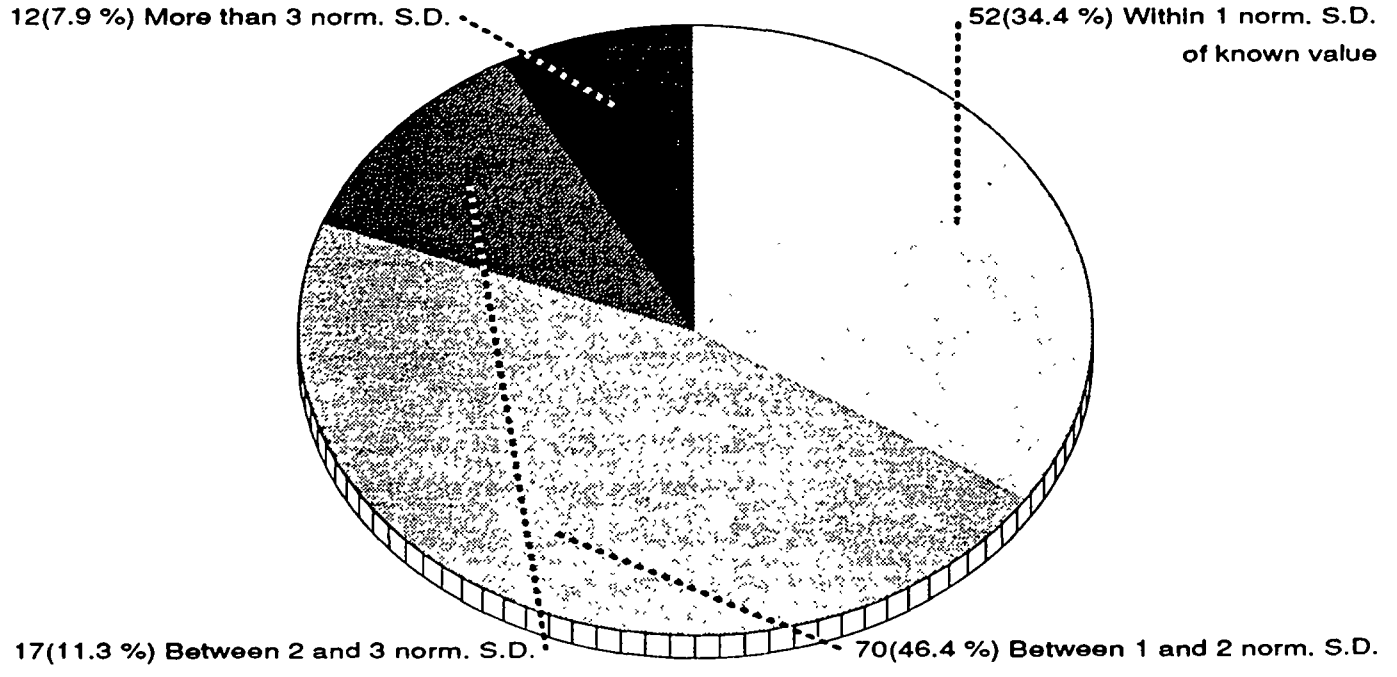
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta Statistical Summary 189 Participants

The known value of this nuclide is **3.9 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 12.6; the warning regions are 0.0 to 0.0 and 9.7 to 12.6



Statistic	Respondents	Non-outliers
Mean	8.34	**Grand Avg 7.44**
Std. Dev.	5.03	2.59
Variance	25.27	6.70
% Coef. of Var.	60.30	34.78
% deviation of mean from known value	113.74	90.76
Norm. dev. of mean from known value	0.88	1.37
Median	7.57	7.50
% deviation of median from known value	94.02	92.31
Norm. dev. of median from known value	0.73	1.39



11 / 16 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 30-Jan-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	5.2	5.1	5.6	0.26	0.059	5.30	-0.74	0.48	
AE	6.8	6.8	6.5	0.17	0.035	6.70	-0.26	0.97	
AF	9.4	10.7	9.3	0.78	0.165	9.80	0.82	2.04	
AH	8.0	8.6	9.4	0.70	0.165	8.67	0.43	1.65	
AJ	6.1	7.8	6.5	0.89	0.201	6.80	-0.22	1.00	
AK	5.9	5.2	5.4	0.36	0.083	5.50	-0.67	0.55	
AL	7.4	7.2	7.3	0.10	0.024	7.30	-0.05	1.18	
AP									•
AR	7.7	8.3	7.7	0.35	0.071	7.90	0.16	1.39	
AU	7.4	9.6	6.1	1.77	0.413	7.70	0.09	1.32	
AW	6.6	7.8	8.3	0.87	0.201	7.57	0.04	1.27	
AZ	7.0	6.0	4.8	1.10	0.260	5.93	-0.52	0.70	
BA	10.3	15.6	16.7	3.42	0.756	14.20	2.34	3.57	⇑
BB									•
BC	9.9	15.5	11.8	2.85	0.662	12.40	1.72	2.94	
BG									•
BH	8.4	6.9	7.6	0.75	0.177	7.63	0.07	1.29	
BK	7.7	6.9	5.3	1.22	0.284	6.63	-0.28	0.95	
BL	8.4	8.5	8.3	0.10	0.024	8.40	0.33	1.56	
BM	7.2	6.3	6.5	0.47	0.106	6.67	-0.27	0.96	
BN	1.4	2.0	2.1	0.38	0.083	1.83	-1.94	-0.72	
BO	4.1	4.2	4.7	0.32	0.071	4.33	-1.08	0.15	
BS	6.4	7.3	7.1	0.47	0.106	6.93	-0.18	1.05	
C	5.0	4.7	4.2	0.40	0.095	4.63	-0.97	0.25	
CA	7.1	5.9	6.8	0.62	0.142	6.60	-0.29	0.94	
CC									•
CE	4.6	4.6	5.2	0.35	0.071	4.80	-0.91	0.31	
CJ	5.6	6.5	4.7	0.90	0.213	5.60	-0.64	0.59	
CO	3.3	5.9	5.4	1.38	0.307	4.87	-0.89	0.33	
CP	8.0	7.0	7.0	0.58	0.118	7.33	-0.04	1.19	
CS									•
CX	8.2	4.4	7.1	1.96	0.449	6.57	-0.30	0.92	
D	9.0	8.8	8.2	0.42	0.095	8.67	0.43	1.65	
D*	4.6	6.7	4.8	1.16	0.248	5.37	-0.72	0.51	
DB	8.1	9.1	10.3	1.10	0.260	9.17	0.60	1.82	
DD	16.6	13.0	15.7	1.87	0.425	15.10	2.65	3.88	⇑
DE	5.3	5.6	5.7	0.21	0.047	5.53	-0.66	0.57	
DH	6.2	7.3	7.3	0.64	0.130	6.93	-0.18	1.05	
DO	8.9	7.6	8.3	0.65	0.154	8.27	0.29	1.51	
DR	6.3	7.3	7.1	0.53	0.118	6.90	-0.19	1.04	
DT	7.8	9.2	8.0	0.76	0.165	8.33	0.31	1.54	
DZ	10.2	12.2	12.7	1.32	0.295	11.70	1.48	2.70	
E									•
EB	8.0	6.8	7.2	0.61	0.142	7.33	-0.04	1.19	
EL	6.8	5.8	7.4	0.81	0.189	6.67	-0.27	0.96	

• ≡ 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
EO	10.0	8.0	8.0	1.15	0.236	8.67	0.43	1.65	
ER									•
EV	9.6	6.6	6.8	1.68	0.354	7.67	0.08	1.30	
EW	9.2	9.4	9.3	0.10	0.024	9.30	0.64	1.87	
EX	4.5	5.3	5.7	0.61	0.142	5.17	-0.79	0.44	
FE	6.0	6.0	5.0	0.58	0.118	5.67	-0.61	0.61	
FF	9.4	9.0	9.4	0.23	0.047	9.27	0.63	1.86	
FJ									•
FL	8.8	7.4	6.5	1.16	0.272	7.57	0.04	1.27	
FN	9.0	8.0	10.0	1.00	0.236	9.00	0.54	1.77	
GQ	29.3	24.8	25.9	2.35	0.532	26.67	6.66	7.89	×
GZ									•
HE									•
HI	20.9	21.8	15.6	3.35	0.732	19.43	4.15	5.38	×
HK	8.8	9.3	7.6	0.87	0.201	8.57	0.39	1.62	
HL	7.2	19.4	8.5	6.70	1.840	11.70	1.48	2.70	
HP	8.1	9.4	5.6	1.93	0.449	7.70	0.09	1.32	
I	7.3	5.4	6.4	0.95	0.224	6.37	-0.37	0.85	
ID	13.5	10.8	13.4	1.53	0.319	12.57	1.78	3.00	
IU	9.6	8.4	9.3	0.62	0.142	9.10	0.58	1.80	
J	5.6	5.9	6.1	0.25	0.059	5.87	-0.54	0.68	
JE	14.3	8.9	8.7	3.18	0.662	10.63	1.11	2.33	
JG	5.5	5.2	4.8	0.35	0.083	5.17	-0.79	0.44	
JM	7.8	6.8	8.1	0.68	0.154	7.57	0.04	1.27	
JN	0.5	0.1	1.0	0.45	0.106	0.53	-2.39	-1.17	
JP	4.2	6.1	3.0	1.56	0.366	4.43	-1.04	0.18	
JQ	0.0	0.0	0.0	0.00	0.000	0.00	-2.58	-1.35	
JS	2.8	4.2	4.7	0.98	0.224	3.90	-1.23	0.00	
JY	7.2	10.8	9.6	1.83	0.425	9.20	0.61	1.84	
K	7.6	8.5	9.2	0.80	0.189	8.43	0.34	1.57	
KE	9.1	8.1	11.0	1.47	0.343	9.40	0.68	1.91	
KH	7.0	5.9	5.9	0.64	0.130	6.27	-0.41	0.82	
KT	3.0	4.0	5.0	1.00	0.236	4.00	-1.19	0.03	
KX	7.0	8.0	7.0	0.58	0.118	7.33	-0.04	1.19	
L	7.3	6.7	8.6	0.97	0.224	7.53	0.03	1.26	
LE									•
LF	7.6	7.1	7.0	0.32	0.071	7.23	-0.07	1.15	
LL	8.2	5.3	6.2	1.48	0.343	6.57	-0.30	0.92	
LR	8.6	8.0	11.0	1.59	0.354	9.20	0.61	1.84	
LT	6.2	9.0	8.7	1.54	0.331	7.97	0.18	1.41	
M	6.0	6.1	3.9	1.24	0.260	5.33	-0.73	0.50	
MF	10.0	11.2	9.7	0.79	0.177	10.30	0.99	2.22	
MV	9.4	9.2	16.0	3.87	0.803	11.53	1.42	2.64	
MX									•
N	3.0	3.4	3.2	0.20	0.047	3.20	-1.47	-0.24	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 30-Jan-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NA	6.1	6.2	6.8	0.38	0.083	6.37	-0.37	0.85	
NB	8.5	9.7	7.7	1.01	0.236	8.63	0.41	1.64	
NH	8.0	9.0	11.0	1.53	0.354	9.33	0.66	1.88	
NJ	7.1	6.5	7.6	0.55	0.130	7.07	-0.13	1.10	
NK									•
NO									•
NP	7.3	6.6	6.3	0.51	0.118	6.73	-0.24	0.98	
O	6.5	6.7	7.1	0.31	0.071	6.77	-0.23	0.99	
OA									•
OB	18.3	17.8	20.0	1.15	0.260	18.70	3.90	5.13	×
OF	4.7	4.9	5.5	0.42	0.095	5.03	-0.83	0.39	
OS	8.0	9.0	8.0	0.58	0.118	8.33	0.31	1.54	
OT	6.8	8.7	6.0	1.39	0.319	7.17	-0.09	1.13	
OY									•
P	8.5	7.0	10.8	1.91	0.449	8.77	0.46	1.69	
PA									•
PB	8.8	8.6	8.6	0.12	0.024	8.67	0.43	1.65	
PD	16.8	9.7	10.2	3.96	0.839	12.23	1.66	2.89	
PG	9.3	10.0	8.3	0.85	0.201	9.20	0.61	1.84	
PM	7.8	9.0	5.2	1.94	0.449	7.33	-0.04	1.19	
Q	9.0	8.6	7.7	0.67	0.154	8.43	0.34	1.57	
QM	8.3	7.3	8.6	0.68	0.154	8.07	0.22	1.44	
QP	0.4	0.9	1.0	0.32	0.071	0.77	-2.31	-1.09	
QQ	7.4	10.7	5.5	2.63	0.614	7.87	0.15	1.37	
QT	4.9	0.9	7.5	3.32	0.780	4.43	-1.04	0.18	
QU	9.9	10.0	11.9	1.13	0.236	10.60	1.09	2.32	
QW	8.9	9.1	7.9	0.64	0.142	8.63	0.41	1.64	
QX	9.8	11.4	10.4	0.81	0.189	10.53	1.07	2.30	
QZ	6.1	5.7	5.3	0.40	0.095	5.70	-0.60	0.62	
R	7.1	7.1	7.7	0.35	0.071	7.30	-0.05	1.18	
RB	20.0	23.6	22.9	1.91	0.425	22.17	5.10	6.33	×
RD	23.9	15.1	19.4	4.40	1.075	19.47	4.17	5.39	×
RG	8.4	9.4	9.4	0.58	0.118	9.07	0.56	1.79	
RI	11.2	7.0	13.9	3.48	0.815	10.70	1.13	2.36	
RK									•
RR	9.4	8.1	8.3	0.70	0.154	8.60	0.40	1.63	
RZ	9.5	10.3	9.4	0.49	0.106	9.73	0.79	2.02	
S	10.1	10.4	9.9	0.25	0.059	10.13	0.93	2.16	
SC									•
SD									•
SF	5.2	4.7	4.6	0.32	0.071	4.83	-0.90	0.32	
SG	6.0	4.3	6.3	1.08	0.236	5.53	-0.66	0.57	
SI	11.1	9.9	7.5	1.83	0.425	9.50	0.71	1.94	
SL	4.2	4.8	4.7	0.32	0.071	4.57	-1.00	0.23	
SM	7.8	6.0	6.3	0.96	0.213	6.70	-0.26	0.97	

• ≡ 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
SN	6.0	6.2	6.1	0.10	0.024	6.10	-0.46	0.76	
SO	6.9	7.2	7.0	0.15	0.035	7.03	-0.14	1.09	
SR	7.4	8.0	8.2	0.42	0.095	7.87	0.15	1.37	
SS	7.1	6.7	6.7	0.23	0.047	6.83	-0.21	1.02	
SU	5.1	5.3	5.6	0.25	0.059	5.33	-0.73	0.50	
SV	8.6	6.4	8.0	1.14	0.260	7.67	0.08	1.30	
SX	9.2	9.5	10.0	0.40	0.095	9.57	0.74	1.96	
SZ	5.8	5.8	5.7	0.06	0.012	5.77	-0.58	0.65	
T	5.1	3.8	6.9	1.56	0.366	5.27	-0.75	0.47	
TD	2.7	3.3	3.9	0.60	0.142	3.30	-1.43	-0.21	
TL									•
TN	9.3	7.9	6.7	1.30	0.307	7.97	0.18	1.41	
TQ	5.2	6.1	5.6	0.45	0.106	5.63	-0.63	0.60	
TW	5.8	3.5	2.7	1.61	0.366	4.00	-1.19	0.03	
TX									•
TY	4.9	5.0	4.6	0.21	0.047	4.83	-0.90	0.32	
U	7.5	7.7	8.1	0.31	0.071	7.77	0.11	1.34	
UA									•
UM									•
UP	5.6	6.7	5.9	0.57	0.130	6.07	-0.48	0.75	
UQ	7.3	8.4	8.6	0.70	0.154	8.10	0.23	1.45	
UY	7.1	6.9	7.5	0.31	0.071	7.17	-0.09	1.13	
VA									•
VC									•
VH	16.3	15.2	14.8	0.78	0.177	15.43	2.77	4.00	⇑
VI	8.8	7.8	5.9	1.47	0.343	7.50	0.02	1.25	
VJ	10.7	10.4	9.8	0.46	0.106	10.30	0.99	2.22	
VO	9.5	8.9	9.3	0.31	0.071	9.23	0.62	1.85	
VT	22.7	26.4	16.1	5.22	1.413	21.73	4.95	6.18	×
W									•
WE	8.1	10.0	7.8	1.19	0.260	8.63	0.41	1.64	
WH	2.3	2.9	3.3	0.50	0.118	2.83	-1.60	-0.37	
WJ									•
WN	43.3	43.7	56.1	7.28	1.975	47.70	13.95	15.17	×
WO	10.5	13.3	10.7	1.56	0.331	11.50	1.41	2.63	
WP									•
WR	8.1	10.6	12.2	2.07	0.484	10.30	0.99	2.22	
WS									•
WU									•
WW	5.1	3.6	6.7	1.55	0.366	5.13	-0.80	0.43	
WX									•
X	9.8	6.8	7.7	1.54	0.354	8.10	0.23	1.45	
XB									•
XC									•
XD									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 30-Jan-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XF	4.8	5.3	3.2	1.10	0.248	4.43	-1.04	0.18	
XI	13.0	13.0	9.0	2.31	0.473	11.67	1.46	2.69	
XJ									•
XK									•
XL	9.1	9.3	8.9	0.20	0.047	9.10	0.58	1.80	
XM	2.3	3.1	2.9	0.42	0.095	2.77	-1.62	-0.39	
XN	9.0	9.9	7.7	1.11	0.260	8.87	0.49	1.72	
XO									•
XQ	17.9	19.0	20.1	1.10	0.260	19.00	4.00	5.23	×

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.00		**JQ**	5.60		**CJ**	7.30		**AL**
0.53		**JN**	5.63		**TQ**	7.33		**PM**
0.77		**QP**	5.67		**FE**	7.33		**KX**
1.83		**BN**	5.70		**QZ**	7.33		**EB**
2.77		**XM**	5.77		**SZ**	7.33		**CP**
2.83		**WH**	5.87		**J**	7.50		**VI**
3.20		**N**	5.93		**AZ**	7.53		**L**
3.30		**TD**	6.07		**UP**	7.57		**JM**
3.90		**JS**	6.10		**SN**	7.57		**FL**
4.00		**TW**	6.27		**KH**	7.57		**AW**
4.00		**KT**	6.37		**NA**	7.63		**BH**
4.33		**BO**	6.37		**I**	7.67		**SV**
4.43		**XF**	6.57		**LL**	7.67		**EV**
4.43		**QT**	6.57		**CX**	7.70		**HP**
4.43		**JP**	6.60		**CA**	7.70		**AU**
4.57		**SL**	6.63		**BK**	7.77		**U**
4.63		**C**	6.67		**EL**	7.87		**SR**
4.80		**CE**	6.67		**BM**	7.87		**QQ**
4.83		**TY**	6.70		**SM**	7.90		**AR**
4.83		**SF**	6.70		**AE**	7.97		**TN**
4.87		**CO**	6.73		**NP**	7.97		**LT**
5.03		**OF**	6.77		**O**	8.07		**QM**
5.13		**WW**	6.80		**AJ**	8.10		**X**
5.17		**JG**	6.83		**SS**	8.10		**UQ**
5.17		**EX**	6.90		**DR**	8.27		**DO**
5.27		**T**	6.93		**DH**	8.33		**OS**
5.30		**A**	6.93		**BS**	8.33		**DT**
5.33		**SU**	7.03		**SO**	8.40		**BL**
5.33		**M**	7.07		**NJ**	8.43		**Q**
5.37		**D***	7.17		**UY**	8.43		**K**
5.50		**AK**	7.17		**OT**	8.57		**HK**
5.53		**SG**	7.23		**LF**	8.60		**RR**
5.53		**DE**	7.30		**R**	8.63		**QW**

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

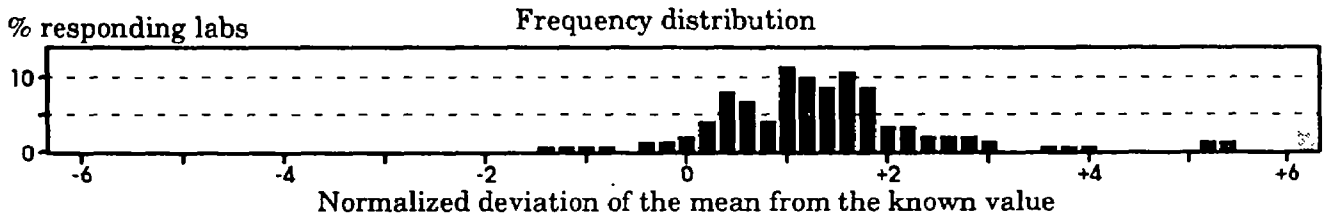
⇑ ≡ Above control limit

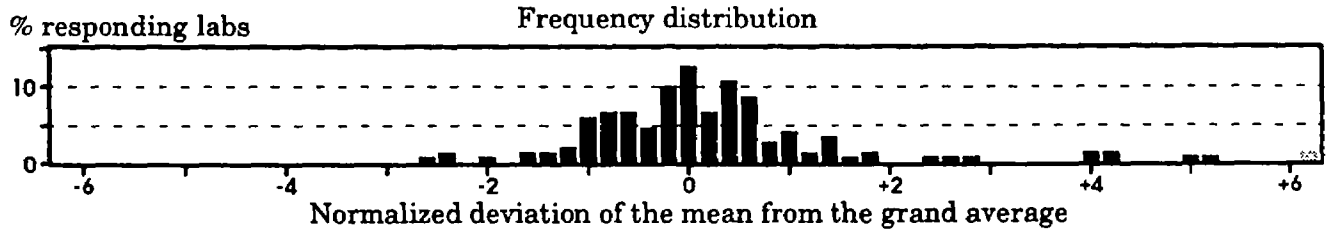
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.63		NB	9.27		FF	11.53		MV
8.63		WE	9.30		EW	11.67		XI
8.67		PB	9.33		NH	11.70		HL
8.67		EO	9.40		KE	11.70		DZ
8.67		D	9.50		SI	12.23		PD
8.67		AH	9.57		SX	12.40		BC
8.77		P	9.73		RZ	12.57		ID
8.87		XN	9.80		AF	14.20	⇑	BA
9.00		FN	10.13		S	15.10	⇑	DD
9.07		RG	10.30		WR	15.43	⇑	VH
9.10		XL	10.30		VJ	18.70	×	OB
9.10		IU	10.30		MF	19.00	×	XQ
9.17		DB	10.53		QX	19.43	×	HI
9.20		PG	10.60		QU	19.47	×	RD
9.20		LR	10.63		JE	21.73	×	VT
9.20		JY	10.70		RI	22.17	×	RB
9.23		VO	11.50		WO	26.67	×	GQ
						47.70	×	WN





• ≡ 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

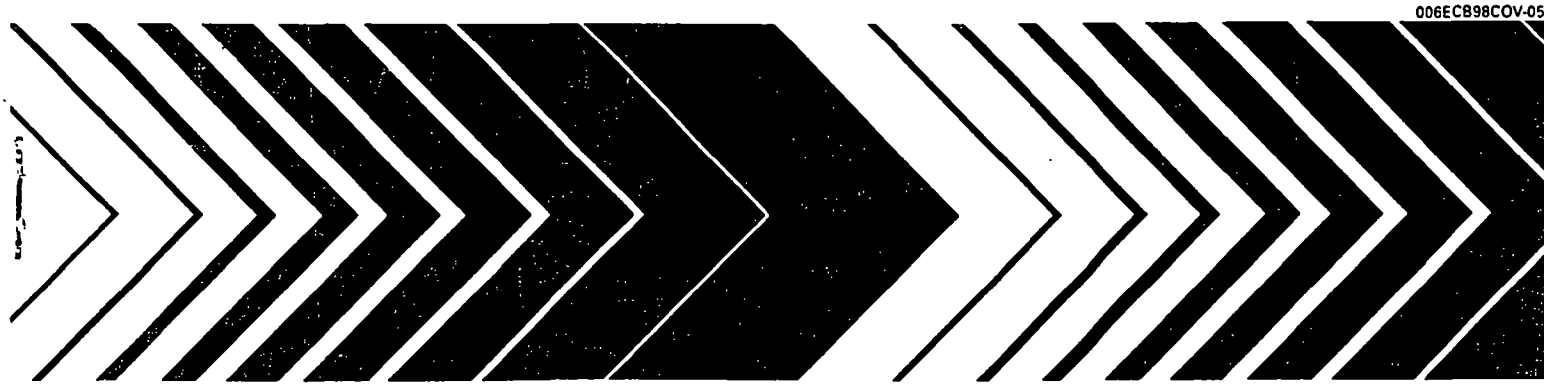
EPA/600/R-98/059
May 1998

EPA

Iodine in Water Performance Evaluation Study

A Statistical Evaluation of the February 6, 1998 Data

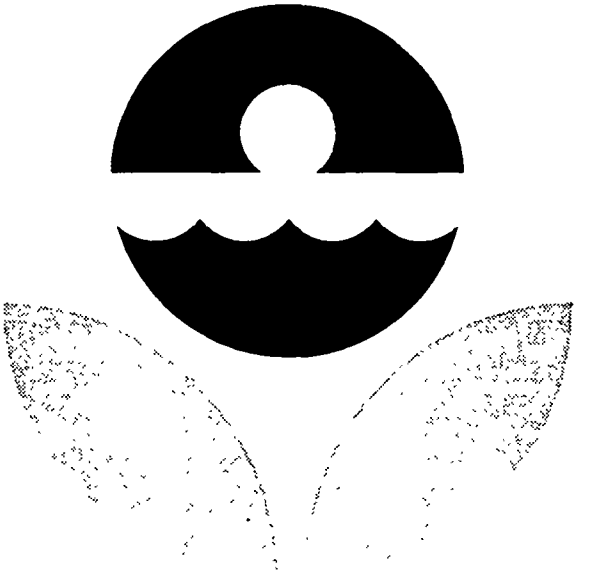
006EC898COV-059



Iodine in Water

Performance Evaluation Study

February 6, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Iodine in Water; February 6, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

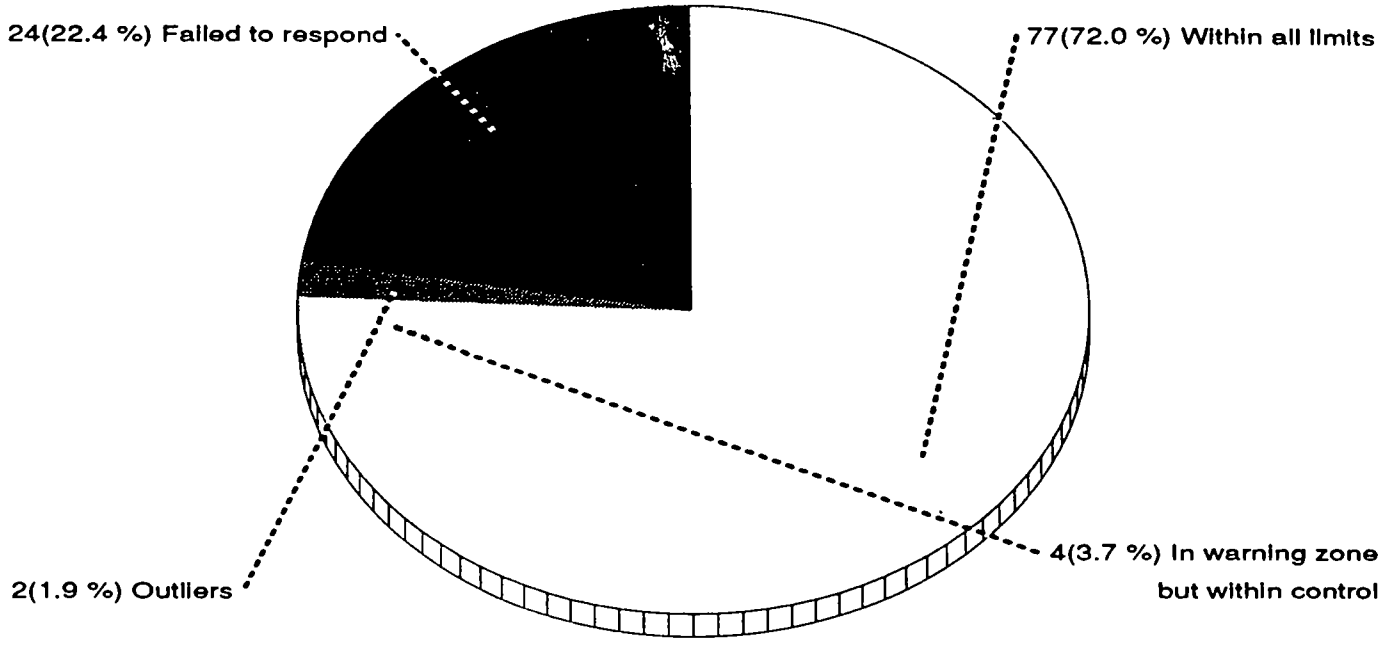
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

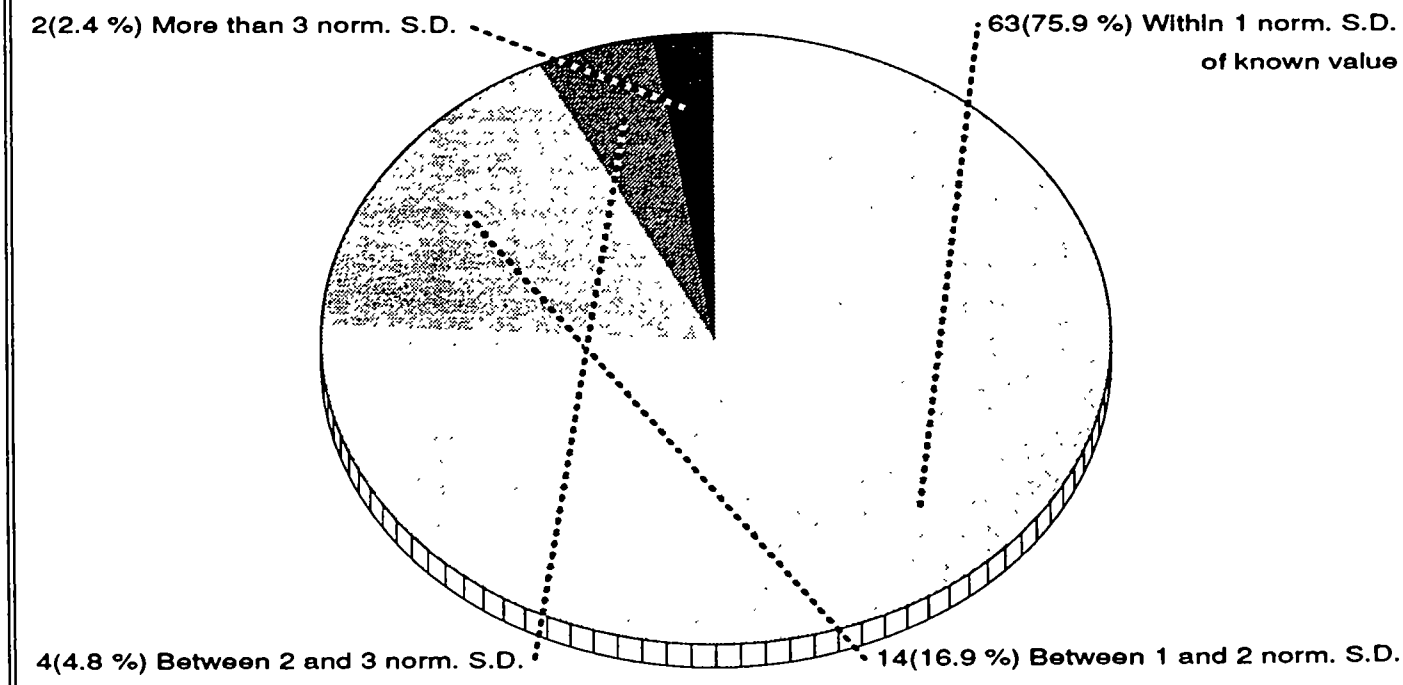
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Iodine-131 Statistical Summary 107 Participants

The known value of this nuclide is **104.9 pCi/l** with an expected precision of **10.5**; the control limits are 86.7 to 123.1; the warning regions are 86.7 to 92.7 and 117.1 to 123.1



Statistic	Respondents	Non-outliers
Mean	104.94	**Grand Avg 105.74**
Std. Dev.	7.39	5.43
Variance	54.59	29.50
% Coef. of Var.	7.04	5.14
% deviation of mean from known value	0.04	0.80
Norm. dev. of mean from known value	0.01	0.15
Median	104.83	105.00
% deviation of median from known value	-0.06	0.10
Norm. dev. of median from known value	-0.01	0.02



ESD-LV Performance Evaluation: Iodine in Water, 6-Feb-1998

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	107.2	106.9	107.1	0.15	0.017	107.07	0.22	0.36	
AF	107.2	108.1	107.6	0.45	0.051	107.63	0.31	0.45	
AJ	105.5	98.0	99.3	4.01	0.422	100.93	-0.79	-0.65	
AK	107.6	107.8	109.3	0.93	0.096	108.23	0.41	0.55	
AL	102.4	106.7	101.2	2.89	0.309	103.43	-0.38	-0.24	
AP									•
AU	104.2	102.9	101.6	1.30	0.146	102.90	-0.47	-0.33	
AW	96.4	102.7	96.1	3.73	0.371	98.40	-1.21	-1.07	
AY									•
AZ	112.4	116.7	116.9	2.54	0.253	115.33	1.58	1.72	
BA	115.0	114.0	111.0	2.08	0.225	113.33	1.25	1.39	
BC	104.1	100.7	102.4	1.70	0.191	102.40	-0.55	-0.41	
BH	109.0	107.0	113.0	3.06	0.338	109.67	0.65	0.79	
BK	106.0	104.0	105.0	1.00	0.113	105.00	-0.12	0.02	
BL	97.0	103.7	110.5	6.75	0.759	103.73	-0.33	-0.19	
BM	108.6	105.6	108.4	1.68	0.169	107.53	0.30	0.43	
BO	104.0	104.0	107.0	1.73	0.169	105.00	-0.12	0.02	
C	103.0	102.0	104.0	1.00	0.113	103.00	-0.45	-0.31	
CA	110.1	111.4	111.8	0.89	0.096	111.10	0.88	1.02	
CC									•
CE	98.2	103.8	98.1	3.26	0.321	100.03	-0.94	-0.80	
CJ	110.0	110.0	110.0	0.00	0.000	110.00	0.70	0.84	
CP	116.6	116.7	104.3	7.13	0.698	112.53	1.12	1.26	
CS									•
CX	103.3	100.0	104.2	2.21	0.236	102.50	-0.53	-0.40	
D	108.9	107.2	110.1	1.46	0.163	108.73	0.49	0.63	
DD	104.0	107.0	105.0	1.53	0.169	105.33	-0.07	0.07	
DE	103.0	104.0	104.0	0.58	0.056	103.67	-0.34	-0.20	
DR	107.0	107.0	111.0	2.31	0.225	108.33	0.43	0.57	
DT	107.0	102.0	109.0	3.61	0.394	106.00	0.04	0.18	
DY									•
E	103.2	107.4	98.9	4.25	0.478	103.17	-0.42	-0.29	
EB	104.0	104.0	105.0	0.58	0.056	104.33	-0.23	-0.09	
EH	122.0	92.0	105.0	15.04	2.310	106.33	0.10	0.24	
EL	109.7	106.8	110.2	1.84	0.191	108.90	0.52	0.66	
EX	94.3	107.0	92.2	8.01	0.833	97.83	-1.30	-1.17	
FE									•
FL	109.0	106.0	112.0	3.00	0.338	109.00	0.54	0.68	
GI	103.8	107.4	101.4	3.02	0.338	104.20	-0.25	-0.12	
HE	111.1	120.7	116.8	4.83	0.540	116.20	1.73	1.86	
HK	99.4	99.6	99.5	0.10	0.011	99.50	-1.03	-0.89	
HP	122.0	111.0	110.0	6.66	0.675	114.33	1.42	1.56	
I	107.1	102.9	104.5	2.12	0.236	104.83	-0.15	-0.01	
IA									•
IU	107.0	110.0	107.0	1.73	0.169	108.00	0.37	0.51	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ 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
J									•
JR									•
JS	117.0	120.0	119.0	1.53	0.169	118.67	2.13	2.27	
JY	126.0	111.0	109.0	9.29	0.956	115.33	1.58	1.72	
K	101.2	108.5	97.3	5.69	0.630	102.33	-0.56	-0.42	
KL	106.7	106.8	103.7	1.76	0.174	105.73	0.00	0.14	
KM	95.7	98.1	98.8	1.63	0.174	97.53	-1.35	-1.22	
KX	100.0	101.0	101.0	0.58	0.056	100.67	-0.84	-0.70	
L	103.7	102.7	100.2	1.80	0.197	102.20	-0.58	-0.45	
LF	100.0	100.0	110.0	5.77	0.563	103.33	-0.40	-0.26	
LT	104.0	104.0	107.0	1.73	0.169	105.00	-0.12	0.02	
M	85.0	90.0	87.0	2.52	0.281	87.33	-3.04	-2.90	
MN	100.0	106.0	101.0	3.21	0.338	102.33	-0.56	-0.42	
MP	107.0	105.0	100.0	3.61	0.394	104.00	-0.29	-0.15	
MV									•
N	102.4	103.4	103.9	0.76	0.084	103.23	-0.41	-0.27	
NJ	98.0	106.0	106.0	4.62	0.450	103.33	-0.40	-0.26	
NO	84.4	93.2	102.1	8.85	0.996	93.23	-2.06	-1.92	
O	110.0	107.0	109.0	1.53	0.169	108.67	0.48	0.62	
OA	106.1	101.4	105.6	2.58	0.264	104.37	-0.23	-0.09	
OB	110.6	111.6	103.3	4.53	0.467	108.50	0.46	0.59	
OT	119.7	116.7	121.8	2.56	0.287	119.40	2.25	2.39	
PB	104.5	102.7	105.0	1.21	0.129	104.07	-0.28	-0.14	
PE									•
PW	108.0	96.0	110.0	7.57	0.788	104.67	-0.18	-0.04	
Q	100.4	100.0	103.3	1.80	0.186	101.23	-0.74	-0.60	
QX	101.2	95.8	96.5	2.94	0.304	97.83	-1.30	-1.17	
QY	102.0	100.0	100.3	1.08	0.113	100.77	-0.82	-0.68	
QZ	120.0	120.0	115.0	2.89	0.281	118.33	2.08	2.22	
R	105.6	103.3	103.0	1.42	0.146	103.97	-0.29	-0.15	
RK	110.0	117.0	115.0	3.61	0.394	114.00	1.36	1.50	
S	101.4	103.1	105.1	1.85	0.208	103.20	-0.42	-0.28	
SC									•
SD	106.6	107.9	109.0	1.20	0.135	107.83	0.35	0.48	
SM	114.8	103.7	107.6	5.63	0.624	108.70	0.49	0.63	
SS	99.0	104.8	109.5	5.26	0.591	104.43	-0.22	-0.08	
SV	106.9	107.4	104.1	1.78	0.186	106.13	0.07	0.20	
SZ	108.6	103.5	106.8	2.59	0.287	106.30	0.09	0.23	
TA	102.4	95.9	113.2	8.74	0.973	103.83	-0.31	-0.18	
TC	76.1	67.5	76.7	5.15	0.518	73.43	-5.33	-5.19	×
TD	101.9	105.1	105.3	1.91	0.191	104.10	-0.27	-0.13	
TF									•
TL									•
TQ	105.0	107.0	115.0	5.29	0.563	109.00	0.54	0.68	
U	101.3	110.2	104.0	4.56	0.501	105.17	-0.09	0.04	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

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× ≡ Determined to be an outlier

⇓ ≡ 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
UC									•
UI									•
UM									•
UP	108.0	106.0	110.0	2.00	0.225	108.00	0.37	0.51	
UY	110.0	110.0	111.0	0.58	0.056	110.33	0.76	0.90	
VA									•
VC									•
VM	100.0	100.0	100.0	0.00	0.000	100.00	-0.95	-0.81	
VN	110.5	109.7	113.2	1.83	0.197	111.13	0.89	1.03	
W									•
WM									•
WO	60.0	70.8	85.8	12.96	1.860	72.20	-5.53	-5.39	×
X	99.1	102.5	106.5	3.70	0.416	102.70	-0.50	-0.36	
XK									•
XO									•
XQ									•
Y	111.0	102.0	103.0	4.93	0.506	105.33	-0.07	0.07	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
72.20	×	**WO**	103.23		**N**	106.13		**SV**
73.43	×	**TC**	103.33		**NJ**	106.30		**SZ**
87.33		**M**	103.33		**LF**	106.33		**EH**
93.23		**NO**	103.43		**AL**	107.07		**A**
97.53		**KM**	103.67		**DE**	107.53		**BM**
97.83		**QX**	103.73		**BL**	107.63		**AF**
97.83		**EX**	103.83		**TA**	107.83		**SD**
98.40		**AW**	103.97		**R**	108.00		**UP**
99.50		**HK**	104.00		**MP**	108.00		**IU**
100.00		**VM**	104.07		**PB**	108.23		**AK**
100.03		**CE**	104.10		**TD**	108.33		**DR**
100.67		**KX**	104.20		**GI**	108.50		**OB**
100.77		**QY**	104.33		**EB**	108.67		**O**
100.93		**AJ**	104.37		**OA**	108.70		**SM**
101.23		**Q**	104.43		**SS**	108.73		**D**
102.20		**L**	104.67		**PW**	108.90		**EL**
102.33		**MN**	104.83		**I**	109.00		**TQ**
102.33		**K**	105.00		**LT**	109.00		**FL**
102.40		**BC**	105.00		**BO**	109.67		**BH**
102.50		**CX**	105.00		**BK**	110.00		**CJ**
102.70		**X**	105.17		**U**	110.33		**UY**
102.90		**AU**	105.33		**Y**	111.10		**CA**
103.00		**C**	105.33		**DD**	111.13		**VN**
103.17		**E**	105.73		**KL**	112.53		**CP**
103.20		**S**	106.00		**DT**	113.33		**BA**

• ≡ No data submitted
∅ ≡ Insufficient data

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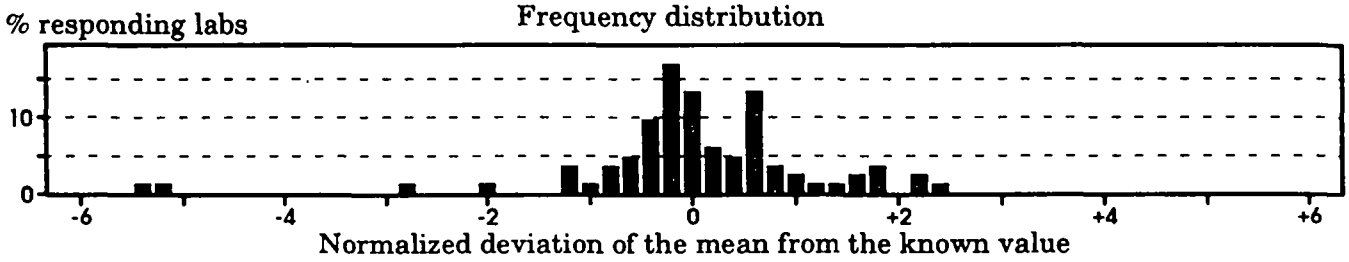
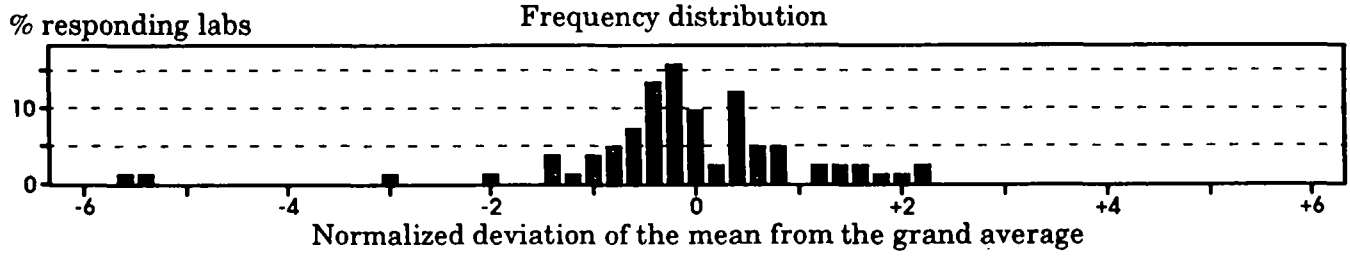
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Iodine-131

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
114.00		**RK**	115.33		**JY**	118.33		**QZ**
114.33		**HP**	115.33		**AZ**	118.67		**JS**
			116.20		**HE**	119.40		**OT**





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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-98/061
May 1998

EPA

Uranium-Radium in Water Performance Evaluation Study

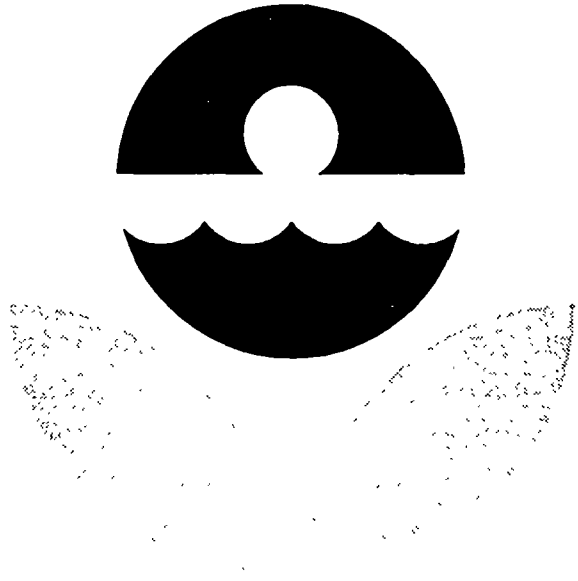
A Statistical Evaluation of the February 13, 1998 Data

006ECB98COV-061

Uranium-Radium in Water

Performance Evaluation Study

February 13, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Uranium-Radium in Water; February 13, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

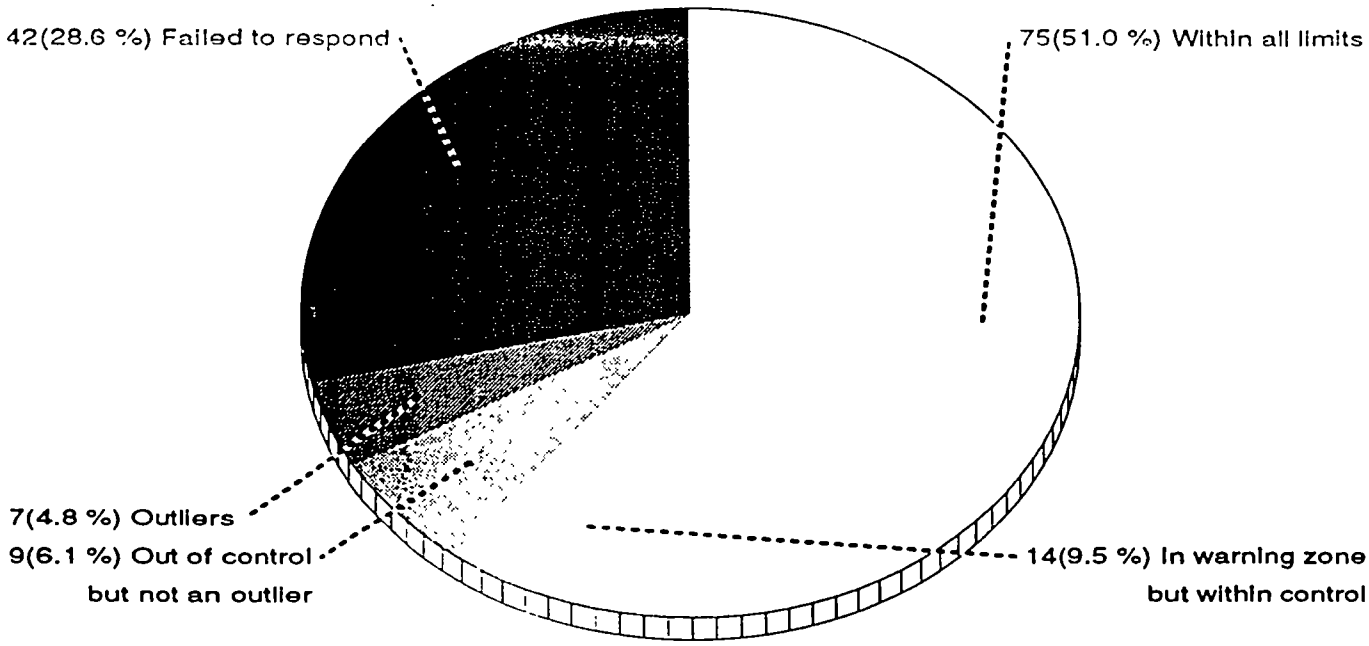
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

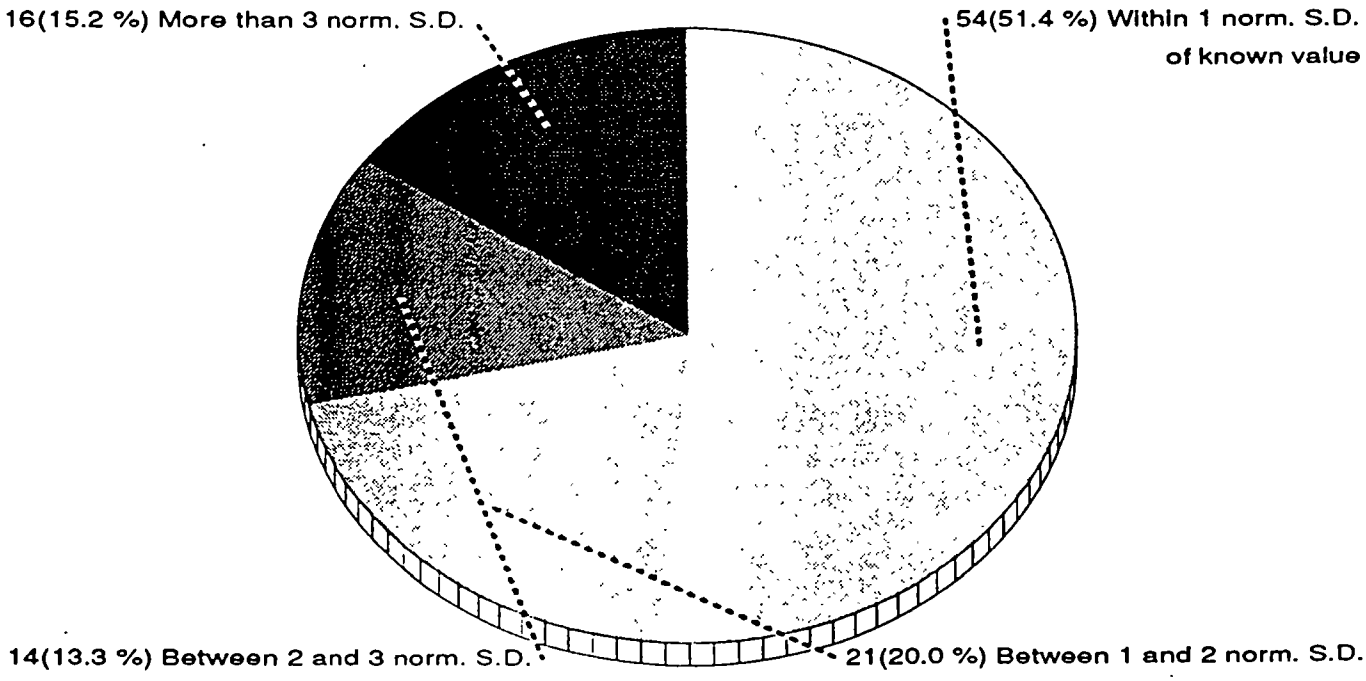
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Uranium (Natural) Statistical Summary 147 Participants

The known value of this nuclide is 32.0 pCi/l with an expected precision of 3.0; the control limits are 26.8 to 37.2; the warning regions are 26.8 to 28.5 and 35.5 to 37.2



Statistic	Respondents	Non-outliers
Mean	30.78	**Grand Avg 31.27**
Std. Dev.	5.09	3.00
Variance	25.93	8.97
% Coef. of Var.	16.54	9.58
% deviation of mean from known value	-3.81	-2.27
Norm. dev. of mean from known value	-0.24	-0.24
Median	31.10	31.22
% deviation of median from known value	-2.81	-2.45
Norm. dev. of median from known value	-0.18	-0.26



 ESD-LV Performance Evaluation: Uranium-Radium in Water, 13-Feb-1998

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	29.7	32.0	31.4	1.19	0.453	31.03	-0.14	-0.56	
AE	32.4	34.3	33.7	0.97	0.374	33.47	1.27	0.85	
AF	25.1	26.3	26.1	0.64	0.236	25.83	-3.14	-3.56	⇓
AH	19.8	19.8	20.7	0.52	0.177	20.10	-6.45	-6.87	×
AJ	24.4	29.4	27.8	2.55	0.984	27.20	-2.35	-2.77	
AK	36.5	34.5	36.0	1.04	0.394	35.67	2.54	2.12	
AL	36.0	37.1	37.2	0.67	0.236	36.77	3.17	2.75	
AP	31.8	31.3	32.1	0.40	0.158	31.73	0.27	-0.15	
AR	28.2	28.5	28.5	0.17	0.059	28.40	-1.66	-2.08	
AU									•
AW	32.9	32.0	33.2	0.62	0.236	32.70	0.82	0.40	
AZ	31.7	31.9	32.0	0.15	0.059	31.87	0.34	-0.08	
BA	32.7	30.3	31.9	1.22	0.473	31.63	0.21	-0.21	
BC	31.3	31.3	31.2	0.06	0.020	31.27	0.00	-0.42	
BG									•
BH	32.2	30.0	33.7	1.86	0.728	31.97	0.40	-0.02	
BK	32.3	36.0	33.4	1.90	0.728	33.90	1.52	1.10	
BM	31.5	32.0	33.1	0.82	0.315	32.20	0.54	0.12	
BN	21.2	22.9	18.8	2.06	0.807	20.97	-5.95	-6.37	×
BO	33.6	32.0	33.8	0.99	0.354	33.13	1.07	0.65	
C	34.0	34.7	33.6	0.56	0.217	34.10	1.63	1.21	
CA	26.8	25.9	24.7	1.05	0.413	25.80	-3.16	-3.58	⇓
CC									•
CE	34.4	33.8	33.1	0.65	0.256	33.77	1.44	1.02	
CJ	27.0	28.0	26.0	1.00	0.394	27.00	-2.47	-2.89	
CS	27.3	28.0	28.3	0.51	0.197	27.87	-1.97	-2.39	
CX	35.0	36.4	35.3	0.74	0.276	35.57	2.48	2.06	
D	31.2	33.2	30.4	1.44	0.551	31.60	0.19	-0.23	
DB	27.3	27.3	28.0	0.40	0.138	27.53	-2.16	-2.58	
DE	34.8	34.8	34.9	0.06	0.020	34.83	2.06	1.64	
DI									•
DO	30.1	31.3	30.7	0.60	0.236	30.70	-0.33	-0.75	
DR									•
DT	27.6	30.9	33.8	3.10	1.420	30.77	-0.29	-0.71	
DZ	42.7	43.0	44.1	0.74	0.276	43.27	6.92	6.50	×
E	31.5	31.8	31.7	0.15	0.059	31.67	0.23	-0.19	
EB	32.2	28.4	26.0	3.13	1.420	28.87	-1.39	-1.81	
EL	28.4	29.1	29.1	0.40	0.138	28.87	-1.39	-1.81	
EO									•
EP									•
ER	30.3	31.1	29.1	1.01	0.394	30.17	-0.64	-1.06	
FE									•
FJ	30.1	31.1	32.9	1.42	0.551	31.37	0.05	-0.37	
FN	38.0	39.0	38.0	0.58	0.197	38.33	4.08	3.66	⇑
GN	30.0	30.0	30.5	0.29	0.098	30.17	-0.64	-1.06	

• ≡ 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
GQ									•
HE	30.4	29.5	29.6	0.49	0.177	29.83	-0.83	-1.25	
HK	32.8	28.3	31.5	2.32	0.886	30.87	-0.23	-0.65	
HL	37.1	35.8	32.6	2.32	0.886	35.17	2.25	1.83	
HP	32.8	32.3	32.5	0.25	0.098	32.53	0.73	0.31	
I	32.9	31.8	31.6	0.70	0.256	32.10	0.48	0.06	
ID									•
J									•
JE	31.2	29.1	30.0	1.05	0.413	30.10	-0.68	-1.10	
JG									•
JK	31.1	31.8	30.0	0.91	0.354	30.97	-0.18	-0.60	
JN	29.3	28.7	27.9	0.70	0.276	28.63	-1.52	-1.94	
JS	30.2	30.0	30.4	0.20	0.079	30.20	-0.62	-1.04	
JX									•
JY	30.8	33.4	32.0	1.30	0.512	32.07	0.46	0.04	
K	33.0	32.9	33.4	0.26	0.098	33.10	1.05	0.64	
KH	32.8	32.5	32.0	0.40	0.158	32.43	0.67	0.25	
KL									•
KT	34.0	35.0	36.0	1.00	0.394	35.00	2.15	1.73	
L	31.2	29.2	30.7	1.04	0.394	30.37	-0.52	-0.94	
LF	29.6	31.6	30.5	1.00	0.394	30.57	-0.41	-0.83	
LH									•
LT									•
LZ	30.0	30.0	29.0	0.58	0.197	29.67	-0.93	-1.35	
M									•
MF									•
MX	9.1	9.1	9.0	0.06	0.020	9.07	-12.82	-13.24	×
N	35.9	36.7	35.8	0.49	0.177	36.13	2.81	2.39	
NA									•
NH	29.2	29.2	28.1	0.64	0.217	28.83	-1.41	-1.83	
NJ	31.8	31.1	33.5	1.23	0.473	32.13	0.50	0.08	
NK									•
NO	32.4	33.4	34.0	0.81	0.315	33.27	1.15	0.73	
O									•
OB	31.2	31.7	30.4	0.66	0.256	31.10	-0.10	-0.52	
OF									•
OS	33.3	28.2	31.1	2.56	1.008	30.87	-0.23	-0.65	
OX									•
P	53.0	49.4	42.4	5.39	3.071	48.27	9.81	9.39	×
PB	35.7	35.4	36.1	0.35	0.138	35.73	2.58	2.16	
PG									•
PQ	32.0	32.8	31.9	0.49	0.177	32.23	0.55	0.13	
PW	20.8	26.4	18.8	3.94	1.945	22.00	-5.35	-5.77	⇓
PX	32.4	32.0	32.9	0.45	0.177	32.43	0.67	0.25	
Q	27.0	30.0	31.0	2.08	0.788	29.33	-1.12	-1.54	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Uranium-Radium in Water, 13-Feb-1998

Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
QM	27.7	27.4	28.2	0.40	0.158	27.77	-2.02	-2.44	
QQ	32.6	32.0	30.8	0.92	0.354	31.80	0.30	-0.12	
QU	33.8	33.5	36.8	1.82	0.650	34.70	1.98	1.56	
QX	10.6	10.8	10.9	0.15	0.059	10.77	-11.84	-12.26	×
QZ	32.0	31.3	32.0	0.40	0.138	31.77	0.28	-0.13	
R									•
RD	30.8	30.8	30.1	0.40	0.138	30.57	-0.41	-0.83	
RG	31.3	31.4	30.9	0.26	0.098	31.20	-0.04	-0.46	
RK	27.3	30.2	27.6	1.59	0.571	28.37	-1.68	-2.10	
RP	31.5	31.1	31.1	0.23	0.079	31.23	-0.02	-0.44	
RR									•
RX	42.0	35.0	40.0	3.61	1.720	39.00	4.46	4.04	⇑
RZ	31.3	32.2	31.3	0.52	0.177	31.60	0.19	-0.23	
S	27.8	28.4	28.2	0.31	0.118	28.13	-1.81	-2.23	
SD	33.9	33.4	33.5	0.26	0.098	33.60	1.34	0.92	
SF									•
SI	29.5	30.0	30.1	0.32	0.118	29.87	-0.81	-1.23	
SL	13.6	15.0	15.5	0.98	0.374	14.70	-9.57	-9.99	×
SM	30.7	30.9	30.1	0.42	0.158	30.57	-0.41	-0.83	
SO	29.9	28.2	28.6	0.89	0.335	28.90	-1.37	-1.79	
SS	32.4	32.4	31.8	0.35	0.118	32.20	0.54	0.12	
SX	29.8	31.2	30.2	0.72	0.276	30.40	-0.50	-0.92	
SZ	31.3	31.6	29.9	0.91	0.335	30.93	-0.20	-0.62	
T	33.1	35.5	36.4	1.71	0.650	35.00	2.15	1.73	
TD	31.2	30.9	31.2	0.17	0.059	31.10	-0.10	-0.52	
TN									•
TQ	33.1	32.9	32.9	0.12	0.039	32.97	0.98	0.56	
TS									•
U	30.2	31.0	31.0	0.46	0.158	30.73	-0.31	-0.73	
UM									•
UP	29.0	31.0	31.1	1.18	0.413	30.37	-0.52	-0.94	
UQ									•
UZ									•
VA									•
VH	41.5	39.9	38.3	1.60	0.630	39.90	4.98	4.56	⇑
VI	29.8	24.4	30.2	3.24	1.270	28.13	-1.81	-2.23	
W	34.4	31.7	31.4	1.65	0.591	32.50	0.71	0.29	
WC									•
WG									•
WH	27.4	23.3	26.4	2.14	0.807	25.70	-3.22	-3.64	⇓
WI	31.0	30.6	31.0	0.23	0.079	30.87	-0.23	-0.65	
WJ	30.0	31.6	31.6	0.92	0.315	31.07	-0.12	-0.54	
WO	26.4	26.9	25.9	0.50	0.197	26.40	-2.81	-3.23	⇓
WR	31.6	32.3	33.7	1.07	0.413	32.53	0.73	0.31	
WX	21.6	21.9	23.0	0.74	0.276	22.17	-5.26	-5.68	⇓

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ 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
X	33.6	30.4	27.7	2.95	1.308	30.57	-0.41	-0.83	
XA	34.2	30.9	31.1	1.85	0.650	32.07	0.46	0.04	
XC									•
XD									•
XI									•
XK									•
XL	31.5	32.0	32.4	0.45	0.177	31.97	0.40	-0.02	
XM	30.8	30.3	30.6	0.25	0.098	30.57	-0.41	-0.83	
XO									•
XQ									•
XR									•
Y	32.0	32.7	31.8	0.47	0.177	32.17	0.52	0.10	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
9.07	×	MX	30.17		GN	31.67		E
10.77	×	QX	30.17		ER	31.73		AP
14.70	×	SL	30.20		JS	31.77		QZ
20.10	×	AH	30.37		UP	31.80		QQ
20.97	×	BN	30.37		L	31.87		AZ
22.00	⇓	PW	30.40		SX	31.97		XL
22.17	⇓	WX	30.57		XM	31.97		BH
25.70	⇓	WH	30.57		X	32.07		XA
25.80	⇓	CA	30.57		RD	32.07		JY
25.83	⇓	AF	30.57		SM	32.10		I
26.40	⇓	WO	30.57		LF	32.13		NJ
27.00		CJ	30.70		DO	32.17		Y
27.20		AJ	30.73		U	32.20		SS
27.53		DB	30.77		DT	32.20		BM
27.77		QM	30.87		WI	32.23		PQ
27.87		CS	30.87		OS	32.43		PX
28.13		VI	30.87		HK	32.43		KH
28.13		S	30.93		SZ	32.50		W
28.37		RK	30.97		JK	32.53		WR
28.40		AR	31.03		A	32.53		HP
28.63		JN	31.07		WJ	32.70		AW
28.83		NH	31.10		TD	32.97		TQ
28.87		EL	31.10		OB	33.10		K
28.87		EB	31.20		RG	33.13		BO
28.90		SO	31.23		RP	33.27		NO
29.33		Q	31.27		BC	33.47		AE
29.67		LZ	31.37		FJ	33.60		SD
29.83		HE	31.60		RZ	33.77		CE
29.87		SI	31.60		D	33.90		BK
30.10		JE	31.63		BA	34.10		C

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

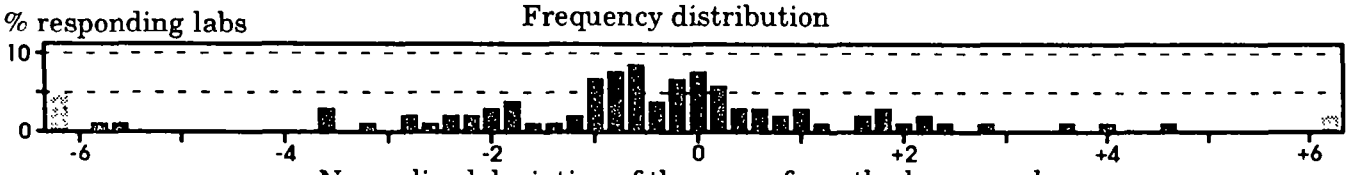
⇑ ≡ Above control limit

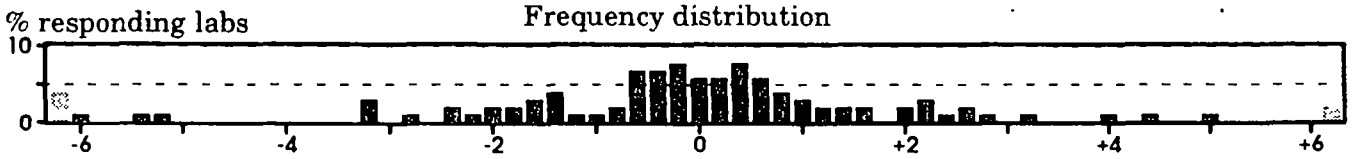
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
34.70		**QU**	35.57		**CX**	38.33	⇑	**FN**
34.83		**DE**	35.67		**AK**	39.00	⇑	**RX**
35.00		**T**	35.73		**PB**	39.90	⇑	**VH**
35.00		**KT**	36.13		**N**	43.27	×	**DZ**
35.17		**HL**	36.77		**AL**	48.27	×	**P**





• ≡ No data submitted
∅ ≡ Insufficient data

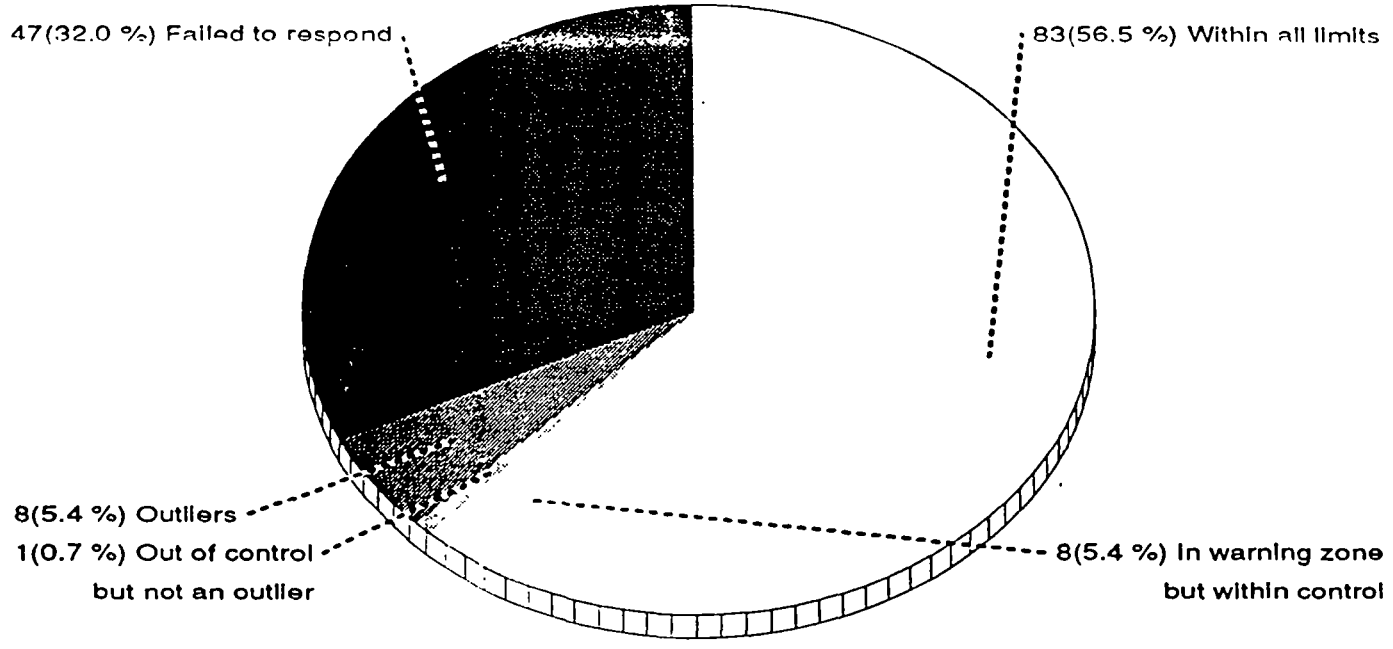
TAG SYMBOLS

× ≡ Determined to be an outlier

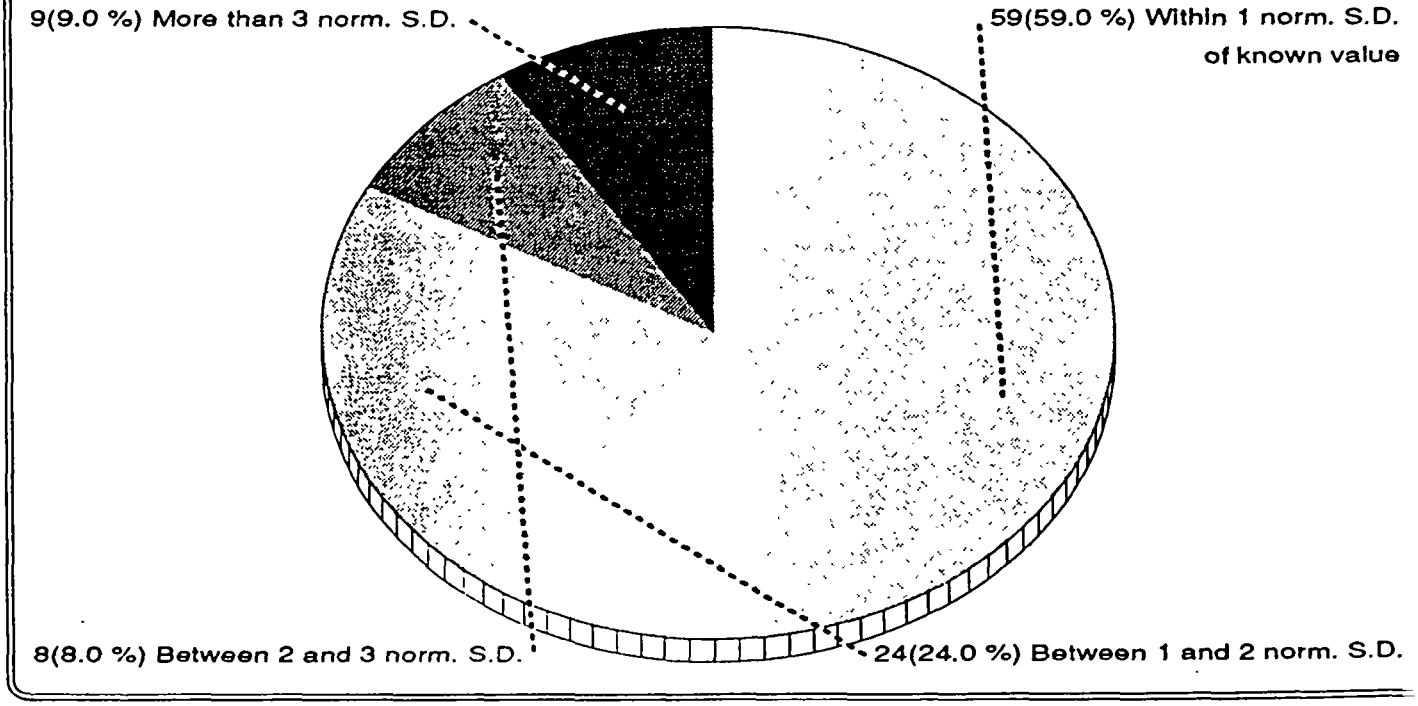
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 147 Participants

The known value of this nuclide is 16.0 pCi/l with an expected precision of **2.4**; the control limits are 11.8 to 20.2; the warning regions are 11.8 to 13.2 and 18.8 to 20.2



Statistic	Respondents	Non-outliers
Mean	17.54	**Grand Avg 16.05**
Std. Dev.	8.78	1.67
Variance	77.00	2.80
% Coef. of Var.	50.02	10.42
% deviation of mean from known value	9.65	0.32
Norm. dev. of mean from known value	0.18	0.03
Median	15.93	15.88
% deviation of median from known value	-0.42	-0.73
Norm. dev. of median from known value	-0.01	-0.07



Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	16.0	13.2	15.8	1.56	0.689	15.00	-0.76	-0.72	
AE	15.3	15.6	15.9	0.30	0.148	15.60	-0.33	-0.29	
AF	15.5	15.7	16.1	0.31	0.148	15.77	-0.21	-0.17	
AH	13.7	13.5	13.9	0.20	0.098	13.70	-1.70	-1.66	
AJ	43.4	46.0	35.7	5.36	3.924	41.70	18.51	18.55	×
AK	14.6	15.2	14.5	0.38	0.172	14.77	-0.93	-0.89	
AL	13.8	15.4	16.0	1.14	0.541	15.07	-0.71	-0.67	
AP	17.9	19.4	19.0	0.78	0.369	18.77	1.96	2.00	
AR									•
AU	7.9	8.8	8.4	0.45	0.222	8.37	-5.55	-5.51	×
AW	16.4	15.3	14.0	1.20	0.591	15.23	-0.59	-0.55	
AZ	15.1	13.3	16.9	1.80	0.886	15.10	-0.69	-0.65	
BA	16.1	17.9	19.0	1.46	0.714	17.67	1.17	1.20	
BC	13.3	13.3	13.3	0.00	0.000	13.30	-1.99	-1.95	
BG									•
BH	15.5	14.9	16.1	0.60	0.295	15.50	-0.40	-0.36	
BK	16.0	16.5	16.7	0.36	0.172	16.40	0.25	0.29	
BM	16.1	16.3	16.1	0.12	0.049	16.17	0.08	0.12	
BN	13.1	14.6	16.4	1.65	0.812	14.70	-0.98	-0.94	
BO	16.0	15.8	16.3	0.25	0.123	16.03	-0.01	0.02	
C	16.5	17.0	18.7	1.15	0.541	17.40	0.97	1.01	
CA	15.1	16.1	13.6	1.26	0.615	14.93	-0.81	-0.77	
CC									•
CE	16.4	16.1	15.4	0.51	0.246	15.97	-0.06	-0.02	
CJ	15.0	15.0	14.0	0.58	0.246	14.67	-1.00	-0.96	
CS	17.2	15.9	18.1	1.11	0.541	17.07	0.73	0.77	
CX									•
D									•
DB	17.7	17.2	16.6	0.55	0.271	17.17	0.80	0.84	
DE	15.4	15.4	15.5	0.06	0.025	15.43	-0.45	-0.41	
DI									•
DO									•
DR									•
DT	14.4	14.0	15.5	0.78	0.369	14.63	-1.02	-0.99	
DZ	16.0	14.8	15.8	0.64	0.295	15.53	-0.37	-0.34	
E	18.5	20.1	19.4	0.80	0.394	19.33	2.37	2.41	
EB	14.2	14.3	14.4	0.10	0.049	14.30	-1.26	-1.23	
EL	16.1	17.5	16.8	0.70	0.345	16.80	0.54	0.58	
EO	15.0	15.4	13.9	0.78	0.369	14.77	-0.93	-0.89	
EP									•
ER	16.3	16.1	16.1	0.12	0.049	16.17	0.08	0.12	
FE									•
FJ									•
FN	17.8	18.2	17.4	0.40	0.197	17.80	1.26	1.30	
GN	15.3	14.3	16.3	1.00	0.492	15.30	-0.54	-0.51	

• ≡ 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
GQ									•
HE	14.6	15.3	16.2	0.80	0.394	15.37	-0.49	-0.46	
HK	15.9	15.6	14.7	0.62	0.295	15.40	-0.47	-0.43	
HL	17.1	17.0	16.2	0.49	0.222	16.77	0.52	0.55	
HP	15.3	14.9	16.0	0.56	0.271	15.40	-0.47	-0.43	
I	19.9	18.5	17.1	1.40	0.689	18.50	1.77	1.80	
ID	11.8	12.8	12.8	0.58	0.246	12.47	-2.59	-2.55	
J									•
JE	17.5	17.8	18.1	0.30	0.148	17.80	1.26	1.30	
JG									•
JK									•
JN									•
JS	15.4	15.2	14.4	0.53	0.246	15.00	-0.76	-0.72	
JX	16.7	15.3	16.2	0.71	0.345	16.07	0.01	0.05	
JY	19.3	19.5	17.6	1.04	0.468	18.80	1.98	2.02	
K	16.4	15.7	16.8	0.56	0.271	16.30	0.18	0.22	
KH	14.2	14.3	14.5	0.15	0.074	14.33	-1.24	-1.20	
KL	18.1	19.8	18.8	0.85	0.418	18.90	2.06	2.09	
KT									•
L	11.5	11.9	12.8	0.67	0.320	12.07	-2.88	-2.84	
LF									•
LH									•
LT	13.4	11.5	13.8	1.23	0.566	12.90	-2.27	-2.24	
LZ	14.1	13.1	13.1	0.58	0.246	13.43	-1.89	-1.85	
M	13.5	14.5	13.4	0.61	0.271	13.80	-1.63	-1.59	
MF									•
MX	25.4	21.5	23.2	1.96	0.960	23.37	5.28	5.32	×
N	16.6	15.7	16.4	0.47	0.222	16.23	0.13	0.17	
NA									•
NH	15.9	15.5	15.0	0.45	0.222	15.47	-0.42	-0.38	
NJ	16.6	18.3	21.1	2.27	1.205	18.67	1.89	1.92	
NK									•
NO	14.8	17.1	18.2	1.73	0.837	16.70	0.47	0.51	
O	16.9	18.2	17.1	0.70	0.320	17.40	0.97	1.01	
OB									•
OF									•
OS									•
OX	16.7	16.1	16.1	0.35	0.148	16.30	0.18	0.22	
P	15.6	17.8	19.1	1.77	0.861	17.50	1.05	1.08	
PB	16.8	17.2	16.5	0.35	0.172	16.83	0.56	0.60	
PG									•
PQ									•
PW	15.5	16.2	17.2	0.85	0.418	16.30	0.18	0.22	
PX	17.1	16.4	16.4	0.40	0.172	16.63	0.42	0.46	
Q	20.1	20.8	23.2	1.63	0.763	21.37	3.84	3.87	⇑

TAG SYMBOLS

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

 ESD-LV Performance Evaluation: Uranium-Radium in Water, 13-Feb-1998

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
QM	16.2	15.3	16.8	0.75	0.369	16.10	0.03	0.07	
QQ	19.6	17.2	18.4	1.20	0.591	18.40	1.69	1.73	
QU	13.4	13.3	14.4	0.61	0.271	13.70	-1.70	-1.66	
QX	9.0	5.8	7.8	1.62	0.788	7.53	-6.15	-6.11	×
QZ	18.4	18.1	15.4	1.65	0.738	17.30	0.90	0.94	
R	13.9	16.1	12.4	1.86	0.911	14.13	-1.38	-1.35	
RD	70.2	56.6	61.3	6.91	5.471	62.70	33.67	33.70	×
RG									•
RK	14.2	12.5	13.4	0.85	0.418	13.37	-1.94	-1.90	
RP									•
RR									•
RX	7.7	5.0	10.0	2.50	1.439	7.57	-6.12	-6.09	×
RZ	15.9	15.6	15.1	0.40	0.197	15.53	-0.37	-0.34	
S	16.1	16.1	15.8	0.17	0.074	16.00	-0.04	0.00	
SD	16.4	14.1	14.5	1.23	0.566	15.00	-0.76	-0.72	
SF									•
SI	18.9	19.1	18.9	0.12	0.049	18.97	2.10	2.14	
SL									•
SM	18.6	18.0	18.0	0.35	0.148	18.20	1.55	1.59	
SO									•
SS	15.7	15.1	15.6	0.32	0.148	15.47	-0.42	-0.38	
SX	16.1	17.3	15.5	0.92	0.443	16.30	0.18	0.22	
SZ	16.9	16.5	17.0	0.26	0.123	16.80	0.54	0.58	
T	15.7	16.0	15.9	0.15	0.074	15.87	-0.13	-0.10	
TD	15.4	15.4	15.5	0.06	0.025	15.43	-0.45	-0.41	
TN	14.7	14.7	14.8	0.06	0.025	14.73	-0.95	-0.91	
TQ	16.2	15.7	15.8	0.26	0.123	15.90	-0.11	-0.07	
TS									•
U	17.8	17.9	17.6	0.15	0.074	17.77	1.24	1.27	
UM									•
UP	15.4	15.9	16.1	0.36	0.172	15.80	-0.18	-0.14	
UQ	15.9	15.9	16.1	0.12	0.049	15.97	-0.06	-0.02	
UZ									•
VA									•
VH	13.9	17.1	14.3	1.74	0.788	15.10	-0.69	-0.65	
VI	16.9	16.7	17.7	0.53	0.246	17.10	0.76	0.79	
W	16.2	15.1	15.8	0.56	0.271	15.70	-0.25	-0.22	
WC	15.9	21.5	18.3	2.81	1.720	18.57	1.81	1.85	
WG									•
WH	15.0	16.1	16.2	0.67	0.295	15.77	-0.21	-0.17	
WI									•
WJ	15.9	15.6	15.7	0.15	0.074	15.73	-0.23	-0.19	
WO	19.9	19.2	19.8	0.38	0.172	19.63	2.58	2.62	
WR									•
WX	69.0	62.0	75.0	6.51	5.189	68.67	37.97	38.01	×

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ 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
X	13.9	14.2	14.0	0.15	0.074	14.03	-1.46	-1.42	
XA	18.1	16.7	17.5	0.70	0.345	17.43	1.00	1.03	
XC									•
XD									•
XI									•
XK									•
XL	14.9	15.9	16.8	0.95	0.468	15.87	-0.13	-0.10	
XM	57.2	60.2	55.6	2.34	1.252	57.67	30.03	30.07	×
XO									•
XQ									•
XR									•
Y	16.3	16.5	16.3	0.12	0.049	16.37	0.23	0.26	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
7.53	×	QX	15.30		GN	16.30		SX
7.57	×	RX	15.37		HE	16.30		PW
8.37	×	AU	15.40		HP	16.30		OX
12.07		L	15.40		HK	16.37		Y
12.47		ID	15.43		TD	16.40		BK
12.90		LT	15.43		DE	16.63		PX
13.30		BC	15.47		SS	16.70		NO
13.37		RK	15.47		NH	16.77		HL
13.43		LZ	15.50		BH	16.80		SZ
13.70		QU	15.53		RZ	16.80		EL
13.70		AH	15.53		DZ	16.83		PB
13.80		M	15.60		AE	17.07		CS
14.03		X	15.70		W	17.10		VI
14.13		R	15.73		WJ	17.17		DB
14.30		EB	15.77		AF	17.30		QZ
14.33		KH	15.77		WH	17.40		O
14.63		DT	15.80		UP	17.40		C
14.67		CJ	15.87		XL	17.43		XA
14.70		BN	15.87		T	17.50		P
14.73		TN	15.90		TQ	17.67		BA
14.77		EO	15.97		UQ	17.77		U
14.77		AK	15.97		CE	17.80		JE
14.93		CA	16.00		S	17.80		FN
15.00		SD	16.03		BO	18.20		SM
15.00		JS	16.07		JX	18.40		QQ
15.00		A	16.10		QM	18.50		I
15.07		AL	16.17		ER	18.57		WC
15.10		VH	16.17		BM	18.67		NJ
15.10		AZ	16.23		N	18.77		AP
15.23		AW	16.30		K	18.80		JY

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

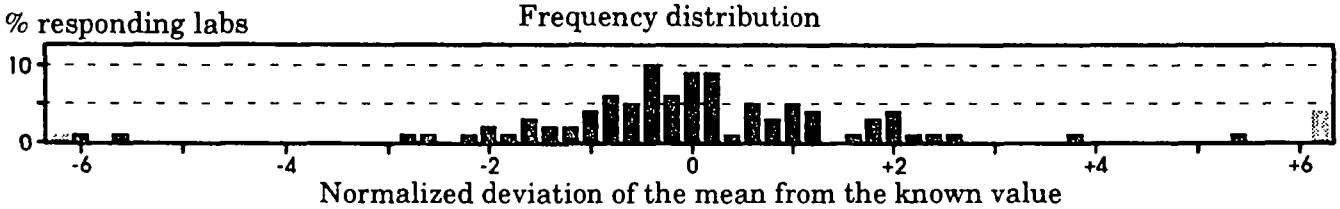
× ≡ Determined to be an outlier

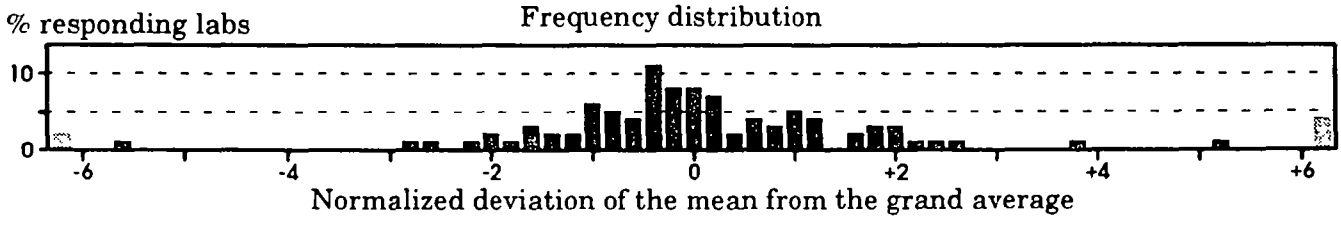
⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
18.90		**KL**	19.63		**WO**	41.70	×	**AJ**
18.97		**SI**	21.37	⇑	**Q**	57.67	×	**XM**
19.33		**E**	23.37	×	**MX**	62.70	×	**RD**
						68.67	×	**WX**





• ≡ No data submitted
∅ ≡ Insufficient data

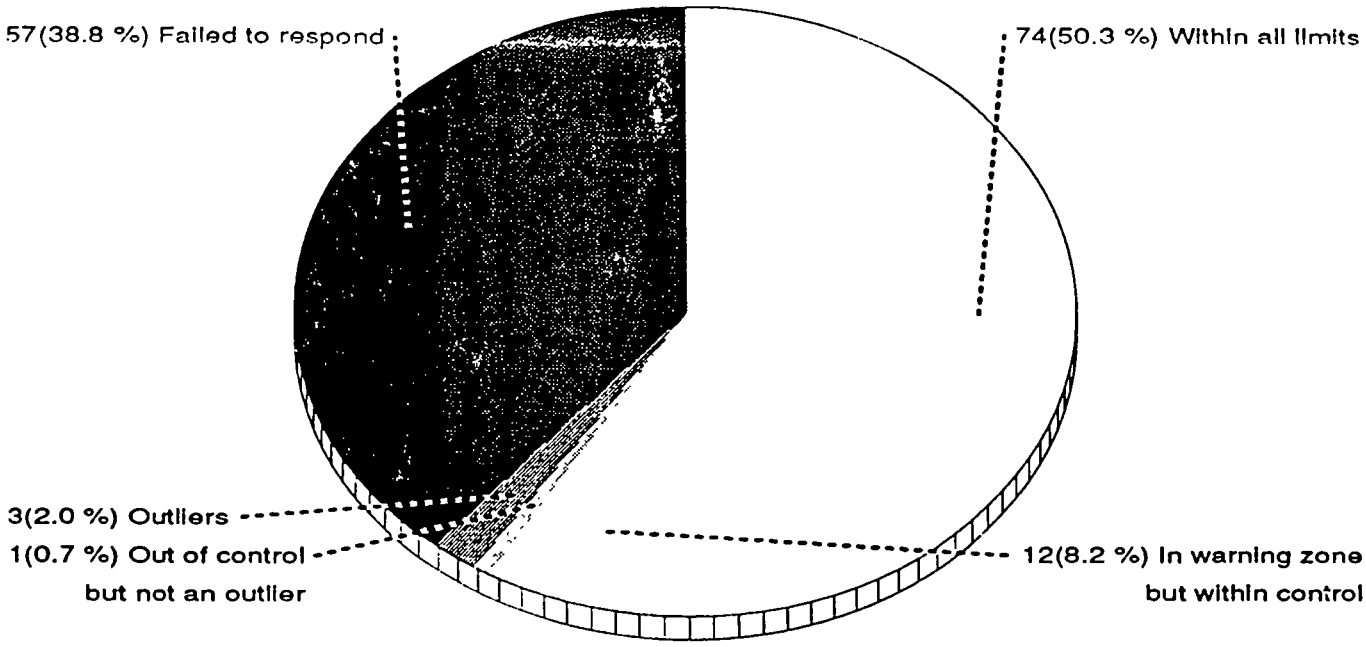
TAG SYMBOLS

× ≡ Determined to be an outlier

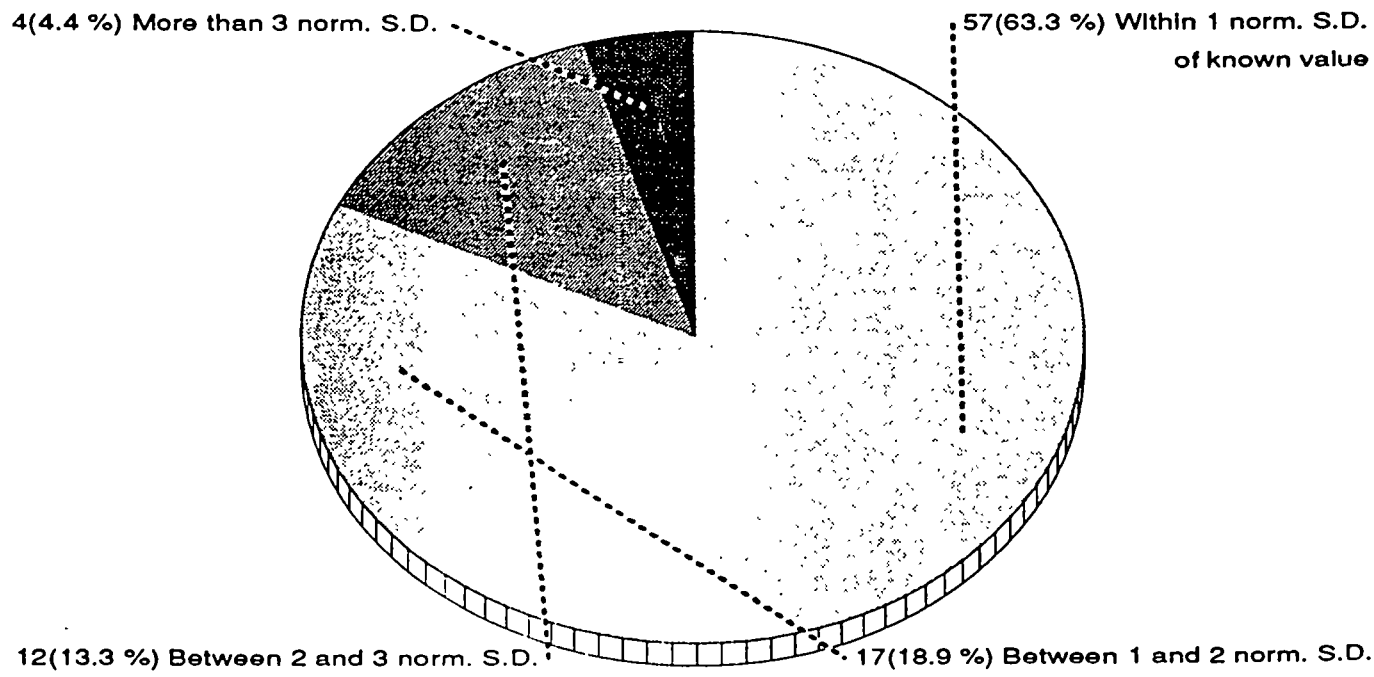
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 147 Participants

The known value of this nuclide is 33.3 pCi/l with an expected precision of 8.3; the control limits are 18.9 to 47.7; the warning regions are 18.9 to 23.7 and 42.9 to 47.7



Statistic	Respondents	Non-outliers
Mean	31.72	**Grand Avg 31.89**
Std. Dev.	7.61	5.93
Variance	57.89	35.12
% Coef. of Var.	23.98	18.59
% deviation of mean from known value	-4.74	-4.25
Norm. dev. of mean from known value	-0.21	-0.24
Median	31.70	31.73
% deviation of median from known value	-4.80	-4.70
Norm. dev. of median from known value	-0.21	-0.26



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	32.8	34.5	35.2	1.23	0.171	34.17	0.48	0.18	
AE	33.3	33.5	32.4	0.59	0.078	33.07	0.25	-0.05	
AF	36.4	35.5	37.5	1.00	0.142	36.47	0.96	0.66	
AH	26.9	26.1	26.9	0.46	0.057	26.63	-1.10	-1.39	
AJ	30.9	32.3	30.2	1.07	0.149	31.13	-0.16	-0.45	
AK	20.7	20.8	22.2	0.84	0.107	21.23	-2.22	-2.52	
AL	33.9	36.0	31.4	2.30	0.327	33.77	0.39	0.10	
AP	35.3	33.4	31.4	1.95	0.278	33.37	0.31	0.01	
AR									•
AU	21.7	22.3	16.7	3.07	0.399	20.23	-2.43	-2.73	
AW	36.5	36.9	38.0	0.78	0.107	37.13	1.10	0.80	
AZ	31.5	33.7	32.3	1.11	0.157	32.50	0.13	-0.17	
BA	39.6	43.1	39.4	2.08	0.263	40.70	1.84	1.54	
BC	36.0	36.1	37.2	0.67	0.085	36.43	0.95	0.65	
BG									•
BH	34.1	37.0	40.9	3.41	0.484	37.33	1.14	0.84	
BK	33.8	34.5	32.8	0.85	0.121	33.70	0.38	0.08	
BM	36.4	35.2	38.8	1.83	0.256	36.80	1.03	0.73	
BN									•
BO	36.6	33.2	31.6	2.55	0.356	33.80	0.40	0.10	
C	33.0	34.5	35.7	1.35	0.192	34.40	0.52	0.23	
CA	32.2	31.8	28.7	1.92	0.249	30.90	-0.21	-0.50	
CC									•
CE	26.5	32.6	29.6	3.05	0.434	29.57	-0.48	-0.78	
CJ	32.0	30.0	34.0	2.00	0.285	32.00	0.02	-0.27	
CS	40.0	41.1	40.6	0.55	0.078	40.57	1.81	1.52	
CX									•
D									•
DB	28.1	29.2	30.7	1.31	0.185	29.33	-0.53	-0.83	
DE	24.5	24.5	24.6	0.06	0.007	24.53	-1.53	-1.83	
DI									•
DO									•
DR									•
DT	24.8	28.2	27.4	1.78	0.242	26.80	-1.06	-1.36	
DZ	31.2	30.9	30.0	0.62	0.085	30.70	-0.25	-0.54	
E	33.6	33.3	32.3	0.68	0.093	33.07	0.25	-0.05	
EB	31.0	31.4	32.8	0.95	0.128	31.73	-0.03	-0.33	
EL	32.2	34.3	34.6	1.31	0.171	33.70	0.38	0.08	
EO	32.6	29.0	29.0	2.08	0.256	30.20	-0.35	-0.65	
EP									•
ER									•
FE									•
FJ									•
FN	39.1	39.4	36.7	1.48	0.192	38.40	1.36	1.06	
GN									•

• ≡ 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
GQ									•
HE	25.8	24.9	24.3	0.75	0.107	25.00	-1.44	-1.73	
HK	24.5	22.8	29.9	3.71	0.505	25.73	-1.28	-1.58	
HL	30.6	29.1	29.6	0.76	0.107	29.77	-0.44	-0.74	
HP	31.2	25.7	30.1	2.91	0.391	29.00	-0.60	-0.90	
I	35.4	37.0	32.2	2.44	0.342	34.87	0.62	0.33	
ID	23.1	27.7	29.1	3.14	0.427	26.63	-1.10	-1.39	
J									•
JE	34.1	33.1	33.6	0.50	0.071	33.60	0.36	0.06	
JG									•
JK									•
JN									•
JS	29.1	28.2	28.3	0.49	0.064	28.53	-0.70	-0.99	
JX	28.3	30.1	27.3	1.42	0.199	28.57	-0.69	-0.99	
JY	43.8	45.6	39.8	2.97	0.413	43.07	2.33	2.04	
K	39.9	45.4	50.9	5.50	0.783	45.40	2.82	2.53	
KH	30.3	29.5	29.5	0.46	0.057	29.77	-0.44	-0.74	
KL	40.0	40.9	38.4	1.27	0.178	39.77	1.64	1.35	
KT									•
L	31.4	32.8	30.7	1.07	0.149	31.63	-0.05	-0.35	
LF									•
LH									•
LT	51.0	45.9	50.6	2.84	0.363	49.17	3.61	3.31	⇑
LZ									•
M	34.4	35.4	34.8	0.50	0.071	34.87	0.62	0.33	
MF									•
MX	32.3	31.7	33.1	0.70	0.100	32.37	0.10	-0.19	
N	28.0	28.3	26.1	1.19	0.157	27.47	-0.92	-1.22	
NA									•
NH	31.5	34.6	30.4	2.18	0.299	32.17	0.06	-0.24	
NJ	32.0	34.0	32.0	1.15	0.142	32.67	0.16	-0.13	
NK									•
NO	27.7	31.4	32.6	2.55	0.349	30.57	-0.28	-0.57	
O	22.9	22.9	20.7	1.27	0.157	22.17	-2.03	-2.32	
OB									•
OF									•
OS									•
OX	33.4	34.0	34.0	0.35	0.043	33.80	0.40	0.10	
P	44.1	46.8	48.8	2.36	0.334	46.57	3.06	2.77	
PB	32.2	32.0	32.4	0.20	0.028	32.20	0.07	-0.23	
PG									•
PQ									•
PW	32.8	33.7	32.6	0.59	0.078	33.03	0.24	-0.06	
PX									•
Q	38.6	39.4	39.8	0.61	0.085	39.27	1.54	1.25	

• ≡ 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
QM									•
QQ									•
QU	22.9	21.6	24.3	1.35	0.192	22.93	-1.87	-2.16	
QX	21.5	18.9	20.5	1.31	0.185	20.30	-2.42	-2.71	
QZ	30.5	32.9	30.9	1.29	0.171	31.43	-0.09	-0.39	
R									•
RD	30.6	29.2	27.1	1.76	0.249	28.97	-0.61	-0.90	
RG									•
RK	10.7	10.5	10.7	0.12	0.014	10.63	-4.43	-4.73	×
RP									•
RR									•
RX	30.0	31.5	32.0	1.04	0.142	31.17	-0.15	-0.45	
RZ	33.0	33.5	32.7	0.40	0.057	33.07	0.25	-0.05	
S	30.7	31.7	31.9	0.64	0.085	31.43	-0.09	-0.39	
SD	37.8	36.8	38.9	1.05	0.149	37.83	1.24	0.95	
SF									•
SI	28.4	26.9	26.3	1.08	0.149	27.20	-0.98	-1.27	
SL									•
SM	30.2	32.0	32.7	1.29	0.178	31.63	-0.05	-0.35	
SO									•
SS	35.0	35.1	33.0	1.18	0.149	34.37	0.52	0.22	
SX	25.0	30.2	21.7	4.29	0.605	25.63	-1.30	-1.60	
SZ	51.5	42.4	48.9	4.69	0.648	47.60	3.28	2.98	
T	36.2	37.1	36.8	0.46	0.064	36.70	1.00	0.71	
TD	18.6	23.6	22.7	2.67	0.356	21.63	-2.14	-2.43	
TN	29.9	32.6	35.7	2.90	0.413	32.73	0.18	-0.12	
TQ	33.5	33.6	33.9	0.21	0.028	33.67	0.37	0.08	
TS									•
U	30.2	30.3	30.6	0.21	0.028	30.37	-0.32	-0.61	
UM									•
UP	36.4	32.6	33.0	2.09	0.270	34.00	0.44	0.15	
UQ	36.2	34.5	37.0	1.28	0.178	35.90	0.84	0.54	
UZ									•
VA									•
VH	26.9	24.7	23.3	1.81	0.256	24.97	-1.44	-1.74	
VI	31.9	35.4	27.7	3.86	0.548	31.67	-0.05	-0.34	
W									•
WC	5.4	7.0	6.7	0.85	0.114	6.37	-5.33	-5.62	×
WG									•
WH	29.2	29.6	30.6	0.72	0.100	29.80	-0.44	-0.73	
WI									•
WJ	26.0	23.8	28.4	2.30	0.327	26.07	-1.21	-1.51	
WO	28.6	28.2	27.3	0.67	0.093	28.03	-0.80	-1.10	
WR	18.8	21.2	25.6	3.45	0.484	21.87	-2.09	-2.39	
WX	56.0	72.0	64.0	8.00	1.264	64.00	6.70	6.41	×

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ 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
X	20.2	19.0	22.8	1.94	0.270	20.67	-2.34	-2.64	
XA									•
XC									•
XD									•
XI									•
XK									•
XL	29.2	29.6	30.0	0.40	0.057	29.60	-0.48	-0.77	
XM	30.8	28.5	33.1	2.30	0.327	30.80	-0.23	-0.52	
XO									•
XQ									•
XR									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.37	×	WC	29.77		HL	33.70		EL
10.63	×	RK	29.80		WH	33.70		BK
20.23		AU	30.20		EO	33.77		AL
20.30		QX	30.37		U	33.80		OX
20.67		X	30.57		NO	33.80		BO
21.23		AK	30.70		DZ	34.00		UP
21.63		TD	30.80		XM	34.17		A
21.87		WR	30.90		CA	34.37		SS
22.17		O	31.13		AJ	34.40		C
22.93		QU	31.17		RX	34.87		M
24.53		DE	31.43		S	34.87		I
24.97		VH	31.43		QZ	35.90		UQ
25.00		HE	31.63		SM	36.43		BC
25.63		SX	31.63		L	36.47		AF
25.73		HK	31.67		VI	36.70		T
26.07		WJ	31.73		EB	36.80		BM
26.63		ID	32.00		CJ	37.13		AW
26.63		AH	32.17		NH	37.33		BH
26.80		DT	32.20		PB	37.83		SD
27.20		SI	32.37		MX	38.40		FN
27.47		N	32.50		AZ	39.27		Q
28.03		WO	32.67		NJ	39.77		KL
28.53		JS	32.73		TN	40.57		CS
28.57		JX	33.03		PW	40.70		BA
28.97		RD	33.07		E	43.07		JY
29.00		HP	33.07		RZ	45.40		K
29.33		DB	33.07		AE	46.57		P
29.57		CE	33.37		AP	47.60		SZ
29.60		XL	33.60		JE	49.17	⇑	LT
29.77		KH	33.67		TQ	64.00	×	WX

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
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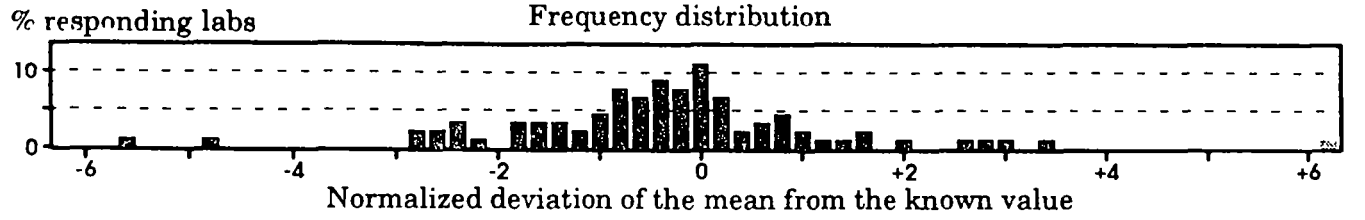
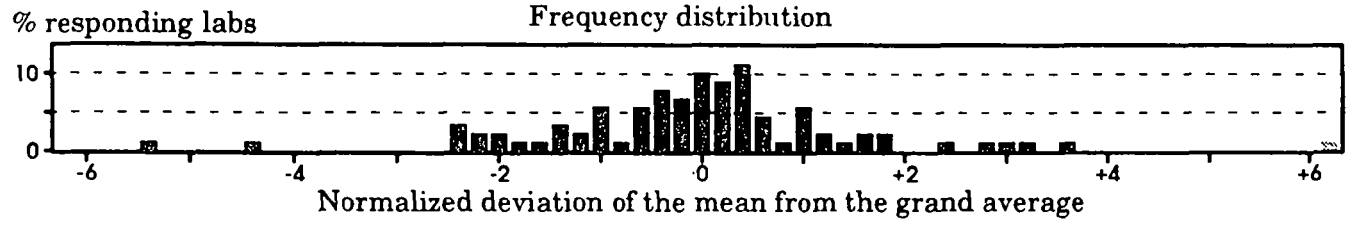
Radium-228


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


% 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

Office of Research and
Development
Washington, DC 20460

EPA/600/R-98/062
May 1998

EPA

Tritium in Water Performance Evaluation Study

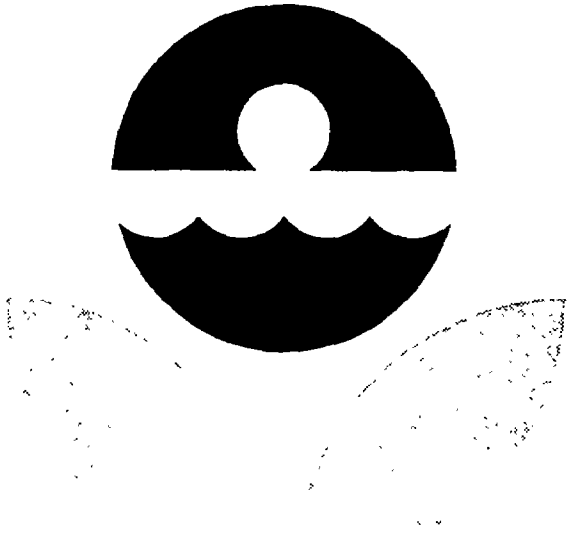
A Statistical Evaluation of the March 13, 1998 Data

006ECB98COV-062

Tritium in Water

Performance Evaluation Study

March 13, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Tritium in Water; March 13, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

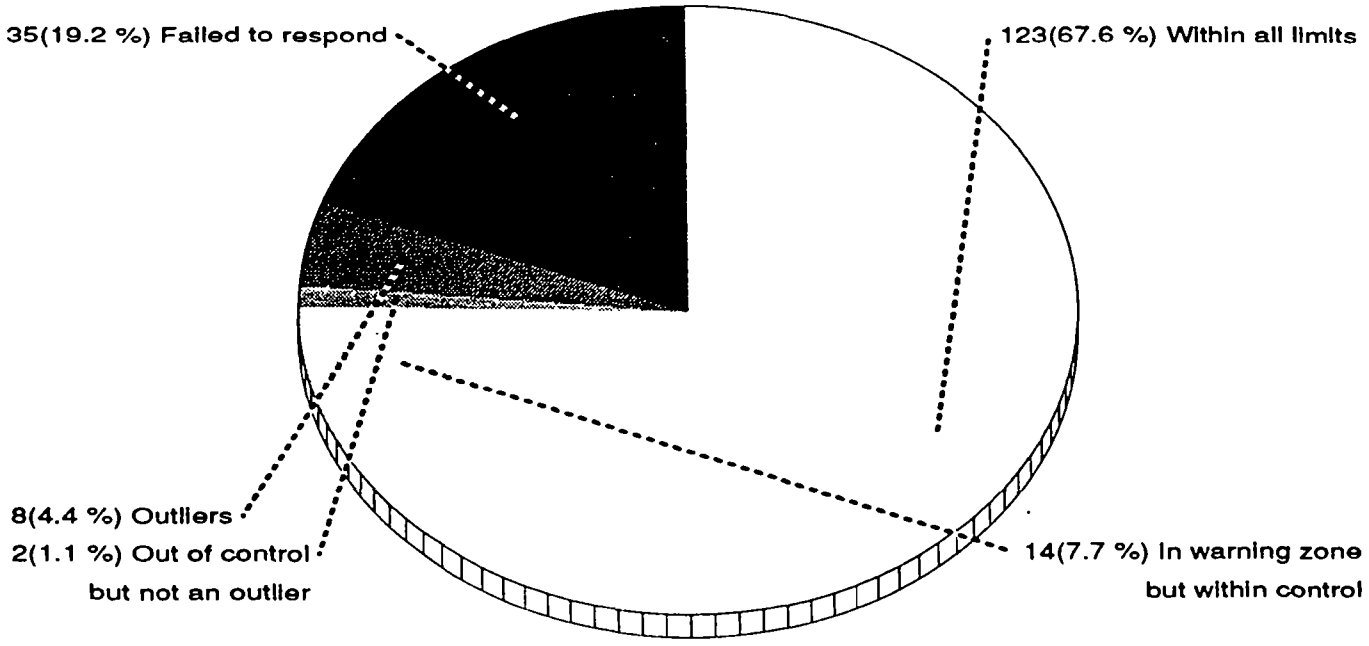
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

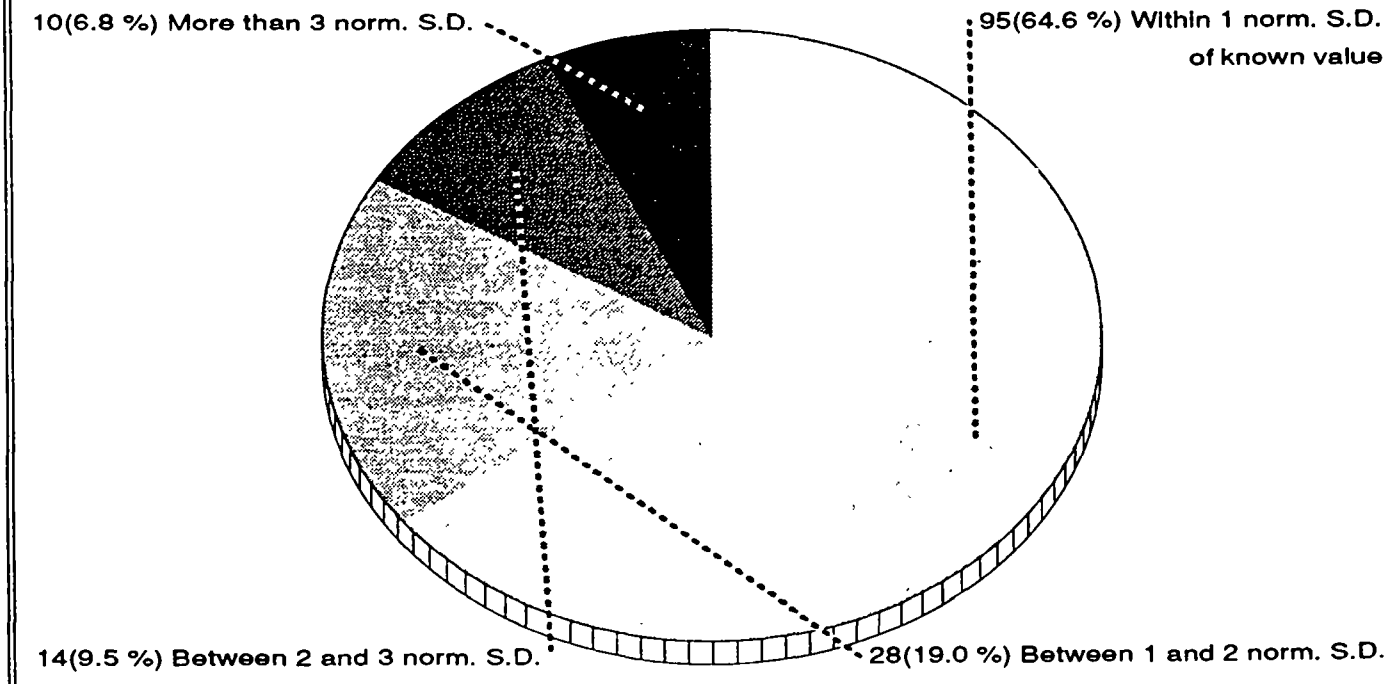
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Tritium Statistical Summary 182 Participants

The known value of this nuclide is **2155.0 pCi/l** with an expected precision of **348.0**; the control limits are 1551.2 to 2758.8; the warning regions are 1551.2 to 1752.2 and 2557.8 to 2758.8



Statistic	Respondents	Non-outliers
Mean	2407.23	**Grand Avg 2159.47**
Std. Dev.	1804.38	234.20
Variance	3255782.36	54849.07
% Coef. of Var.	74.96	10.85
% deviation of mean from known value	11.70	0.21
Norm. dev. of mean from known value	0.14	0.02
Median	2147.67	2136.00
% deviation of median from known value	-0.34	-0.88
Norm. dev. of median from known value	0.00	-0.08



ESD-LV Performance Evaluation: Tritium in Water, 13-Mar-1998

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	2145.0	2089.0	2257.0	85.54	0.285	2163.67	0.02	0.04	
AE	2047.0	2148.0	2118.0	51.87	0.171	2104.33	-0.27	-0.25	
AF	2148.0	2237.0	2203.0	44.91	0.151	2196.00	0.18	0.20	
AH	2111.0	2082.0	2063.0	24.17	0.081	2085.33	-0.37	-0.35	
AI	2236.0	3164.0	2666.0	464.42	2.095	2688.67	2.63	2.66	
AJ	2027.0	2103.0	2351.0	169.44	0.550	2160.33	0.00	0.03	
AK	2150.0	2168.0	2081.0	45.92	0.148	2133.00	-0.13	-0.11	
AP									•
AU	1660.0	1840.0	1820.0	98.66	0.306	1773.33	-1.92	-1.90	
AW	2097.0	2122.0	2111.0	12.53	0.042	2110.00	-0.25	-0.22	
AY	2174.0	2269.0	2382.0	104.13	0.353	2275.00	0.58	0.60	
AZ	2420.0	2186.0	2480.0	155.34	0.499	2362.00	1.01	1.03	
BA	2366.0	2349.0	2230.0	74.10	0.231	2315.00	0.77	0.80	
BB	2120.0	2130.0	2130.0	5.77	0.017	2126.67	-0.16	-0.14	
BC	1900.0	2040.0	1970.0	70.00	0.238	1970.00	-0.94	-0.92	
BG									•
BL	2212.0	2171.0	2215.0	24.58	0.075	2199.33	0.20	0.22	
BM	2200.0	2060.0	2110.0	70.95	0.238	2123.33	-0.18	-0.16	
BO	2120.0	2070.0	2110.0	26.46	0.085	2100.00	-0.30	-0.27	
BW									•
C	2083.0	2047.0	2076.0	19.09	0.061	2068.67	-0.45	-0.43	
CA	2151.0	2047.0	2193.0	75.16	0.248	2130.33	-0.15	-0.12	
CC									•
CE	2240.0	2060.0	2170.0	90.74	0.306	2156.67	-0.01	0.01	
CJ	1800.0	1800.0	1900.0	57.74	0.170	1833.33	-1.62	-1.60	
CO	1840.0	1980.0	1870.0	73.71	0.238	1896.67	-1.31	-1.29	
CP	2286.0	2263.0	2158.0	68.24	0.217	2235.67	0.38	0.40	
CS	2188.0	2290.0	1975.0	160.73	0.535	2151.00	-0.04	-0.02	
CX	2080.0	1930.0	1760.0	160.10	0.543	1923.33	-1.18	-1.15	
D	2098.0	2137.0	2176.0	39.00	0.132	2137.00	-0.11	-0.09	
DD	2000.0	2240.0	2005.0	137.14	0.407	2081.67	-0.39	-0.36	
DE	2175.0	2183.0	2187.0	6.11	0.020	2181.67	0.11	0.13	
DH	2163.0	2107.0	2173.0	35.57	0.112	2147.67	-0.06	-0.04	
DI									•
DR	2037.0	2135.0	2144.0	59.35	0.182	2105.33	-0.27	-0.25	
DT	2200.0	2300.0	2400.0	100.00	0.339	2300.00	0.70	0.72	
DY									•
E	1974.0	2011.0	2168.0	103.00	0.329	2051.00	-0.54	-0.52	
EA									•
EB	1952.0	2036.0	2030.0	46.86	0.143	2006.00	-0.76	-0.74	
EH	1490.0	1980.0	1940.0	272.09	0.832	1803.33	-1.77	-1.75	
EL	2147.0	2095.0	2044.0	51.50	0.175	2095.33	-0.32	-0.30	
EW	2263.0	2132.0	2406.0	137.04	0.465	2267.00	0.54	0.56	
EX	2318.0	2341.0	2345.0	14.57	0.046	2334.67	0.87	0.89	
FE									•

TAG SYMBOLS

• ≡ No data submitted

Ø ≡ 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
FJ	2060.0	1950.0	2120.0	86.22	0.289	2043.33	-0.58	-0.56	
FL	2155.0	2020.0	2345.0	163.27	0.552	2173.33	0.07	0.09	
GO									•
GQ	2100.0	2100.0	2200.0	57.74	0.170	2133.33	-0.13	-0.11	
HI	2066.0	2107.0	2078.0	21.08	0.070	2083.67	-0.38	-0.36	
HK	2115.0	2146.0	2276.0	85.42	0.273	2179.00	0.10	0.12	
HP	2280.0	2220.0	2040.0	124.90	0.407	2180.00	0.10	0.12	
HR	2228.0	2245.0	2232.0	8.89	0.029	2235.00	0.38	0.40	
I	2640.0	2770.0	2533.0	118.69	0.402	2647.67	2.43	2.45	
IA									•
IU	1775.0	1893.0	1757.0	73.87	0.231	1808.33	-1.75	-1.73	
J									•
JE	1732.0	1858.0	1451.0	208.36	0.691	1680.33	-2.38	-2.36	
JK	2004.0	2351.0	2111.0	177.70	0.589	2155.33	-0.02	0.00	
JM	2142.0	2032.0	2084.0	55.03	0.187	2086.00	-0.37.	-0.34	
JN	2219.0	2015.0	2278.0	138.00	0.446	2170.67	0.06	0.08	
JP	2172.0	2293.0	2091.0	101.66	0.343	2185.33	0.13	0.15	
JR									•
JS	2427.0	2437.0	2298.0	77.53	0.236	2387.33	1.13	1.16	
JY	2270.0	1870.0	2430.0	288.44	0.950	2190.00	0.15	0.17	
K	2084.0	1864.0	1941.0	111.64	0.373	1963.00	-0.98	-0.96	
KH	2196.0	2176.0	2173.0	12.50	0.039	2181.67	0.11	0.13	
KM	1061.0	1084.0	1311.0	138.18	0.424	1152.00	-5.01	-4.99	×
KX	2080.0	2160.0	2130.0	40.41	0.136	2123.33	-0.18	-0.16	
L	2055.0	2135.0	2017.0	60.23	0.200	2069.00	-0.45	-0.43	
LE									•
LF	2100.0	2200.0	2200.0	57.74	0.170	2166.67	0.04	0.06	
LR	2280.0	2222.0	2122.0	79.92	0.268	2208.00	0.24	0.26	
LT	2190.0	2570.0	2380.0	190.00	0.645	2380.00	1.10	1.12	
M	2616.0	2519.0	2713.0	97.00	0.329	2616.00	2.27	2.29	
MN	2505.0	2545.0	2615.0	55.68	0.187	2555.00	1.97	1.99	
MT	1752.0	1758.0	1768.0	8.08	0.027	1759.33	-1.99	-1.97	
MV	1914.0	2526.0	2122.0	311.19	1.074	2187.33	0.14	0.16	
N	1985.0	2100.0	2210.0	112.51	0.382	2098.33	-0.30	-0.28	
NB	4116.0	4005.0	4051.0	55.78	0.188	4057.33	9.45	9.47	×
NH	2188.0	2191.0	2201.0	6.81	0.022	2193.33	0.17	0.19	
NJ	2042.0	2129.0	2210.0	84.02	0.285	2127.00	-0.16	-0.14	
NK									•
NO	3276.0	3458.0	3541.0	135.55	0.450	3425.00	6.30	6.32	×
NP	2206.0	1994.0	2155.0	110.65	0.360	2118.33	-0.20	-0.18	
O	2082.0	2256.0	2061.0	107.04	0.331	2133.00	-0.13	-0.11	
OA	1900.0	2000.0	2000.0	57.74	0.170	1966.67	-0.96	-0.94	
OK	2320.0	2383.0	2239.0	72.19	0.244	2314.00	0.77	0.79	
OM	2070.0	2070.0	2250.0	103.92	0.306	2130.00	-0.15	-0.12	
OT	2345.0	2193.0	2735.0	279.57	0.920	2424.33	1.32	1.34	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Tritium in Water, 13-Mar-1998

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
OX									•
PB	2128.0	2117.0	2163.0	24.02	0.078	2136.00	-0.12	-0.09	
PD	17036.0	10446.0	13741.0	3295.00	20.401	13741.00	57.64	57.67	×
PE									•
PM	2250.0	2196.0	2178.0	37.47	0.122	2208.00	0.24	0.26	
Q	2067.0	2311.0	2402.0	173.23	0.569	2260.00	0.50	0.52	
QC	2190.0	1970.0	2190.0	127.02	0.373	2116.67	-0.21	-0.19	
QD	2364.0	2280.0	2212.0	76.14	0.258	2285.33	0.63	0.65	
QI	2306.0	2405.0	2500.0	97.01	0.329	2403.67	1.22	1.24	
QM	2090.0	1902.0	2038.0	97.08	0.319	2010.00	-0.74	-0.72	
QP	2532.0	2467.0	2365.0	84.18	0.283	2454.67	1.47	1.49	
QQ	2366.0	2388.0	2327.0	30.89	0.104	2360.33	1.00	1.02	
QT	2858.0	2326.0	2177.0	358.00	1.297	2453.67	1.46	1.49	
QU	2655.0	2924.0	1941.0	508.01	2.273	2506.67	1.73	1.75	
QW	2458.0	2536.0	2614.0	78.00	0.265	2536.00	1.87	1.90	
QX	1700.0	1774.0	1610.0	82.13	0.278	1694.67	-2.31	-2.29	
QZ	2226.0	2131.0	2016.0	105.16	0.356	2124.33	-0.17	-0.15	
R	2064.0	2110.0	2025.0	42.55	0.144	2066.33	-0.46	-0.44	
RB	2000.0	2050.0	2000.0	28.87	0.085	2016.67	-0.71	-0.69	
RK	20256.0	22997.0	17521.0	2738.00	16.799	20258.00	90.08	90.10	×
RO									•
RR	2122.0	2356.0	2367.0	138.38	0.416	2281.67	0.61	0.63	
RU	2067.0	2169.0	1983.0	93.15	0.316	2073.00	-0.43	-0.41	
RX	2379.0	2491.0	3014.0	338.94	1.148	2628.00	2.33	2.35	
S	2181.0	2242.0	2104.0	69.15	0.234	2175.67	0.08	0.10	
SD	2300.0	2200.0	2285.0	53.93	0.170	2261.67	0.51	0.53	
SF	2050.0	2110.0	2200.0	75.50	0.255	2120.00	-0.20	-0.17	
SI	2450.0	2240.0	2160.0	149.78	0.492	2283.33	0.62	0.64	
SM	2134.0	2033.0	1958.0	88.32	0.299	2041.67	-0.59	-0.56	
SN	1970.0	1967.0	1970.0	1.73	0.005	1969.00	-0.95	-0.93	
SS	2300.0	2400.0	2300.0	57.74	0.170	2333.33	0.87	0.89	
SU	2100.0	2128.0	1824.0	168.02	0.516	2017.33	-0.71	-0.69	
SV	2401.0	2280.0	1611.0	425.50	1.649	2097.33	-0.31	-0.29	
SZ	2048.0	2053.0	2289.0	137.72	0.409	2130.00	-0.15	-0.12	
T	1917.0	1810.0	1929.0	65.52	0.202	1885.33	-1.36	-1.34	
TA									•
TC	2559.0	2122.0	2086.0	263.31	0.803	2255.67	0.48	0.50	
TD	2632.0	2550.0	2549.0	47.64	0.141	2577.00	2.08	2.10	
TF									•
TL									•
TN	2308.0	2012.0	2050.0	161.05	0.502	2123.33	-0.18	-0.16	
TO	2145.0	1864.0	2050.0	142.93	0.477	2019.67	-0.70	-0.67	
TQ	2060.0	2000.0	1850.0	108.17	0.356	1970.00	-0.94	-0.92	
TU	4316.0	2241.0	3196.0	1038.59	5.804	3251.00	5.43	5.45	×
TX									•

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
U	2090.0	2020.0	2060.0	35.12	0.119	2056.67	-0.51	-0.49	
UC									•
UI									•
UK	2970.0	2750.0	2790.0	117.19	0.373	2836.67	3.37	3.39	⇑
UM									•
UP	2561.0	2578.0	2694.0	72.38	0.226	2611.00	2.25	2.27	
UT									•
UX									•
UY	1864.0	1934.0	2037.0	87.02	0.294	1945.00	-1.07	-1.05	
VA									•
VC	2230.0	2004.0	2203.0	123.43	0.384	2145.67	-0.07	-0.05	
VE									•
VI	1776.0	2013.0	1699.0	163.65	0.533	1829.33	-1.64	-1.62	
VM	2618.0	2039.0	2339.0	289.56	0.983	2332.00	0.86	0.88	
VN									•
VP	2550.0	2650.0	2750.0	100.00	0.339	2650.00	2.44	2.46	
VR	1098.0	2266.0	2837.0	886.41	4.717	2067.00	-0.46	-0.44	
VW	1889.0	1852.0	1872.0	18.52	0.063	1871.00	-1.44	-1.41	
VZ	2164.0	1695.0	2633.0	469.00	2.128	2164.00	0.02	0.04	
W	2070.0	2070.0	2060.0	5.77	0.017	2066.67	-0.46	-0.44	
WD	1993.0	1892.0	1892.0	58.31	0.171	1925.67	-1.16	-1.14	
WH	2340.0	2826.0	2652.0	246.24	0.825	2606.00	2.22	2.24	
WJ									•
WO	2190.0	2610.0	1890.0	361.66	1.423	2230.00	0.35	0.37	
WP	2523.0	2341.0	2877.0	272.56	0.910	2580.33	2.09	2.12	
WR	2289.0	2029.0	2324.0	161.17	0.501	2214.00	0.27	0.29	
WS	5300.0	4400.0	4700.0	458.26	2.005	4800.00	13.14	13.16	×
WT	1602.0	1052.0	2681.0	828.69	4.362	1778.33	-1.90	-1.87	
WV	1760.0	1600.0	1790.0	102.14	0.322	1716.67	-2.20	-2.18	
WW	2250.0	2347.0	2238.0	59.77	0.185	2278.33	0.59	0.61	
WX	2000.0	1900.0	2000.0	57.74	0.170	1966.67	-0.96	-0.94	
WZ	1997.0	1943.0	2048.0	52.51	0.178	1996.00	-0.81	-0.79	
X	1800.0	2000.0	1800.0	115.47	0.339	1866.67	-1.46	-1.44	
XB	2425.0	1555.0	1600.0	489.82	1.908	1860.00	-1.49	-1.47	
XC	2439.0	2809.0	2399.0	226.05	0.696	2549.00	1.94	1.96	
XD	1596.0	1583.0	1541.0	28.75	0.093	1573.33	-2.92	-2.90	
XE	2847.0	2908.0	3283.0	236.09	0.740	3012.67	4.25	4.27	×
XF	3019.0	2485.0	2399.0	335.90	1.100	2634.33	2.36	2.39	
XG	2165.0	2174.0	2255.0	49.57	0.153	2198.00	0.19	0.21	
XH	2180.0	2455.0	2477.0	165.49	0.504	2370.67	1.05	1.07	
XI									•
XK									•
XM	1043.0	1707.0	1505.0	340.38	1.242	1418.33	-3.69	-3.67	⇓
XO									•
XQ									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ 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
XR									•
Y	2061.0	2127.0	2135.0	40.61	0.126	2107.67	-0.26	-0.24	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1152.00	×	**KM**	2068.67		**C**	2166.67		**LF**
1418.33	⇓	**XM**	2069.00		**L**	2170.67		**JN**
1573.33		**XD**	2073.00		**RU**	2173.33		**FL**
1680.33		**JE**	2081.67		**DD**	2175.67		**S**
1694.67		**QX**	2083.67		**HI**	2179.00		**HK**
1716.67		**WV**	2085.33		**AH**	2180.00		**HP**
1759.33		**MT**	2086.00		**JM**	2181.67		**KH**
1773.33		**AU**	2095.33		**EL**	2181.67		**DE**
1778.33		**WT**	2097.33		**SV**	2185.33		**JP**
1803.33		**EH**	2098.33		**N**	2187.33		**MV**
1808.33		**IU**	2100.00		**BO**	2190.00		**JY**
1829.33		**VI**	2104.33		**AE**	2193.33		**NH**
1833.33		**CJ**	2105.33		**DR**	2196.00		**AF**
1860.00		**XB**	2107.67		**Y**	2198.00		**XG**
1866.67		**X**	2110.00		**AW**	2199.33		**BL**
1871.00		**VW**	2116.67		**QC**	2208.00		**PM**
1885.33		**T**	2118.33		**NP**	2208.00		**LR**
1896.67		**CO**	2120.00		**SF**	2214.00		**WR**
1923.33		**CX**	2123.33		**TN**	2230.00		**WO**
1925.67		**WD**	2123.33		**KX**	2235.00		**HR**
1945.00		**UY**	2123.33		**BM**	2235.67		**CP**
1963.00		**K**	2124.33		**QZ**	2255.67		**TC**
1966.67		**WX**	2126.67		**BB**	2260.00		**Q**
1966.67		**OA**	2127.00		**NJ**	2261.67		**SD**
1969.00		**SN**	2130.00		**SZ**	2267.00		**EW**
1970.00		**TQ**	2130.00		**OM**	2275.00		**AY**
1970.00		**BC**	2130.33		**CA**	2278.33		**WW**
1996.00		**WZ**	2133.00		**O**	2281.67		**RR**
2006.00		**EB**	2133.00		**AK**	2283.33		**SI**
2010.00		**QM**	2133.33		**GQ**	2285.33		**QD**
2016.67		**RB**	2136.00		**PB**	2300.00		**DT**
2017.33		**SU**	2137.00		**D**	2314.00		**OK**
2019.67		**TO**	2145.67		**VC**	2315.00		**BA**
2041.67		**SM**	2147.67		**DH**	2332.00		**VM**
2043.33		**FJ**	2151.00		**CS**	2333.33		**SS**
2051.00		**E**	2155.33		**JK**	2334.67		**EX**
2056.67		**U**	2156.67		**CE**	2360.33		**QQ**
2066.33		**R**	2160.33		**AJ**	2362.00		**AZ**
2066.67		**W**	2163.67		**A**	2370.67		**XH**
2067.00		**VR**	2164.00		**VZ**	2380.00		**LT**

TAG SYMBOLS

• ≡ No data submitted
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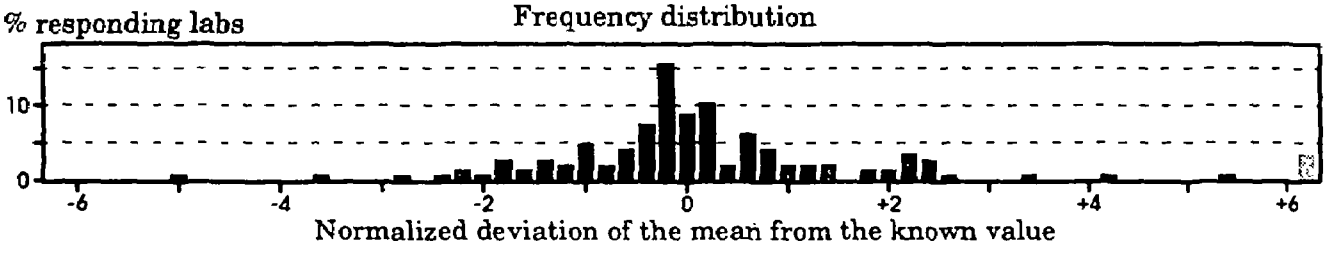
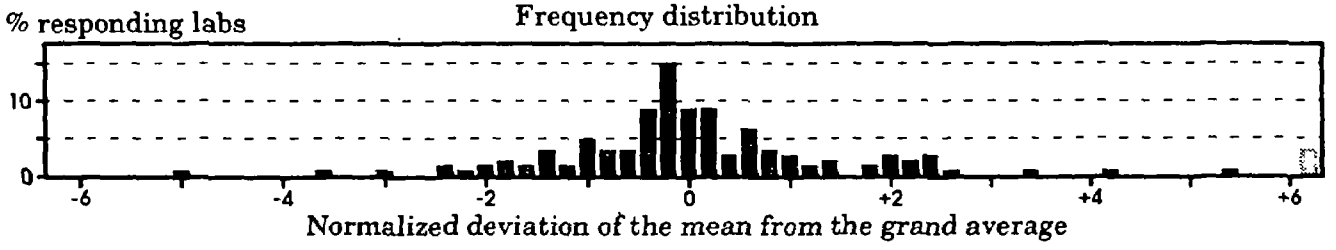
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Tritium

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2387.33		JS	2577.00		TD	2688.67		AI
2403.67		QI	2580.33		WP	2836.67	⇑	UK
2424.33		OT	2606.00		WH	3012.67	×	XE
2453.67		QT	2611.00		UP	3251.00	×	TU
2454.67		QP	2616.00		M	3425.00	×	NO
2506.67		QU	2628.00		RX	4057.33	×	NB
2536.00		QW	2634.33		XF	4800.00	×	WS
2549.00		XC	2647.67		I	13741.00	×	PD
2555.00		MN	2650.00		VP	20258.00	×	RK





• ≡ No data submitted
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TAG SYMBOLS

× ≡ Determined to be an outlier

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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-98/121A
September 1998

EPA

Blind-A Performance Evaluation Study

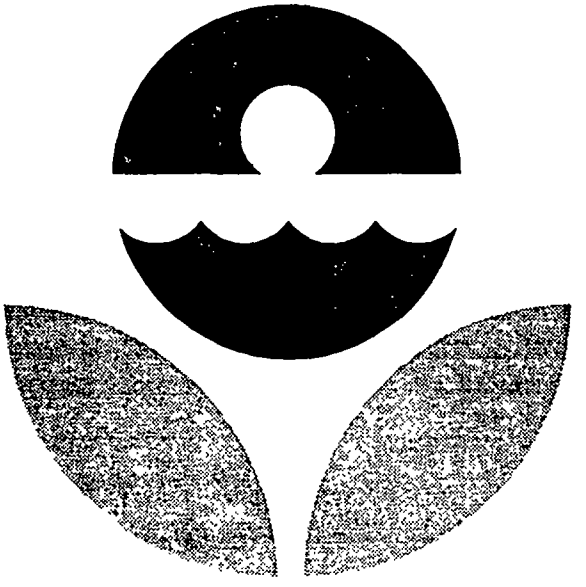
A Statistical Evaluation of the April 21, 1998 Data

006ECB98-121a

Blind-A

Performance Evaluation Study

April 21, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Blind-A; April 21, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

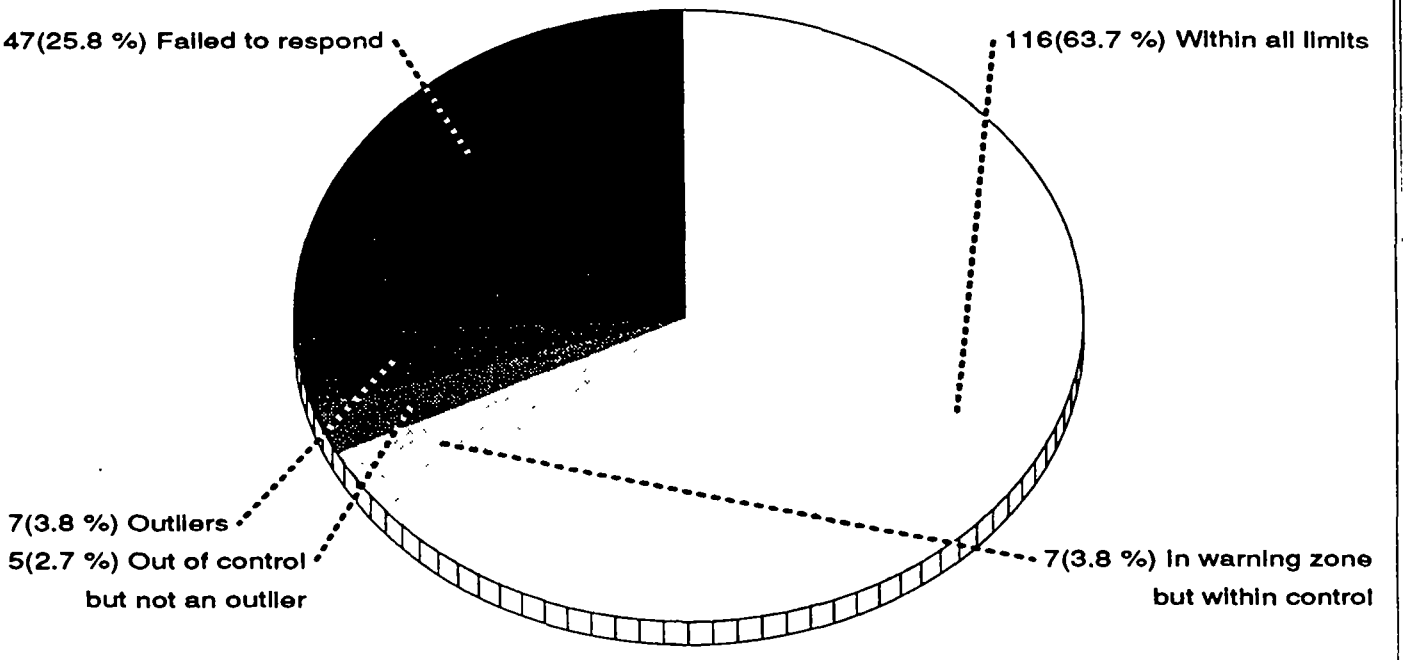
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

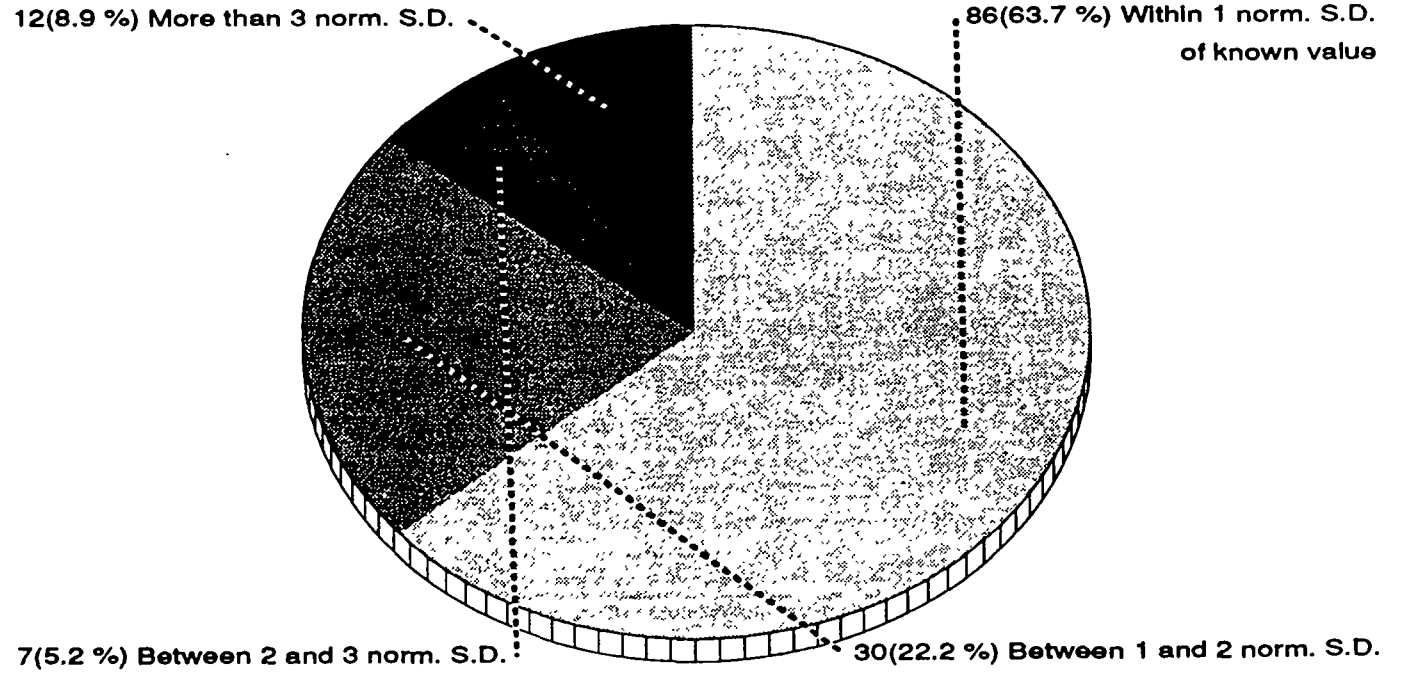
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Alpha Statistical Summary 182 Participants

The known value of this nuclide is **54.4 pCi/l** with an expected precision of **13.6**; the control limits are 30.8 to 78.0; the warning regions are 30.8 to 38.7 and 70.1 to 78.0



Statistic	Respondents	Non-outliers
Mean	55.18	**Grand Avg 53.26**
Std. Dev.	20.09	9.73
Variance	403.46	94.77
% Coef. of Var.	36.40	18.28
% deviation of mean from known value	1.43	-2.09
Norm. dev. of mean from known value	0.04	-0.12
Median	53.43	53.27
% deviation of median from known value	-1.78	-2.08
Norm. dev. of median from known value	-0.05	-0.12



ESD-LV Performance Evaluation: Blind-A, 21-Apr-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	44.8	44.6	45.5	0.47	0.039	44.97	-1.06	-1.20	
AE	36.8	33.6	31.7	2.58	0.222	34.03	-2.45	-2.59	
AF	55.4	58.1	65.7	5.34	0.447	59.73	0.82	0.68	
AH	71.1	68.9	70.2	1.11	0.096	70.07	2.14	2.00	
AJ	85.5	78.5	77.4	4.39	0.352	80.47	3.46	3.32	⇑
AK	64.0	58.9	61.5	2.55	0.222	61.47	1.04	0.90	
AL	61.6	61.7	59.1	1.47	0.113	60.80	0.96	0.82	
AP									•
AR	117.3	113.4	120.9	3.75	0.326	117.20	8.14	8.00	×
AU	58.6	63.0	62.6	2.43	0.191	61.40	1.04	0.89	
AW	49.9	52.1	55.3	2.72	0.235	52.43	-0.11	-0.25	
AZ	52.6	54.2	53.5	0.80	0.069	53.43	0.02	-0.12	
BA	61.1	62.7	57.9	2.44	0.208	60.57	0.93	0.79	
BB	38.1	40.8	40.2	1.42	0.117	39.70	-1.73	-1.87	
BC	71.1	73.6	73.3	1.36	0.109	72.67	2.47	2.33	
BG									•
BH	54.2	56.9	54.9	1.40	0.117	55.33	0.26	0.12	
BK	60.0	61.0	62.0	1.00	0.087	61.00	0.99	0.84	
BL									•
BM	61.8	61.2	61.3	0.32	0.026	61.43	1.04	0.90	
BN	63.9	69.9	69.9	3.46	0.261	67.90	1.86	1.72	
BO	53.0	48.0	48.0	2.89	0.217	49.67	-0.46	-0.60	
BS	52.4	58.1	50.9	3.80	0.313	53.80	0.07	-0.08	
BW									•
C	49.5	49.1	49.0	0.26	0.022	49.20	-0.52	-0.66	
CA	50.0	48.0	47.0	1.53	0.130	48.33	-0.63	-0.77	
CC									•
CE	56.8	56.1	56.6	0.36	0.030	56.50	0.41	0.27	
CJ	51.0	48.0	51.0	1.73	0.130	50.00	-0.42	-0.56	
CO	51.0	45.6	50.2	2.91	0.235	48.93	-0.55	-0.70	
CP	56.8	54.0	59.6	2.80	0.243	56.80	0.45	0.31	
CS	40.5	46.3	40.1	3.47	0.269	42.30	-1.40	-1.54	
CX	59.8	61.9	60.1	1.14	0.091	60.60	0.93	0.79	
D	59.4	71.3	62.0	6.26	0.517	64.23	1.40	1.25	
DB	52.0	54.0	53.0	1.00	0.087	53.00	-0.03	-0.18	
DD	49.5	51.6	47.4	2.10	0.182	49.50	-0.48	-0.62	
DE	58.7	58.9	59.1	0.20	0.017	58.90	0.72	0.57	
DI									•
DO									•
DT	50.1	47.9	47.4	1.44	0.117	48.47	-0.61	-0.76	
DZ	55.3	53.1	47.7	3.91	0.330	52.03	-0.16	-0.30	
E	56.0	64.5	60.5	4.25	0.369	60.33	0.90	0.76	
EB	54.6	55.4	54.1	0.66	0.056	54.70	0.18	0.04	
EL									•
EO	47.0	57.0	58.0	6.08	0.478	54.00	0.09	-0.05	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ 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
ER	61.5	60.9	64.1	1.70	0.139	62.17	1.13	0.99	
EV	51.7	49.1	45.3	3.22	0.278	48.70	-0.58	-0.73	
EX	60.5	53.2	41.7	9.48	0.817	51.80	-0.19	-0.33	
FE	99.7	101.8	102.1	1.31	0.104	101.20	6.10	5.96	×
FF	29.5	29.9	28.5	0.72	0.061	29.30	-3.05	-3.20	⇓
FJ									•
FL	37.7	39.9	45.4	3.97	0.334	41.00	-1.56	-1.71	
FN	40.0	35.0	36.0	2.65	0.217	37.00	-2.07	-2.22	
GI									•
GQ	30.9	31.0	30.5	0.26	0.022	30.80	-2.86	-3.01	⇓
GZ	66.3	66.6	60.0	3.73	0.287	64.30	1.41	1.26	
HI	52.8	42.8	36.1	8.40	0.725	43.90	-1.19	-1.34	
HK	66.1	67.0	74.6	4.67	0.369	69.23	2.03	1.89	
HL	49.6	46.0	45.5	2.24	0.178	47.03	-0.79	-0.94	
HP	52.6	52.5	53.1	0.32	0.026	52.73	-0.07	-0.21	
I	41.7	43.9	45.7	2.00	0.174	43.77	-1.21	-1.35	
ID	51.0	52.2	49.9	1.15	0.100	51.03	-0.28	-0.43	
IU									•
J									•
JE	59.5	53.5	41.8	9.00	0.769	51.60	-0.21	0.36	
JG									•
JM	40.0	40.9	40.2	0.47	0.039	40.37	-1.64	1.79	
JN	65.5	51.2	42.3	11.70	1.014	53.00	-0.03	0.18	
JQ	52.6	58.3	54.7	2.88	0.248	55.20	0.25	0.10	
JS	42.4	44.5	43.8	1.07	0.091	43.57	-1.24	-1.38	
JY	59.0	52.9	51.6	3.95	0.321	54.50	0.16	0.01	
K	46.7	55.4	57.7	5.80	0.478	53.27	0.00	-0.14	
KE	203.0	224.4	228.0	13.51	1.163	218.47	21.04	20.89	×
KT	50.0	52.0	54.0	2.00	0.174	52.00	-0.16	-0.31	
KX	70.2	64.8	69.0	2.84	0.235	68.00	1.88	1.73	
L	46.9	45.0	48.7	1.85	0.161	46.87	-0.81	-0.96	
LE									•
LF	45.0	49.0	46.0	2.08	0.174	46.67	-0.84	-0.98	
LL	55.0	68.9	43.5	12.72	1.196	55.80	0.32	0.18	
LR	48.2	45.6	45.9	1.42	0.113	46.57	-0.85	-1.00	
LT									•
M									•
MF	72.6	81.8	77.1	4.60	0.400	77.17	3.04	2.90	
MP									•
MT									•
MV	67.5	50.8	62.0	8.51	0.725	60.10	0.87	0.73	
MY									•
N	50.2	47.2	51.1	2.04	0.169	49.50	-0.48	-0.62	
NA	69.0	68.0	66.0	1.53	0.130	67.67	1.83	1.69	
NH	46.0	50.0	46.0	2.31	0.174	47.33	-0.76	-0.90	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-A, 21-Apr-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
NJ	50.8	52.7	49.2	1.75	0.152	50.90	-0.30	-0.45	
NK									•
NO	55.0	60.0	65.0	5.00	0.434	60.00	0.86	0.71	
O	66.9	70.2	66.5	2.03	0.161	67.87	1.86	1.72	
OB	56.0	40.7	49.7	7.69	0.665	48.80	-0.57	-0.71	
OF	56.5	59.1	59.8	1.74	0.143	58.47	0.66	0.52	
OM									•
OS	55.0	53.0	53.0	1.15	0.087	53.67	0.05	-0.09	
OY									•
P	45.3	64.8	48.0	10.57	0.847	52.70	-0.07	-0.22	
PA									•
PB	55.7	55.4	57.2	0.96	0.078	56.10	0.36	0.22	
PD									•
PG									•
PM	46.3	43.8	40.9	2.70	0.235	43.67	-1.22	-1.37	
PW									•
Q	56.3	58.1	59.4	1.56	0.135	57.93	0.59	0.45	
QM	43.2	42.7	38.8	2.41	0.191	41.57	-1.49	-1.63	
QP	57.4	59.2	56.4	1.42	0.122	57.67	0.56	0.42	
QQ	50.3	50.9	52.5	1.14	0.096	51.23	-0.26	-0.40	
QT	54.1	60.8	52.9	4.26	0.343	55.93	0.34	0.20	
QU	89.5	96.0	102.5	6.50	0.565	96.00	5.44	5.30	×
QW	90.0	93.8	100.1	5.10	0.439	94.63	5.27	5.12	×
QX	61.7	63.3	63.4	0.95	0.074	62.80	1.21	1.07	
QY									•
QZ	48.7	48.4	53.7	2.98	0.230	50.27	-0.38	-0.53	
RB	64.1	63.9	63.0	0.59	0.048	63.67	1.32	1.18	
RD	49.5	53.1	48.0	2.62	0.222	50.20	-0.39	-0.53	
RG	58.6	60.5	59.5	0.95	0.083	59.53	0.80	0.65	
RI	42.9	49.7	48.1	3.56	0.295	46.90	-0.81	-0.96	
RK	62.6	58.0	60.2	2.30	0.200	60.27	0.89	0.75	
RP									•
RR									•
RU									•
RZ									•
S	52.9	64.4	57.7	5.78	0.499	58.33	0.65	0.50	
SD	57.4	48.1	52.8	4.65	0.404	52.77	-0.06	-0.21	
SF									•
SG	46.8	46.9	47.2	0.21	0.017	46.97	-0.80	-0.95	
SI	58.5	53.1	52.3	3.37	0.269	54.63	0.17	0.03	
SL	77.1	77.7	77.0	0.38	0.030	77.27	3.06	2.91	
SM	58.7	57.6	57.9	0.57	0.048	58.07	0.61	0.47	
SN	69.0	60.0	58.0	5.86	0.478	62.33	1.15	1.01	
SO	50.6	47.4	47.9	1.72	0.139	48.63	-0.59	-0.73	
SR	3.2	3.6	3.6	0.23	0.017	3.47	-6.34	-6.49	×

• ≡ 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
SS	56.8	60.4	60.9	2.24	0.178	59.37	0.78	0.63	
SX	53.1	58.0	55.0	2.47	0.213	55.37	0.27	0.12	
SZ	60.1	67.2	68.9	4.67	0.382	65.40	1.55	1.40	
T	49.5	43.5	40.4	4.63	0.395	44.47	-1.12	-1.27	
TD	43.3	52.7	51.8	5.19	0.408	49.27	-0.51	-0.65	
TL									•
TN	55.9	61.2	62.6	3.53	0.291	59.90	0.85	0.70	
TQ	66.1	65.4	68.3	1.51	0.126	66.60	1.70	1.55	
TS									•
TU	21.5	19.0	30.0	5.77	0.478	23.50	-3.79	-3.94	⇓
TY	57.3	58.6	55.9	1.35	0.117	57.27	0.51	0.37	
U	38.9	39.2	37.0	1.19	0.096	38.37	-1.90	-2.04	
UA									•
UK									•
UM									•
UP	45.5	44.5	47.2	1.37	0.117	45.73	-0.96	-1.10	
UQ	53.3	55.1	54.7	0.95	0.078	54.37	0.14	0.00	
UY	0.1	0.1	0.1	0.00	0.000	0.10	-6.77	-6.92	×
VA	59.0	46.1	31.8	13.61	1.345	45.63	-0.97	-1.12	
VC									•
VH	56.4	60.9	55.0	3.08	0.256	57.43	0.53	0.39	
VI	58.4	59.9	59.2	0.75	0.065	59.17	0.75	0.61	
VJ	27.7	28.2	26.7	0.76	0.065	27.53	-3.28	-3.42	⇓
VM									•
VO									•
VT	63.5	72.7	67.2	4.63	0.400	67.80	1.85	1.71	
W									•
WE	48.4	43.3	43.3	2.94	0.222	45.00	-1.05	-1.20	
WH	50.8	45.2	50.7	3.20	0.243	48.90	-0.56	-0.70	
WO	47.1	47.3	47.0	0.15	0.013	47.13	-0.78	-0.93	
WR	51.6	55.3	59.5	3.95	0.343	55.47	0.28	0.14	
WW	47.4	52.2	46.7	2.99	0.239	48.77	-0.57	-0.72	
X	58.0	56.9	47.0	6.06	0.478	53.97	0.09	-0.06	
XA									•
XC									•
XD									•
XF	53.2	54.0	52.6	0.70	0.061	53.27	0.00	-0.14	
XI	48.0	46.0	48.0	1.15	0.087	47.33	-0.76	-0.90	
XJ	47.9	50.1	46.4	1.86	0.161	48.13	-0.65	-0.80	
XK	55.0	55.0	54.9	0.05	0.004	54.97	0.22	0.07	
XL	44.2	42.5	41.7	1.28	0.109	42.80	-1.33	-1.48	
XM	61.9	57.7	53.3	4.30	0.374	57.63	0.56	0.41	
XN	48.0	37.8	38.7	5.65	0.443	41.50	-1.50	-1.64	
XO									•
XP									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

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⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-A, 21-Apr-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XQ	39.0	30.1	39.0	5.14	0.387	36.03	-2.19	-2.34	
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.10	×	**UY**	48.77		**WW**	55.47		**WR**
3.47	×	**SR**	48.80		**OB**	55.80		**LL**
23.50	⇓	**TU**	48.90		**WH**	55.93		**QT**
27.53	⇓	**VJ**	48.93		**CO**	56.10		**PB**
29.30	⇓	**FF**	49.20		**C**	56.50		**CE**
30.80	⇓	**GQ**	49.27		**TD**	56.80		**CP**
34.03		**AE**	49.50		**N**	57.27		**TY**
36.03		**XQ**	49.50		**DD**	57.43		**VH**
37.00		**FN**	49.67		**BO**	57.63		**XM**
38.37		**U**	50.00		**CJ**	57.67		**QP**
39.70		**BB**	50.20		**RD**	57.93		**Q**
40.37		**JM**	50.27		**QZ**	58.07		**SM**
41.00		**FL**	50.90		**NJ**	58.33		**S**
41.50		**XN**	51.03		**ID**	58.47		**OF**
41.57		**QM**	51.23		**QQ**	58.90		**DE**
42.30		**CS**	51.60		**JE**	59.17		**VI**
42.80		**XL**	51.80		**EX**	59.37		**SS**
43.57		**JS**	52.00		**KT**	59.53		**RG**
43.67		**PM**	52.03		**DZ**	59.73		**AF**
43.77		**I**	52.43		**AW**	59.90		**TN**
43.90		**HI**	52.70		**P**	60.00		**NO**
44.47		**T**	52.73		**HP**	60.10		**MV**
44.97		**A**	52.77		**SD**	60.27		**RK**
45.00		**WE**	53.00		**JN**	60.33		**E**
45.63		**VA**	53.00		**DB**	60.57		**BA**
45.73		**UP**	53.27		**XF**	60.60		**CX**
46.57		**LR**	53.27		**K**	60.80		**AL**
46.67		**LF**	53.43		**AZ**	61.00		**BK**
46.87		**L**	53.67		**OS**	61.40		**AU**
46.90		**RI**	53.80		**BS**	61.43		**BM**
46.97		**SG**	53.97		**X**	61.47		**AK**
47.03		**HL**	54.00		**EO**	62.17		**ER**
47.13		**WO**	54.37		**UQ**	62.33		**SN**
47.33		**XI**	54.50		**JY**	62.80		**QX**
47.33		**NH**	54.63		**SI**	63.67		**RB**
48.13		**XJ**	54.70		**EB**	64.23		**D**
48.33		**CA**	54.97		**XK**	64.30		**GZ**
48.47		**DT**	55.20		**JQ**	65.40		**SZ**
48.63		**SO**	55.33		**BH**	66.60		**TQ**
48.70		**EV**	55.37		**SX**	67.67		**NA**

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

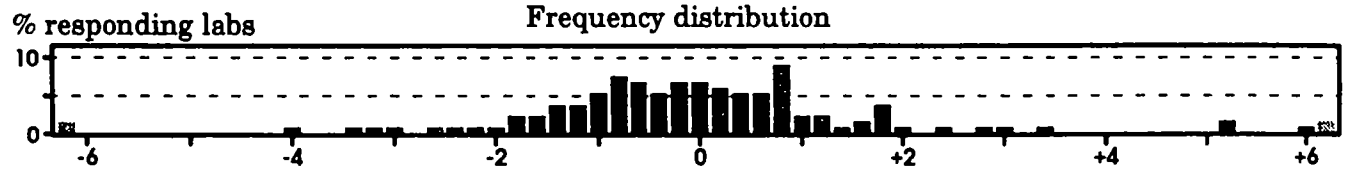
× ≡ Determined to be an outlier

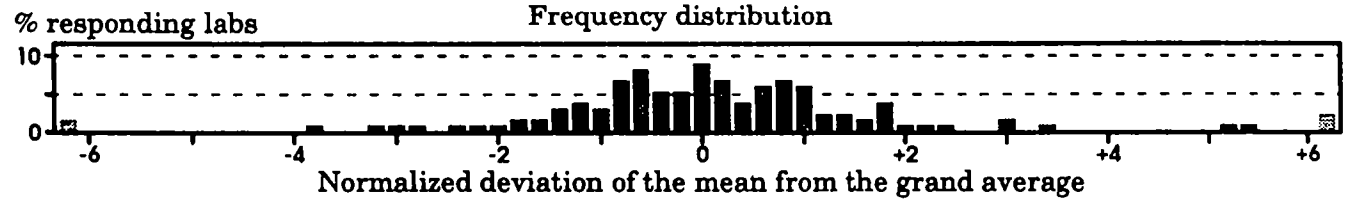
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
67.80		VT	70.07		AH	94.63	×	QW
67.87		O	72.67		BC	96.00	×	QU
67.90		BN	77.17		MF	101.20	×	FE
68.00		KX	77.27		SL	117.20	×	AR
69.23		HK	80.47	⇑	AJ	218.47	×	KE





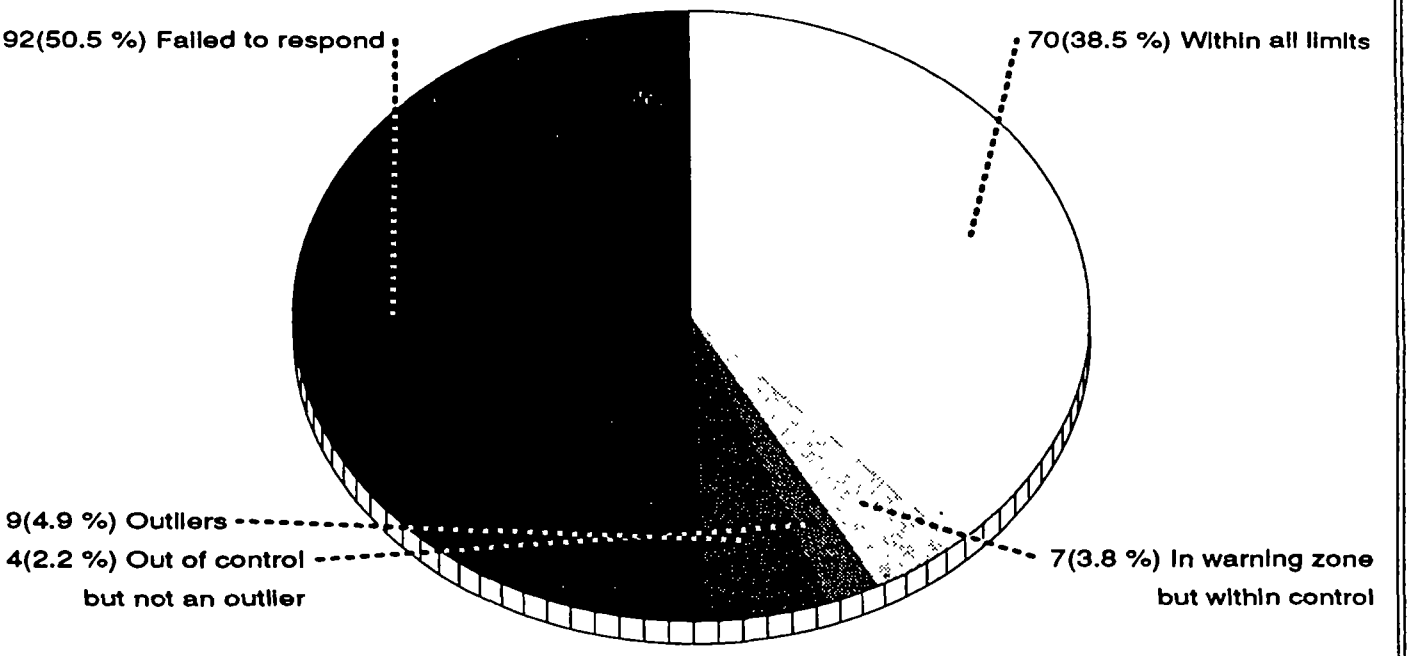
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

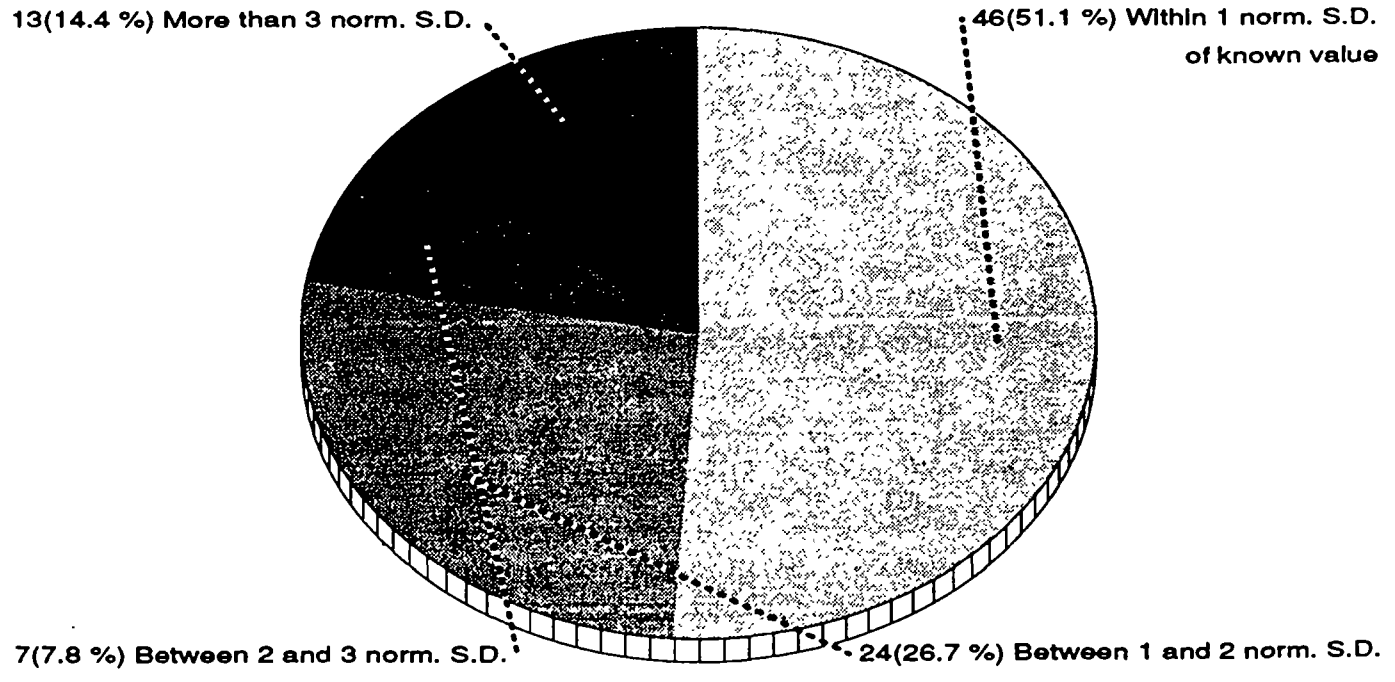
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 182 Participants

The known value of this nuclide is **15.0 pCi/l** with an expected precision of **2.3**; the control limits are 11.0 to 19.0; the warning regions are 11.0 to 12.3 and 17.7 to 19.0



Statistic	Respondents	Non-outliers
Mean	17.91	**Grand Avg 14.57**
Std. Dev.	26.63	1.70
Variance	709.33	2.91
% Coef. of Var.	148.72	11.70
% deviation of mean from known value	19.39	-2.88
Norm. dev. of mean from known value	0.11	-0.25
Median	14.38	14.37
% deviation of median from known value	-4.11	-4.22
Norm. dev. of median from known value	-0.02	-0.37



ESD-LV Performance Evaluation: Blind-A, 21-Apr-1998

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	13.6	13.8	12.4	0.76	0.360	13.27	-0.98	-1.31	
AE	13.2	13.8	14.0	0.42	0.205	13.67	-0.68	-1.00	
AF	14.3	14.1	14.0	0.15	0.077	14.13	-0.33	-0.65	
AH									•
AJ	20.0	19.8	18.5	0.81	0.385	19.43	3.66	3.34	⇑
AK	13.7	13.9	14.6	0.47	0.231	14.07	-0.38	-0.70	
AL	14.5	14.0	14.6	0.32	0.154	14.37	-0.15	-0.48	
AP									•
AR									•
AU	7.2	6.6	6.5	0.38	0.180	6.77	-5.88	-6.20	×
AW	14.0	14.1	14.5	0.26	0.128	14.20	-0.28	-0.60	
AZ	16.1	17.6	16.0	0.90	0.411	16.57	1.50	1.18	
BA	13.0	13.6	14.2	0.60	0.308	13.60	-0.73	-1.05	
BB									•
BC	16.4	19.3	16.2	1.73	0.796	17.30	2.06	1.73	
BG									•
BH	13.4	15.2	15.8	1.25	0.616	14.80	0.17	-0.15	
BK	14.7	15.0	14.6	0.21	0.103	14.77	0.15	-0.18	
BL									•
BM	13.4	14.0	12.1	0.97	0.488	13.17	-1.06	-1.38	
BN	12.5	12.8	12.9	0.21	0.103	12.73	-1.38	-1.71	
BO	14.3	15.2	14.5	0.47	0.231	14.67	0.07	-0.25	
BS									•
BW									•
C	15.1	15.4	15.3	0.15	0.077	15.27	0.53	0.20	
CA	14.6	16.3	14.9	0.91	0.437	15.27	0.53	0.20	
CC									•
CE	12.7	13.1	15.6	1.57	0.745	13.80	-0.58	-0.90	
CJ	15.0	15.0	15.0	0.00	0.000	15.00	0.32	0.00	
CO									•
CP									•
CS	16.3	16.0	15.9	0.21	0.103	16.07	1.13	0.80	
CX									•
D									•
DB	13.8	13.6	14.0	0.20	0.103	13.80	-0.58	-0.90	
DD									•
DE	14.1	14.3	14.5	0.20	0.103	14.30	-0.20	-0.53	
DI									•
DO									•
DT	14.0	14.2	14.6	0.31	0.154	14.27	-0.23	-0.55	
DZ	16.2	13.6	15.0	1.30	0.668	14.93	0.27	-0.05	
E	14.1	14.3	14.8	0.36	0.180	14.40	-0.13	-0.45	
EB	11.9	12.4	12.3	0.26	0.128	12.20	-1.78	-2.11	
EL	16.8	18.6	17.0	0.99	0.462	17.47	2.18	1.86	
EO	15.1	15.8	15.5	0.35	0.180	15.47	0.68	0.35	

• ≡ 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
ER	15.1	15.8	15.5	0.35	0.180	15.47	0.68	0.35	
EV									•
EX									•
FE	13.5	14.9	13.5	0.81	0.360	13.97	-0.45	-0.78	
FF									•
FJ									•
FL									•
FN	18.4	16.6	18.0	0.95	0.462	17.67	2.33	2.01	
GI									•
GQ	13.5	12.1	12.8	0.70	0.360	12.80	-1.33	-1.66	
GZ									•
HI									•
HK	14.9	15.2	14.7	0.25	0.128	14.93	0.27	-0.05	
HL	14.7	14.6	15.1	0.26	0.128	14.80	0.17	-0.15	
HP	14.9	14.5	15.2	0.35	0.180	14.87	0.22	-0.10	
I	14.5	12.1	13.4	1.20	0.616	13.33	-0.93	-1.26	
ID	14.1	14.7	10.9	2.04	0.976	13.23	-1.01	-1.33	
IU									•
J									•
JE	14.4	18.4	13.7	2.54	1.394	15.50	0.70	0.38	
JG									•
JM	14.3	14.3	15.6	0.75	0.334	14.73	0.12	-0.20	
JN									•
JQ									•
JS	14.0	15.6	11.2	2.23	1.248	13.60	-0.73	-1.05	
JY	19.0	18.8	19.9	0.59	0.282	19.23	3.51	3.19	⇑
K	13.8	14.2	15.0	0.61	0.308	14.33	-0.18	-0.50	
KE									•
KT									•
KX									•
L	11.6	11.6	12.3	0.40	0.180	11.83	-2.06	-2.38	
LE									•
LF									•
LL									•
LR	21.0	24.0	22.0	1.53	0.770	22.33	5.85	5.52	×
LT									•
M									•
MF	11.4	13.4	12.7	1.01	0.514	12.50	-1.56	-1.88	
MP									•
MT									•
MV									•
MY									•
N	15.2	14.1	14.4	0.57	0.282	14.57	0.00	-0.33	
NA									•
NH	12.1	12.8	12.9	0.44	0.205	12.60	-1.48	-1.81	

• ≡ 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
NJ	16.1	18.3	15.7	1.40	0.668	16.70	1.60	1.28	
NK									•
NO	15.5	15.7	16.7	0.64	0.308	15.97	1.05	0.73	
O	15.3	15.1	13.7	0.87	0.411	14.70	0.10	-0.23	
OB									•
OF									•
OM									•
OS									•
OY									•
P	15.7	17.6	14.7	1.47	0.745	16.00	1.08	0.75	
PA									•
PB	14.5	15.0	14.8	0.25	0.128	14.77	0.15	-0.18	
PD									•
PG									•
PM									•
PW	20.8	21.4	21.0	0.31	0.154	21.07	4.89	4.57	×
Q	14.1	14.4	14.6	0.25	0.128	14.37	-0.15	-0.48	
QM	12.8	13.2	13.0	0.20	0.103	13.00	-1.18	-1.51	
QP									•
QQ	10.5	10.9	10.7	0.20	0.103	10.70	-2.91	-3.24	⇓
QT	3.1	6.4	6.5	1.93	0.873	5.33	-6.95	-7.28	×
QU	21.8	21.4	20.5	0.67	0.334	21.23	5.02	4.69	×
QW									•
QX									•
QY	60.7	60.1	61.5	0.70	0.360	60.77	34.79	34.47	×
QZ	13.9	14.3	13.3	0.50	0.257	13.83	-0.55	-0.88	
RB									•
RD	12.6	16.3	13.7	1.90	0.950	14.20	-0.28	-0.60	
RG									•
RI									•
RK	12.8	12.9	14.0	0.67	0.308	13.23	-1.01	-1.33	
RP									•
RR									•
RU	344.4	248.9	95.4	75.67	71.981	262.23	186.51	186.18	×
RZ									•
S	15.4	15.2	15.2	0.12	0.051	15.27	0.53	0.20	
SD	13.7	12.9	12.5	0.61	0.308	13.03	-1.16	-1.48	
SF									•
SG									•
SI	10.2	11.1	9.9	0.62	0.308	10.40	-3.14	3.46	⇓
SL									
SM	18.8	19.0	19.0	0.12	0.051	18.93	3.29	2.96	
SN									•
SO									•
SR									•

• ≡ 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
SS	15.8	14.1	15.8	0.98	0.437	15.23	0.50	0.18	
SX	13.9	14.8	13.7	0.59	0.282	14.13	-0.33	-0.65	
SZ	17.0	14.4	15.5	1.31	0.668	15.63	0.80	0.48	
T	15.2	15.3	15.2	0.06	0.026	15.23	0.50	0.18	
TD	23.4	22.9	26.1	1.72	0.822	24.13	7.20	6.88	×
TL									•
TN	12.8	14.8	15.4	1.36	0.668	14.33	-0.18	0.50	
TQ	15.3	14.8	15.3	0.29	0.128	15.13	0.43	0.10	
TS									•
TU	12.1	11.2	13.1	0.95	0.488	12.13	-1.83	2.16	
TY									•
U	13.3	13.8	13.7	0.26	0.128	13.60	-0.73	1.05	
UA									•
UK									•
UM									•
UP	14.9	14.8	12.8	1.18	0.539	14.17	-0.30	-0.63	
UQ	13.3	14.4	13.4	0.61	0.282	13.70	-0.65	-0.98	
UY									•
VA	19.0	14.8	16.1	2.15	1.150	16.63	1.55	1.23	
VC									•
VH	14.6	13.2	13.1	0.84	0.385	13.63	-0.70	-1.03	
VI	16.2	13.4	13.4	1.62	0.719	14.33	-0.18	-0.50	
VJ									•
VM									•
VO									•
VT									•
W	12.4	10.8	11.6	0.80	0.411	11.60	-2.24	-2.56	
WE									•
WH	15.3	16.0	15.8	0.36	0.180	15.70	0.85	0.53	
WO	17.5	13.5	18.0	2.47	1.296	16.33	1.33	1.00	
WR									•
WW									•
X	13.3	13.9	13.7	0.31	0.154	13.63	-0.70	-1.03	
XA	18.1	16.4	19.9	1.75	0.899	18.13	2.68	2.36	
XC									•
XD									•
XF									•
XI	7.1	8.6	7.8	0.75	0.385	7.83	-5.07	-5.40	×
XJ									•
XK									•
XL	14.7	15.1	15.5	0.40	0.205	15.10	0.40	0.08	
XM	13.0	14.0	13.9	0.55	0.257	13.63	-0.70	-1.03	
XN									•
XO									•
XP									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

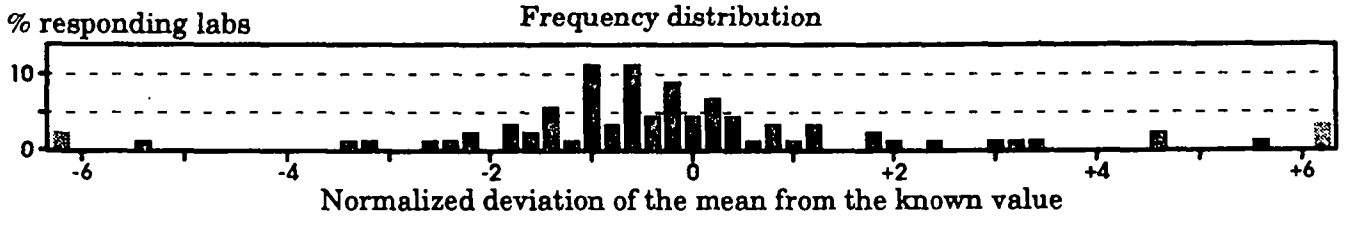
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XQ									•
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.33	×	QT	13.83		QZ	15.23		T
6.77	×	AU	13.97		FE	15.23		SS
7.83	×	XI	14.07		AK	15.27		S
10.40	⇓	SI	14.13		SX	15.27		CA
10.70	⇓	QQ	14.13		AF	15.27		C
11.60		W	14.17		UP	15.47		ER
11.83		L	14.20		RD	15.47		EO
12.13		TU	14.20		AW	15.50		JE
12.20		EB	14.27		DT	15.63		SZ
12.50		MF	14.30		DE	15.70		WH
12.60		NH	14.33		VI	15.97		NO
12.73		BN	14.33		TN	16.00		P
12.80		GQ	14.33		K	16.07		CS
13.00		QM	14.37		Q	16.33		WO
13.03		SD	14.37		AL	16.57		AZ
13.17		BM	14.40		E	16.63		VA
13.23		RK	14.57		N	16.70		NJ
13.23		ID	14.67		BO	17.30		BC
13.27		A	14.70		O	17.47		EL
13.33		I	14.73		JM	17.67		FN
13.60		U	14.77		PB	18.13		XA
13.60		JS	14.77		BK	18.93		SM
13.60		BA	14.80		HL	19.23	⇑	JY
13.63		XM	14.80		BH	19.43	⇑	AJ
13.63		X	14.87		HP	21.07	×	PW
13.63		VH	14.93		HK	21.23	×	QU
13.67		AE	14.93		DZ	22.33	×	LR
13.70		UQ	15.00		CJ	24.13	×	TD
13.80		DB	15.10		XL	60.77	×	QY
13.80		CE	15.13		TQ	262.23	×	RU



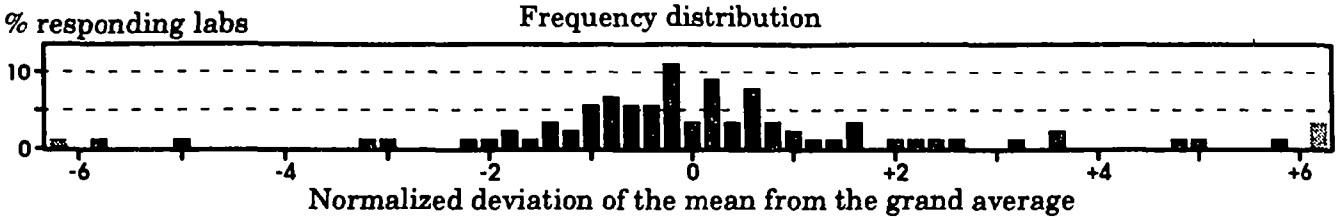
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

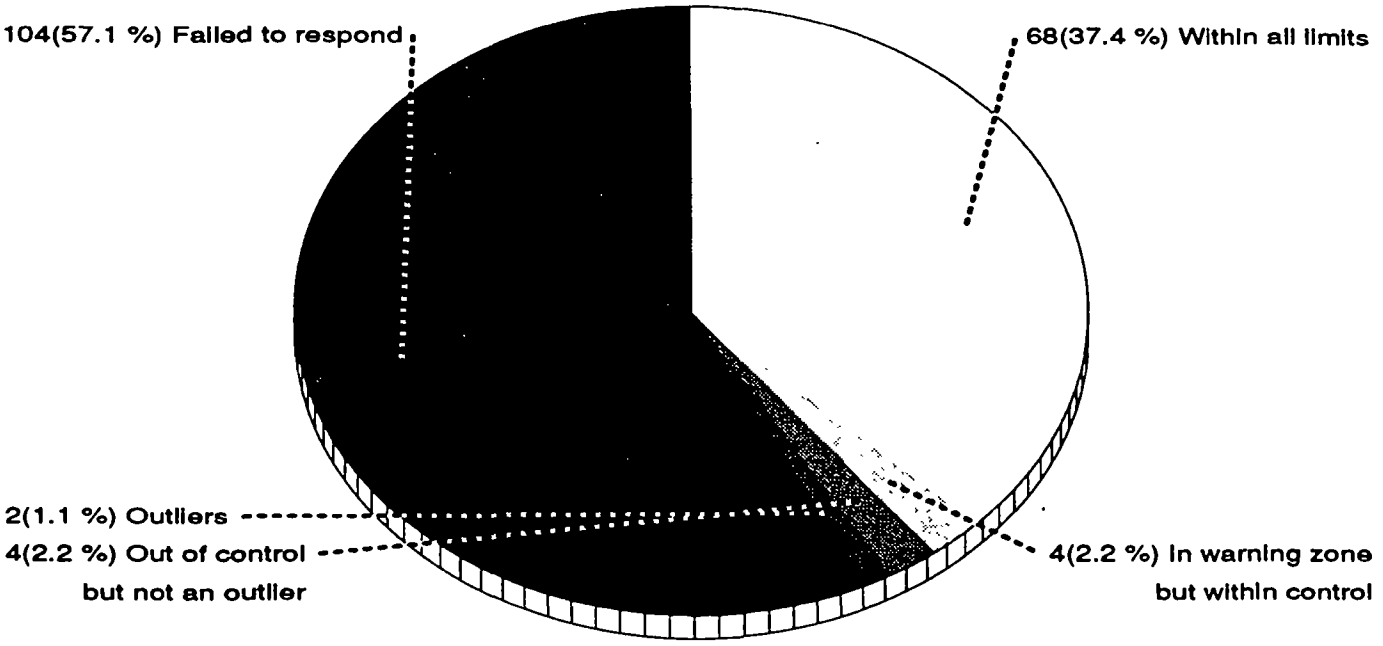
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226

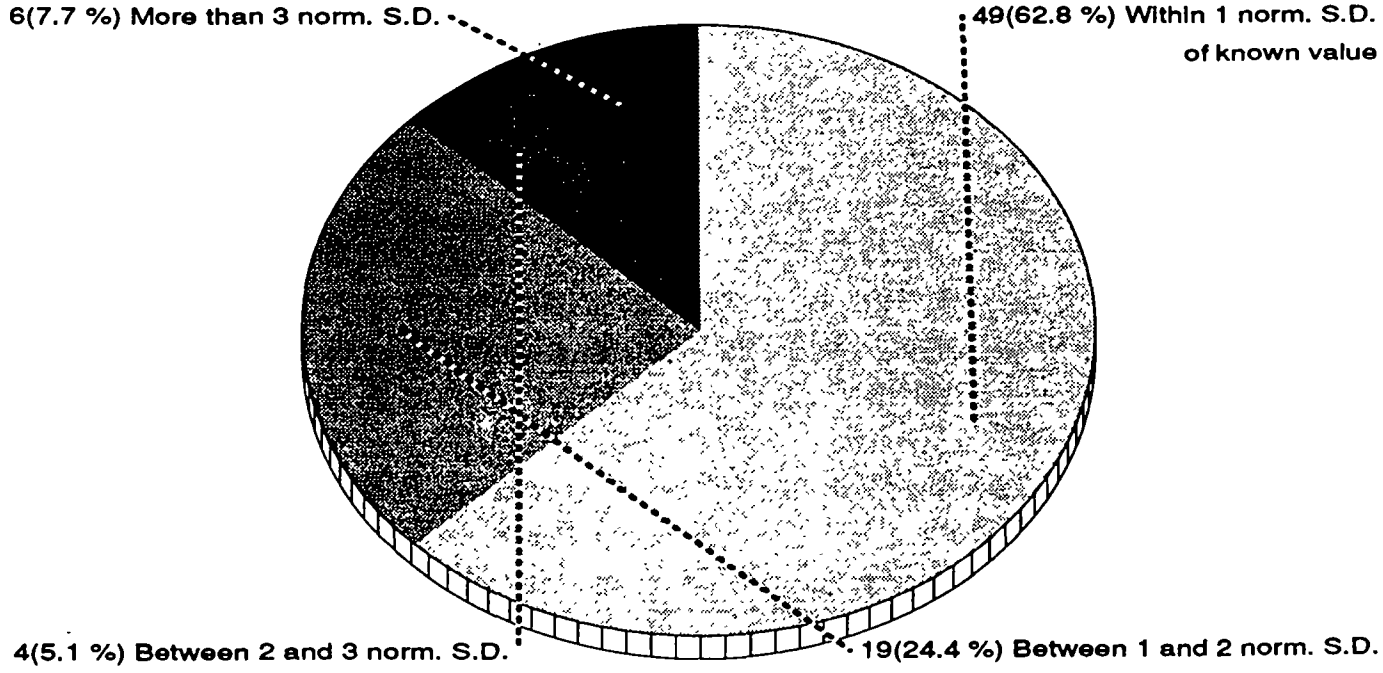

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Radium-228 Statistical Summary 182 Participants

The known value of this nuclide is **9.3 pCi/l** with an expected precision of **2.3**; the control limits are 5.3 to 13.3; the warning regions are 5.3 to 6.6 and 12.0 to 13.3



Statistic	Respondents	Non-outliers
Mean	11.90	**Grand Avg 9.50**
Std. Dev.	19.12	1.61
Variance	365.48	2.59
% Coef. of Var.	160.69	16.94
% deviation of mean from known value	27.93	2.12
Norm. dev. of mean from known value	0.14	0.12
Median	9.42	9.33
% deviation of median from known value	1.25	0.36
Norm. dev. of median from known value	0.01	0.02



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	8.0	8.0	7.6	0.23	0.103	7.87	-1.23	-1.08	
AE	8.2	8.3	8.5	0.15	0.077	8.33	-0.88	-0.73	
AF	11.7	10.8	12.3	0.75	0.385	11.60	1.58	1.73	
AH									•
AJ	7.4	10.2	8.3	1.43	0.719	8.63	-0.65	-0.50	
AK	7.9	6.9	7.0	0.55	0.257	7.27	-1.68	-1.53	
AL	11.2	7.7	8.1	1.92	0.899	9.00	-0.37	-0.23	
AP									•
AR									•
AU	1.7	10.0	2.7	4.53	3.155	4.80	-3.54	-3.39	⇓
AW	11.6	12.1	12.3	0.36	0.180	12.00	1.88	2.03	
AZ	9.9	9.7	10.4	0.36	0.180	10.00	0.38	0.53	
BA	8.2	7.8	7.6	0.31	0.154	7.87	-1.23	1.08	
BB									•
BC	11.9	11.6	11.7	0.15	0.077	11.73	1.68	1.83	
BG									•
BH	9.4	8.4	9.5	0.61	0.282	9.10	-0.30	0.15	
BK	10.2	9.2	9.7	0.50	0.257	9.70	0.15	0.30	
BL									•
BM	10.5	10.8	10.7	0.15	0.077	10.67	0.88	1.03	
BN									•
BO	9.7	9.3	10.3	0.50	0.257	9.77	0.20	0.35	
BS									•
BW									•
C	9.4	9.5	9.6	0.10	0.051	9.50	0.00	0.15	
CA	8.9	7.0	7.5	0.98	0.488	7.80	-1.28	1.13	
CC									•
CE	12.1	9.2	9.2	1.67	0.745	10.17	0.50	0.65	
CJ	8.3	8.7	8.5	0.20	0.103	8.50	-0.75	0.60	
CO									•
CP									•
CS	10.1	9.4	9.0	0.56	0.282	9.50	0.00	0.15	
CX									•
D									•
DB	8.4	8.3	8.0	0.21	0.103	8.23	-0.95	-0.80	
DD									•
DE	7.1	7.3	7.5	0.20	0.103	7.30	-1.65	-1.51	
DI									•
DO									•
DT	8.4	8.5	7.5	0.55	0.257	8.13	-1.03	-0.88	
DZ	8.7	9.0	8.9	0.15	0.077	8.87	-0.47	-0.33	
E	8.9	9.3	9.6	0.35	0.180	9.27	-0.17	-0.03	
EB	9.5	9.1	9.1	0.23	0.103	9.23	-0.20	-0.05	
EL	7.8	8.8	10.3	1.26	0.642	8.97	-0.40	-0.25	
EO	9.8	8.9	9.4	0.45	0.231	9.37	-0.10	0.05	

• ≡ 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
ER									•
EV									•
EX									•
FE									•
FF									•
FJ									•
FL									•
FN	9.7	9.4	9.5	0.15	0.077	9.53	0.03	0.18	
GI									•
GQ	14.2	12.3	13.3	0.95	0.488	13.27	2.84	2.99	
GZ									•
HI									•
HK	8.6	9.8	8.8	0.64	0.308	9.07	-0.32	-0.18	
HL	7.4	8.5	7.8	0.56	0.282	7.90	-1.20	-1.05	
HP	8.8	10.1	9.5	0.65	0.334	9.47	-0.02	0.13	
I	9.9	8.2	9.4	0.87	0.437	9.17	-0.25	-0.10	
ID	8.5	6.2	9.3	1.61	0.796	8.00	-1.13	-0.98	
IU									•
J									•
JE	9.4	8.8	9.1	0.30	0.154	9.10	-0.30	-0.15	
JG									•
JM									•
JN									•
JQ									•
JS	10.2	9.2	12.2	1.53	0.770	10.53	0.78	0.93	
JY	13.9	13.4	13.1	0.40	0.205	13.47	2.99	3.14	⇑
K	14.0	13.4	13.5	0.32	0.154	13.63	3.11	3.26	⇑
KE									•
KT									•
KX									•
L	10.3	8.9	9.7	0.70	0.360	9.63	0.10	0.25	
LE									•
LF									•
LL									•
LR									•
LT									•
M									•
MF	9.8	10.4	9.6	0.42	0.205	9.93	0.33	0.48	
MP									•
MT									•
MV									•
MY									•
N	10.9	10.3	9.7	0.60	0.308	10.30	0.60	0.75	
NA									•
NH	11.1	9.5	10.3	0.80	0.411	10.30	0.60	0.75	

• ≡ 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
NJ	11.5	10.0	10.5	0.76	0.385	10.67	0.88	1.03	
NK									•
NO	8.0	9.0	10.0	1.00	0.514	9.00	-0.37	-0.23	
O	9.4	9.6	10.1	0.36	0.180	9.70	0.15	0.30	
OB									•
OF									•
OM									•
OS									•
OY									•
P	7.7	8.4	6.9	0.75	0.385	7.67	-1.38	-1.23	
PA									•
PB	9.4	9.6	9.8	0.20	0.103	9.60	0.08	0.23	
PD									•
PG									•
PM									•
PW	10.8	11.0	10.6	0.20	0.103	10.80	0.98	1.13	
Q	10.0	9.1	10.3	0.62	0.308	9.80	0.23	0.38	
QM									•
QP									•
QQ									•
QT	8.6	8.9	8.8	0.15	0.077	8.77	-0.55	-0.40	
QU	12.4	12.9	13.3	0.45	0.231	12.87	2.54	2.69	
QW									•
QX									•
QY									•
QZ	8.2	8.5	8.9	0.35	0.180	8.53	-0.73	-0.58	
RB									•
RD	10.2	10.4	9.8	0.31	0.154	10.13	0.48	0.63	
RG									•
RI									•
RK	27.1	30.9	30.2	2.02	0.976	29.40	14.99	15.14	×
RP									•
RR									•
RU	191.6	182.1	156.8	17.99	16.118	176.83	126.02	126.16	×
RZ									•
S	7.9	7.9	8.0	0.06	0.026	7.93	-1.18	-1.03	
SD	7.6	9.2	10.8	1.60	0.822	9.20	-0.22	-0.08	
SF									•
SG									•
SI	9.1	8.2	7.7	0.71	0.360	8.33	-0.88	-0.73	
SL									•
SM	10.0	9.9	9.7	0.15	0.077	9.87	0.28	0.43	
SN									•
SO									•
SR									•

• ≡ No data submitted

∅ ≡ Insufficient data

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Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
SS	13.6	10.5	9.1	2.30	1.296	11.07	1.18	1.33	
SX	9.1	12.8	8.5	2.33	1.199	10.13	0.48	0.63	
SZ	12.0	11.1	13.7	1.32	0.668	12.27	2.09	2.23	
T	9.6	10.4	11.3	0.85	0.437	10.43	0.71	0.85	
TD	7.2	9.3	11.4	2.10	1.150	9.30	-0.15	0.00	
TL									•
TN	11.8	8.2	8.5	2.00	0.925	9.50	0.00	0.15	
TQ	8.7	7.6	9.2	0.82	0.411	8.50	-0.75	-0.60	
TS									•
TU									•
TY									•
U	7.7	7.8	8.2	0.26	0.128	7.90	-1.20	-1.05	
UA									•
UK									•
UM									•
UP	10.0	10.3	10.3	0.17	0.077	10.20	0.53	0.68	
UQ	10.5	10.8	10.0	0.40	0.205	10.43	0.71	0.85	
UY									•
VA	14.1	13.6	12.5	0.82	0.411	13.40	2.94	3.09	⇑
VC									•
VH	7.5	7.4	6.7	0.44	0.205	7.20	-1.73	-1.58	
VI	12.5	11.3	9.1	1.72	0.873	10.97	1.11	1.26	
VJ									•
VM									•
VO									•
VT									•
W									•
WE									•
WH	8.7	8.1	7.8	0.46	0.231	8.20	-0.98	-0.83	
WO	8.8	5.2	7.7	1.84	0.925	7.23	-1.70	-1.56	
WR									•
WW									•
X	8.4	6.9	8.0	0.78	0.385	7.77	-1.30	-1.15	
XA									•
XC									•
XD									•
XF									•
XI									•
XJ									•
XK									•
XL	8.1	8.9	9.4	0.66	0.334	8.80	-0.52	-0.38	
XM	9.1	9.3	9.0	0.15	0.077	9.13	-0.27	-0.13	
XN									•
XO									•
XP									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

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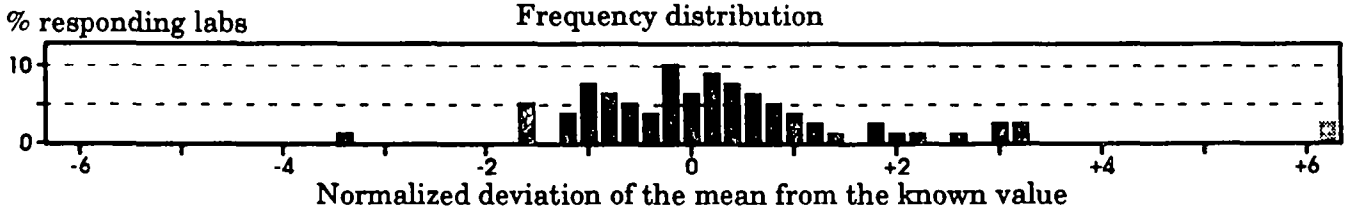
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
XQ									•
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
4.80	⇓	AU	8.97		EL	10.00		AZ
7.20		VH	9.00		NO	10.13		RD
7.23		WO	9.00		AL	10.13		SX
7.27		AK	9.07		HK	10.17		CE
7.30		DE	9.10		BH	10.20		UP
7.67		P	9.10		JE	10.30		NH
7.77		X	9.13		XM	10.30		N
7.80		CA	9.17		I	10.43		UQ
7.87		BA	9.20		SD	10.43		T
7.87		A	9.23		EB	10.53		JS
7.90		U	9.27		E	10.67		NJ
7.90		HL	9.30		TD	10.67		BM
7.93		S	9.37		EO	10.80		PW
8.00		ID	9.47		HP	10.97		VI
8.13		DT	9.50		TN	11.07		SS
8.20		WH	9.50		CS	11.60		AF
8.23		DB	9.50		C	11.73		BC
8.33		SI	9.53		FN	12.00		AW
8.33		AE	9.60		PB	12.27		SZ
8.50		TQ	9.63		L	12.87		QU
8.50		CJ	9.70		O	13.27		GQ
8.53		QZ	9.70		BK	13.40	⇑	VA
8.63		AJ	9.77		BO	13.47	⇑	JY
8.77		QT	9.80		Q	13.63	⇑	K
8.80		XL	9.87		SM	29.40	×	RK
8.87		DZ	9.93		MF	176.83	×	RU



• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

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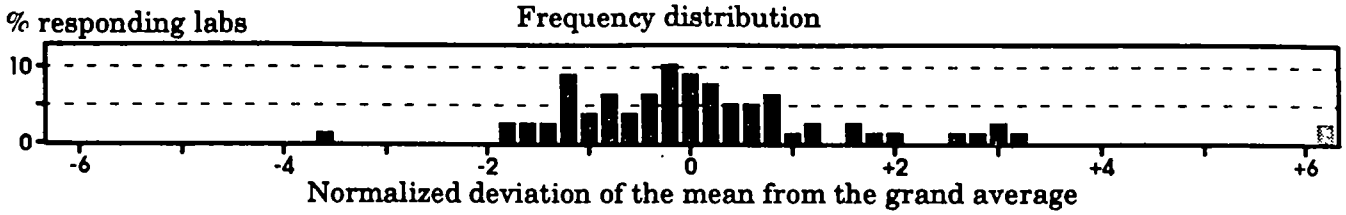
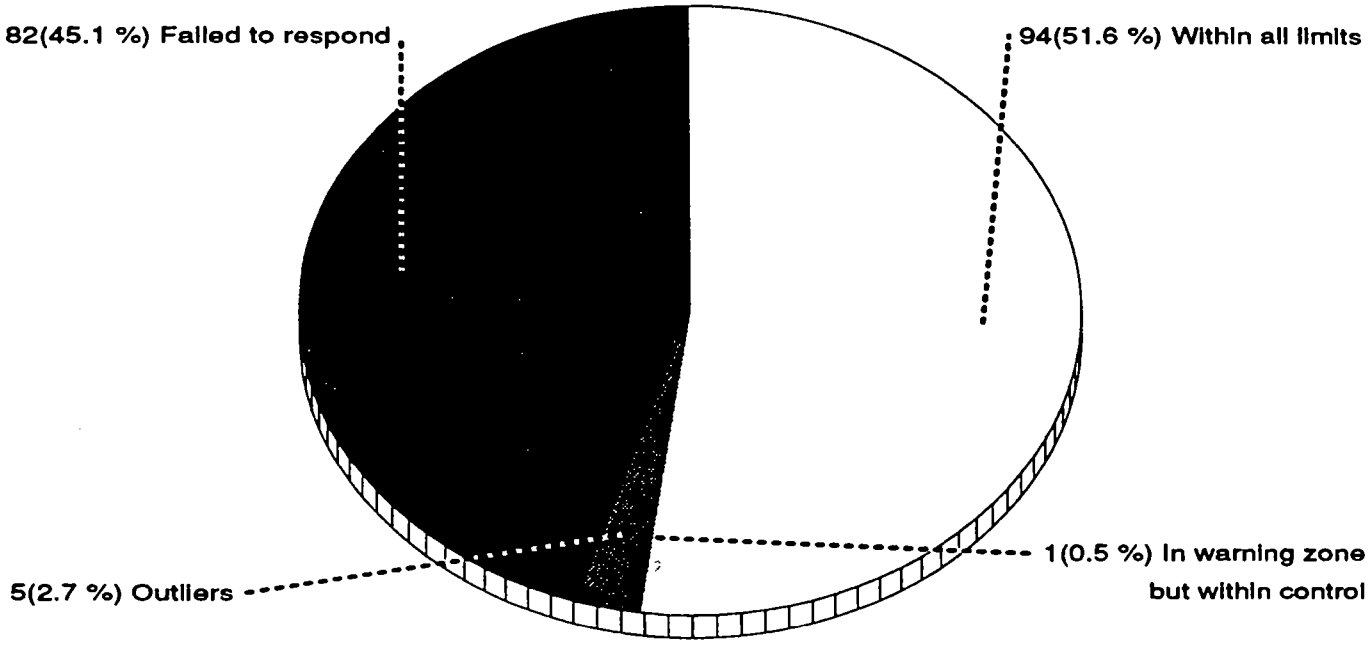
Radium-228

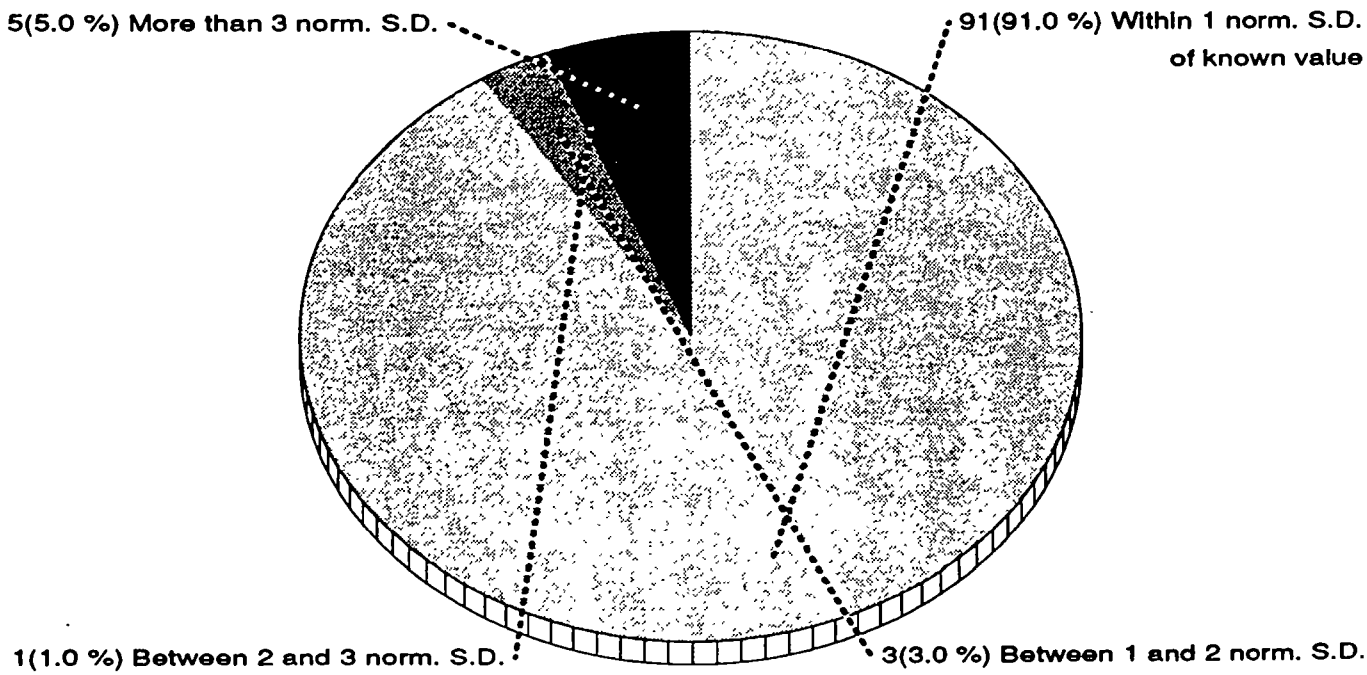

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Uranium (Natural) Statistical Summary 182 Participants

The known value of this nuclide is **5.0 pCi/l** with an expected precision of **3.0**; the control limits are 0.0 to 10.2; the warning regions are 0.0 to 1.5 and 8.5 to 10.2



Statistic	Respondents	Non-outliers
Mean	6.93	**Grand Avg 5.08**
Std. Dev.	9.81	0.82
Variance	96.17	0.68
% Coef. of Var.	141.41	16.20
% deviation of mean from known value	38.69	1.56
Norm. dev. of mean from known value	0.20	0.09
Median	5.07	5.03
% deviation of median from known value	1.33	0.67
Norm. dev. of median from known value	0.01	0.04



Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	4.9	5.0	4.9	0.06	0.020	4.93	-0.08	-0.04	
AE	5.1	5.3	5.5	0.20	0.079	5.30	0.13	0.17	
AF	5.7	5.7	5.4	0.17	0.059	5.60	0.30	0.35	
AH	4.9	5.2	4.8	0.21	0.079	4.97	-0.06	-0.02	
AJ	5.2	4.7	4.2	0.50	0.197	4.70	-0.22	-0.17	
AK	6.2	6.7	6.2	0.29	0.098	6.37	0.74	0.79	
AL	5.7	5.6	6.1	0.26	0.098	5.80	0.42	0.46	
AP									•
AR	4.5	4.4	4.4	0.06	0.020	4.43	-0.37	-0.33	
AU									•
AW	5.2	5.0	5.3	0.15	0.059	5.17	0.05	0.10	
AZ	5.3	5.3	5.3	0.00	0.000	5.30	0.13	0.17	
BA	5.4	5.9	5.1	0.40	0.158	5.47	0.22	0.27	
BB	4.0	4.3	4.2	0.15	0.059	4.17	-0.53	-0.48	
BC	5.1	5.2	5.3	0.10	0.039	5.20	0.07	0.12	
BG									•
BH	6.1	6.0	5.7	0.21	0.079	5.93	0.49	0.54	
BK	5.6	5.4	5.6	0.12	0.039	5.53	0.26	0.31	
BL									•
BM	5.6	5.4	5.0	0.31	0.118	5.33	0.15	0.19	
BN	3.1	4.6	3.6	0.76	0.295	3.77	-0.76	-0.71	
BO	4.6	4.6	4.7	0.06	0.020	4.63	-0.26	-0.21	
BS									•
BW									•
C	4.6	4.9	5.1	0.25	0.098	4.87	-0.12	-0.08	
CA	5.2	5.0	5.0	0.12	0.039	5.07	-0.01	0.04	
CC									•
CE	5.3	5.5	5.7	0.20	0.079	5.50	0.24	0.29	
CJ	4.5	4.8	4.3	0.25	0.098	4.53	-0.31	-0.27	
CO	3.5	3.4	3.4	0.06	0.020	3.43	-0.95	-0.90	
CP									•
CS	36.7	37.0	37.7	0.51	0.197	37.13	18.51	18.55	×
CX	5.7	5.3	5.5	0.20	0.079	5.50	0.24	0.29	
D	4.8	5.2	5.0	0.20	0.079	5.00	-0.04	0.00	
DB	4.4	4.5	4.6	0.10	0.039	4.50	-0.33	-0.29	
DD									•
DE	6.0	7.0	7.0	0.58	0.197	6.67	0.92	0.96	
DI									•
DO	5.4	4.9	4.9	0.29	0.098	5.07	-0.01	0.04	
DT	5.0	5.2	7.0	1.10	0.394	5.73	0.38	0.42	
DZ	8.3	7.9	8.7	0.40	0.158	8.30	1.86	1.91	
E	5.3	4.9	5.0	0.21	0.079	5.07	-0.01	0.04	
EB	4.5	4.3	5.1	0.42	0.158	4.63	-0.26	-0.21	
EL	4.0	4.2	4.0	0.12	0.039	4.07	-0.58	-0.54	
EO									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ 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
ER	5.2	5.1	4.8	0.21	0.079	5.03	-0.03	0.02	
EV									•
EX									•
FE	4.1	3.9	4.1	0.12	0.039	4.03	-0.60	-0.56	
FF									•
FJ	5.5	5.5	5.5	0.00	0.000	5.50	0.24	0.29	
FL									•
FN	2.8	2.0	2.3	0.40	0.158	2.37	-1.57	-1.52	
GI									•
GQ	4.9	4.6	4.8	0.15	0.059	4.77	-0.18	-0.13	
GZ									•
HI									•
HK	5.1	5.2	5.3	0.10	0.039	5.20	0.07	0.12	
HL	4.4	5.3	4.7	0.46	0.177	4.80	-0.16	-0.12	
HP	5.2	5.2	5.4	0.12	0.039	5.27	0.11	0.15	
I	4.9	5.1	4.8	0.15	0.059	4.93	-0.08	-0.04	
ID	4.7	4.9	4.8	0.10	0.039	4.80	-0.16	-0.12	
IU									•
J									•
JE	4.8	4.9	4.8	0.06	0.020	4.83	-0.14	-0.10	
JG									•
JM									•
JN	3.6	4.9	5.2	0.85	0.315	4.57	0.30	-0.25	
JQ									•
JS	85.5	90.9	85.5	3.12	1.120	87.30	7.47	47.52	×
JY	4.5	5.0	4.3	0.36	0.138	4.60	0.28	-0.23	
K	4.8	4.7	4.8	0.06	0.020	4.77	0.18	-0.13	
KE									•
KT	5.0	5.5	6.0	0.50	0.197	5.50	0.24	0.29	
KX									•
L	5.0	5.6	5.3	0.30	0.118	5.30	0.13	0.17	
LE									•
LF	4.9	5.0	5.0	0.06	0.020	4.97	0.06	-0.02	
LL									•
LR									•
LT									•
M									•
MF									•
MP									•
MT									•
MV									•
MY									•
N	5.7	5.1	4.9	0.42	0.158	5.23	0.09	0.13	
NA	5.0	6.0	6.0	0.58	0.197	5.67	0.34	0.38	
NH	5.4	3.3	4.0	1.07	0.413	4.23	-0.49	-0.44	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

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⇓ ≡ 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
NJ	5.1	4.8	4.9	0.15	0.059	4.93	-0.08	-0.04	
NK									•
NO	4.5	5.5	6.5	1.00	0.394	5.50	0.24	0.29	
O									•
OB	5.1	5.1	5.5	0.23	0.079	5.23	0.09	0.13	
OF									•
OM									•
OS	4.7	4.9	4.9	0.12	0.039	4.83	-0.14	-0.10	
OY									•
P	5.4	5.1	7.7	1.42	0.512	6.07	0.57	0.62	
PA									•
PB	4.1	4.1	4.0	0.06	0.020	4.07	-0.58	-0.54	
PD									•
PG									•
PM									•
PW	17.6	20.6	20.0	1.59	0.591	19.40	8.27	8.31	×
Q	5.0	4.1	4.6	0.45	0.177	4.57	-0.30	-0.25	
QM	5.4	5.2	4.8	0.31	0.118	5.13	0.03	0.08	
QP									•
QQ	3.8	4.1	5.4	0.85	0.315	4.43	-0.37	-0.33	
QT									•
QU	5.5	5.6	5.3	0.15	0.059	5.47	0.22	0.27	
QW									•
QX	24.6	22.8	25.0	1.17	0.433	24.13	11.00	11.05	×
QY									•
QZ	4.8	4.9	4.8	0.06	0.020	4.83	-0.14	-0.10	
RB									•
RD	4.8	4.8	4.8	0.00	0.000	4.80	-0.16	-0.12	
RG	5.0	4.9	5.0	0.06	0.020	4.97	-0.06	-0.02	
RI									•
RK	41.0	43.3	45.0	2.01	0.788	43.10	21.95	22.00	×
RP	5.0	4.8	4.9	0.10	0.039	4.90	-0.10	-0.06	
RR									•
RU									•
RZ									•
S	4.5	4.7	4.9	0.20	0.079	4.70	-0.22	-0.17	
SD	5.8	5.2	5.3	0.32	0.118	5.43	0.21	0.25	
SF									•
SG									•
SI	5.2	5.0	5.1	0.10	0.039	5.10	0.01	0.06	
SL	2.5	2.5	2.6	0.06	0.020	2.53	-1.47	-1.42	
SM	5.2	5.0	5.3	0.15	0.059	5.17	0.05	0.10	
SN									•
SO	6.3	5.0	6.5	0.81	0.295	5.93	0.49	0.54	
SR									•

• ≡ 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
SS	5.0	4.9	5.1	0.10	0.039	5.00	-0.04	0.00	
SX	4.8	5.0	5.2	0.20	0.079	5.00	-0.04	0.00	
SZ	4.7	5.0	4.9	0.15	0.059	4.87	-0.12	-0.08	
T	6.2	6.2	6.3	0.06	0.020	6.23	0.67	0.71	
TD	4.9	4.8	4.8	0.06	0.020	4.83	-0.14	-0.10	
TL									•
TN									•
TQ	5.3	5.3	5.2	0.06	0.020	5.27	0.11	0.15	
TS									•
TU	5.4	5.1	5.2	0.15	0.059	5.23	0.09	0.13	
TY									•
U	5.8	5.8	5.9	0.06	0.020	5.83	0.44	0.48	
UA									•
UK									•
UM									•
UP	4.8	4.2	5.3	0.55	0.217	4.77	-0.18	-0.13	
UQ									•
UY									•
VA	5.4	4.9	6.4	0.76	0.295	5.57	0.28	0.33	
VC									•
VH	6.0	5.6	5.9	0.21	0.079	5.83	0.44	0.48	
VI	5.4	5.3	5.0	0.21	0.079	5.23	0.09	0.13	
VJ									•
VM									•
VO	5.6	4.8	4.9	0.44	0.158	5.10	0.01	0.06	
VT									•
W	5.1	5.2	5.3	0.10	0.039	5.20	0.07	0.12	
WE									•
WH	4.1	4.6	5.1	0.50	0.197	4.60	-0.28	-0.23	
WO	5.0	4.6	4.7	0.21	0.079	4.77	-0.18	-0.13	
WR	5.0	5.0	5.1	0.06	0.020	5.03	-0.03	0.02	
WW									•
X	4.5	4.5	4.4	0.06	0.020	4.47	-0.35	-0.31	
XA	9.8	6.6	9.3	1.72	0.630	8.57	2.01	2.06	
XC									•
XD									•
XF									•
XI	5.3	5.5	5.5	0.12	0.039	5.43	0.21	0.25	
XJ									•
XK									•
XL	5.7	5.3	5.6	0.21	0.079	5.53	0.26	0.31	
XM	4.5	4.6	4.5	0.06	0.020	4.53	-0.31	-0.27	
XN									•
XO									•
XP									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ 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
XQ									•
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.37		FN	4.83		JE	5.30		AZ
2.53		SL	4.87		SZ	5.30		AE
3.43		CO	4.87		C	5.33		BM
3.77		BN	4.90		RP	5.43		XI
4.03		FE	4.93		NJ	5.43		SD
4.07		PB	4.93		I	5.47		QU
4.07		EL	4.93		A	5.47		BA
4.17		BB	4.97		RG	5.50		NO
4.23		NH	4.97		LF	5.50		KT
4.43		QQ	4.97		AH	5.50		FJ
4.43		AR	5.00		SX	5.50		CX
4.47		X	5.00		SS	5.50		CE
4.50		DB	5.00		D	5.53		XL
4.53		XM	5.03		WR	5.53		BK
4.53		CJ	5.03		ER	5.57		VA
4.57		Q	5.07		CA	5.60		AF
4.57		JN	5.07		E	5.67		NA
4.60		WH	5.07		DO	5.73		DT
4.60		JY	5.10		VO	5.80		AL
4.63		BO	5.10		SI	5.83		VH
4.63		EB	5.13		QM	5.83		U
4.70		AJ	5.17		SM	5.93		BH
4.70		S	5.17		AW	5.93		SO
4.77		WO	5.20		W	6.07		P
4.77		UP	5.20		HK	6.23		T
4.77		K	5.20		BC	6.37		AK
4.77		GQ	5.23		TU	6.67		DE
4.80		RD	5.23		OB	8.30		DZ
4.80		ID	5.23		N	8.57		XA
4.80		HL	5.23		VI	19.40	×	PW
4.83		TD	5.27		TQ	24.13	×	QX
4.83		QZ	5.27		HP	37.13	×	CS
4.83		OS	5.30		L	43.10	×	RK
						87.30	×	JS

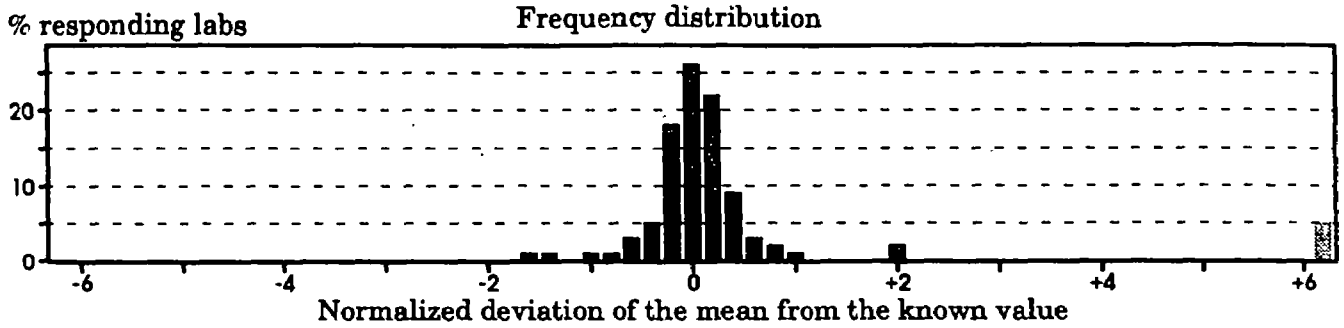
• ≡ No data submitted
∅ ≡ Insufficient data

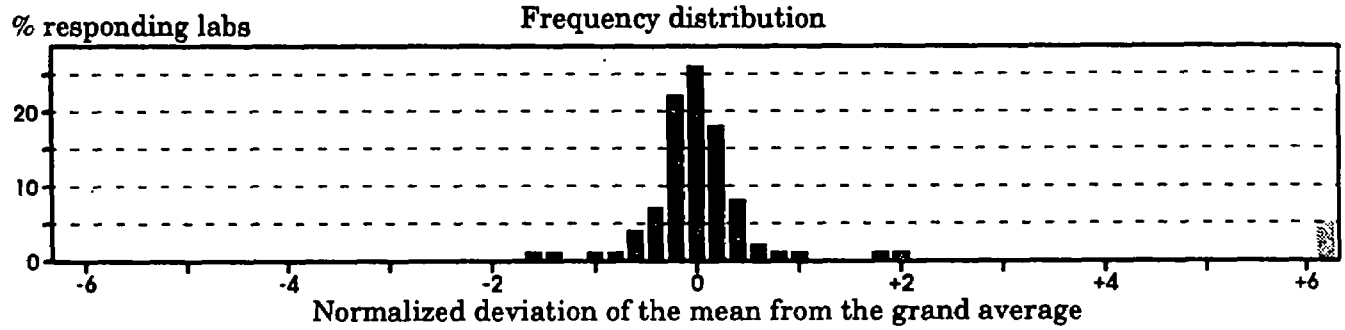
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural)





United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

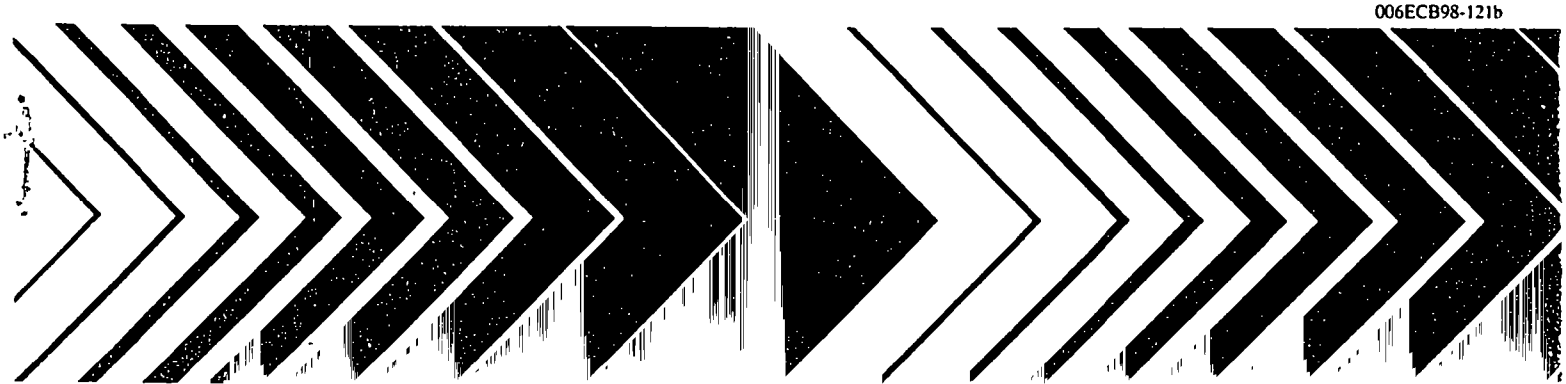
EPA/600/R-98/121B
September 1998

EPA

Blind-B Performance Evaluation Study

A Statistical Evaluation of the April 21, 1998 Data

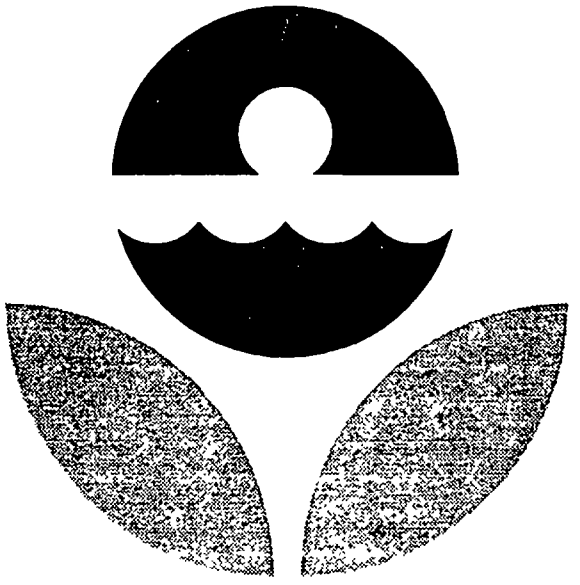
006ECB98-121b



Blind-B

Performance Evaluation Study

April 21, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Blind-B; April 21, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

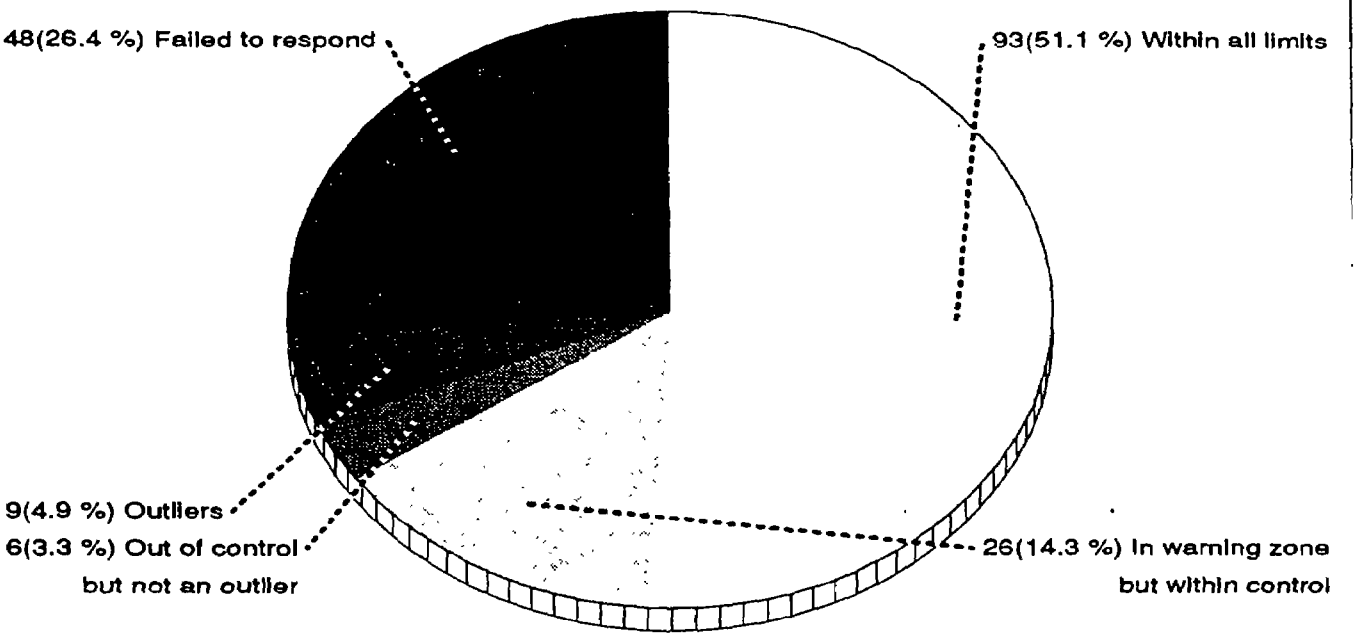
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

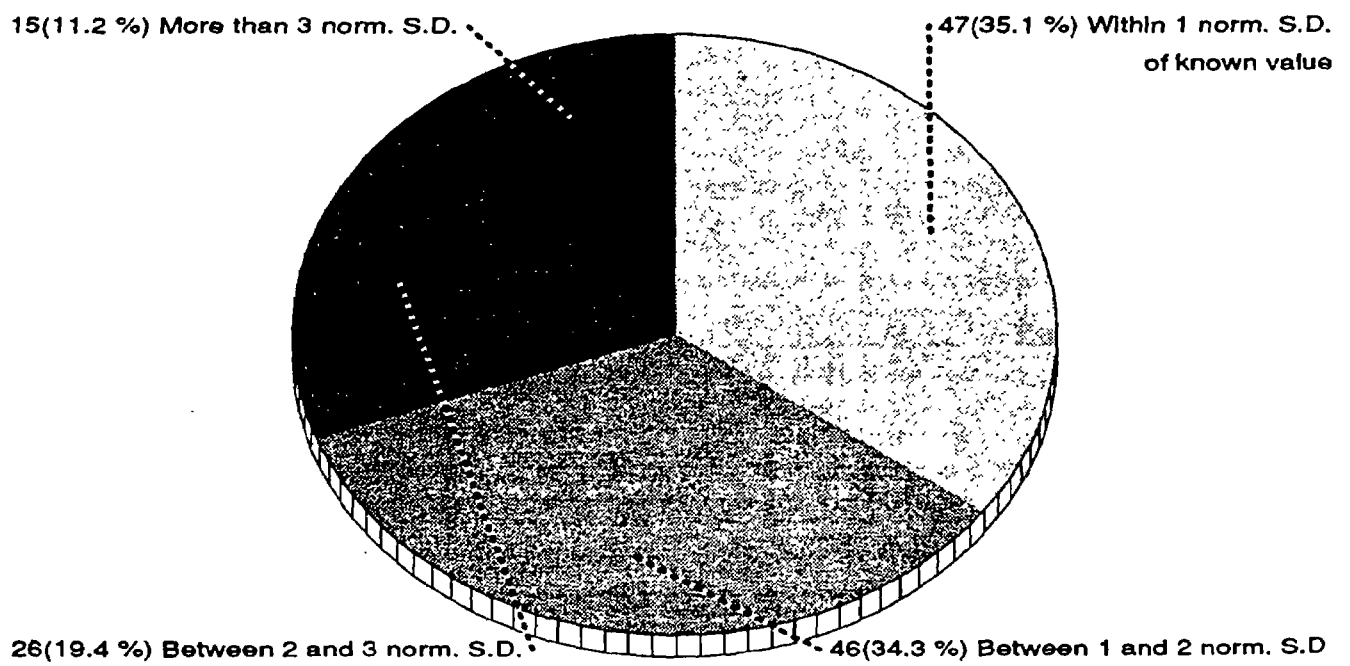
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Beta Statistical Summary 182 Participants

The known value of this nuclide is **94.7 pCi/l** with an expected precision of **10.0**; the control limits are 77.4 to 112.0; the warning regions are 77.4 to 83.1 and 106.3 to 112.0



Statistic	Respondents	Non-outliers
Mean	98.78	**Grand Avg 97.73**
Std. Dev.	20.27	9.53
Variance	410.79	90.90
% Coef. of Var.	20.52	9.76
% deviation of mean from known value	4.31	3.20
Norm. dev. of mean from known value	0.20	0.32
Median	98.93	98.87
% deviation of median from known value	4.47	4.40
Norm. dev. of median from known value	0.21	0.44



Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	106.2	95.3	101.7	5.48	0.644	101.07	0.58	1.10	
AE	83.9	85.1	83.7	0.76	0.083	84.23	-2.34	-1.81	
AF	110.9	112.4	112.3	0.84	0.089	111.87	2.45	2.97	
AH	113.3	122.1	125.2	6.17	0.703	120.20	3.89	4.42	⇑
AJ	84.7	86.1	88.0	1.66	0.195	86.27	-1.99	-1.46	
AK	95.6	95.4	97.1	0.93	0.100	96.03	-0.29	0.23	
AL	98.1	101.5	98.2	1.94	0.201	99.27	0.27	0.79	
AP									•
AR	204.8	196.7	201.9	4.10	0.478	201.13	17.91	18.43	×
AU	105.1	104.0	100.9	2.18	0.248	103.33	0.97	1.50	
AW	92.9	93.2	95.4	1.37	0.148	93.83	-0.67	-0.15	
AZ	96.5	101.0	102.0	2.93	0.325	99.83	0.36	0.89	
BA	98.5	81.2	83.1	9.49	1.042	87.60	-1.75	-1.23	
BB	99.9	100.9	95.8	2.70	0.301	98.87	0.20	0.72	
BC	96.8	90.0	98.3	4.42	0.490	95.03	-0.47	0.06	
BG									•
BH	103.2	102.9	104.2	0.68	0.077	103.43	0.99	1.51	
BK	102.0	105.0	106.0	2.08	0.236	104.33	1.14	1.67	
BL									•
BM	99.8	100.0	100.2	0.20	0.024	100.00	0.39	0.92	
BN	85.3	84.1	85.5	0.76	0.083	84.97	-2.21	-1.69	
BO	89.0	94.0	96.0	3.61	0.413	93.00	-0.82	-0.29	
BS	98.0	94.8	98.8	2.12	0.236	97.20	-0.09	0.43	
BW									•
C	102.8	101.1	105.3	2.11	0.248	103.07	0.92	1.45	
CA	95.8	90.4	90.2	3.18	0.331	92.13	-0.97	-0.44	
CC									•
CE	98.9	94.0	102.9	4.46	0.526	98.60	0.15	0.68	
CJ	101.0	109.0	96.0	6.56	0.768	102.00	0.74	1.26	
CO	85.1	81.1	81.8	2.14	0.236	82.67	-2.61	-2.08	
CP									•
CS	79.4	80.6	83.7	2.22	0.254	81.23	-2.86	-2.33	
CX	84.7	82.9	80.3	2.21	0.260	82.63	-2.61	-2.09	
D	106.3	105.1	104.3	1.01	0.118	105.23	1.30	1.82	
DB	101.0	103.0	97.0	3.06	0.354	100.33	0.45	0.98	
DD	89.7	88.4	91.9	1.77	0.207	90.00	-1.34	-0.81	
DE	98.2	98.4	98.6	0.20	0.024	98.40	0.12	0.64	
DI									•
DO									•
DT	109.9	109.8	111.8	1.13	0.118	110.50	2.21	2.74	
DZ	107.6	111.3	109.1	1.86	0.219	109.33	2.01	2.53	
E	102.2	101.6	102.1	0.32	0.035	101.97	0.73	1.26	
EB	96.8	95.7	96.7	0.61	0.065	96.40	-0.23	0.29	
EL									•
EO	99.0	99.0	97.0	1.15	0.118	98.33	0.10	0.63	

• ≡ 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
ER									•
EV	106.3	108.4	115.4	4.76	0.538	110.03	2.13	2.66	
EX	108.6	133.9	101.9	16.88	2.695	114.80	2.96	3.48	⇑
FE	98.6	99.2	99.2	0.35	0.035	99.00	0.22	0.74	
FF	78.2	77.5	82.5	2.71	0.295	79.40	-3.17	-2.65	
FJ									•
FL	88.8	89.7	93.3	2.38	0.266	90.60	-1.23	-0.71	
FN	52.0	48.0	47.0	2.65	0.295	49.00	-8.44	-7.92	×
GI									•
GQ	98.8	98.8	98.9	0.07	0.006	98.83	0.19	0.72	
GZ	94.7	93.2	89.2	2.84	0.325	92.37	-0.93	-0.40	
HI	72.3	41.4	47.6	16.35	2.572	53.77	-7.61	-7.09	×
HK	104.1	106.6	04.8	1.29	0.148	105.17	1.29	1.81	
HL	98.5	98.0	98.9	0.45	0.053	98.47	0.13	0.65	
HP	99.3	101.0	100.0	0.85	0.100	100.10	0.41	0.94	
I	97.2	102.6	103.5	3.41	0.372	101.10	0.58	1.11	
ID	89.1	91.7	92.1	1.63	0.177	90.97	-1.17	-0.65	
IU									•
J									•
JE	108.9	110.1	108.6	0.79	0.089	109.20	1.99	2.51	
JG									•
JM	107.0	107.0	110.0	1.73	0.177	108.00	1.78	2.30	
JN	99.3	96.4	91.8	3.78	0.443	95.83	-0.33	0.20	
JQ	153.0	150.0	150.0	1.73	0.177	151.00	9.23	9.75	×
JS	102.4	104.3	102.2	1.16	0.124	102.97	0.91	1.43	
JY	93.4	90.5	87.7	2.85	0.337	90.53	-1.25	-0.72	
K	77.6	79.6	80.3	1.40	0.159	79.17	-3.21	-2.69	
KE	206.1	210.7	214.7	4.30	0.508	210.50	19.53	20.06	×
KT	138.0	140.0	142.0	2.00	0.236	140.00	7.32	7.85	×
KX	105.6	105.2	103.5	1.12	0.124	104.77	1.22	1.74	
L	87.8	88.2	88.3	0.26	0.030	88.10	-1.67	-1.14	
LE									•
LF	82.0	100.0	80.0	11.02	1.345	87.33	-1.80	-1.28	
LL	108.9	98.1	92.1	8.51	0.992	99.70	0.34	0.87	
LR	111.0	111.0	111.0	0.00	0.000	111.00	2.30	2.82	
LT									•
M									•
MF	103.6	105.0	102.0	1.50	0.177	103.53	1.01	1.53	
MP									•
MT									•
MV	109.9	114.4	109.1	2.86	0.313	111.13	2.32	2.85	
MY									•
N	97.7	98.1	100.5	1.51	0.165	98.77	0.18	0.70	
NA	106.0	97.0	108.0	5.86	0.650	103.67	1.03	1.55	
NH	93.0	95.0	93.0	1.15	0.118	93.67	-0.70	-0.18	

• ≡ 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)	(known)	Tag
NJ	93.4	90.7	98.6	4.02	0.467	94.23	-0.61	-0.08	
NK									•
NO	98.0	100.0	102.0	2.00	0.236	100.00	0.39	0.92	
O	105.3	104.9	104.9	0.23	0.024	105.03	1.27	1.79	
OB	94.0	91.4	97.1	2.85	0.337	94.17	-0.62	-0.09	
OF	79.9	89.1	92.7	6.60	0.756	87.23	-1.82	-1.29	
OM									•
OS	91.0	86.0	89.0	2.52	0.295	88.67	-1.57	-1.05	
OY									•
P	117.6	95.7	85.1	16.57	2.752	99.47	0.30	0.83	
PA									•
PB	106.5	105.0	105.8	0.75	0.089	105.77	1.39	1.92	
PD	126.3	118.2	108.8	8.76	1.064	117.77	3.47	4.00	⇑
PG									•
PM	107.0	103.0	95.7	5.73	0.667	101.90	0.72	1.25	
PW									•
Q	109.8	111.7	107.5	2.10	0.248	109.67	2.07	2.59	
QM	105.7	105.5	106.7	0.64	0.071	105.97	1.43	1.95	
QP	91.4	86.1	85.3	3.31	0.360	87.60	-1.75	-1.23	
QQ	91.1	93.1	92.6	1.04	0.118	92.27	-0.95	-0.42	
QT	102.6	105.8	103.7	1.63	0.189	104.03	1.09	1.62	
QU	114.0	107.8	100.7	6.66	0.786	107.50	1.69	2.22	
QW	105.3	104.1	106.4	1.15	0.136	105.27	1.31	1.83	
QX	106.8	107.0	107.2	0.20	0.024	107.00	1.61	2.13	
QY									•
QZ	78.8	77.3	77.6	0.79	0.089	77.90	-3.43	-2.91	
RB	110.0	105.0	105.0	2.89	0.295	106.67	1.55	2.07	
RD	95.4	93.1	100.7	3.90	0.449	96.40	-0.23	0.29	
RG	102.0	109.0	107.0	3.61	0.413	106.00	1.43	1.96	
RI	107.2	105.7	111.2	2.84	0.325	108.03	1.79	2.31	
RK	81.5	82.3	90.0	4.69	0.502	84.60	-2.27	-1.75	
RP									•
RR									•
RU									•
RZ									•
S	101.4	106.8	105.8	2.87	0.319	104.67	1.20	1.73	
SD	106.3	111.0	108.7	2.35	0.278	108.67	1.89	2.42	
SF									•
SG	88.1	97.9	99.2	6.07	0.656	95.07	-0.46	0.06	
SI	90.9	88.2	90.1	1.39	0.159	89.73	-1.38	-0.86	
SL	88.9	92.0	93.0	2.14	0.242	91.30	-1.11	-0.59	
SM	84.5	85.2	81.7	1.85	0.207	83.80	-2.41	-1.89	
SN	96.0	99.0	98.0	1.53	0.177	97.67	-0.01	0.51	
SO	103.7	102.8	103.1	0.46	0.053	103.20	0.95	1.47	
SR	87.0	93.6	81.0	6.30	0.744	87.20	-1.82	-1.30	

• ≡ 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
SS	85.1	86.2	85.2	0.61	0.065	85.50	-2.12	-1.59	
SX	107.1	112.4	93.9	9.53	1.177	104.47	1.17	1.69	
SZ	95.4	92.8	91.7	1.90	0.219	93.30	-0.77	-0.24	
T	99.9	101.9	101.5	1.06	0.118	101.10	0.58	1.11	
TD	148.4	152.9	148.5	2.51	0.260	149.90	9.04	9.56	×
TL									•
TN	83.9	81.1	82.8	1.41	0.165	82.60	-2.62	-2.10	
TQ	107.7	105.7	108.9	1.62	0.189	107.43	1.68	2.21	
TS									•
TU	42.3	23.6	20.1	11.94	1.593	28.67	-11.96	-11.44	×
TY	99.9	102.0	100.1	1.16	0.124	100.67	0.51	1.03	
U	89.9	93.0	94.2	2.22	0.254	92.37	-0.93	-0.40	
UA									•
UK									•
UM									•
UP	86.7	76.7	78.4	5.35	0.591	80.60	-2.97	-2.44	
UQ	96.8	95.5	97.6	1.06	0.124	96.63	-0.19	0.33	
UY	88.0	86.4	87.8	0.87	0.095	87.40	-1.79	-1.26	
VA	109.1	96.2	125.7	14.79	2.414	110.33	2.18	2.71	
VC									•
VH	103.2	98.3	102.6	2.67	0.289	101.37	0.63	1.15	
VI	121.1	120.7	119.0	1.12	0.124	120.27	3.90	4.43	⇑
VJ	37.1	36.7	37.4	0.35	0.041	37.07	-10.51	-9.98	×
VM									•
VO									•
VT	109.2	107.5	104.1	2.60	0.301	106.93	1.59	2.12	
W									•
WE	91.1	102.8	103.4	6.93	0.727	99.10	0.24	0.76	
WH	86.7	99.1	93.3	6.20	0.732	93.03	-0.81	-0.29	
WO	94.9	83.7	90.6	5.65	0.662	89.73	-1.38	-0.86	
WR	86.6	88.7	89.7	1.58	0.183	88.33	-1.63	-1.10	
WW	103.1	85.5	95.9	8.85	1.075	94.83	-0.50	0.02	
X	108.3	99.4	113.4	7.09	0.827	107.03	1.61	2.14	
XA									•
XC									•
XD									•
XF	103.5	104.2	107.7	2.25	0.248	105.13	1.28	1.81	
XI	100.0	110.0	100.0	5.77	0.591	103.33	0.97	1.50	
XJ	86.1	85.6	83.3	1.49	0.165	85.00	-2.20	-1.68	
XK	106.0	101.0	104.0	2.52	0.295	103.67	1.03	1.55	
XL	89.5	93.6	97.7	4.10	0.484	93.60	-0.71	-0.19	
XM	95.4	98.6	97.0	1.60	0.189	97.00	-0.13	0.40	
XN	72.7	71.4	72.7	0.75	0.077	72.27	-4.41	-3.89	⇓
XO									•
XP									•

• ≡ 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)	(known)	Tag
XQ	90.1	68.7	72.4	11.44	1.503	77.07	-3.58	-3.05	⇓
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
28.67	×	**TU**	92.37		**GZ**	101.10		**T**
37.07	×	**VJ**	93.00		**BO**	101.37		**VH**
49.00	×	**FN**	93.03		**WH**	101.90		**PM**
53.77	×	**HI**	93.30		**SZ**	101.97		**E**
72.27	⇓	**XN**	93.60		**XL**	102.00		**CJ**
77.07	⇓	**XQ**	93.67		**NH**	102.97		**JS**
77.90		**QZ**	93.83		**AW**	103.07		**C**
79.17		**K**	94.17		**OB**	103.20		**SO**
79.40		**FF**	94.23		**NJ**	103.33		**XI**
80.60		**UP**	94.83		**WW**	103.33		**AU**
81.23		**CS**	95.03		**BC**	103.43		**BH**
82.60		**TN**	95.07		**SG**	103.53		**MF**
82.63		**CX**	95.83		**JN**	103.67		**XK**
82.67		**CO**	96.03		**AK**	103.67		**NA**
83.80		**SM**	96.40		**RD**	104.03		**QT**
84.23		**AE**	96.40		**EB**	104.33		**BK**
84.60		**RK**	96.63		**UQ**	104.47		**SX**
84.97		**BN**	97.00		**XM**	104.67		**S**
85.00		**XJ**	97.20		**BS**	104.77		**KX**
85.50		**SS**	97.67		**SN**	105.03		**O**
86.27		**AJ**	98.33		**EO**	105.13		**XF**
87.20		**SR**	98.40		**DE**	105.17		**HK**
87.23		**OF**	98.47		**HL**	105.23		**D**
87.33		**LF**	98.60		**CE**	105.27		**QW**
87.40		**UY**	98.77		**N**	105.77		**PB**
87.60		**BA**	98.83		**GQ**	105.97		**QM**
87.60		**QP**	98.87		**BB**	106.00		**RG**
88.10		**L**	99.00		**FE**	106.67		**RB**
88.33		**WR**	99.10		**WE**	106.93		**VT**
88.67		**OS**	99.27		**AL**	107.00		**QX**
89.73		**WO**	99.47		**P**	107.03		**X**
89.73		**SI**	99.70		**LL**	107.43		**TQ**
90.00		**DD**	99.83		**AZ**	107.50		**QU**
90.53		**JY**	100.00		**NO**	108.00		**JM**
90.60		**FL**	100.00		**BM**	108.03		**RI**
90.97		**ID**	100.10		**HP**	108.67		**SD**
91.30		**SL**	100.33		**DB**	109.20		**JE**
92.13		**CA**	100.67		**TY**	109.33		**DZ**
92.27		**QQ**	101.07		**A**	109.67		**Q**
92.37		**U**	101.10		**I**	110.03		**EV**

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

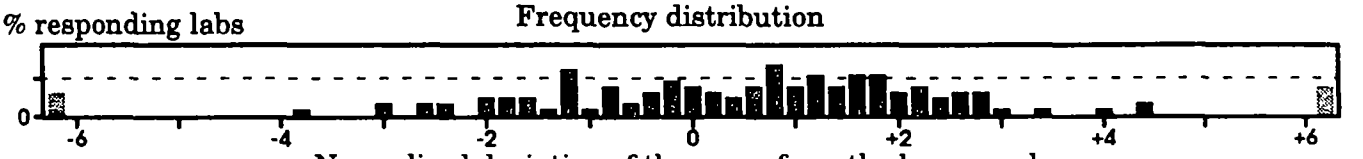
× ≡ Determined to be an outlier

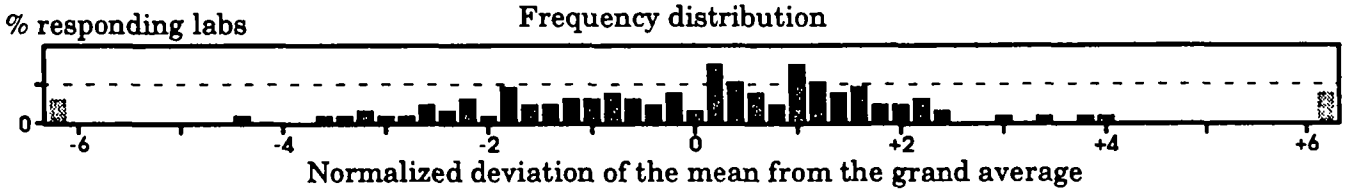
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
110.33		VA	111.87		AF	140.00	×	KT
110.50		DT	114.80	⇑	EX	149.90	×	TD
111.00		LR	117.77	⇑	PD	151.00	×	JQ
111.13		MV	120.20	⇑	AH	201.13	×	AR
			120.27	⇑	VI	210.50	×	KE





• ≡ No data submitted
Ø ≡ Insufficient data

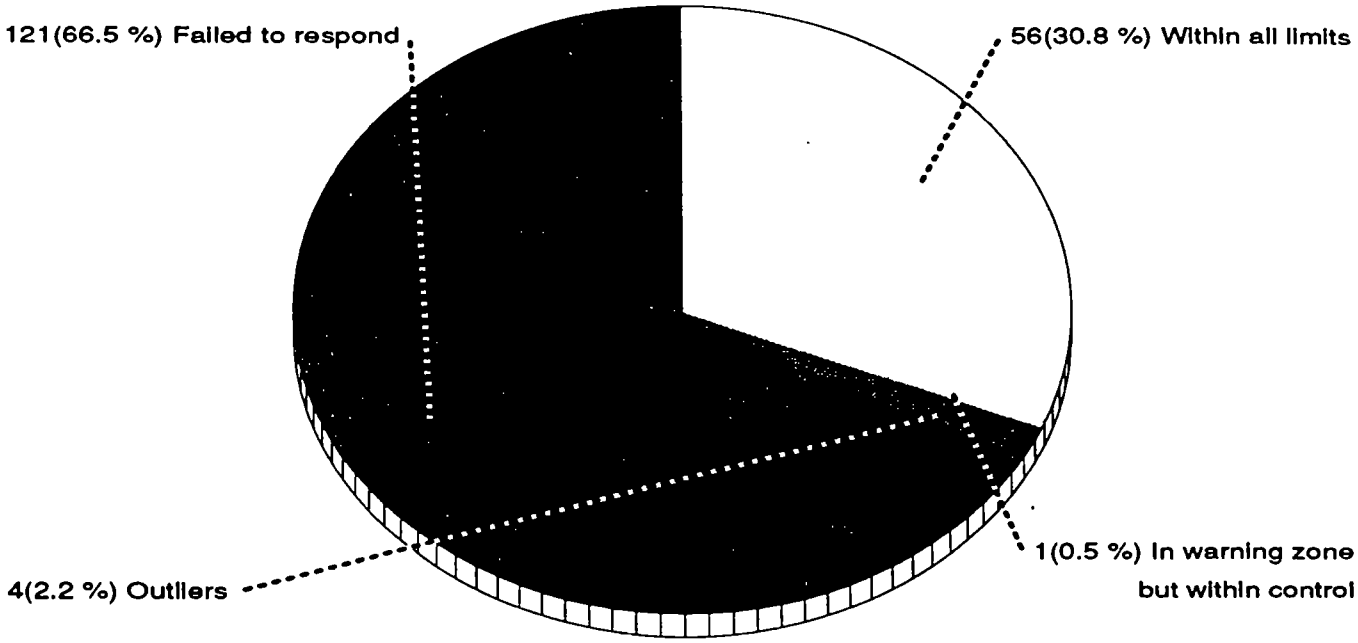
TAG SYMBOLS

× ≡ Determined to be an outlier

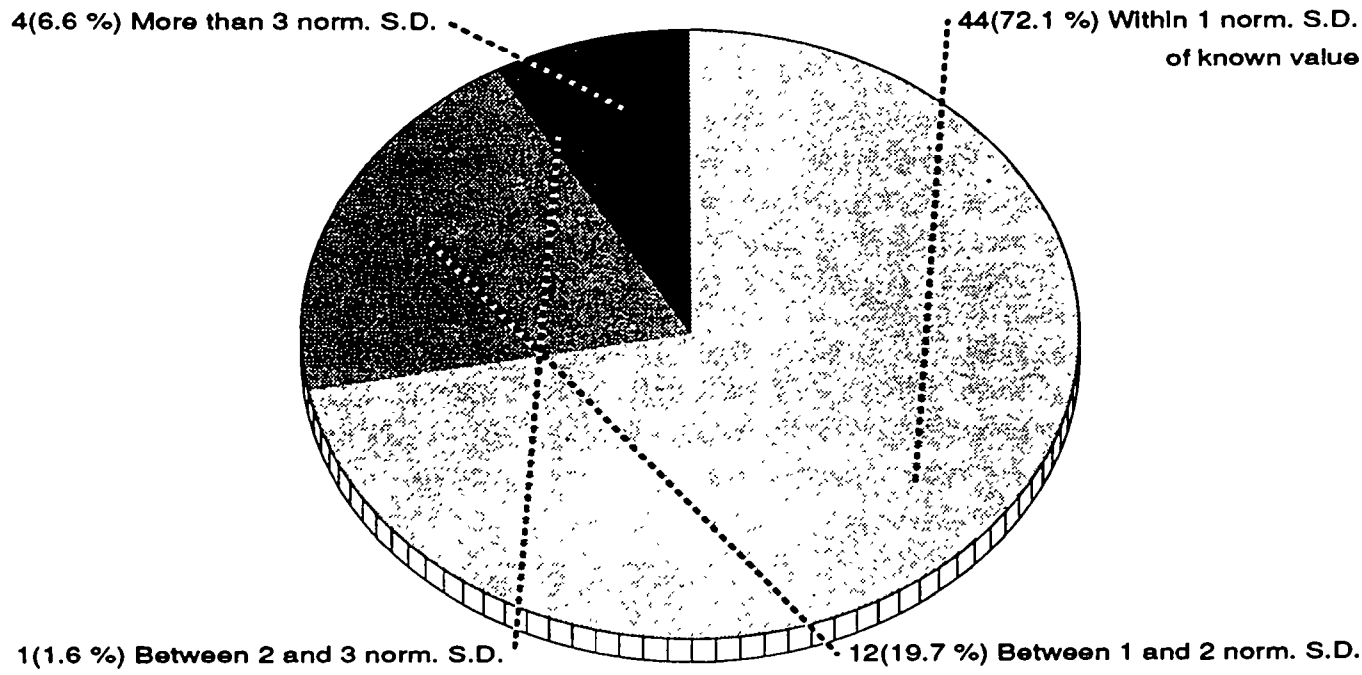
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89 Statistical Summary 182 Participants

The known value of this nuclide is **6.0 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 14.7; the warning regions are 0.0 to 0.2 and 11.8 to 14.7



Statistic	Respondents	Non-outliers
Mean	8.70	**Grand Avg 6.15**
Std. Dev.	11.10	2.53
Variance	123.24	6.40
% Coef. of Var.	127.53	41.16
% deviation of mean from known value	45.08	2.44
Norm. dev. of mean from known value	0.24	0.06
Median	6.33	5.67
% deviation of median from known value	5.56	-5.56
Norm. dev. of median from known value	0.03	-0.13



Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	6.0	4.0	5.0	1.00	0.236	5.00	-0.40	-0.35	
AE	4.0	5.0	5.0	0.58	0.118	4.67	-0.51	-0.46	
AF	7.0	7.0	6.0	0.58	0.118	6.67	0.18	0.23	
AH									•
AJ	11.0	12.0	10.0	1.00	0.236	11.00	1.68	1.73	
AK	7.0	7.0	3.0	2.31	0.473	5.67	-0.17	-0.12	
AL	8.0	8.0	8.0	0.00	0.000	8.00	0.64	0.69	
AP									•
AR									•
AU									•
AW	5.0	6.0	7.0	1.00	0.236	6.00	-0.05	0.00	
AZ	8.0	7.0	7.0	0.58	0.118	7.33	0.41	0.46	
BA	11.0	11.0	14.0	1.73	0.354	12.00	2.03	2.08	
BB									•
BC									•
BG									•
BH	4.0	7.0	13.0	4.58	1.120	8.00	0.64	0.69	
BK									•
BL	8.0	9.0	8.0	0.58	0.118	8.33	0.76	0.81	
BM	10.0	9.0	6.0	2.08	0.473	8.33	0.76	0.81	
BN									•
BO	9.0	8.0	6.0	1.53	0.354	7.67	0.53	0.58	
BS									•
BW									•
C	4.0	5.0	4.0	0.58	0.118	4.33	-0.63	-0.58	
CA	5.0	4.0	7.0	1.53	0.354	5.33	-0.28	-0.23	
CC									•
CE									•
CJ	4.0	6.0	4.0	1.15	0.236	4.67	-0.51	-0.46	
CO									•
CP									•
CS	29.0	32.0	31.0	1.53	0.354	30.67	8.49	8.54	×
CX	4.0	5.0	6.0	1.00	0.236	5.00	-0.40	-0.35	
D	8.0	7.0	6.0	1.00	0.236	7.00	0.30	0.35	
DB									•
DD	4.0	5.0	5.0	0.58	0.118	4.67	-0.51	-0.46	
DE	6.0	7.0	7.0	0.58	0.118	6.67	0.18	0.23	
DI									•
DO	8.0	8.0	6.0	1.15	0.236	7.33	0.41	0.46	
DT	1.0	1.0	1.0	0.00	0.000	1.00	-1.78	-1.73	
DZ									•
E	8.0	9.0	6.0	1.53	0.354	7.67	0.53	0.58	
EB	3.0	4.0	6.0	1.53	0.354	4.33	-0.63	-0.58	
EL	1.0	1.0	1.0	0.00	0.000	1.00	-1.78	-1.73	
EO									•

• ≡ 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
ER									•
EV									•
EX									•
FE	4.0	4.0	5.0	0.58	0.118	4.33	-0.63	-0.58	
FF									•
FJ									•
FL									•
FN									•
GI									•
GQ	5.0	5.0	5.0	0.00	0.000	5.00	-0.40	-0.35	
GZ									•
HI									•
HK	5.0	5.0	5.0	0.00	0.000	5.00	-0.40	-0.35	
HL									•
HP	91.0	76.0	62.0	14.50	5.621	76.33	24.31	24.36	×
I	9.0	9.0	11.0	1.15	0.236	9.67	1.22	1.27	
ID									•
IU									•
J									•
JE									•
JG									•
JM									•
JN									•
JQ									•
JS	7.0	12.0	8.0	2.65	0.591	9.00	0.99	1.04	
JY	4.0	6.0	3.0	1.53	0.354	4.33	-0.63	-0.58	
K	4.0	5.0	7.0	1.53	0.354	5.33	-0.28	-0.23	
KE									•
KT									•
KX									•
L	7.0	7.0	7.0	0.00	0.000	7.00	0.30	0.35	
LE									•
LF	5.0	4.0	5.0	0.58	0.118	4.67	-0.51	-0.46	
LL									•
LR									•
LT									•
M									•
MF									•
MP									•
MT									•
MV									•
MY									•
N	8.0	8.0	9.0	0.58	0.118	8.33	0.76	0.81	
NA									•
NH									•

• ≡ 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
NJ	7.0	4.0	8.0	2.08	0.473	6.33	0.06	0.12	
NK									•
NO									•
O									•
OB									•
OF									•
OM									•
OS									•
OY									•
P									•
PA									•
PB	2.0	2.0	2.0	0.00	0.000	2.00	-1.44	-1.39	
PD									•
PG									•
PM									•
PW									•
Q	9.0	6.0	6.0	1.73	0.354	7.00	0.30	0.35	
QM	1.0	2.0	2.0	0.58	0.118	1.67	-1.55	-1.50	
QP									•
QQ									•
QT									•
QU	11.0	12.0	12.0	0.58	0.118	11.67	1.91	1.96	
QW	10.0	11.0	10.0	0.58	0.118	10.33	1.45	1.50	
QX									•
QY									•
QZ	9.0	7.0	6.0	1.53	0.354	7.33	0.41	0.46	
RB									•
RD									•
RG									•
RI									•
RK									•
RP									•
RR									•
RU									•
RZ									•
S									•
SD									•
SF									•
SG									•
SI	37.0	43.0	41.0	3.06	0.709	40.33	11.84	11.89	×
SL									•
SM	11.0	6.0	10.0	2.65	0.591	9.00	0.99	1.04	
SN									•
SO									•
SR									•

• ≡ 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
SS	4.0	4.0	4.0	0.00	0.000	4.00	-0.74	-0.69	
SX									•
SZ	1.0	1.0	1.0	0.00	0.000	1.00	-1.78	-1.73	
T	3.0	4.0	5.0	1.00	0.236	4.00	-0.74	-0.69	
TD	5.0	7.0	9.0	2.00	0.473	7.00	0.30	0.35	
TL									•
TN									•
TQ	5.0	4.0	5.0	0.58	0.118	4.67	-0.51	-0.46	
TS									•
TU									•
TY									•
U									•
UA									•
UK									•
UM									•
UP	5.0	5.0	6.0	0.58	0.118	5.33	-0.28	-0.23	
UQ									•
UY									•
VA	35.0	26.0	39.0	6.66	2.020	33.33	9.42	9.47	×
VC									•
VH	7.0	7.0	8.0	0.58	0.118	7.33	0.41	0.46	
VI									•
VJ									•
VM									•
VO									•
VT									•
W	5.0	6.0	6.0	0.58	0.118	5.67	-0.17	-0.12	
WE									•
WH									•
WO	9.0	8.0	7.0	1.00	0.236	8.00	0.64	0.69	
WR									•
WW									•
X	4.0	3.0	4.0	0.58	0.118	3.67	-0.86	-0.81	
XA									•
XC									•
XD									•
XF									•
XI	5.0	3.0	6.0	1.53	0.354	4.67	-0.51	-0.46	
XJ									•
XK	4.0	5.0	4.0	0.58	0.118	4.33	-0.63	-0.58	
XL	5.0	5.0	5.0	0.00	0.000	5.00	-0.40	-0.35	
XM	10.0	10.0	10.0	0.00	0.000	10.00	1.33	1.39	
XN									•
XO									•
XP									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

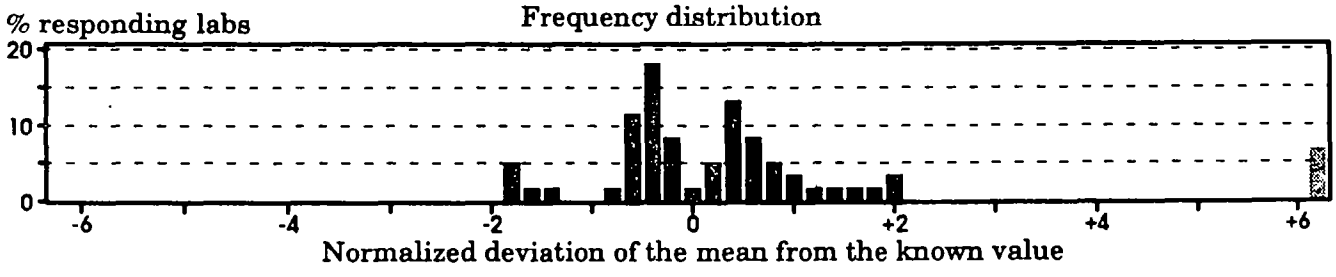
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XQ									∅
XR									∅

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.00		**SZ**	5.00		**HK**	7.33		**AZ**
1.00		**EL**	5.00		**GQ**	7.67		**E**
1.00		**DT**	5.00		**CX**	7.67		**BO**
1.67		**QM**	5.00		**A**	8.00		**WO**
2.00		**PB**	5.33		**UP**	8.00		**BH**
3.67		**X**	5.33		**K**	8.00		**AL**
4.00		**T**	5.33		**CA**	8.33		**N**
4.00		**SS**	5.67		**W**	8.33		**BM**
4.33		**XK**	5.67		**AK**	8.33		**BL**
4.33		**JY**	6.00		**AW**	9.00		**SM**
4.33		**FE**	6.33		**NJ**	9.00		**JS**
4.33		**EB**	6.67		**DE**	9.67		**I**
4.33		**C**	6.67		**AF**	10.00		**XM**
4.67		**XI**	7.00		**TD**	10.33		**QW**
4.67		**TQ**	7.00		**Q**	11.00		**AJ**
4.67		**LF**	7.00		**L**	11.67		**QU**
4.67		**DD**	7.00		**D**	12.00		**BA**
4.67		**CJ**	7.33		**VH**	30.67	×	**CS**
4.67		**AE**	7.33		**QZ**	33.33	×	**VA**
5.00		**XL**	7.33		**DO**	40.33	×	**SI**
						76.33	×	**HP**



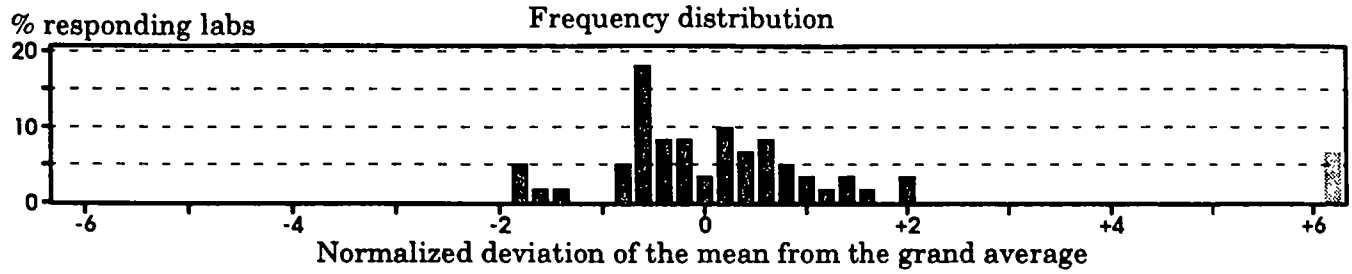
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

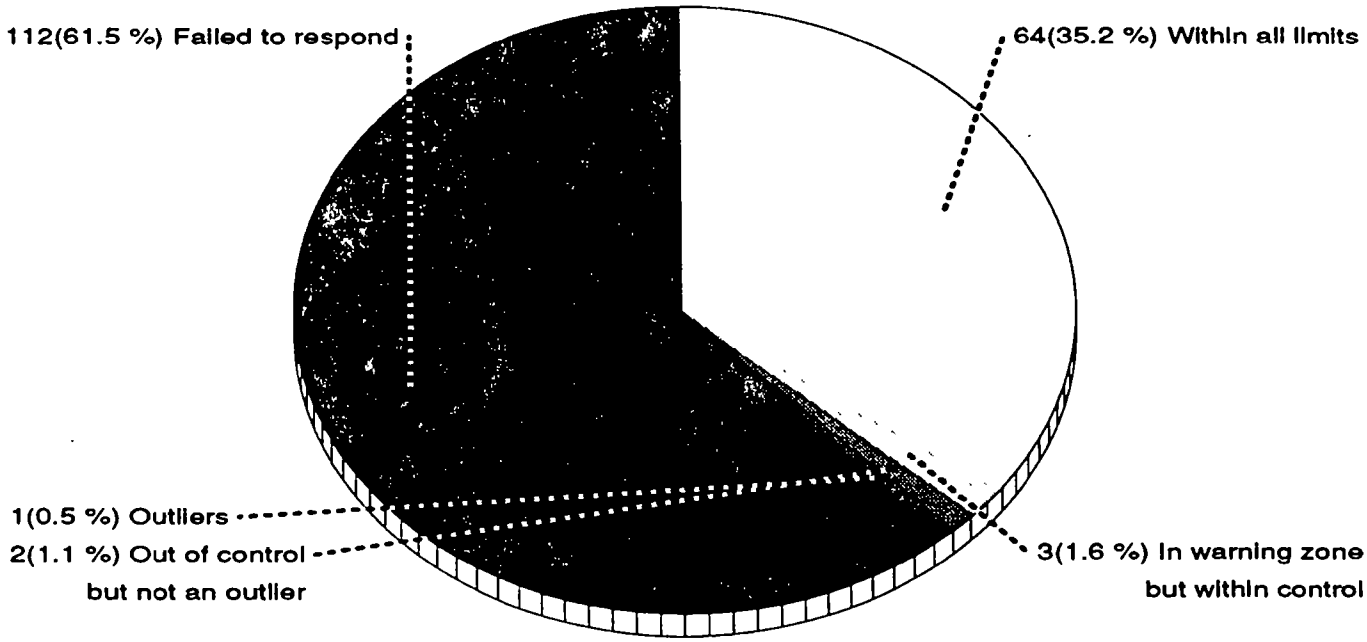
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

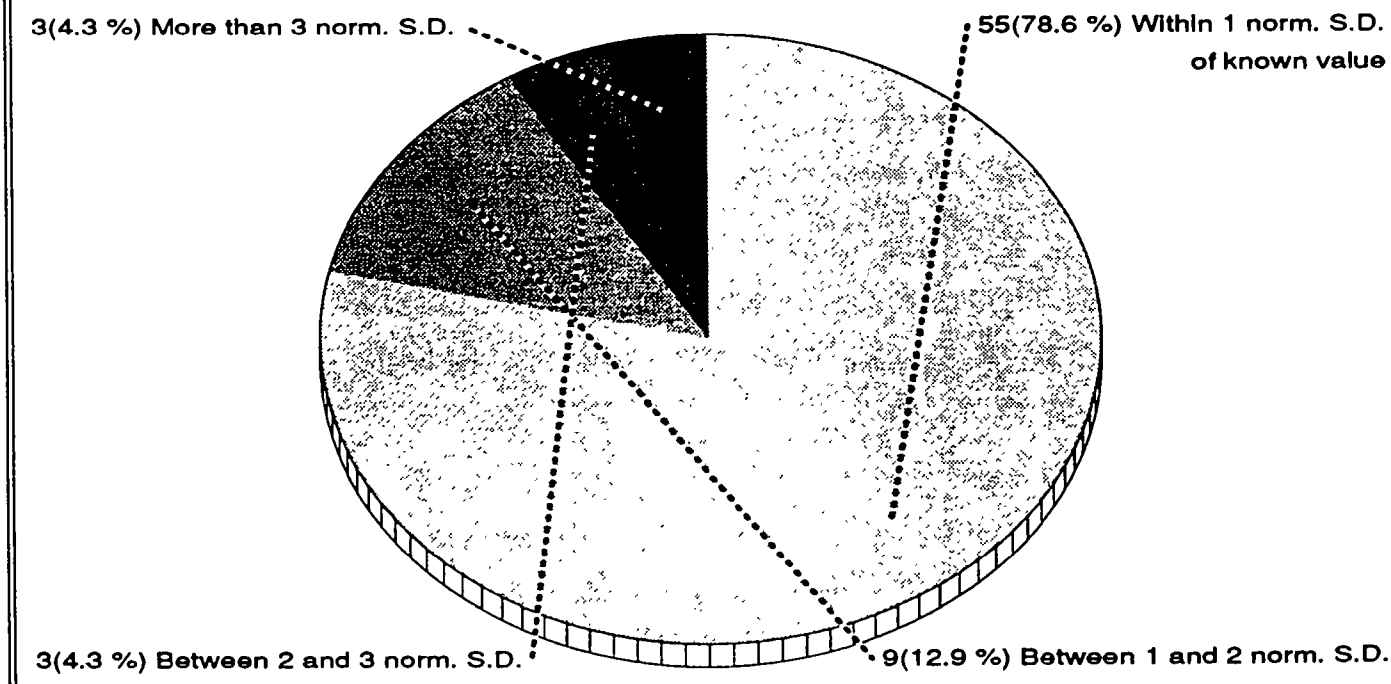


Strontium-90 Statistical Summary 182 Participants

The known value of this nuclide is **18.0 pCi/l** with an expected precision of **5.0**; the control limits are 9.3 to 26.7; the warning regions are 9.3 to 12.2 and 23.8 to 26.7



Statistic	Respondents	Non-outliers
Mean	17.50	**Grand Avg 17.06**
Std. Dev.	4.60	2.75
Variance	21.13	7.56
% Coef. of Var.	26.26	16.12
% deviation of mean from known value	-2.75	-5.21
Norm. dev. of mean from known value	-0.11	-0.34
Median	17.33	17.33
% deviation of median from known value	-3.70	-3.70
Norm. dev. of median from known value	-0.15	-0.24



Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	18.0	19.0	20.0	1.00	0.236	19.00	0.67	0.35	
AE	17.0	17.0	16.0	0.58	0.118	16.67	-0.14	-0.46	
AF	18.0	17.0	18.0	0.58	0.118	17.67	0.21	-0.12	
AH									•
AJ	16.0	16.0	17.0	0.58	0.118	16.33	-0.25	-0.58	
AK	17.0	18.0	18.0	0.58	0.118	17.67	0.21	-0.12	
AL	16.0	15.0	16.0	0.58	0.118	15.67	-0.48	-0.81	
AP									•
AR									•
AU	17.0	20.0	22.0	2.52	0.591	19.67	0.90	0.58	
AW	18.0	18.0	18.0	0.00	0.000	18.00	0.32	0.00	
AZ	17.0	17.0	18.0	0.58	0.118	17.33	0.09	-0.23	
BA	16.0	16.0	15.0	0.58	0.118	15.67	-0.48	-0.81	
BB	15.0	15.0	15.0	0.00	0.000	15.00	-0.71	-1.04	
BC	18.0	18.0	18.0	0.00	0.000	18.00	0.32	0.00	
BG									•
BH	17.0	18.0	20.0	1.53	0.354	18.33	0.44	0.12	
BK									•
BL	19.0	17.0	19.0	1.15	0.236	18.33	0.44	0.12	
BM	17.0	18.0	18.0	0.58	0.118	17.67	0.21	-0.12	
BN									•
BO	15.0	17.0	16.0	1.00	0.236	16.00	-0.37	-0.69	
BS									•
BW									•
C	18.0	17.0	17.0	0.58	0.118	17.33	0.09	-0.23	
CA	19.0	17.0	16.0	1.53	0.354	17.33	0.09	-0.23	
CC									•
CE	17.0	17.0	17.0	0.00	0.000	17.00	-0.02	-0.35	
CJ	21.0	21.0	23.0	1.15	0.236	21.67	1.59	1.27	
CO	18.0	14.0	17.0	2.08	0.473	16.33	-0.25	-0.58	
CP	18.0	17.0	17.0	0.58	0.118	17.33	0.09	-0.23	
CS	24.0	26.0	26.0	1.15	0.236	25.33	2.86	2.54	
CX	18.0	14.0	13.0	2.65	0.591	15.00	-0.71	-1.04	
D	16.0	16.0	17.0	0.58	0.118	16.33	-0.25	-0.58	
DB									•
DD	18.0	17.0	17.0	0.58	0.118	17.33	0.09	-0.23	
DE	18.0	19.0	19.0	0.58	0.118	18.67	0.56	0.23	
DI									•
DO	16.0	16.0	16.0	0.00	0.000	16.00	-0.37	-0.69	
DT	19.0	19.0	19.0	0.00	0.000	19.00	0.67	0.35	
DZ	23.0	22.0	24.0	1.00	0.236	23.00	2.06	1.73	
E	18.0	17.0	18.0	0.58	0.118	17.67	0.21	-0.12	
EB	16.0	17.0	18.0	1.00	0.236	17.00	-0.02	-0.35	
EL	16.0	16.0	15.0	0.58	0.118	15.67	-0.48	-0.81	
EO									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ 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
ER									•
EV									•
EX									•
FE	21.0	19.0	20.0	1.00	0.236	20.00	1.02	0.69	
FF									•
FJ									•
FL									•
FN									•
GI									•
GQ	20.0	20.0	20.0	0.00	0.000	20.00	1.02	0.69	
GZ									•
HI									•
HK	17.0	17.0	17.0	0.00	0.000	17.00	-0.02	-0.35	
HL									•
HP	9.0	10.0	14.0	2.65	0.591	11.00	-2.10	-2.42	
I	19.0	19.0	19.0	0.00	0.000	19.00	0.67	0.35	
ID									•
IU									•
J									•
JE									•
JG									•
JM									•
JN									•
JQ									•
JS	16.0	16.0	17.0	0.58	0.118	16.33	-0.25	-0.58	
JY	18.0	15.0	17.0	1.53	0.354	16.67	-0.14	-0.46	
K	16.0	16.0	16.0	0.00	0.000	16.00	-0.37	-0.69	
KE									•
KT									•
KX									•
L	17.0	17.0	17.0	0.00	0.000	17.00	-0.02	-0.35	
LE									•
LF	16.0	16.0	20.0	2.31	0.473	17.33	0.09	-0.23	
LL									•
LR									•
LT									•
M									•
MF									•
MP									•
MT									•
MV									•
MY									•
N	18.0	18.0	19.0	0.58	0.118	18.33	0.44	0.12	
NA									•
NH									•

• ≡ 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)	(known)	Tag
NJ	13.0	16.0	15.0	1.53	0.354	14.67	-0.83	-1.15	
NK									•
NO									•
O									•
OB									•
OF									•
OM									•
OS									•
OY									•
P									•
PA									•
PB	20.0	20.0	20.0	0.00	0.000	20.00	1.02	0.69	
PD									•
PG									•
PM									•
PW									•
Q	21.0	20.0	20.0	0.58	0.118	20.33	1.13	0.81	
QM	14.0	14.0	12.0	1.15	0.236	13.33	-1.29	-1.62	
QP									•
QQ									•
QT									•
QU	17.0	18.0	19.0	1.00	0.236	18.00	0.32	0.00	
QW	15.0	14.0	16.0	1.00	0.236	15.00	-0.71	-1.04	
QX									•
QY									•
QZ	17.0	17.0	17.0	0.00	0.000	17.00	-0.02	-0.35	
RB									•
RD									•
RG									•
RI									•
RK									•
RP									•
RR									•
RU									•
RZ									•
S									•
SD	20.0	19.0	21.0	1.00	0.236	20.00	1.02	0.69	
SF									•
SG									•
SI	9.0	8.0	9.0	0.58	0.118	8.67	-2.91	-3.23	⇓
SL									•
SM	12.0	17.0	14.0	2.52	0.591	14.33	-0.95	-1.27	
SN									•
SO									•
SR									•

• ≡ 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
SS	18.0	17.0	18.0	0.58	0.118	17.67	0.21	-0.12	
SX									•
SZ	21.0	19.0	21.0	1.15	0.236	20.33	1.13	0.81	
T	17.0	16.0	18.0	1.00	0.236	17.00	-0.02	-0.35	
TD	18.0	18.0	20.0	1.15	0.236	18.67	0.56	0.23	
TL									•
TN									•
TQ	16.0	17.0	18.0	1.00	0.236	17.00	-0.02	-0.35	
TS									•
TU									•
TY									•
U									•
UA									•
UK									•
UM									•
UP	46.0	50.0	48.0	2.00	0.473	48.00	10.72	10.39	×
UQ									•
UY									•
VA	9.0	10.0	8.0	1.00	0.236	9.00	-2.79	-3.12	⇓
VC									•
VH	24.0	16.0	20.0	4.00	0.945	20.00	1.02	0.69	
VI									•
VJ									•
VM									•
VO									•
VT									•
W	17.0	19.0	18.0	1.00	0.236	18.00	0.32	0.00	
WE									•
WH									•
WO	12.0	10.0	10.0	1.15	0.236	10.67	-2.22	-2.54	
WR	12.0	12.0	13.0	0.58	0.118	12.33	-1.64	-1.96	
WW									•
X	18.0	17.0	17.0	0.58	0.118	17.33	0.09	-0.23	
XA									•
XC									•
XL									•
XF									•
XI	13.0	20.0	15.0	3.61	0.827	16.00	-0.37	-0.69	
XJ									•
XK	17.0	15.0	16.0	1.00	0.236	16.00	-0.37	-0.69	
XL	16.0	16.0	16.0	0.00	0.000	16.00	-0.37	-0.69	
XM	16.0	16.0	17.0	0.58	0.118	16.33	-0.25	-0.58	
XN									•
XO									•
XP									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

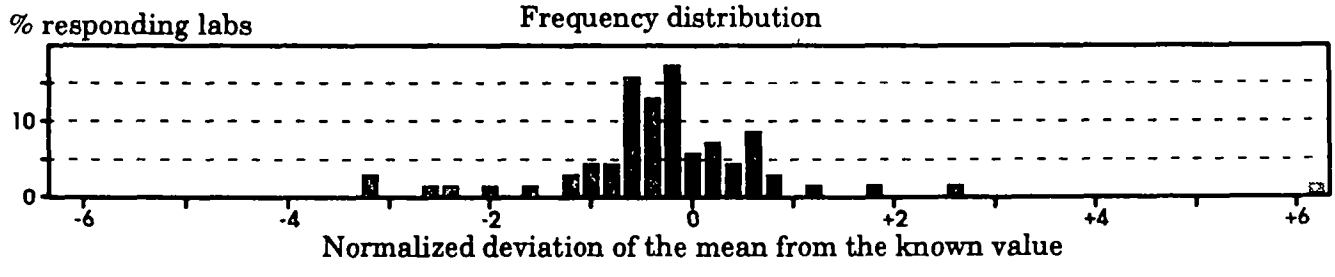
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XQ									•
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.67	⇓	**SI**	16.33		**CO**	18.00		**W**
9.00	⇓	**VA**	16.33		**AJ**	18.00		**QU**
10.67		**WO**	16.67		**JY**	18.00		**BC**
11.00		**HP**	16.67		**AE**	18.00		**AW**
12.33		**WR**	17.00		**TQ**	18.33		**N**
13.33		**QM**	17.00		**T**	18.33		**BL**
14.33		**SM**	17.00		**QZ**	18.33		**BH**
14.67		**NJ**	17.00		**L**	18.67		**TD**
15.00		**QW**	17.00		**HK**	18.67		**DE**
15.00		**CX**	17.00		**EB**	19.00		**I**
15.00		**BB**	17.00		**CE**	19.00		**DT**
15.67		**EL**	17.33		**X**	19.00		**A**
15.67		**BA**	17.33		**LF**	19.67		**AU**
15.67		**AL**	17.33		**DD**	20.00		**VH**
16.00		**XL**	17.33		**CP**	20.00		**SD**
16.00		**XK**	17.33		**CA**	20.00		**PB**
16.00		**XI**	17.33		**C**	20.00		**GQ**
16.00		**K**	17.33		**AZ**	20.00		**FE**
16.00		**DO**	17.67		**SS**	20.33		**SZ**
16.00		**BO**	17.67		**E**	20.33		**Q**
16.33		**XM**	17.67		**BM**	21.67		**CJ**
16.33		**JS**	17.67		**AK**	23.00		**DZ**
16.33		**D**	17.67		**AF**	25.33		**CS**
						48.00	×	**UP**



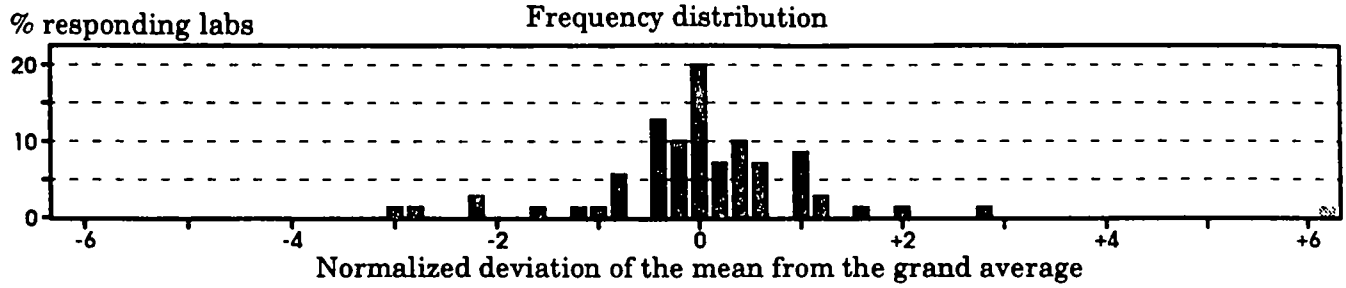
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

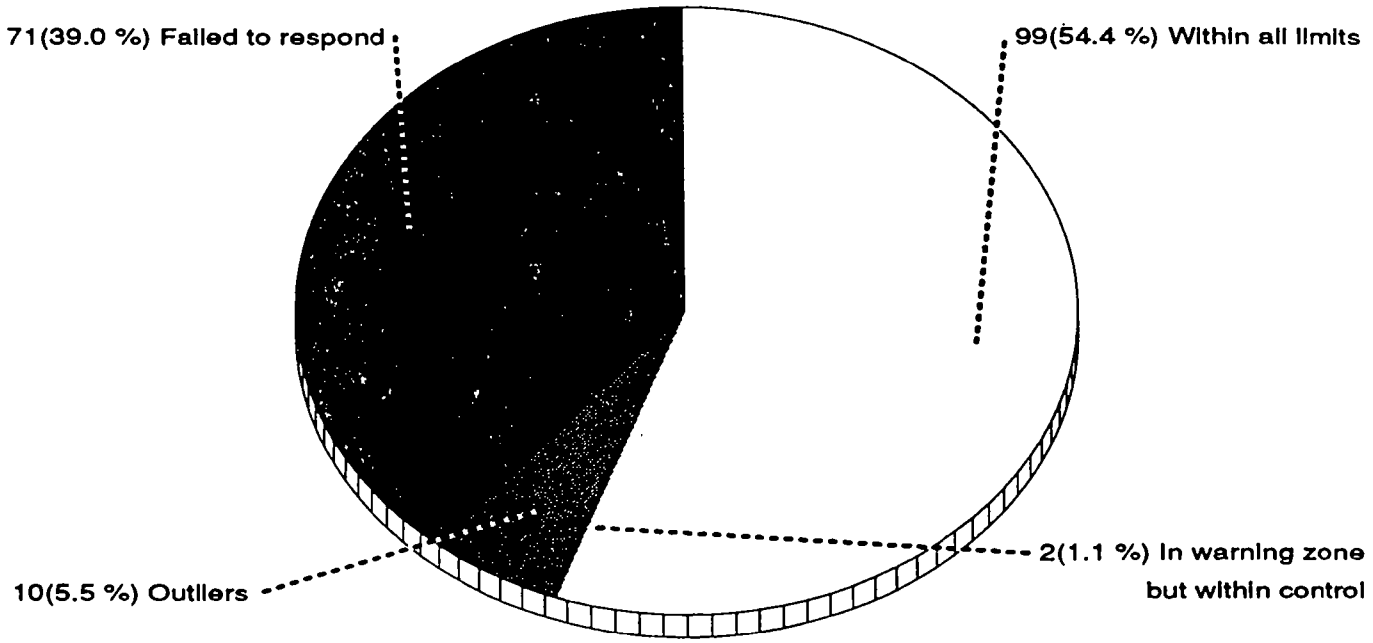
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

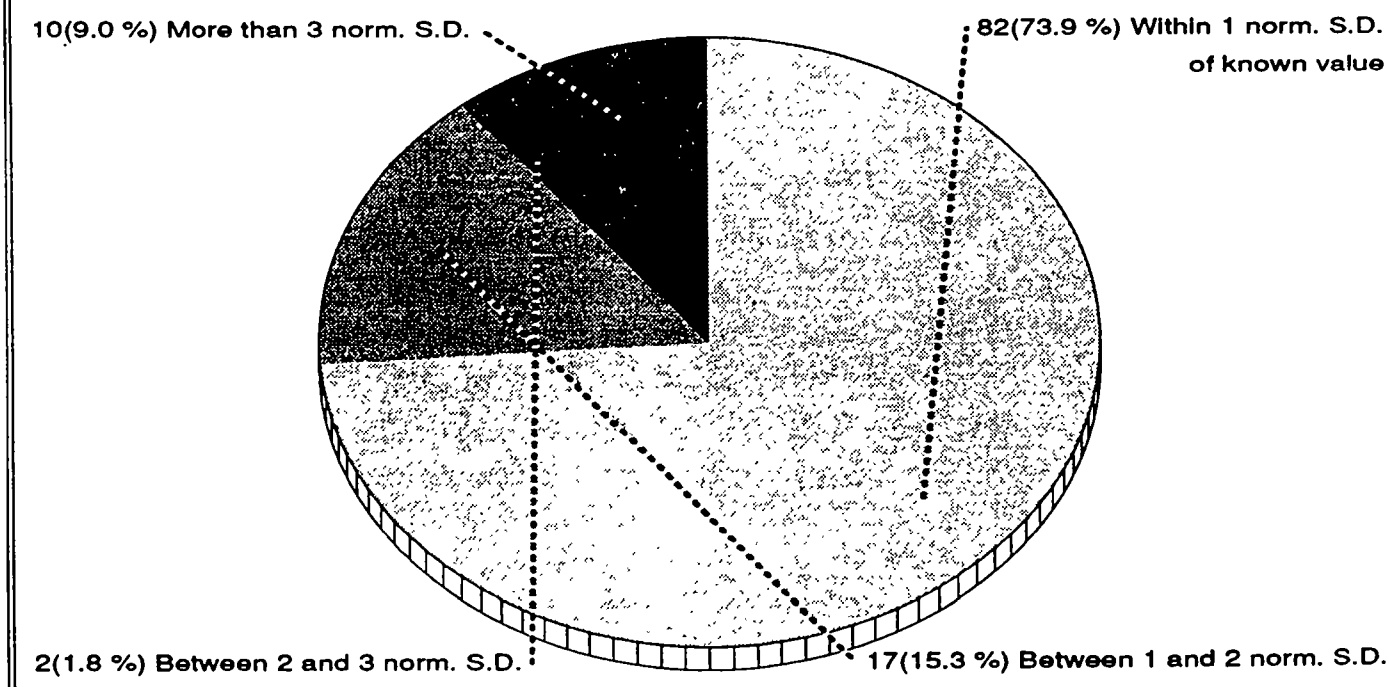


Cobalt-60 Statistical Summary 182 Participants

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	64.42	**Grand Avg 49.65**
Std. Dev.	102.54	2.25
Variance	10513.89	5.08
% Coef. of Var.	159.18	4.54
% deviation of mean from known value	28.83	-0.70
Norm. dev. of mean from known value	0.14	-0.16
Median	49.67	49.67
% deviation of median from known value	-0.67	-0.67
Norm. dev. of median from known value	0.00	-0.15



Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	48.0	49.0	50.0	1.00	0.236	49.00	-0.23	-0.35	
AE	50.0	49.0	48.0	1.00	0.236	49.00	-0.23	-0.35	
AF	50.0	52.0	52.0	1.15	0.236	51.33	0.58	0.46	
AH									•
AJ	46.0	53.0	50.0	3.51	0.827	49.67	0.01	-0.12	
AK	51.0	49.0	52.0	1.53	0.354	50.67	0.35	0.23	
AL	43.0	42.0	43.0	0.58	0.118	42.67	-2.42	-2.54	
AP									•
AR									•
AU	48.0	46.0	46.0	1.15	0.236	46.67	-1.03	-1.15	
AW	51.0	52.0	50.0	1.00	0.236	51.00	0.47	0.35	
AZ	43.0	45.0	50.0	3.61	0.827	46.00	-1.26	-1.39	
BA	51.0	45.0	55.0	5.03	1.345	50.33	0.24	0.12	
BB	50.0	49.0	51.0	1.00	0.236	50.00	0.12	0.00	
BC	50.0	50.0	50.0	0.00	0.000	50.00	0.12	0.00	
BG									•
BH	49.0	50.0	51.0	1.00	0.236	50.00	0.12	0.00	
BK	77.0	78.0	78.0	0.58	0.118	77.67	9.71	9.58	×
BL	54.0	51.0	49.0	2.52	0.591	51.33	0.58	0.46	
BM	50.0	49.0	49.0	0.58	0.118	49.33	-0.11	-0.23	
BN	49.0	54.0	49.0	2.89	0.591	50.67	0.35	0.23	
BO	51.0	52.0	50.0	1.00	0.236	51.00	0.47	0.35	
BS									•
BW									•
C	52.0	55.0	55.0	1.73	0.354	54.00	1.51	1.39	
CA	51.0	51.0	48.0	1.73	0.354	50.00	0.12	0.00	
CC									•
CE	52.0	50.0	53.0	1.53	0.354	51.67	0.70	0.58	
CJ	54.0	51.0	52.0	1.53	0.354	52.33	0.93	0.81	
CO	49.0	52.0	58.0	4.58	1.120	53.00	1.16	1.04	
CP	54.0	48.0	53.0	3.21	0.709	51.67	0.70	0.58	
CS	52.0	48.0	51.0	2.08	0.473	50.33	0.24	0.12	
CX	58.0	58.0	56.0	1.15	0.236	57.33	2.66	2.54	
D	50.0	50.0	53.0	1.73	0.354	51.00	0.47	0.35	
DB									•
DD	48.0	47.0	48.0	0.58	0.118	47.67	-0.69	-0.81	
DE	53.0	53.0	53.0	0.00	0.000	53.00	1.16	1.04	
DI									•
DO	50.0	50.0	51.0	0.58	0.118	50.33	0.24	0.12	
DT	52.0	51.0	53.0	1.00	0.236	52.00	0.81	0.69	
DZ									•
E	51.0	51.0	47.0	2.31	0.473	49.67	0.01	-0.12	
EB	51.0	51.0	51.0	0.00	0.000	51.00	0.47	0.35	
EL	48.0	48.0	49.0	0.58	0.118	48.33	-0.46	-0.58	
EO									•

• ≡ 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
ER									•
EV									•
EX	49.0	48.0	41.0	4.36	0.945	46.00	-1.26	-1.39	
FE	45.0	52.0	50.0	3.61	0.827	49.00	-0.23	-0.35	
FF									•
FJ									•
FL	46.0	49.0	48.0	1.53	0.354	47.67	-0.69	-0.81	
FN									•
GI	47.0	50.0	49.0	1.53	0.354	48.67	-0.34	-0.46	
GQ	51.0	51.0	51.0	0.00	0.000	51.00	0.47	0.35	
GZ									•
HI	74.0	73.0	73.0	0.58	0.118	73.33	8.20	8.08	×
HK	49.0	49.0	50.0	0.58	0.118	49.33	-0.11	-0.23	
HL	48.0	47.0	49.0	1.00	0.236	48.00	-0.57	-0.69	
HP	48.0	49.0	47.0	1.00	0.236	48.00	-0.57	-0.69	
I	50.0	49.0	47.0	1.53	0.354	48.67	-0.34	-0.46	
ID									•
IU	49.0	52.0	48.0	2.08	0.473	49.67	0.01	-0.12	
J									•
JE	49.0	50.0	51.0	1.00	0.236	50.00	0.12	0.00	
JG									•
JM	49.0	49.0	49.0	0.00	0.000	49.00	-0.23	-0.35	
JN									•
JQ									•
JS	49.0	50.0	49.0	0.58	0.118	49.33	-0.11	-0.23	
JY	51.0	50.0	52.0	1.00	0.236	51.00	0.47	0.35	
K	47.0	51.0	46.0	2.65	0.591	48.00	-0.57	-0.69	
KE									•
KT									•
KX	48.0	50.0	47.0	1.53	0.354	48.33	-0.46	-0.58	
L	47.0	51.0	52.0	2.65	0.591	50.00	0.12	0.00	
LE									•
LF	51.0	49.0	50.0	1.00	0.236	50.00	0.12	0.00	
LL									•
LR	47.0	50.0	47.0	1.73	0.354	48.00	-0.57	-0.69	
LT									•
M									•
MF									•
MP	53.0	50.0	49.0	2.08	0.473	50.67	0.35	0.23	
MT									•
MV	41.0	35.0	41.0	3.46	0.709	39.00	-3.69	-3.81	×
MY									•
N	48.0	53.0	51.0	2.52	0.591	50.67	0.35	0.23	
NA									•
NH	53.0	48.0	49.0	2.65	0.591	50.00	0.12	0.00	

• ≡ 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
NJ	49.0	51.0	49.0	1.15	0.236	49.67	0.01	-0.12	
NK									•
NO									•
O	50.0	50.0	51.0	0.58	0.118	50.33	0.24	0.12	
OB	51.0	51.0	50.0	0.58	0.118	50.67	0.35	0.23	
OF									•
OM	47.0	49.0	45.0	2.00	0.473	47.00	-0.92	-1.04	
OS									•
OY									•
P	50.0	51.0	53.0	1.53	0.354	51.33	0.58	0.46	
PA									•
PB	50.0	49.0	50.0	0.58	0.118	49.67	0.01	-0.12	
PD	52.0	44.0	48.0	4.00	0.945	48.00	-0.57	-0.69	
PG									•
PM	50.0	53.0	52.0	1.53	0.354	51.67	0.70	0.58	
PW	48.0	48.0	48.0	0.00	0.000	48.00	-0.57	-0.69	
Q	52.0	56.0	50.0	3.06	0.709	52.67	1.04	0.92	
QM	55.0	54.0	58.0	2.08	0.473	55.67	2.08	1.96	
QP	47.0	49.0	48.0	1.00	0.236	48.00	-0.57	-0.69	
QQ									•
QT	48.0	48.0	48.0	0.00	0.000	48.00	-0.57	-0.69	
QU	48.0	47.0	50.0	1.53	0.354	48.33	-0.46	-0.58	
QW	44.0	47.0	48.0	2.08	0.473	46.33	-1.15	-1.27	
QX	64.0	58.0	64.0	3.46	0.709	62.00	4.28	4.16	×
QY									•
QZ	50.0	51.0	53.0	1.53	0.354	51.33	0.58	0.46	
RB									•
RD									•
RG									•
RI									•
RK	47.0	47.0	47.0	0.00	0.000	47.00	-0.92	-1.04	
RP									•
RR									•
RU	772.0	770.0	769.0	1.53	0.354	770.33	249.65	249.53	×
RZ									•
S	48.0	50.0	49.0	1.00	0.236	49.00	-0.23	-0.35	
SD	50.0	46.0	48.0	2.00	0.473	48.00	-0.57	-0.69	
SF									•
SG									•
SI	52.0	52.0	59.0	4.04	0.827	54.33	1.62	1.50	
SL									•
SM	47.0	50.0	52.0	2.52	0.591	49.67	0.01	-0.12	
SN	48.0	45.0	45.0	1.73	0.354	46.00	-1.26	-1.39	
SO									•
SR	47.0	49.0	46.0	1.53	0.354	47.33	-0.80	-0.92	

• ≡ 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
SS	47.0	44.0	45.0	1.53	0.354	45.33	-1.50	-1.62	
SX	50.0	49.0	48.0	1.00	0.236	49.00	-0.23	-0.35	
SZ	48.0	49.0	49.0	0.58	0.118	48.67	-0.34	-0.46	
T	50.0	49.0	49.0	0.58	0.118	49.33	-0.11	-0.23	
TD	48.0	53.0	54.0	3.21	0.709	51.67	0.70	0.58	
TL									•
TN									•
TQ	47.0	45.0	44.0	1.53	0.354	45.33	-1.50	-1.62	
TS									•
TU	30.0	32.0	50.0	11.02	3.596	37.33	-4.27	-4.39	×
TY									•
U	49.0	50.0	48.0	1.00	0.236	49.00	-0.23	-0.35	
UA									•
UK	60.0	62.0	57.0	2.52	0.591	59.67	3.47	3.35	×
UM									•
UP	51.0	50.0	52.0	1.00	0.236	51.00	0.47	0.35	
UQ									•
UY	51.0	51.0	52.0	0.58	0.118	51.33	0.58	0.46	
VA	47.0	50.0	45.0	2.52	0.591	47.33	-0.80	-0.92	
VC	49.0	48.0	48.0	0.58	0.118	48.33	-0.46	-0.58	
VH	49.0	47.0	49.0	1.15	0.236	48.33	-0.46	-0.58	
VI	49.0	51.0	51.0	1.15	0.236	50.33	0.24	0.12	
VJ									•
VM									•
VO	95.0	98.0	97.0	1.53	0.354	96.67	16.29	16.17	×
VT	51.0	51.0	51.0	0.00	0.000	51.00	0.47	0.35	
W	49.0	43.0	47.0	3.06	0.709	46.33	-1.15	-1.27	
WE									•
WH									•
WO	54.0	53.0	53.0	0.58	0.118	53.33	1.28	1.15	
WR	45.0	48.0	49.0	2.08	0.473	47.33	-0.80	-0.92	
WW	49.0	49.0	48.0	0.58	0.118	48.67	-0.34	-0.46	
X	61.0	61.0	57.0	2.31	0.473	59.67	3.47	3.35	×
XA	49.0	50.0	50.0	0.58	0.118	49.67	0.01	-0.12	
XC									•
XD	52.0	52.0	52.0	0.00	0.000	52.00	0.81	0.69	
XF	46.0	48.0	50.0	2.00	0.473	48.00	-0.57	-0.69	
XI	49.0	48.0	49.0	0.58	0.118	48.67	-0.34	-0.46	
XJ									•
XK	54.0	55.0	52.0	1.53	0.354	53.67	1.39	1.27	
XL									•
XM									•
XN									•
XO									•
XP									•

• ≡ 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
XQ	860.0	860.0	860.0	0.00	0.000	860.00	280.71	280.59	×
XR									•

Data sorted by Laboratory Average

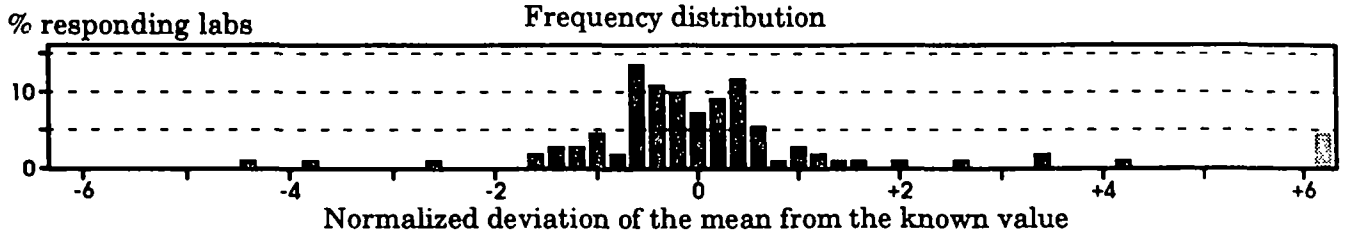
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
37.33	×	**TU**	48.67		**GI**	51.00		**VT**
39.00	×	**MV**	49.00		**U**	51.00		**UP**
42.67		**AL**	49.00		**SX**	51.00		**JY**
45.33		**TQ**	49.00		**S**	51.00		**GQ**
45.33		**SS**	49.00		**JM**	51.00		**EB**
46.00		**SN**	49.00		**FE**	51.00		**D**
46.00		**EX**	49.00		**AE**	51.00		**BO**
46.00		**AZ**	49.00		**A**	51.00		**AW**
46.33		**W**	49.33		**T**	51.33		**UY**
46.33		**QW**	49.33		**JS**	51.33		**QZ**
46.67		**AU**	49.33		**HK**	51.33		**P**
47.00		**RK**	49.33		**BM**	51.33		**BL**
47.00		**OM**	49.67		**XA**	51.33		**AF**
47.33		**WR**	49.67		**SM**	51.67		**TD**
47.33		**VA**	49.67		**PB**	51.67		**PM**
47.33		**SR**	49.67		**NJ**	51.67		**CP**
47.67		**FL**	49.67		**IU**	51.67		**CE**
47.67		**DD**	49.67		**E**	52.00		**XD**
48.00		**XF**	49.67		**AJ**	52.00		**DT**
48.00		**SD**	50.00		**NH**	52.33		**CJ**
48.00		**QT**	50.00		**LF**	52.67		**Q**
48.00		**QP**	50.00		**L**	53.00		**DE**
48.00		**PW**	50.00		**JE**	53.00		**CO**
48.00		**PD**	50.00		**CA**	53.33		**WO**
48.00		**LR**	50.00		**BH**	53.67		**XK**
48.00		**K**	50.00		**BC**	54.00		**C**
48.00		**HP**	50.00		**BB**	54.33		**SI**
48.00		**HL**	50.33		**VI**	55.67		**QM**
48.33		**VH**	50.33		**O**	57.33		**CX**
48.33		**VC**	50.33		**DO**	59.67	×	**X**
48.33		**QU**	50.33		**CS**	59.67	×	**UK**
48.33		**KX**	50.33		**BA**	62.00	×	**QX**
48.33		**EL**	50.67		**OB**	73.33	×	**HI**
48.67		**XI**	50.67		**N**	77.67	×	**BK**
48.67		**WW**	50.67		**MP**	96.67	×	**VO**
48.67		**SZ**	50.67		**BN**	770.33	×	**RU**
48.67		**I**	50.67		**AK**	860.00	×	**XQ**

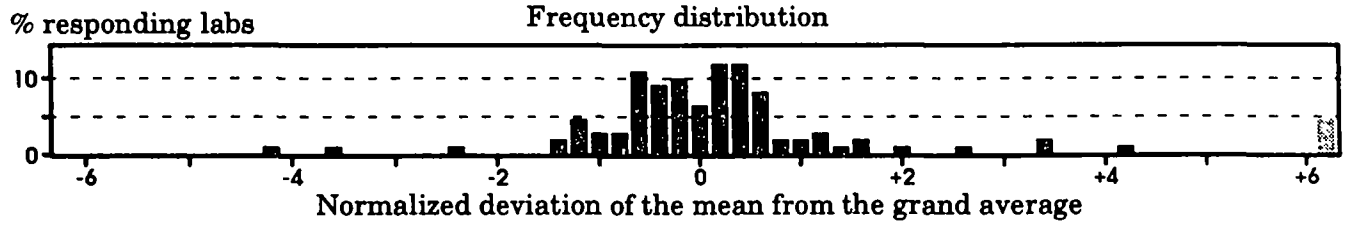
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

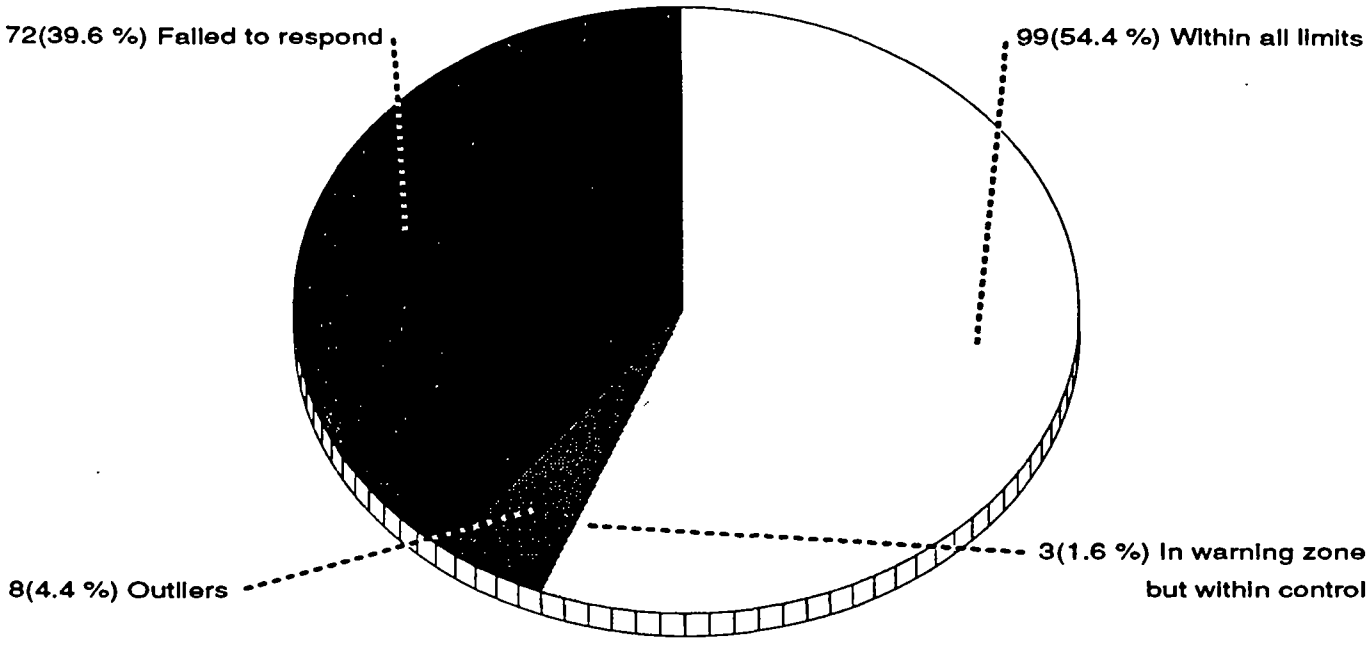
Cobalt-60


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

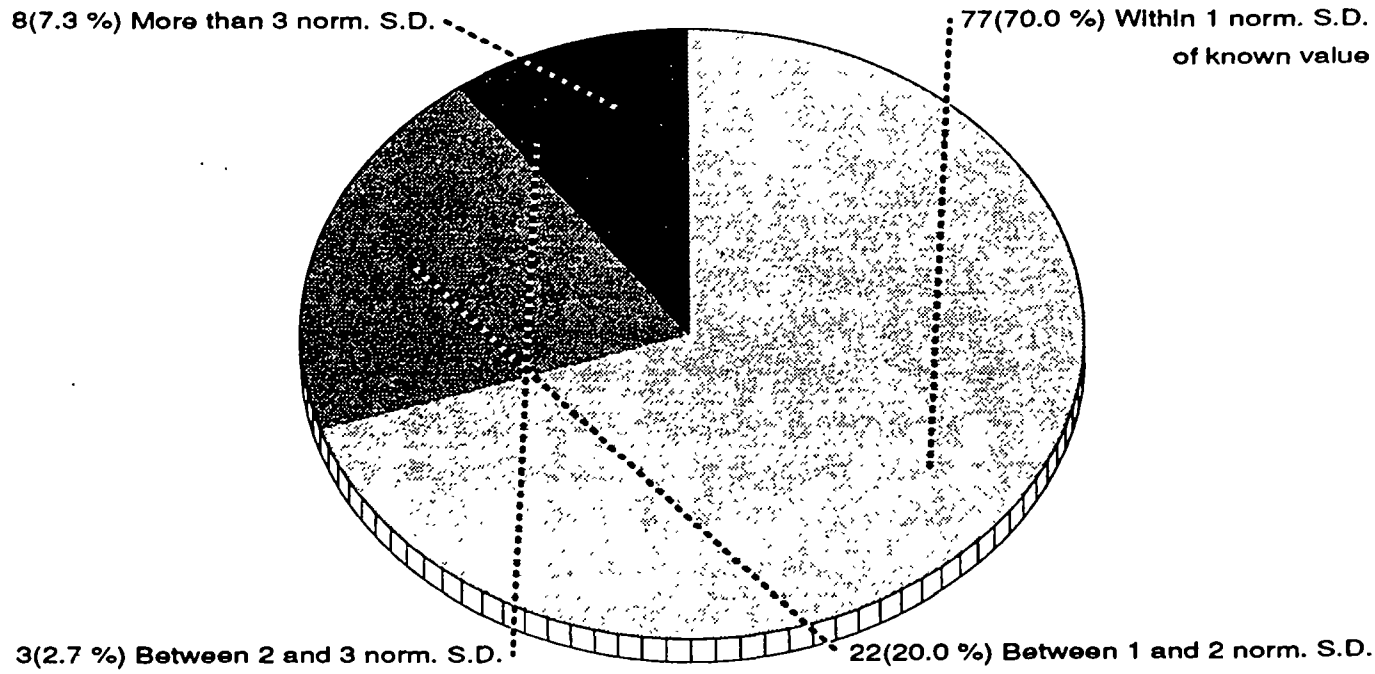

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-134 Statistical Summary 182 Participants

The known value of this nuclide is **22.0 pCi/l** with an expected precision of **5.0**; the control limits are 13.3 to 30.7; the warning regions are 13.3 to 16.2 and 27.8 to 30.7



Statistic	Respondents	Non-outliers
Mean	25.52	**Grand Avg 20.74**
Std. Dev.	35.06	2.29
Variance	1229.40	5.26
% Coef. of Var.	137.40	11.06
% deviation of mean from known value	15.99	-5.72
Norm. dev. of mean from known value	0.10	-0.55
Median	20.33	20.33
% deviation of median from known value	-7.58	-7.58
Norm. dev. of median from known value	-0.05	-0.73



Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	21.0	22.0	22.0	0.58	0.118	21.67	0.32	-0.12	
AE	21.0	22.0	21.0	0.58	0.118	21.33	0.20	-0.23	
AF	19.0	20.0	19.0	0.58	0.118	19.33	-0.49	-0.92	
AH									•
AJ	16.0	19.0	16.0	1.73	0.354	17.00	-1.30	-1.73	
AK	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
AL	28.0	24.0	31.0	3.51	0.827	27.67	2.40	1.96	
AP									•
AR									•
AU	20.0	21.0	20.0	0.58	0.118	20.33	-0.14	-0.58	
AW	22.0	22.0	22.0	0.00	0.000	22.00	0.44	0.00	
AZ	23.0	25.0	28.0	2.52	0.591	25.33	1.59	1.15	
BA	22.0	17.0	21.0	2.65	0.591	20.00	-0.26	-0.69	
BB	20.0	22.0	21.0	1.00	0.236	21.00	0.09	-0.35	
BC	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
BG									•
BH	22.0	22.0	23.0	0.58	0.118	22.33	0.55	0.12	
BK	32.0	32.0	32.0	0.00	0.000	32.00	3.90	3.46	×
BL	22.0	20.0	20.0	1.15	0.236	20.67	-0.03	-0.46	
BM	21.0	21.0	20.0	0.58	0.118	20.67	-0.03	-0.46	
BN	16.0	11.0	9.0	3.61	0.827	12.00	-3.03	-3.46	×
BO	23.0	24.0	24.0	0.58	0.118	23.67	1.01	0.58	
BS									•
BW									•
C	25.0	21.0	24.0	2.08	0.473	23.33	0.90	0.46	
CA	20.0	20.0	22.0	1.15	0.236	20.67	-0.03	-0.46	
CC									•
CE	20.0	21.0	20.0	0.58	0.118	20.33	-0.14	-0.58	
CJ	21.0	22.0	20.0	1.00	0.236	21.00	0.09	-0.35	
CO	19.0	21.0	22.0	1.53	0.354	20.67	-0.03	-0.46	
CP	22.0	21.0	21.0	0.58	0.118	21.33	0.20	-0.23	
CS	20.0	19.0	18.0	1.00	0.236	19.00	-0.60	-1.04	
CX	33.0	27.0	25.0	4.16	0.945	28.33	2.63	2.19	
D	19.0	19.0	20.0	0.58	0.118	19.33	-0.49	-0.92	
DB									•
DD	20.0	19.0	20.0	0.58	0.118	19.67	-0.37	-0.81	
DE	24.0	25.0	25.0	0.58	0.118	24.67	1.36	0.92	
DI									•
DO	20.0	19.0	20.0	0.58	0.118	19.67	-0.37	-0.81	
DT	25.0	21.0	20.0	2.65	0.591	22.00	0.44	0.00	
DZ									•
E	20.0	21.0	20.0	0.58	0.118	20.33	-0.14	-0.58	
EB	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
EL	21.0	22.0	21.0	0.58	0.118	21.33	0.20	-0.23	
EO									•

• ≡ 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
ER									•
EV									•
EX	19.0	17.0	15.0	2.00	0.473	17.00	-1.30	-1.73	
FE	24.0	22.0	23.0	1.00	0.236	23.00	0.78	0.35	
FF									•
FJ									•
FL	19.0	21.0	20.0	1.00	0.236	20.00	-0.26	-0.69	
FN									•
GI	17.0	19.0	18.0	1.00	0.236	18.00	-0.95	-1.39	
GQ	23.0	23.0	23.0	0.00	0.000	23.00	0.78	0.35	
GZ									•
HI	31.0	32.0	31.0	0.58	0.118	31.33	3.67	3.23	×
HK	21.0	20.0	20.0	0.58	0.118	20.33	-0.14	-0.58	
HL	21.0	20.0	21.0	0.58	0.118	20.67	-0.03	-0.46	
HP	17.0	20.0	19.0	1.53	0.354	18.67	-0.72	-1.15	
I	20.0	20.0	19.0	0.58	0.118	19.67	-0.37	-0.81	
ID									•
IU	20.0	23.0	19.0	2.08	0.473	20.67	-0.03	-0.46	
J									•
JE	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
JG									•
JM	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
JN									•
JQ									•
JS	20.0	20.0	21.0	0.58	0.118	20.33	-0.14	-0.58	
JY	19.0	19.0	19.0	0.00	0.000	19.00	-0.60	-1.04	
K	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
KE									•
KT									•
KX	21.0	22.0	22.0	0.58	0.118	21.67	0.32	-0.12	
L	19.0	21.0	22.0	1.53	0.354	20.67	-0.03	-0.46	
LE									•
LF	20.0	21.0	19.0	1.00	0.236	20.00	-0.26	-0.69	
LL									•
LR	19.0	18.0	19.0	0.58	0.118	18.67	-0.72	-1.15	
LT									•
M									•
MF									•
MP	18.0	21.0	20.0	1.53	0.354	19.67	-0.37	-0.81	
MT									•
MV	12.0	14.0	12.0	1.15	0.236	12.67	-2.80	-3.23	×
MY									•
N	22.0	21.0	21.0	0.58	0.118	21.33	0.20	-0.23	
NA									•
NH	19.0	18.0	19.0	0.58	0.118	18.67	-0.72	-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
NJ	21.0	22.0	22.0	0.58	0.118	21.67	0.32	-0.12	
NK									•
NO									•
O	22.0	22.0	20.0	1.15	0.236	21.33	0.20	-0.23	
OB									•
OF									•
OM	19.0	18.0	20.0	1.00	0.236	19.00	-0.60	-1.04	
OS									•
OY									•
P	12.0	11.0	10.0	1.00	0.236	11.00	-3.37	-3.81	×
PA									•
PB	25.0	24.0	25.0	0.58	0.118	24.67	1.36	0.92	
PD	21.0	20.0	21.0	0.58	0.118	20.67	-0.03	-0.46	
PG									•
PM	22.0	21.0	19.0	1.53	0.354	20.67	-0.03	-0.46	
PW	19.0	20.0	20.0	0.58	0.118	19.67	-0.37	-0.81	
Q	22.0	17.0	20.0	2.52	0.591	19.67	-0.37	-0.81	
QM	16.0	17.0	17.0	0.58	0.118	16.67	-1.41	-1.85	
QP	21.0	25.0	21.0	2.31	0.473	22.33	0.55	0.12	
QQ									•
QT	20.0	19.0	20.0	0.58	0.118	19.67	-0.37	-0.81	
QU	27.0	28.0	26.0	1.00	0.236	27.00	2.17	1.73	
QW	29.0	27.0	26.0	1.53	0.354	27.33	2.28	1.85	
QX	21.0	20.0	25.0	2.65	0.591	22.00	0.44	0.00	
QY									•
QZ	20.0	20.0	21.0	0.58	0.118	20.33	-0.14	-0.58	
RB									•
RD									•
RG									•
RI									•
RK	20.0	20.0	20.0	0.00	0.000	20.00	-0.26	-0.69	
RP									•
RR									•
RU	335.0	315.0	315.0	11.55	3.596	321.67	104.24	103.81	×
RZ									•
S	21.0	20.0	19.0	1.00	0.236	20.00	-0.26	-0.69	
SD	22.0	21.0	19.0	1.53	0.354	20.67	-0.03	-0.46	
SF									•
SG									•
SI	21.0	18.0	18.0	1.73	0.354	19.00	-0.60	-1.04	
SL									•
SM	19.0	21.0	21.0	1.15	0.236	20.33	-0.14	-0.58	
SN	20.0	20.0	19.0	0.58	0.118	19.67	-0.37	-0.81	
SO									•
SR	20.0	19.0	20.0	0.58	0.118	19.67	-0.37	-0.81	

• ≡ 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
SS	19.0	18.0	19.0	0.58	0.118	18.67	-0.72	-1.15	
SX	22.0	20.0	21.0	1.00	0.236	21.00	0.09	-0.35	
SZ	18.0	20.0	20.0	1.15	0.236	19.33	-0.49	-0.92	
T	19.0	20.0	19.0	0.58	0.118	19.33	-0.49	-0.92	
TD	20.0	19.0	22.0	1.53	0.354	20.33	-0.14	-0.58	
TL									•
TN									•
TQ	19.0	20.0	19.0	0.58	0.118	19.33	-0.49	-0.92	
TS									•
TU	13.0	13.0	19.0	3.46	0.709	15.00	-1.99	-2.42	
TY									•
U	23.0	22.0	21.0	1.00	0.236	22.00	0.44	0.00	
UA									•
UK	19.0	18.0	17.0	1.00	0.236	18.00	-0.95	-1.39	
UM									•
UP	20.0	21.0	19.0	1.00	0.236	20.00	-0.26	-0.69	
UQ									•
UY	21.0	21.0	21.0	0.00	0.000	21.00	0.09	-0.35	
VA	20.0	23.0	21.0	1.53	0.354	21.33	0.20	-0.23	
VC	19.0	19.0	18.0	0.58	0.118	18.67	-0.72	-1.15	
VH	19.0	21.0	20.0	1.00	0.236	20.00	-0.26	-0.69	
VI	18.0	21.0	20.0	1.53	0.354	19.67	-0.37	-0.81	
VJ									•
VM									•
VO	37.0	40.0	39.0	1.53	0.354	38.67	6.21	5.77	×
VT	22.0	20.0	21.0	1.00	0.236	21.00	0.09	-0.35	
W	21.0	19.0	21.0	1.15	0.236	20.33	-0.14	-0.58	
WE									•
WH									•
WO	21.0	38.0	25.0	8.89	2.921	28.00	2.51	2.08	
WR	19.0	21.0	22.0	1.53	0.354	20.67	-0.03	-0.46	
WW	20.0	19.0	18.0	1.00	0.236	19.00	-0.60	-1.04	
X	28.0	25.0	25.0	1.73	0.354	26.00	1.82	1.39	
XA	19.0	19.0	20.0	0.58	0.118	19.33	-0.49	-0.92	
XC									•
XD	21.0	21.0	22.0	0.58	0.118	21.33	0.20	-0.23	
XF	19.0	18.0	19.0	0.58	0.118	18.67	-0.72	-1.15	
XI	19.0	19.0	19.0	0.00	0.000	19.00	-0.60	-1.04	
XJ									•
XK	21.0	21.0	21.0	0.00	0.000	21.00	0.09	-0.35	
XL									•
XM									•
XN									•
XO									•
XP									•

• ≡ 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
XQ	232.0	232.0	232.0	0.00	0.000	232.00	73.18	72.75	×
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
11.00	×	P	19.67		DD	21.00		SX
12.00	×	BN	20.00		VH	21.00		CJ
12.67	×	MV	20.00		UP	21.00		BB
15.00		TU	20.00		S	21.33		XD
16.67		QM	20.00		RK	21.33		VA
17.00		EX	20.00		LF	21.33		O
17.00		AJ	20.00		K	21.33		N
18.00		UK	20.00		JM	21.33		EL
18.00		GI	20.00		JE	21.33		CP
18.67		XF	20.00		FL	21.33		AE
18.67		VC	20.00		EB	21.67		NJ
18.67		SS	20.00		BC	21.67		KX
18.67		NH	20.00		BA	21.67		A
18.67		LR	20.00		AK	22.00		U
18.67		HP	20.33		W	22.00		QX
19.00		XI	20.33		TD	22.00		DT
19.00		WW	20.33		SM	22.00		AW
19.00		SI	20.33		QZ	22.33		QP
19.00		OM	20.33		JS	22.33		BH
19.00		JY	20.33		HK	23.00		GQ
19.00		CS	20.33		E	23.00		FE
19.33		XA	20.33		CE	23.33		C
19.33		TQ	20.33		AU	23.67		BO
19.33		T	20.67		WR	24.67		PB
19.33		SZ	20.67		SD	24.67		DE
19.33		D	20.67		PM	25.33		AZ
19.33		AF	20.67		PD	26.00		X
19.67		VI	20.67		L	27.00		QU
19.67		SR	20.67		IU	27.33		QW
19.67		SN	20.67		HL	27.67		AL
19.67		QT	20.67		CO	28.00		WO
19.67		Q	20.67		CA	28.33		CX
19.67		PW	20.67		BM	31.33	×	HI
19.67		MP	20.67		BL	32.00	×	BK
19.67		I	21.00		XK	38.67	×	VO
19.67		DO	21.00		VT	232.00	×	XQ
			21.00		UY	321.67	×	RU

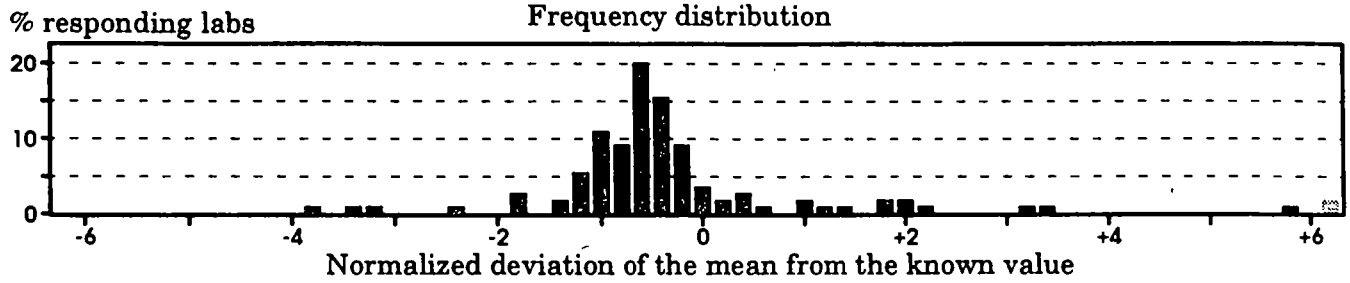
• ≡ No data submitted
∅ ≡ Insufficient data

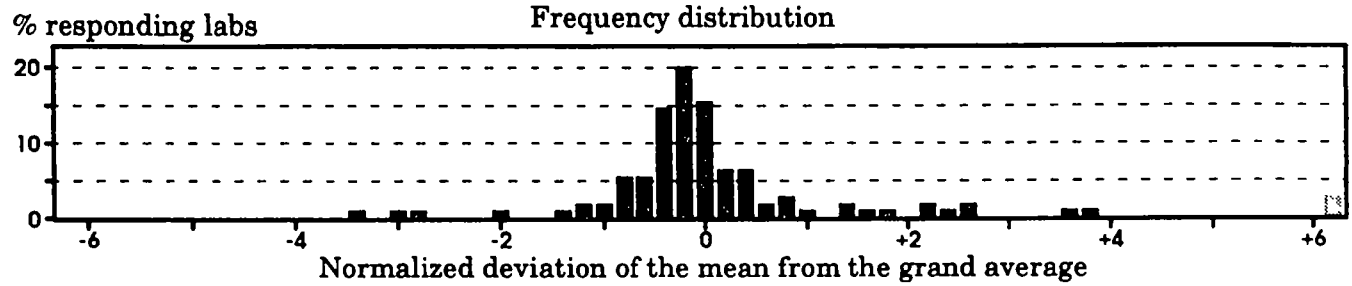
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

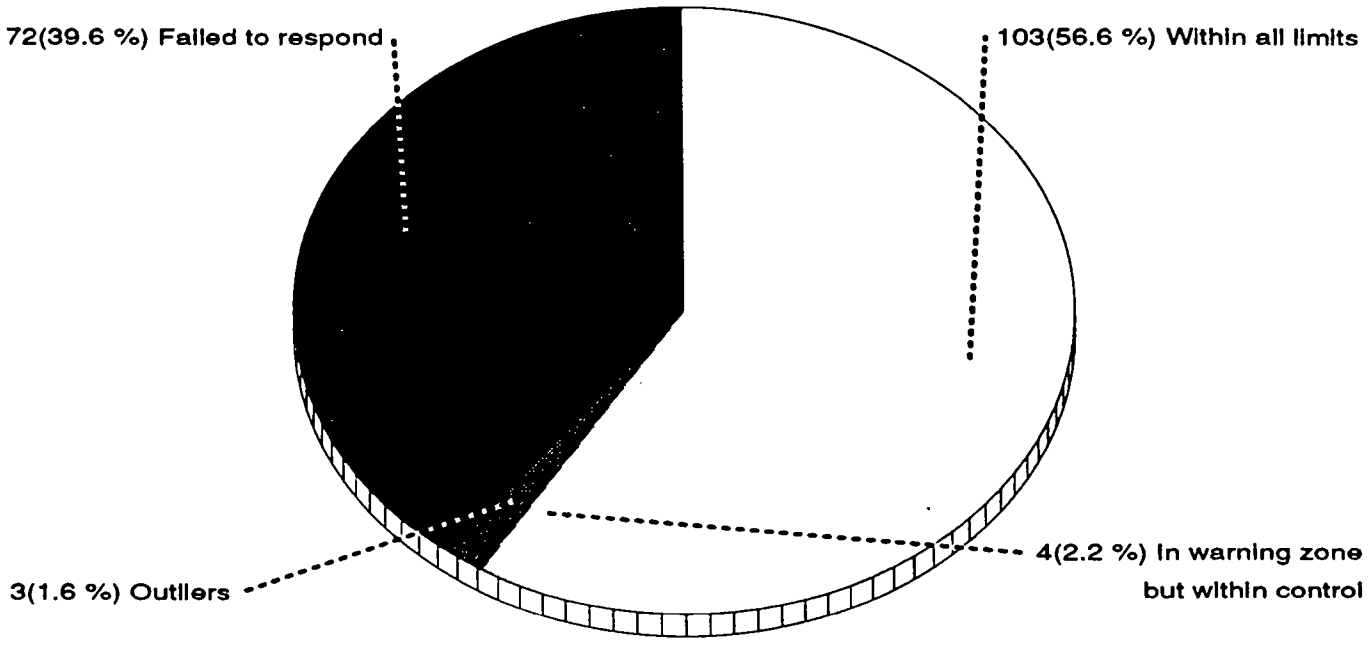
Cesium-134


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

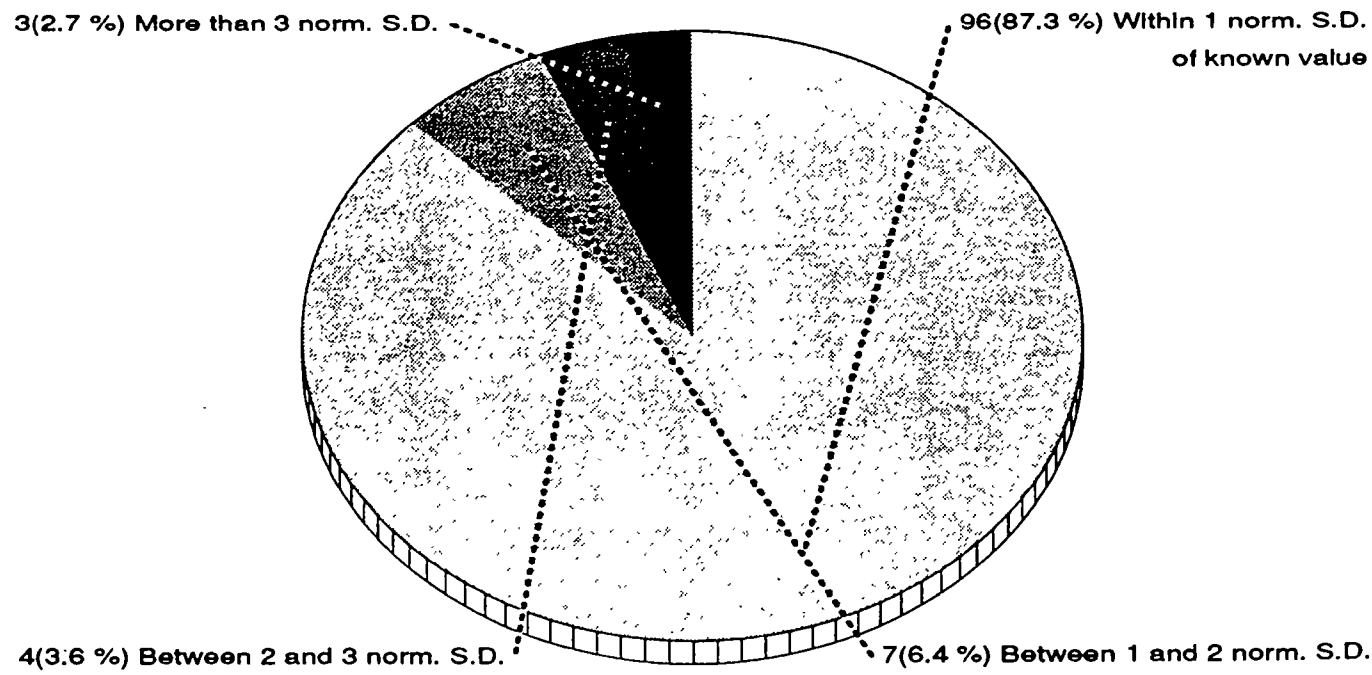

% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-137 Statistical Summary 182 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	16.13	**Grand Avg 10.82**
Std. Dev.	43.11	1.72
Variance	1858.47	2.95
% Coef. of Var.	267.26	15.87
% deviation of mean from known value	61.30	8.16
Norm. dev. of mean from known value	0.14	0.48
Median	10.33	10.33
% deviation of median from known value	3.33	3.33
Norm. dev. of median from known value	0.01	0.19



Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	10.0	10.0	11.0	0.58	0.118	10.33	-0.17	0.12	
AE	9.0	10.0	10.0	0.58	0.118	9.67	-0.40	-0.12	
AF	10.0	11.0	9.0	1.00	0.236	10.00	-0.28	0.00	
AH									•
AJ	10.0	14.0	8.0	3.06	0.709	10.67	-0.05	0.23	
AK	13.0	11.0	11.0	1.15	0.236	11.67	0.29	0.58	
AL	12.0	10.0	5.0	3.61	0.827	9.00	-0.63	-0.35	
AP									•
AR									•
AU	10.0	10.0	9.0	0.58	0.118	9.67	-0.40	-0.12	
AW	12.0	12.0	12.0	0.00	0.000	12.00	0.41	0.69	
AZ	9.0	12.0	9.0	1.73	0.354	10.00	-0.28	0.00	
BA	12.0	10.0	9.0	1.53	0.354	10.33	-0.17	0.12	
BB	10.0	12.0	9.0	1.53	0.354	10.33	-0.17	0.12	
BC	11.0	11.0	10.0	0.58	0.118	10.67	-0.05	0.23	
BG									•
BH	11.0	9.0	10.0	1.00	0.236	10.00	-0.28	0.00	
BK	17.0	16.0	16.0	0.58	0.118	16.33	1.91	2.19	
BL	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
BM	13.0	11.0	12.0	1.00	0.236	12.00	0.41	0.69	
BN	11.0	8.0	7.0	2.08	0.473	8.67	-0.74	-0.46	
BO	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
BS									•
BW									•
C	9.0	10.0	10.0	0.58	0.118	9.67	-0.40	-0.12	
CA	9.0	8.0	10.0	1.00	0.236	9.00	-0.63	-0.35	
CC									•
CE	11.0	11.0	10.0	0.58	0.118	10.67	-0.05	0.23	
CJ	12.0	11.0	12.0	0.58	0.118	11.67	0.29	0.58	
CO	10.0	12.0	14.0	2.00	0.473	12.00	0.41	0.69	
CP	12.0	10.0	10.0	1.15	0.236	10.67	-0.05	0.23	
CS	11.0	13.0	14.0	1.53	0.354	12.67	0.64	0.92	
CX	14.0	22.0	12.0	5.29	1.345	16.00	1.80	2.08	
D	10.0	10.0	11.0	0.58	0.118	10.33	-0.17	0.12	
DB									•
DD	10.0	11.0	11.0	0.58	0.118	10.67	-0.05	0.23	
DE	10.0	11.0	11.0	0.58	0.118	10.67	-0.05	0.23	
DI									•
DO	9.0	10.0	9.0	0.58	0.118	9.33	-0.51	-0.23	
DT	16.0	11.0	11.0	2.89	0.591	12.67	0.64	0.92	
DZ									•
E	10.0	11.0	10.0	0.58	0.118	10.33	-0.17	0.12	
EB	11.0	12.0	12.0	0.58	0.118	11.67	0.29	0.58	
EL	9.0	10.0	9.0	0.58	0.118	9.33	-0.51	-0.23	
EO									•

• ≡ 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)	Normalized deviation (known)	Tag
ER									•
EV									•
EX	9.0	11.0	14.0	2.52	0.591	11.33	0.18	0.46	
FE	11.0	8.0	11.0	1.73	0.354	10.00	-0.28	0.00	
FF									•
FJ									•
FL	12.0	10.0	10.0	1.15	0.236	10.67	-0.05	0.23	
FN									•
GI	10.0	10.0	9.0	0.58	0.118	9.67	-0.40	-0.12	
GQ	9.0	9.0	9.0	0.00	0.000	9.00	-0.63	-0.35	
GZ									•
HI	15.0	15.0	15.0	0.00	0.000	15.00	1.45	1.73	
HK	10.0	11.0	11.0	0.58	0.118	10.67	-0.05	0.23	
HL	13.0	13.0	13.0	0.00	0.000	13.00	0.76	1.04	
HP	10.0	11.0	11.0	0.58	0.118	10.67	-0.05	0.23	
I	11.0	11.0	10.0	0.58	0.118	10.67	-0.05	0.23	
ID									•
IU	10.0	7.0	11.0	2.08	0.473	9.33	-0.51	-0.23	
J									•
JE	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
JG									•
JM	11.0	9.0	11.0	1.15	0.236	10.33	-0.17	0.12	
JN									•
JQ									•
JS	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
JY	11.0	10.0	10.0	0.58	0.118	10.33	-0.17	0.12	
K	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
KE									•
KT									•
KX	15.0	14.0	12.0	1.53	0.354	13.67	0.99	1.27	
L	10.0	9.0	10.0	0.58	0.118	9.67	-0.40	-0.12	
LE									•
LF	12.0	11.0	10.0	1.00	0.236	11.00	0.06	0.35	
LL									•
LR	11.0	12.0	11.0	0.58	0.118	11.33	0.18	0.46	
LT									•
M									•
MF									•
MP	9.0	10.0	10.0	0.58	0.118	9.67	-0.40	-0.12	
MT									•
MV	9.0	15.0	9.0	3.46	0.709	11.00	0.06	0.35	
MY									•
N	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
NA									•
NH	10.0	9.0	10.0	0.58	0.118	9.67	-0.40	-0.12	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-B, 21-Apr-1998

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NJ	11.0	10.0	10.0	0.58	0.118	10.33	-0.17	0.12	
NK									•
NO									•
O	9.0	9.0	10.0	0.58	0.118	9.33	-0.51	-0.23	
OB	11.0	11.0	11.0	0.00	0.000	11.00	0.06	0.35	
OF									•
OM	13.0	12.0	13.0	0.58	0.118	12.67	0.64	0.92	
OS									•
OY									•
P									•
PA									•
PB	9.0	10.0	9.0	0.58	0.118	9.33	-0.51	-0.23	
PD	12.0	12.0	12.0	0.00	0.000	12.00	0.41	0.69	
PG									•
PM	12.0	13.0	10.0	1.53	0.354	11.67	0.29	0.58	
PW	10.0	10.0	11.0	0.58	0.118	10.33	-0.17	0.12	
Q	10.0	12.0	12.0	1.15	0.236	11.33	0.18	0.46	
QM	9.0	10.0	12.0	1.53	0.354	10.33	-0.17	0.12	
QP	12.0	14.0	9.0	2.52	0.591	11.67	0.29	0.58	
QQ									•
QT	8.0	9.0	8.0	0.58	0.118	8.33	-0.86	-0.58	
QU	11.0	9.0	13.0	2.00	0.473	11.00	0.06	0.35	
QW	11.0	12.0	12.0	0.58	0.118	11.67	0.29	0.58	
QX	15.0	20.0	15.0	2.89	0.591	16.67	2.03	2.31	
QY									•
QZ	10.0	10.0	11.0	0.58	0.118	10.33	-0.17	0.12	
RB									•
RD									•
RG									•
RI									•
RK	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
RP									•
RR									•
RU	158.0	160.0	159.0	1.00	0.236	159.00	51.33	51.62	×
RZ									•
S	11.0	10.0	12.0	1.00	0.236	11.00	0.06	0.35	
SD	10.0	9.0	11.0	1.00	0.236	10.00	-0.28	0.00	
SF									•
SG									•
SI	15.0	13.0	12.0	1.53	0.354	13.33	0.87	1.15	
SL									•
SM	13.0	15.0	11.0	2.00	0.473	13.00	0.76	1.04	
SN	10.0	10.0	11.0	0.58	0.118	10.33	-0.17	0.12	
SO									•
SR	9.0	11.0	9.0	1.15	0.236	9.67	-0.40	-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)	Normalized deviation (known)	Tag
SS	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
SX	12.0	12.0	12.0	0.00	0.000	12.00	0.41	0.69	
SZ	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
T	9.0	8.0	8.0	0.58	0.118	8.33	-0.86	-0.58	
TD	9.0	10.0	6.0	2.08	0.473	8.33	-0.86	-0.58	
TL									•
TN									•
TQ	10.0	8.0	13.0	2.52	0.591	10.33	-0.17	0.12	
TS									•
TU	5.0	7.0	13.0	4.16	0.945	8.33	-0.86	-0.58	
TY									•
U	10.0	11.0	10.0	0.58	0.118	10.33	-0.17	0.12	
UA									•
UK	9.0	10.0	11.0	1.00	0.236	10.00	-0.28	0.00	
UM									•
UP	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
UQ									•
UY	9.0	12.0	11.0	1.53	0.354	10.67	-0.05	0.23	
VA	12.0	10.0	10.0	1.15	0.236	10.67	-0.05	0.23	
VC	9.0	10.0	10.0	0.58	0.118	9.67	-0.40	-0.12	
VH	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
VI	12.0	10.0	10.0	1.15	0.236	10.67	-0.05	0.23	
VJ									•
VM									•
VO	17.0	21.0	19.0	2.00	0.473	19.00	2.83	3.12	×
VT	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
W	12.0	11.0	11.0	0.58	0.118	11.33	0.18	0.46	
WE									•
WH									•
WO	14.0	21.0	15.0	3.79	0.827	16.67	2.03	2.31	
WR	7.0	9.0	11.0	2.00	0.473	9.00	-0.63	-0.35	
WW	8.0	14.0	8.0	3.46	0.709	10.00	-0.28	0.00	
X	15.0	16.0	14.0	1.00	0.236	15.00	1.45	1.73	
XA	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
XC									•
XD	10.0	11.0	10.0	0.58	0.118	10.33	-0.17	0.12	
XF	10.0	9.0	10.0	0.58	0.118	9.67	-0.40	-0.12	
XI	10.0	10.0	10.0	0.00	0.000	10.00	-0.28	0.00	
XJ									•
XK	14.0	14.0	18.0	2.31	0.473	15.33	1.56	1.85	
XL									•
XM									•
XN									•
XO									•
XP									•

• ≡ 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
XQ	439.0	439.0	439.0	0.00	0.000	439.00	148.33	148.61	×
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.33		**TU**	10.00		**K**	11.00		**S**
8.33		**TD**	10.00		**JS**	11.00		**QU**
8.33		**T**	10.00		**JE**	11.00		**OB**
8.33		**QT**	10.00		**FE**	11.00		**MV**
8.67		**BN**	10.00		**BO**	11.00		**LF**
9.00		**WR**	10.00		**BL**	11.33		**W**
9.00		**GQ**	10.00		**BH**	11.33		**Q**
9.00		**CA**	10.00		**AZ**	11.33		**LR**
9.00		**AL**	10.00		**AF**	11.33		**EX**
9.33		**PB**	10.33		**XD**	11.67		**QW**
9.33		**O**	10.33		**U**	11.67		**QP**
9.33		**IU**	10.33		**TQ**	11.67		**PM**
9.33		**EL**	10.33		**SN**	11.67		**EB**
9.33		**DO**	10.33		**QZ**	11.67		**CJ**
9.67		**XF**	10.33		**QM**	11.67		**AK**
9.67		**VC**	10.33		**PW**	12.00		**SX**
9.67		**SR**	10.33		**NJ**	12.00		**PD**
9.67		**NH**	10.33		**JY**	12.00		**CO**
9.67		**MP**	10.33		**JM**	12.00		**BM**
9.67		**L**	10.33		**E**	12.00		**AW**
9.67		**GI**	10.33		**D**	12.67		**OM**
9.67		**C**	10.33		**BB**	12.67		**DT**
9.67		**AU**	10.33		**BA**	12.67		**CS**
9.67		**AE**	10.33		**A**	13.00		**SM**
10.00		**XI**	10.67		**VI**	13.00		**HL**
10.00		**XA**	10.67		**VA**	13.33		**SI**
10.00		**WW**	10.67		**UY**	13.67		**KX**
10.00		**VT**	10.67		**I**	15.00		**X**
10.00		**VH**	10.67		**HP**	15.00		**HI**
10.00		**UP**	10.67		**HK**	15.33		**XK**
10.00		**UK**	10.67		**FL**	16.00		**CX**
10.00		**SZ**	10.67		**DE**	16.33		**BK**
10.00		**SS**	10.67		**DD**	16.67		**WO**
10.00		**SD**	10.67		**CP**	16.67		**QX**
10.00		**RK**	10.67		**CE**	19.00	×	**VO**
10.00		**N**	10.67		**BC**	159.00	×	**RU**
			10.67		**AJ**	439.00	×	**XQ**

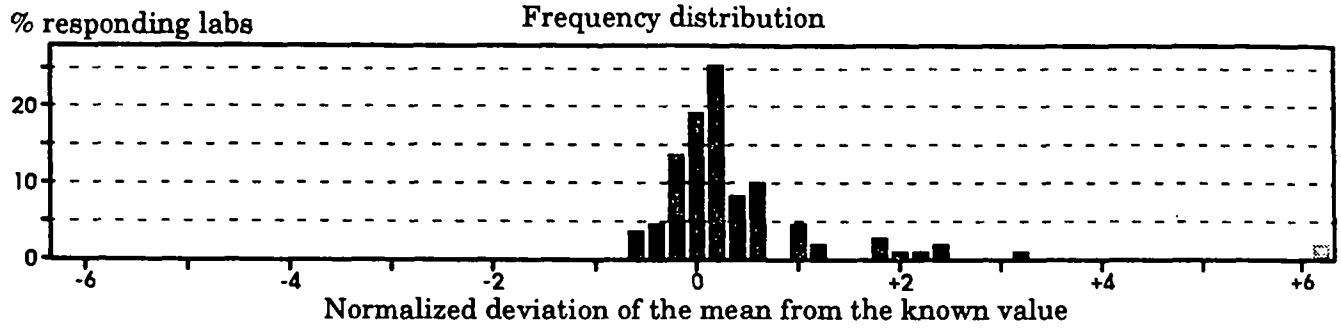
• ≡ No data submitted
∅ ≡ Insufficient data

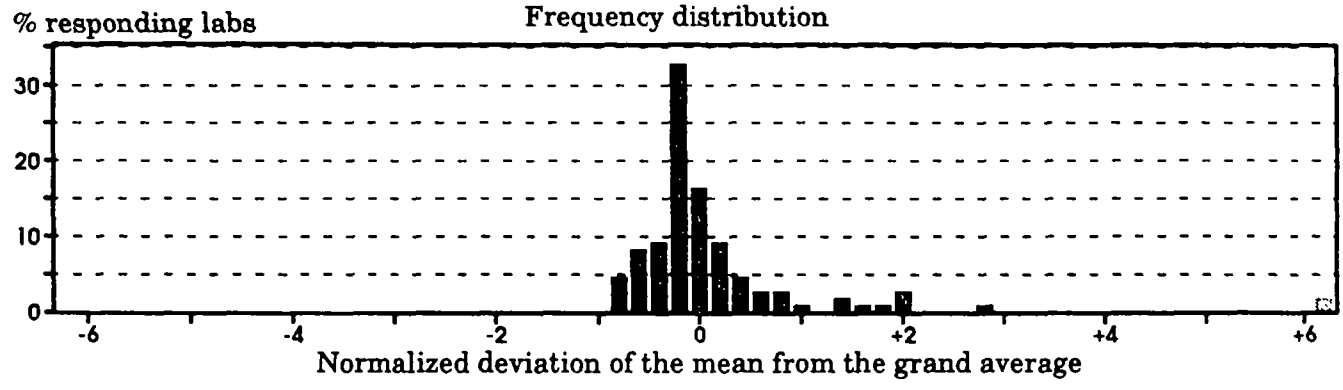
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137


% 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
30
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-98/120
September 1998

EPA

Gamma in Water Performance Evaluation Study

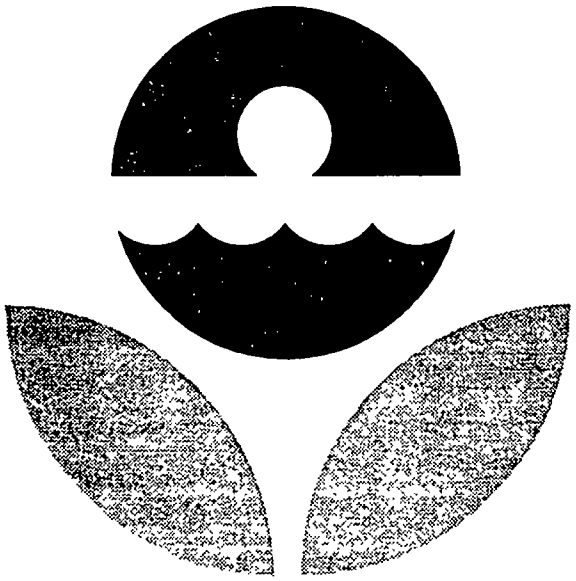
A Statistical Evaluation of the June 5, 1998 Data

006ECB98-120

Gamma in Water

Performance Evaluation Study

June 5, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Gamma in Water; June 5, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

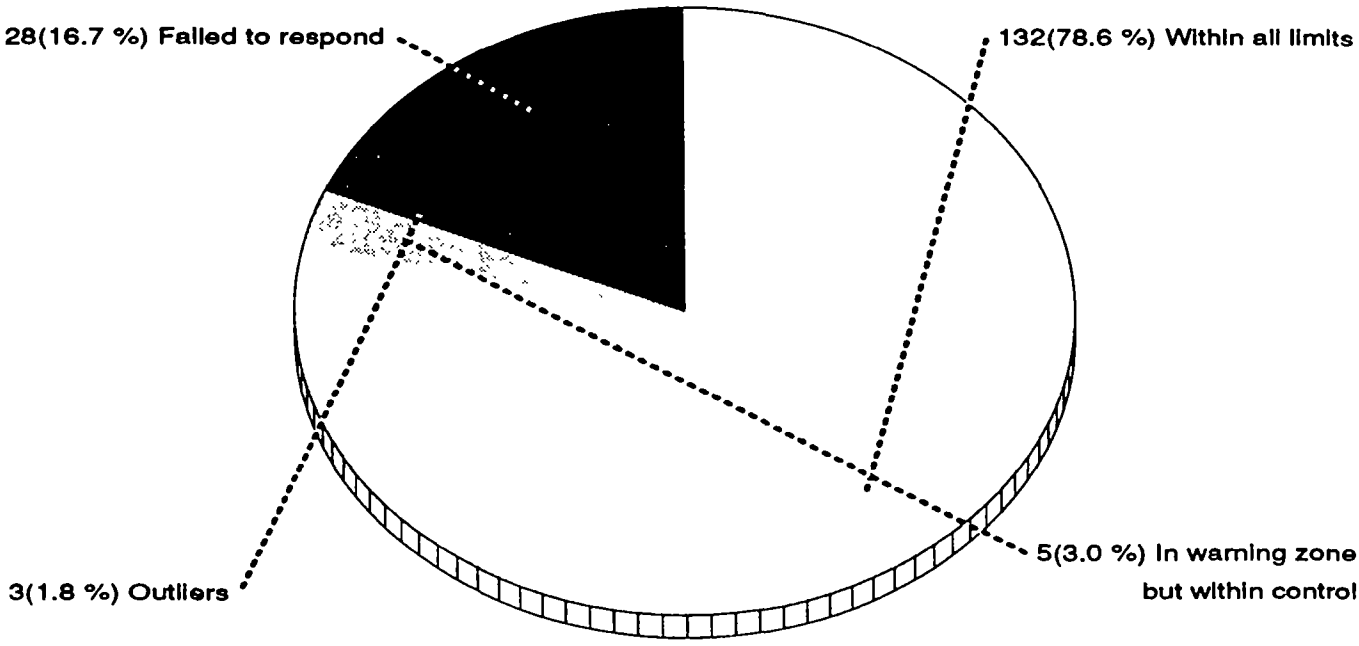
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

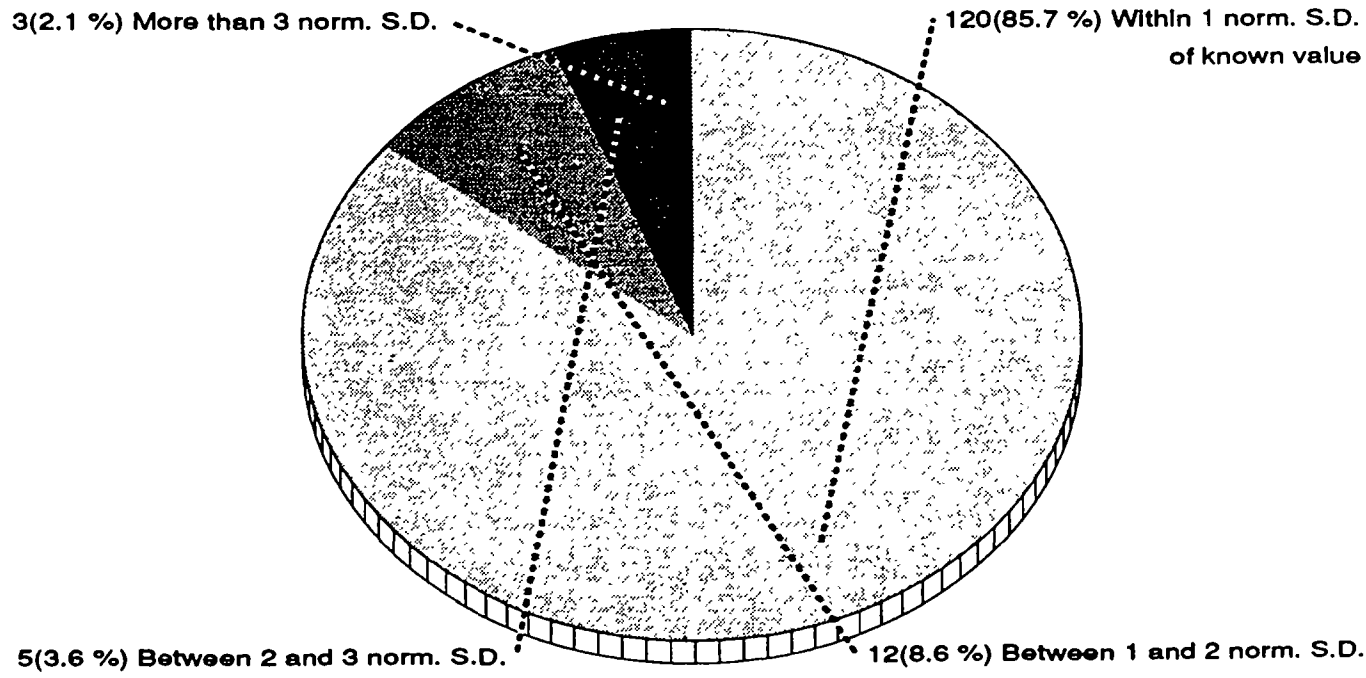
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Cobalt-60 Statistical Summary 168 Participants

The known value of this nuclide is **12.0 pCi/l** with an expected precision of **5.0**; the control limits are 3.3 to 20.7; the warning regions are 3.3 to 6.2 and 17.8 to 20.7



Statistic	Respondents	Non-outliers
Mean	13.31	**Grand Avg 12.74**
Std. Dev.	5.17	1.81
Variance	26.78	3.28
% Coef. of Var.	38.88	14.21
% deviation of mean from known value	10.91	6.20
Norm. dev. of mean from known value	0.25	0.41
Median	12.50	12.33
% deviation of median from known value	4.17	2.78
Norm. dev. of median from known value	0.10	0.18



Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	12.0	13.0	13.0	0.58	0.118	12.67	-0.03	0.23	
AE	12.0	12.0	14.0	1.15	0.236	12.67	-0.03	0.23	
AF	11.0	12.0	13.0	1.00	0.236	12.00	-0.26	0.00	
AH	13.0	12.0	12.0	0.58	0.118	12.33	-0.14	0.12	
AI	11.0	11.0	11.0	0.00	0.000	11.00	-0.60	-0.35	
AJ	10.0	12.0	16.0	3.06	0.709	12.67	-0.03	0.23	
AK	11.0	11.0	11.0	0.00	0.000	11.00	-0.60	-0.35	
AL	18.0	17.0	20.0	1.53	0.354	18.33	1.94	2.19	
AP	12.0	12.0	13.0	0.58	0.118	12.33	-0.14	0.12	
AU	10.0	13.0	14.0	2.08	0.473	12.33	-0.14	0.12	
AW	10.0	11.0	11.0	0.58	0.118	10.67	-0.72	-0.46	
AY									•
AZ	13.0	14.0	12.0	1.00	0.236	13.00	0.09	0.35	
BA	10.0	10.0	11.0	0.58	0.118	10.33	-0.84	-0.58	
BB	12.0	13.0	15.0	1.53	0.354	13.33	0.20	0.46	
BC	12.0	12.0	14.0	1.15	0.236	12.67	-0.03	0.23	
BG									•
BH	11.0	11.0	13.0	1.15	0.236	11.67	-0.37	-0.12	
BK	14.0	14.0	14.0	0.00	0.000	14.00	0.43	0.69	
BL	14.0	12.0	12.0	1.15	0.236	12.67	-0.03	0.23	
BM	13.0	12.0	13.0	0.58	0.118	12.67	-0.03	0.23	
BN	13.0	13.0	12.0	0.58	0.118	12.67	-0.03	0.23	
BO	13.0	11.0	13.0	1.15	0.236	12.33	-0.14	0.12	
C	13.0	14.0	13.0	0.58	0.118	13.33	0.20	0.46	
CA	13.0	14.0	15.0	1.00	0.236	14.00	0.43	0.69	
CC									•
CE	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
CJ	13.0	12.0	14.0	1.00	0.236	13.00	0.09	0.35	
CO	15.0	13.0	16.0	1.53	0.354	14.67	0.67	0.92	
CP	14.0	14.0	15.0	0.58	0.118	14.33	0.55	0.81	
CS	26.0	27.0	29.0	1.53	0.354	27.33	5.05	5.31	×
CX	15.0	17.0	20.0	2.52	0.591	17.33	1.59	1.85	
D	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
DD	11.0	13.0	12.0	1.00	0.236	12.00	-0.26	0.00	
DE	14.0	14.0	14.0	0.00	0.000	14.00	0.43	0.69	
DH	12.0	12.0	13.0	0.58	0.118	12.33	-0.14	0.12	
DO	12.0	12.0	14.0	1.15	0.236	12.67	-0.03	0.23	
DR	13.0	13.0	13.0	0.00	0.000	13.00	0.09	0.35	
DT	12.0	13.0	14.0	1.00	0.236	13.00	0.09	0.35	
E	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
EA									•
EB	12.0	11.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
EL	11.0	13.0	11.0	1.15	0.236	11.67	-0.37	-0.12	
EW	13.0	12.0	13.0	0.58	0.118	12.67	-0.03	0.23	
EX	10.0	9.0	7.0	1.53	0.354	8.67	-1.41	-1.15	

• ≡ 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
FE	12.0	8.0	9.0	2.08	0.473	9.67	-1.07	-0.81	
FJ	13.0	14.0	13.0	0.58	0.118	13.33	0.20	0.46	
FL	13.0	13.0	12.0	0.58	0.118	12.67	-0.03	0.23	
GI									•
GL	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
GQ	13.0	13.0	13.0	0.00	0.000	13.00	0.09	0.35	
HE	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
HI	13.0	14.0	13.0	0.58	0.118	13.33	0.20	0.46	
HK	12.0	12.0	13.0	0.58	0.118	12.33	-0.14	0.12	
HL	20.0	18.0	22.0	2.00	0.473	20.00	2.51	2.77	
HP	13.0	12.0	14.0	1.00	0.236	13.00	0.09	0.35	
I	12.0	11.0	11.0	0.58	0.118	11.33	-0.49	-0.23	
IU									•
J									•
JE	13.0	12.0	12.0	0.58	0.118	12.33	-0.14	0.12	
JG									•
JM	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
JS	11.0	12.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
JY	13.0	12.0	13.0	0.58	0.118	12.67	-0.03	0.23	
K	13.0	11.0	13.0	1.15	0.236	12.33	-0.14	0.12	
KH	6.0	7.0	7.0	0.58	0.118	6.67	-2.11	-1.85	
KL	13.0	12.0	11.0	1.00	0.236	12.00	-0.26	0.00	
KX	12.0	12.0	13.0	0.58	0.118	12.33	-0.14	0.12	
L	14.0	12.0	11.0	1.53	0.354	12.33	-0.14	0.12	
LE									•
LF	13.0	13.0	13.0	0.00	0.000	13.00	0.09	0.35	
LR	7.0	11.0	12.0	2.65	0.591	10.00	-0.95	-0.69	
M									•
MP	11.0	13.0	14.0	1.53	0.354	12.67	-0.03	0.23	
MT	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
MV									•
MX	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
N	13.0	13.0	13.0	0.00	0.000	13.00	0.09	0.35	
NH									•
NJ	13.0	13.0	13.0	0.00	0.000	13.00	0.09	0.35	
NK									•
NO	10.0	14.0	18.0	4.00	0.945	14.00	0.43	0.69	
NP	10.0	12.0	12.0	1.15	0.236	11.33	-0.49	-0.23	
O	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
OA	12.0	11.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
OB	13.0	12.0	12.0	0.58	0.118	12.33	-0.14	0.12	
OM	17.0	19.0	19.0	1.15	0.236	18.33	1.94	2.19	
OT	8.0	12.0	11.0	2.08	0.473	10.33	-0.84	-0.58	
P	18.0	14.0	17.0	2.08	0.473	16.33	1.24	1.50	
PB									•

• ≡ 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
PD	9.0	15.0	11.0	3.06	0.709	11.67	-0.37	-0.12	
PE									•
PM	16.0	10.0	13.0	3.00	0.709	13.00	0.09	0.35	
PW	13.0	12.0	12.0	0.58	0.118	12.33	-0.14	0.12	
PX	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
Q	16.0	12.0	12.0	2.31	0.473	13.33	0.20	0.46	
QM	14.0	15.0	16.0	1.00	0.236	15.00	0.78	1.04	
QP	10.0	11.0	12.0	1.00	0.236	11.00	-0.60	-0.35	
QT	12.0	12.0	14.0	1.15	0.236	12.67	-0.03	0.23	
QU	13.0	12.0	13.0	0.58	0.118	12.67	-0.03	0.23	
QW	12.0	12.0	11.0	0.58	0.118	11.67	-0.37	-0.12	
QX									•
QZ	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
R	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
RK									•
RO	13.0	12.0	13.0	0.58	0.118	12.67	-0.03	0.23	
RR									•
RU	11.0	12.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
RX	12.0	11.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
RZ	9.0	7.0	9.0	1.15	0.236	8.33	-1.53	-1.27	
S	12.0	12.0	11.0	0.58	0.118	11.67	-0.37	-0.12	
SD	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
SF									•
SI	18.0	12.0	24.0	6.00	1.795	18.00	1.82	2.08	
SM	12.0	14.0	16.0	2.00	0.473	14.00	0.43	0.69	
SN	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
SR	14.0	12.0	16.0	2.00	0.473	14.00	0.43	0.69	
SS	12.0	11.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
SV	13.0	14.0	13.0	0.58	0.118	13.33	0.20	0.46	
SX	12.0	13.0	12.0	0.58	0.118	12.33	-0.14	0.12	
SZ	11.0	12.0	11.0	0.58	0.118	11.33	-0.49	-0.23	
T	12.0	11.0	11.0	0.58	0.118	11.33	-0.49	-0.23	
TC	15.0	15.0	15.0	0.00	0.000	15.00	0.78	1.04	
TD	16.0	16.0	14.0	1.15	0.236	15.33	0.90	1.15	
TF									•
TO	19.0	28.0	20.0	4.93	1.120	22.33	3.32	3.58	×
TQ	12.0	11.0	12.0	0.58	0.118	11.67	-0.37	-0.12	
TR	69.0	69.0	65.0	2.31	0.473	67.67	19.03	19.28	×
TU	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
U									•
UM									•
UP	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
UR	13.0	15.0	12.0	1.53	0.354	13.33	0.20	0.46	
UV	12.0	14.0	14.0	1.15	0.236	13.33	0.20	0.46	
UX	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	

• ≡ 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
UY	13.0	17.0	14.0	2.08	0.473	14.67	0.67	0.92	
VA	14.0	12.0	13.0	1.00	0.236	13.00	0.09	0.35	
VC	13.0	13.0	14.0	0.58	0.118	13.33	0.20	0.46	
VE	15.0	12.0	15.0	1.73	0.354	14.00	0.43	0.69	
VH	13.0	12.0	15.0	1.53	0.354	13.33	0.20	0.46	
VI	12.0	14.0	15.0	1.53	0.354	13.67	0.32	0.58	
VM	15.0	15.0	15.0	0.00	0.000	15.00	0.78	1.04	
VO	11.0	10.0	13.0	1.53	0.354	11.33	-0.49	-0.23	
VS	16.0	14.0	16.0	1.15	0.236	15.33	0.90	1.15	
W	14.0	12.0	13.0	1.00	0.236	13.00	0.09	0.35	
WD	10.0	11.0	12.0	1.00	0.236	11.00	-0.60	-0.35	
WI									•
WJ	13.0	13.0	11.0	1.15	0.236	12.33	-0.14	0.12	
WK	11.0	10.0	12.0	1.00	0.236	11.00	-0.60	-0.35	
WO	15.0	13.0	12.0	1.53	0.354	13.33	0.20	0.46	
WR	11.0	12.0	15.0	2.08	0.473	12.67	-0.03	0.23	
WS	12.0	10.0	13.0	1.53	0.354	11.67	-0.37	-0.12	
WV	15.0	15.0	15.0	0.00	0.000	15.00	0.78	1.04	
WW	12.0	12.0	11.0	0.58	0.118	11.67	-0.37	-0.12	
WX									•
X	14.0	15.0	17.0	1.53	0.354	15.33	0.90	1.15	
XA									•
XB	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
XC									•
XD	15.0	13.0	13.0	1.15	0.236	13.67	0.32	0.58	
XF	12.0	11.0	11.0	0.58	0.118	11.33	-0.49	-0.23	
XG	13.0	13.0	14.0	0.58	0.118	13.33	0.20	0.46	
XI	12.0	12.0	12.0	0.00	0.000	12.00	-0.26	0.00	
XK	12.0	10.0	15.0	2.52	0.591	12.33	-0.14	0.12	
XO									•
XQ	17.0	15.0	25.0	5.29	1.345	19.00	2.17	2.42	
XR									•
Y	13.0	13.0	13.0	0.00	0.000	13.00	0.09	0.35	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.67		KH	11.00		WD	11.33		I
8.33		RZ	11.00		QP	11.67		WW
8.67		EX	11.00		AK	11.67		WS
9.67		FE	11.00		AI	11.67		TQ
10.00		LR	11.33		XF	11.67		SS
10.33		OT	11.33		VO	11.67		S
10.33		BA	11.33		T	11.67		RX
10.67		AW	11.33		SZ	11.67		RU
11.00		WK	11.33		NP	11.67		QW

• ≡ 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

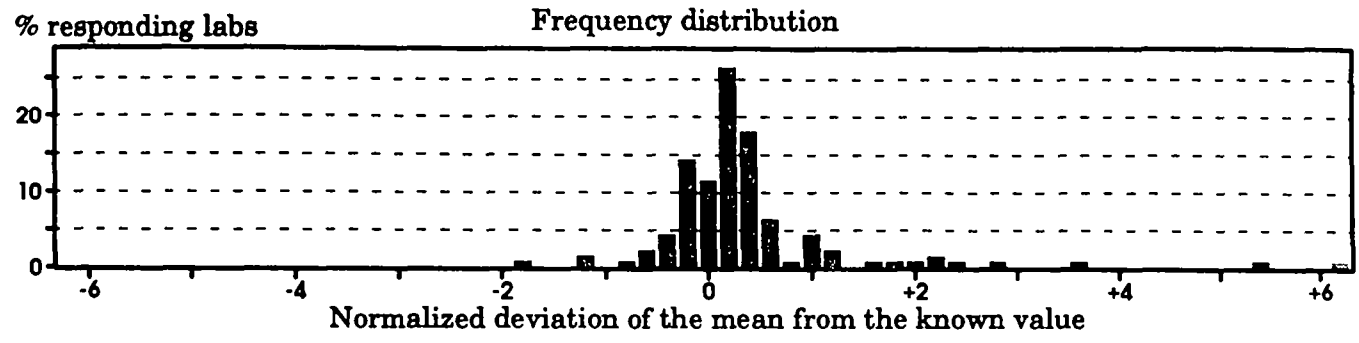
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
11.67		PD	12.33		DH	13.33		VC
11.67		OA	12.33		D	13.33		UV
11.67		JS	12.33		BO	13.33		UR
11.67		EL	12.33		AU	13.33		SV
11.67		EB	12.33		AP	13.33		Q
11.67		BH	12.33		AH	13.33		HI
12.00		XI	12.67		WR	13.33		FJ
12.00		XB	12.67		RO	13.33		C
12.00		UX	12.67		QU	13.33		BB
12.00		UP	12.67		QT	13.67		XD
12.00		TU	12.67		MP	13.67		VI
12.00		SD	12.67		JY	14.00		VE
12.00		PX	12.67		FL	14.00		SR
12.00		O	12.67		EW	14.00		SM
12.00		MX	12.67		DO	14.00		NO
12.00		MT	12.67		BN	14.00		DE
12.00		KL	12.67		BM	14.00		CA
12.00		GL	12.67		BL	14.00		BK
12.00		E	12.67		BC	14.33		CP
12.00		DD	12.67		AJ	14.67		UY
12.00		CE	12.67		AE	14.67		CO
12.00		AF	12.67		A	15.00		WV
12.33		XK	13.00		Y	15.00		VM
12.33		WJ	13.00		W	15.00		TC
12.33		SX	13.00		VA	15.00		QM
12.33		SN	13.00		PM	15.33		X
12.33		R	13.00		NJ	15.33		VS
12.33		QZ	13.00		N	15.33		TD
12.33		PW	13.00		LF	16.33		P
12.33		OB	13.00		HP	17.33		CX
12.33		L	13.00		GQ	18.00		SI
12.33		KX	13.00		DT	18.33		OM
12.33		K	13.00		DR	18.33		AL
12.33		JM	13.00		CJ	19.00		XQ
12.33		JE	13.00		AZ	20.00		HL
12.33		HK	13.33		XG	22.33	×	TO
12.33		HE	13.33		WO	27.33	×	CS
			13.33		VH	67.67	×	TR

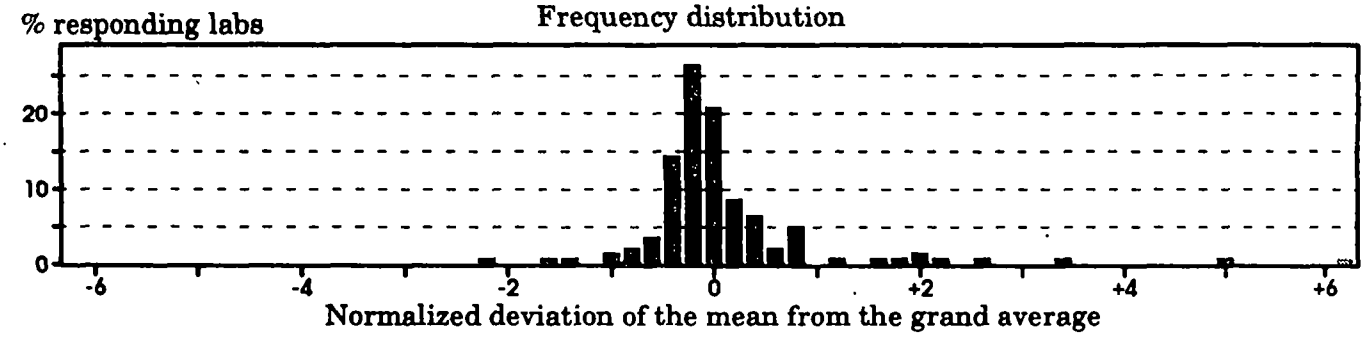
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

⇑ ≡ Above control limit
× ≡ Determined to be an outlier
⇓ ≡ Below control limit

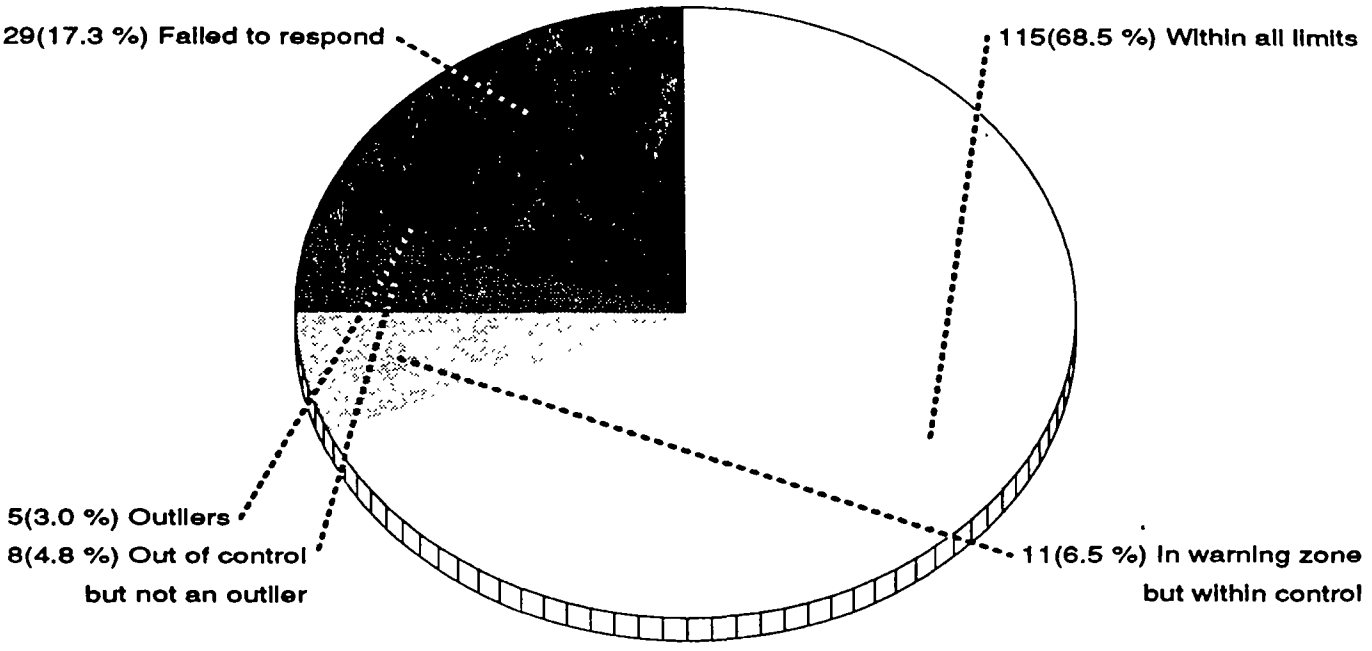
Cobalt-60


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

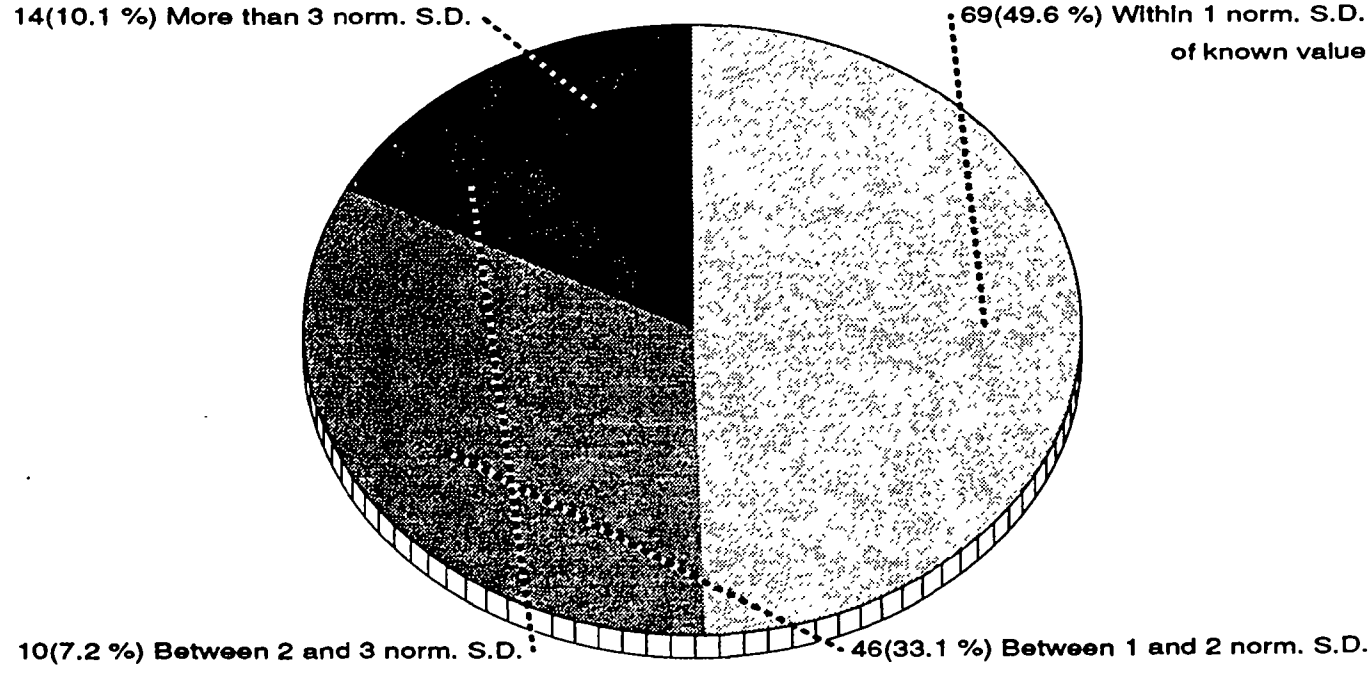

% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Zinc-65 Statistical Summary 168 Participants

The known value of this nuclide is **104.0 pCi/l** with an expected precision of **10.0**; the control limits are 86.7 to 121.3; the warning regions are 86.7 to 92.4 and 115.6 to 121.3



Statistic	Respondents	Non-outliers
Mean	110.18	**Grand Avg 108.45**
Std. Dev.	23.50	7.54
Variance	552.23	56.84
% Coef. of Var.	21.33	6.95
% deviation of mean from known value	5.94	4.28
Norm. dev. of mean from known value	0.26	0.59
Median	108.67	108.67
% deviation of median from known value	4.49	4.49
Norm. dev. of median from known value	0.20	0.62



ESD-LV Performance Evaluation: Gamma in Water, 5-Jun-1998

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	116.0	114.0	1.53	0.177	114.33	1.02	1.79	
AE	105.0	110.0	106.0	2.65	0.295	107.00	-0.25	0.52	
AF	111.0	120.0	113.0	4.73	0.532	114.67	1.08	1.85	
AH	108.0	106.0	111.0	2.52	0.295	108.33	-0.02	0.75	
AI	101.0	101.0	100.0	0.58	0.059	100.67	-1.35	-0.58	
AJ	98.0	93.0	100.0	3.61	0.413	97.00	-1.98	-1.21	
AK	94.0	94.0	96.0	1.15	0.118	94.67	-2.39	-1.62	
AL	95.0	98.0	93.0	2.52	0.295	95.33	-2.27	-1.50	
AP	107.0	110.0	107.0	1.73	0.177	108.00	-0.08	0.69	
AU	102.0	102.0	93.0	5.20	0.532	99.00	-1.64	-0.87	
AW	100.0	108.0	106.0	4.16	0.473	104.67	-0.65	0.12	
AY									•
AZ	120.0	126.0	116.0	5.03	0.591	120.67	2.12	2.89	
BA	113.0	110.0	105.0	4.04	0.473	109.33	0.15	0.92	
BB	120.0	114.0	105.0	7.55	0.886	113.00	0.79	1.56	
BC	108.0	109.0	107.0	1.00	0.118	108.00	-0.08	0.69	
BG									•
BH	115.0	116.0	112.0	2.08	0.236	114.33	1.02	1.79	
BK	121.0	124.0	123.0	1.53	0.177	122.67	2.46	3.23	⇑
BL	111.0	102.0	100.0	5.86	0.650	104.33	-0.71	0.06	
BM	111.0	106.0	106.0	2.89	0.295	107.67	-0.14	0.64	
BN	114.0	110.0	117.0	3.51	0.413	113.67	0.90	1.67	
BO	109.0	110.0	108.0	1.00	0.118	109.00	0.10	0.87	
C	109.0	105.0	110.0	2.65	0.295	108.00	-0.08	0.69	
CA	86.0	109.0	102.0	11.79	1.683	99.00	-1.64	-0.87	
CC									•
CE	113.0	108.0	106.0	3.61	0.413	109.00	0.10	0.87	
CJ	109.0	114.0	112.0	2.52	0.295	111.67	0.56	1.33	
CO	126.0	120.0	122.0	3.06	0.354	122.67	2.46	3.23	⇑
CP	103.0	110.0	104.0	3.79	0.413	105.67	-0.48	0.29	
CS	280.0	272.0	275.0	4.04	0.473	275.67	28.96	29.73	×
CX	103.0	101.0	106.0	2.52	0.295	103.33	-0.89	-0.12	
D	108.0	110.0	109.0	1.00	0.118	109.00	0.10	0.87	
DD	106.0	109.0	102.0	3.51	0.413	105.67	-0.48	0.29	
DE	111.0	112.0	112.0	0.58	0.059	111.67	0.56	1.33	
DH	96.0	102.0	98.0	3.06	0.354	98.67	-1.69	-0.92	
DO	125.0	126.0	120.0	3.21	0.354	123.67	2.64	3.41	⇑
DR	112.0	114.0	108.0	3.06	0.354	111.33	0.50	1.27	
DT	110.0	104.0	115.0	5.51	0.650	109.67	0.21	0.98	
E	113.0	101.0	114.0	7.23	0.768	109.33	0.15	0.92	
EA									•
EB	121.0	116.0	121.0	2.89	0.295	119.33	1.89	2.66	
EL	105.0	107.0	100.0	3.61	0.413	104.00	-0.77	0.00	
EW	109.0	106.0	105.0	2.08	0.236	106.67	-0.31	0.46	
EX	101.0	105.0	109.0	4.00	0.473	105.00	-0.60	0.17	

• ≡ No data submitted

∅ ≡ 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)	(known)	Tag
FE	106.0	109.0	116.0	5.13	0.591	110.33	0.33	1.10	
FJ	107.0	112.0	111.0	2.65	0.295	110.00	0.27	1.04	
FL	110.0	116.0	117.0	3.79	0.413	114.33	1.02	1.79	
GI									•
GL	115.0	114.0	115.0	0.58	0.059	114.67	1.08	1.85	
GQ	95.0	95.0	95.0	0.00	0.000	95.00	-2.33	-1.56	
HE	113.0	105.0	111.0	4.16	0.473	109.67	0.21	0.98	
HI	103.0	109.0	112.0	4.58	0.532	108.00	-0.08	0.69	
HK	114.0	111.0	110.0	2.08	0.236	111.67	0.56	1.33	
HL	111.0	110.0	110.0	0.58	0.059	110.33	0.33	1.10	
HP	113.0	109.0	117.0	4.00	0.473	113.00	0.79	1.56	
I	104.0	101.0	101.0	1.73	0.177	102.00	-1.12	-0.35	
IU									
J									
JE	116.0	109.0	115.0	3.79	0.413	113.33	0.85	1.62	
JG									•
JM	104.0	106.0	105.0	1.00	0.118	105.00	-0.60	0.17	
JS	107.0	107.0	109.0	1.15	0.118	107.67	-0.14	0.64	
JY	117.0	121.0	121.0	2.31	0.236	119.67	1.94	2.71	
K	103.0	106.0	104.0	1.53	0.177	104.33	-0.71	0.06	
KH	55.0	56.0	57.0	1.00	0.118	56.00	-9.08	-8.31	×
KL	104.0	100.0	109.0	4.51	0.532	104.33	-0.71	0.06	
KX	106.0	105.0	105.0	0.58	0.059	105.33	-0.54	0.23	
L	108.0	106.0	99.0	4.73	0.532	104.33	-0.71	0.06	
LE									•
LF	110.0	97.0	110.0	7.51	0.768	105.67	-0.48	0.29	
LR	75.0	109.0	110.0	19.92	3.033	98.00	-1.81	-1.04	
M									•
MP	112.0	109.0	112.0	1.73	0.177	111.00	0.44	1.21	
MT	106.0	106.0	107.0	0.58	0.059	106.33	-0.37	0.40	
MV									•
MX	105.0	106.0	106.0	0.58	0.059	105.67	-0.48	0.29	
N	104.0	106.0	108.0	2.00	0.236	106.00	-0.42	0.35	
NH									•
NJ	108.0	109.0	111.0	1.53	0.177	109.33	0.15	0.92	
NK									•
NO	122.0	129.0	144.0	11.24	1.570	131.67	4.02	4.79	⇑
NP	107.0	103.0	111.0	4.00	0.473	107.00	-0.25	0.52	
O	111.0	110.0	112.0	1.00	0.118	111.00	0.44	1.21	
OA	108.0	96.0	105.0	6.24	0.709	103.00	-0.94	-0.17	
OB									•
OM	94.0	103.0	99.0	4.51	0.532	98.67	-1.69	-0.92	
OT	105.0	95.0	113.0	9.02	1.120	104.33	-0.71	0.06	
P	100.0	109.0	101.0	4.93	0.532	103.33	-0.89	-0.12	
PB									•

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gamma in Water, 5-Jun-1998

Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
PD	115.0	108.0	109.0	3.79	0.413	110.67	0.38	1.15	
PE									•
PM	109.0	110.0	112.0	1.53	0.177	110.33	0.33	1.10	
PW	110.0	104.0	109.0	3.21	0.354	107.67	-0.14	0.64	
PX	101.0	95.0	104.0	4.58	0.532	100.00	-1.46	-0.69	
Q	116.0	110.0	117.0	3.79	0.413	114.33	1.02	1.79	
QM	111.0	59.0	87.0	26.03	4.946	85.67	-3.95	-3.18	⇓
QP	108.0	110.0	99.0	5.86	0.650	105.67	-0.48	0.29	
QT	104.0	106.0	111.0	3.61	0.413	107.00	-0.25	0.52	
QU	101.0	102.0	102.0	0.58	0.059	101.67	-1.17	-0.40	
QW	99.0	101.0	100.0	1.00	0.118	100.00	-1.46	-0.69	
QX									•
QZ	111.0	110.0	113.0	1.53	0.177	111.33	0.50	1.27	
R	113.0	109.0	114.0	2.65	0.295	112.00	0.62	1.39	
RK									•
RO	109.0	115.0	112.0	3.00	0.354	112.00	0.62	1.39	
RR									•
RU	109.0	109.0	110.0	0.58	0.059	109.33	0.15	0.92	
RX	95.0	101.0	104.0	4.58	0.532	100.00	-1.46	-0.69	
RZ	93.0	97.0	98.0	2.65	0.295	96.00	-2.16	-1.39	
S	111.0	111.0	109.0	1.15	0.118	110.33	0.33	1.10	
SD	106.0	114.0	114.0	4.62	0.473	111.33	0.50	1.27	
SF									•
SI	102.0	106.0	116.0	7.21	0.827	108.00	-0.08	0.69	
SM	122.0	111.0	112.0	6.08	0.650	115.00	1.13	1.91	
SN	97.0	92.0	96.0	2.65	0.295	95.00	-2.33	-1.56	
SR	110.0	107.0	117.0	5.13	0.591	111.33	0.50	1.27	
SS	104.0	107.0	108.0	2.08	0.236	106.33	-0.37	0.40	
SV	113.0	114.0	114.0	0.58	0.059	113.67	0.90	1.67	
SX	103.0	112.0	118.0	7.55	0.886	111.00	0.44	1.21	
SZ	102.0	104.0	103.0	1.00	0.118	103.00	-0.94	-0.17	
T	103.0	111.0	108.0	4.04	0.473	107.33	-0.19	0.58	
TC	112.0	106.0	105.0	3.79	0.413	107.67	-0.14	0.64	
TD	114.0	96.0	112.0	9.87	1.120	107.33	-0.19	0.58	
TF									•
TO	117.0	121.0	139.0	11.72	1.570	125.67	2.98	3.75	⇑
TQ	107.0	106.0	104.0	1.53	0.177	105.67	-0.48	0.29	
TR	131.0	131.0	131.0	0.00	0.000	131.00	3.91	4.68	⇑
TU	110.0	107.0	109.0	1.53	0.177	108.67	0.04	0.81	
U									•
UM									•
UP	118.0	117.0	119.0	1.00	0.118	118.00	1.65	2.42	
UR	121.0	125.0	118.0	3.51	0.413	121.33	2.23	3.00	
UV	101.0	100.0	120.0	11.27	1.345	107.00	-0.25	0.52	
UX	108.0	114.0	115.0	3.79	0.413	112.33	0.67	1.44	

• ≡ No data submitted
∅ ≡ 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)	(known)	Tag
UY	98.0	122.0	109.0	12.01	1.795	109.67	0.21	0.98	
VA	99.0	100.0	97.0	1.53	0.177	98.67	-1.69	-0.92	
VC	122.0	118.0	120.0	2.00	0.236	120.00	2.00	2.77	
VE	127.0	125.0	120.0	3.61	0.413	124.00	2.69	3.46	⇑
VH	105.0	109.0	112.0	3.51	0.413	108.67	0.04	0.81	
VI	121.0	125.0	114.0	5.57	0.650	120.00	2.00	2.77	
VM	90.0	90.0	90.0	0.00	0.000	90.00	-3.20	-2.42	
VO	107.0	105.0	118.0	7.00	0.768	110.00	0.27	1.04	
VS	109.0	110.0	111.0	1.00	0.118	110.00	0.27	1.04	
W	100.0	106.0	97.0	4.58	0.532	101.00	-1.29	-0.52	
WD	106.0	113.0	112.0	3.79	0.413	110.33	0.33	1.10	
WI									•
WJ	118.0	104.0	117.0	7.81	0.827	113.00	0.79	1.56	
WK	103.0	107.0	105.0	2.00	0.236	105.00	-0.60	0.17	
WO	100.0	89.0	102.0	7.00	0.768	97.00	-1.98	-1.21	
WR	100.0	96.0	91.0	4.51	0.532	95.67	-2.21	-1.44	
WS	264.0	271.0	259.0	6.03	0.709	264.67	27.06	27.83	×
WV	121.0	120.0	117.0	2.08	0.236	119.33	1.89	2.66	
WW	99.0	101.0	105.0	3.06	0.354	101.67	-1.17	-0.40	
WX									•
X	121.0	120.0	110.0	6.08	0.650	117.00	1.48	2.25	
XA									•
XB	116.0	116.0	115.0	0.58	0.059	115.67	1.25	2.02	
XC									•
XD	105.0	116.0	113.0	5.69	0.650	111.33	0.50	1.27	
XF	93.0	106.0	106.0	7.51	0.768	101.67	-1.17	-0.40	
XG	109.0	110.0	109.0	0.58	0.059	109.33	0.15	0.92	
XI	110.0	110.0	110.0	0.00	0.000	110.00	0.27	1.04	
XK	11.0	11.0	12.0	0.58	0.059	11.33	-16.82	-16.05	×
XO									•
XQ	177.0	187.0	163.0	12.06	1.795	175.67	11.64	12.41	×
XR									•
Y	110.0	106.0	110.0	2.31	0.236	108.67	0.04	0.81	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
11.33	×	XK	96.00		RZ	100.00		RX
56.00	×	KH	97.00		WO	100.00		QW
85.67	⇓	QM	97.00		AJ	100.00		PX
90.00		VM	98.00		LR	100.67		AI
94.67		AK	98.67		VA	101.00		W
95.00		SN	98.67		OM	101.67		XF
95.00		GQ	98.67		DH	101.67		WW
95.33		AL	99.00		CA	101.67		QU
95.67		WR	99.00		AU	102.00		I

• ≡ 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
103.00		SZ	108.00		C	111.67		DE
103.00		OA	108.00		BC	111.67		CJ
103.33		P	108.00		AP	112.00		RO
103.33		CX	108.33		AH	112.00		R
104.00		EL	108.67		Y	112.33		UX
104.33		OT	108.67		VH	113.00		WJ
104.33		L	108.67		TU	113.00		HP
104.33		KL	109.00		D	113.00		BB
104.33		K	109.00		CE	113.33		JE
104.33		BL	109.00		BO	113.67		SV
104.67		AW	109.33		XG	113.67		BN
105.00		WK	109.33		RU	114.33		Q
105.00		JM	109.33		NJ	114.33		FL
105.00		EX	109.33		E	114.33		BH
105.33		KX	109.33		BA	114.33		A
105.67		TQ	109.67		UY	114.67		GL
105.67		QP	109.67		HE	114.67		AF
105.67		MX	109.67		DT	115.00		SM
105.67		LF	110.00		XI	115.67		XB
105.67		DD	110.00		VS	117.00		X
105.67		CP	110.00		VO	118.00		UP
106.00		N	110.00		FJ	119.33		WV
106.33		SS	110.33		WD	119.33		EB
106.33		MT	110.33		S	119.67		JY
106.67		EW	110.33		PM	120.00		VI
107.00		UV	110.33		HL	120.00		VC
107.00		QT	110.33		FE	120.67		AZ
107.00		NP	110.67		PD	121.33		UR
107.00		AE	111.00		SX	122.67	⇑	CO
107.33		TD	111.00		O	122.67	⇑	BK
107.33		T	111.00		MP	123.67	⇑	DO
107.67		TC	111.33		XD	124.00	⇑	VE
107.67		PW	111.33		SR	125.67	⇑	TO
107.67		JS	111.33		SD	131.00	⇑	TR
107.67		BM	111.33		QZ	131.67	⇑	NO
108.00		SI	111.33		DR	175.67	×	XQ
108.00		HI	111.67		HK	264.67	×	WS
						275.67	×	CS

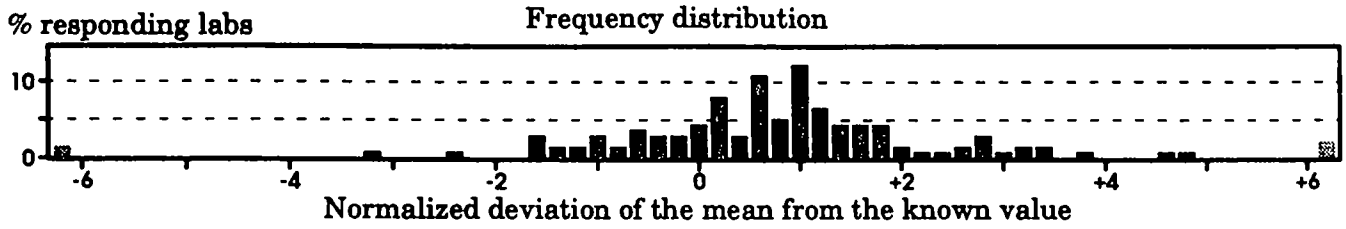
• ≡ No data submitted
∅ ≡ Insufficient data

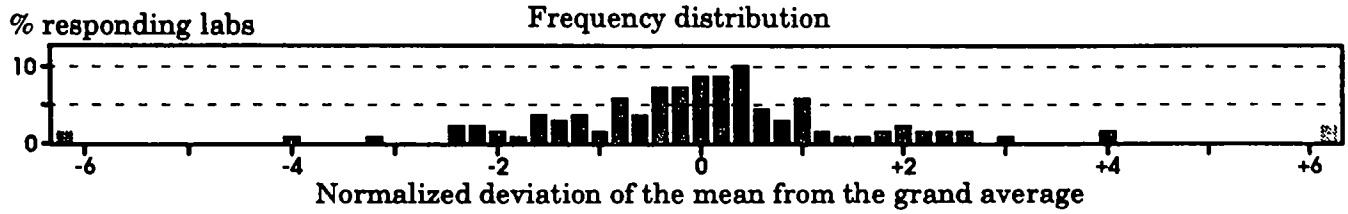
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

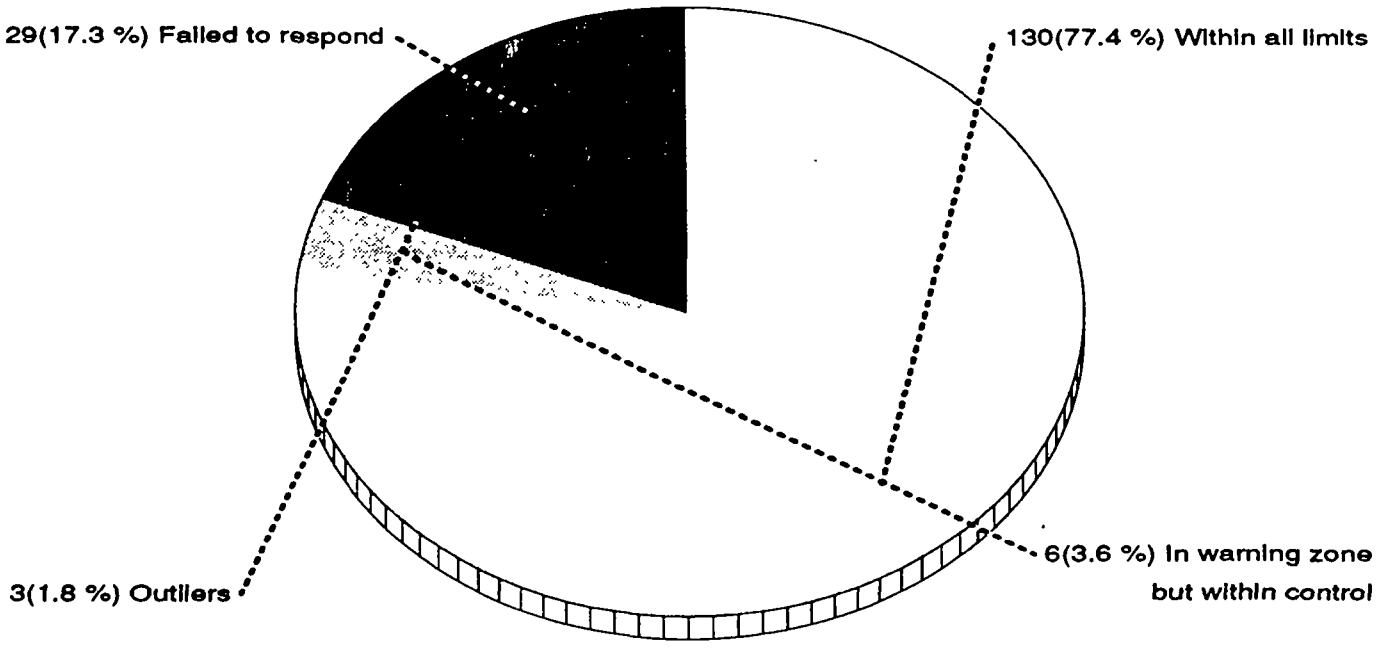
Zinc-65


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

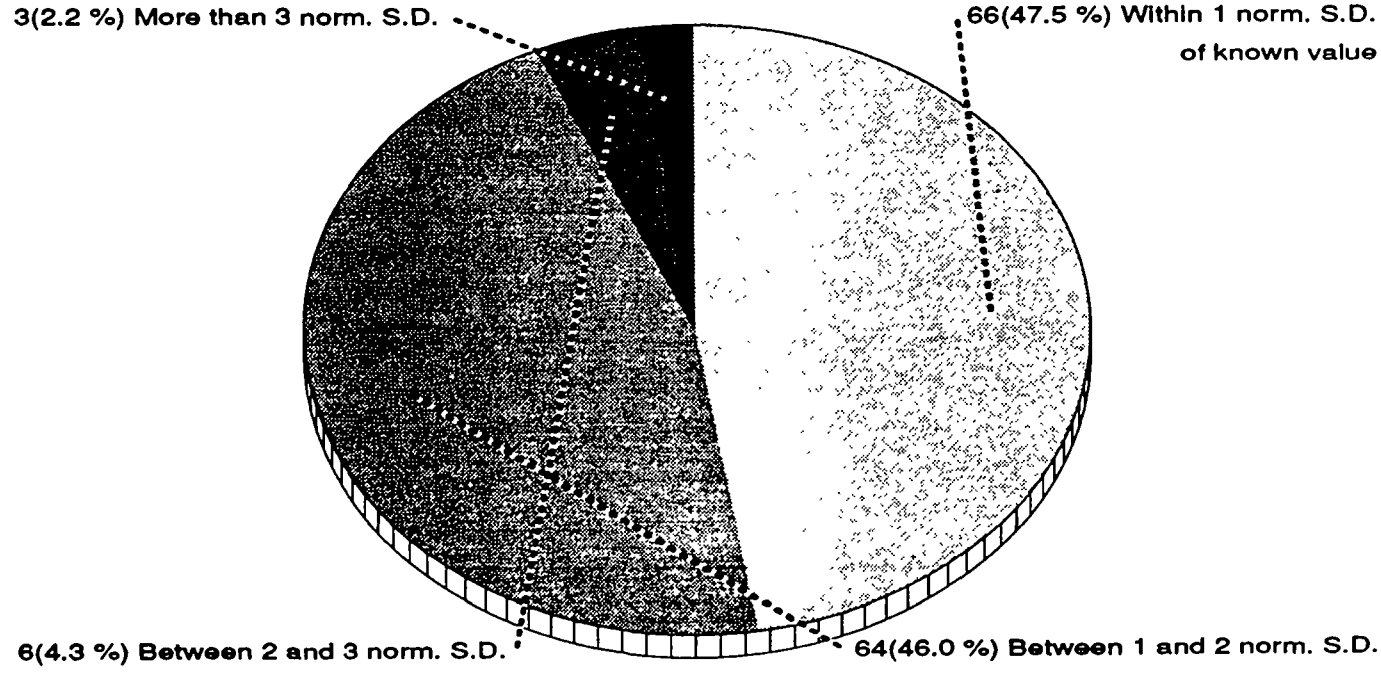

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-134 Statistical Summary 168 Participants

The known value of this nuclide is **31.0 pCi/l** with an expected precision of **5.0**; the control limits are 22.3 to 39.7; the warning regions are 22.3 to 25.2 and 36.8 to 39.7



Statistic	Respondents	Non-outliers
Mean	28.54	**Grand Avg 28.42**
Std. Dev.	4.31	2.16
Variance	18.55	4.68
% Coef. of Var.	15.09	7.61
% deviation of mean from known value	-7.94	-8.31
Norm. dev. of mean from known value	-0.57	-1.19
Median	28.33	28.33
% deviation of median from known value	-8.60	-8.60
Norm. dev. of median from known value	-0.62	-1.23



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	33.0	31.0	1.15	0.236	31.67	1.12	0.23	
AE	28.0	29.0	30.0	1.00	0.236	29.00	0.20	-0.69	
AF	29.0	27.0	30.0	1.53	0.354	28.67	0.08	-0.81	
AH	26.0	25.0	26.0	0.58	0.118	25.67	-0.96	-1.85	
AI	26.0	25.0	27.0	1.00	0.236	26.00	-0.84	-1.73	
AJ	26.0	27.0	26.0	0.58	0.118	26.33	-0.72	-1.62	
AK	25.0	25.0	25.0	0.00	0.000	25.00	-1.19	-2.08	
AL	31.0	37.0	32.0	3.21	0.709	33.33	1.70	0.81	
AP	30.0	28.0	29.0	1.00	0.236	29.00	0.20	-0.69	
AU	27.0	26.0	28.0	1.00	0.236	27.00	-0.49	-1.39	
AW	28.0	30.0	29.0	1.00	0.236	29.00	0.20	-0.69	
AY									•
AZ	33.0	33.0	35.0	1.15	0.236	33.67	1.82	0.92	
BA	27.0	28.0	28.0	0.58	0.118	27.67	-0.26	-1.15	
BB	29.0	31.0	29.0	1.15	0.236	29.67	0.43	-0.46	
BC	29.0	28.0	28.0	0.58	0.118	28.33	-0.03	-0.92	
BG									•
BH	31.0	26.0	30.0	2.65	0.591	29.00	0.20	-0.69	
BK	32.0	33.0	32.0	0.58	0.118	32.33	1.35	0.46	
BL	29.0	30.0	31.0	1.00	0.236	30.00	0.55	-0.35	
BM	29.0	30.0	31.0	1.00	0.236	30.00	0.55	-0.35	
BN	30.0	29.0	27.0	1.53	0.354	28.67	0.08	-0.81	
BO	34.0	31.0	31.0	1.73	0.354	32.00	1.24	0.35	
C	31.0	30.0	33.0	1.53	0.354	31.33	1.01	0.12	
CA	26.0	28.0	26.0	1.15	0.236	26.67	-0.61	-1.50	
CC									•
CE	26.0	27.0	29.0	1.53	0.354	27.33	-0.38	-1.27	
CJ	33.0	32.0	32.0	0.58	0.118	32.33	1.35	0.46	
CO	32.0	26.0	27.0	3.21	0.709	28.33	-0.03	-0.92	
CP	30.0	29.0	29.0	0.58	0.118	29.33	0.31	-0.58	
CS	69.0	70.0	67.0	1.53	0.354	68.67	13.94	13.05	×
CX	30.0	26.0	28.0	2.00	0.473	28.00	-0.15	-1.04	
D	30.0	30.0	29.0	0.58	0.118	29.67	0.43	-0.46	
DD	30.0	28.0	28.0	1.15	0.236	28.67	0.08	-0.81	
DE	28.0	28.0	29.0	0.58	0.118	28.33	-0.03	-0.92	
DH	28.0	30.0	31.0	1.53	0.354	29.67	0.43	-0.46	
DO	28.0	30.0	29.0	1.00	0.236	29.00	0.20	-0.69	
DR	27.0	28.0	29.0	1.00	0.236	28.00	-0.15	-1.04	
DT	30.0	32.0	30.0	1.15	0.236	30.67	0.78	-0.12	
E	29.0	27.0	27.0	1.15	0.236	27.67	-0.26	-1.15	
EA									•
EB	27.0	26.0	27.0	0.58	0.118	26.67	-0.61	-1.50	
EL	29.0	28.0	27.0	1.00	0.236	28.00	-0.15	-1.04	
EW	27.0	26.0	26.0	0.58	0.118	26.33	-0.72	-1.62	
EX	24.0	24.0	25.0	0.58	0.118	24.33	-1.42	-2.31	

• ≡ 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
FE	27.0	29.0	31.0	2.00	0.473	29.00	0.20	-0.69	
FJ	29.0	27.0	28.0	1.00	0.236	28.00	-0.15	-1.04	
FL	30.0	28.0	28.0	1.15	0.236	28.67	0.08	-0.81	
GI									•
GL	27.0	26.0	26.0	0.58	0.118	26.33	-0.72	-1.62	
GQ	31.0	31.0	31.0	0.00	0.000	31.00	0.89	0.00	
HE	31.0	32.0	32.0	0.58	0.118	31.67	1.12	0.23	
HI	28.0	29.0	29.0	0.58	0.118	28.67	0.08	-0.81	
HK	30.0	30.0	29.0	0.58	0.118	29.67	0.43	-0.46	
HL	30.0	31.0	30.0	0.58	0.118	30.33	0.66	-0.23	
HP	27.0	29.0	28.0	1.00	0.236	28.00	-0.15	-1.04	
I	28.0	26.0	27.0	1.00	0.236	27.00	-0.49	-1.39	
IU									•
J									•
JE	30.0	29.0	28.0	1.00	0.236	29.00	0.20	-0.69	
JG									•
JM	26.0	27.0	27.0	0.58	0.118	26.67	-0.61	-1.50	
JS	29.0	28.0	29.0	0.58	0.118	28.67	0.08	-0.81	
JY	26.0	27.0	27.0	0.58	0.118	26.67	-0.61	-1.50	
K	29.0	27.0	27.0	1.15	0.236	27.67	-0.26	-1.15	
KH	14.0	14.0	14.0	0.00	0.000	14.00	-5.00	-5.89	×
KL	29.0	27.0	29.0	1.15	0.236	28.33	-0.03	-0.92	
KX	28.0	29.0	28.0	0.58	0.118	28.33	-0.03	-0.92	
L	29.0	29.0	27.0	1.15	0.236	28.33	-0.03	-0.92	
LE									•
LF	28.0	31.0	28.0	1.73	0.354	29.00	0.20	-0.69	
LR	22.0	27.0	26.0	2.65	0.591	25.00	-1.19	-2.08	
M									•
MP	30.0	25.0	29.0	2.65	0.591	28.00	-0.15	-1.04	
MT	28.0	27.0	28.0	0.58	0.118	27.67	-0.26	-1.15	
MV									•
MX	28.0	27.0	27.0	0.58	0.118	27.33	-0.38	-1.27	
N	27.0	26.0	28.0	1.00	0.236	27.00	-0.49	-1.39	
NH									•
NJ	32.0	30.0	32.0	1.15	0.236	31.33	1.01	0.12	
NK									•
NO	33.0	34.0	35.0	1.00	0.236	34.00	1.93	1.04	
NP	27.0	27.0	29.0	1.15	0.236	27.67	-0.26	-1.15	
O	29.0	29.0	29.0	0.00	0.000	29.00	0.20	-0.69	
OA	28.0	28.0	27.0	0.58	0.118	27.67	-0.26	-1.15	
OB									•
OM	27.0	26.0	27.0	0.58	0.118	26.67	-0.61	-1.50	
OT	29.0	27.0	24.0	2.52	0.591	26.67	-0.61	-1.50	
P	18.0	19.0	18.0	0.58	0.118	18.33	-3.50	-4.39	×
PB									•

• ≡ 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
PD	29.0	29.0	30.0	0.58	0.118	29.33	0.31	-0.58	
PE									•
PM	26.0	28.0	23.0	2.52	0.591	25.67	-0.96	-1.85	
PW	30.0	29.0	28.0	1.00	0.236	29.00	0.20	-0.69	
PX	31.0	31.0	31.0	0.00	0.000	31.00	0.89	0.00	
Q	28.0	25.0	27.0	1.53	0.354	26.67	-0.61	-1.50	
QM	27.0	25.0	24.0	1.53	0.354	25.33	-1.07	-1.96	
QP	31.0	28.0	29.0	1.53	0.354	29.33	0.31	-0.58	
QT	27.0	29.0	27.0	1.15	0.236	27.67	-0.26	-1.15	
QU	28.0	29.0	27.0	1.00	0.236	28.00	-0.15	-1.04	
QW	29.0	27.0	27.0	1.15	0.236	27.67	-0.26	-1.15	
QX									•
QZ	29.0	28.0	29.0	0.58	0.118	28.67	0.08	-0.81	
R	29.0	29.0	29.0	0.00	0.000	29.00	0.20	-0.69	
RK									•
RO	28.0	28.0	29.0	0.58	0.118	28.33	-0.03	-0.92	
RR									•
RU	29.0	30.0	28.0	1.00	0.236	29.00	0.20	-0.69	
RX	25.0	24.0	23.0	1.00	0.236	24.00	-1.53	-2.42	
RZ	29.0	30.0	32.0	1.53	0.354	30.33	0.66	-0.23	
S	27.0	27.0	27.0	0.00	0.000	27.00	-0.49	-1.39	
SD	28.0	30.0	28.0	1.15	0.236	28.67	0.08	-0.81	
SF									•
SI	27.0	19.0	30.0	5.69	1.570	25.33	-1.07	-1.96	
SM	25.0	28.0	27.0	1.53	0.354	26.67	-0.61	-1.50	
SN	28.0	25.0	29.0	2.08	0.473	27.33	-0.38	-1.27	
SR	29.0	31.0	29.0	1.15	0.236	29.67	0.43	-0.46	
SS	28.0	28.0	27.0	0.58	0.118	27.67	-0.26	-1.15	
SV	24.0	24.0	26.0	1.15	0.236	24.67	-1.30	-2.19	
SX	30.0	29.0	30.0	0.58	0.118	29.67	0.43	-0.46	
SZ	27.0	27.0	26.0	0.58	0.118	26.67	-0.61	-1.50	
T	28.0	27.0	27.0	0.58	0.118	27.33	-0.38	-1.27	
TC	28.0	26.0	27.0	1.00	0.236	27.00	-0.49	-1.39	
TD	30.0	26.0	29.0	2.08	0.473	28.33	-0.03	-0.92	
TF									•
TO	34.0	31.0	34.0	1.73	0.354	33.00	1.59	0.69	
TQ	24.0	27.0	26.0	1.53	0.354	25.67	-0.96	-1.85	
TR	29.0	26.0	25.0	2.08	0.473	26.67	-0.61	-1.50	
TU	27.0	28.0	28.0	0.58	0.118	27.67	-0.26	-1.15	
U									•
UM									•
UP	28.0	27.0	29.0	1.00	0.236	28.00	-0.15	-1.04	
UR	35.0	41.0	32.0	4.58	1.120	36.00	2.62	1.73	
UV	27.0	25.0	27.0	1.15	0.236	26.33	-0.72	-1.62	
UX	27.0	26.0	29.0	1.53	0.354	27.33	-0.38	-1.27	

• ≡ 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
UY	34.0	29.0	34.0	2.89	0.591	32.33	1.35	0.46	
VA	26.0	27.0	25.0	1.00	0.236	26.00	-0.84	-1.73	
VC	31.0	31.0	30.0	0.58	0.118	30.67	0.78	-0.12	
VE	31.0	31.0	31.0	0.00	0.000	31.00	0.89	0.00	
VH	28.0	24.0	26.0	2.00	0.473	26.00	-0.84	-1.73	
VI	25.0	27.0	27.0	1.15	0.236	26.33	-0.72	-1.62	
VM	28.0	28.0	28.0	0.00	0.000	28.00	-0.15	-1.04	
VO	30.0	29.0	29.0	0.58	0.118	29.33	0.31	-0.58	
VS	27.0	30.0	28.0	1.53	0.354	28.33	-0.03	-0.92	
W	27.0	30.0	30.0	1.73	0.354	29.00	0.20	-0.69	
WD	29.0	28.0	28.0	0.58	0.118	28.33	-0.03	-0.92	
WI									•
WJ	27.0	25.0	28.0	1.53	0.354	26.67	-0.61	-1.50	
WK	27.0	27.0	26.0	0.58	0.118	26.67	-0.61	-1.50	
WO	26.0	27.0	22.0	2.65	0.591	25.00	-1.19	-2.08	
WR	27.0	31.0	26.0	2.65	0.591	28.00	-0.15	-1.04	
WS	34.0	35.0	35.0	0.58	0.118	34.67	2.16	1.27	
WV	28.0	28.0	28.0	0.00	0.000	28.00	-0.15	-1.04	
WW	29.0	27.0	27.0	1.15	0.236	27.67	-0.26	-1.15	
WX									•
X	27.0	24.0	28.0	2.08	0.473	26.33	-0.72	-1.62	
XA									•
XB	28.0	27.0	29.0	1.00	0.236	28.00	-0.15	-1.04	
XC									•
XD	29.0	29.0	28.0	0.58	0.118	28.67	0.08	-0.81	
XF	24.0	26.0	26.0	1.15	0.236	25.33	-1.07	-1.96	
XG	33.0	33.0	32.0	0.58	0.118	32.67	1.47	0.58	
XI	27.0	27.0	27.0	0.00	0.000	27.00	-0.49	-1.39	
XK	30.0	28.0	27.0	1.53	0.354	28.33	-0.03	-0.92	
XO									•
XQ	31.0	31.0	34.0	1.73	0.354	32.00	1.24	0.35	
XR									•
Y	29.0	28.0	28.0	0.58	0.118	28.33	-0.03	-0.92	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
14.00	×	KH	25.33		SI	26.33		VI
18.33	×	P	25.33		QM	26.33		UV
24.00		RX	25.67		TQ	26.33		GL
24.33		EX	25.67		PM	26.33		EW
24.67		SV	25.67		AH	26.33		AJ
25.00		WO	26.00		VH	26.67		WK
25.00		LR	26.00		VA	26.67		WJ
25.00		AK	26.00		AI	26.67		TR
25.33		XF	26.33		X	26.67		SZ

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

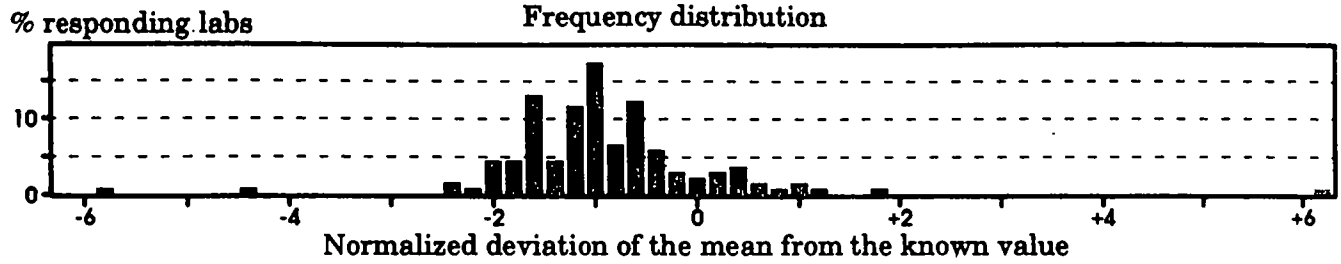
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
26.67		SM	28.00		HP	29.00		AP
26.67		Q	28.00		FJ	29.00		AE
26.67		OT	28.00		EL	29.33		VO
26.67		OM	28.00		DR	29.33		QP
26.67		JY	28.00		CX	29.33		PD
26.67		JM	28.33		Y	29.33		CP
26.67		EB	28.33		XK	29.67		SX
26.67		CA	28.33		WD	29.67		SR
27.00		XI	28.33		VS	29.67		HK
27.00		TC	28.33		TD	29.67		DH
27.00		S	28.33		RO	29.67		D
27.00		N	28.33		L	29.67		BB
27.00		I	28.33		KX	30.00		BM
27.00		AU	28.33		KL	30.00		BL
27.33		UX	28.33		DE	30.33		RZ
27.33		T	28.33		CO	30.33		HL
27.33		SN	28.33		BC	30.67		VC
27.33		MX	28.67		XD	30.67		DT
27.33		CE	28.67		SD	31.00		VE
27.67		WW	28.67		QZ	31.00		PX
27.67		TU	28.67		JS	31.00		GQ
27.67		SS	28.67		HI	31.33		NJ
27.67		QW	28.67		FL	31.33		C
27.67		QT	28.67		DD	31.67		HE
27.67		OA	28.67		BN	31.67		A
27.67		NP	28.67		AF	32.00		XQ
27.67		MT	29.00		W	32.00		BO
27.67		K	29.00		RU	32.33		UY
27.67		E	29.00		R	32.33		CJ
27.67		BA	29.00		PW	32.33		BK
28.00		XB	29.00		O	32.67		XG
28.00		WV	29.00		LF	33.00		TO
28.00		WR	29.00		JE	33.33		AL
28.00		VM	29.00		FE	33.67		AZ
28.00		UP	29.00		DO	34.00		NO
28.00		QU	29.00		BH	34.67		WS
28.00		MP	29.00		AW	36.00		UR
						68.67	×	CS

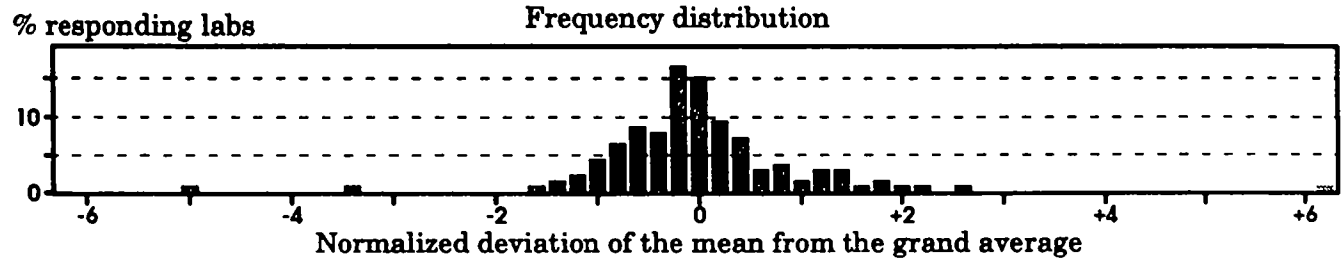
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

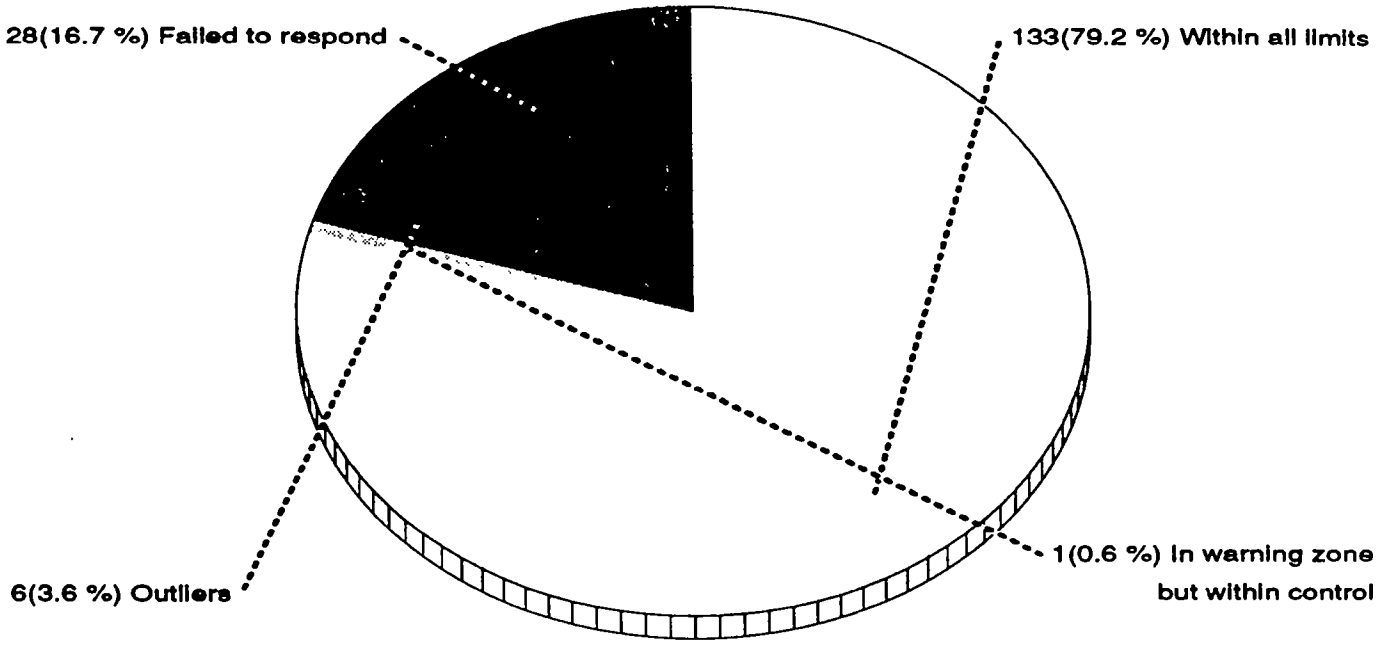
Cesium-134


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

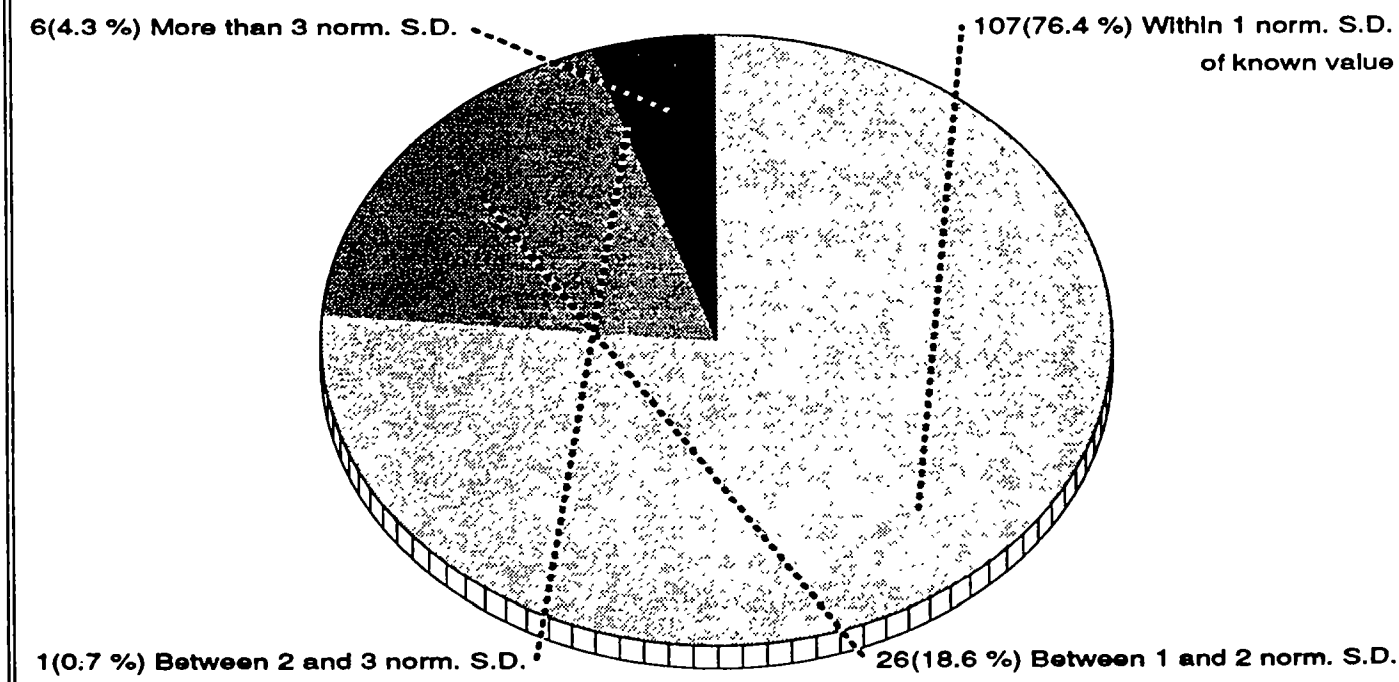

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-137 Statistical Summary 168 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	36.48	**Grand Avg 36.15**
Std. Dev.	5.83	2.06
Variance	34.03	4.25
% Coef. of Var.	15.99	5.70
% deviation of mean from known value	4.22	3.28
Norm. dev. of mean from known value	0.25	0.56
Median	36.00	36.00
% deviation of median from known value	2.86	2.86
Norm. dev. of median from known value	0.17	0.49



ESD-LV Performance Evaluation: Gamma in Water, 5-Jun-1998

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	36.0	37.0	37.0	0.58	0.118	36.67	0.18	0.58	
AE	35.0	35.0	37.0	1.15	0.236	35.67	-0.17	0.23	
AF	39.0	35.0	35.0	2.31	0.473	36.33	0.06	0.46	
AH	36.0	36.0	39.0	1.73	0.354	37.00	0.30	0.69	
AI	34.0	33.0	33.0	0.58	0.118	33.33	-0.97	-0.58	
AJ	39.0	39.0	39.0	0.00	0.000	39.00	0.99	1.39	
AK	31.0	34.0	34.0	1.73	0.354	33.00	-1.09	-0.69	
AL	35.0	31.0	36.0	2.65	0.591	34.00	-0.74	-0.35	
AP	36.0	36.0	38.0	1.15	0.236	36.67	0.18	0.58	
AU	34.0	37.0	36.0	1.53	0.354	35.67	-0.17	0.23	
AW	37.0	35.0	36.0	1.00	0.236	36.00	-0.05	0.35	
AY									•
AZ	37.0	39.0	38.0	1.00	0.236	38.00	0.64	1.04	
BA	35.0	34.0	31.0	2.08	0.473	33.33	-0.97	-0.58	
BB	36.0	37.0	34.0	1.53	0.354	35.67	-0.17	0.23	
BC	41.0	40.0	40.0	0.58	0.118	40.33	1.45	1.85	
BG									•
BH	38.0	35.0	37.0	1.53	0.354	36.67	0.18	0.58	
BK	42.0	41.0	42.0	0.58	0.118	41.67	1.91	2.31	
BL	35.0	35.0	34.0	0.58	0.118	34.67	-0.51	-0.12	
BM	36.0	35.0	36.0	0.58	0.118	35.67	-0.17	0.23	
BN	37.0	35.0	41.0	3.06	0.709	37.67	0.53	0.92	
BO	35.0	39.0	32.0	3.51	0.827	35.33	-0.28	0.12	
C	35.0	36.0	35.0	0.58	0.118	35.33	-0.28	0.12	
CA	30.0	37.0	31.0	3.79	0.827	32.67	-1.21	-0.81	
CC									•
CE	38.0	36.0	41.0	2.52	0.591	38.33	0.76	1.15	
CJ	36.0	37.0	40.0	2.08	0.473	37.67	0.53	0.92	
CO	36.0	36.0	34.0	1.15	0.236	35.33	-0.28	0.12	
CP	34.0	35.0	36.0	1.00	0.236	35.00	-0.40	0.00	
CS	89.0	90.0	91.0	1.00	0.236	90.00	18.66	19.05	×
CX	36.0	36.0	40.0	2.31	0.473	37.33	0.41	0.81	
D	35.0	36.0	35.0	0.58	0.118	35.33	-0.28	0.12	
DD	37.0	37.0	33.0	2.31	0.473	35.67	-0.17	0.23	
DE	34.0	34.0	35.0	0.58	0.118	34.33	-0.63	-0.23	
DH	33.0	36.0	36.0	1.73	0.354	35.00	-0.40	0.00	
DO	42.0	38.0	40.0	2.00	0.473	40.00	1.33	1.73	
DR	38.0	35.0	40.0	2.52	0.591	37.67	0.53	0.92	
DT	34.0	37.0	38.0	2.08	0.473	36.33	0.06	0.46	
E	37.0	33.0	35.0	2.00	0.473	35.00	-0.40	0.00	
EA									•
EB	40.0	40.0	41.0	0.58	0.118	40.33	1.45	1.85	
EL	35.0	36.0	34.0	1.00	0.236	35.00	-0.40	0.00	
EW	35.0	35.0	35.0	0.00	0.000	35.00	-0.40	0.00	
EX	32.0	36.0	32.0	2.31	0.473	33.33	-0.97	-0.58	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ 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
FE	28.0	32.0	30.0	2.00	0.473	30.00	-2.13	-1.73	
FJ	46.0	46.0	46.0	0.00	0.000	46.00	3.41	3.81	×
FL	37.0	37.0	37.0	0.00	0.000	37.00	0.30	0.69	
GI									•
GL	37.0	34.0	35.0	1.53	0.354	35.33	-0.28	0.12	
GQ	36.0	36.0	36.0	0.00	0.000	36.00	-0.05	0.35	
HE	34.0	36.0	35.0	1.00	0.236	35.00	-0.40	0.00	
HI	36.0	36.0	36.0	0.00	0.000	36.00	-0.05	0.35	
HK	36.0	39.0	37.0	1.53	0.354	37.33	0.41	0.81	
HL	42.0	39.0	41.0	1.53	0.354	40.67	1.57	1.96	
HP	36.0	34.0	36.0	1.15	0.236	35.33	-0.28	0.12	
I	37.0	35.0	35.0	1.15	0.236	35.67	-0.17	0.23	
IU									•
J									•
JE	37.0	36.0	35.0	1.00	0.236	36.00	-0.05	0.35	
JG									•
JM	35.0	35.0	34.0	0.58	0.118	34.67	-0.51	-0.12	
JS	34.0	33.0	35.0	1.00	0.236	34.00	-0.74	-0.35	
JY	37.0	38.0	38.0	0.58	0.118	37.67	0.53	0.92	
K	35.0	34.0	35.0	0.58	0.118	34.67	-0.51	-0.12	
KH	19.0	19.0	19.0	0.00	0.000	19.00	-5.94	-5.54	×
KL	34.0	36.0	39.0	2.52	0.591	36.33	0.06	0.46	
KX	37.0	40.0	36.0	2.08	0.473	37.67	0.53	0.92	
L	35.0	34.0	34.0	0.58	0.118	34.33	-0.63	-0.23	
LE									•
LF	33.0	35.0	35.0	1.15	0.236	34.33	-0.63	-0.23	
LR	27.0	41.0	34.0	7.00	2.245	34.00	-0.74	-0.35	
M									•
MP	39.0	39.0	39.0	0.00	0.000	39.00	0.99	1.39	
MT	35.0	35.0	34.0	0.58	0.118	34.67	-0.51	-0.12	
MV									•
MX	34.0	34.0	34.0	0.00	0.000	34.00	-0.74	-0.35	
N	34.0	35.0	35.0	0.58	0.118	34.67	-0.51	-0.12	
NH									•
NJ	36.0	37.0	39.0	1.53	0.354	37.33	0.41	0.81	
NK									•
NO	36.0	38.0	40.0	2.00	0.473	38.00	0.64	1.04	
NP	35.0	34.0	37.0	1.53	0.354	35.33	-0.28	0.12	
O	37.0	37.0	37.0	0.00	0.000	37.00	0.30	0.69	
OA	36.0	34.0	34.0	1.15	0.236	34.67	-0.51	-0.12	
OB	39.0	39.0	37.0	1.15	0.236	38.33	0.76	1.15	
OM	39.0	39.0	40.0	0.58	0.118	39.33	1.10	1.50	
OT	33.0	32.0	35.0	1.53	0.354	33.33	-0.97	-0.58	
P	25.0	23.0	24.0	1.00	0.236	24.00	-4.21	-3.81	×
PB									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gamma in Water, 5-Jun-1998

Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
PD	34.0	38.0	34.0	2.31	0.473	35.33	-0.28	0.12	
PE									•
PM	35.0	36.0	36.0	0.58	0.118	35.67	-0.17	0.23	
PW	37.0	36.0	35.0	1.00	0.236	36.00	-0.05	0.35	
PX	34.0	34.0	34.0	0.00	0.000	34.00	-0.74	-0.35	
Q	34.0	42.0	34.0	4.62	0.945	36.67	0.18	0.58	
QM	42.0	41.0	37.0	2.65	0.591	40.00	1.33	1.73	
QP	38.0	41.0	35.0	3.00	0.709	38.00	0.64	1.04	
QT	38.0	34.0	41.0	3.51	0.827	37.67	0.53	0.92	
QU	32.0	33.0	35.0	1.53	0.354	33.33	-0.97	-0.58	
QW	32.0	34.0	34.0	1.15	0.236	33.33	-0.97	-0.58	
QX									•
QZ	37.0	38.0	37.0	0.58	0.118	37.33	0.41	0.81	
R	38.0	38.0	37.0	0.58	0.118	37.67	0.53	0.92	
RK									•
RO	37.0	38.0	37.0	0.58	0.118	37.33	0.41	0.81	
RR									•
RU	35.0	35.0	36.0	0.58	0.118	35.33	-0.28	0.12	
RX	36.0	36.0	38.0	1.15	0.236	36.67	0.18	0.58	
RZ	36.0	33.0	37.0	2.08	0.473	35.33	-0.28	0.12	
S	35.0	36.0	38.0	1.53	0.354	36.33	0.06	0.46	
SD	40.0	40.0	40.0	0.00	0.000	40.00	1.33	1.73	
SF									•
SI	34.0	36.0	48.0	7.57	2.245	39.33	1.10	1.50	
SM	34.0	38.0	35.0	2.08	0.473	35.67	-0.17	0.23	
SN	38.0	35.0	35.0	1.73	0.354	36.00	-0.05	0.35	
SR	33.0	36.0	35.0	1.53	0.354	34.67	-0.51	-0.12	
SS	37.0	36.0	36.0	0.58	0.118	36.33	0.06	0.46	
SV	34.0	35.0	33.0	1.00	0.236	34.00	-0.74	-0.35	
SX	35.0	40.0	38.0	2.52	0.591	37.67	0.53	0.92	
SZ	37.0	33.0	35.0	2.00	0.473	35.00	-0.40	0.00	
T	32.0	33.0	34.0	1.00	0.236	33.00	-1.09	-0.69	
TC	33.0	34.0	35.0	1.00	0.236	34.00	-0.74	-0.35	
TD	37.0	31.0	39.0	4.16	0.945	35.67	-0.17	0.23	
TF									•
TO	38.0	43.0	40.0	2.52	0.591	40.33	1.45	1.85	
TQ	34.0	35.0	40.0	3.21	0.709	36.33	0.06	0.46	
TR	61.0	58.0	62.0	2.08	0.473	60.33	8.38	8.78	×
TU	36.0	36.0	37.0	0.58	0.118	36.33	0.06	0.46	
U									•
UM									•
UP	37.0	36.0	38.0	1.00	0.236	37.00	0.30	0.69	
UR	31.0	34.0	30.0	2.08	0.473	31.67	-1.55	-1.15	
UV	33.0	33.0	33.0	0.00	0.000	33.00	-1.09	-0.69	
UX	36.0	37.0	36.0	0.58	0.118	36.33	0.06	0.46	

• ≡ 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)	Normalized deviation (known)	Tag
UY	39.0	34.0	44.0	5.00	1.345	39.00	0.99	1.39	
VA	31.0	32.0	32.0	0.58	0.118	31.67	-1.55	-1.15	
VC	37.0	38.0	38.0	0.58	0.118	37.67	0.53	0.92	
VE	43.0	35.0	37.0	4.16	0.945	38.33	0.76	1.15	
VH	37.0	35.0	36.0	1.00	0.236	36.00	-0.05	0.35	
VI	38.0	35.0	37.0	1.53	0.354	36.67	0.18	0.58	
VM	40.0	40.0	40.0	0.00	0.000	40.00	1.33	1.73	
VO	37.0	34.0	42.0	4.04	0.945	37.67	0.53	0.92	
VS	42.0	39.0	40.0	1.53	0.354	40.33	1.45	1.85	
W	37.0	35.0	37.0	1.15	0.236	36.33	0.06	0.46	
WD	35.0	35.0	37.0	1.15	0.236	35.67	-0.17	0.23	
WI									•
WJ	36.0	36.0	33.0	1.73	0.354	35.00	-0.40	0.00	
WK	35.0	36.0	35.0	0.58	0.118	35.33	-0.28	0.12	
WO	40.0	39.0	35.0	2.65	0.591	38.00	0.64	1.04	
WR	37.0	38.0	34.0	2.08	0.473	36.33	0.06	0.46	
WS	32.0	33.0	34.0	1.00	0.236	33.00	-1.09	-0.69	
WV	38.0	38.0	37.0	0.58	0.118	37.67	0.53	0.92	
WW	36.0	36.0	34.0	1.15	0.236	35.33	-0.28	0.12	
WX									•
X	37.0	38.0	40.0	1.53	0.354	38.33	0.76	1.15	
XA									•
XB	37.0	36.0	36.0	0.58	0.118	36.33	0.06	0.46	
XC									•
XD	38.0	35.0	39.0	2.08	0.473	37.33	0.41	0.81	
XF	35.0	35.0	31.0	2.31	0.473	33.67	-0.86	-0.46	
XG	34.0	35.0	34.0	0.58	0.118	34.33	-0.63	-0.23	
XI	36.0	36.0	37.0	0.58	0.118	36.33	0.06	0.46	
XK	40.0	38.0	36.0	2.00	0.473	38.00	0.64	1.04	
XO									•
XQ	23.0	27.0	21.0	3.06	0.709	23.67	-4.32	-3.93	×
XR									•
Y	37.0	36.0	36.0	0.58	0.118	36.33	0.06	0.46	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
19.00	×	KH	33.00		T	34.00		TC
23.67	×	XQ	33.00		AK	34.00		SV
24.00	×	P	33.33		QW	34.00		PX
30.00		FE	33.33		QU	34.00		MX
31.67		VA	33.33		OT	34.00		LR
31.67		UR	33.33		EX	34.00		JS
32.67		CA	33.33		BA	34.00		AL
33.00		WS	33.33		AI	34.33		XG
33.00		UV	33.67		XF	34.33		LF

• ≡ 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
34.33		L	35.67		AU	37.67		WV
34.33		DE	35.67		AE	37.67		VO
34.67		SR	36.00		VH	37.67		VC
34.67		OA	36.00		SN	37.67		SX
34.67		N	36.00		PW	37.67		R
34.67		MT	36.00		JE	37.67		QT
34.67		K	36.00		HI	37.67		KX
34.67		JM	36.00		GQ	37.67		JY
34.67		BL	36.00		AW	37.67		DR
35.00		WJ	36.33		Y	37.67		CJ
35.00		SZ	36.33		XI	37.67		BN
35.00		HE	36.33		XB	38.00		XK
35.00		EW	36.33		WR	38.00		WO
35.00		EL	36.33		W	38.00		QP
35.00		E	36.33		UX	38.00		NO
35.00		DH	36.33		TU	38.00		AZ
35.00		CP	36.33		TQ	38.33		X
35.33		WW	36.33		SS	38.33		VE
35.33		WK	36.33		S	38.33		OB
35.33		RZ	36.33		KL	38.33		CE
35.33		RU	36.33		DT	39.00		UY
35.33		PD	36.33		AF	39.00		MP
35.33		NP	36.67		VI	39.00		AJ
35.33		HP	36.67		RX	39.33		SI
35.33		GL	36.67		Q	39.33		OM
35.33		D	36.67		BH	40.00		VM
35.33		CO	36.67		AP	40.00		SD
35.33		C	36.67		A	40.00		QM
35.33		BO	37.00		UP	40.00		DO
35.67		WD	37.00		O	40.33		VS
35.67		TD	37.00		FL	40.33		TO
35.67		SM	37.00		AH	40.33		EB
35.67		PM	37.33		XD	40.33		BC
35.67		I	37.33		RO	40.67		HL
35.67		DD	37.33		QZ	41.67		BK
35.67		BM	37.33		NJ	46.00	×	FJ
35.67		BB	37.33		HK	60.33	×	TR
			37.33		CX	90.00	×	CS

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

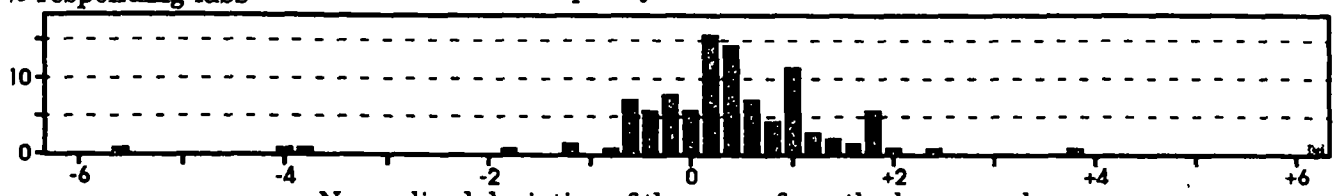
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

% responding labs

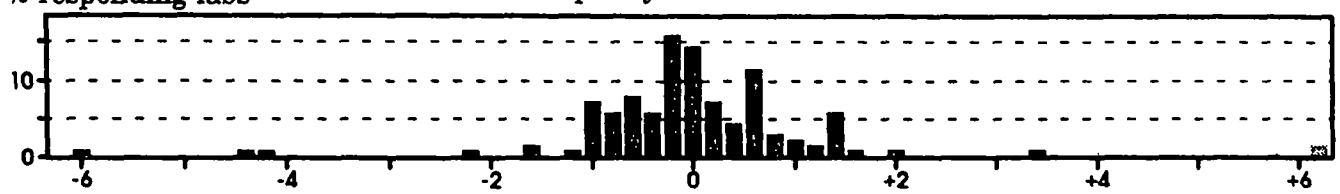
Frequency distribution



Normalized deviation of the mean from the known value

% responding labs

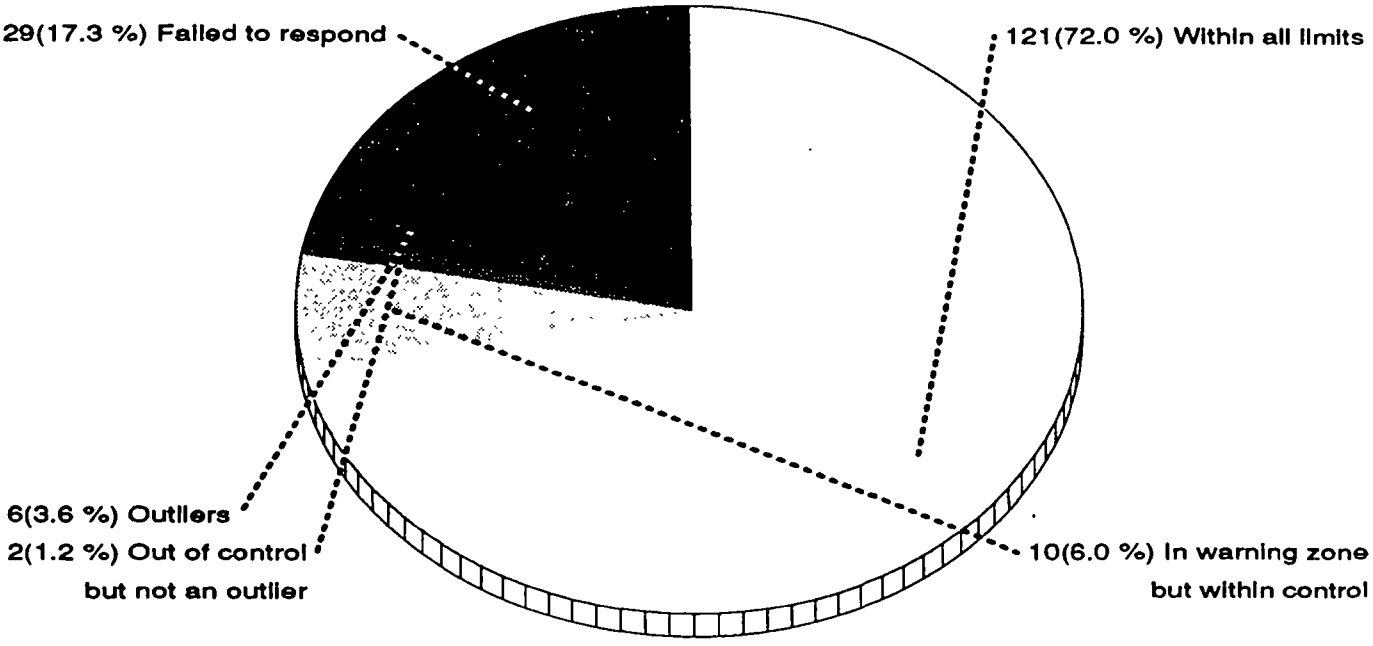
Frequency distribution



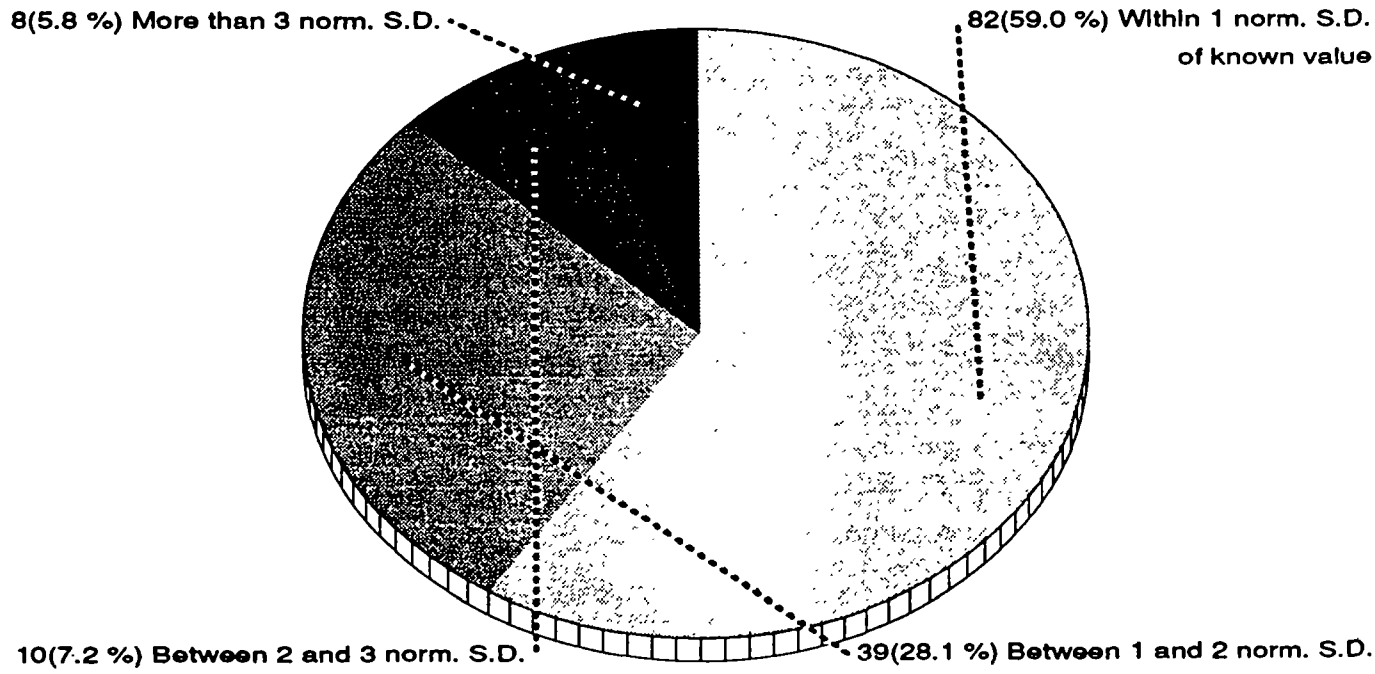
Normalized deviation of the mean from the grand average

Barium-133 Statistical Summary 168 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	38.52	**Grand Avg 38.11**
Std. Dev.	6.55	2.84
Variance	42.93	8.07
% Coef. of Var.	17.01	7.45
% deviation of mean from known value	-3.70	-4.73
Norm. dev. of mean from known value	-0.23	-0.67
Median	38.00	38.00
% deviation of median from known value	-5.00	-5.00
Norm. dev. of median from known value	-0.31	-0.70



ESD-LV Performance Evaluation: Gamma in Water, 5-Jun-1998

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	39.0	40.0	38.0	1.00	0.236	39.00	0.31	-0.35	
AE	39.0	37.0	38.0	1.00	0.236	38.00	-0.04	-0.69	
AF	36.0	37.0	38.0	1.00	0.236	37.00	-0.38	-1.04	
AH	32.0	34.0	37.0	2.52	0.591	34.33	-1.31	-1.96	
AI	37.0	36.0	35.0	1.00	0.236	36.00	-0.73	-1.39	
AJ	28.0	24.0	23.0	2.65	0.591	25.00	-4.54	-5.20	×
AK	32.0	33.0	33.0	0.58	0.118	32.67	-1.88	-2.54	
AL	40.0	35.0	39.0	2.65	0.591	38.00	-0.04	-0.69	
AP	37.0	37.0	36.0	0.58	0.118	36.67	-0.50	-1.15	
AU	38.0	36.0	37.0	1.00	0.236	37.00	-0.38	-1.04	
AW	41.0	40.0	39.0	1.00	0.236	40.00	0.66	0.00	
AY									•
AZ	40.0	45.0	42.0	2.52	0.591	42.33	1.46	0.81	
BA	35.0	35.0	36.0	0.58	0.118	35.33	-0.96	-1.62	
BB	41.0	38.0	36.0	2.52	0.591	38.33	0.08	-0.58	
BC	35.0	36.0	35.0	0.58	0.118	35.33	-0.96	-1.62	
BG									•
BH	35.0	31.0	30.0	2.65	0.591	32.00	-2.12	-2.77	
BK	41.0	41.0	43.0	1.15	0.236	41.67	1.23	0.58	
BL	40.0	41.0	41.0	0.58	0.118	40.67	0.89	0.23	
BM	40.0	42.0	37.0	2.52	0.591	39.67	0.54	-0.12	
BN	40.0	42.0	37.0	2.52	0.591	39.67	0.54	-0.12	
BO	40.0	37.0	38.0	1.53	0.354	38.33	0.08	-0.58	
C	38.0	37.0	39.0	1.00	0.236	38.00	-0.04	-0.69	
CA	35.0	36.0	37.0	1.00	0.236	36.00	-0.73	-1.39	
CC									•
CE	40.0	38.0	40.0	1.15	0.236	39.33	0.42	-0.23	
CJ	37.0	36.0	32.0	2.65	0.591	35.00	-1.08	-1.73	
CO	35.0	50.0	40.0	7.64	2.470	41.67	1.23	0.58	
CP	42.0	40.0	41.0	1.00	0.236	41.00	1.00	0.35	
CS	90.0	89.0	90.0	0.58	0.118	89.67	17.86	17.21	×
CX	39.0	39.0	42.0	1.73	0.354	40.00	0.66	0.00	
D	39.0	39.0	39.0	0.00	0.000	39.00	0.31	-0.35	
DD	40.0	39.0	36.0	2.08	0.473	38.33	0.08	-0.58	
DE	37.0	38.0	38.0	0.58	0.118	37.67	-0.15	-0.81	
DH	33.0	37.0	38.0	2.65	0.591	36.00	-0.73	-1.39	
DO	40.0	38.0	39.0	1.00	0.236	39.00	0.31	-0.35	
DR	34.0	39.0	37.0	2.52	0.591	36.67	-0.50	-1.15	
DT	33.0	40.0	40.0	4.04	0.827	37.67	-0.15	-0.81	
E	37.0	37.0	39.0	1.15	0.236	37.67	-0.15	-0.81	
EA									•
EB	38.0	36.0	37.0	1.00	0.236	37.00	-0.38	-1.04	
EL	39.0	36.0	39.0	1.73	0.354	38.00	-0.04	-0.69	
EW	39.0	39.0	38.0	0.58	0.118	38.67	0.19	-0.46	
EX	34.0	33.0	31.0	1.53	0.354	32.67	-1.88	-2.54	

• ≡ 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
FE	36.0	38.0	40.0	2.00	0.473	38.00	-0.04	-0.69	
FJ	41.0	39.0	36.0	2.52	0.591	38.67	0.19	-0.46	
FL	40.0	40.0	41.0	0.58	0.118	40.33	0.77	0.12	
GI									•
GL	36.0	36.0	36.0	0.00	0.000	36.00	-0.73	-1.39	
GQ	40.0	40.0	40.0	0.00	0.000	40.00	0.66	0.00	
HE	43.0	39.0	41.0	2.00	0.473	41.00	1.00	0.35	
HI	38.0	38.0	38.0	0.00	0.000	38.00	-0.04	-0.69	
HK	37.0	38.0	37.0	0.58	0.118	37.33	-0.27	-0.92	
HL	39.0	41.0	41.0	1.15	0.236	40.33	0.77	0.12	
HP	41.0	37.0	43.0	3.06	0.709	40.33	0.77	0.12	
I	37.0	36.0	35.0	1.00	0.236	36.00	-0.73	-1.39	
IU									•
J									•
JE	38.0	39.0	38.0	0.58	0.118	38.33	0.08	-0.58	
JG									•
JM	37.0	34.0	34.0	1.73	0.354	35.00	-1.08	-1.73	
JS	34.0	34.0	36.0	1.15	0.236	34.67	-1.19	-1.85	
JY	41.0	40.0	41.0	0.58	0.118	40.67	0.89	0.23	
K	40.0	38.0	39.0	1.00	0.236	39.00	0.31	-0.35	
KH	17.0	17.0	17.0	0.00	0.000	17.00	-7.31	-7.97	×
KL	38.0	36.0	40.0	2.00	0.473	38.00	-0.04	-0.69	
KX	37.0	39.0	39.0	1.15	0.236	38.33	0.08	-0.58	
L	41.0	39.0	37.0	2.00	0.473	39.00	0.31	-0.35	
LE									•
LF	38.0	40.0	42.0	2.00	0.473	40.00	0.66	0.00	
LR	27.0	32.0	25.0	3.61	0.827	28.00	-3.50	-4.16	×
M									•
MP	36.0	37.0	37.0	0.58	0.118	36.67	-0.50	-1.15	
MT	41.0	41.0	39.0	1.15	0.236	40.33	0.77	0.12	
MV									•
MX	37.0	36.0	36.0	0.58	0.118	36.33	-0.61	-1.27	
N	37.0	41.0	38.0	2.08	0.473	38.67	0.19	-0.46	
NH									•
NJ	38.0	40.0	39.0	1.00	0.236	39.00	0.31	-0.35	
NK									•
NO	37.0	41.0	43.0	3.06	0.709	40.33	0.77	0.12	
NP	36.0	36.0	40.0	2.31	0.473	37.33	-0.27	-0.92	
O	38.0	38.0	38.0	0.00	0.000	38.00	-0.04	-0.69	
OA	39.0	38.0	35.0	2.08	0.473	37.33	-0.27	-0.92	
OB									•
OM	38.0	39.0	39.0	0.58	0.118	38.67	0.19	-0.46	
OT	34.0	34.0	37.0	1.73	0.354	35.00	-1.08	-1.73	
P	38.0	35.0	40.0	2.52	0.591	37.67	-0.15	-0.81	
PB									•

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gamma in Water, 5-Jun-1998

Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
PD	50.0	38.0	41.0	6.24	1.795	43.00	1.69	1.04	
PE									•
PM	37.0	38.0	41.0	2.08	0.473	38.67	0.19	-0.46	
PW	38.0	36.0	36.0	1.15	0.236	36.67	-0.50	-1.15	
PX	40.0	38.0	41.0	1.53	0.354	39.67	0.54	-0.12	
Q	37.0	40.0	38.0	1.53	0.354	38.33	0.08	-0.58	
QM	48.0	49.0	46.0	1.53	0.354	47.67	3.31	2.66	
QP	34.0	31.0	41.0	5.13	1.345	35.33	-0.96	-1.62	
QT	33.0	32.0	34.0	1.00	0.236	33.00	-1.77	-2.42	
QU	40.0	41.0	43.0	1.53	0.354	41.33	1.12	0.46	
QW	43.0	42.0	42.0	0.58	0.118	42.33	1.46	0.81	
QX									•
QZ	39.0	38.0	39.0	0.58	0.118	38.67	0.19	-0.46	
R	38.0	35.0	38.0	1.73	0.354	37.00	-0.38	-1.04	
RK									•
RO	36.0	40.0	38.0	2.00	0.473	38.00	-0.04	-0.69	
RR									•
RU	36.0	38.0	38.0	1.15	0.236	37.33	-0.27	-0.92	
RX	44.0	42.0	43.0	1.00	0.236	43.00	1.69	1.04	
RZ	34.0	35.0	34.0	0.58	0.118	34.33	-1.31	-1.96	
S	43.0	43.0	41.0	1.15	0.236	42.33	1.46	0.81	
SD	34.0	38.0	38.0	2.31	0.473	36.67	-0.50	-1.15	
SF									•
SI	36.0	29.0	25.0	5.57	1.570	30.00	-2.81	-3.46	⇓
SM	38.0	43.0	40.0	2.52	0.591	40.33	0.77	0.12	
SN	37.0	36.0	35.0	1.00	0.236	36.00	-0.73	-1.39	
SR	41.0	36.0	38.0	2.52	0.591	38.33	0.08	-0.58	
SS	40.0	40.0	37.0	1.73	0.354	39.00	0.31	-0.35	
SV	41.0	42.0	40.0	1.00	0.236	41.00	1.00	0.35	
SX	44.0	39.0	41.0	2.52	0.591	41.33	1.12	0.46	
SZ	37.0	37.0	37.0	0.00	0.000	37.00	-0.38	-1.04	
T	40.0	38.0	36.0	2.00	0.473	38.00	-0.04	-0.69	
TC	33.0	34.0	33.0	0.58	0.118	33.33	-1.65	-2.31	
TD	35.0	30.0	36.0	3.21	0.709	33.67	-1.54	-2.19	
TF									•
TO	57.0	47.0	52.0	5.00	1.345	52.00	4.81	4.16	×
TQ	34.0	41.0	36.0	3.61	0.827	37.00	-0.38	-1.04	
TR	76.0	74.0	73.0	1.53	0.354	74.33	12.55	11.89	×
TU	36.0	35.0	36.0	0.58	0.118	35.67	-0.85	-1.50	
U									•
UM									•
UP	39.0	38.0	40.0	1.00	0.236	39.00	0.31	-0.35	
UR	49.0	49.0	45.0	2.31	0.473	47.67	3.31	2.66	
UV	35.0	41.0	34.0	3.79	0.827	36.67	-0.50	-1.15	
UX	40.0	40.0	40.0	0.00	0.000	40.00	0.66	0.00	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ 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
UY	41.0	31.0	39.0	5.29	1.345	37.00	-0.38	-1.04	
VA	38.0	43.0	36.0	3.61	0.827	39.00	0.31	-0.35	
VC	38.0	38.0	39.0	0.58	0.118	38.33	0.08	-0.58	
VE	41.0	44.0	43.0	1.53	0.354	42.67	1.58	0.92	
VH	38.0	33.0	34.0	2.65	0.591	35.00	-1.08	-1.73	
VI	39.0	37.0	36.0	1.53	0.354	37.33	-0.27	-0.92	
VM	39.0	39.0	39.0	0.00	0.000	39.00	0.31	-0.35	
VO	40.0	40.0	42.0	1.15	0.236	40.67	0.89	0.23	
VS	34.0	32.0	32.0	1.15	0.236	32.67	-1.88	-2.54	
W	39.0	39.0	39.0	0.00	0.000	39.00	0.31	-0.35	
WD	36.0	38.0	40.0	2.00	0.473	38.00	-0.04	-0.69	
WI									•
WJ	39.0	40.0	35.0	2.65	0.591	38.00	-0.04	-0.69	
WK	37.0	37.0	36.0	0.58	0.118	36.67	-0.50	-1.15	
WO	25.0	30.0	34.0	4.51	1.120	29.67	-2.92	-3.58	⇓
WR	35.0	36.0	40.0	2.65	0.591	37.00	-0.38	-1.04	
WS	41.0	42.0	42.0	0.58	0.118	41.67	1.23	0.58	
WV	37.0	37.0	37.0	0.00	0.000	37.00	-0.38	-1.04	
WW	38.0	39.0	38.0	0.58	0.118	38.33	0.08	-0.58	
WX									•
X	37.0	37.0	37.0	0.00	0.000	37.00	-0.38	-1.04	
XA									•
XB	40.0	38.0	37.0	1.53	0.354	38.33	0.08	-0.58	
XC									•
XD	38.0	38.0	39.0	0.58	0.118	38.33	0.08	-0.58	
XF	35.0	36.0	35.0	0.58	0.118	35.33	-0.96	-1.62	
XG	38.0	39.0	39.0	0.58	0.118	38.67	0.19	-0.46	
XI	34.0	36.0	36.0	1.15	0.236	35.33	-0.96	-1.62	
XK	36.0	39.0	41.0	2.52	0.591	38.67	0.19	-0.46	
XO									•
XQ	49.0	52.0	38.0	7.37	2.245	46.33	2.85	2.19	
XR									•
Y	40.0	40.0	41.0	0.58	0.118	40.33	0.77	0.12	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
17.00	×	KH	33.00		QT	35.00		CJ
25.00	×	AJ	33.33		TC	35.33		XI
28.00	×	LR	33.67		TD	35.33		XF
29.67	⇓	WO	34.33		RZ	35.33		QP
30.00	⇓	SI	34.33		AH	35.33		BC
32.00		BH	34.67		JS	35.33		BA
32.67		VS	35.00		VH	35.67		TU
32.67		EX	35.00		OT	36.00		SN
32.67		AK	35.00		JM	36.00		I

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133

Data sorted by Laboratory Average

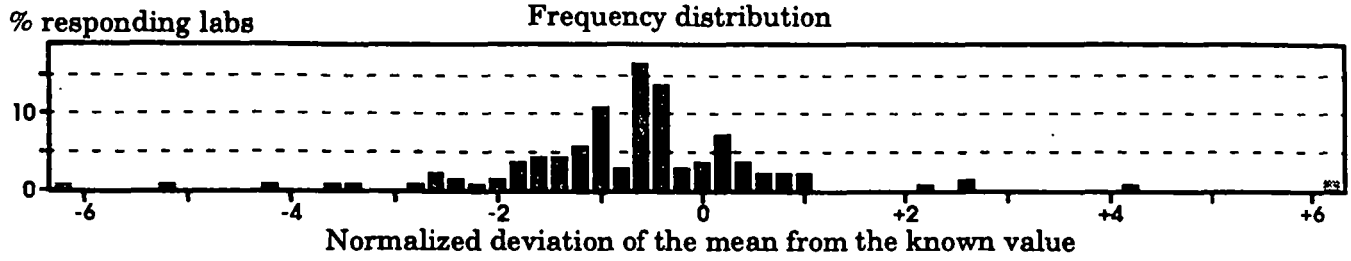
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
36.00		GL	38.00		HI	39.67		PX
36.00		DH	38.00		FE	39.67		BN
36.00		CA	38.00		EL	39.67		BM
36.00		AI	38.00		C	40.00		UX
36.33		MX	38.00		AL	40.00		LF
36.67		WK	38.00		AE	40.00		GQ
36.67		UV	38.33		XD	40.00		CX
36.67		SD	38.33		XB	40.00		AW
36.67		PW	38.33		WW	40.33		Y
36.67		MP	38.33		VC	40.33		SM
36.67		DR	38.33		SR	40.33		NO
36.67		AP	38.33		Q	40.33		MT
37.00		X	38.33		KX	40.33		HP
37.00		WV	38.33		JE	40.33		HL
37.00		WR	38.33		DD	40.33		FL
37.00		UY	38.33		BO	40.67		VO
37.00		TQ	38.33		BB	40.67		JY
37.00		SZ	38.67		XK	40.67		BL
37.00		R	38.67		XG	41.00		SV
37.00		EB	38.67		QZ	41.00		HE
37.00		AU	38.67		PM	41.00		CP
37.00		AF	38.67		OM	41.33		SX
37.33		VI	38.67		N	41.33		QU
37.33		RU	38.67		FJ	41.67		WS
37.33		OA	38.67		EW	41.67		CO
37.33		NP	39.00		W	41.67		BK
37.33		HK	39.00		VM	42.33		S
37.67		P	39.00		VA	42.33		QW
37.67		E	39.00		UP	42.33		AZ
37.67		DT	39.00		SS	42.67		VE
37.67		DE	39.00		NJ	43.00		RX
38.00		WJ	39.00		L	43.00		PD
38.00		WD	39.00		K	46.33		XQ
38.00		T	39.00		DO	47.67		UR
38.00		RO	39.00		D	47.67		QM
38.00		O	39.00		A	52.00	×	TO
38.00		KL	39.33		CE	74.33	×	TR
						89.67	×	CS

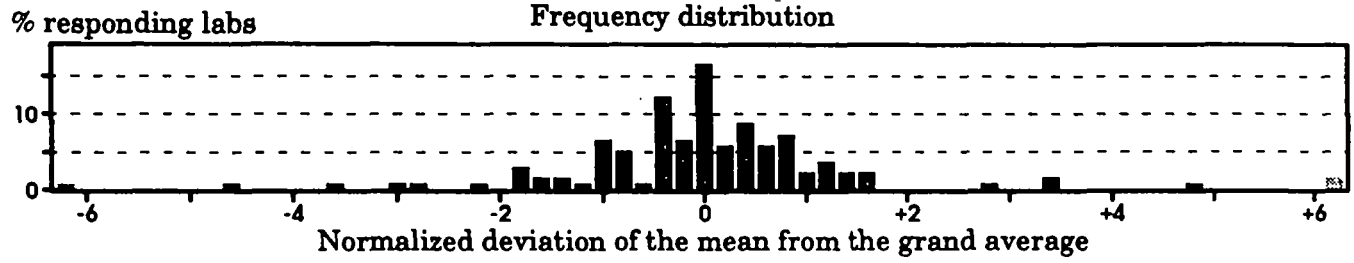
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133


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


% 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

Office of Research and
Development
Washington, DC 20460

EPA/600/R-98/119
September 1998

EPA

Uranium-Radium in Water Performance Evaluation Study

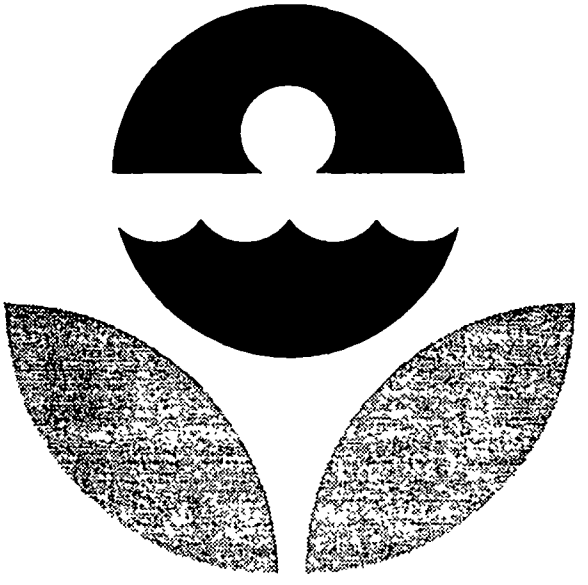
A Statistical Evaluation of the June 12, 1998 Data

006ECB98-11

Uranium-Radium in Water

Performance Evaluation Study

June 12, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Uranium-Radium in Water; June 12, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

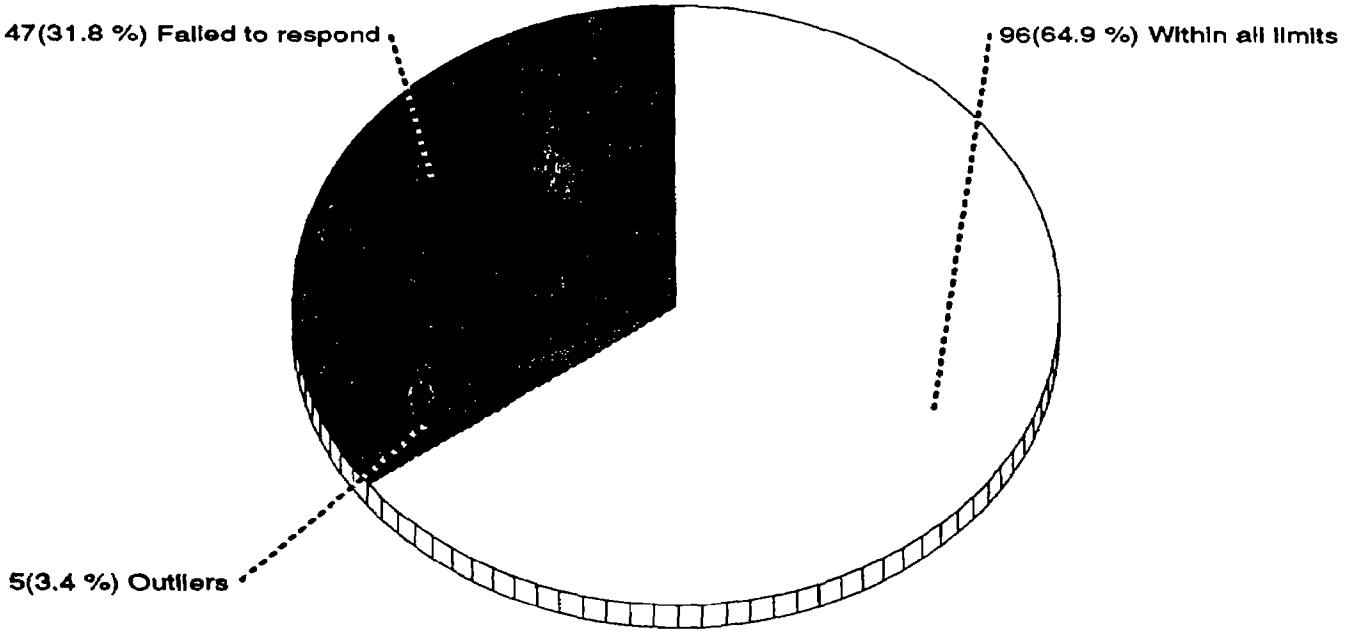
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

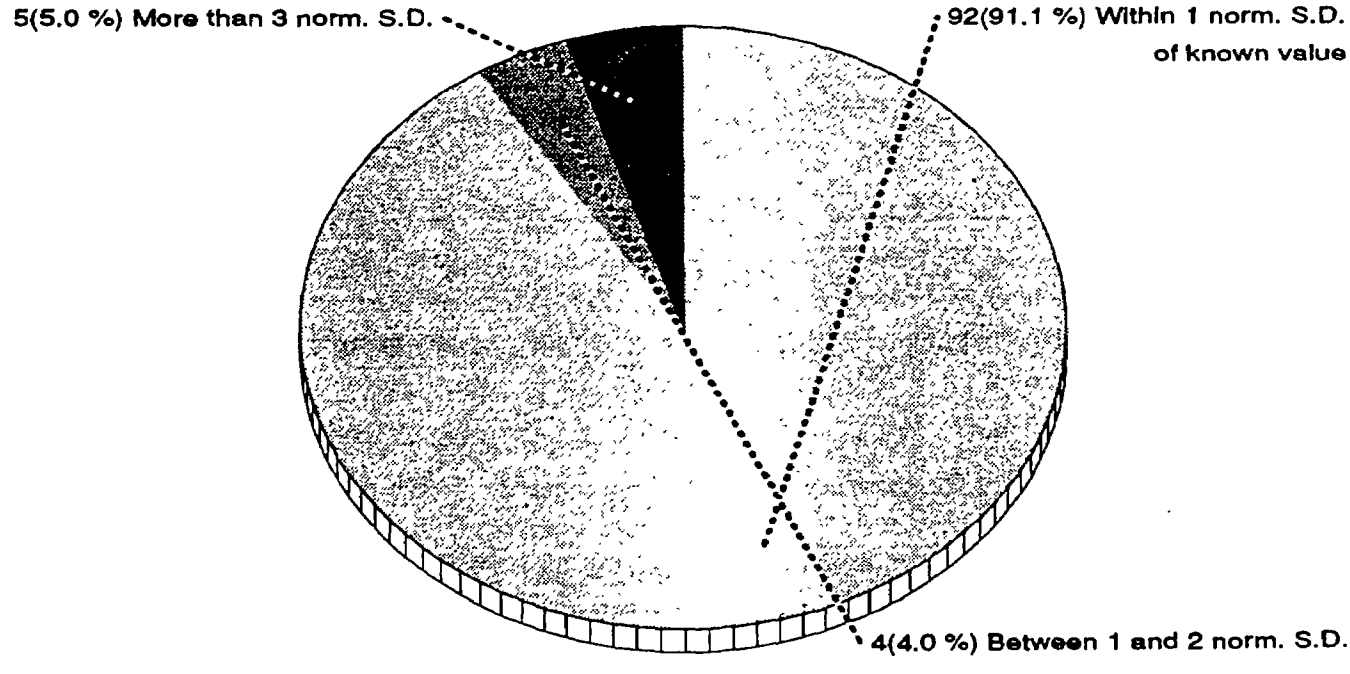
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Uranium (Natural) Statistical Summary 148 Participants

The known value of this nuclide is **3.0 pCi/l** with an expected precision of **3.0**; the control limits are 0.0 to 8.2; the warning regions are 0.0 to 0.0 and 6.5 to 8.2



Statistic	Respondents	Non-outliers
Mean	4.66	**Grand Avg 3.15**
Std. Dev.	7.97	0.67
Variance	63.45	0.45
% Coef. of Var.	170.89	21.18
% deviation of mean from known value	55.38	5.09
Norm. dev. of mean from known value	0.21	0.23
Median	3.07	3.07
% deviation of median from known value	2.22	2.22
Norm. dev. of median from known value	0.01	0.10



Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	3.0	3.0	3.0	0.00	0.000	3.00	-0.09	0.00	
AE	3.3	3.0	3.6	0.30	0.118	3.30	0.08	0.17	
AF	3.7	3.7	3.3	0.23	0.079	3.57	0.24	0.33	
AH	3.0	2.7	2.8	0.15	0.059	2.83	-0.18	-0.10	
AJ	2.7	4.0	3.8	0.70	0.256	3.50	0.20	0.29	
AK	3.2	3.7	3.6	0.26	0.098	3.50	0.20	0.29	
AL	3.4	3.4	3.2	0.12	0.039	3.33	0.10	0.19	
AP									•
AR	2.8	2.7	2.8	0.06	0.020	2.77	-0.22	-0.13	
AU									•
AW	3.9	4.2	4.4	0.25	0.098	4.17	0.59	0.67	
AZ	3.1	3.2	2.9	0.15	0.059	3.07	-0.05	0.04	
BA	3.6	4.5	4.5	0.52	0.177	4.20	0.60	0.69	
BC	2.7	2.8	2.8	0.06	0.020	2.77	-0.22	-0.13	
BG									•
BH	3.9	3.0	3.9	0.52	0.177	3.60	0.26	0.35	
BK	3.1	3.2	3.2	0.06	0.020	3.17	0.01	0.10	
BM	3.2	3.6	2.9	0.35	0.138	3.23	0.05	0.13	
BN	3.1	3.1	2.1	0.58	0.197	2.77	-0.22	-0.13	
BO	3.2	3.2	3.1	0.06	0.020	3.17	0.01	0.10	
C	2.8	3.1	3.4	0.30	0.118	3.10	-0.03	0.06	
CA	3.0	3.2	2.8	0.20	0.079	3.00	-0.09	0.00	
CC									•
CE	2.4	2.7	2.4	0.17	0.059	2.50	-0.38	-0.29	
CJ	3.0	3.0	2.9	0.06	0.020	2.97	-0.11	-0.02	
CS	3.2	3.0	3.0	0.12	0.039	3.07	-0.05	0.04	
CX	3.4	3.5	3.6	0.10	0.039	3.50	0.20	0.29	
D	3.1	2.9	3.1	0.12	0.039	3.03	-0.07	0.02	
DB	2.2	2.6	1.9	0.35	0.138	2.23	-0.53	-0.44	
DE	3.0	3.0	3.0	0.00	0.000	3.00	-0.09	0.00	
DI									•
DO	2.8	2.8	3.0	0.12	0.039	2.87	-0.17	-0.08	
DR									•
DT	3.1	2.8	3.0	0.15	0.059	2.97	-0.11	-0.02	
DZ	4.9	4.5	4.8	0.21	0.079	4.73	0.91	1.00	
E	3.1	2.7	2.9	0.20	0.079	2.90	-0.15	-0.06	
EB	3.0	2.8	2.5	0.25	0.098	2.77	-0.22	-0.13	
EL	3.4	3.5	3.4	0.06	0.020	3.43	0.16	0.25	
EO									•
EP									•
ER	3.3	3.2	3.1	0.10	0.039	3.20	0.03	0.12	
FE									•
FJ	3.2	3.2	3.2	0.00	0.000	3.20	0.03	0.12	
FN	0.1	0.2	0.2	0.06	0.020	0.17	-1.72	-1.64	
GN	3.4	3.6	3.8	0.20	0.079	3.60	0.26	0.35	

• ≡ 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
GQ	3.4	2.9	3.2	0.25	0.098	3.17	0.01	0.10	
HE	2.7	2.8	2.7	0.06	0.020	2.73	-0.24	-0.15	
HK	3.2	3.4	3.4	0.12	0.039	3.33	0.10	0.19	
HL	3.2	3.0	2.8	0.20	0.079	3.00	-0.09	0.00	
HP	3.6	3.3	3.3	0.17	0.059	3.40	0.14	0.23	
I	3.3	3.4	3.8	0.26	0.098	3.50	0.20	0.29	
ID	3.3	3.3	3.2	0.06	0.020	3.27	0.07	0.15	
J									•
JE	2.8	2.9	2.6	0.15	0.059	2.77	-0.22	-0.13	
JG									•
JK	2.8	2.9	2.8	0.06	0.020	2.83	-0.18	-0.10	
JN	3.0	3.1	3.4	0.21	0.079	3.17	0.01	0.10	
JS	60.2	59.6	58.6	0.81	0.315	59.47	32.51	32.60	×
JX									•
JY	3.0	3.4	2.7	0.35	0.138	3.03	-0.07	0.02	
K	3.0	3.6	3.4	0.31	0.118	3.33	0.10	0.19	
KH	2.9	2.9	2.8	0.06	0.020	2.87	-0.17	-0.08	
KL									•
KT	3.0	4.0	5.0	1.00	0.394	4.00	0.49	0.58	
L	3.2	3.0	3.0	0.12	0.039	3.07	-0.05	0.04	
LF	3.2	3.0	2.7	0.25	0.098	2.97	0.11	-0.02	
LH									•
LZ	3.2	3.1	3.1	0.06	0.020	3.13	-0.01	0.08	
M									•
MF									•
MX	5.9	5.2	4.4	0.75	0.295	5.17	1.16	1.25	
N	2.8	2.4	2.6	0.20	0.079	2.60	-0.32	-0.23	
NA									•
NH	3.0	4.8	5.4	1.25	0.473	4.40	0.72	0.81	
NJ	3.1	3.2	2.9	0.15	0.059	3.07	-0.05	0.04	
NK									•
NO									•
O									•
OB	4.3	4.3	3.2	0.64	0.217	3.93	0.45	0.54	
OF									•
OS	48.3	43.4	52.7	4.65	2.583	48.13	25.97	26.06	×
OX									•
P	3.5	4.2	4.8	0.65	0.256	4.17	0.59	0.67	
PB									•
PG	9.7	10.8	11.2	0.78	0.295	10.57	4.28	4.37	×
PW	4.6	3.5	5.7	1.10	0.433	4.60	0.84	0.92	
PX	39.6	40.9	33.0	4.24	2.058	37.83	20.02	20.11	×
Q	4.0	4.0	3.0	0.58	0.197	3.67	0.30	0.38	
QM	4.2	4.2	4.2	0.00	0.000	4.20	0.60	0.69	
QQ	2.5	2.1	2.6	0.26	0.098	2.40	-0.43	-0.35	

• ≡ 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
QU	3.0	3.2	3.0	0.12	0.039	3.07	-0.05	0.04	
QX									•
QZ	2.9	2.9	2.9	0.00	0.000	2.90	-0.15	-0.06	
R									•
RD	3.2	2.9	3.0	0.15	0.059	3.03	-0.07	0.02	
RG									•
RK	2.4	2.7	2.7	0.17	0.059	2.60	-0.32	-0.23	
RP	2.8	2.8	2.9	0.06	0.020	2.83	-0.18	-0.10	
RR									•
RX	2.8	3.1	4.0	0.62	0.236	3.30	0.08	0.17	
RZ	2.1	2.1	2.5	0.23	0.079	2.23	-0.53	-0.44	
S	2.8	2.6	2.6	0.12	0.039	2.67	-0.28	-0.19	
SD	2.7	3.2	3.6	0.45	0.177	3.17	0.01	0.10	
SF									•
SI	3.6	3.5	3.6	0.06	0.020	3.57	0.24	0.33	
SL	1.5	1.4	1.4	0.06	0.020	1.43	-0.99	-0.90	
SM	2.9	3.0	3.1	0.10	0.039	3.00	-0.09	0.00	
SO	3.1	2.6	2.8	0.25	0.098	2.83	-0.18	-0.10	
SS	3.1	3.2	2.9	0.15	0.059	3.07	-0.05	0.04	
SX	3.1	3.0	2.7	0.21	0.079	2.93	-0.13	-0.04	
SZ	2.9	2.9	2.7	0.12	0.039	2.83	-0.18	-0.10	
T									•
TD	3.0	3.0	2.9	0.06	0.020	2.97	-0.11	-0.02	
TN									•
TQ	2.8	3.1	3.1	0.17	0.059	3.00	-0.09	0.00	
TU									•
U	3.6	3.4	3.5	0.10	0.039	3.50	0.20	0.29	
UM									•
UP	2.7	2.6	2.3	0.21	0.079	2.53	-0.36	-0.27	
UQ									•
UR									•
UZ	10.3	11.5	14.6	2.22	0.847	12.13	5.18	5.27	×
VA									•
VH	5.3	5.3	5.5	0.12	0.039	5.37	1.28	1.37	
VI	2.8	3.0	3.0	0.12	0.039	2.93	-0.13	-0.04	
W	3.6	3.8	3.7	0.10	0.039	3.70	0.32	0.40	
WC									•
WG	3.4	3.2	3.2	0.12	0.039	3.27	0.07	0.15	
WH	2.5	2.5	2.3	0.12	0.039	2.43	-0.42	-0.33	
WI	3.0	3.1	3.0	0.06	0.020	3.03	-0.07	0.02	
WJ	3.5	3.2	3.4	0.15	0.059	3.37	0.12	0.21	
WO	2.7	2.7	2.7	0.00	0.000	2.70	-0.26	-0.17	
WR	2.8	3.0	3.2	0.20	0.079	3.00	-0.09	0.00	
WS									•
WX									•

• ≡ 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
X	2.6	3.0	3.2	0.31	0.118	2.93	-0.13	-0.04	
XA									•
XC									•
XD									•
XI	3.0	3.3	3.2	0.15	0.059	3.17	0.01	0.10	
XK									•
XL	2.3	2.4	2.4	0.06	0.020	2.37	-0.45	-0.37	
XM	2.9	3.3	2.8	0.26	0.098	3.00	-0.09	0.00	
XO									•
XQ									•
XR									•
XS									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.17		FN	2.93		VI	3.17		GQ
1.43		SL	2.93		SX	3.17		BO
2.23		RZ	2.97		DT	3.17		BK
2.23		DB	2.97		TD	3.20		FJ
2.37		XL	2.97		LF	3.20		ER
2.40		QQ	2.97		CJ	3.23		BM
2.43		WH	3.00		XM	3.27		WG
2.50		CE	3.00		WR	3.27		ID
2.53		UP	3.00		TQ	3.30		RX
2.60		RK	3.00		SM	3.30		AE
2.60		N	3.00		HL	3.33		K
2.67		S	3.00		DE	3.33		HK
2.70		WO	3.00		CA	3.33		AL
2.73		HE	3.00		A	3.37		WJ
2.77		JE	3.03		WI	3.40		HP
2.77		EB	3.03		RD	3.43		EL
2.77		BN	3.03		JY	3.50		U
2.77		BC	3.03		D	3.50		I
2.77		AR	3.07		SS	3.50		CX
2.83		SZ	3.07		QU	3.50		AK
2.83		SO	3.07		NJ	3.50		AJ
2.83		RP	3.07		L	3.57		SI
2.83		JK	3.07		CS	3.57		AF
2.83		AH	3.07		AZ	3.60		GN
2.87		KH	3.10		C	3.60		BH
2.87		DO	3.13		LZ	3.67		Q
2.90		E	3.17		XI	3.70		W
2.90		QZ	3.17		SD	3.93		OB
2.93		X	3.17		JN	4.00		KT

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

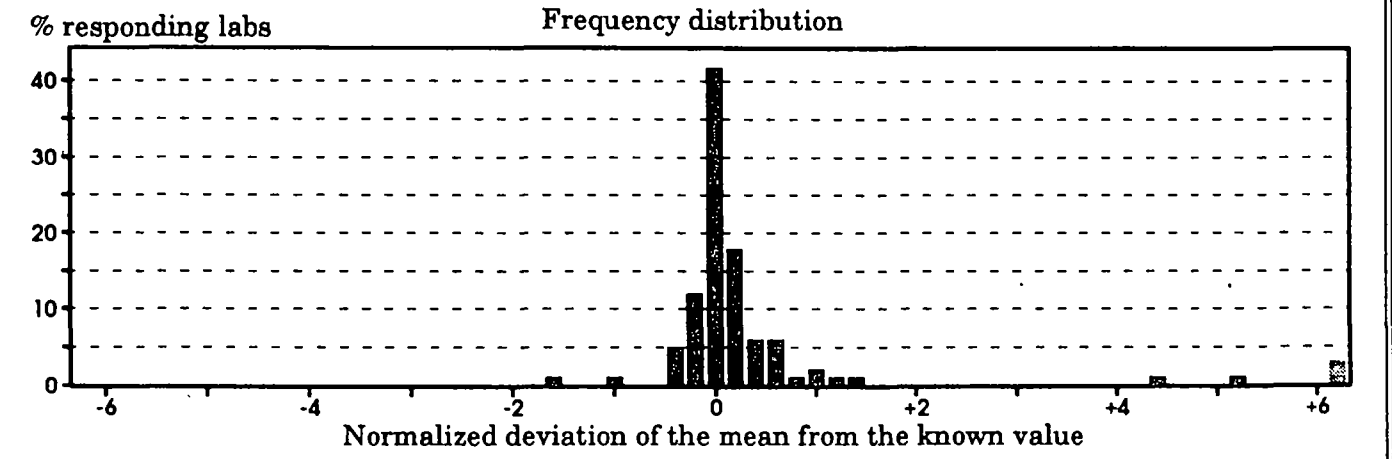
× ≡ Determined to be an outlier

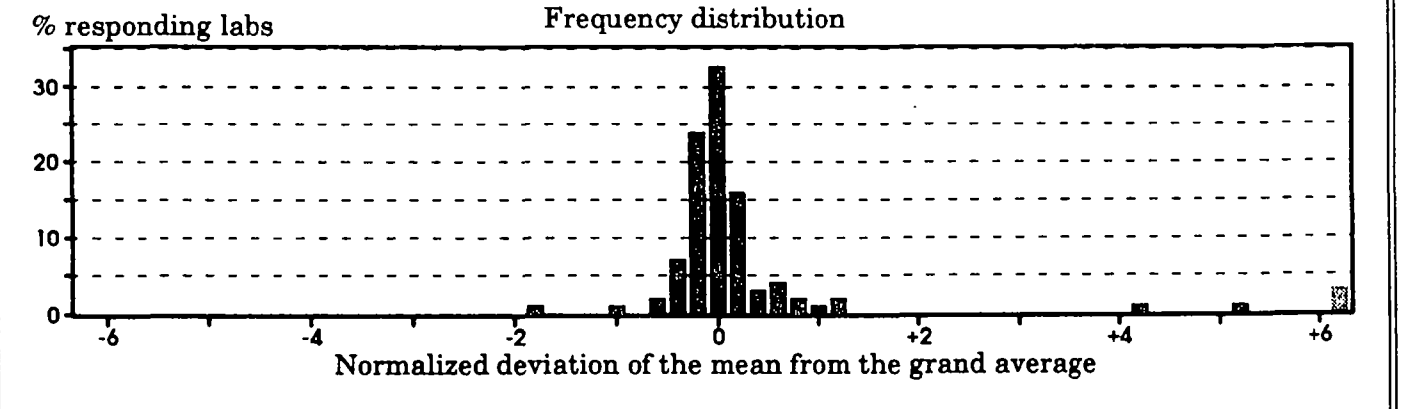
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
4.17		**P**	4.40		**NH**	10.57	×	**PG**
4.17		**AW**	4.60		**PW**	12.13	×	**UZ**
4.20		**QM**	4.73		**DZ**	37.83	×	**PX**
4.20		**BA**	5.17		**MX**	48.13	×	**OS**
			5.37		**VH**	59.47	×	**JS**





• ≡ No data submitted
Ø ≡ Insufficient data

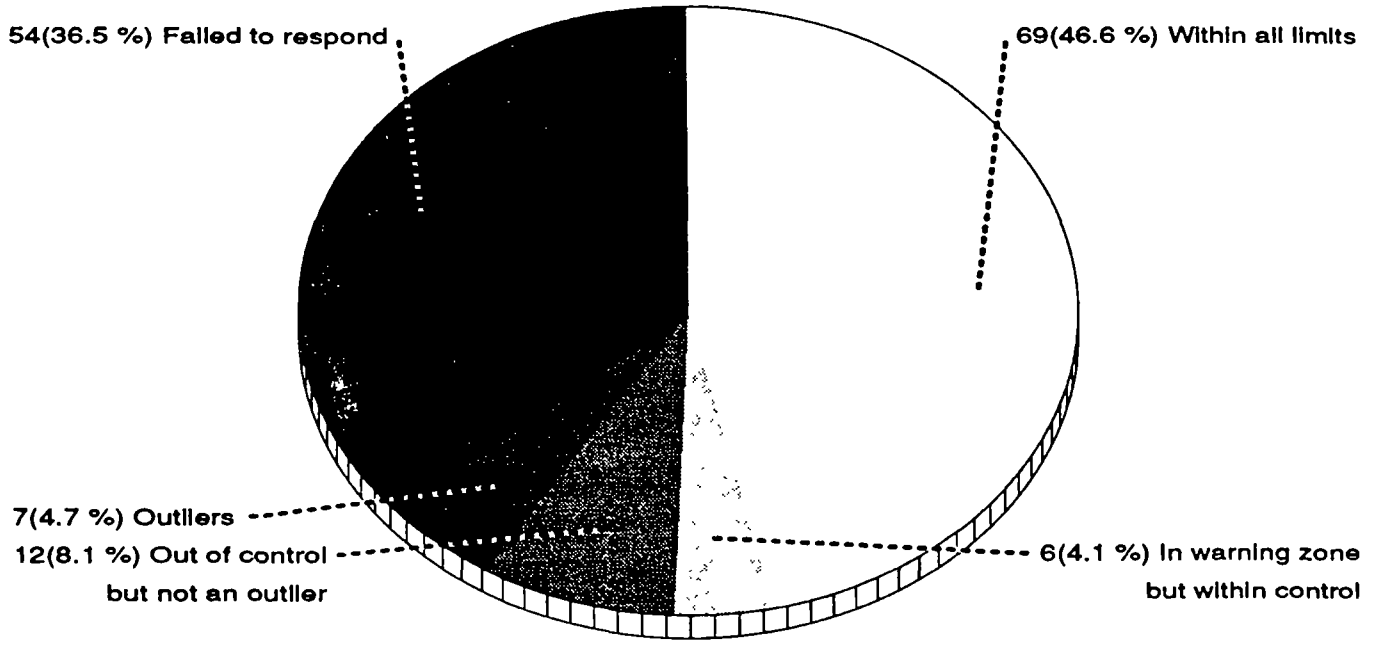
TAG SYMBOLS

× ≡ Determined to be an outlier

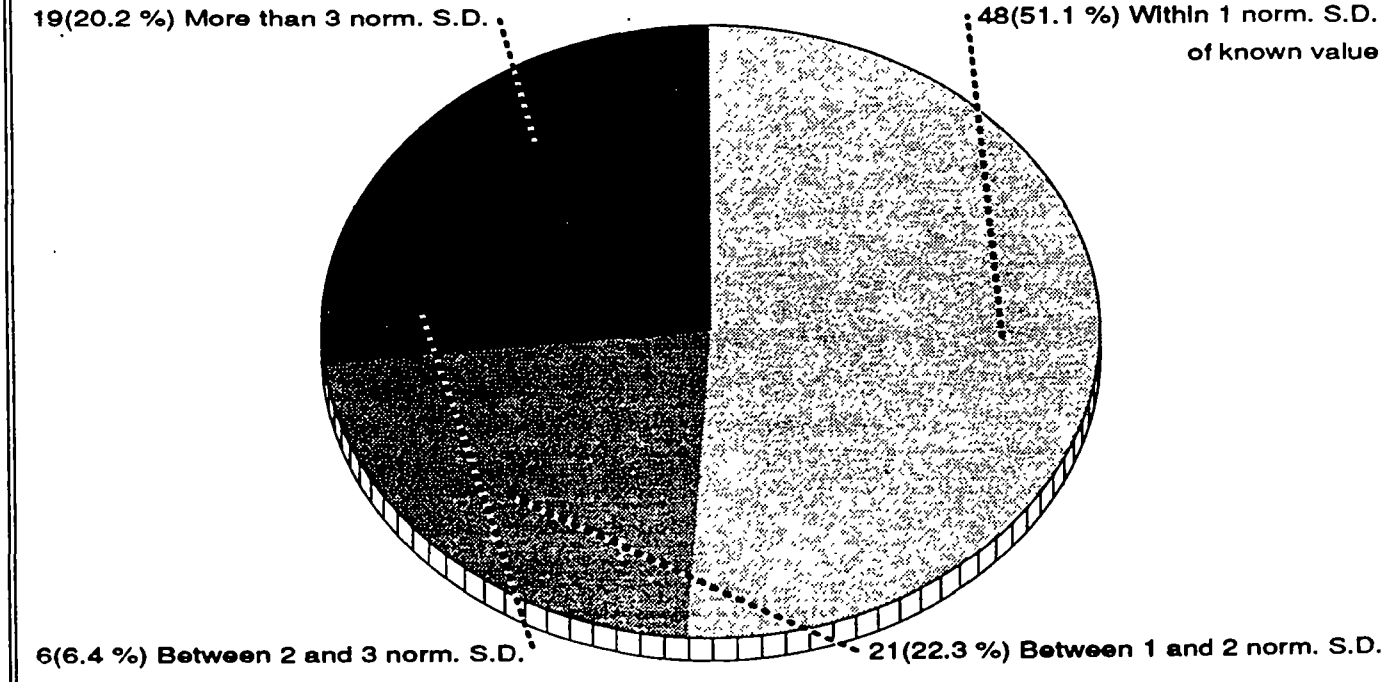
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 148 Participants

The known value of this nuclide is **4.9 pCi/l** with an expected precision of **0.7**; the control limits are 3.7 to 6.1; the warning regions are 3.7 to 4.1 and 5.7 to 6.1



Statistic	Respondents	Non-outliers
Mean	5.59	**Grand Avg 4.70**
Std. Dev.	8.04	0.70
Variance	64.64	0.49
% Coef. of Var.	143.80	14.83
% deviation of mean from known value	14.10	-4.14
Norm. dev. of mean from known value	0.09	-0.29
Median	4.80	4.80
% deviation of median from known value	-2.04	-2.04
Norm. dev. of median from known value	-0.01	-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	4.6	4.7	4.7	0.06	0.084	4.67	-0.07	-0.58	
AE	4.4	4.6	4.6	0.12	0.169	4.53	-0.40	-0.91	
AF	4.8	4.8	4.9	0.06	0.084	4.83	0.34	-0.16	
AH									•
AJ	5.9	4.5	5.2	0.70	1.345	5.20	1.24	0.74	
AK	4.9	4.6	4.9	0.17	0.253	4.80	0.26	-0.25	
AL	4.6	4.8	5.0	0.20	0.338	4.80	0.26	-0.25	
AP									•
AR									•
AU	2.1	2.2	2.1	0.06	0.084	2.13	-6.34	-6.85	×
AW	4.8	5.1	5.4	0.30	0.506	5.10	1.00	0.49	
AZ	5.8	5.4	4.8	0.50	0.844	5.33	1.57	1.07	
BA	5.9	5.0	5.4	0.45	0.759	5.43	1.82	1.32	
BC	80.9	81.6	83.8	1.51	3.756	82.10	191.52	191.02	×
BG									•
BH	4.2	5.1	5.1	0.52	0.759	4.80	0.26	-0.25	
BK	4.9	4.8	4.9	0.06	0.084	4.87	0.42	-0.08	
BM	4.9	5.1	5.0	0.10	0.169	5.00	0.75	0.25	
BN	4.2	4.7	4.5	0.25	0.422	4.47	-0.57	-1.07	
BO	5.0	5.2	4.6	0.31	0.506	4.93	0.58	0.08	
C	5.1	4.9	4.8	0.15	0.253	4.93	0.58	0.08	
CA	4.3	5.0	4.7	0.35	0.591	4.67	-0.07	-0.58	
CC									•
CE	5.2	4.5	4.6	0.38	0.591	4.77	0.17	-0.33	
CJ	3.5	4.8	5.1	0.85	1.667	4.47	-0.57	-1.07	
CS	4.7	5.5	4.7	0.46	0.675	4.97	0.67	0.16	
CX									•
D									•
DB	5.0	4.9	4.8	0.10	0.169	4.90	0.50	0.00	
DE	4.9	4.9	5.0	0.06	0.084	4.93	0.58	0.08	
DI									•
DO									•
DR									•
DT	4.3	4.8	5.1	0.40	0.675	4.73	0.09	-0.41	
DZ	5.2	5.5	5.7	0.25	0.422	5.47	1.90	1.40	
E	4.3	4.5	4.6	0.15	0.253	4.47	-0.57	-1.07	
EB	4.1	4.1	4.2	0.06	0.084	4.13	-1.39	-1.90	
EL	4.7	4.9	4.6	0.15	0.253	4.73	0.09	-0.41	
EO	4.9	4.7	4.8	0.10	0.169	4.80	0.26	-0.25	
EP									•
ER	4.9	5.4	4.9	0.29	0.422	5.07	0.91	0.41	
FE									•
FJ									•
FN	5.1	6.1	5.6	0.50	0.844	5.60	2.23	1.73	
GN	4.6	5.1	5.2	0.32	0.506	4.97	0.67	0.16	

• ≡ 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
GQ	3.9	3.5	3.6	0.21	0.338	3.67	-2.55	-3.05	⇓
HE	4.3	4.0	4.2	0.15	0.253	4.17	-1.31	-1.81	
HK	4.9	4.7	4.9	0.12	0.169	4.83	0.34	-0.16	
HL	4.5	5.3	4.5	0.46	0.675	4.77	0.17	-0.33	
HP	5.3	4.8	5.2	0.26	0.422	5.10	1.00	0.49	
I	4.1	4.2	4.7	0.32	0.506	4.33	-0.90	-1.40	
ID	5.5	4.8	4.7	0.44	0.675	5.00	0.75	0.25	
J									•
JE	5.4	5.2	5.4	0.12	0.169	5.33	1.57	1.07	
JG									•
JK									•
JN									•
JS	4.9	4.6	4.3	0.30	0.506	4.60	-0.24	-0.74	
JX	5.0	5.2	4.6	0.31	0.506	4.93	0.58	0.08	
JY	8.0	7.9	6.4	0.90	1.667	7.43	6.77	6.27	×
K	5.7	4.8	4.5	0.62	1.024	5.00	0.75	0.25	
KH	4.9	4.4	4.6	0.25	0.422	4.63	-0.16	-0.66	
KL	6.5	5.4	5.6	0.59	0.928	5.83	2.81	2.31	
KT									•
L	4.4	4.0	3.9	0.26	0.422	4.10	-1.48	-1.98	
LF									•
LH									•
LZ	5.2	5.2	5.3	0.06	0.084	5.23	1.33	0.82	
M	3.7	4.4	3.0	0.70	1.345	3.70	-2.47	-2.97	
MF	3.4	2.7	2.7	0.40	0.591	2.93	-4.36	-4.87	⇓
MX	3.8	3.1	3.6	0.36	0.591	3.50	-2.96	-3.46	⇓
N	5.0	4.9	5.0	0.06	0.084	4.97	0.67	0.16	
NA									•
NH	4.5	4.8	4.7	0.15	0.253	4.67	-0.07	-0.58	
NJ	4.4	3.5	3.2	0.62	1.024	3.70	-2.47	-2.97	
NK									•
NO									•
O	5.2	5.2	4.7	0.29	0.422	5.03	0.83	0.33	
OB									•
OF									•
OS									•
OX	5.2	5.1	5.2	0.06	0.084	5.17	1.16	0.66	
P	4.3	4.9	4.9	0.35	0.506	4.70	0.01	-0.49	
PB									•
PG	1.6	1.8	1.8	0.12	0.169	1.73	-7.33	-7.84	×
PW	3.0	2.2	3.8	0.80	1.667	3.00	-4.20	-4.70	⇓
PX	5.6	5.2	5.4	0.20	0.338	5.40	1.74	1.24	
Q	3.3	3.3	3.5	0.12	0.169	3.37	-3.29	-3.79	⇓
QM									•
QQ	6.3	5.6	4.9	0.70	1.345	5.60	2.23	1.73	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Uranium-Radium in Water, 12-Jun-1998

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
QU	2.9	3.0	3.1	0.10	0.169	3.00	-4.20	-4.70	⇓
QX									•
QZ	5.2	5.5	4.8	0.35	0.591	5.17	1.16	0.66	
R	4.7	4.4	4.5	0.15	0.253	4.53	-0.40	-0.91	
RD	9.1	8.8	8.3	0.40	0.675	8.73	9.99	9.49	×
RG									•
RK	3.7	4.8	4.4	0.56	0.928	4.30	-0.98	-1.48	
RP									•
RR									•
RX	8.0	6.8	8.2	0.76	1.345	7.67	7.35	6.85	×
RZ	6.2	6.3	6.4	0.10	0.169	6.30	3.97	3.46	⇑
S	5.1	5.1	5.1	0.00	0.000	5.10	1.00	0.49	
SD	3.5	3.7	4.1	0.31	0.506	3.77	-2.30	-2.80	
SF									•
SI	4.5	4.2	4.4	0.15	0.253	4.37	-0.82	-1.32	
SL									•
SM	5.4	5.4	5.4	0.00	0.000	5.40	1.74	1.24	
SO									•
SS	4.8	5.1	4.5	0.30	0.506	4.80	0.26	-0.25	
SX	4.3	4.1	4.5	0.20	0.338	4.30	-0.98	-1.48	
SZ	4.5	3.7	3.6	0.49	0.759	3.93	-1.89	-2.39	
T									•
TD	3.2	3.6	3.5	0.21	0.338	3.43	-3.13	-3.63	⇓
TN	4.8	3.8	5.1	0.68	1.185	4.57	-0.32	-0.82	
TQ	5.3	5.1	4.6	0.36	0.591	5.00	0.75	0.25	
TU									•
U	4.4	4.3	4.5	0.10	0.169	4.40	-0.73	-1.24	
UM									•
UP	4.9	5.0	5.1	0.10	0.169	5.00	0.75	0.25	
UQ	4.9	4.9	5.1	0.12	0.169	4.97	0.67	0.16	
UR									•
UZ									•
VA	6.7	6.2	6.1	0.32	0.506	6.33	4.05	3.55	⇑
VH	6.5	7.9	7.0	0.71	1.345	7.13	6.03	5.53	×
VI	4.1	4.3	3.8	0.25	0.422	4.07	-1.56	-2.06	
W	4.9	4.4	4.5	0.26	0.422	4.60	-0.24	-0.74	
WC	3.7	4.1	3.0	0.56	0.928	3.60	-2.71	-3.22	⇓
WG									•
WH	4.7	5.0	4.7	0.17	0.253	4.80	0.26	-0.25	
WI									•
WJ	4.9	5.0	4.6	0.21	0.338	4.83	0.34	-0.16	
WO	6.1	5.7	6.7	0.50	0.844	6.17	3.64	3.13	⇑
WR									•
WS									•
WX									•

• ≡ 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
X	4.7	4.4	4.3	0.21	0.338	4.47	-0.57	-1.07	
XA									•
XC									•
XD									•
XI	2.9	3.4	2.8	0.32	0.506	3.03	-4.12	-4.62	⇓
XK									•
XL	5.0	5.1	5.1	0.06	0.084	5.07	0.91	0.41	
XM	5.9	5.6	5.6	0.17	0.253	5.70	2.48	1.98	
XO									•
XQ									•
XR									•
XS									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.73	×	PG	4.53		AE	4.97		N
2.13	×	AU	4.57		TN	4.97		GN
2.93	⇓	MF	4.60		W	4.97		CS
3.00	⇓	QU	4.60		JS	5.00		UP
3.00	⇓	PW	4.63		KH	5.00		TQ
3.03	⇓	XI	4.67		NH	5.00		K
3.37	⇓	Q	4.67		CA	5.00		ID
3.43	⇓	TD	4.67		A	5.00		BM
3.50	⇓	MX	4.70		P	5.03		O
3.60	⇓	WC	4.73		EL	5.07		XL
3.67	⇓	GQ	4.73		DT	5.07		ER
3.70		NJ	4.77		HL	5.10		S
3.70		M	4.77		CE	5.10		HP
3.77		SD	4.80		WH	5.10		AW
3.93		SZ	4.80		BH	5.17		QZ
4.07		VI	4.80		SS	5.17		OX
4.10		L	4.80		EO	5.20		AJ
4.13		EB	4.80		AL	5.23		LZ
4.17		HE	4.80		AK	5.33		JE
4.30		SX	4.83		WJ	5.33		AZ
4.30		RK	4.83		HK	5.40		SM
4.33		I	4.83		AF	5.40		PX
4.37		SI	4.87		BK	5.43		BA
4.40		U	4.90		DB	5.47		DZ
4.47		X	4.93		JX	5.60		FN
4.47		E	4.93		DE	5.60		QQ
4.47		CJ	4.93		C	5.70		XM
4.47		BN	4.93		BO	5.83		KL
4.53		R	4.97		UQ	6.17	⇑	WO

• ≡ No data submitted
∅ ≡ Insufficient data

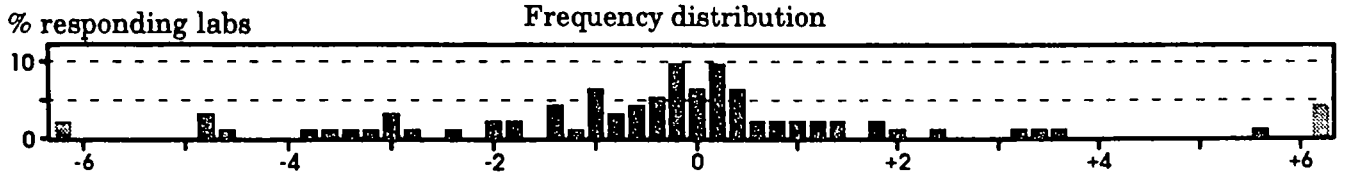
TAG SYMBOLS
× ≡ Determined to be an outlier

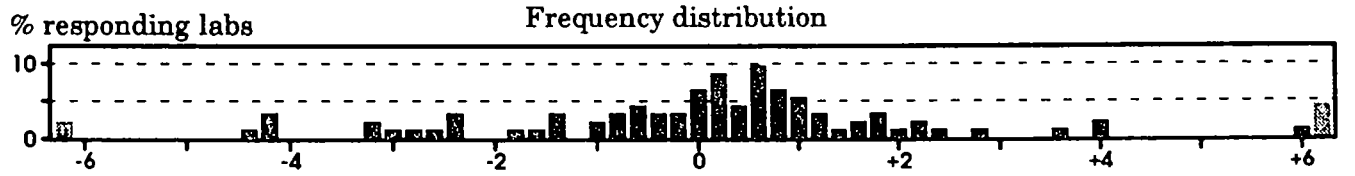
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
6.30	⇑	**RZ**	7.13	×	**VH**	7.67	×	**RX**
6.33	⇑	**VA**	7.43	×	**JY**	8.73	×	**RD**
						82.10	×	**BC**





• ≡ No data submitted
∅ ≡ Insufficient data

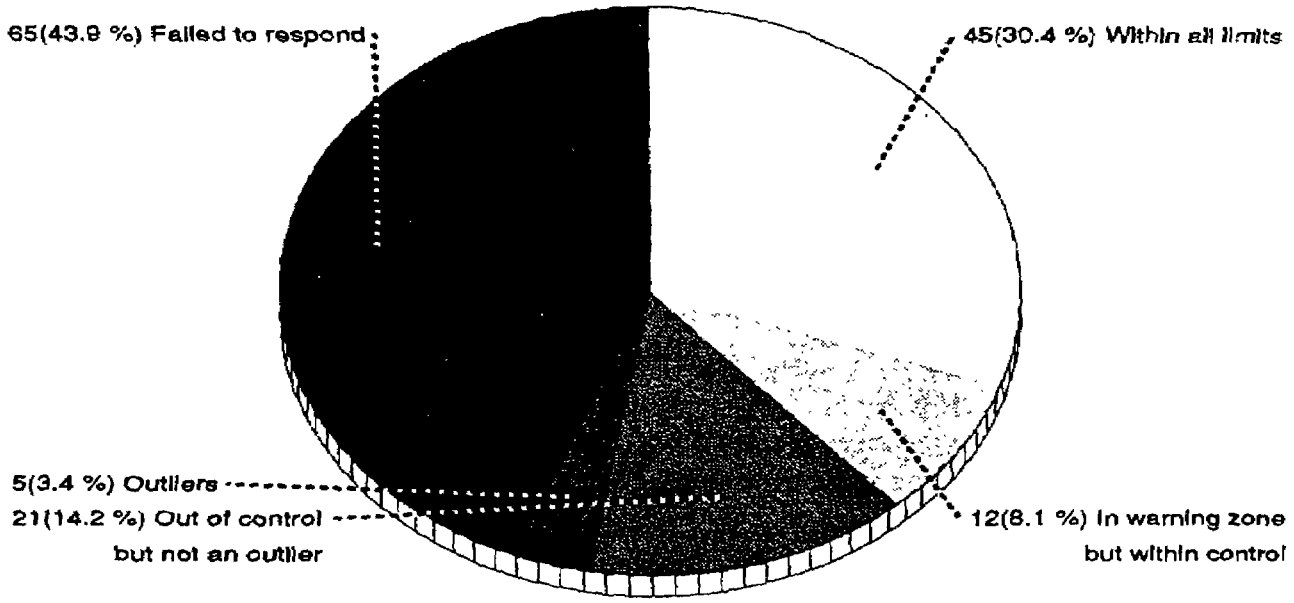
TAG SYMBOLS

× ≡ Determined to be an outlier

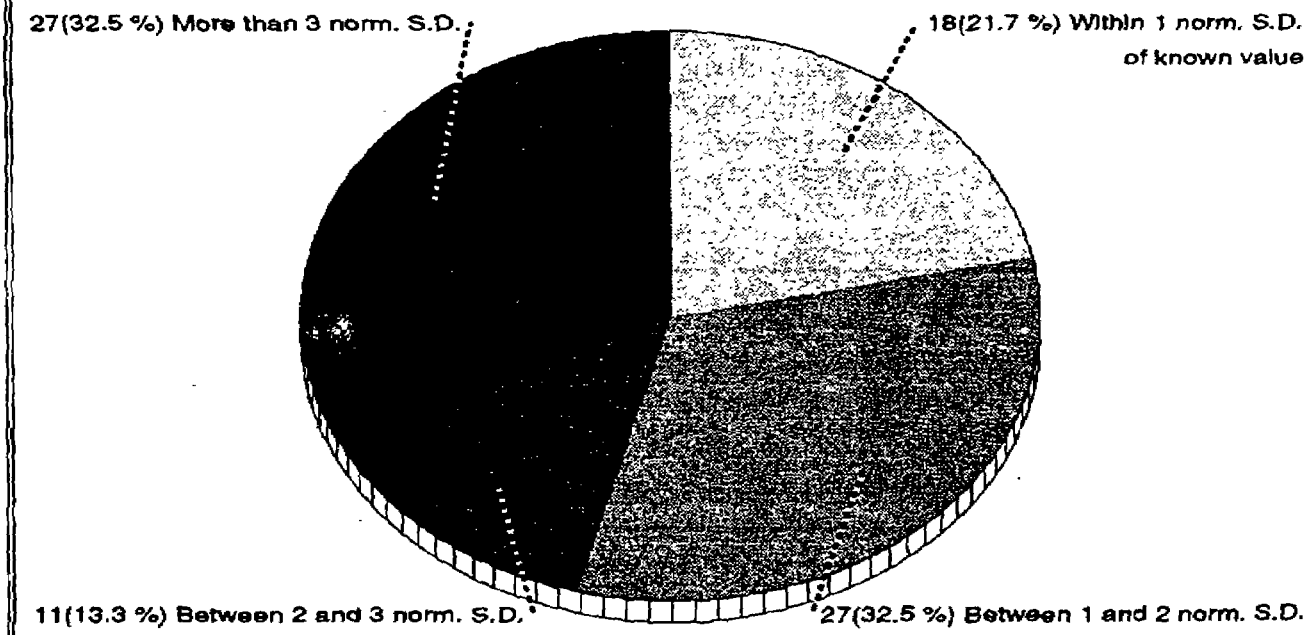
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 148 Participants

The known value of this nuclide is **2.1** pCi/l with an expected precision of **0.5**; the control limits are 1.2 to 3.0; the warning regions are 1.2 to 1.5 and 2.7 to 3.0



Statistic	Respondents	Non-outliers
Mean	2.93	**Grand Avg 2.62**
Std. Dev.	1.57	0.64
Variance	2.46	0.41
% Coef. of Var.	53.53	24.32
% deviation of mean from known value	39.47	24.70
Norm. dev. of mean from known value	0.53	0.81
Median	2.60	2.55
% deviation of median from known value	23.81	21.43
Norm. dev. of median from known value	0.32	0.71



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	2.7	3.0	2.4	0.30	0.709	2.70	0.28	2.08	
AE	1.7	1.8	2.1	0.21	0.473	1.87	-2.61	-0.81	
AF	2.5	2.5	2.4	0.06	0.118	2.47	-0.53	1.27	
AH									•
AJ	2.2	3.7	2.0	0.93	2.921	2.63	0.05	1.85	
AK	2.9	2.4	2.5	0.26	0.591	2.60	-0.07	1.73	
AL	2.8	2.2	2.4	0.31	0.709	2.47	-0.53	1.27	
AP									•
AR									•
AU									•
AW	2.9	3.0	3.3	0.21	0.473	3.07	1.55	3.35	⇑
AZ	2.1	1.6	2.2	0.32	0.709	1.97	-2.26	-0.46	
BA	3.9	3.6	3.9	0.17	0.354	3.80	4.09	5.89	⇑
BC	2.4	2.7	2.9	0.25	0.591	2.67	0.17	1.96	
BG									•
BH	2.8	2.1	2.3	0.36	0.827	2.40	-0.76	1.04	
BK	1.9	2.1	2.1	0.12	0.236	2.03	-2.03	-0.23	
BM	2.4	2.7	2.2	0.25	0.591	2.43	-0.64	1.15	
BN									•
BO	2.5	2.8	2.1	0.35	0.827	2.47	-0.53	1.27	
C	2.4	2.4	2.6	0.12	0.236	2.47	-0.53	1.27	
CA	2.6	3.3	1.9	0.70	2.245	2.60	-0.07	1.73	
CC									•
CE	3.4	3.4	2.9	0.29	0.591	3.23	2.13	3.93	⇑
CJ	2.1	1.7	2.0	0.21	0.473	1.93	-2.37	-0.58	
CS	2.9	2.5	2.6	0.21	0.473	2.67	0.17	1.96	
CX									•
D									•
DB	1.8	1.9	1.7	0.10	0.236	1.80	-2.84	-1.04	
DE	2.2	2.4	2.6	0.20	0.473	2.40	-0.76	1.04	
DI									•
DO									•
DR									•
DT	3.4	3.6	2.9	0.36	0.827	3.30	2.36	4.16	⇑
DZ	3.2	2.8	2.9	0.21	0.473	2.97	1.21	3.00	
E	2.8	2.7	2.6	0.10	0.236	2.70	0.28	2.08	
EB	2.6	3.0	3.2	0.31	0.709	2.93	1.09	2.89	
EL	3.1	2.3	1.8	0.66	2.020	2.40	-0.76	1.04	
EO	2.1	2.2	2.2	0.06	0.118	2.17	-1.57	0.23	
EP									•
ER									•
FE									•
FJ									•
FN	3.1	2.5	2.7	0.31	0.709	2.77	0.51	2.31	
GN	4.2	4.6	4.5	0.21	0.473	4.43	6.29	8.08	⇑

• ≡ 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
GQ	2.9	2.3	3.4	0.55	1.570	2.87	0.86	2.66	
HE	2.6	2.2	2.4	0.20	0.473	2.40	-0.76	1.04	
HK	1.8	1.8	1.8	0.00	0.000	1.80	-2.84	-1.04	
HL	1.8	1.7	1.8	0.06	0.118	1.77	-2.95	-1.15	
HP	2.3	3.9	3.1	0.80	2.695	3.10	1.67	3.46	⇑
I	2.9	2.7	3.1	0.20	0.473	2.90	0.97	2.77	
ID	2.6	1.6	1.0	0.81	2.695	1.73	-3.07	-1.27	
J									•
JE	3.3	3.3	2.9	0.23	0.473	3.17	1.90	3.70	⇑
JG									•
JK									•
JN									•
JS	1.7	1.1	1.1	0.35	0.709	1.30	-4.57	-2.77	
JX									•
JY	3.1	3.3	2.8	0.25	0.591	3.07	1.55	3.35	⇑
K	2.8	4.1	3.8	0.68	2.020	3.57	3.28	5.08	⇑
KH	1.6	1.7	1.8	0.10	0.236	1.70	-3.18	-1.39	
KL	4.5	3.7	2.4	1.06	3.821	3.53	3.17	4.97	⇑
KT									•
L	2.5	2.5	2.7	0.12	0.236	2.57	-0.18	1.62	
LF									•
LH									•
LZ									•
M									•
MF	3.4	4.0	3.5	0.32	0.709	3.63	3.51	5.31	⇑
MX	1.3	1.7	1.6	0.21	0.473	1.53	-3.76	-1.96	
N	2.9	3.6	2.9	0.40	0.827	3.13	1.78	3.58	⇑
NA									•
NH									•
NJ	3.3	4.0	3.7	0.35	0.827	3.67	3.63	5.43	⇑
NK									•
NO									•
O	2.4	2.3	2.1	0.15	0.354	2.27	-1.22	0.58	
OB									•
OF									•
OS									•
OX	1.9	1.9	1.9	0.00	0.000	1.90	-2.49	-0.69	
P	1.9	1.9	1.8	0.06	0.118	1.87	-2.61	-0.81	
PB									•
PG									•
PW	2.9	2.7	3.1	0.20	0.473	2.90	0.97	2.77	
PX									•
Q	2.0	2.1	2.4	0.21	0.473	2.17	-1.57	0.23	
QM									•
QQ									•

• ≡ 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
QU	2.8	3.2	2.6	0.31	0.709	2.87	0.86	2.66	
QX									•
QZ	2.3	2.2	1.9	0.21	0.473	2.13	-1.68	0.12	
R									•
RD	2.4	3.0	2.3	0.38	0.827	2.57	-0.18	1.62	
RG									•
RK	11.6	13.8	11.6	1.27	4.046	12.33	33.65	35.45	×
RP									•
RR									•
RX	1.8	1.9	1.7	0.10	0.236	1.80	-2.84	-1.04	
RZ	2.5	2.5	2.4	0.06	0.118	2.47	-0.53	1.27	
S	2.3	2.0	2.0	0.17	0.354	2.10	-1.80	0.00	
SD	5.2	4.5	5.5	0.51	1.345	5.07	8.48	10.28	×
SF									•
SI	2.4	1.9	2.2	0.25	0.591	2.17	-1.57	0.23	
SL									•
SM	4.3	4.3	4.3	0.00	0.000	4.30	5.82	7.62	⇑
SO									•
SS	3.0	3.0	2.5	0.29	0.591	2.83	0.74	2.54	
SX	6.5	5.8	5.3	0.60	1.795	5.87	11.25	13.05	×
SZ	10.1	8.1	13.1	2.52	10.346	10.43	27.07	28.87	×
T									•
TD	3.0	0.4	7.4	3.54	14.846	3.60	3.40	5.20	⇑
TN	3.5	2.7	2.5	0.53	1.345	2.90	0.97	2.77	
TQ	2.0	2.2	1.9	0.15	0.354	2.03	-2.03	-0.23	
TU									•
U	1.8	2.0	1.9	0.10	0.236	1.90	-2.49	-0.69	
UM									•
UP	2.6	2.1	2.4	0.25	0.591	2.37	-0.87	0.92	
UQ	2.0	2.5	2.3	0.25	0.591	2.27	-1.22	0.58	
UR									•
UZ									•
VA	2.8	3.7	3.3	0.45	1.120	3.27	2.24	4.04	⇑
VH	5.3	4.4	5.7	0.67	2.020	5.13	8.71	10.51	×
VI	2.3	3.7	3.5	0.76	2.245	3.17	1.90	3.70	⇑
W	3.5	2.7	4.2	0.75	2.470	3.47	2.94	4.73	⇑
WC	2.8	3.7	2.9	0.49	1.120	3.13	1.78	3.58	⇑
WG									•
WH	2.0	2.1	3.1	0.61	1.570	2.40	-0.76	1.04	
WI									•
WJ									•
WO	2.1	2.4	3.1	0.51	1.345	2.53	-0.30	1.50	
WR	2.8	3.0	3.4	0.31	0.709	3.07	1.55	3.35	⇑
WS									•
WX									•

• ≡ 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
X	2.6	2.5	2.5	0.06	0.118	2.53	-0.30	1.50	
XA									•
XC									•
XD									•
XI	4.4	3.1	2.8	0.85	2.695	3.43	2.82	4.62	⇑
XK									•
XL	2.0	2.3	2.5	0.25	0.591	2.27	-1.22	0.58	
XM	1.4	1.7	2.4	0.51	1.345	1.83	-2.72	-0.92	
XO									•
XQ									•
XR									•
XS									•
Y									•

Data sorted by Laboratory Average

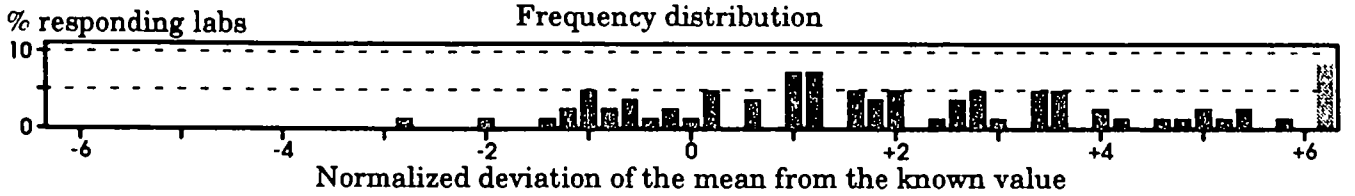
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.30		JS	2.40		EL	2.93		EB
1.53		MX	2.40		BH	2.97		DZ
1.70		KH	2.40		HE	3.07	⇑	WR
1.73		ID	2.40		DE	3.07	⇑	JY
1.77		HL	2.43		BM	3.07	⇑	AW
1.80		RX	2.47		RZ	3.10	⇑	HP
1.80		HK	2.47		C	3.13	⇑	WC
1.80		DB	2.47		BO	3.13	⇑	N
1.83		XM	2.47		AL	3.17	⇑	VI
1.87		P	2.47		AF	3.17	⇑	JE
1.87		AE	2.53		X	3.23	⇑	CE
1.90		U	2.53		WO	3.27	⇑	VA
1.90		OX	2.57		RD	3.30	⇑	DT
1.93		CJ	2.57		L	3.43	⇑	XI
1.97		AZ	2.60		CA	3.47	⇑	W
2.03		TQ	2.60		AK	3.53	⇑	KL
2.03		BK	2.63		AJ	3.57	⇑	K
2.10		S	2.67		CS	3.60	⇑	TD
2.13		QZ	2.67		BC	3.63	⇑	MF
2.17		SI	2.70		E	3.67	⇑	NJ
2.17		Q	2.70		A	3.80	⇑	BA
2.17		EO	2.77		FN	4.30	⇑	SM
2.27		XL	2.83		SS	4.43	⇑	GN
2.27		UQ	2.87		QU	5.07	×	SD
2.27		O	2.87		GQ	5.13	×	VH
2.37		UP	2.90		TN	5.87	×	SX
2.40		WH	2.90		PW	10.43	×	SZ
			2.90		I	12.33	×	RK

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228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Frequency distribution
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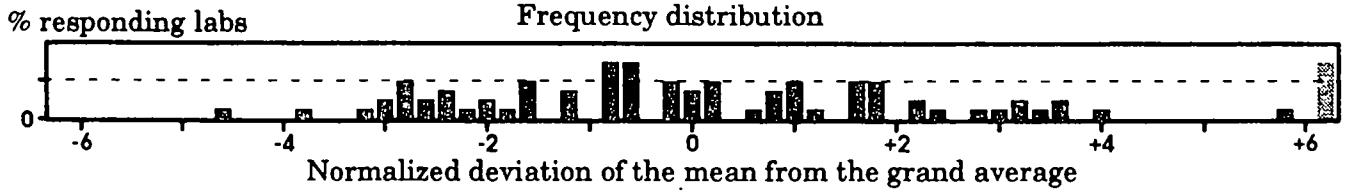
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the known value


% responding labs
Frequency distribution
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

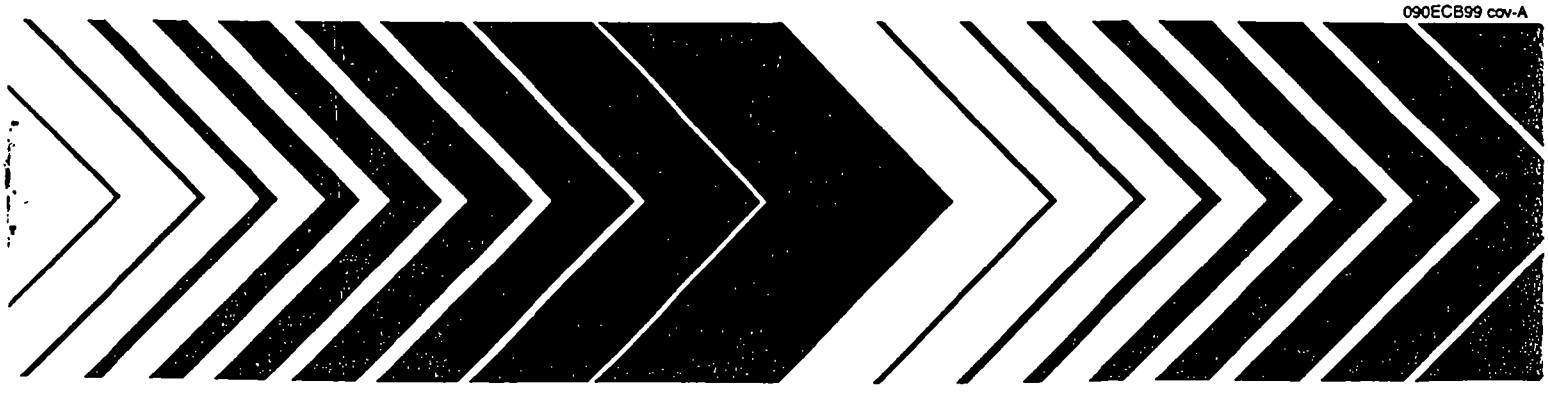
EPA 600/R-98/178
December 1998

EPA

Strontium in Water Performance Evaluation Study

A Statistical Evaluation of the July 17, 1998 Data

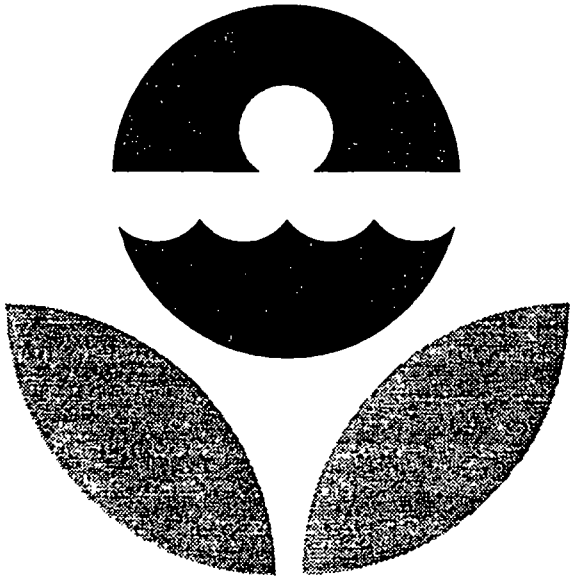
090ECB99 cov-A



Strontium in Water

Performance Evaluation Study

July 17, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Strontium in Water; July 17, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

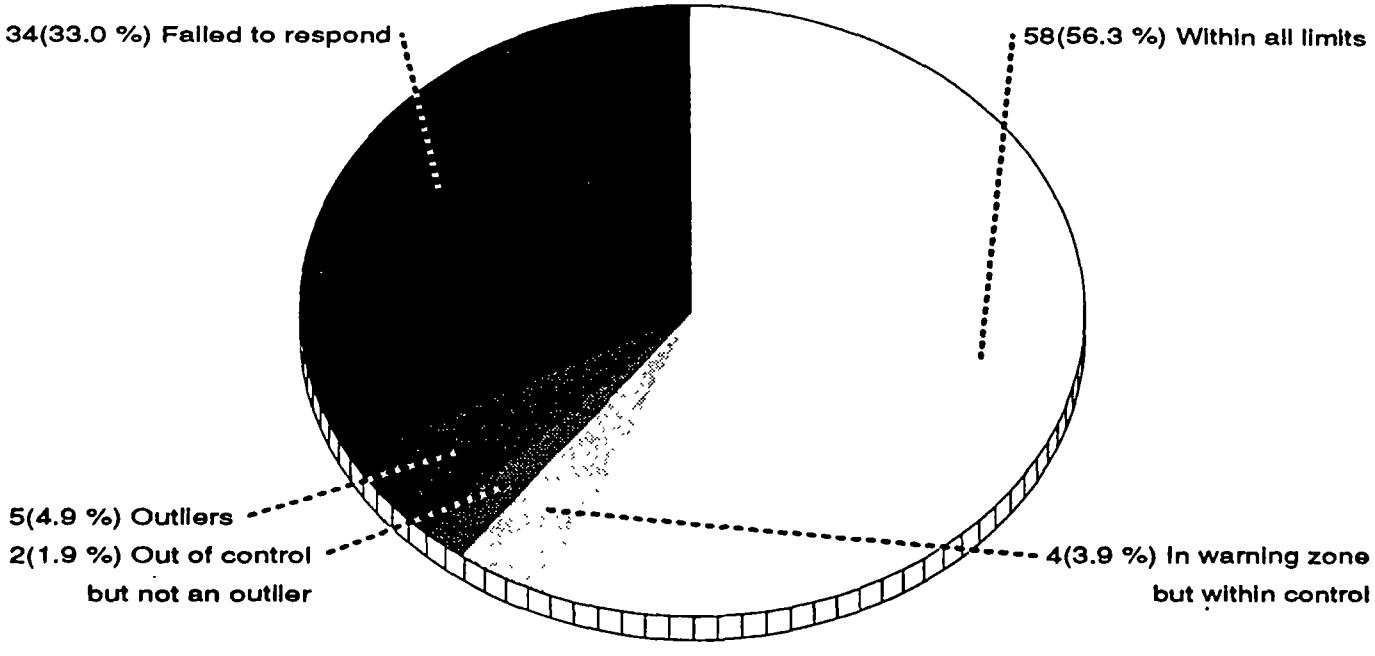
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

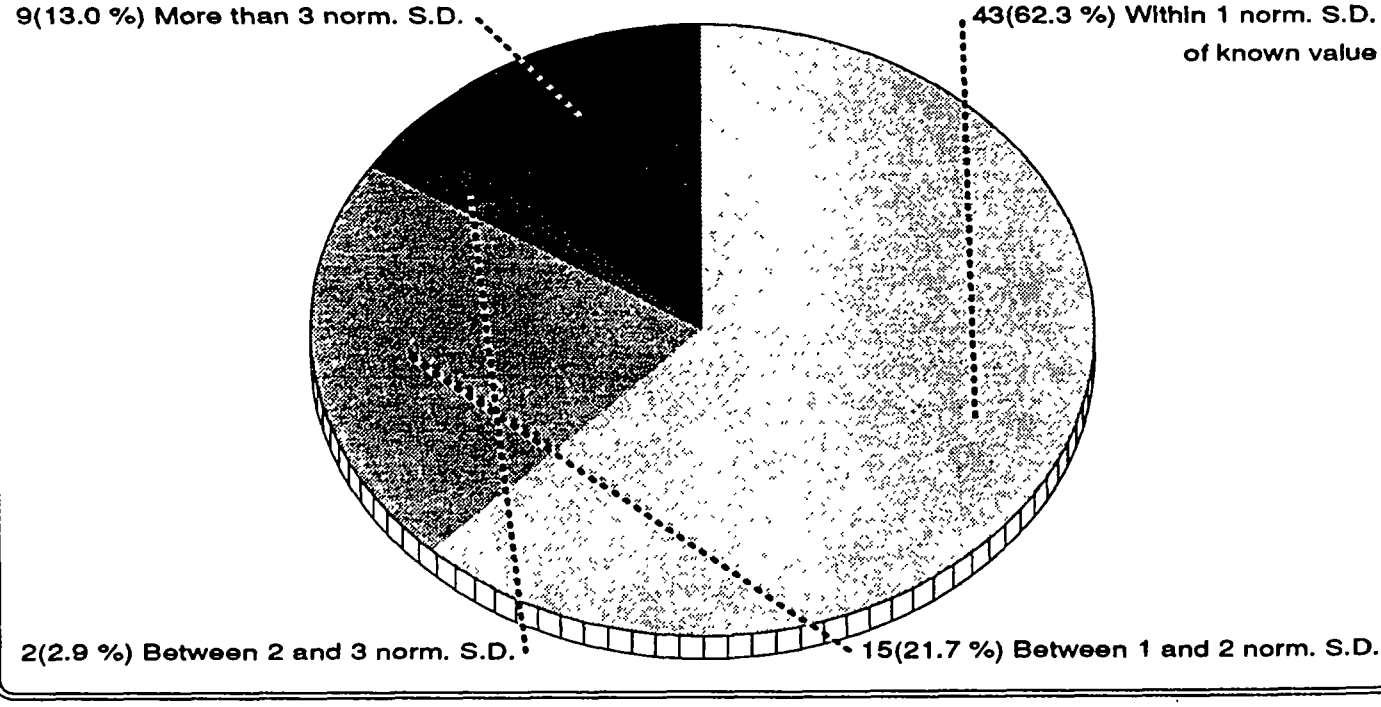
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Strontium-89 Statistical Summary 103 Participants

The known value of this nuclide is **21.0 pCi/l** with an expected precision of **5.0**; the control limits are 12.3 to 29.7; the warning regions are 12.3 to 15.2 and 26.8 to 29.7



Statistic	Respondents	Non-outliers
Mean	22.31	**Grand Avg 20.53**
Std. Dev.	19.20	3.50
Variance	368.45	12.25
% Coef. of Var.	86.02	17.05
% deviation of mean from known value	6.26	-2.23
Norm. dev. of mean from known value	0.07	-0.13
Median	20.67	20.67
% deviation of median from known value	-1.59	-1.59
Norm. dev. of median from known value	-0.02	-0.10



Strontium-89

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	21.0	21.0	20.0	0.58	0.118	20.67	0.05	-0.12	
AE	21.0	21.0	21.0	0.00	0.000	21.00	0.16	0.00	
AF	20.0	19.0	19.0	0.58	0.118	19.33	-0.41	-0.58	
AJ	36.0	27.0	26.0	5.51	1.345	29.67	3.16	3.00	
AK	15.0	15.0	16.0	0.58	0.118	15.33	-1.80	-1.96	
AL	21.0	22.0	21.0	0.58	0.118	21.33	0.28	0.12	
AU	29.0	28.0	28.0	0.58	0.118	28.33	2.70	2.54	
AW	22.0	22.0	23.0	0.58	0.118	22.33	0.62	0.46	
AY									•
AZ	19.0	22.0	21.0	1.53	0.354	20.67	0.05	-0.12	
BA	19.0	19.0	20.0	0.58	0.118	19.33	-0.41	-0.58	
BB									•
BC	17.0	17.0	17.0	0.00	0.000	17.00	-1.22	-1.39	
BG									•
BH	22.0	24.0	20.0	2.00	0.473	22.00	0.51	0.35	
BL	21.0	20.0	23.0	1.53	0.354	21.33	0.28	0.12	
BM	22.0	23.0	21.0	1.00	0.236	22.00	0.51	0.35	
BO	21.0	21.0	20.0	0.58	0.118	20.67	0.05	-0.12	
C	22.0	21.0	21.0	0.58	0.118	21.33	0.28	0.12	
CA	16.0	19.0	22.0	3.00	0.709	19.00	-0.53	-0.69	
CC									•
CE									•
CJ	20.0	21.0	22.0	1.00	0.236	21.00	0.16	0.00	
CO	30.0	22.0	32.0	5.29	1.345	28.00	2.59	2.42	
CP	19.0	17.0	20.0	1.53	0.354	18.67	-0.65	-0.81	
CS	24.0	26.0	25.0	1.00	0.236	25.00	1.55	1.39	
CX	13.0	19.0	20.0	3.79	0.827	17.33	-1.11	-1.27	
D	21.0	20.0	16.0	2.65	0.591	19.00	-0.53	-0.69	
DD	22.0	25.0	23.0	1.53	0.354	23.33	0.97	0.81	
DE	18.0	18.0	18.0	0.00	0.000	18.00	-0.88	-1.04	
DO	27.0	24.0	22.0	2.52	0.591	24.33	1.32	1.15	
DT	19.0	20.0	15.0	2.65	0.591	18.00	-0.88	-1.04	
DZ									•
E	24.0	21.0	22.0	1.53	0.354	22.33	0.62	0.46	
EB	24.0	25.0	26.0	1.00	0.236	25.00	1.55	1.39	
EL	20.0	20.0	22.0	1.15	0.236	20.67	0.05	-0.12	
FE	28.0	25.0	25.0	1.73	0.354	26.00	1.89	1.73	
GQ	7.0	6.0	6.0	0.58	0.118	6.33	-4.92	-5.08	×
HK	19.0	19.0	21.0	1.15	0.236	19.67	-0.30	-0.46	
HP	22.0	18.0	18.0	2.31	0.473	19.33	-0.41	-0.58	
I	20.0	19.0	20.0	0.58	0.118	19.67	-0.30	-0.46	
J									•
JE	9.0	12.0	10.0	1.53	0.354	10.33	-3.53	-3.70	⇓
JS	20.0	21.0	19.0	1.00	0.236	20.00	-0.18	-0.35	
JY	23.0	23.0	19.0	2.31	0.473	21.67	0.39	0.23	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ 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
K	20.0	24.0	22.0	2.00	0.473	22.00	0.51	0.35	
KH	19.0	22.0	21.0	1.53	0.354	20.67	0.05	-0.12	
KL	18.0	17.0	18.0	0.58	0.118	17.67	-0.99	-1.15	
L	20.0	23.0	20.0	1.73	0.354	21.00	0.16	0.00	
LE									
LF	23.0	19.0	23.0	2.31	0.473	21.67	0.39	0.23	
M									
N	24.0	22.0	22.0	1.15	0.236	22.67	0.74	0.58	
NJ	16.0	16.0	17.0	0.58	0.118	16.33	-1.45	-1.62	
NO									
OA	171.0	178.0	174.0	3.51	0.827	174.33	53.28	53.12	×
PB									
Q	20.0	21.0	23.0	1.53	0.354	21.33	0.28	0.12	
QM	4.0	3.0	2.0	1.00	0.236	3.00	-6.07	-6.24	×
QU	22.0	23.0	23.0	0.58	0.118	22.67	0.74	0.58	
QW	20.0	23.0	22.0	1.53	0.354	21.67	0.39	0.23	
QZ	19.0	18.0	20.0	1.00	0.236	19.00	-0.53	-0.69	
R	17.0	18.0	17.0	0.58	0.118	17.33	-1.11	-1.27	
RK									
RR									
S	20.0	20.0	20.0	0.00	0.000	20.00	-0.18	-0.35	
SD	25.0	20.0	22.0	2.52	0.591	22.33	0.62	0.46	
SF									
SI	31.0	34.0	37.0	3.00	0.709	34.00	4.67	4.50	×
SL									
SM	17.0	18.0	18.0	0.58	0.118	17.67	-0.99	-1.15	
SS	21.0	19.0	19.0	1.15	0.236	19.67	-0.30	-0.46	
SZ	19.0	23.0	22.0	2.08	0.473	21.33	0.28	0.12	
T	21.0	21.0	18.0	1.73	0.354	20.00	-0.18	-0.35	
TD									
TF									
TL									
TQ	15.0	18.0	19.0	2.08	0.473	17.33	-1.11	-1.27	
U	18.0	19.0	20.0	1.00	0.236	19.00	-0.53	-0.69	
UM									
UP	25.0	26.0	26.0	0.58	0.118	25.67	1.78	1.62	
VA									
VC									
VH									
VI									
W	19.0	19.0	20.0	0.58	0.118	19.33	-0.41	-0.58	
WG									
WI									
WJ									
WO	13.0	13.0	11.0	1.15	0.236	12.33	-2.84	-3.00	

• ≡ 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
WR									•
WS									•
WV									•
X	18.0	20.0	22.0	2.00	0.473	20.00	-0.18	-0.35	
XI	11.0	8.0	13.0	2.52	0.591	10.67	-3.42	-3.58	⇓
XK	8.0	8.0	8.0	0.00	0.000	8.00	-4.34	-4.50	×
XL	21.0	23.0	24.0	1.53	0.354	22.67	0.74	0.58	
XM	22.0	24.0	24.0	1.15	0.236	23.33	0.97	0.81	
XO									•
XQ									•
XR									•
XT									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.00	×	**QM**	19.33		**BA**	21.67		**LF**
6.33	×	**GQ**	19.33		**AF**	21.67		**JY**
8.00	×	**XK**	19.67		**SS**	22.00		**K**
10.33	⇓	**JE**	19.67		**I**	22.00		**BM**
10.67	⇓	**XI**	19.67		**HK**	22.00		**BH**
12.33		**WO**	20.00		**X**	22.33		**SD**
15.33		**AK**	20.00		**T**	22.33		**E**
16.33		**NJ**	20.00		**S**	22.33		**AW**
17.00		**BC**	20.00		**JS**	22.67		**XL**
17.33		**TQ**	20.67		**KH**	22.67		**QU**
17.33		**R**	20.67		**EL**	22.67		**N**
17.33		**CX**	20.67		**BO**	23.33		**XM**
17.67		**SM**	20.67		**AZ**	23.33		**DD**
17.67		**KL**	20.67		**A**	24.33		**DO**
18.00		**DT**	21.00		**L**	25.00		**EB**
18.00		**DE**	21.00		**CJ**	25.00		**CS**
18.67		**CP**	21.00		**AE**	25.67		**UP**
19.00		**U**	21.33		**SZ**	26.00		**FE**
19.00		**QZ**	21.33		**Q**	28.00		**CO**
19.00		**D**	21.33		**C**	28.33		**AU**
19.00		**CA**	21.33		**BL**	29.67		**AJ**
19.33		**W**	21.33		**AL**	34.00	×	**SI**
19.33		**HP**	21.67		**QW**	174.33	×	**OA**

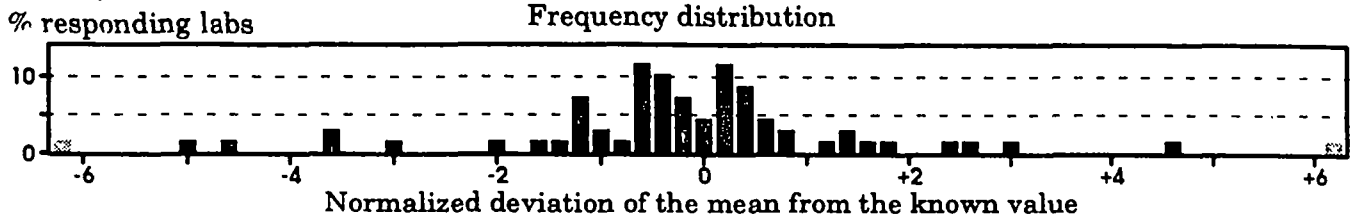
• ≡ No data submitted
∅ ≡ Insufficient data

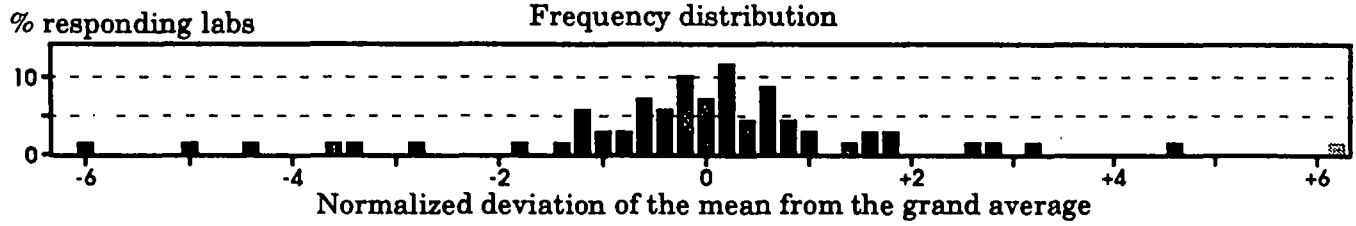
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

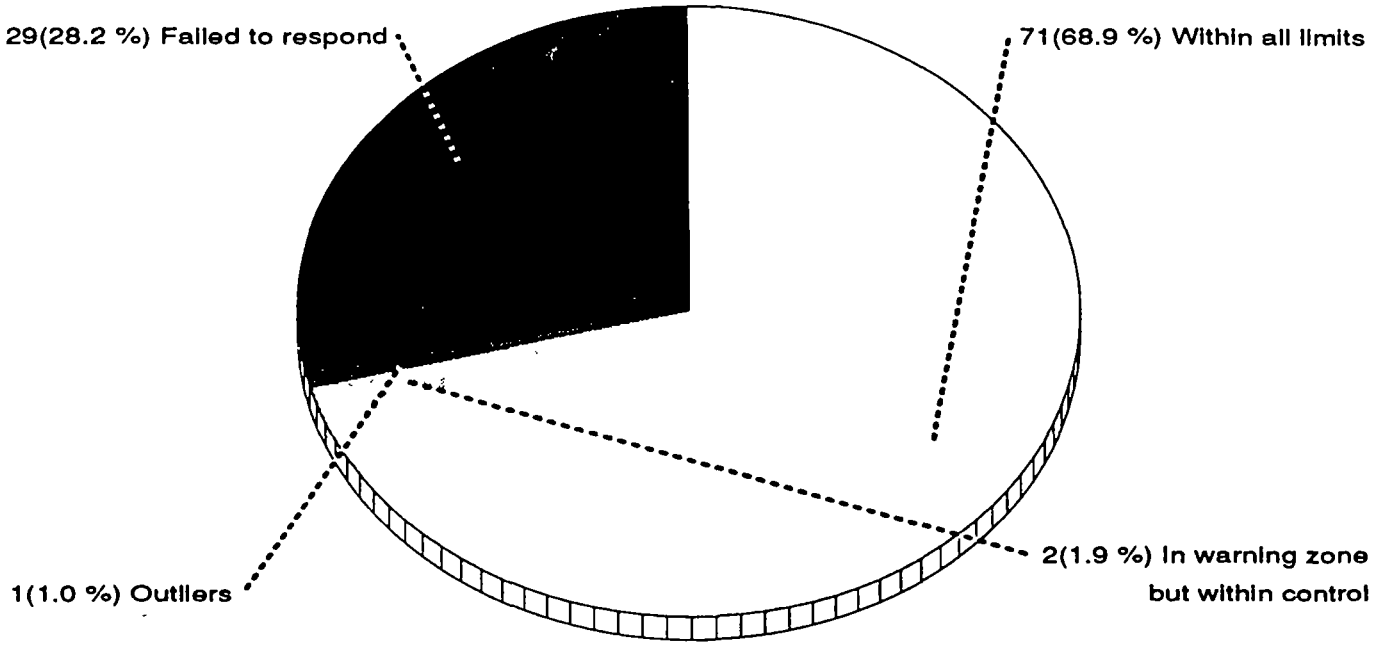
Strontium-89



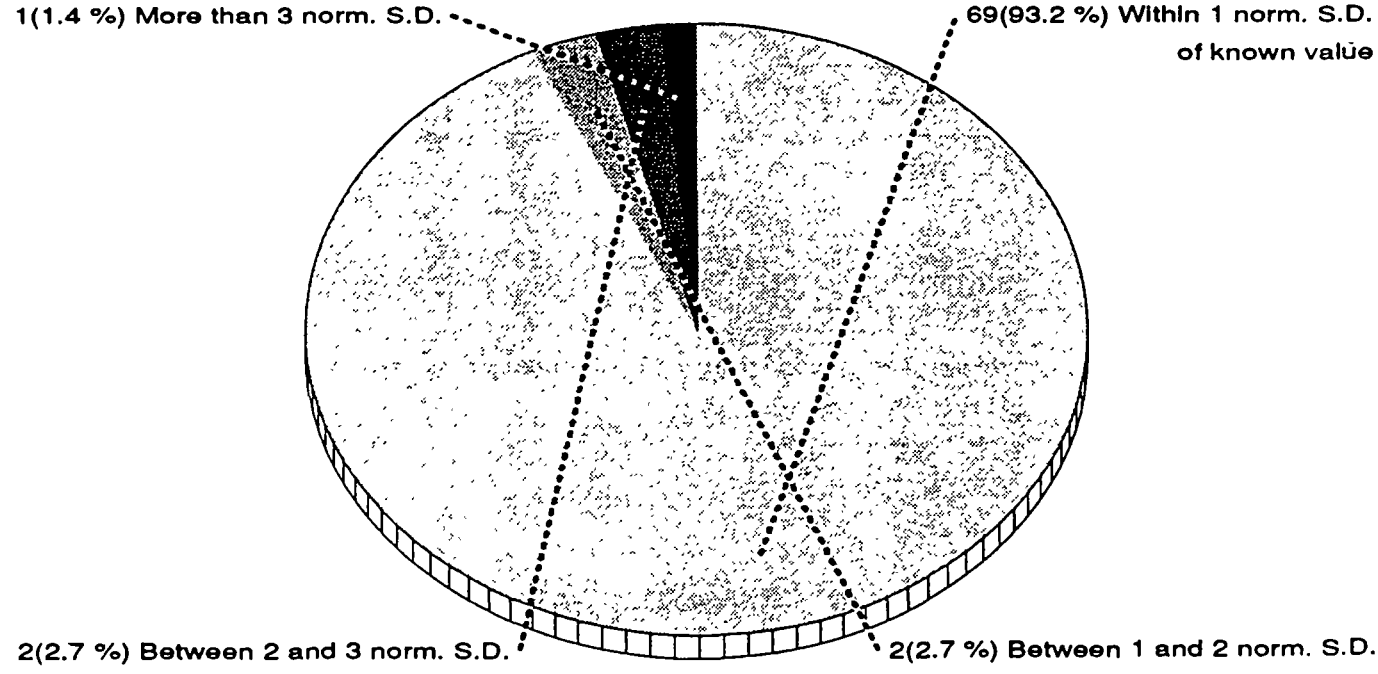


Strontium-90 Statistical Summary 103 Participants

The known value of this nuclide is **7.0 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 15.7; the warning regions are 0.0 to 1.2 and 12.8 to 15.7



Statistic	Respondents	Non-outliers
Mean	7.44	**Grand Avg 6.82**
Std. Dev.	5.66	1.80
Variance	32.00	3.22
% Coef. of Var.	76.02	26.33
% deviation of mean from known value	6.31	-2.61
Norm. dev. of mean from known value	0.08	-0.10
Median	6.67	6.67
% deviation of median from known value	-4.76	-4.76
Norm. dev. of median from known value	-0.06	-0.19



ESD-LV Performance Evaluation: Strontium in Water, 17-Jul-1998

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	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
AE	6.0	6.0	7.0	0.58	0.118	6.33	-0.17	-0.23	
AF	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
AJ	3.0	5.0	5.0	1.15	0.236	4.33	-0.86	-0.92	
AK	8.0	8.0	7.0	0.58	0.118	7.67	0.29	0.23	
AL	6.0	6.0	6.0	0.00	0.000	6.00	-0.28	-0.35	
AU	5.0	8.0	7.0	1.53	0.354	6.67	-0.05	-0.12	
AW	7.0	8.0	9.0	1.00	0.236	8.00	0.41	0.35	
AY	8.0	8.0	8.0	0.00	0.000	8.00	0.41	0.35	
AZ	6.0	5.0	6.0	0.58	0.118	5.67	-0.40	-0.46	
BA	5.0	6.0	6.0	0.58	0.118	5.67	-0.40	-0.46	
BB	6.0	7.0	6.0	0.58	0.118	6.33	-0.17	-0.23	
BC	8.0	8.0	7.0	0.58	0.118	7.67	0.29	0.23	
BG									•
BH	7.0	6.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
BL	8.0	8.0	8.0	0.00	0.000	8.00	0.41	0.35	
BM	7.0	7.0	8.0	0.58	0.118	7.33	0.18	0.12	
BO	6.0	7.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
C	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
CA	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
CC									•
CE	7.0	6.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
CJ	6.0	6.0	7.0	0.58	0.118	6.33	-0.17	-0.23	
CO	10.0	11.0	8.0	1.53	0.354	9.67	0.99	0.92	
CP	5.0	4.0	4.0	0.58	0.118	4.33	-0.86	-0.92	
CS	6.0	4.0	6.0	1.15	0.236	5.33	-0.51	-0.58	
CX	7.0	8.0	10.0	1.53	0.354	8.33	0.53	0.46	
D	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
DD	6.0	6.0	6.0	0.00	0.000	6.00	-0.28	-0.35	
DE	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
DO	5.0	5.0	7.0	1.15	0.236	5.67	-0.40	-0.46	
DT	7.0	7.0	9.0	1.15	0.236	7.67	0.29	0.23	
DZ	8.0	9.0	7.0	1.00	0.236	8.00	0.41	0.35	
E	8.0	8.0	8.0	0.00	0.000	8.00	0.41	0.35	
EB	7.0	6.0	6.0	0.58	0.118	6.33	-0.17	-0.23	
EL	10.0	7.0	7.0	1.73	0.354	8.00	0.41	0.35	
FE	8.0	7.0	9.0	1.00	0.236	8.00	0.41	0.35	
GQ	15.0	14.0	14.0	0.58	0.118	14.33	2.60	2.54	
HK	7.0	7.0	6.0	0.58	0.118	6.67	-0.05	-0.12	
HP	4.0	4.0	5.0	0.58	0.118	4.33	-0.86	-0.92	
I	6.0	7.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
J									•
JE	5.0	3.0	4.0	1.00	0.236	4.00	-0.98	-1.04	
JS	6.0	6.0	7.0	0.58	0.118	6.33	-0.17	-0.23	
JY	6.0	6.0	7.0	0.58	0.118	6.33	-0.17	-0.23	

• ≡ 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)	Normalized deviation (known)	Tag
K	6.0	5.0	7.0	1.00	0.236	6.00	-0.28	-0.35	
KH	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
KL	8.0	8.0	8.0	0.00	0.000	8.00	0.41	0.35	
L	7.0	6.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
LE									•
LF	6.0	7.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
M									•
N	6.0	6.0	6.0	0.00	0.000	6.00	-0.28	-0.35	
NJ	5.0	5.0	5.0	0.00	0.000	5.00	-0.63	-0.69	
NO									•
OA	60.0	49.0	50.0	6.08	1.570	53.00	16.00	15.93	×
PB									•
Q	11.0	8.0	8.0	1.73	0.354	9.00	0.76	0.69	
QM	14.0	14.0	14.0	0.00	0.000	14.00	2.49	2.42	
QU	6.0	6.0	7.0	0.58	0.118	6.33	-0.17	-0.23	
QW	6.0	6.0	7.0	0.58	0.118	6.33	-0.17	-0.23	
QZ	6.0	7.0	6.0	0.58	0.118	6.33	-0.17	-0.23	
R	6.0	6.0	6.0	0.00	0.000	6.00	-0.28	-0.35	
RK									•
RR									•
S	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
SD	8.0	9.0	8.0	0.58	0.118	8.33	0.53	0.46	
SF									•
SI	5.0	4.0	4.0	0.58	0.118	4.33	-0.86	-0.92	
SL									•
SM	5.0	6.0	5.0	0.58	0.118	5.33	-0.51	-0.58	
SS	6.0	7.0	6.0	0.58	0.118	6.33	-0.17	-0.23	
SZ	9.0	8.0	10.0	1.00	0.236	9.00	0.76	0.69	
T	6.0	6.0	5.0	0.58	0.118	5.67	-0.40	-0.46	
TD									•
TF									•
TL									•
TQ	7.0	6.0	7.0	0.58	0.118	6.67	-0.05	-0.12	
U	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
UM									•
UP	7.0	7.0	8.0	0.58	0.118	7.33	0.18	0.12	
VA									•
VC									•
VH									•
VI									•
W	7.0	6.0	6.0	0.58	0.118	6.33	-0.17	-0.23	
WG									•
WI									•
WJ									•
WO	2.0	2.0	5.0	1.73	0.354	3.00	-1.32	-1.39	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Strontium in Water, 17-Jul-1998

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
WR	4.0	4.0	5.0	0.58	0.118	4.33	-0.86	-0.92	
WS									•
WV									•
X	8.0	6.0	6.0	1.15	0.236	6.67	-0.05	-0.12	
XI	11.0	10.0	8.0	1.53	0.354	9.67	0.99	0.92	
XK	3.0	4.0	6.0	1.53	0.354	4.33	-0.86	-0.92	
XL	7.0	7.0	7.0	0.00	0.000	7.00	0.06	0.00	
XM	6.0	6.0	6.0	0.00	0.000	6.00	-0.28	-0.35	
XO									•
XQ									•
XR									•
XT									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.00		WO	6.33		QW	7.00		C
4.00		JE	6.33		QU	7.00		AF
4.33		XK	6.33		JY	7.00		A
4.33		WR	6.33		JS	7.33		UP
4.33		SI	6.33		EB	7.33		BM
4.33		HP	6.33		CJ	7.67		DT
4.33		CP	6.33		BB	7.67		BC
4.33		AJ	6.33		AE	7.67		AK
5.00		NJ	6.67		X	8.00		KL
5.33		SM	6.67		TQ	8.00		FE
5.33		CS	6.67		LF	8.00		EL
5.67		T	6.67		L	8.00		E
5.67		DO	6.67		I	8.00		DZ
5.67		BA	6.67		HK	8.00		BL
5.67		AZ	6.67		CE	8.00		AY
6.00		XM	6.67		BO	8.00		AW
6.00		R	6.67		BH	8.33		SD
6.00		N	6.67		AU	8.33		CX
6.00		K	7.00		XL	9.00		SZ
6.00		DD	7.00		U	9.00		Q
6.00		AL	7.00		S	9.67		XI
6.33		W	7.00		KH	9.67		CO
6.33		SS	7.00		DE	14.00		QM
6.33		QZ	7.00		D	14.33		GQ
			7.00		CA	53.00	×	OA

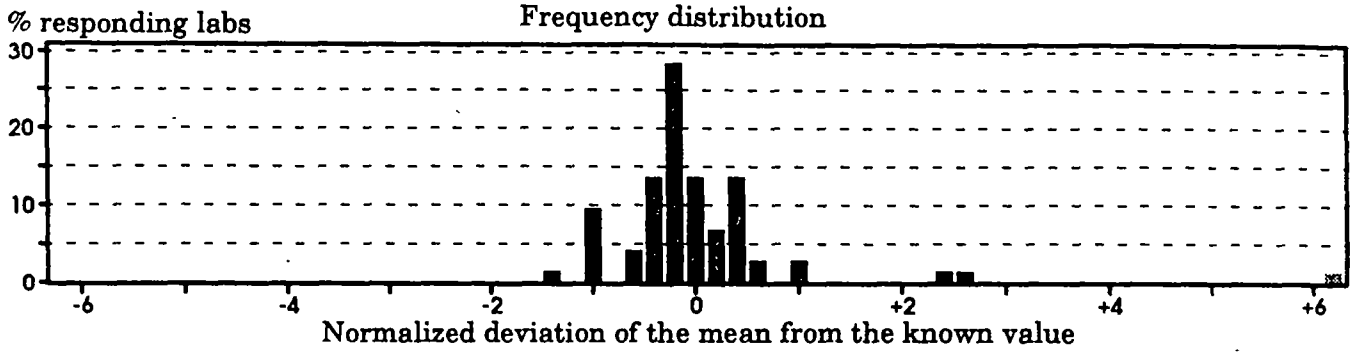
• ≡ No data submitted
∅ ≡ Insufficient data

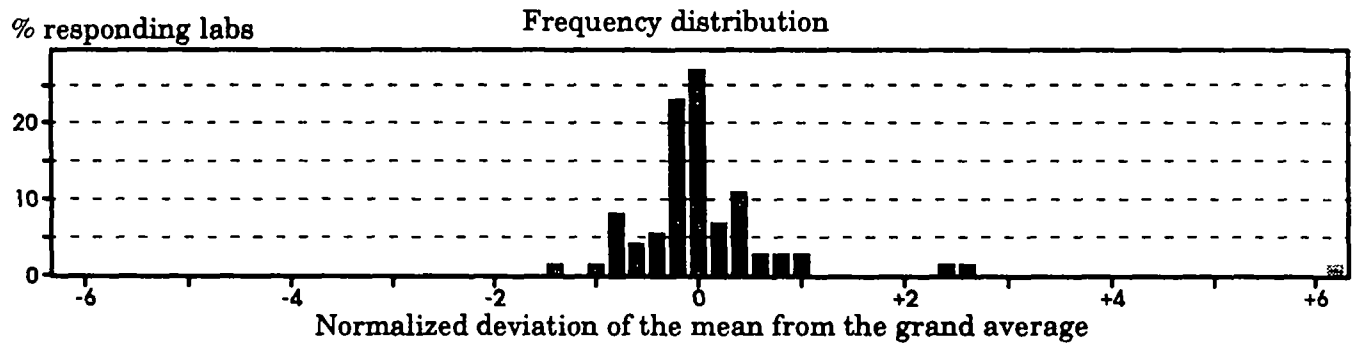
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90





United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA 600/R-98/179
December 1998

EPA

Gross Alpha-Beta in Water Performance Evaluation Study

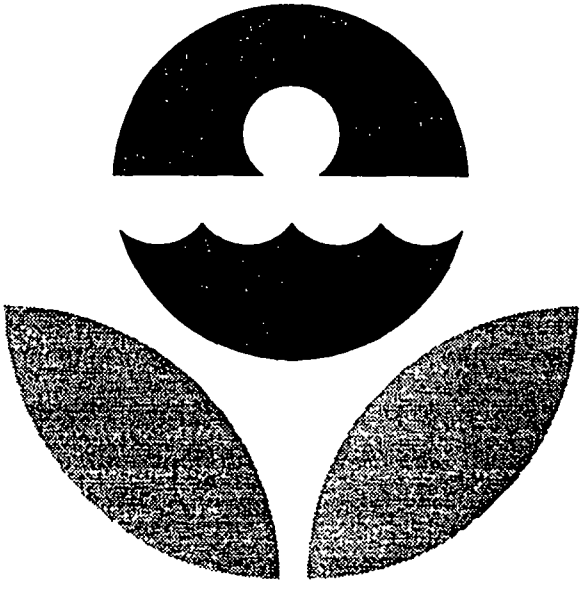
A Statistical Evaluation of the July 24, 1998 Data

090ECB99 cov-B

Gross Alpha-Beta in Water

Performance Evaluation Study

July 24, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Gross Alpha-Beta in Water; July 24, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pla at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pla
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

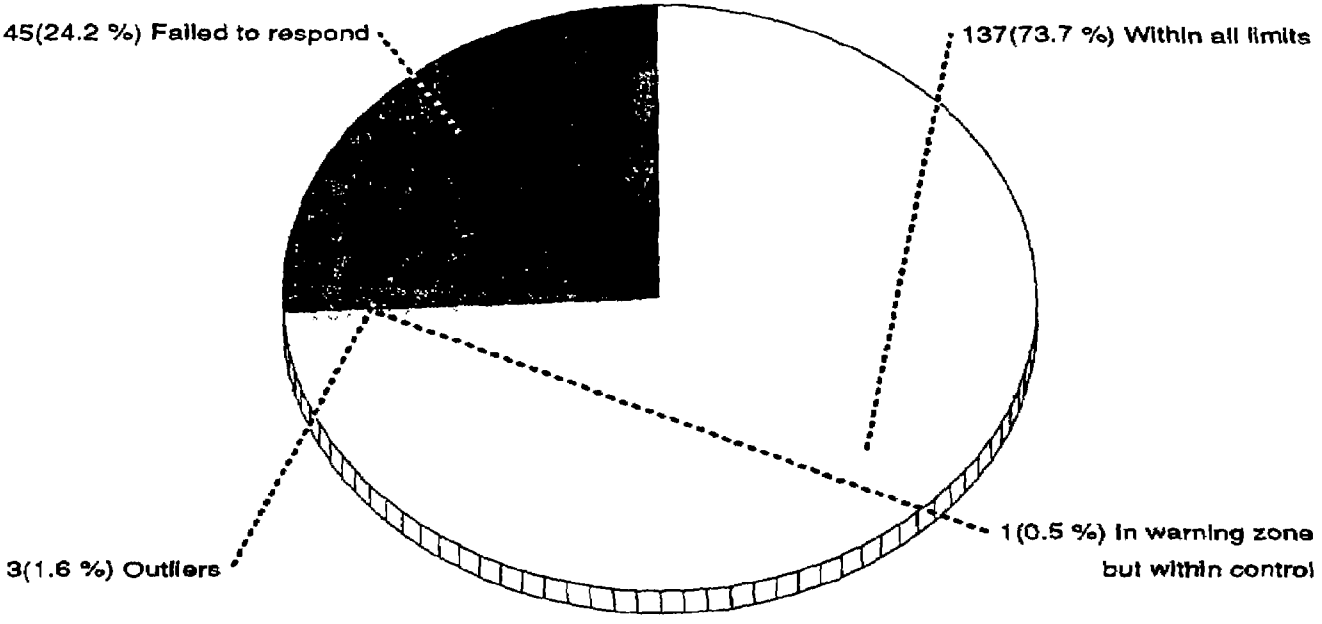
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

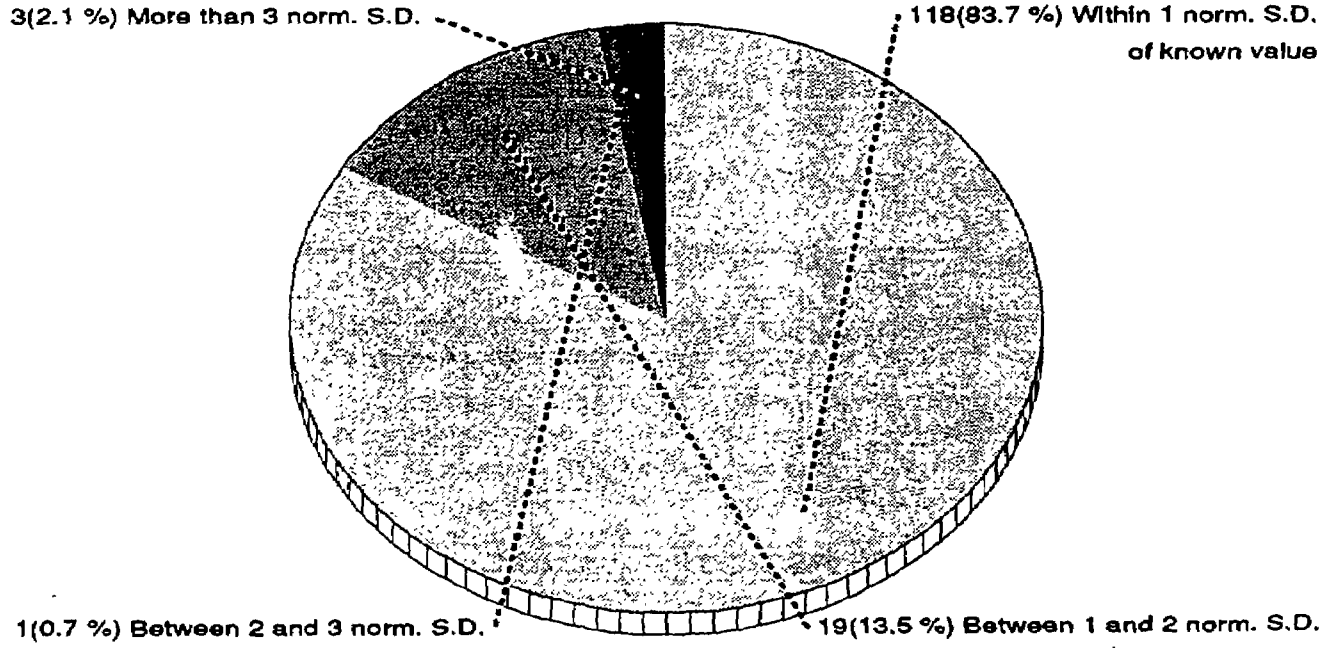
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Alpha Statistical Summary 186 Participants

The known value of this nuclide is **7.2 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 15.9; the warning regions are 0.0 to 1.4 and 13.0 to 15.9



Statistic	Respondents	Non-outliers
Mean	7.67	**Grand Avg 7.27**
Std. Dev.	3.92	1.98
Variance	15.33	3.94
% Coef. of Var.	51.08	27.31
% deviation of mean from known value	6.47	0.93
Norm. dev. of mean from known value	0.12	0.03
Median	7.10	7.03
% deviation of median from known value	-1.39	-2.31
Norm. dev. of median from known value	-0.03	-0.08



ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 24-Jul-1998

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	8.0	8.1	7.8	0.15	0.035	7.97	0.24	0.27	
AE	10.7	8.7	7.7	1.53	0.354	9.03	0.61	0.64	
AF	6.1	8.5	6.9	1.22	0.284	7.17	-0.03	-0.01	
AH	8.2	7.9	7.5	0.35	0.083	7.87	0.21	0.23	
AJ	8.9	8.4	8.8	0.26	0.059	8.70	0.50	0.52	
AK	9.9	9.6	8.9	0.51	0.118	9.47	0.76	0.79	
AL	7.1	7.3	6.0	0.70	0.154	6.80	-0.16	-0.14	
AP									•
AR	8.3	8.8	8.2	0.32	0.071	8.43	0.40	0.43	
AU	8.3	8.1	9.5	0.76	0.165	8.63	0.47	0.50	
AW	10.9	10.9	12.8	1.10	0.224	11.53	1.48	1.50	
AZ	8.9	9.4	7.7	0.87	0.201	8.67	0.48	0.51	
BA	6.8	6.2	6.9	0.38	0.083	6.63	-0.22	-0.20	
BB	6.6	6.5	6.2	0.21	0.047	6.43	-0.29	-0.27	
BC	7.8	7.9	8.6	0.44	0.095	8.10	0.29	0.31	
BG									•
BH	7.5	7.1	7.1	0.23	0.047	7.23	-0.01	0.01	
BK	7.5	8.4	7.5	0.52	0.106	7.80	0.18	0.21	
BL	15.5	16.3	17.1	0.80	0.189	16.30	3.13	3.15	×
BM	9.1	8.7	7.3	0.95	0.213	8.37	0.38	0.40	
BN	6.6	5.1	5.6	0.76	0.177	5.77	-0.52	-0.50	
BO	3.4	3.2	4.0	0.42	0.095	3.53	-1.29	-1.27	
BS	9.4	10.4	6.5	2.03	0.461	8.77	0.52	0.54	
C	7.5	6.7	7.3	0.42	0.095	7.17	-0.03	-0.01	
CA	5.3	5.9	6.1	0.42	0.095	5.77	-0.52	-0.50	
CC									•
CE	5.6	4.8	7.3	1.28	0.295	5.90	-0.47	-0.45	
CJ	5.7	5.9	4.7	0.64	0.142	5.43	-0.64	-0.61	
CO	3.2	2.4	5.4	1.55	0.354	3.67	-1.25	-1.22	
CP	11.9	8.7	11.2	1.68	0.378	10.60	1.15	1.18	
CS									•
CX	46.1	47.8	42.9	2.49	0.579	45.60	13.28	13.30	×
D	9.9	8.1	11.2	1.56	0.366	9.73	0.85	0.88	
DB	7.1	7.7	6.6	0.55	0.130	7.13	-0.05	-0.02	
DD									•
DE	8.8	9.5	9.9	0.56	0.130	9.40	0.74	0.76	
DH	6.3	6.8	4.3	1.32	0.295	5.80	-0.51	-0.48	
DO	10.7	11.2	9.0	1.15	0.260	10.30	1.05	1.07	
DR									•
DT	8.9	6.9	7.1	1.10	0.236	7.63	0.13	0.15	
DZ	11.6	12.8	10.8	1.01	0.236	11.73	1.55	1.57	
E	9.4	9.8	8.3	0.78	0.177	9.17	0.66	0.68	
EB	7.0	5.8	6.6	0.61	0.142	6.47	-0.28	-0.25	
EL	6.2	4.0	6.1	1.24	0.260	5.43	-0.64	-0.61	
EO	7.0	7.0	5.0	1.15	0.236	6.33	-0.32	-0.30	

• ≡ 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
ER	6.6	6.9	7.2	0.30	0.071	6.90	-0.13	-0.10	
EV	5.2	4.2	3.9	0.68	0.154	4.43	-0.98	-0.96	
EW									•
EX	4.1	4.8	4.4	0.35	0.083	4.43	-0.98	-0.96	
FE	8.2	8.4	10.0	0.99	0.213	8.87	0.55	0.58	
FF	5.1	5.3	5.5	0.20	0.047	5.30	-0.68	-0.66	
FJ	4.6	5.2	5.5	0.46	0.106	5.10	-0.75	-0.73	
FL	7.2	4.3	5.1	1.50	0.343	5.53	-0.60	-0.58	
FN	8.0	7.0	9.0	1.00	0.236	8.00	0.25	0.28	
GQ	7.6	6.6	6.3	0.68	0.154	6.83	-0.15	-0.13	
GZ	7.6	7.4	8.4	0.53	0.118	7.80	0.18	0.21	
HE	11.0	12.4	12.4	0.81	0.165	11.93	1.62	1.64	
HI	9.3	7.6	6.8	1.28	0.295	7.90	0.22	0.24	
HK	6.1	6.1	6.1	0.00	0.000	6.10	-0.40	-0.38	
HL	4.0	4.9	5.3	0.67	0.154	4.73	-0.88	-0.85	
HP	4.8	5.4	6.1	0.65	0.154	5.43	-0.64	-0.61	
I	7.6	3.4	4.9	2.13	0.496	5.30	-0.68	-0.66	
ID	6.0	8.0	4.8	1.62	0.378	6.27	-0.35	-0.32	
J									•
JE	7.4	6.6	7.4	0.46	0.095	7.13	-0.05	-0.02	
JG									•
JM	5.5	5.9	6.0	0.26	0.059	5.80	-0.51	-0.48	
JN	5.1	6.1	5.4	0.51	0.118	5.53	-0.60	-0.58	
JP	7.2	7.8	8.5	0.65	0.154	7.83	0.20	0.22	
JQ	6.0	7.0	5.7	0.68	0.154	6.23	-0.36	-0.33	
JS	8.5	7.7	7.7	0.46	0.095	7.97	0.24	0.27	
JY	8.6	7.6	11.2	1.86	0.425	9.13	0.65	0.67	
K									•
KE	7.7	9.2	8.3	0.75	0.177	8.40	0.39	0.42	
KH	7.9	7.9	7.6	0.17	0.035	7.80	0.18	0.21	
KT	8.0	9.5	11.0	1.50	0.354	9.50	0.77	0.80	
KX	9.0	9.0	8.5	0.29	0.059	8.83	0.54	0.57	
L	4.9	4.8	5.5	0.38	0.083	5.07	-0.76	-0.74	
LE									•
LF	6.3	6.5	6.5	0.12	0.024	6.43	-0.29	-0.27	
LL									•
LR	5.5	5.3	4.6	0.47	0.106	5.13	-0.74	-0.72	
M									•
MF	7.7	7.6	9.0	0.78	0.165	8.10	0.29	0.31	
MT									•
MV									•
MX	4.6	3.3	4.0	0.65	0.154	3.97	1.14	-1.12	
N	5.0	5.4	5.2	0.20	0.047	5.20	-0.72	-0.69	
NA	8.6	7.1	8.1	0.76	0.177	7.93	0.23	0.25	
NB	4.1	3.3	5.2	0.95	0.224	4.20	-1.06	-1.04	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 24-Jul-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NH	6.0	5.0	5.0	0.58	0.118	5.33	-0.67	-0.65	
NJ	6.2	6.5	6.3	0.15	0.035	6.33	-0.32	-0.30	
NK									•
NO									•
NP	6.9	5.8	7.0	0.67	0.142	6.57	-0.24	-0.22	
O	9.9	11.5	12.0	1.10	0.248	11.13	1.34	1.36	
OA	7.4	6.9	5.1	1.21	0.272	6.47	-0.28	-0.25	
OB	9.4	10.4	10.1	0.51	0.118	9.97	0.94	0.96	
OF	9.6	8.2	9.2	0.72	0.165	9.00	0.60	0.62	
OS	6.0	6.0	6.0	0.00	0.000	6.00	-0.44	-0.42	
OT									•
OY									•
P	5.0	5.8	8.7	1.95	0.437	6.50	-0.27	-0.24	
PB									•
PD									•
PG	0.1	0.3	0.2	0.10	0.024	0.20	-2.45	-2.42	
PM	7.4	6.1	6.7	0.65	0.154	6.73	-0.18	-0.16	
Q	8.6	6.3	8.6	1.33	0.272	7.83	0.20	0.22	
QM	5.3	4.2	5.7	0.78	0.177	5.07	-0.76	-0.74	
QP	10.6	10.6	10.4	0.12	0.024	10.53	1.13	1.15	
QQ	6.5	8.3	5.2	1.56	0.366	6.67	-0.21	-0.18	
QT	5.9	7.4	11.6	2.95	0.673	8.30	0.36	0.38	
QU	11.6	10.5	9.3	1.15	0.272	10.47	1.11	1.13	
QW	10.3	9.7	10.6	0.46	0.106	10.20	1.02	1.04	
QX	9.3	8.8	8.7	0.32	0.071	8.93	0.58	0.60	
QZ	5.9	5.7	5.6	0.15	0.035	5.73	-0.53	-0.51	
R	5.9	5.6	5.8	0.15	0.035	5.77	-0.52	-0.50	
RB	8.6	7.4	8.6	0.69	0.142	8.20	0.32	0.35	
RD	6.8	5.3	3.3	1.76	0.413	5.13	-0.74	-0.72	
RG	10.3	9.5	9.5	0.46	0.095	9.77	0.87	0.89	
RI	7.2	6.2	5.3	0.95	0.224	6.23	-0.36	-0.33	
RK	3.4	4.8	3.6	0.76	0.165	3.93	-1.15	-1.13	
RR									•
RZ	6.8	7.2	7.6	0.40	0.095	7.20	-0.02	0.00	
S	8.0	9.4	10.7	1.35	0.319	9.37	0.73	0.75	
SD	9.2	9.1	8.9	0.15	0.035	9.07	0.62	0.65	
SF									•
SG	13.6	10.3	10.9	1.76	0.390	11.60	1.50	1.52	
SI	6.8	6.3	6.7	0.26	0.059	6.60	-0.23	-0.21	
SL	7.2	8.0	7.8	0.42	0.095	7.67	0.14	0.16	
SM	6.0	5.7	6.8	0.57	0.130	6.17	-0.38	-0.36	
SN	7.4	7.7	6.0	0.91	0.201	7.03	-0.08	-0.06	
SO	6.4	6.3	5.8	0.32	0.071	6.17	-0.38	-0.36	
SR									•
SS	6.5	7.6	7.3	0.57	0.130	7.13	-0.05	-0.02	

• ≡ 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
SU	10.5	21.9	16.0	5.70	1.660	16.13	3.07	3.09	×
SV	11.7	10.4	10.3	0.78	0.165	10.80	1.22	1.25	
SX	8.0	8.7	10.8	1.46	0.331	9.17	0.66	0.68	
SZ	4.8	5.8	6.0	0.64	0.142	5.53	-0.60	-0.58	
T	6.2	5.2	5.1	0.61	0.130	5.50	-0.61	-0.59	
TD	11.5	7.6	10.6	2.04	0.461	9.90	0.91	0.94	
TL									•
TN	12.1	11.1	8.1	2.08	0.473	10.43	1.10	1.12	
TO									•
TQ	4.7	5.3	5.3	0.35	0.071	5.10	-0.75	-0.73	
TW	7.0	5.6	5.7	0.78	0.165	6.10	-0.40	-0.38	
TX									•
TY	5.4	5.8	5.8	0.23	0.047	5.67	-0.55	-0.53	
U	7.3	6.9	6.9	0.23	0.047	7.03	-0.08	-0.06	
UA									•
UM									•
UP	7.0	6.5	6.8	0.25	0.059	6.77	-0.17	-0.15	
UQ									•
UY									•
VA	7.0	6.3	7.1	0.44	0.095	6.80	-0.16	-0.14	
VC									•
VH									•
VI	8.1	7.6	7.4	0.36	0.083	7.70	0.15	0.17	
VJ	9.0	9.0	9.5	0.29	0.059	9.17	0.66	0.68	
VO	5.4	8.3	5.1	1.77	0.378	6.27	-0.35	-0.32	
VT									•
W	7.7	7.0	6.6	0.56	0.130	7.10	-0.06	-0.03	
WE	6.3	5.5	5.2	0.57	0.130	5.67	-0.55	-0.53	
WH	8.2	8.9	7.9	0.51	0.118	8.33	0.37	0.39	
WJ									•
WN	10.6	10.3	11.5	0.62	0.142	10.80	1.22	1.25	
WO	5.0	4.2	5.2	0.53	0.118	4.80	-0.85	-0.83	
WP									•
WR	6.2	7.3	11.4	2.74	0.614	8.30	0.36	0.38	
WS									•
WW	6.5	6.2	4.7	0.96	0.213	5.80	-0.51	-0.48	
WX									•
X	5.8	6.2	5.2	0.50	0.118	5.73	-0.53	-0.51	
XB									•
XC									•
XD									•
XF	8.0	7.3	7.8	0.36	0.083	7.70	0.15	0.17	
XI	7.7	6.3	6.2	0.84	0.177	6.73	-0.18	-0.16	
XJ									•
XK									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 24-Jul-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XL	5.6	6.2	5.6	0.35	0.071	5.80	-0.51	-0.48	
XM	6.8	6.8	6.8	0.00	0.000	6.80	-0.16	-0.14	
XN	12.0	8.9	10.9	1.57	0.366	10.60	1.15	1.18	
XO									
XQ	5.6	4.0	8.8	2.44	0.567	6.13	-0.39	-0.37	
XR									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.20		**PG**	5.80		**JM**	7.13		**JE**
3.53		**BO**	5.80		**DH**	7.13		**DB**
3.67		**CO**	5.90		**CE**	7.17		**C**
3.93		**RK**	6.00		**OS**	7.17		**AF**
3.97		**MX**	6.10		**TW**	7.20		**RZ**
4.20		**NB**	6.10		**HK**	7.23		**BH**
4.43		**EX**	6.13		**XQ**	7.63		**DT**
4.43		**EV**	6.17		**SO**	7.67		**SL**
4.73		**HL**	6.17		**SM**	7.70		**XF**
4.80		**WO**	6.23		**RI**	7.70		**VI**
5.07		**QM**	6.23		**JQ**	7.80		**KH**
5.07		**L**	6.27		**VO**	7.80		**GZ**
5.10		**TQ**	6.27		**ID**	7.80		**BK**
5.10		**FJ**	6.33		**NJ**	7.83		**JP**
5.13		**RD**	6.33		**EO**	7.83		**Q**
5.13		**LR**	6.43		**BB**	7.87		**AH**
5.20		**N**	6.43		**LF**	7.90		**HI**
5.30		**I**	6.47		**OA**	7.93		**NA**
5.30		**FF**	6.47		**EB**	7.97		**JS**
5.33		**NH**	6.50		**P**	7.97		**A**
5.43		**EL**	6.57		**NP**	8.00		**FN**
5.43		**CJ**	6.60		**SI**	8.10		**MF**
5.43		**HP**	6.63		**BA**	8.10		**BC**
5.50		**T**	6.67		**QQ**	8.20		**RB**
5.53		**SZ**	6.73		**XI**	8.30		**WR**
5.53		**JN**	6.73		**PM**	8.30		**QT**
5.53		**FL**	6.77		**UP**	8.33		**WH**
5.67		**WE**	6.80		**VA**	8.37		**BM**
5.67		**TY**	6.80		**AL**	8.40		**KE**
5.73		**X**	6.80		**XM**	8.43		**AR**
5.73		**QZ**	6.83		**GQ**	8.63		**AU**
5.77		**BN**	6.90		**ER**	8.67		**AZ**
5.77		**R**	7.03		**U**	8.70		**AJ**
5.77		**CA**	7.03		**SN**	8.77		**BS**
5.80		**XL**	7.10		**W**	8.83		**KX**
5.80		**WW**	7.13		**SS**	8.87		**FE**

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

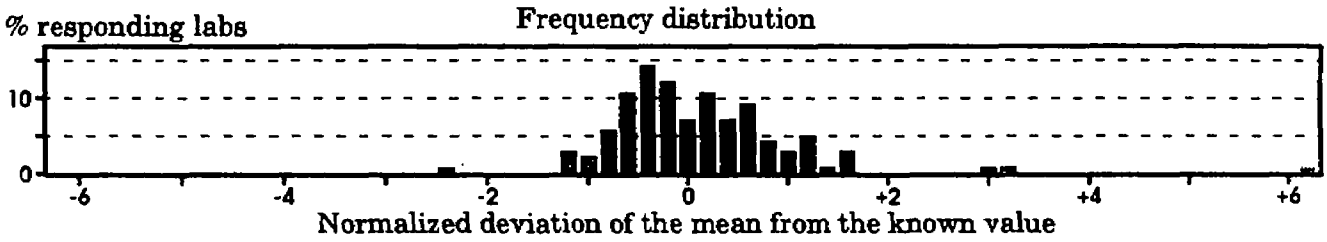
× ≡ Determined to be an outlier

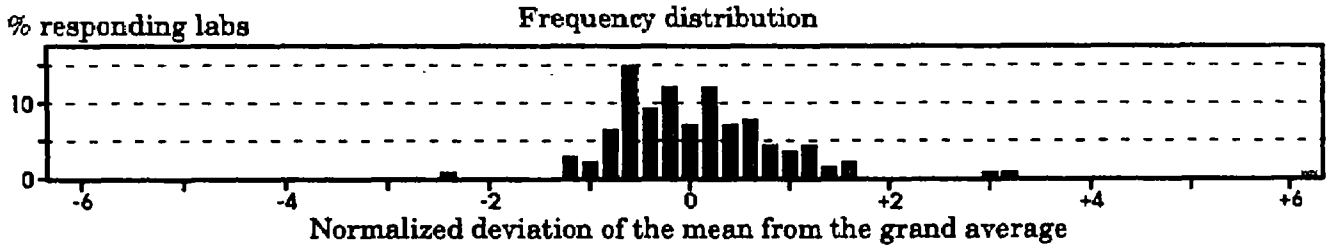
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
8.93		QX	9.50		KT	10.60		CP
9.00		OF	9.73		D	10.80		WN
9.03		AE	9.77		RG	10.80		SV
9.07		SD	9.90		TD	11.13		O
9.13		JY	9.97		OB	11.53		AW
9.17		VJ	10.20		QW	11.60		SG
9.17		SX	10.30		DO	11.73		DZ
9.17		E	10.43		TN	11.93		HE
9.37		S	10.47		QU	16.13	×	SU
9.40		DE	10.53		QP	16.30	×	BL
9.47		AK	10.60		XN	45.60	×	CX





• ≡ No data submitted
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TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
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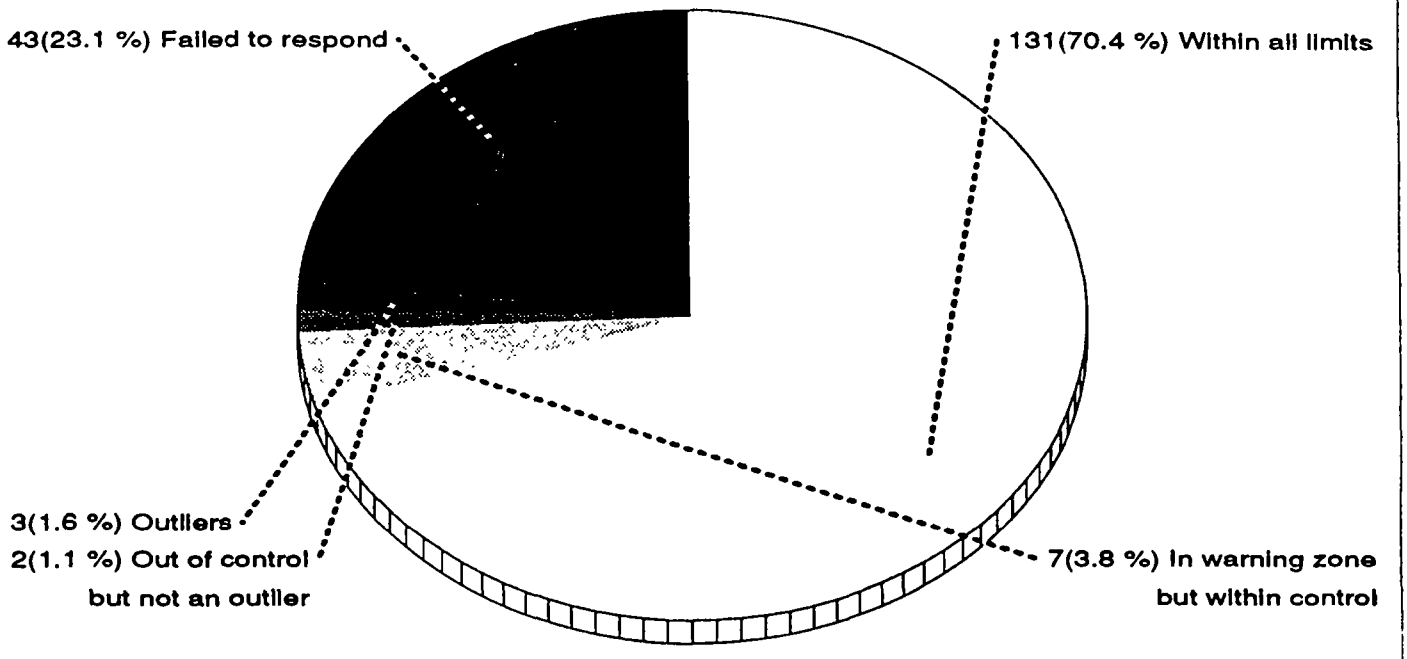
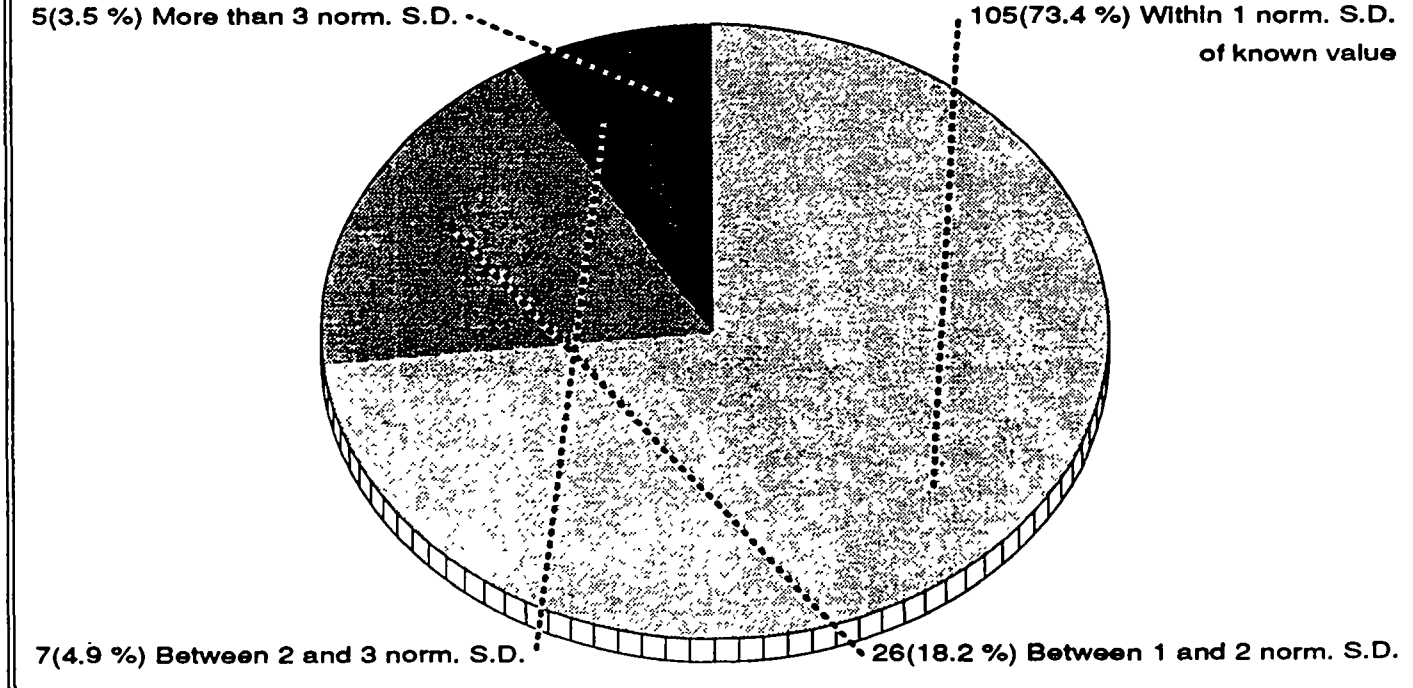
Gross Beta Statistical Summary 186 Participants

The known value of this nuclide is **12.8 pCi/l** with an expected precision of **5.0**; the control limits are 4.1 to 21.5; the warning regions are 4.1 to 7.0 and 18.6 to 21.5



Statistic	Respondents	Non-outliers
Mean	13.43	**Grand Avg 13.23**
Std. Dev.	3.93	2.84
Variance	15.44	8.07
% Coef. of Var.	29.26	21.48
% deviation of mean from known value	4.89	3.33
Norm. dev. of mean from known value	0.16	0.15
Median	13.23	13.23
% deviation of median from known value	3.39	3.39
Norm. dev. of median from known value	0.11	0.15



ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 24-Jul-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	12.5	12.5	11.5	0.58	0.118	12.17	-0.37	-0.22	
AE	12.1	10.5	11.3	0.80	0.189	11.30	-0.67	-0.52	
AF	13.2	12.6	11.1	1.08	0.248	12.30	-0.32	-0.17	
AH	16.6	16.6	15.9	0.40	0.083	16.37	1.09	1.24	
AJ	9.2	10.3	9.0	0.70	0.154	9.50	-1.29	-1.14	
AK	14.4	13.9	14.9	0.50	0.118	14.40	0.41	0.55	
AL	12.4	12.6	12.0	0.31	0.071	12.33	-0.31	-0.16	
AP									•
AR	15.0	16.0	17.4	1.21	0.284	16.13	1.01	1.15	
AU	13.0	12.8	12.5	0.25	0.059	12.77	-0.16	-0.01	
AW	15.7	16.7	17.1	0.72	0.165	16.50	1.13	1.28	
AZ	11.7	9.0	10.6	1.36	0.319	10.43	-0.97	-0.82	
BA	12.1	13.0	12.1	0.52	0.106	12.40	-0.29	-0.14	
BB	13.1	13.9	13.3	0.42	0.095	13.43	0.07	0.22	
BC	8.2	9.5	8.1	0.78	0.165	8.60	-1.60	-1.45	
BG									•
BH	11.3	12.1	12.1	0.46	0.095	11.83	-0.48	-0.33	
BK	13.0	13.8	15.5	1.28	0.295	14.10	0.30	0.45	
BL	15.5	16.8	15.1	0.89	0.201	15.80	0.89	1.04	
BM	12.3	14.5	12.8	1.15	0.260	13.20	-0.01	0.14	
BN	5.5	7.1	7.5	1.06	0.236	6.70	-2.26	-2.11	
BO	7.8	7.0	6.0	0.90	0.213	6.93	-2.18	-2.03	
BS	14.6	14.6	12.2	1.39	0.284	13.80	0.20	0.35	
C	13.0	12.6	12.5	0.26	0.059	12.70	-0.18	-0.03	
CA	12.2	12.8	12.2	0.35	0.071	12.40	-0.29	-0.14	
CC									•
CE	12.2	11.7	16.3	2.52	0.543	13.40	0.06	0.21	
CJ	17.0	14.0	13.0	2.08	0.473	14.67	0.50	0.65	
CO	8.2	6.5	8.3	1.01	0.213	7.67	-1.93	-1.78	
CP	40.6	33.1	45.9	6.43	1.975	39.87	9.23	9.38	×
CS									•
CX	13.2	11.2	10.5	1.40	0.319	11.63	-0.55	-0.40	
D	17.8	17.5	17.7	0.15	0.035	17.67	1.54	1.69	
DB	15.7	16.2	16.6	0.45	0.106	16.17	1.02	1.17	
DD									•
DE	13.3	13.6	13.6	0.17	0.035	13.50	0.09	0.24	
DH	12.2	14.6	15.7	1.79	0.413	14.17	0.33	0.47	
DO	14.0	11.0	13.0	1.53	0.354	12.67	-0.19	-0.05	
DR									•
DT	12.3	12.5	13.1	0.42	0.095	12.63	-0.21	-0.06	
DZ	17.3	16.9	20.0	1.69	0.366	18.07	1.68	1.82	
E	14.1	12.1	13.1	1.00	0.236	13.10	-0.04	0.10	
EB	12.4	11.3	12.0	0.56	0.130	11.90	-0.46	-0.31	
EL	12.4	12.9	11.9	0.50	0.118	12.40	-0.29	-0.14	
EO	18.0	13.0	12.0	3.21	0.709	14.33	0.38	0.53	

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
ER									•
EV	14.6	13.3	12.7	0.97	0.224	13.53	0.11	0.25	
EW	19.3	19.0	19.3	0.17	0.035	19.20	2.07	2.22	
EX	13.6	12.9	13.2	0.35	0.083	13.23	0.00	0.15	
FE	11.9	11.9	11.2	0.40	0.083	11.67	-0.54	-0.39	
FF	12.4	13.4	12.8	0.50	0.118	12.87	-0.12	0.02	
FJ									•
FL	15.6	14.2	9.9	2.97	0.673	13.23	0.00	0.15	
FN	7.0	8.0	7.0	0.58	0.118	7.33	-2.04	-1.89	
GQ	13.6	14.6	11.7	1.47	0.343	13.30	0.03	0.17	
GZ	11.8	12.4	12.7	0.46	0.106	12.30	-0.32	-0.17	
HE	13.6	15.2	14.9	0.85	0.189	14.57	0.46	0.61	
HI	15.7	13.0	13.2	1.50	0.319	13.97	0.26	0.40	
HK	10.7	14.4	15.4	2.48	0.555	13.50	0.09	0.24	
HL	13.6	12.6	11.9	0.85	0.201	12.70	-0.18	-0.03	
HP	9.1	11.4	10.8	1.19	0.272	10.43	-0.97	-0.82	
I	15.1	14.8	13.4	0.91	0.201	14.43	0.42	0.57	
ID	14.1	12.3	10.0	2.06	0.484	12.13	-0.38	-0.23	
J									•
JE	11.2	13.1	9.3	1.90	0.449	11.20	-0.70	-0.55	
JG									•
JM	14.6	14.3	13.5	0.57	0.130	14.13	0.31	0.46	
JN	9.3	9.6	9.8	0.25	0.059	9.57	-1.27	-1.12	
JP	13.8	14.7	13.9	0.49	0.106	14.13	0.31	0.46	
JQ	8.6	10.7	11.4	1.46	0.331	10.23	-1.04	-0.89	
JS	15.2	13.0	13.8	1.11	0.260	14.00	0.27	0.42	
JY	17.2	14.3	13.4	1.99	0.449	14.97	0.60	0.75	
K									•
KE	15.0	14.4	14.1	0.46	0.106	14.50	0.44	0.59	
KH	14.9	12.6	13.7	1.15	0.272	13.73	0.18	0.32	
KT	6.5	7.0	8.0	0.76	0.177	7.17	-2.10	-1.95	
KX	12.2	14.3	14.2	1.18	0.248	13.57	0.12	0.27	
L	14.7	12.1	15.0	1.59	0.343	13.93	0.25	0.39	
LE									•
LF	14.0	14.0	14.0	0.00	0.000	14.00	0.27	0.42	
LL									•
LR	16.2	16.5	17.0	0.40	0.095	16.57	1.16	1.30	
M									•
MF	13.7	15.0	14.5	0.66	0.154	14.40	0.41	0.55	
MT									•
MV									•
MX	11.3	12.1	11.7	0.40	0.095	11.70	-0.53	-0.38	
N	7.6	10.1	8.9	1.25	0.295	8.87	-1.51	-1.36	
NA	10.7	12.0	11.0	0.68	0.154	11.23	-0.69	-0.54	
NB	17.0	13.6	15.2	1.70	0.402	15.27	0.71	0.85	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 24-Jul-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NH	12.0	12.0	12.0	0.00	0.000	12.00	-0.42	-0.28	
NJ	13.5	13.5	12.3	0.69	0.142	13.10	-0.04	0.10	
NK									•
NO									•
NP	9.4	8.4	9.0	0.50	0.118	8.93	-1.49	-1.34	
O	14.1	14.7	15.2	0.55	0.130	14.67	0.50	0.65	
OA	29.0	26.0	28.0	1.53	0.354	27.67	5.00	5.15	×
OB	13.0	10.8	15.4	2.30	0.543	13.07	-0.06	0.09	
OF	10.6	11.2	11.5	0.46	0.106	11.10	-0.74	-0.59	
OS	13.0	13.0	14.0	0.58	0.118	13.33	0.04	0.18	
OT	16.3	17.2	15.2	1.00	0.236	16.23	1.04	1.19	
OY									•
P	13.0	18.5	17.0	2.84	0.650	16.17	1.02	1.17	
PB									•
PD	15.8	14.0	13.7	1.14	0.248	14.50	0.44	0.59	
PG	0.7	0.6	0.7	0.06	0.012	0.67	-4.35	-4.20	×
PM	15.2	14.9	15.4	0.25	0.059	15.17	0.67	0.82	
Q	15.8	14.0	16.7	1.37	0.319	15.50	0.79	0.94	
QM	7.0	6.8	7.0	0.12	0.024	6.93	-2.18	-2.03	
QP	8.0	7.6	8.7	0.56	0.130	8.10	-1.78	-1.63	
QQ	14.5	14.0	14.5	0.29	0.059	14.33	0.38	0.53	
QT	17.4	30.9	13.2	9.25	3.078	20.50	2.52	2.67	
QU	15.1	15.3	16.4	0.70	0.154	15.60	0.82	0.97	
QW	16.8	17.3	17.5	0.36	0.083	17.20	1.38	1.52	
QX	19.3	20.0	20.5	0.60	0.142	19.93	2.32	2.47	
QZ	11.3	12.5	11.8	0.60	0.142	11.87	-0.47	-0.32	
R	13.4	14.0	15.4	1.03	0.236	14.27	0.36	0.51	
RB	12.0	11.5	12.0	0.29	0.059	11.83	-0.48	-0.33	
RD	11.6	17.1	19.4	4.01	0.921	16.03	0.97	1.12	
RG	17.9	18.9	18.0	0.55	0.118	18.27	1.75	1.89	
RI	12.3	11.5	15.0	1.83	0.413	12.93	-0.10	0.05	
RK	12.4	13.7	11.7	1.01	0.236	12.60	-0.22	-0.07	
RR									•
RZ	13.0	12.9	14.3	0.78	0.165	13.40	0.06	0.21	
S	17.6	17.5	17.3	0.15	0.035	17.47	1.47	1.62	
SD	10.0	10.0	10.1	0.06	0.012	10.03	-1.11	-0.96	
SF									•
SG	17.9	15.6	13.5	2.20	0.520	15.67	0.85	0.99	
SI	15.1	11.2	13.8	1.99	0.461	13.37	0.05	0.20	
SL	11.9	12.1	11.0	0.59	0.130	11.67	-0.54	-0.39	
SM	10.1	9.8	11.0	0.62	0.142	10.30	-1.01	-0.87	
SN	14.4	14.0	13.2	0.61	0.142	13.87	0.22	0.37	
SO	12.1	12.0	11.1	0.55	0.118	11.73	-0.52	-0.37	
SR									•
SS	12.2	13.1	12.6	0.45	0.106	12.63	-0.21	-0.06	

• ≡ 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)	Normalized deviation (known)	Tag
SU	26.1	19.9	21.0	3.31	0.732	22.33	3.15	3.30	⇑
SV	14.2	13.7	14.1	0.26	0.059	14.00	0.27	0.42	
SX	16.2	20.6	14.5	3.15	0.721	17.10	1.34	1.49	
SZ	11.7	12.2	11.4	0.40	0.095	11.77	-0.51	-0.36	
T	13.1	11.5	12.2	0.80	0.189	12.27	-0.33	-0.18	
TD	15.0	17.7	16.1	1.36	0.319	16.27	1.05	1.20	
TL									•
TN	13.4	13.2	12.0	0.76	0.165	12.87	-0.12	0.02	
TO									•
TQ	12.4	12.9	12.5	0.26	0.059	12.60	-0.22	-0.07	
TW	12.3	9.9	10.0	1.36	0.284	10.73	-0.86	-0.72	
TX									•
TY	12.1	11.7	11.9	0.20	0.047	11.90	-0.46	-0.31	
U	12.3	11.8	12.1	0.25	0.059	12.07	-0.40	-0.25	
UA									•
UM									•
UP	14.5	11.2	12.4	1.67	0.390	12.70	-0.18	-0.03	
UQ									•
UY	10.3	11.3	11.1	0.53	0.118	10.90	-0.81	-0.66	
VA	9.2	8.7	7.2	1.04	0.236	8.37	-1.68	-1.54	
VC									•
VH									•
VI	15.6	14.2	14.1	0.84	0.177	14.63	0.49	0.64	
VJ	17.5	13.5	11.8	2.93	0.673	14.27	0.36	0.51	
VO	14.1	19.4	9.8	4.81	1.255	14.43	0.42	0.57	
VT									•
W	13.7	13.8	12.2	0.90	0.189	13.23	0.00	0.15	
WE	16.1	13.9	15.2	1.11	0.260	15.07	0.64	0.79	
WH	17.6	13.7	14.7	2.03	0.461	15.33	0.73	0.88	
WJ									•
WN	4.5	4.9	5.2	0.35	0.083	4.87	-2.90	-2.75	
WO	17.0	11.5	13.0	2.84	0.650	13.83	0.21	0.36	
WP									•
WR	11.2	11.7	18.1	3.85	0.815	13.67	0.15	0.30	
WS									•
WW	12.6	11.0	10.8	0.99	0.213	11.47	-0.61	-0.46	
WX									•
X	13.0	11.2	13.4	1.17	0.260	12.53	-0.24	-0.09	
XB									•
XC									•
XD									•
XF	14.6	13.8	13.3	0.66	0.154	13.90	0.23	0.38	
XI	12.0	11.0	12.0	0.58	0.118	11.67	-0.54	-0.39	
XJ									•
XK									•

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 24-Jul-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XL	13.7	16.4	13.7	1.56	0.319	14.60	0.48	0.62	
XM	16.4	11.6	8.9	3.80	0.886	12.30	-0.32	-0.17	
XN	12.9	12.1	10.2	1.39	0.319	11.73	-0.52	-0.37	
XO									•
XQ	2.8	10.2	53.9	27.62	10.594	22.30	3.14	3.29	⇑
XR									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.67	×	PG	11.83		BH	13.30		GQ
4.87		WN	11.87		QZ	13.33		OS
6.70		BN	11.90		TY	13.37		SI
6.93		QM	11.90		EB	13.40		RZ
6.93		BO	12.00		NH	13.40		CE
7.17		KT	12.07		U	13.43		BB
7.33		FN	12.13		ID	13.50		HK
7.67		CO	12.17		A	13.50		DE
8.10		QP	12.27		T	13.53		EV
8.37		VA	12.30		XM	13.57		KX
8.60		BC	12.30		GZ	13.67		WR
8.87		N	12.30		AF	13.73		KH
8.93		NP	12.33		AL	13.80		BS
9.50		AJ	12.40		EL	13.83		WO
9.57		JN	12.40		CA	13.87		SN
10.03		SD	12.40		BA	13.90		XF
10.23		JQ	12.53		X	13.93		L
10.30		SM	12.60		TQ	13.97		HI
10.43		HP	12.60		RK	14.00		SV
10.43		AZ	12.63		SS	14.00		LF
10.73		TW	12.63		DT	14.00		JS
10.90		UY	12.67		DO	14.10		BK
11.10		OF	12.70		UP	14.13		JP
11.20		JE	12.70		HL	14.13		JM
11.23		NA	12.70		C	14.17		DH
11.30		AE	12.77		AU	14.27		VJ
11.47		WW	12.87		TN	14.27		R
11.63		CX	12.87		FF	14.33		QQ
11.67		XI	12.93		RI	14.33		EO
11.67		SL	13.07		OB	14.40		MF
11.67		FE	13.10		NJ	14.40		AK
11.70		MX	13.10		E	14.43		VO
11.73		XN	13.20		BM	14.43		I
11.73		SO	13.23		W	14.50		PD
11.77		SZ	13.23		FL	14.50		KE
11.83		RB	13.23		EX	14.57		HE

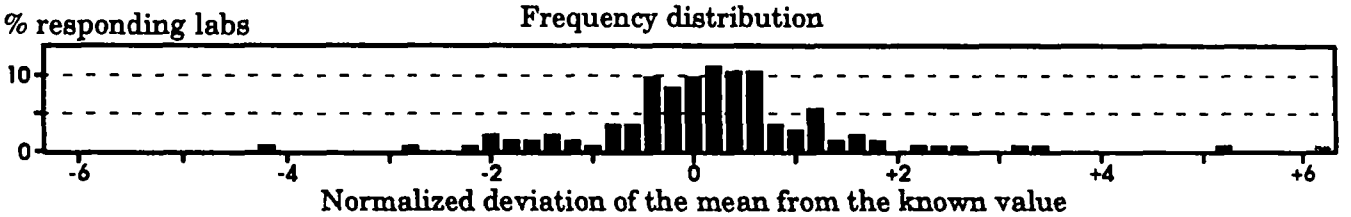
TAG SYMBOLS

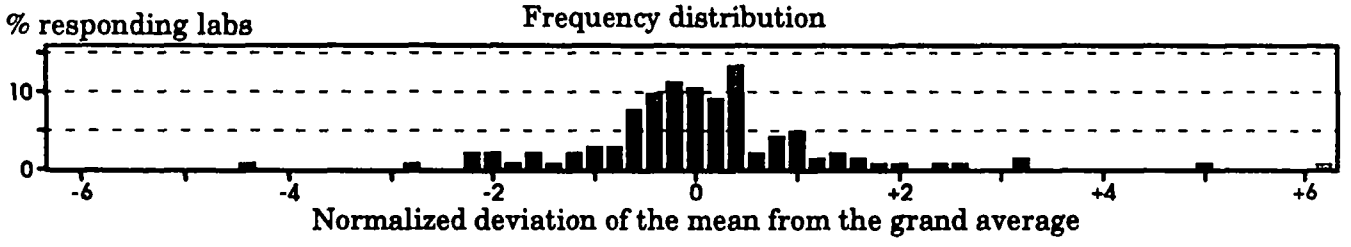
• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
14.60		XL	15.67		SG	17.20		QW
14.63		VI	15.80		BL	17.47		S
14.67		O	16.03		RD	17.67		D
14.67		CJ	16.13		AR	18.07		DZ
14.97		JY	16.17		P	18.27		RG
15.07		WE	16.17		DB	19.20		EW
15.17		PM	16.23		OT	19.93		QX
15.27		NB	16.27		TD	20.50		QT
15.33		WH	16.37		AH	22.30	⇑	XQ
15.50		Q	16.50		AW	22.33	⇑	SU
15.60		QU	16.57		LR	27.67	×	OA
			17.10		SX	39.87	×	CP





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United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

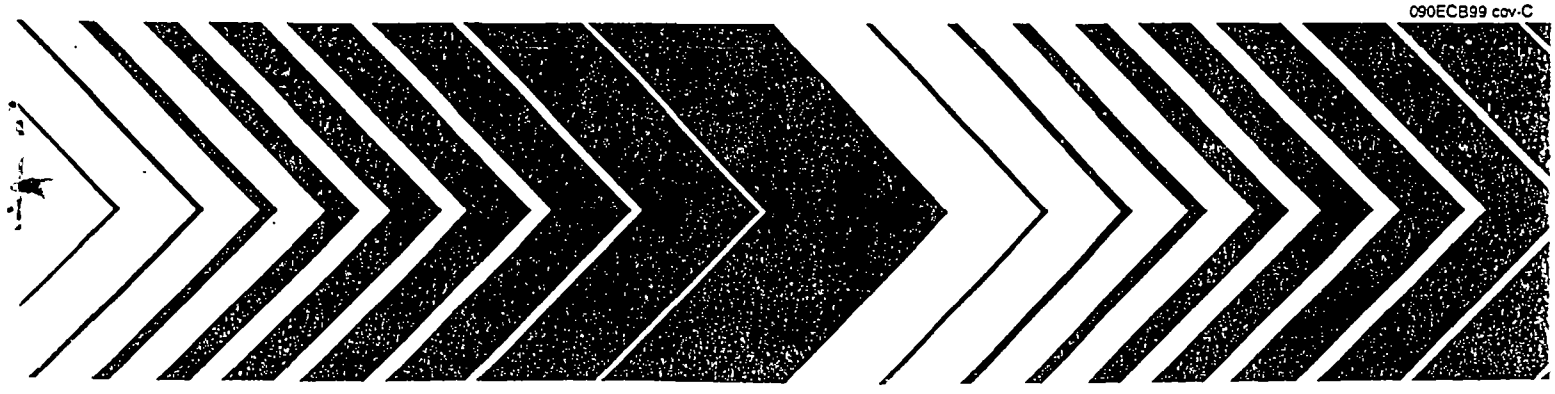
EPA 600/R-98/177
December 1999

EPA

Tritium in Water Performance Evaluation Study

A Statistical Evaluation of the August 7, 1998 Data

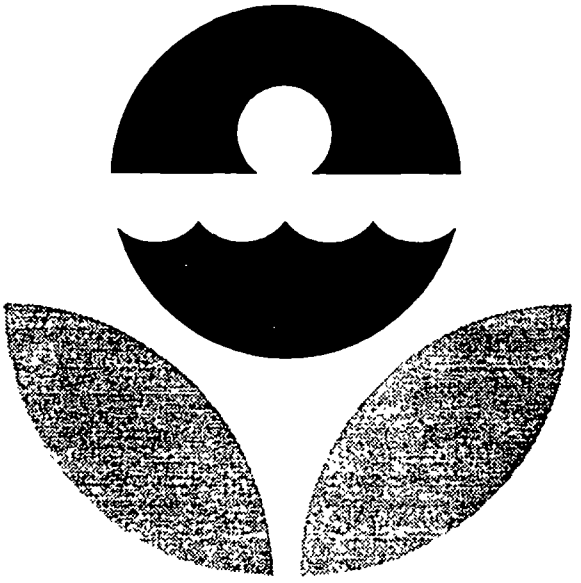
090ECB99 cov-C



Tritium in Water

Performance Evaluation Study

August 7, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Tritium in Water; August 7, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

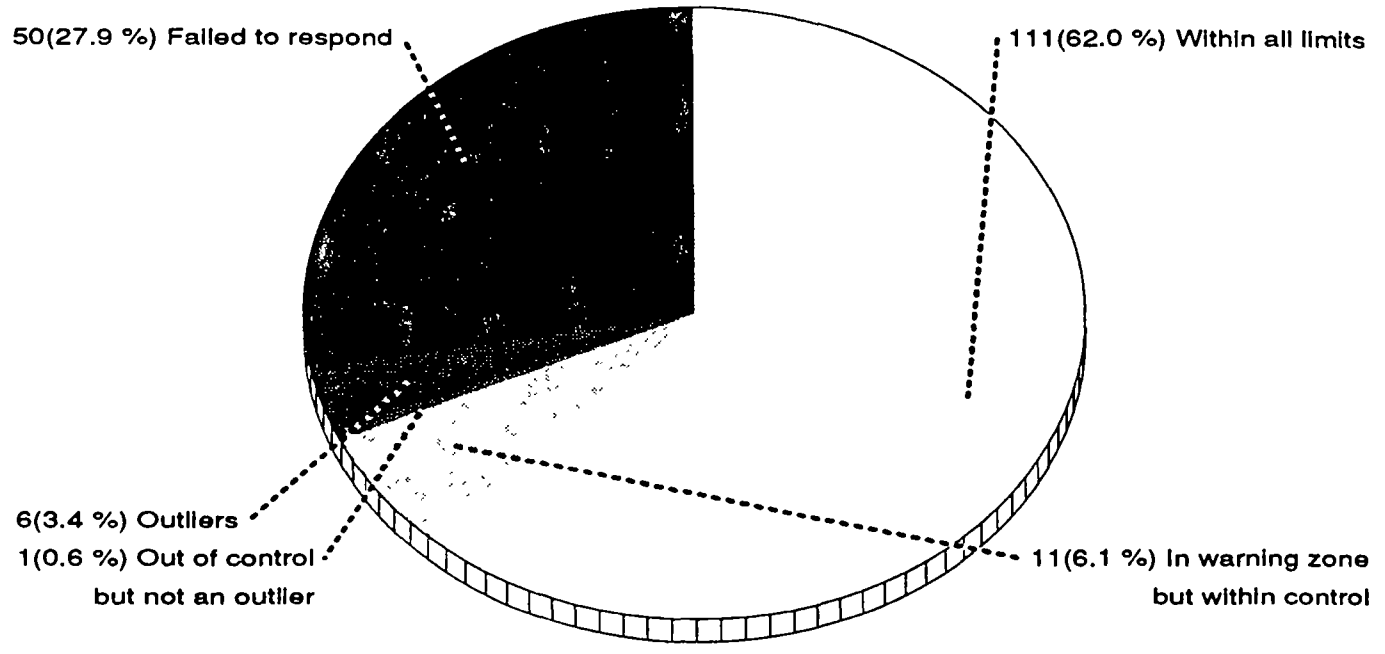
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

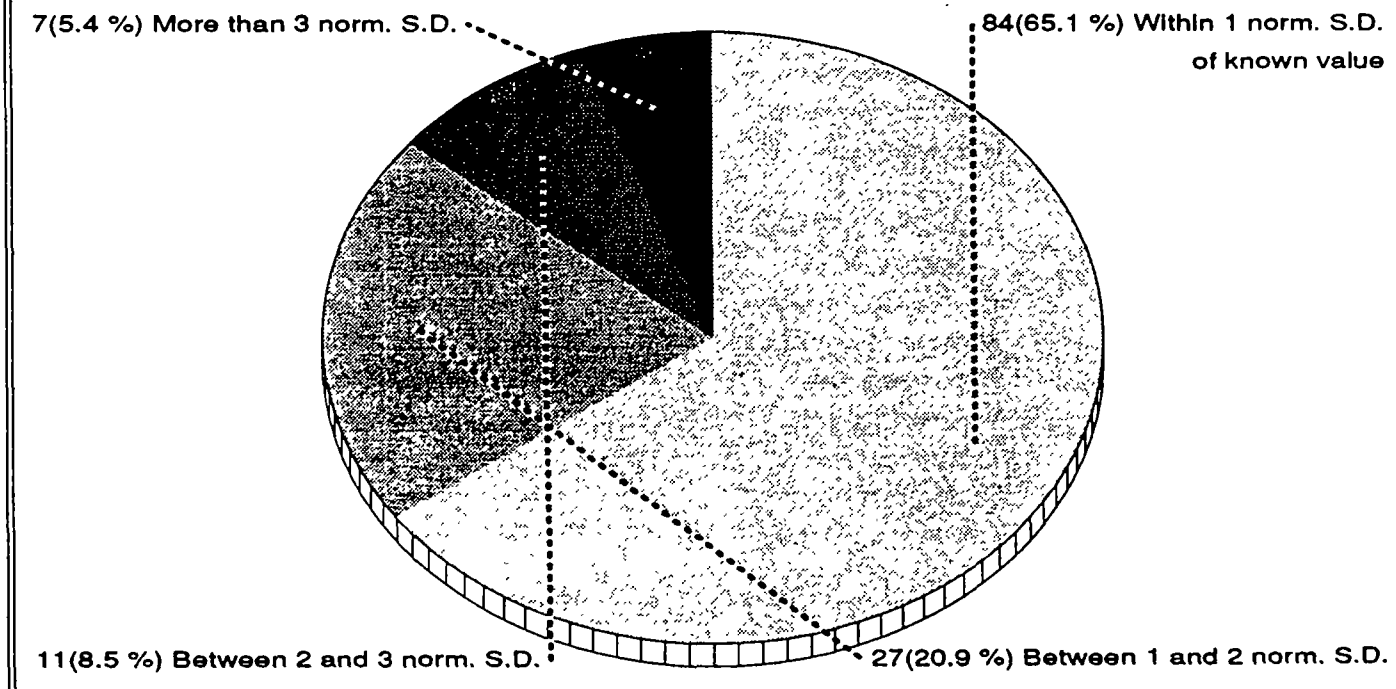
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Tritium Statistical Summary 179 Participants

The known value of this nuclide is **17996 pCi/l** with an expected precision of **1800.0**; the control limits are 14873.1 to 21118.9; the warning regions are 14873.1 to 15912.3 and 20079.7 to 21118.9



Statistic	Respondents	Non-outliers
Mean	17513.72	**Grand Avg 17874.29**
Std. Dev.	2979.77	1189.17
Variance	8879039.55	1414119.30
% Coef. of Var.	17.01	6.65
% deviation of mean from known value	-2.68	-0.68
Norm. dev. of mean from known value	-0.16	-0.10
Median	17800.33	17833.33
% deviation of median from known value	-1.09	-0.90
Norm. dev. of median from known value	-0.07	-0.14



ESD-LV Performance Evaluation: Tritium in Water, 7-Aug-1998

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	17810.0	17920.0	17960.0	77.66	0.049	17896.67	0.02	-0.10	
AE	17830.0	17574.0	17467.0	186.57	0.119	17623.67	-0.24	-0.36	
AF	18174.0	18405.0	18095.0	161.09	0.102	18224.67	0.34	0.22	
AH	17100.0	17700.0	17700.0	346.42	0.197	17500.00	-0.36	-0.48	
AI	18600.0	18960.0	19000.0	220.30	0.131	18853.33	0.94	0.82	
AJ	17489.0	17261.0	17166.0	165.98	0.106	17305.33	-0.55	-0.66	
AK	15680.0	15001.0	15333.0	339.52	0.223	15338.00	-2.44	-2.56	
AP									•
AU	16600.0	16800.0	16800.0	115.47	0.066	16733.33	-1.10	-1.22	
AW	18297.0	18016.0	18106.0	143.46	0.092	18139.67	0.26	0.14	
AY	17895.0	17959.0	18512.0	339.28	0.202	18122.00	0.24	0.12	
AZ									•
BA	18121.0	19190.0	19053.0	581.67	0.351	18788.00	0.88	0.76	
BB	17.0	18.0	19.0	1.00	0.001	18.00	-17.18	-17.30	×
BC	16573.0	16513.0	16874.0	193.47	0.118	16653.33	-1.17	-1.29	
BG									•
BL	17889.0	18018.0	17792.0	113.37	0.074	17899.67	0.02	-0.09	
BM	17650.0	17340.0	17600.0	166.40	0.102	17530.00	-0.33	-0.45	
BO	17100.0	17100.0	17500.0	230.96	0.131	17233.33	-0.62	-0.73	
C	20183.0	19534.0	19318.0	450.17	0.284	19678.33	1.74	1.62	
CA	17699.0	17761.0	17736.0	31.11	0.020	17732.00	-0.14	-0.25	
CC	14322.0	11626.0	13007.0	1348.13	0.885	12985.00	-4.70	-4.82	×
CE	17110.0	18000.0	16830.0	610.94	0.384	17313.33	-0.54	-0.66	
CJ	16000.0	16000.0	16000.0	0.00	0.000	16000.00	-1.80	-1.92	
CO	17100.0	16700.0	17100.0	230.96	0.131	16966.67	-0.87	-0.99	
CP	16755.0	16353.0	16554.0	200.98	0.132	16554.00	-1.27	-1.39	
CS	18778.0	18873.0	18993.0	107.77	0.071	18881.33	0.97	0.85	
CX	18400.0	18800.0	18100.0	351.18	0.230	18433.33	0.54	0.42	
D	17311.0	17497.0	17262.0	124.00	0.077	17356.67	-0.50	-0.62	
DD									•
DE	17916.0	17936.0	17956.0	20.40	0.013	17936.00	0.06	-0.06	
DH	18075.0	17944.0	17583.0	254.81	0.161	17867.33	-0.01	-0.12	
DI									•
DR									•
DT	18100.0	17700.0	18300.0	305.52	0.197	18033.33	0.15	0.04	
DY									•
E	17370.0	17429.0	17251.0	90.74	0.058	17350.00	-0.50	-0.62	
EA									•
EB	18062.0	17953.0	17236.0	448.74	0.271	17750.33	-0.12	-0.24	
EH	16300.0	16500.0	16900.0	305.52	0.197	16566.67	-1.26	-1.38	
EL	17660.0	17550.0	17450.0	105.06	0.069	17553.33	-0.31	-0.43	
EW	18600.0	19000.0	18790.0	200.12	0.131	18796.67	0.89	0.77	
EX	18758.0	18690.0	18753.0	38.05	0.022	18733.67	0.83	0.71	
FE	18290.0	18080.0	18230.0	108.22	0.069	18200.00	0.31	0.20	
FJ	19800.0	20600.0	20600.0	461.91	0.263	20333.33	2.37	2.25	

• ≡ 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
FL	17838.0	17937.0	17725.0	106.12	0.070	17833.33	-0.04	-0.16	
GO									
GQ									
HI	18088.0	17998.0	17775.0	161.18	0.103	17953.67	0.08	-0.04	
HK	17657.0	17604.0	17222.0	237.36	0.143	17494.33	-0.37	-0.48	
HP									
HR	19510.0	19248.0	19453.0	137.83	0.086	19403.67	1.47	1.35	
I	16807.0	16963.0	16968.0	91.56	0.053	16912.67	-0.93	-1.04	
IA									
IU									
J									
JE	15911.0	16950.0	15792.0	637.00	0.380	16217.67	-1.59	-1.71	
JK	15570.0	14194.0	16393.0	1111.02	0.722	15385.67	-2.39	-2.51	
JM	18389.0	17807.0	18301.0	313.74	0.191	18165.67	0.28	0.16	
JN	20089.0	20093.0	19931.0	92.35	0.053	20037.67	2.08	1.96	
JP	17410.0	18095.0	17896.0	352.40	0.225	17800.33	-0.07	-0.19	
JR									
JS	19723.0	19073.0	19622.0	349.76	0.213	19472.67	1.54	1.42	
JY	17200.0	17500.0	17900.0	351.21	0.230	17533.33	-0.33	-0.45	
K	17400.0	17613.0	17369.0	132.78	0.080	17460.67	-0.40	-0.52	
KH	18000.0	18400.0	18200.0	200.00	0.131	18200.00	0.31	0.20	
KM	18919.0	18695.0	18992.0	154.81	0.097	18868.67	0.96	0.84	
KX	5710.0	5730.0	5720.0	10.00	0.007	5720.00	-11.70	-11.81	×
L	17686.0	17622.0	17811.0	96.17	0.062	17706.33	-0.16	-0.28	
LE									
LF	19000.0	19000.0	19000.0	5.66	0.000	19000.00	1.08	0.97	
LR	14917.0	17123.0	16270.0	1112.41	0.724	16103.33	-1.70	-1.82	
M	16828.0	16416.0	16702.0	211.09	0.135	16648.67	-1.18	-1.30	
MN	18000.0	18600.0	18800.0	416.33	0.263	18466.67	0.57	0.45	
MT	17602.0	17607.0	17597.0	5.10	0.003	17602.00	-0.26	-0.38	
MV	17746.0	17259.0	18075.0	410.53	0.268	17693.33	-0.17	-0.29	
N	18144.0	18283.0	18307.0	88.00	0.053	18244.67	0.36	0.24	
NB	20037.0	20080.0	20000.0	39.88	0.026	20039.00	2.08	1.97	
NH	17863.0	18067.0	18044.0	111.78	0.067	17991.33	0.11	0.00	
NJ	15835.0	15432.0	15700.0	205.15	0.132	15655.67	-2.13	-2.25	
NK									
NO									
NP	18326.0	18380.0	17991.0	210.77	0.128	18232.33	0.34	0.23	
O	18022.0	17534.0	17793.0	244.18	0.160	17783.00	-0.09	-0.20	
OA	17800.0	17300.0	17700.0	264.61	0.164	17600.00	-0.26	-0.38	
OK									
OM	19600.0	18000.0	19000.0	808.29	0.525	18866.67	0.95	0.84	
OT	18400.0	17600.0	19000.0	702.38	0.459	18333.33	0.44	0.32	
OX	17695.0	17584.0	17724.0	73.84	0.046	17667.67	-0.20	-0.32	
PB	17955.0	17597.0	17877.0	188.24	0.117	17809.67	-0.06	-0.18	

TAG SYMBOLS

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

ESD-LV Performance Evaluation: Tritium in Water, 7-Aug-1998

Tritium

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
PD	18966.0	19088.0	19232.0	133.20	0.087	19095.33	1.17	1.06	
PE									•
PM	18540.0	18169.0	18420.0	189.29	0.122	18376.33	0.48	0.37	
Q	18751.0	18556.0	18784.0	123.18	0.075	18697.00	0.79	0.67	
QC	17900.0	17600.0	17500.0	208.21	0.131	17666.67	-0.20	-0.32	
QD	18292.0	17827.0	17959.0	239.62	0.153	18026.00	0.15	0.03	
QI	16468.0	17086.0	17022.0	339.82	0.203	16858.67	-0.98	-1.09	
QM	15721.0	16581.0	16765.0	557.29	0.343	16355.67	-1.46	-1.58	
QP	20337.0	20808.0	21021.0	350.03	0.224	20722.00	2.74	2.62	
QQ	21261.0	20063.0	18827.0	1217.06	0.799	20050.33	2.09	1.98	
QT	20761.0	20387.0	20493.0	192.80	0.123	20547.00	2.57	2.45	
QU	18512.0	17513.0	18666.0	625.99	0.378	18230.33	0.34	0.23	
QW	18066.0	17592.0	17256.0	406.95	0.266	17638.00	-0.23	-0.34	
QX	12001.0	12478.0	12445.0	266.37	0.157	12308.00	-5.36	-5.47	×
QZ	17380.0	17810.0	17230.0	301.03	0.190	17473.33	-0.39	-0.50	
R	17345.0	17417.0	17326.0	47.89	0.030	17362.67	-0.49	-0.61	
RB	17300.0	17400.0	17800.0	264.56	0.164	17500.00	-0.36	-0.48	
RK	1.0	1.0	1.0	0.00	0.000	1.00	-17.20	-17.32	×
RO	18370.0	18361.0	17105.0	727.76	0.415	17945.33	0.07	-0.05	
RR									•
RU									•
RX									•
S	17758.0	17679.0	17613.0	72.55	0.048	17683.33	-0.18	-0.30	
SD	20700.0	20900.0	20100.0	416.30	0.263	20566.67	2.59	2.47	
SF									•
SI	17900.0	17700.0	17900.0	115.50	0.066	17833.33	-0.04	-0.16	
SM	15900.0	16900.0	16580.0	510.69	0.328	16460.00	-1.36	-1.48	
SN	18000.0	17000.0	17000.0	577.35	0.328	17333.33	-0.52	-0.64	
SS	17900.0	17600.0	18000.0	208.15	0.131	17833.33	-0.04	-0.16	
SU	15933.0	15840.0	16036.0	97.98	0.064	15936.33	-1.86	-1.98	
SV									•
SZ	17600.0	18400.0	18500.0	493.28	0.295	18166.67	0.28	0.16	
T	16854.0	16483.0	16593.0	190.53	0.122	16643.33	-1.18	-1.30	
TA									•
TC	17227.0	17342.0	17582.0	181.13	0.116	17383.67	-0.47	-0.59	
TD									•
TF									•
TL									•
TN	19151.0	19381.0	18941.0	220.11	0.144	19157.67	1.23	1.12	
TQ									•
TU	28800.0	29900.0	30400.0	818.57	0.525	29700.00	11.38	11.26	×
TX									•
U	18700.0	18100.0	18600.0	321.48	0.197	18466.67	0.57	0.45	
UC									•
UI									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

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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)	Normalized deviation (known)	Tag
UK									•
UM									•
UP	17686.0	17967.0	18581.0	457.71	0.294	18078.00	0.20	0.08	
UT									•
UX	18100.0	18257.0	18129.0	83.49	0.052	18162.00	0.28	0.16	
UY									•
VA	21433.0	20219.0	19043.0	1195.05	0.784	20231.67	2.27	2.15	
VC	17400.0	17600.0	17500.0	99.96	0.066	17500.00	-0.36	-0.48	
VE									•
VI	14900.0	14300.0	14700.0	305.52	0.197	14633.33	-3.12	-3.24	⇓
VM	18401.0	17780.0	18078.0	310.57	0.204	18086.33	0.20	0.09	
VN									•
VP	17800.0	18300.0	18800.0	499.99	0.328	18300.00	0.41	0.29	
VR	17082.0	19027.0	19178.0	1168.98	0.688	18429.00	0.53	0.42	
VW	16536.0	15864.0	16031.0	349.88	0.221	16143.67	-1.67	-1.78	
VZ									•
W	18280.0	17670.0	17950.0	305.36	0.200	17966.67	0.09	-0.03	
WD	17435.0	17262.0	17537.0	138.97	0.090	17411.33	-0.45	-0.56	
WH	20478.0	21019.0	20789.0	271.55	0.178	20762.00	2.78	2.66	
WJ									•
WO	14700.0	15200.0	15500.0	404.16	0.263	15133.33	-2.64	-2.75	
WP	20386.0	20572.0	20554.0	102.61	0.061	20504.00	2.53	2.41	
WR	18340.0	18594.0	19015.0	340.92	0.222	18649.67	0.75	0.63	
WS	17890.0	18750.0	17640.0	582.26	0.364	18093.33	0.21	0.09	
WT									•
WV	17600.0	17400.0	17400.0	115.47	0.066	17466.67	-0.39	-0.51	
WW	19835.0	19592.0	19914.0	167.73	0.106	19780.33	1.83	1.72	
WX									•
WZ	16972.0	17322.0	17428.0	238.63	0.150	17240.67	-0.61	-0.73	
X	17900.0	18200.0	17700.0	251.69	0.164	17933.33	0.06	-0.06	
XB	16700.0	18000.0	16500.0	814.46	0.492	17066.67	-0.78	-0.89	
XC	17114.0	17157.0	17165.0	27.66	0.017	17145.33	-0.70	-0.82	
XD									•
XE									•
XF	17770.0	17330.0	18170.0	420.15	0.276	17756.67	-0.11	-0.23	
XG	18770.0	18730.0	19100.0	203.07	0.121	18866.67	0.95	0.84	
XH	13502.0	17414.0	17696.0	2344.25	1.717	16204.00	-1.61	-1.72	
XI	17000.0	16000.0	16500.0	499.99	0.328	16500.00	-1.32	-1.44	
XK									•
XM	15848.0	16449.0	16972.0	562.44	0.369	16423.00	-1.40	-1.51	
XO									•
XQ									•
XR									•
Y									•

• ≡ 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
1.00	×	RK	17473.33		QZ	18165.67		JM
18.00	×	BB	17494.33		HK	18166.67		SZ
5720.00	×	KX	17500.00		VC	18200.00		KH
12308.00	×	QX	17500.00		RB	18200.00		FE
12985.00	×	CC	17500.00		AH	18224.67		AF
14633.33	⇓	VI	17530.00		BM	18230.33		QU
15133.33		WO	17533.33		JY	18232.33		NP
15338.00		AK	17553.33		EL	18244.67		N
15385.67		JK	17600.00		OA	18300.00		VP
15655.67		NJ	17602.00		MT	18333.33		OT
15936.33		SU	17623.67		AE	18376.33		PM
16000.00		CJ	17638.00		QW	18429.00		VR
16103.33		LR	17666.67		QC	18433.33		CX
16143.67		VW	17667.67		OX	18466.67		U
16204.00		XH	17683.33		S	18466.67		MN
16217.67		JE	17693.33		MV	18649.67		WR
16355.67		QM	17706.33		L	18697.00		Q
16423.00		XM	17732.00		CA	18733.67		EX
16460.00		SM	17750.33		EB	18788.00		BA
16500.00		XI	17756.67		XF	18796.67		EW
16554.00		CP	17783.00		O	18853.33		AI
16566.67		EH	17800.33		JP	18866.67		XG
16643.33		T	17809.67		PB	18866.67		OM
16648.67		M	17833.33		SS	18868.67		KM
16653.33		BC	17833.33		SI	18881.33		CS
16733.33		AU	17833.33		FL	19000.00		LF
16858.67		QI	17867.33		DH	19095.33		PD
16912.67		I	17896.67		A	19157.67		TN
16966.67		CO	17899.67		BL	19403.67		HR
17066.67		XB	17933.33		X	19472.67		JS
17145.33		XC	17936.00		DE	19678.33		C
17233.33		BO	17945.33		RO	19780.33		WW
17240.67		WZ	17953.67		HI	20037.67		JN
17305.33		AJ	17966.67		W	20039.00		NB
17313.33		CE	17991.33		NH	20050.33		QQ
17333.33		SN	18026.00		QD	20231.67		VA
17350.00		E	18033.33		DT	20333.33		FJ
17356.67		D	18078.00		UP	20504.00		WP
17362.67		R	18086.33		VM	20547.00		QT
17383.67		TC	18093.33		WS	20566.67		SD
17411.33		WD	18122.00		AY	20722.00		QP
17460.67		K	18139.67		AW	20762.00		WH
17466.67		WV	18162.00		UX	29700.00	×	TU

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ Determined to be an outlier
⇑ ≡ Above control limit
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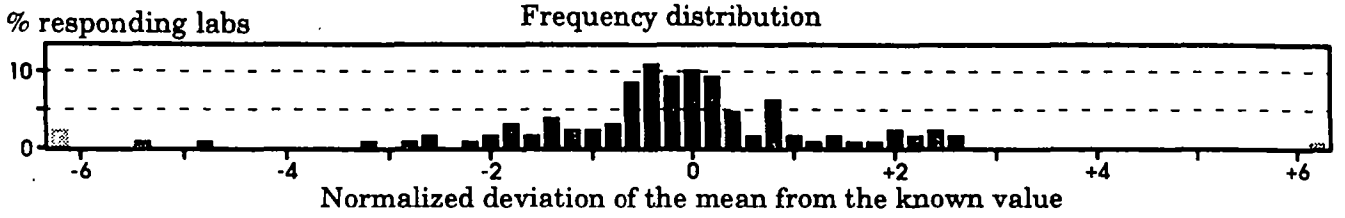
Tritium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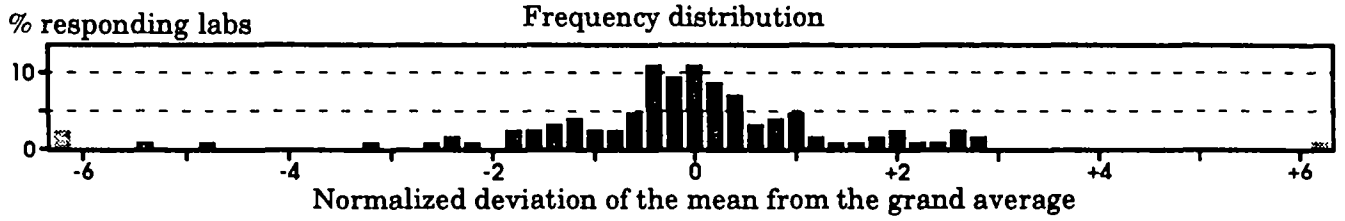
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the known value


% 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

Office of Research and
Development
Washington, DC 20460

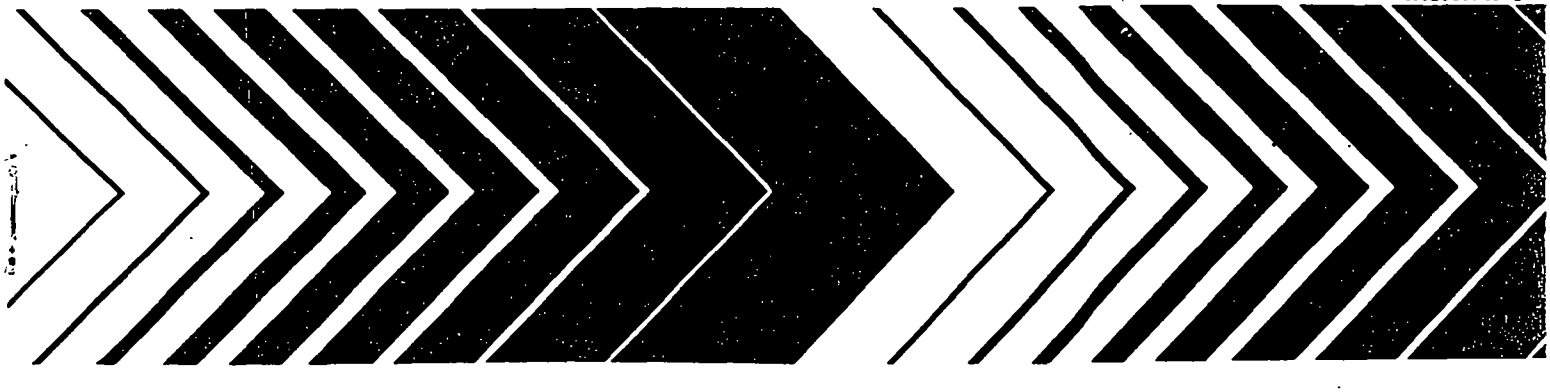
EPA 600/R-98/176
December 1998

EPA

Iodine in Water Performance Evaluation Study

A Statistical Evaluation of the September 11, 1998 Data

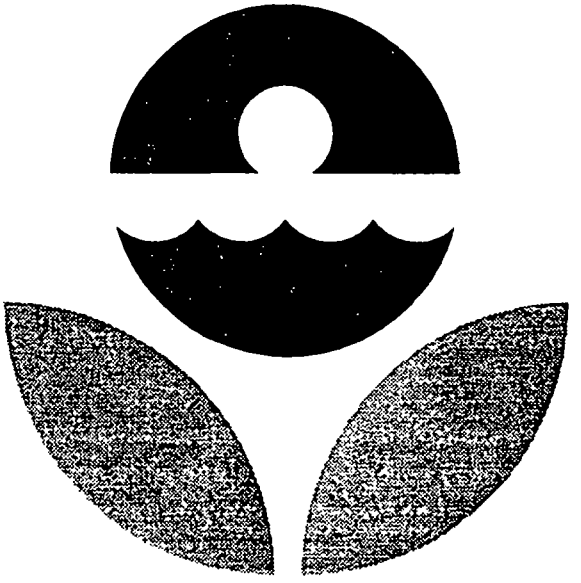
090ECB99 cov-D



Iodine in Water

Performance Evaluation Study

September 11, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Iodine in Water; September 11, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pla at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia

Stephen Pia
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.

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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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

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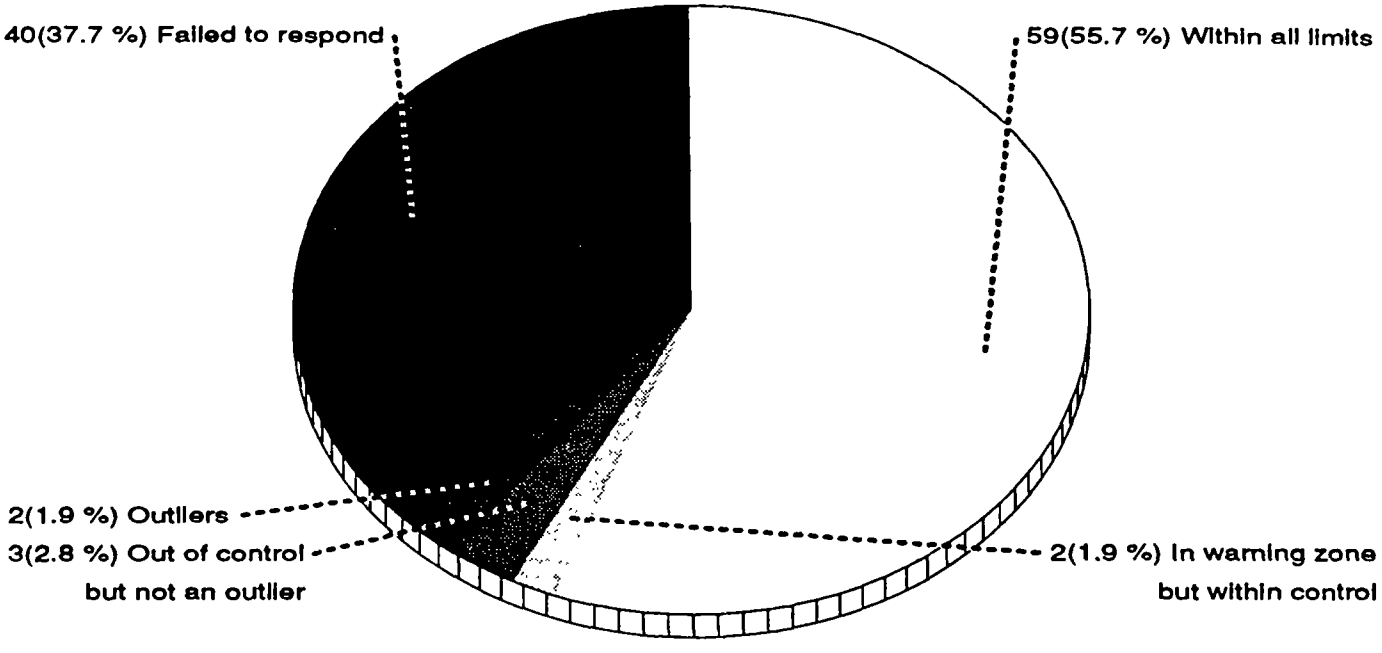
The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three 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.

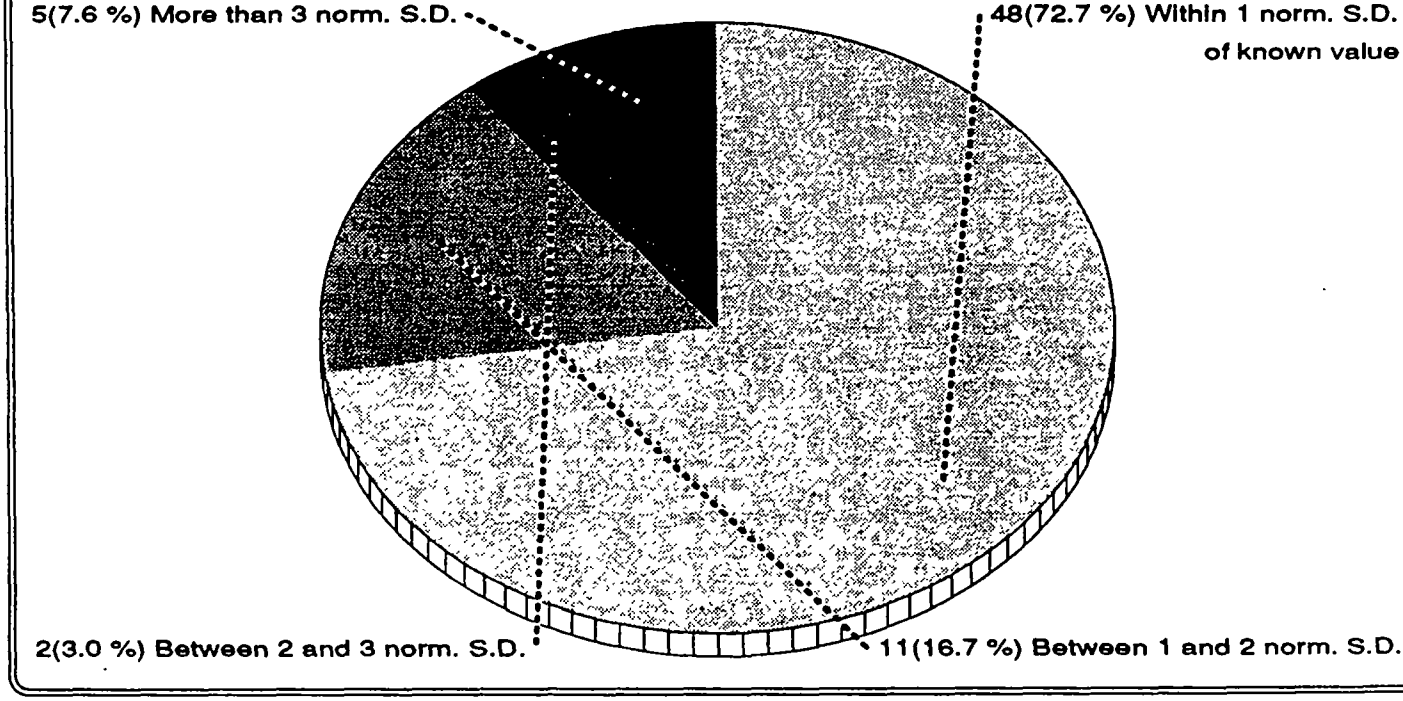
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Iodine-131 Statistical Summary 106 Participants

The known value of this nuclide is **6.1 pCi/l** with an expected precision of **2.0**; the control limits are 2.6 to 9.6; the warning regions are 2.6 to 3.8 and 8.4 to 9.6



Statistic	Respondents	Non-outliers
Mean	6.91	**Grand Avg 6.70**
Std. Dev.	1.69	1.17
Variance	2.87	1.38
% Coef. of Var.	24.50	17.55
% deviation of mean from known value	13.28	9.77
Norm. dev. of mean from known value	0.48	0.51
Median	6.48	6.43
% deviation of median from known value	6.28	5.46
Norm. dev. of median from known value	0.23	0.28



ESD-LV Performance Evaluation: Iodine in Water, 11-Sep-1998

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	6.5	6.1	5.7	0.40	0.236	6.10	-0.52	0.00	
AF	7.2	6.1	6.0	0.67	0.354	6.43	-0.23	0.29	
AJ	7.4	11.1	3.6	3.75	3.314	7.37	0.58	1.10	
AK	7.9	9.1	7.2	0.96	0.561	8.07	1.19	1.70	
AL	5.2	6.7	5.1	0.90	0.473	5.67	-0.89	-0.38	
AP									•
AU									•
AW	5.9	5.9	6.2	0.17	0.089	6.00	-0.60	-0.09	
AY	9.2	11.4	9.4	1.22	0.650	10.00	2.86	3.38	⇑
AZ	6.4	4.0	4.9	1.21	0.709	5.10	-1.38	-0.87	
BA	7.7	4.9	6.0	1.41	0.827	6.20	-0.43	0.09	
BC									•
BH	7.4	8.3	7.1	0.62	0.354	7.60	0.78	1.30	
BK	6.9	7.1	8.5	0.87	0.473	7.50	0.70	1.21	
BL	7.2	6.2	6.4	0.53	0.295	6.60	-0.08	0.43	
BM	6.3	6.8	5.4	0.71	0.413	6.17	-0.46	0.06	
BO	5.9	6.1	5.3	0.42	0.236	5.77	-0.80	-0.29	
C	5.8	5.2	6.0	0.42	0.236	5.67	-0.89	-0.38	
CA	6.0	6.0	5.8	0.12	0.059	5.93	-0.66	-0.14	
CC									•
CE	6.8	7.8	6.0	0.90	0.532	6.87	0.15	0.66	
CJ	5.4	5.9	6.5	0.55	0.325	5.93	-0.66	-0.14	
CP									•
CS									•
CX	5.5	10.2	9.0	2.44	1.739	8.23	1.33	1.85	
D	7.0	6.0	7.0	0.58	0.295	6.67	-0.03	0.49	
DD	7.7	8.4	8.0	0.35	0.207	8.03	1.16	1.67	
DE	9.6	9.8	10.0	0.20	0.118	9.80	2.69	3.20	⇑
DR	8.3	10.6	9.0	1.18	0.679	9.30	2.26	2.77	
DT	5.2	6.3	5.7	0.55	0.325	5.73	-0.83	-0.32	
DY	6.7	6.4	5.6	0.57	0.325	6.23	-0.40	0.12	
E	8.1	8.2	4.5	2.11	1.177	6.93	0.21	0.72	
EB	5.5	4.8	5.3	0.36	0.207	5.20	-1.30	-0.78	
EH	5.4	5.6	6.8	0.76	0.413	5.93	-0.66	-0.14	
EL	6.0	6.0	4.8	0.69	0.354	5.60	-0.95	-0.43	
EX	6.8	5.8	6.7	0.55	0.295	6.43	-0.23	0.29	
FE									•
FL	6.8	7.1	5.7	0.74	0.413	6.53	-0.14	0.38	
GI	5.8	7.8	6.8	1.00	0.591	6.80	0.09	0.61	
HK	6.9	6.6	6.3	0.30	0.177	6.60	-0.08	0.43	
HP									•
I	5.7	5.5	5.8	0.15	0.089	5.67	-0.89	-0.38	
IA									•
IU									•
J	6.4	5.8	5.4	0.50	0.295	5.87	-0.72	-0.20	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ 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)	Normalized deviation (known)	Tag
JR									•
JS	5.5	6.4	6.0	0.45	0.266	5.97	-0.63	-0.12	
JY	5.0	5.0	5.0	0.00	0.000	5.00	-1.47	-0.95	
K	8.3	5.7	6.0	1.42	0.768	6.67	-0.03	0.49	
KL	5.6	6.3	7.0	0.70	0.413	6.30	-0.34	0.17	
KM	5.4	5.5	5.3	0.10	0.059	5.40	-1.12	-0.61	
KX									•
L	6.9	6.5	6.3	0.31	0.177	6.57	-0.11	0.40	
LF	7.2	6.4	7.4	0.53	0.295	7.00	0.26	0.78	
LR	8.3	6.5	10.4	1.95	1.289	8.40	1.48	1.99	
M	5.8	5.0	5.4	0.40	0.236	5.40	-1.12	-0.61	
MN									•
MP									•
MV	13.4	16.4	14.8	1.50	0.886	14.87	7.08	7.59	×
N	6.6	7.9	6.4	0.81	0.443	6.97	0.23	0.75	
NH	7.4	6.1	6.6	0.66	0.384	6.70	0.00	0.52	
NJ	6.3	5.1	5.7	0.60	0.354	5.70	-0.86	-0.35	
NO									•
O	6.3	6.4	6.1	0.15	0.089	6.27	-0.37	0.14	
OA	4.5	7.0	6.9	1.42	0.738	6.13	-0.49	0.03	
OB									•
OT	13.0	9.0	16.0	3.51	3.033	12.67	5.17	5.69	×
PB									•
PE									•
PW	7.0	8.0	6.0	1.00	0.591	7.00	0.26	0.78	
Q	6.7	8.3	7.8	0.82	0.473	7.60	0.78	1.30	
QX	5.1	6.0	7.6	1.27	0.738	6.23	-0.40	0.12	
QY									•
QZ	6.1	6.6	6.4	0.21	0.118	6.33	-0.31	0.20	
R	7.0	6.6	7.0	0.23	0.118	6.87	0.15	0.66	
RK									•
S	5.4	6.1	4.4	0.85	0.502	5.30	-1.21	-0.69	
SD									•
SM									•
SS	5.8	6.0	6.3	0.25	0.148	6.03	-0.57	-0.06	
SV	10.6	8.9	7.8	1.41	0.827	9.10	2.08	2.60	
SZ									•
TA									•
TC	7.3	7.4	7.8	0.26	0.148	7.50	0.70	1.21	
TD									•
TF									•
TL									•
TQ	5.4	7.7	3.7	2.01	1.345	5.60	-0.95	-0.43	
U	7.1	7.6	7.1	0.29	0.148	7.27	0.49	1.01	
UC									•

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ESD-LV Performance Evaluation: Iodine in Water, 11-Sep-1998

Iodine-131

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UI									•
UM									•
UP	5.2	6.3	6.0	0.57	0.325	5.83	-0.75	-0.23	
UY									•
VA									•
VC									•
VM	10.0	10.0	10.0	0.00	0.000	10.00	2.86	3.38	⇑
VN									•
W									•
WM									•
WO									•
X	9.5	7.5	3.7	2.95	2.358	6.90	0.18	0.69	
XK									•
XQ									•
XT									•
Y	7.0	8.6	8.3	0.85	0.473	7.97	1.10	1.62	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.00		JY	6.10		A	6.93		E
5.10		AZ	6.13		OA	6.97		N
5.20		EB	6.17		BM	7.00		PW
5.30		S	6.20		BA	7.00		LF
5.40		M	6.23		QX	7.27		U
5.40		KM	6.23		DY	7.37		AJ
5.60		TQ	6.27		O	7.50		TC
5.60		EL	6.30		KL	7.50		BK
5.67		I	6.33		QZ	7.60		Q
5.67		C	6.43		AF	7.60		BH
5.67		AL	6.43		EX	7.97		Y
5.70		NJ	6.53		FL	8.03		DD
5.73		DT	6.57		L	8.07		AK
5.77		BO	6.60		BL	8.23		CX
5.83		UP	6.60		HK	8.40		LR
5.87		J	6.67		K	9.10		SV
5.93		EH	6.67		D	9.30		DR
5.93		CJ	6.70		NH	9.80	⇑	DE
5.93		CA	6.80		GI	10.00	⇑	VM
5.97		JS	6.87		R	10.00	⇑	AY
6.00		AW	6.87		CE	12.67	×	OT
6.03		SS	6.90		X	14.87	×	MV

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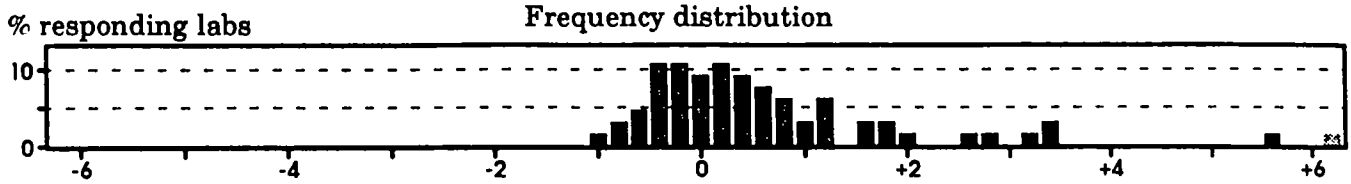
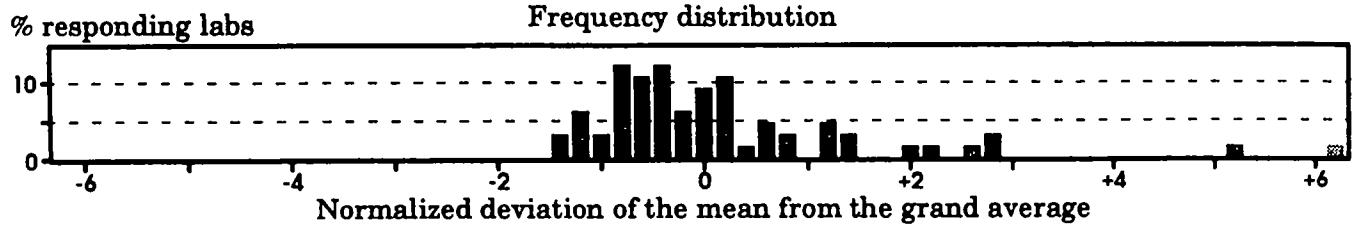
Iodine-131


% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the known value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10
0
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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-98/180
December 1998

EPA

Uranium-Radium in Water Performance Evaluation Study

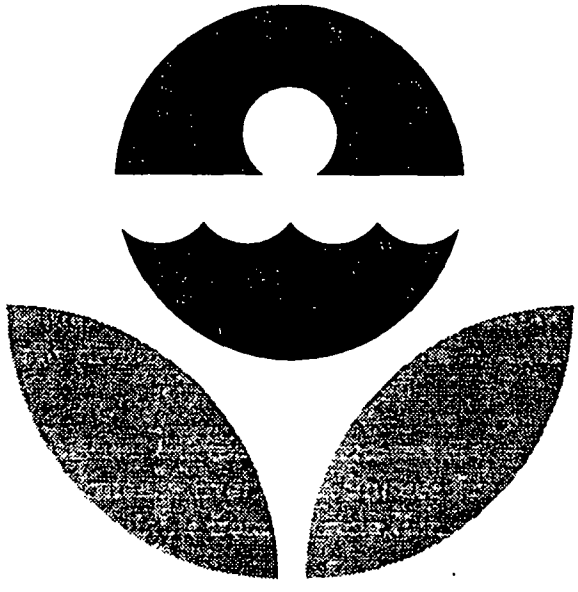
A Statistical Evaluation of the September 18, 1998 Data

090ECB99 cov-E

Uranium-Radium in Water

Performance Evaluation Study

September 18, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Uranium-Radium in Water; September 18, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen N. Pia

Stephen Pia
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.

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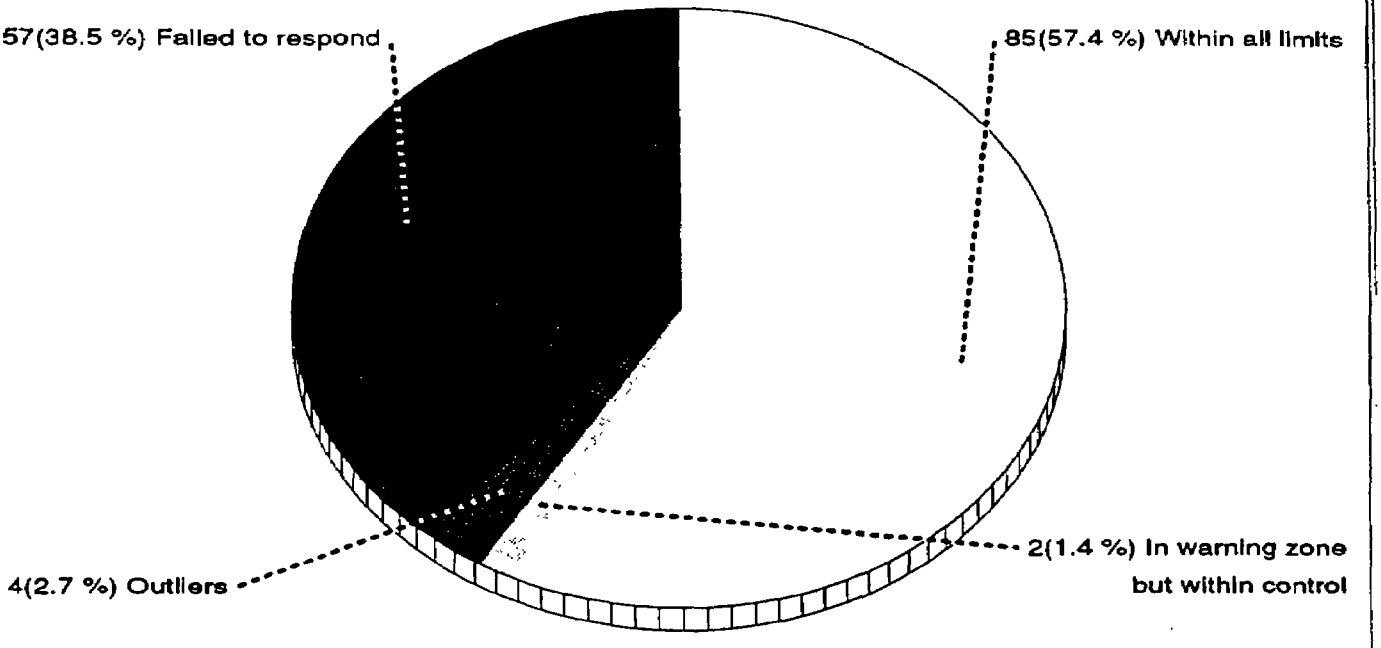
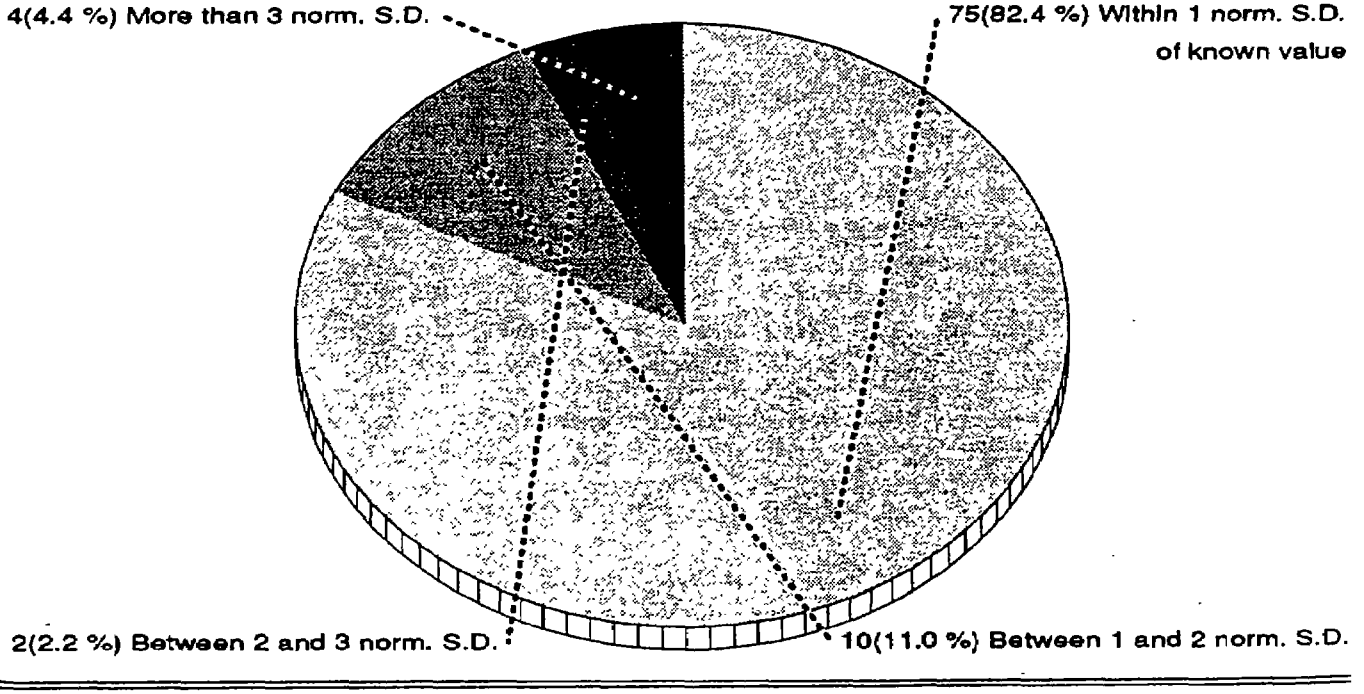
Uranium (Natural) Statistical Summary 148 Participants

The known value of this nuclide is **9.1 pCi/l** with an expected precision of **3.0**; the control limits are 3.9 to 14.3; the warning regions are 3.9 to 5.6 and 12.6 to 14.3



Statistic	Respondents	Non-outliers
Mean	9.74	**Grand Avg 8.62**
Std. Dev.	9.63	1.13
Variance	92.83	1.29
% Coef. of Var.	98.88	13.17
% deviation of mean from known value	7.08	-5.31
Norm. dev. of mean from known value	0.07	-0.43
Median	8.73	8.73
% deviation of median from known value	-4.03	-4.03
Norm. dev. of median from known value	-0.04	-0.32



Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	8.5	8.5	8.5	0.00	0.000	8.50	-0.07	-0.35	
AE	8.3	7.9	8.2	0.21	0.079	8.13	-0.28	-0.56	
AF	11.0	11.4	10.3	0.56	0.217	10.90	1.32	1.04	
AH									•
AJ	7.2	7.0	8.1	0.59	0.217	7.43	-0.68	-0.96	
AK	11.0	10.9	10.9	0.06	0.020	10.93	1.34	1.06	
AL	7.0	8.2	7.9	0.62	0.236	7.70	-0.53	-0.81	
AP									•
AR	8.1	7.9	7.8	0.15	0.059	7.93	-0.39	-0.67	
AU									•
AW	8.1	7.9	8.5	0.31	0.118	8.17	-0.26	-0.54	
AZ									•
BA	9.7	9.3	9.7	0.23	0.079	9.57	0.55	0.27	
BB	8.2	8.7	8.5	0.25	0.098	8.47	-0.09	-0.37	
BC	8.7	8.6	8.4	0.15	0.059	8.57	-0.03	-0.31	
BG									•
BH	10.3	10.6	10.6	0.17	0.059	10.50	1.09	0.81	
BK	8.9	8.9	8.8	0.06	0.020	8.87	0.14	-0.13	
BM	8.9	9.7	10.2	0.66	0.256	9.60	0.57	0.29	
BN	10.4	8.5	7.1	1.66	0.650	8.67	0.03	-0.25	
BO	10.1	10.0	9.9	0.10	0.039	10.00	0.80	0.52	
C	9.3	8.7	8.5	0.42	0.158	8.83	0.12	-0.15	
CA	8.6	7.7	8.2	0.45	0.177	8.17	-0.26	-0.54	
CC									•
CE	9.3	9.8	9.8	0.29	0.098	9.63	0.59	0.31	
CJ	9.5	9.6	9.2	0.21	0.079	9.43	0.47	0.19	
CS	8.8	8.8	8.8	0.00	0.000	8.80	0.11	-0.17	
CX	10.4	10.2	10.0	0.20	0.079	10.20	0.91	0.64	
D	9.1	8.8	9.0	0.15	0.059	8.97	0.20	-0.08	
DB	6.3	5.9	7.4	0.78	0.295	6.53	-1.20	-1.48	
DE	9.5	9.5	9.5	0.00	0.000	9.50	0.51	0.23	
DI									•
DO	8.0	8.5	8.4	0.26	0.098	8.30	-0.18	-0.46	
DR									•
DT	8.2	8.3	8.8	0.32	0.118	8.43	-0.11	-0.38	
DZ	9.3	9.3	9.6	0.17	0.059	9.40	0.45	0.17	
E	9.1	9.0	9.1	0.06	0.020	9.07	0.26	-0.02	
EB									•
EL	8.5	8.5	8.4	0.06	0.020	8.47	-0.09	-0.37	
EO									•
EP									•
ER	8.6	8.3	7.9	0.35	0.138	8.27	-0.20	-0.48	
FE									•
FJ									•
FN									•

• ≡ 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
GN	5.7	7.3	7.0	0.85	0.315	6.67	-1.13	-1.40	
GQ	6.5	7.0	8.7	1.15	0.433	7.40	-0.70	-0.98	
HE	8.0	8.1	7.9	0.10	0.039	8.00	-0.36	-0.64	
HK	10.4	9.4	9.6	0.53	0.197	9.80	0.68	0.40	
HL	8.9	8.8	8.9	0.06	0.020	8.87	0.14	-0.13	
HP	99.2	95.4	102.0	3.31	1.570	98.87	52.11	51.83	×
I	8.9	8.5	8.6	0.21	0.079	8.67	0.03	-0.25	
ID									
J									
JE	8.4	8.7	8.0	0.35	0.138	8.37	-0.14	-0.42	
JG									
JK	8.5	9.0	8.6	0.26	0.098	8.70	0.05	-0.23	
JN	8.1	8.6	8.3	0.25	0.098	8.33	-0.16	-0.44	
JS	9.0	8.9	8.9	0.06	0.020	8.93	0.18	-0.10	
JX									
JY	8.9	8.9	8.4	0.29	0.098	8.73	0.07	-0.21	
K	8.1	8.7	8.7	0.35	0.118	8.50	-0.07	-0.35	
KH	9.0	9.0	9.0	0.00	0.000	9.00	0.22	-0.06	
KL									
KT	9.0	9.5	10.0	0.50	0.197	9.50	0.51	0.23	
L	8.9	9.0	9.3	0.21	0.079	9.07	0.26	-0.02	
LF	9.3	8.9	8.7	0.31	0.118	8.97	0.20	-0.08	
LH									
LZ	8.0	8.6	8.3	0.30	0.118	8.30	-0.18	-0.46	
M									
MF									
MX	10.6	7.0	6.1	2.38	0.886	7.90	-0.41	-0.69	
N									
NA	10.0	9.0	11.0	1.00	0.394	10.00	0.80	0.52	
NH	8.0	7.2	9.6	1.22	0.473	8.27	-0.20	-0.48	
NJ	9.1	8.7	8.9	0.20	0.079	8.90	0.16	-0.12	
NK									
NO									
O									
OB	8.0	8.4	9.3	0.67	0.256	8.57	-0.03	-0.31	
OF									
OS	8.4	9.0	8.4	0.35	0.118	8.60	-0.01	-0.29	
OX									
P	8.0	8.6	8.3	0.30	0.118	8.30	-0.18	-0.46	
PB									
PG	4.7	4.6	4.3	0.21	0.079	4.53	-2.36	-2.64	
PQ	10.0	10.3	10.4	0.21	0.079	10.23	0.93	0.65	
PW									
PX	9.4	9.2	9.1	0.15	0.059	9.23	0.36	0.08	
Q	8.1	9.2	9.1	0.61	0.217	8.80	0.11	-0.17	

• ≡ 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
QM	11.0	11.1	10.8	0.15	0.059	10.97	1.36	1.08	
QQ	7.1	7.2	7.5	0.21	0.079	7.27	-0.78	-1.06	
QU	10.2	9.0	9.2	0.64	0.236	9.47	0.49	0.21	
QX									•
QY									•
QZ	8.6	8.9	8.7	0.15	0.059	8.73	0.07	-0.21	
R									•
RD									•
RG	9.0	9.0	9.1	0.06	0.020	9.03	0.24	-0.04	
RK									•
RP	9.2	9.1	8.9	0.15	0.059	9.07	0.26	-0.02	
RR									•
RX	5.6	4.6	5.0	0.50	0.197	5.07	-2.05	-2.33	
RZ	7.9	7.5	7.6	0.21	0.079	7.67	-0.55	-0.83	
S	8.6	8.7	8.5	0.10	0.039	8.60	-0.01	-0.29	
SD	8.2	8.3	8.1	0.10	0.039	8.20	-0.24	-0.52	
SF									•
SI	17.7	18.4	17.6	0.44	0.158	17.90	5.36	5.08	×
SL	5.8	6.4	6.9	0.55	0.217	6.37	-1.30	-1.58	
SM	9.0	8.9	8.9	0.06	0.020	8.93	0.18	-0.10	
SO									•
SS	9.4	9.2	9.1	0.15	0.059	9.23	0.36	0.08	
SX	8.5	8.1	8.4	0.21	0.079	8.33	-0.16	-0.44	
T									•
TD	8.9	8.9	9.0	0.06	0.020	8.93	0.18	-0.10	
TN									•
TQ	9.1	9.4	9.5	0.21	0.079	9.33	0.41	0.13	
U	9.5	8.8	9.5	0.40	0.138	9.27	0.37	0.10	
UM									•
UP	7.9	8.3	7.2	0.56	0.217	7.80	-0.47	-0.75	
UQ									•
UR									•
UZ	6.1	6.1	8.1	1.15	0.394	6.77	-1.07	-1.35	
VA									•
VH									•
VI	9.4	9.1	9.1	0.17	0.059	9.20	0.34	0.06	
W									•
WC									•
WG	9.1	9.3	9.4	0.15	0.059	9.27	0.37	0.10	
WH	7.0	6.9	7.0	0.06	0.020	6.97	-0.95	-1.23	
WI									•
WJ									•
WO	6.0	6.1	6.0	0.06	0.020	6.03	-1.49	-1.77	
WR									•
WS									•

• ≡ 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
WX									•
X	8.6	8.3	8.9	0.30	0.118	8.60	-0.01	-0.29	
XA	7.9	6.5	8.4	0.98	0.374	7.60	-0.59	-0.87	
XC									•
XD									•
XI	18.0	18.0	18.0	0.00	0.000	18.00	5.42	5.14	×
XK									•
XL	10.3	10.5	10.6	0.15	0.059	10.47	1.07	0.79	
XM	8.6	8.9	8.7	0.15	0.059	8.73	0.07	-0.21	
XQ									•
XS	2.2	2.4	2.2	0.12	0.039	2.27	-3.67	-3.95	×
XT									•
Y	8.7	8.8	8.7	0.06	0.020	8.73	0.07	-0.21	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.27	×	XS	8.33		JN	8.97		D
4.53		PG	8.37		JE	9.00		KH
5.07		RX	8.43		DT	9.03		RG
6.03		WO	8.47		EL	9.07		RP
6.37		SL	8.47		BB	9.07		L
6.53		DB	8.50		K	9.07		E
6.67		GN	8.50		A	9.20		VI
6.77		UZ	8.57		OB	9.23		SS
6.97		WH	8.57		BC	9.23		PX
7.27		QQ	8.60		OS	9.27		WG
7.40		GQ	8.60		X	9.27		U
7.43		AJ	8.60		S	9.33		TQ
7.60		XA	8.67		I	9.40		DZ
7.67		RZ	8.67		BN	9.43		CJ
7.70		AL	8.70		JK	9.47		QU
7.80		UP	8.73		JY	9.50		KT
7.90		MX	8.73		Y	9.50		DE
7.93		AR	8.73		XM	9.57		BA
8.00		HE	8.73		QZ	9.60		BM
8.13		AE	8.80		Q	9.63		CE
8.17		CA	8.80		CS	9.80		HF
8.17		AW	8.83		C	10.00		NA
8.20		SD	8.87		HL	10.00		BC
8.27		NH	8.87		BK	10.20		CX
8.27		ER	8.90		NJ	10.23		PC
8.30		P	8.93		TD	10.47		XL
8.30		LZ	8.93		SM	10.50		BI
8.30		DO	8.93		JS	10.90		AI
8.33		SX	8.97		LF	10.93		AI

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limi

∅ ≡ Insufficient data

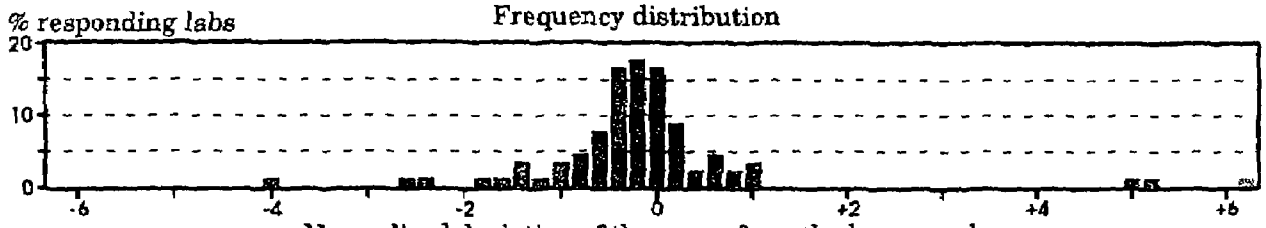
× ≡ Determined to be an outlier

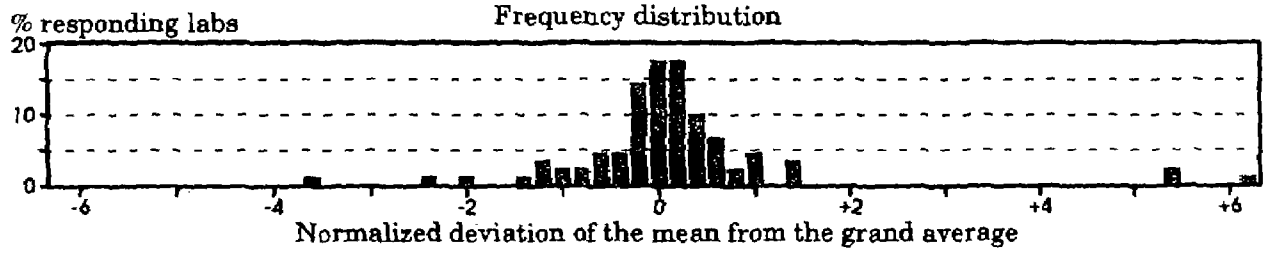
⇓ ≡ Below control limi

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
10.97		**QM**	17.90	×	**SI**	18.00	×	**XI**
						98.87	×	**HP**





• ≡ No data submitted
Ø ≡ Insufficient data

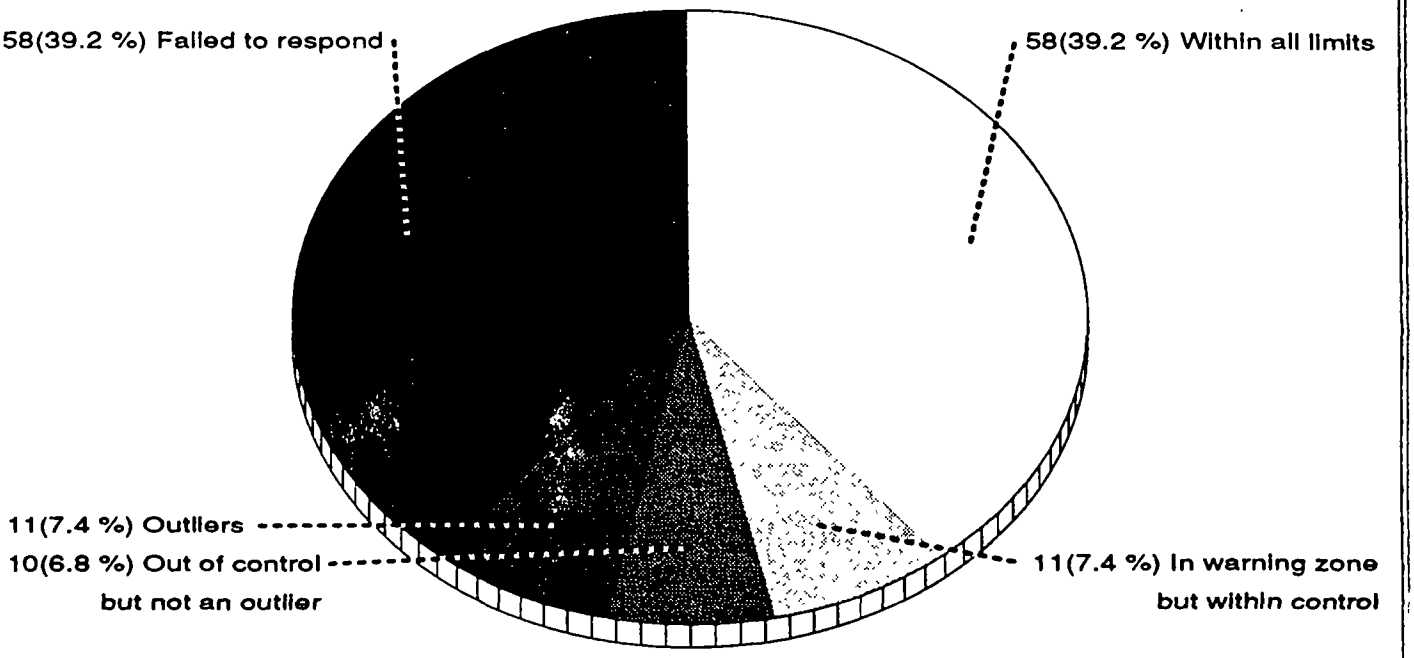
TAG SYMBOLS

× ≡ Determined to be an outlier

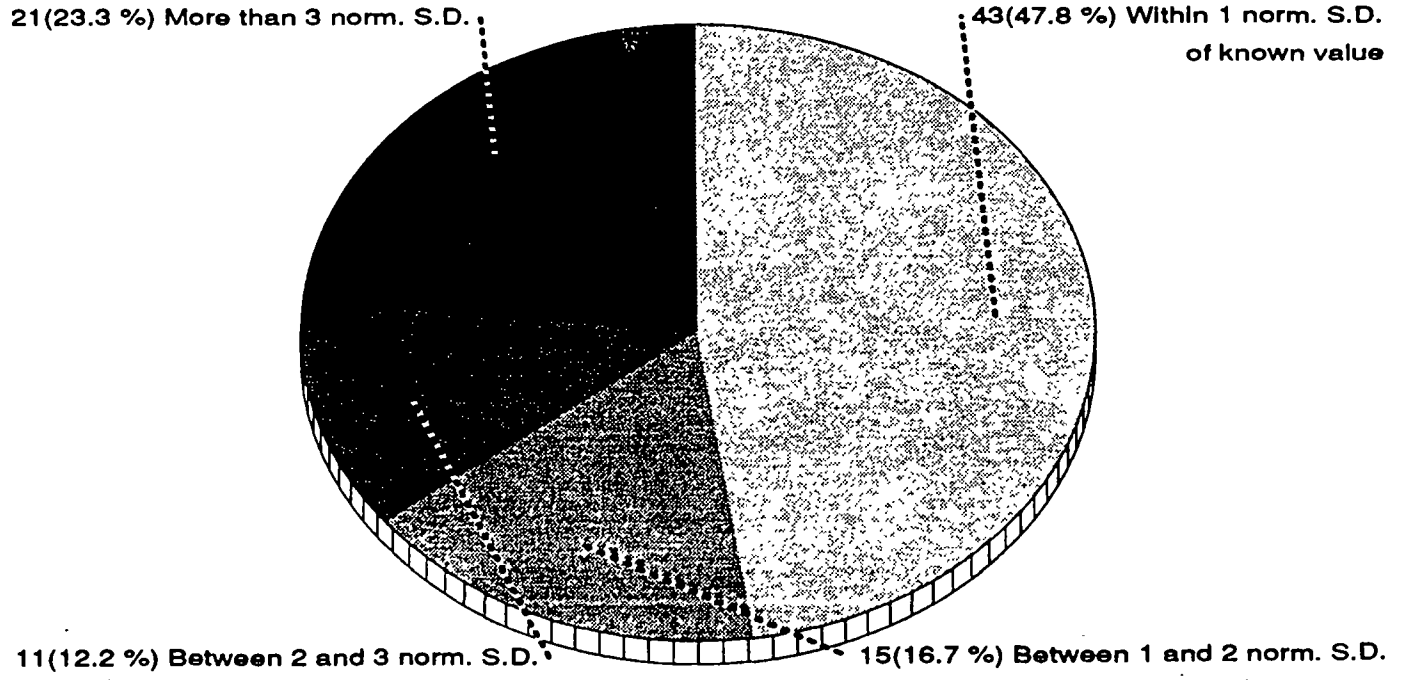
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226 Statistical Summary 148 Participants

The known value of this nuclide is **1.7 pCi/l** with an expected precision of **0.3**; the control limits are 1.2 to 2.2; the warning regions are 1.2 to 1.4 and 2.0 to 2.2



Statistic	Respondents	Non-outliers
Mean	2.25	**Grand Avg 1.82**
Std. Dev.	1.59	0.29
Variance	2.54	0.09
% Coef. of Var.	70.80	16.17
% deviation of mean from known value	32.40	6.95
Norm. dev. of mean from known value	0.35	0.40
Median	1.80	1.77
% deviation of median from known value	5.88	3.92
Norm. dev. of median from known value	0.06	0.23



 ESD-LV Performance Evaluation: Uranium-Radium in Water, 18-Sep-1998

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	1.7	1.6	1.7	0.06	0.197	1.67	-0.87	-0.19	
AE	1.8	1.9	2.0	0.10	0.394	1.90	0.47	1.15	
AF	1.8	1.7	1.8	0.06	0.197	1.77	-0.30	0.38	
AH									•
AJ	2.8	1.1	1.5	0.89	5.471	1.80	-0.10	0.58	
AK	1.8	1.7	1.6	0.10	0.394	1.70	-0.68	0.00	
AL	1.9	1.8	1.4	0.26	0.984	1.70	-0.68	0.00	
AP									•
AR									•
AU	0.8	0.7	0.6	0.10	0.394	0.70	-6.46	-5.77	×
AW	2.2	2.3	2.3	0.06	0.197	2.27	2.59	3.27	⇑
AZ									•
BA	1.4	1.8	1.6	0.20	0.788	1.60	-1.26	-0.58	
BB	2.1	2.3	1.9	0.20	0.788	2.10	1.63	2.31	
BC	2.1	2.0	2.0	0.06	0.197	2.03	1.24	1.92	
BG									•
BH	2.3	1.9	1.7	0.31	1.345	1.97	0.86	1.54	
BK	1.7	1.7	1.7	0.00	0.000	1.70	-0.68	0.00	
BM	2.0	1.9	1.9	0.06	0.197	1.93	0.67	1.35	
BN	3.7	3.4	3.7	0.17	0.591	3.60	10.29	10.97	×
BO	1.7	1.7	1.6	0.06	0.197	1.67	-0.87	-0.19	
C	1.9	1.9	1.9	0.00	0.000	1.90	0.47	1.15	
CA	1.6	1.8	1.8	0.12	0.394	1.73	-0.49	0.19	
CC									•
CE	1.9	1.8	1.8	0.06	0.197	1.83	0.09	0.77	
CJ	1.8	1.0	1.8	0.46	2.095	1.53	-1.64	-0.96	
CS	2.3	2.2	2.4	0.10	0.394	2.30	2.78	3.46	⇑
CX									•
D									•
DB	2.2	2.3	2.1	0.10	0.394	2.20	2.20	2.89	
DE	1.8	1.8	1.9	0.06	0.197	1.83	0.09	0.77	
DI									•
DO									•
DR									•
DT	1.6	1.7	1.6	0.06	0.197	1.63	-1.07	-0.38	
DZ	1.7	1.9	2.1	0.20	0.788	1.90	0.47	1.15	
E	1.9	2.0	2.1	0.10	0.394	2.00	1.05	1.73	
EB	1.6	1.6	1.4	0.12	0.394	1.53	-1.64	-0.96	
EL	1.6	1.8	1.8	0.12	0.394	1.73	-0.49	0.19	
EO	1.7	2.2	2.0	0.25	0.984	1.97	0.86	1.54	
EP									•
ER	1.7	1.7	1.6	0.06	0.197	1.67	-0.87	-0.19	
FE									•
FJ									•
FN									•

• ≡ 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
GN	3.6	3.3	3.4	0.15	0.591	3.43	9.33	10.01	×
GQ	1.1	1.7	1.4	0.30	1.345	1.40	-2.41	-1.73	
HE	1.6	1.7	1.6	0.06	0.197	1.63	-1.07	-0.38	
HK	1.7	1.7	1.7	0.00	0.000	1.70	-0.68	0.00	
HL	1.6	1.4	1.8	0.20	0.788	1.60	-1.26	-0.58	
HP	1.8	2.0	1.8	0.12	0.394	1.87	0.28	0.96	
I	2.1	2.3	2.2	0.10	0.394	2.20	2.20	2.89	
ID	1.6	1.3	1.5	0.15	0.591	1.47	-2.03	-1.35	
J									•
JE	2.3	1.4	1.6	0.47	2.470	1.77	-0.30	0.38	
JG									•
JK									•
JN									•
JS	1.8	1.6	1.1	0.36	1.720	1.50	-1.84	-1.15	
JX	2.1	2.3	2.0	0.15	0.591	2.13	1.82	2.50	
JY	1.3	1.2	1.1	0.10	0.394	1.20	-3.57	-2.89	
K	1.7	1.7	1.8	0.06	0.197	1.73	-0.49	0.19	
KH	1.8	1.8	1.8	0.00	0.000	1.80	-0.10	0.58	
KL	3.3	2.1	1.5	0.92	5.846	2.30	2.78	3.46	⇑
KT									•
L	1.4	1.3	1.2	0.10	0.394	1.30	-2.99	-2.31	
LF									•
LH									•
LZ	1.5	1.7	1.5	0.12	0.394	1.57	-1.45	-0.77	
M	3.0	2.5	2.7	0.25	0.984	2.73	5.28	5.97	⇑
MF	1.1	1.3	1.4	0.15	0.591	1.27	-3.18	-2.50	
MX	1.3	1.7	1.7	0.23	0.788	1.57	-1.45	-0.77	
N									•
NA									•
NH	1.8	1.8	1.9	0.06	0.197	1.83	0.09	0.77	
NJ	2.3	2.8	2.0	0.40	2.095	2.37	3.17	3.85	⇑
NK									•
NO									•
O	2.2	1.8	1.7	0.26	0.984	1.90	0.47	1.15	
OB									•
OF									•
OS									•
OX									•
P	2.2	2.5	2.1	0.21	0.788	2.27	2.59	3.27	⇑
PB									•
PG	7.9	7.9	7.8	0.06	0.197	7.87	34.92	35.60	×
PQ									•
PW									•
PX	1.8	1.8	1.8	0.00	0.000	1.80	-0.10	0.58	
Q	1.4	1.4	1.7	0.17	0.591	1.50	-1.84	-1.15	

• ≡ 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
QM	2.5	2.3	2.3	0.12	0.394	2.37	3.17	3.85	⇑
QQ	2.2	2.0	1.9	0.15	0.591	2.03	1.24	1.92	
QU	3.7	3.8	3.7	0.06	0.197	3.73	11.06	11.74	×
QX									•
QY	1.8	1.9	1.6	0.15	0.591	1.77	-0.30	0.38	
QZ	1.7	1.6	1.8	0.10	0.394	1.70	-0.68	0.00	
R	2.1	1.6	1.3	0.40	2.095	1.67	-0.87	-0.19	
RD	12.5	12.5	12.5	0.00	0.000	12.50	61.67	62.35	×
RG									•
RK									•
RP									•
RR									•
RX	5.2	5.6	5.1	0.26	0.984	5.30	20.10	20.78	×
RZ	1.5	1.6	1.6	0.06	0.197	1.57	-1.45	-0.77	
S	1.8	1.7	1.7	0.06	0.197	1.73	-0.49	0.19	
SD	2.0	1.8	1.7	0.15	0.591	1.83	0.09	0.77	
SF									•
SI	6.1	6.3	5.8	0.25	0.984	6.07	24.53	25.21	×
SL									•
SM	2.0	2.0	2.2	0.12	0.394	2.07	1.43	2.12	
SO									•
SS	1.4	1.9	1.6	0.25	0.984	1.63	-1.07	-0.38	
SX	1.7	1.8	1.6	0.10	0.394	1.70	-0.68	0.00	
T									•
TD	2.2	2.1	2.2	0.06	0.197	2.17	2.01	2.69	
TN	1.9	1.6	1.6	0.17	0.591	1.70	-0.68	0.00	
TQ	1.7	1.5	1.5	0.12	0.394	1.57	-1.45	-0.77	
U	2.4	2.3	2.4	0.06	0.197	2.37	3.17	3.85	⇑
UM									•
UP	1.5	1.6	2.0	0.26	0.984	1.70	-0.68	0.00	
UQ	1.7	1.6	1.7	0.06	0.197	1.67	-0.87	-0.19	
UR									•
UZ									•
VA									•
VH									•
VI	1.7	1.7	1.8	0.06	0.197	1.73	-0.49	0.19	
W									•
WC	5.4	5.8	5.1	0.35	1.720	5.43	20.87	21.55	×
WG									•
WH	1.7	1.9	1.8	0.10	0.394	1.80	-0.10	0.58	
WI									•
WJ	1.6	1.9	1.8	0.15	0.591	1.77	-0.30	0.38	
WO	2.8	3.1	3.1	0.17	0.591	3.00	6.82	7.51	×
WR									•
WS									•

• ≡ 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
WX									•
X	2.0	2.2	2.1	0.10	0.394	2.10	1.63	2.31	
XA	1.3	0.9	1.1	0.20	0.788	1.10	-4.15	-3.46	⇓
XC									•
XD									•
XI	7.0	7.3	7.6	0.30	1.345	7.30	31.65	32.33	×
XK									•
XL	1.6	1.6	1.7	0.06	0.197	1.63	-1.07	-0.38	
XM	1.9	2.1	2.3	0.20	0.788	2.10	1.63	2.31	
XQ									•
XS	2.2	2.4	2.2	0.12	0.394	2.27	2.59	3.27	⇑
XT									•
Y	2.0	2.0	1.8	0.12	0.394	1.93	0.67	1.35	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.70	×	AU	1.70		QZ	1.97		EO
1.10	⇓	XA	1.70		AL	1.97		BH
1.20		JY	1.70		AK	2.00		E
1.27		MF	1.70		HK	2.03		QQ
1.30		L	1.70		BK	2.03		BC
1.40		GQ	1.73		EL	2.07		SM
1.47		ID	1.73		CA	2.10		XM
1.50		Q	1.73		VI	2.10		BB
1.50		JS	1.73		S	2.10		X
1.53		EB	1.73		K	2.13		JX
1.53		CJ	1.77		WJ	2.17		TD
1.57		TQ	1.77		QY	2.20		I
1.57		RZ	1.77		JE	2.20		DB
1.57		MX	1.77		AF	2.27	⇑	XS
1.57		LZ	1.80		WH	2.27	⇑	P
1.60		HL	1.80		PX	2.27	⇑	AW
1.60		BA	1.80		KH	2.30	⇑	KL
1.63		XL	1.80		AJ	2.30	⇑	CS
1.63		SS	1.83		SD	2.37	⇑	QM
1.63		HE	1.83		NH	2.37	⇑	NJ
1.63		DT	1.83		DE	2.37	⇑	U
1.67		UQ	1.83		CE	2.73	⇑	M
1.67		R	1.87		HP	3.00	×	WO
1.67		ER	1.90		DZ	3.43	×	GN
1.67		BO	1.90		C	3.60	×	BN
1.67		A	1.90		AE	3.73	×	QU
1.70		UP	1.90		O	5.30	×	RX
1.70		TN	1.93		Y	5.43	×	WC
1.70		SX	1.93		BM	6.07	×	SI

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

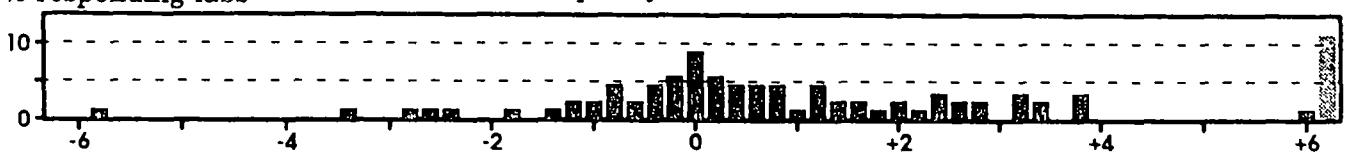
Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
7.30	×	**XI**	7.87	×	**PG**	12.50	×	**RD**

% responding labs

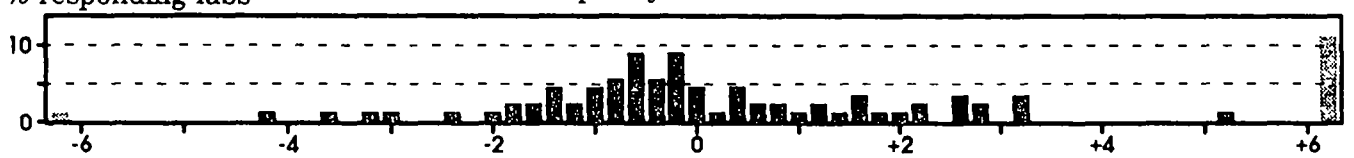
Frequency distribution



Normalized deviation of the mean from the known value

% responding labs

Frequency distribution



Normalized deviation of the mean from the grand average

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

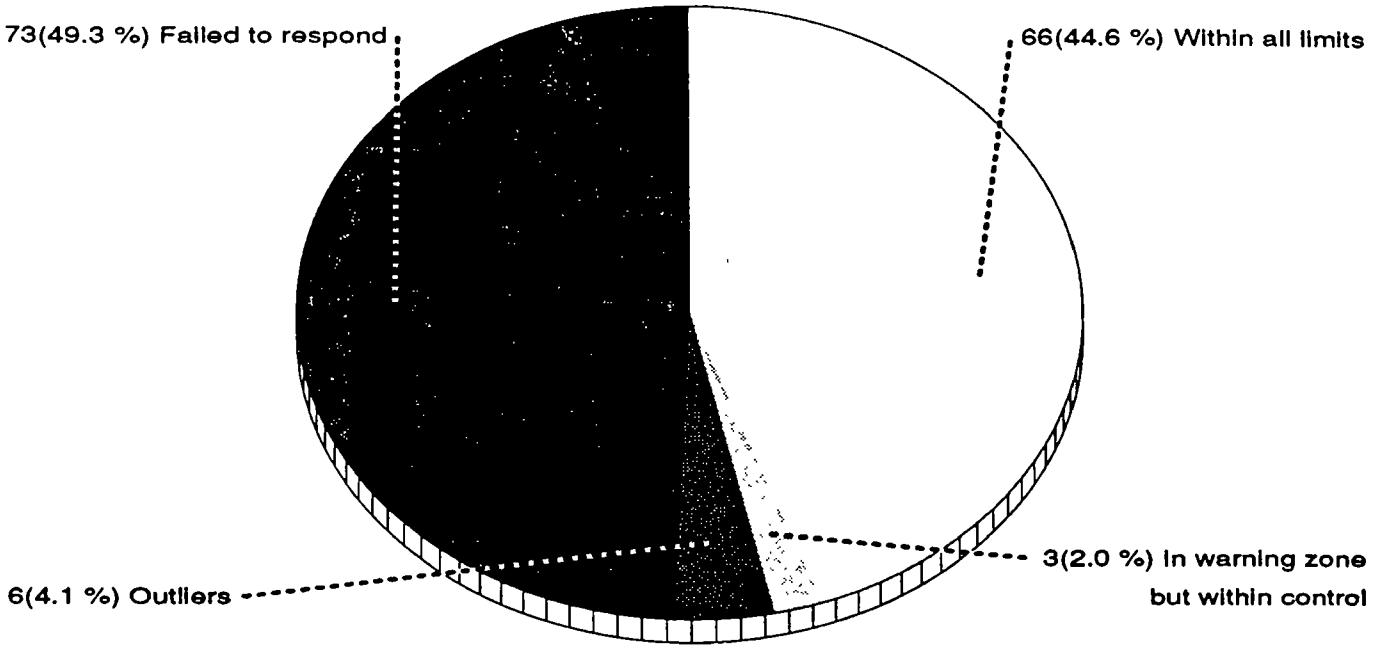
× ≡ Determined to be an outlier

⇑ ≡ Above control limit

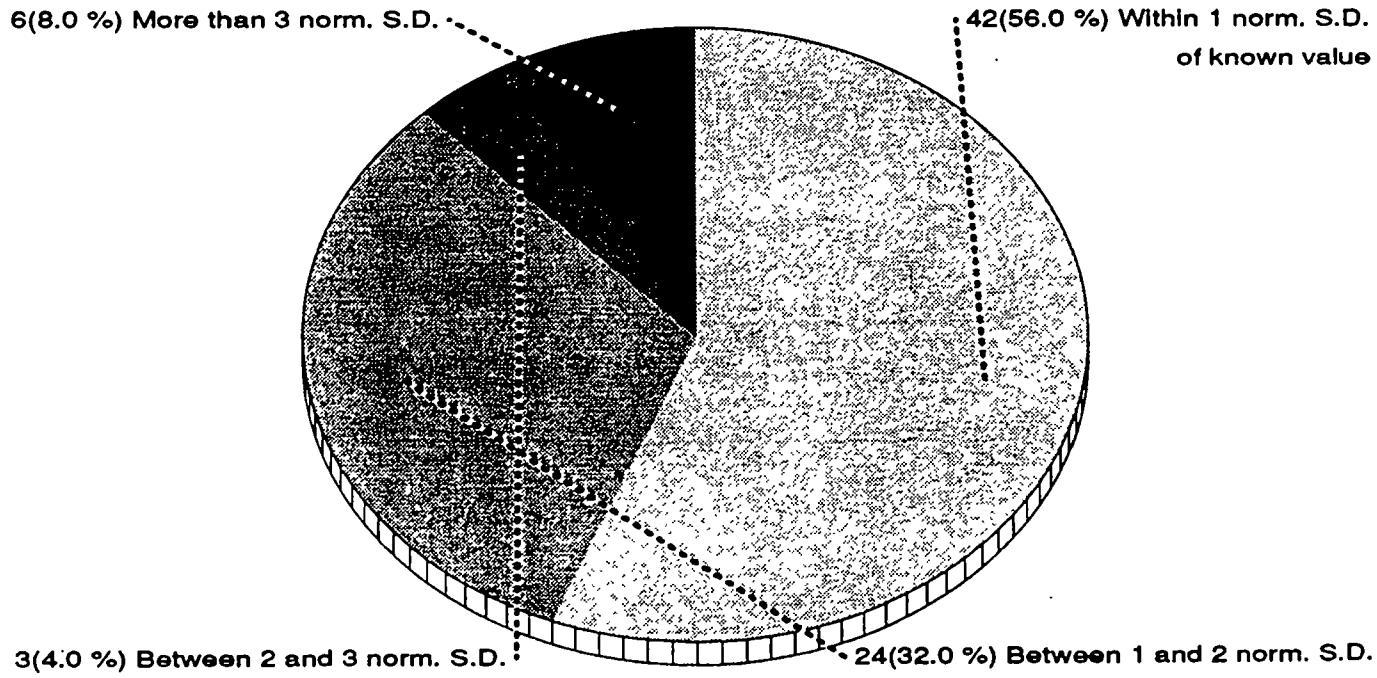
⇓ ≡ Below control limit

Radium-228 Statistical Summary 148 Participants

The known value of this nuclide is **5.7 pCi/l** with an expected precision of **1.4**; the control limits are 3.3 to 8.1; the warning regions are 3.3 to 4.1 and 7.3 to 8.1



Statistic	Respondents	Non-outliers
Mean	5.75	**Grand Avg 5.76**
Std. Dev.	1.29	0.82
Variance	1.66	0.67
% Coef. of Var.	22.42	14.25
% deviation of mean from known value	0.80	1.05
Norm. dev. of mean from known value	0.04	0.07
Median	5.80	5.80
% deviation of median from known value	1.75	1.75
Norm. dev. of median from known value	0.08	0.12



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	7.3	8.8	6.8	1.04	0.844	7.63	2.32	2.39	
AE	4.8	4.7	4.6	0.10	0.084	4.70	-1.31	-1.24	
AF	6.1	6.7	6.5	0.31	0.253	6.43	0.83	0.91	
AH									•
AJ	5.9	5.3	5.8	0.32	0.253	5.67	-0.12	-0.04	
AK	2.6	2.4	2.5	0.10	0.084	2.50	-4.03	-3.96	×
AL	6.1	4.4	4.1	1.08	0.844	4.87	-1.11	-1.03	
AP									•
AR									•
AU									•
AW	4.1	4.5	4.7	0.31	0.253	4.43	-1.64	-1.57	
AZ									•
BA	4.5	5.3	4.8	0.40	0.338	4.87	-1.11	-1.03	
BB	6.8	6.9	6.6	0.15	0.127	6.77	1.25	1.32	
BC	6.6	5.8	5.6	0.53	0.422	6.00	0.30	0.37	
BG									•
BH	6.1	6.5	5.8	0.35	0.295	6.13	0.46	0.54	
BK	6.7	6.2	6.4	0.25	0.211	6.43	0.83	0.91	
BM	5.4	5.8	6.1	0.35	0.295	5.77	0.01	0.08	
BN									•
BO	5.5	5.4	5.3	0.10	0.084	5.40	-0.45	-0.37	
C	4.7	4.7	4.6	0.06	0.042	4.67	-1.35	-1.28	
CA	6.7	5.5	6.0	0.60	0.506	6.07	0.38	0.45	
CC									•
CE	5.7	6.3	5.7	0.35	0.253	5.90	0.17	0.25	
CJ	6.5	7.1	6.5	0.35	0.253	6.70	1.16	1.24	
CS	9.2	9.1	8.4	0.44	0.338	8.90	3.88	3.96	×
CX									•
D									•
DB	6.2	6.4	6.0	0.20	0.169	6.20	0.54	0.62	
DE	4.1	4.1	4.2	0.06	0.042	4.13	-2.01	-1.94	
DI									•
DO									•
DR									•
DT	6.7	6.2	7.1	0.45	0.380	6.67	1.12	1.20	
DZ	6.6	6.4	6.5	0.10	0.084	6.50	0.92	0.99	
E	5.4	6.9	6.2	0.75	0.633	6.17	0.50	0.58	
EB	4.6	4.6	5.0	0.23	0.169	4.73	-1.27	-1.20	
EL	5.7	5.5	7.4	1.04	0.802	6.20	0.54	0.62	
EO	6.4	5.4	5.9	0.50	0.422	5.90	0.17	0.25	
EP									•
ER									•
FE									•
FJ									•
FN									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ 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)	Normalized deviation (known)	Tag
GN	4.8	4.9	5.0	0.10	0.084	4.90	-1.06	-0.99	
GQ	10.1	9.8	9.4	0.35	0.295	9.77	4.96	5.03	×
HE	5.8	5.8	5.9	0.06	0.042	5.83	0.09	0.16	
HK	5.0	4.8	5.3	0.25	0.211	5.03	-0.90	-0.82	
HL	5.0	4.5	4.8	0.25	0.211	4.77	-1.23	-1.15	
HP	4.9	4.1	4.5	0.40	0.338	4.50	-1.56	-1.48	
I	7.0	7.6	5.9	0.86	0.717	6.83	1.33	1.40	
ID	5.0	4.8	4.7	0.15	0.127	4.83	-1.15	-1.07	
J									•
JE									•
JG									•
JK									•
JN									•
JS	5.7	5.4	5.6	0.15	0.127	5.57	-0.24	-0.16	
JX	7.3	6.3	4.5	1.42	1.345	6.03	0.34	0.41	
JY	5.6	5.7	5.5	0.10	0.084	5.60	-0.20	-0.12	
K	5.3	5.0	6.6	0.85	0.675	5.63	-0.16	-0.08	
KH	5.9	5.8	5.8	0.06	0.042	5.83	0.09	0.16	
KL	7.8	7.5	7.1	0.35	0.295	7.47	2.11	2.19	
KT									•
L	5.8	5.4	6.2	0.40	0.338	5.80	0.05	0.12	
LF									•
LH									•
LZ									•
M									•
MF	5.7	6.0	6.8	0.57	0.464	6.17	0.50	0.58	
MX	5.2	5.8	5.6	0.31	0.253	5.53	-0.28	-0.21	
N	5.3	5.6	5.8	0.25	0.211	5.57	-0.24	-0.16	
NA									•
NH	4.3	5.3	4.6	0.51	0.422	4.73	-1.27	-1.20	
NJ	6.1	5.0	6.3	0.70	0.548	5.80	0.05	0.12	
NK									•
NO									•
O	6.3	6.6	6.3	0.17	0.127	6.40	0.79	0.87	
OB									•
OF									•
OS									•
OX									•
P	9.5	7.2	9.5	1.33	0.970	8.73	3.68	3.75	×
PB									•
PG									•
PQ									•
PW									•
PX									•
Q	5.5	6.7	7.2	0.87	0.717	6.47	0.87	0.95	

• ≡ 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
QM									•
QQ									•
QU	6.5	6.4	6.9	0.26	0.211	6.60	1.04	1.11	
QX									•
QY									•
QZ	5.2	4.8	4.8	0.23	0.169	4.93	-1.02	-0.95	
R									•
RD	7.0	7.0	7.0	0.00	0.000	7.00	1.53	1.61	
RG									•
RK									•
RP									•
RR									•
RX	5.4	5.8	5.6	0.20	0.169	5.60	-0.20	-0.12	
RZ	5.7	5.6	5.6	0.06	0.042	5.63	-0.16	-0.08	
S	5.4	5.6	5.3	0.15	0.127	5.43	-0.40	-0.33	
SD	5.5	4.4	5.7	0.70	0.548	5.20	-0.69	-0.62	
SF									•
SI	6.1	6.1	5.9	0.12	0.084	6.03	0.34	0.41	
SL									•
SM	4.7	4.8	4.2	0.32	0.253	4.57	-1.48	-1.40	
SO									•
SS	5.7	6.0	6.7	0.51	0.422	6.13	0.46	0.54	
SX	7.3	6.7	6.7	0.35	0.253	6.90	1.41	1.48	
T									•
TD	4.5	4.4	4.2	0.15	0.127	4.37	-1.72	-1.65	
TN	5.8	5.9	7.1	0.72	0.548	6.27	0.63	0.70	
TQ	5.6	5.3	5.5	0.15	0.127	5.47	-0.36	-0.29	
U	4.7	4.7	4.7	0.00	0.000	4.70	-1.31	-1.24	
UM									•
UP	6.0	7.1	7.1	0.64	0.464	6.73	1.20	1.28	
UQ	6.7	7.0	7.1	0.21	0.169	6.93	1.45	1.53	
UR									•
UZ									•
VA									•
VH									•
VI	7.3	9.2	5.5	1.85	2.069	7.33	1.95	2.02	
W									•
WC	1.4	1.5	2.2	0.44	0.338	1.70	-5.02	-4.95	×
WG									•
WH	5.3	5.6	5.8	0.25	0.211	5.57	-0.24	-0.16	
WI									•
WJ									•
WO	5.6	3.7	4.0	1.02	0.802	4.43	-1.64	-1.57	
WR									•
WS									•

• ≡ 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
WX									•
X	1.7	2.2	1.7	0.29	0.211	1.87	-4.82	-4.74	×
XA									•
XC									•
XD									•
XI	5.6	6.7	6.1	0.55	0.464	6.13	0.46	0.54	
XK									•
XL	5.3	5.4	5.6	0.15	0.127	5.43	-0.40	-0.33	
XM	7.0	6.0	4.4	1.31	1.185	5.80	0.05	0.12	
XQ									•
XS									•
XT									•
Y									•

Data sorted by Laboratory Average

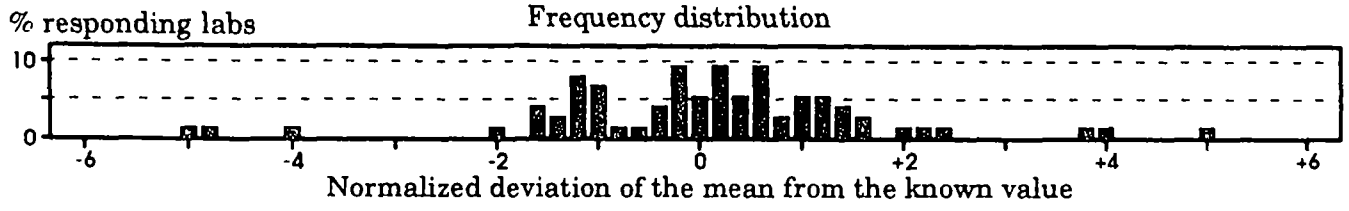
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.70	×	**WC**	5.47		**TQ**	6.17		**MF**
1.87	×	**X**	5.53		**MX**	6.17		**E**
2.50	×	**AK**	5.57		**WH**	6.20		**EL**
4.13		**DE**	5.57		**N**	6.20		**DB**
4.37		**TD**	5.57		**JS**	6.27		**TN**
4.43		**WO**	5.60		**JY**	6.40		**O**
4.43		**AW**	5.60		**RX**	6.43		**BK**
4.50		**HP**	5.63		**RZ**	6.43		**AF**
4.57		**SM**	5.63		**K**	6.47		**Q**
4.67		**C**	5.67		**AJ**	6.50		**DZ**
4.70		**U**	5.77		**BM**	6.60		**QU**
4.70		**AE**	5.80		**XM**	6.67		**DT**
4.73		**EB**	5.80		**NJ**	6.70		**CJ**
4.73		**NH**	5.80		**L**	6.73		**UP**
4.77		**HL**	5.83		**KH**	6.77		**BB**
4.83		**ID**	5.83		**HE**	6.83		**I**
4.87		**BA**	5.90		**EO**	6.90		**SX**
4.87		**AL**	5.90		**CE**	6.93		**UQ**
4.90		**GN**	6.00		**BC**	7.00		**RD**
4.93		**QZ**	6.03		**SI**	7.33		**VI**
5.03		**HK**	6.03		**JX**	7.47		**KL**
5.20		**SD**	6.07		**CA**	7.63		**A**
5.40		**BO**	6.13		**XI**	8.73	×	**P**
5.43		**XL**	6.13		**SS**	8.90	×	**CS**
5.43		**S**	6.13		**BH**	9.77	×	**GQ**

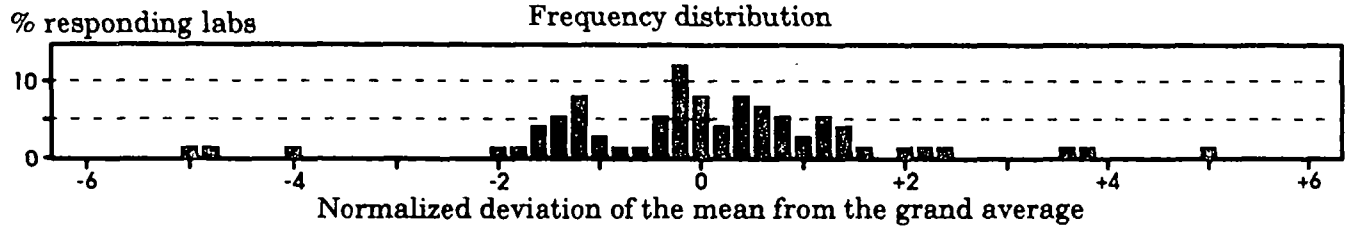
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228


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


% 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

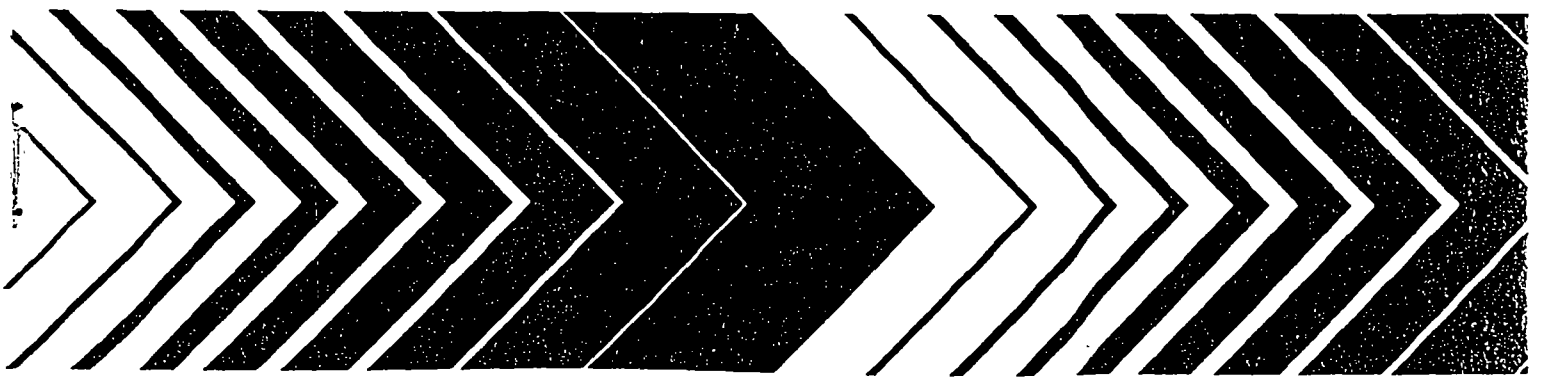
Office of Research and
Development
Washington, DC 20460

EPA/600/R-99/018
February 1999

EPA

Blind-A Performance Evaluation Study

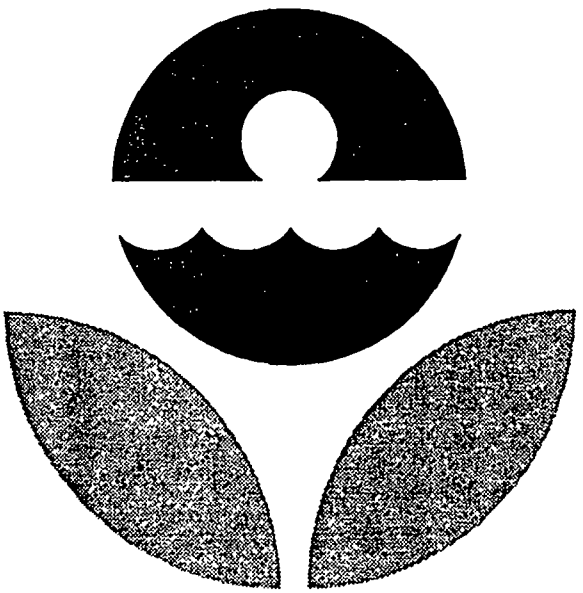
A Statistical Evaluation of the October 20, 1998 Data



Blind-A

Performance Evaluation Study

October 20, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Blind-A; October 20, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

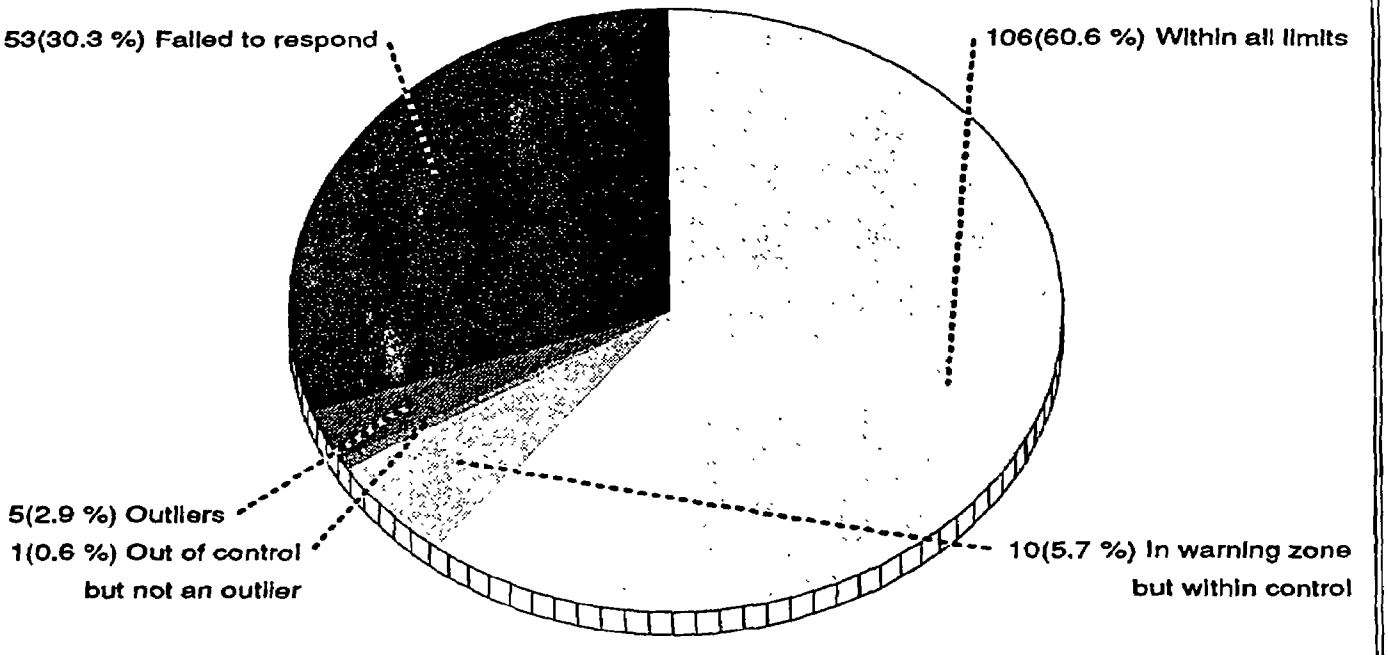
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

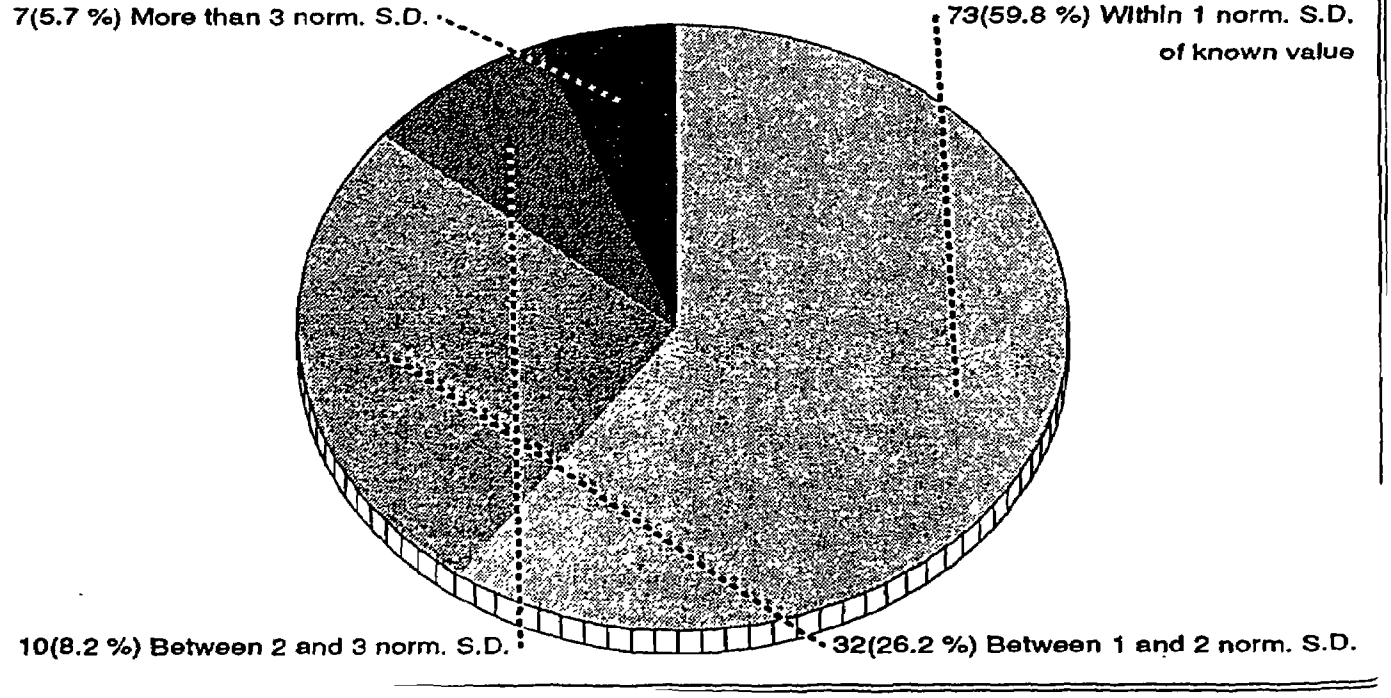
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Alpha Statistical Summary 175 Participants

The known value of this nuclide is 30.1 pCi/l with an expected precision of 7.5; the control limits are 17.1 to 43.1; the warning regions are 17.1 to 21.4 and 38.8 to 43.1



Statistic	Respondents	Non-outliers
Mean	34.81	**Grand Avg 30.01**
Std. Dev.	33.08	5.15
Variance	1094.21	26.55
% Coef. of Var.	95.02	17.17
% deviation of mean from known value	15.66	-0.31
Norm. dev. of mean from known value	0.14	-0.02
Median	29.33	29.00
% deviation of median from known value	-2.55	-3.65
Norm. dev. of median from known value	-0.02	-0.21



ESD-LV Performance Evaluation: Blind-A, 20-Oct-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	29.8	28.1	29.0	0.85	0.134	28.97	-0.24	-0.26	
AE	26.9	28.7	28.4	0.96	0.142	28.00	-0.46	-0.48	
AF	33.5	31.2	33.9	1.46	0.213	32.87	0.66	0.64	
AH	38.1	37.3	28.9	5.10	0.725	34.77	1.10	1.08	
AJ	25.9	23.9	30.0	3.11	0.480	26.60	-0.79	-0.81	
AK	30.2	29.7	30.9	0.60	0.095	30.27	0.06	0.04	
AL	33.5	28.4	31.9	2.61	0.402	31.27	0.29	0.27	
AP									•
AR	35.7	35.4	35.9	0.25	0.039	35.67	1.31	1.29	
AU	35.0	33.4	34.0	0.81	0.126	34.13	0.95	0.93	
AW	21.3	24.3	24.9	1.93	0.284	23.50	-1.50	-1.52	
AZ	26.3	27.8	27.4	0.78	0.118	27.17	-0.66	-0.68	
BA	31.1	30.9	28.8	1.27	0.181	30.27	0.06	0.04	
BB	33.4	35.2	33.2	1.10	0.158	33.93	0.91	0.89	
BC	36.1	37.4	35.7	0.89	0.134	36.40	1.48	1.45	
BG									•
BH	27.5	24.9	26.8	1.35	0.205	26.40	-0.83	-0.85	
BK	38.0	32.0	35.0	3.00	0.473	35.00	1.15	1.13	
BL									•
BM	32.4	30.9	33.5	1.31	0.205	32.27	0.52	0.50	
BN	28.0	29.3	29.0	0.68	0.102	28.77	-0.29	-0.31	
BO	37.3	38.7	40.3	1.50	0.236	38.77	2.02	2.00	
BS	34.0	33.9	32.8	0.67	0.095	33.57	0.82	0.80	
C	25.9	27.1	27.7	0.92	0.142	26.90	-0.72	-0.74	
CA	26.6	24.6	25.2	1.03	0.158	25.47	-1.05	-1.07	
CC									•
CE	22.3	17.0	23.9	3.61	0.543	21.07	-2.06	-2.09	
CJ	23.0	19.0	23.0	2.31	0.315	21.67	-1.93	-1.95	
CO									•
CP	29.8	26.4	25.7	2.19	0.323	27.30	-0.62	-0.65	
CS	253.1	246.9	252.5	3.42	0.488	250.83	51.00	50.98	×
CX	28.6	28.0	27.0	0.81	0.126	27.87	-0.49	-0.52	
D	30.6	31.4	33.0	1.22	0.189	31.67	0.38	0.36	
DB	28.5	29.0	29.5	0.50	0.079	29.00	-0.23	-0.25	
DD	23.7	25.8	24.0	1.14	0.165	24.50	-1.27	-1.29	
DE	32.5	32.9	33.5	0.50	0.079	32.97	0.68	0.66	
DI									•
DO									•
DT	29.2	26.1	27.2	1.57	0.244	27.50	-0.58	-0.60	
DZ	25.9	25.4	25.4	0.29	0.039	25.57	-1.03	-1.05	
E	28.4	28.4	27.3	0.64	0.087	28.03	-0.46	-0.48	
EB	50.0	52.5	52.1	1.34	0.197	51.53	4.97	4.95	×
EL									•
EO	29.0	30.0	33.0	2.08	0.315	30.67	0.15	0.13	
ER									•

• ≡ 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
EV	27.4	23.3	27.2	2.31	0.323	25.97	-0.93	-0.95	
EX	31.0	25.3	27.3	2.89	0.449	27.87	-0.49	-0.52	
FE									•
FF	27.8	26.2	25.8	1.06	0.158	26.60	-0.79	-0.81	
FJ	27.8	26.9	27.8	0.52	0.071	27.50	-0.58	-0.60	
FL	30.0	22.0	27.0	4.04	0.630	26.33	-0.85	-0.87	
FN	56.0	57.0	60.0	2.08	0.315	57.67	6.39	6.37	×
GI									•
GQ	31.7	31.8	31.6	0.10	0.016	31.70	0.39	0.37	
GZ	43.6	40.9	44.5	1.87	0.284	43.00	3.00	2.98	
HI	25.9	21.9	21.9	2.31	0.315	23.23	-1.56	-1.59	
HK	41.4	39.9	39.6	0.96	0.142	40.30	2.38	2.36	
HL	23.2	26.3	26.6	1.88	0.268	25.37	-1.07	-1.09	
HP	25.1	29.5	24.2	2.84	0.417	26.27	-0.86	-0.89	
I	24.9	24.4	27.1	1.44	0.213	25.47	-1.05	-1.07	
ID	28.6	34.8	32.8	3.16	0.488	32.07	0.48	0.45	
IU									•
J									•
JE	30.6	29.3	29.5	0.70	0.102	29.80	-0.05	-0.07	
JG									•
JM	28.6	29.4	30.0	0.70	0.110	29.33	-0.16	-0.18	
JN	37.9	39.8	36.7	1.56	0.244	38.13	1.88	1.86	
JQ	31.9	32.5	32.2	0.30	0.047	32.20	0.51	0.48	
JS	25.5	26.4	24.7	0.85	0.134	25.53	-1.03	-1.05	
JX									•
JY									•
K	30.3	26.3	31.6	2.76	0.417	29.40	-0.14	-0.16	
KE	26.1	25.4	22.9	1.68	0.252	24.80	-1.20	-1.22	
KT	26.0	26.5	27.0	0.50	0.079	26.50	-0.81	-0.83	
KX	42.8	34.4	39.5	4.23	0.662	38.90	2.05	2.03	
L	28.2	25.8	26.6	1.22	0.189	26.87	-0.72	-0.75	
LE									•
LF	24.0	27.0	25.0	1.53	0.236	25.33	-1.08	-1.10	
LL	43.1	50.9	32.7	9.13	1.825	42.23	2.82	2.80	
LR	31.0	32.0	32.0	0.58	0.079	31.67	0.38	0.36	
M									•
MF	29.6	30.5	29.2	0.67	0.102	29.77	-0.06	-0.08	
MP									•
MT									•
MV									•
MY									•
N									•
NA	35.0	35.0	32.0	1.73	0.236	34.00	0.92	0.90	
NH	18.0	26.0	23.0	4.04	0.630	22.33	-1.77	-1.79	
NJ	31.3	30.8	31.9	0.55	0.087	31.33	0.31	0.28	

• ≡ 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
NK									•
NO									•
O	31.7	34.8	36.0	2.22	0.339	34.17	0.96	0.94	
OB									•
OF	34.4	33.0	28.1	3.31	0.496	31.83	0.42	0.40	
OM									•
OS	28.0	27.0	29.0	1.00	0.158	28.00	-0.46	-0.48	
OY									•
P	46.3	44.6	38.4	4.16	0.622	43.10	3.02	3.00	
PB									•
PD									•
PG	42.3	42.3	43.4	0.64	0.087	42.67	2.92	2.90	
PM	27.5	29.2	29.1	0.95	0.134	28.60	-0.32	-0.35	
PW									•
Q	29.6	32.9	32.5	1.80	0.260	31.67	0.38	0.36	
QM									•
QP	30.8	27.9	31.0	1.73	0.244	29.90	-0.02	-0.05	
QQ	31.3	31.6	31.6	0.17	0.024	31.50	0.35	0.32	
QT	25.0	28.1	27.8	1.71	0.244	26.97	-0.70	-0.72	
QU	22.5	22.9	23.8	0.67	0.102	23.07	-1.60	-1.62	
QW	22.9	22.3	22.3	0.35	0.047	22.50	-1.73	-1.76	
QX	23.6	23.5	23.7	0.10	0.016	23.60	-1.48	-1.50	
QZ	26.8	27.1	25.2	1.02	0.150	26.37	-0.84	-0.86	
RB	29.7	29.3	30.3	0.50	0.079	29.77	-0.06	-0.08	
RD	24.2	30.2	26.7	3.01	0.473	27.03	-0.69	-0.71	
RG									•
RI	34.1	34.2	30.0	2.40	0.331	32.77	0.64	0.62	
RK	314.9	318.9	310.8	4.05	0.638	314.87	65.79	65.76	×
RP									•
RR									•
RU									•
RZ	37.4	37.4	37.5	0.06	0.008	37.43	1.72	1.69	
S	36.2	37.1	36.7	0.45	0.071	36.67	1.54	1.52	
SD	32.0	31.5	33.6	1.10	0.165	32.37	0.55	0.52	
SF	31.0	29.2	31.0	1.04	0.142	30.40	0.09	0.07	
SG	30.7	28.5	27.7	1.55	0.236	28.97	-0.24	-0.26	
SI	27.2	28.9	27.6	0.89	0.134	27.90	-0.49	-0.51	
SL	41.6	46.6	45.1	2.57	0.394	44.43	3.33	3.31	⇑
SM	32.4	28.8	34.1	2.71	0.417	31.77	0.41	0.38	
SN	30.9	32.5	31.1	0.87	0.126	31.50	0.35	0.32	
SO	24.2	25.5	25.4	0.72	0.102	25.03	-1.15	-1.17	
SR									•
SS	33.7	26.3	32.1	3.89	0.583	30.70	0.16	0.14	
SX	28.7	27.3	28.5	0.76	0.110	28.17	-0.42	-0.45	
T	25.2	22.5	22.9	1.46	0.213	23.53	-1.49	-1.52	

• ≡ 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
TD	44.8	35.0	37.8	5.05	0.772	39.20	2.12	2.10	
TL									•
TN	19.0	22.9	25.3	3.18	0.496	22.40	-1.76	-1.78	
TQ	34.9	31.8	33.2	1.55	0.244	33.30	0.76	0.74	
TY	24.5	25.1	21.9	1.70	0.252	23.83	-1.43	-1.45	
U	29.2	30.0	28.8	0.61	0.095	29.33	-0.16	-0.18	
UA									•
UM									•
UP	31.0	33.0	34.0	1.53	0.236	32.67	0.61	0.59	
UQ	26.3	26.6	27.4	0.57	0.087	26.77	-0.75	-0.77	
UY									•
VA									•
VC									•
VH	20.0	23.3	28.8	4.45	0.693	24.03	-1.38	-1.40	
VI	31.7	27.7	25.5	3.14	0.488	28.30	-0.39	-0.42	
VJ	34.2	34.8	37.7	1.87	0.276	35.57	1.28	1.26	
VM									•
VO	27.8	28.6	27.0	0.80	0.126	27.80	-0.51	-0.53	
VT	39.6	39.0	41.3	1.19	0.181	39.97	2.30	2.28	
W	38.5	38.4	39.8	0.78	0.110	38.90	2.05	2.03	
WE	25.1	30.6	26.4	2.87	0.433	27.37	-0.61	-0.63	
WH	30.2	25.2	26.2	2.65	0.394	27.20	-0.65	-0.67	
WO	65.9	58.5	60.5	3.83	0.583	61.63	7.30	7.28	×
WR	33.0	37.2	37.3	2.45	0.339	35.83	1.35	1.32	
WW	24.9	24.0	29.2	2.78	0.410	26.03	-0.92	-0.94	
X	33.2	30.5	27.5	2.85	0.449	30.40	0.09	0.07	
XA									•
XC									•
XD									•
XF	29.8	29.5	28.2	0.85	0.126	29.17	-0.19	-0.22	
XI	25.0	24.0	26.0	1.00	0.158	25.00	-1.16	-1.18	
XJ									•
XK									•
XL	24.6	24.6	26.9	1.33	0.181	25.37	-1.07	-1.09	
XM	28.3	28.3	28.5	0.12	0.016	28.37	-0.38	-0.40	
XN	18.5	22.4	28.0	4.78	0.748	22.97	-1.63	-1.65	
XP									•
XQ									•
XT									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
21.07		CE	22.33		NH	22.50		QW
21.67		CJ	22.40		TN	22.97		XN

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

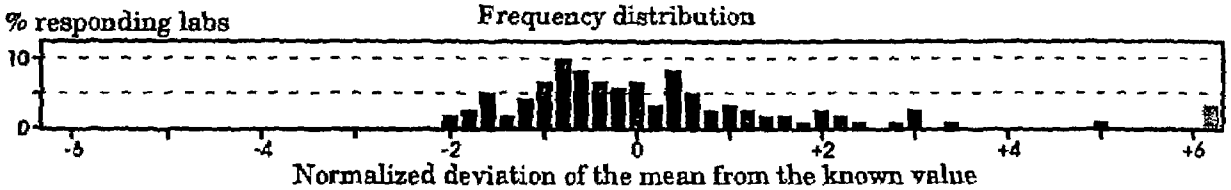
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
23.07		QU	27.80		VO	32.07		ID
23.23		HI	27.87		EX	32.20		JQ
23.50		AW	27.87		CX	32.27		BM
23.53		T	27.90		SI	32.37		SD
23.60		QX	28.00		OS	32.67		UP
23.83		TY	28.00		AE	32.77		RI
24.03		VH	28.03		E	32.87		AF
24.50		DD	28.17		SX	32.97		DE
24.80		KE	28.30		VI	33.30		TQ
25.00		XI	28.37		XM	33.57		BS
25.03		SO	28.60		PM	33.93		BB
25.33		LF	28.77		BN	34.00		NA
25.37		XL	28.97		SG	34.13		AU
25.37		HL	28.97		A	34.17		O
25.47		I	29.00		DB	34.77		AH
25.47		CA	29.17		XF	35.00		BK
25.53		JS	29.33		U	35.57		VJ
25.57		DZ	29.33		JM	35.67		AR
25.97		EV	29.40		K	35.83		WR
26.03		WW	29.77		RB	36.40		BC
26.27		HP	29.77		MF	36.67		S
26.33		FL	29.80		JE	37.43		RZ
26.37		QZ	29.90		QP	38.13		JN
26.40		BH	30.27		BA	38.77		BO
26.50		KT	30.27		AK	38.90		W
26.60		FF	30.40		X	38.90		KX
26.60		AJ	30.40		SF	39.20		TD
26.77		UQ	30.67		EO	39.97		VT
26.87		L	30.70		SS	40.30		HK
26.90		C	31.27		AL	42.23		LL
26.97		QT	31.33		NJ	42.67		PG
27.03		RD	31.50		SN	43.00		GZ
27.17		AZ	31.50		QQ	43.10		P
27.20		WH	31.67		Q	44.43	⇑	SL
27.30		CP	31.67		LR	51.53	×	EB
27.37		WE	31.67		D	57.67	×	FN
27.50		FJ	31.70		GQ	61.63	×	WO
27.50		DT	31.77		SM	250.83	×	CS
			31.83		OF	314.87	×	RK

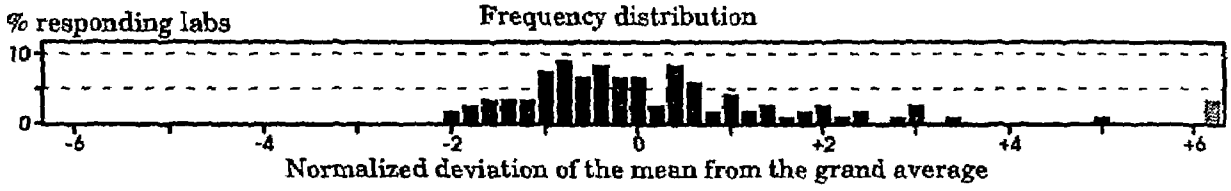
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

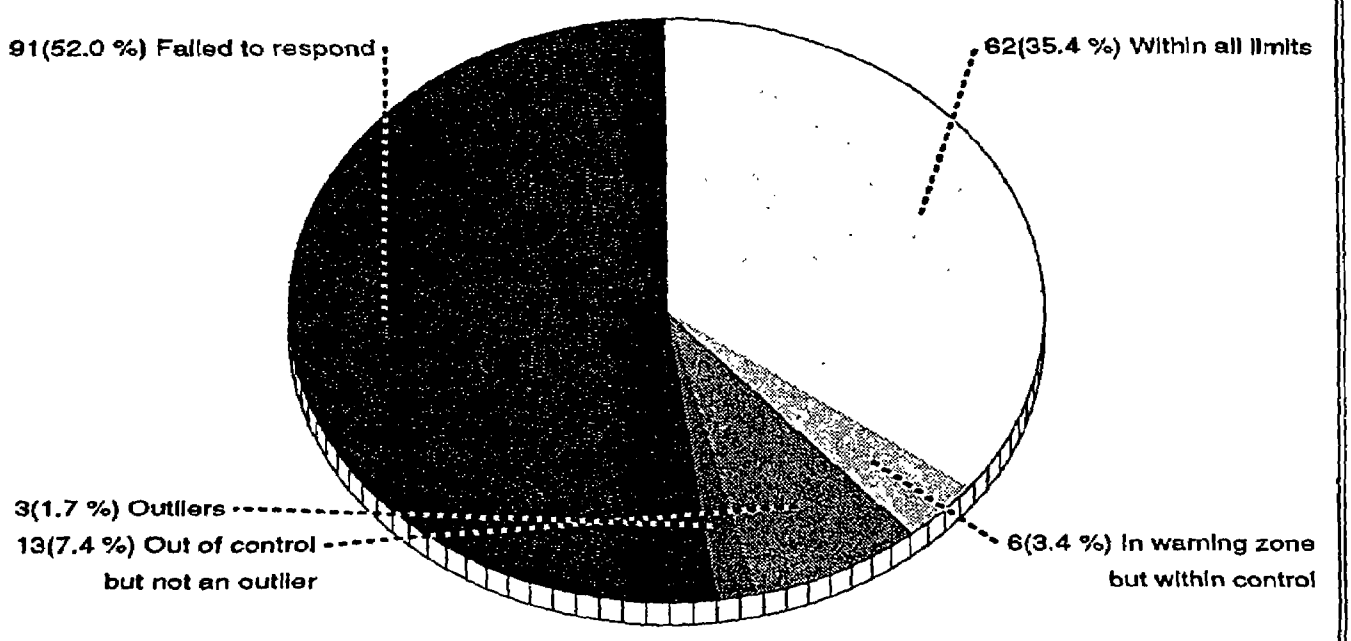
Gross Alpha


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

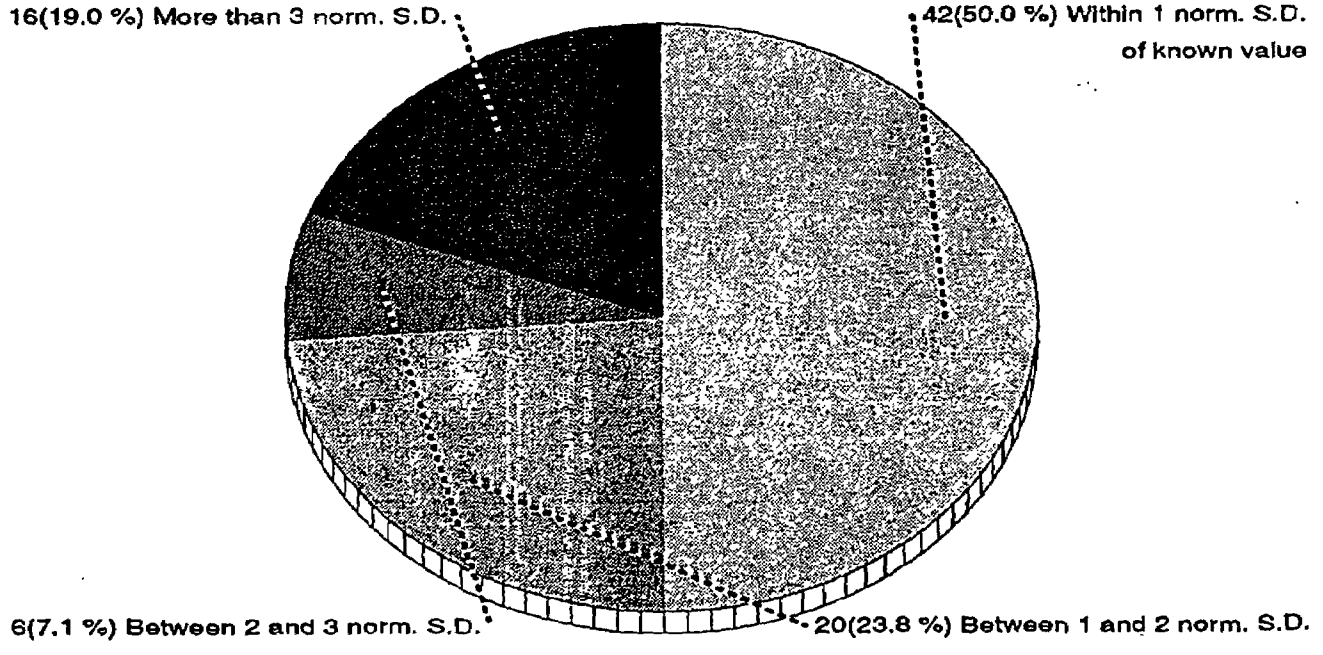

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Radium-226 Statistical Summary 175 Participants

The known value of this nuclide is 4.5 pCi/l with an expected precision of 0.7; the control limits are 3.3 to 5.7; the warning regions are 3.3 to 3.7 and 5.3 to 5.7



Statistic	Respondents	Non-outliers
Mean	4.71	**Grand Avg** 4.53
Std. Dev.	1.41	0.98
Variance	1.98	0.97
% Coef. of Var.	29.90	21.72
% deviation of mean from known value	4.64	0.57
Norm. dev. of mean from known value	0.15	0.03
Median	4.47	4.40
% deviation of median from known value	-0.74	-2.22
Norm. dev. of median from known value	-0.02	-0.10



ESD-LV Performance Evaluation: Blind-A, 20-Oct-1998

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	5.1	4.8	4.5	0.30	0.506	4.80	0.68	0.74	
AE	4.0	4.1	4.1	0.06	0.084	4.07	-1.14	-1.07	
AF	4.2	4.5	4.1	0.21	0.338	4.27	-0.64	-0.58	
AH									•
AJ	8.3	7.4	6.3	1.00	2.310	7.33	6.95	7.01	⇑
AK	4.3	5.9	4.1	0.99	1.988	4.77	0.60	0.66	
AL	4.0	4.2	5.2	0.64	1.024	4.47	-0.15	-0.08	
AP									•
AR									•
AU	1.6	1.6	1.6	0.00	0.000	1.60	-7.24	-7.18	⇓
AW	4.4	4.5	4.6	0.10	0.169	4.50	-0.06	0.00	
AZ	4.2	4.5	4.5	0.17	0.253	4.40	-0.31	-0.25	
BA	4.0	4.2	3.4	0.42	0.675	3.87	-1.63	-1.57	
BB	5.8	6.7	7.1	0.67	1.185	6.53	4.97	5.03	⇑
BC	4.5	4.8	4.6	0.15	0.253	4.63	0.27	0.33	
BG									•
BH	4.6	4.0	4.2	0.31	0.506	4.27	-0.64	-0.58	
BK	4.6	4.7	4.6	0.06	0.084	4.63	0.27	0.33	
BL									•
BM	4.4	4.4	4.4	0.00	0.000	4.40	-0.31	-0.25	
BN	2.6	3.5	2.9	0.46	0.759	3.00	-3.77	-3.71	⇓
BO	4.4	4.4	4.4	0.00	0.000	4.40	-0.31	-0.25	
BS									•
C	5.0	4.8	4.7	0.15	0.253	4.83	0.76	0.82	
CA	4.2	4.4	4.1	0.15	0.253	4.23	-0.72	-0.66	
CC									•
CE	5.0	4.1	3.9	0.59	0.928	4.33	-0.48	-0.41	
CJ	4.7	4.9	4.4	0.25	0.422	4.67	0.35	0.41	
CO									•
CP									•
CS	4.1	4.0	4.6	0.32	0.506	4.23	-0.72	-0.66	
CX									•
D									•
DB	4.8	4.9	5.0	0.10	0.169	4.90	0.93	0.99	
DD									•
DE	4.6	4.6	4.7	0.06	0.084	4.63	0.27	0.33	
DI									•
DO									•
DT	3.9	4.0	4.5	0.32	0.506	4.13	-0.97	-0.91	
DZ	5.0	4.0	4.2	0.53	0.844	4.40	-0.31	-0.25	
E	4.7	4.4	4.0	0.35	0.591	4.37	-0.39	-0.33	
EB	4.0	3.8	3.9	0.10	0.169	3.90	-1.55	-1.48	
EL	5.0	5.1	5.3	0.15	0.253	5.13	1.50	1.57	
EO	4.3	4.3	4.3	0.00	0.000	4.30	-0.56	-0.49	
ER									•

• ≡ 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
EV	•								
EX	•								
FE	•								
FF	•								
FJ	•								
FL	•								
FN	5.6	5.6	5.1	0.29	0.422	5.43	2.25	2.31	
GI	•								
GQ	4.2	4.0	4.7	0.36	0.591	4.30	-0.56	-0.49	
GZ	•								
HI	•								
HK	4.3	4.8	4.5	0.25	0.422	4.53	0.02	0.08	
HL	3.7	3.9	3.6	0.15	0.253	3.73	-1.96	-1.90	
HP	5.9	5.5	4.9	0.50	0.844	5.43	2.25	2.31	
I	4.0	4.1	3.9	0.10	0.169	4.00	-1.30	-1.24	
ID	4.7	3.0	4.5	0.93	1.828	4.07	-1.14	-1.07	
IU	•								
J	•								
JE	5.9	4.5	4.0	0.98	2.149	4.80	0.68	0.74	
JG	•								
JM	2.2	2.3	2.3	0.06	0.084	2.27	-5.59	-5.53	⇓
JN	•								
JQ	•								
JS	4.8	4.9	4.6	0.15	0.253	4.77	0.60	0.66	
JX	4.7	4.7	4.4	0.17	0.253	4.60	0.18	0.25	
JY	•								
K	4.6	4.0	4.9	0.46	0.759	4.50	-0.06	0.00	
KE	•								
KT	•								
KX	•								
L	3.8	4.4	3.5	0.46	0.759	3.90	-1.55	-1.48	
LE	•								
LF	•								
LL	•								
LR	•								
M	3.0	3.4	3.6	0.31	0.506	3.33	-2.95	-2.89	
MF	3.9	4.0	4.1	0.10	0.169	4.00	-1.30	-1.24	
MP	•								
MT	•								
MV	•								
MY	•								
N	•								
NA	•								
NH	4.4	4.1	4.0	0.21	0.338	4.17	-0.89	-0.82	
NJ	5.5	5.9	4.1	0.95	1.988	5.17	1.59	1.65	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-A, 20-Oct-1998

Radium-226

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
NK									•
NO									•
O	4.7	4.5	5.1	0.31	0.506	4.77	0.60	0.66	
OB									•
OF									•
OM									•
OS									•
OY									•
P	2.9	2.1	3.7	0.80	1.667	2.90	-4.02	-3.96	⇓
PB									•
PD									•
PG	6.3	7.8	7.0	0.75	1.506	7.03	6.21	6.27	⇑
PM									•
PW									•
Q	3.5	3.4	3.4	0.06	0.084	3.43	-2.70	-2.64	
QM	2.8	2.9	3.1	0.15	0.253	2.93	-3.94	-3.88	⇓
QP									•
QQ	4.9	4.9	5.4	0.29	0.422	5.07	1.34	1.40	
QT	2.1	2.4	2.0	0.21	0.338	2.17	-5.84	-5.77	⇓
QU	4.9	5.9	5.7	0.53	0.844	5.50	2.41	2.47	
QW									•
QX									•
QZ	4.2	4.4	4.3	0.10	0.169	4.30	-0.56	-0.49	
RB									•
RD	5.1	4.9	5.1	0.12	0.169	5.03	1.26	1.32	
RG									•
RI									•
RK	3.7	4.0	3.5	0.25	0.422	3.73	-1.96	-1.90	
RP									•
RR									•
RU									•
RZ	4.3	4.1	4.3	0.12	0.169	4.23	-0.72	-0.66	
S	5.2	5.7	4.9	0.40	0.675	5.27	1.83	1.90	
SD	4.2	3.6	4.2	0.35	0.506	4.00	-1.30	-1.24	
SF									•
SG									•
SI	13.8	14.2	9.1	2.84	7.292	12.37	19.40	19.46	×
SL									•
SM	7.5	7.7	7.6	0.10	0.169	7.60	7.61	7.67	⇑
SN									•
SO									•
SR									•
SS	4.4	4.7	4.6	0.15	0.253	4.57	0.10	0.16	
SX	4.2	4.1	4.3	0.10	0.169	4.20	-0.61	-0.74	
T	4.7	4.6	4.9	0.15	0.253	4.73	0.51	0.58	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ 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
TD	4.4	4.5	4.5	0.06	0.084	4.47	-0.15	-0.08	
TL									•
TN	4.1	4.7	4.4	0.30	0.506	4.40	-0.31	-0.25	
TQ	4.0	4.5	4.3	0.25	0.422	4.27	-0.64	-0.58	
TY									•
U	4.1	3.8	3.9	0.15	0.253	3.93	-1.47	-1.40	
UA									•
UM									•
UP	5.4	5.4	4.4	0.58	0.844	5.07	1.34	1.40	
UQ	4.1	4.3	4.2	0.10	0.169	4.20	-0.81	-0.74	
UY									•
VA	6.1	6.0	6.2	0.10	0.169	6.10	3.90	3.96	⇑
VC									•
VH	8.6	7.0	10.0	1.50	3.917	8.53	9.92	9.98	×
VI	5.6	5.1	5.7	0.32	0.506	5.47	2.33	2.39	
VJ									•
VM									•
VO									•
VT	6.7	7.6	9.9	1.65	4.238	8.07	8.76	8.83	×
W	3.0	4.2	4.1	0.67	1.024	3.77	-1.88	-1.81	
WE									•
WH	4.0	4.6	4.5	0.32	0.506	4.37	-0.39	-0.33	
WO	6.2	6.2	6.0	0.12	0.169	6.13	3.98	4.04	⇑
WR									•
WW									•
X	4.8	6.0	4.7	0.72	1.185	5.17	1.59	1.65	
XA	4.2	4.6	5.8	0.83	1.667	4.87	0.84	0.91	
XC									•
XD									•
XF									•
XI	7.3	4.6	5.9	1.35	3.435	5.93	3.48	3.55	⇑
XJ									•
XK									•
XL	4.6	4.8	5.0	0.20	0.338	4.80	0.68	0.74	
XM	5.5	5.2	4.8	0.35	0.591	5.17	1.59	1.65	
XN									•
XP									•
XQ									•
XT									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.60	⇓	AU	2.27	⇓	JM	2.93	⇓	QM
2.17	⇓	QT	2.90	⇓	P	3.00	⇓	BN

• ≡ No data submitted
Ø ≡ Insufficient data

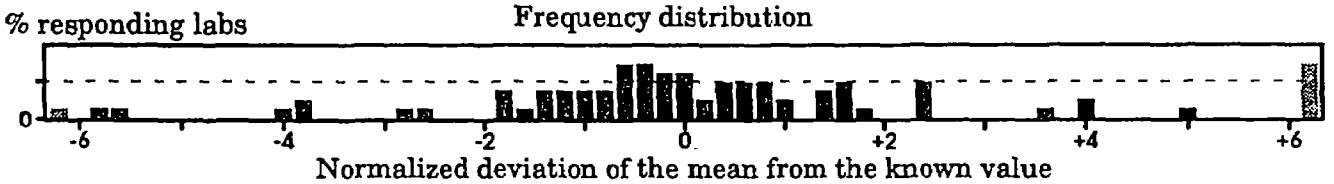
TAG SYMBOLS
× ≡ Determined to be an outlier

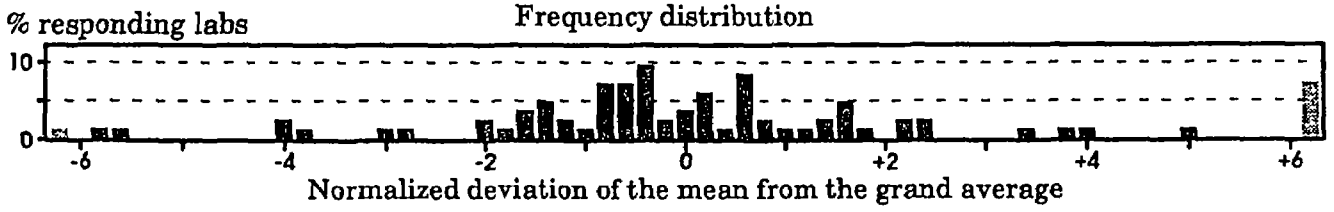
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-226

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
3.33		M	4.30		EO	4.80		A
3.43		Q	4.33		CE	4.83		C
3.73		RK	4.37		WH	4.87		XA
3.73		HL	4.37		E	4.90		DB
3.77		W	4.40		TN	5.03		RD
3.87		BA	4.40		DZ	5.07		UP
3.90		L	4.40		BO	5.07		QQ
3.90		EB	4.40		BM	5.13		EL
3.93		U	4.40		AZ	5.17		XM
4.00		SD	4.47		TD	5.17		X
4.00		MF	4.47		AL	5.17		NJ
4.00		I	4.50		K	5.27		S
4.07		ID	4.50		AW	5.43		FN
4.07		AE	4.53		HK	5.43		HP
4.13		DT	4.57		SS	5.47		VI
4.17		NH	4.60		JX	5.50		QU
4.20		UQ	4.63		DE	5.93	⇑	XI
4.20		SX	4.63		BK	6.10	⇑	VA
4.23		CS	4.63		BC	6.13	⇑	WO
4.23		CA	4.67		CJ	6.53	⇑	BB
4.23		RZ	4.73		T	7.03	⇑	PG
4.27		TQ	4.77		O	7.33	⇑	AJ
4.27		BH	4.77		JS	7.60	⇑	SM
4.27		AF	4.77		AK	8.07	×	VT
4.30		GQ	4.80		XL	8.53	×	VH
4.30		QZ	4.80		JE	12.37	×	SI





• ≡ No data submitted
Ø ≡ Insufficient data

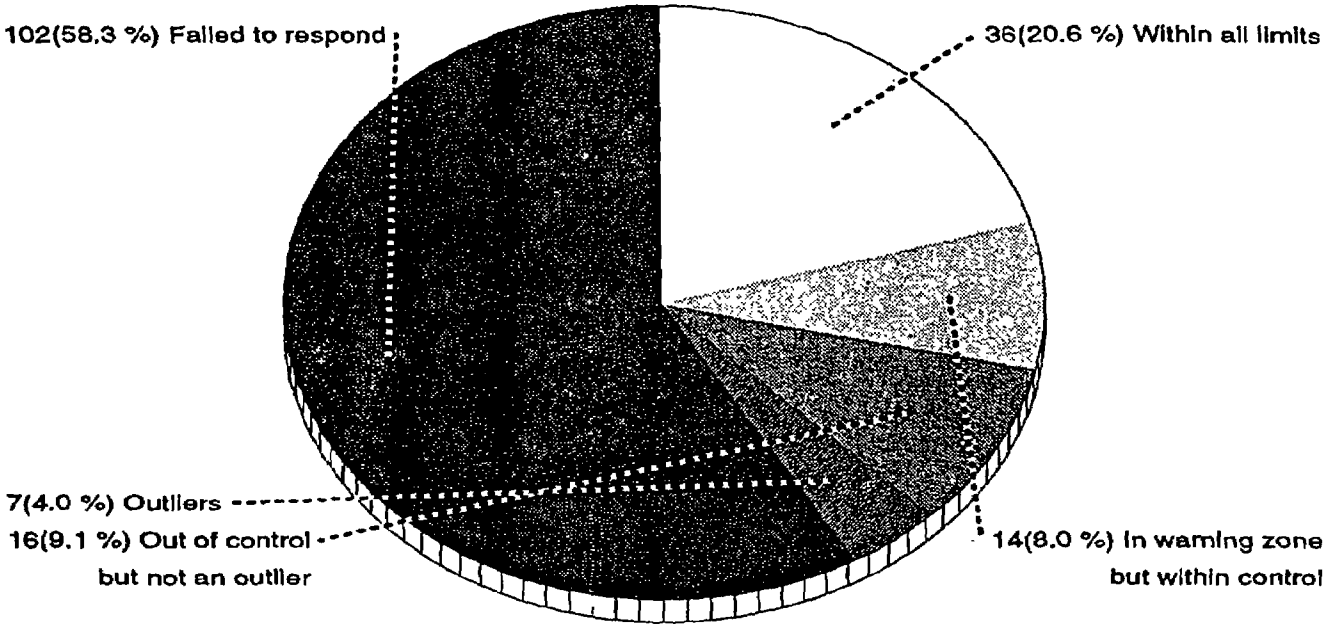
TAG SYMBOLS

× ≡ Determined to be an outlier

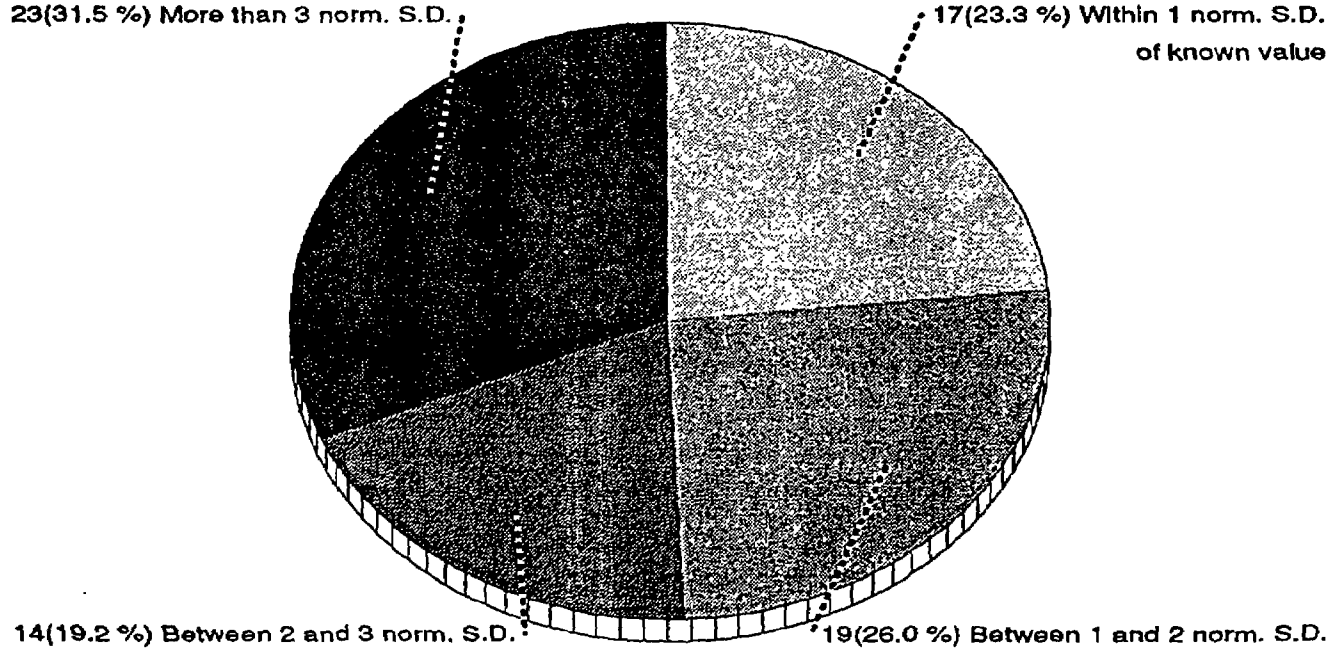
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228 Statistical Summary 175 Participants

The known value of this nuclide is **1.5 pCi/l** with an expected precision of **0.4**; the control limits are 0.8 to 2.2; the warning regions are 0.8 to 1.0 and 2.0 to 2.2



Statistic	Respondents	Non-outliers
Mean	2.48	**Grand Avg 1.92**
Std. Dev.	2.18	0.51
Variance	4.77	0.26
% Coef. of Var.	87.90	26.50
% deviation of mean from known value	65.66	27.85
Norm. dev. of mean from known value	0.45	0.82
Median	1.93	1.88
% deviation of median from known value	28.89	25.56
Norm. dev. of median from known value	0.20	0.75



Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	0.9	1.7	2.9	1.01	4.721	1.83	-0.37	1.44	
AE	1.3	1.8	2.0	0.36	1.064	1.70	-0.94	0.87	
AF	1.8	1.8	2.2	0.23	0.591	1.93	0.07	1.88	
AH									•
AJ	2.6	1.6	2.0	0.50	1.908	2.07	0.65	2.45	
AK	1.9	1.6	1.8	0.15	0.443	1.77	-0.65	1.15	
AL	1.5	1.3	1.1	0.20	0.591	1.30	-2.67	-0.87	
AP									•
AR									•
AU									•
AW	2.7	2.8	3.1	0.21	0.591	2.87	4.11	5.92	⇑
AZ	1.2	1.4	1.8	0.31	0.886	1.47	-1.95	-0.14	
BA	1.2	1.3	1.4	0.10	0.295	1.30	-2.67	-0.87	
BB									•
BC	2.9	3.0	2.6	0.21	0.591	2.83	3.96	5.77	⇑
BG									•
BH	2.1	2.8	2.6	0.36	1.064	2.50	2.52	4.33	⇑
BK	1.9	1.8	1.8	0.06	0.148	1.83	-0.37	1.44	
BL									•
BM	2.2	2.0	2.1	0.10	0.295	2.10	0.79	2.60	
BN									•
BO	1.6	2.3	1.6	0.40	1.064	1.83	-0.37	1.44	
BS									•
C	1.5	1.6	1.7	0.10	0.295	1.60	-1.38	0.43	
CA	4.0	3.8	5.1	0.70	2.752	4.30	10.32	12.12	×
CC									•
CE	1.8	2.9	3.1	0.70	2.752	2.60	2.95	4.76	⇑
CJ	2.6	1.7	1.4	0.62	2.470	1.90	-0.08	1.73	
CO									•
CP									•
CS	0.9	1.0	1.0	0.06	0.148	0.97	-4.12	-2.31	
CX									•
D									•
DB	1.9	2.0	1.9	0.06	0.148	1.93	0.07	1.88	
DD									•
DE	1.7	1.7	1.8	0.06	0.148	1.73	-0.80	1.01	
DI									•
DO									•
DT	1.5	1.7	1.8	0.15	0.443	1.67	-1.09	0.72	
DZ	2.9	2.3	2.4	0.32	0.886	2.53	2.67	4.47	⇑
E	2.0	2.0	1.5	0.29	0.738	1.83	-0.37	1.44	
EB	2.6	1.8	1.5	0.57	2.189	1.97	0.21	2.02	
EL	1.6	0.4	1.8	0.76	3.033	1.27	-2.82	-1.01	
EO	1.6	2.1	1.9	0.25	0.738	1.87	-0.22	1.59	
ER									•

• ≡ 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
EV									
EX									
FE									
FF									
FJ									
FL									
FN	2.4	2.3	2.4	0.06	0.148	2.37	1.94	3.75	⇑
GI									
GQ	2.2	2.3	2.2	0.06	0.148	2.23	1.37	3.18	⇑
GZ									
HI									
HK	2.0	2.0	2.1	0.06	0.148	2.03	0.50	2.31	
HL	1.5	1.6	1.4	0.10	0.295	1.50	-1.81	0.00	
HP	2.2	3.3	1.9	0.74	3.033	2.47	2.38	4.19	⇑
I	1.7	2.8	1.7	0.64	2.189	2.07	0.65	2.45	
ID	2.2	1.9	1.6	0.30	0.886	1.90	-0.08	1.73	
IU									
J									
JE									
JG									
JM									
JN									
JQ									
JS	1.6	1.0	1.1	0.32	0.886	1.23	-2.96	-1.15	
JX									
JY									
K	1.9	2.6	1.8	0.44	1.345	2.10	0.79	2.60	
KE									
KT									
KX									
L	1.9	2.0	1.8	0.10	0.295	1.90	-0.08	1.73	
LE									
LF									
LL									
LP									
M									
MF	2.1	2.0	1.8	0.15	0.443	1.97	0.21	2.02	
MP									
MT									
MV									
MY									
N									
NA									
NH									
NJ	1.2	1.9	1.7	0.36	1.064	1.60	-1.38	0.43	

• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-A, 20-Oct-1998

Radium-228

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
NK									•
NO									•
O	1.4	1.6	1.5	0.10	0.295	1.50	-1.81	0.00	
OB									•
OF									•
OM									•
OS									•
OY									•
P	1.7	0.7	1.0	0.51	1.908	1.13	-3.40	-1.59	
PB									•
PD									•
PG									•
PM									•
PW									•
Q	2.3	2.3	2.4	0.06	0.148	2.33	1.80	3.61	⇑
QM									•
QP									•
QQ									•
QT	2.2	1.8	2.0	0.20	0.591	2.00	0.36	2.17	
QU	2.8	3.2	3.3	0.26	0.738	3.10	5.12	6.93	⇑
QW									•
QX									•
QZ	1.7	1.5	1.5	0.12	0.295	1.57	-1.52	0.29	
RB									•
RD	2.1	3.5	3.2	0.74	3.033	2.93	4.40	6.21	⇑
RG									•
RI									•
RK	1.4	2.0	1.6	0.31	0.886	1.67	-1.09	0.72	
RP									•
RR									•
RU									•
RZ	1.4	1.3	1.4	0.06	0.148	1.37	-2.39	-0.58	
S	1.2	2.5	3.8	1.30	6.408	2.50	2.52	4.33	⇑
SD	3.0	2.6	3.3	0.35	1.064	2.97	4.54	6.35	⇑
SF									•
SG									•
SI	8.2	7.9	9.0	0.57	2.189	8.37	27.92	29.73	×
SL									•
SM	1.7	2.3	1.6	0.38	1.064	1.87	-0.22	1.59	
SN									•
SO									•
SR									•
SS	1.8	1.6	1.9	0.15	0.443	1.77	-0.65	1.15	
SX	1.6	1.6	1.8	0.12	0.295	1.67	-1.09	0.72	
T	2.2	1.9	1.9	0.17	0.443	2.00	0.36	2.17	

• ≡ 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
TD	0.2	2.5	2.1	1.23	5.564	1.60	-1.38	0.43	
TL									•
TN	1.3	1.4	1.8	0.26	0.738	1.50	-1.81	0.00	
TQ	1.9	2.2	0.9	0.68	2.752	1.67	-1.09	0.72	
TY									•
U	1.3	1.2	1.2	0.06	0.148	1.23	-2.96	-1.15	
UA									•
UM									•
UP	2.0	2.3	2.0	0.17	0.443	2.10	0.79	2.60	
UQ	2.1	2.0	2.2	0.10	0.295	2.10	0.79	2.60	
UY									•
VA	15.9	15.7	15.5	0.20	0.591	15.70	59.68	61.49	×
VC									•
VH	10.3	8.5	11.6	1.56	7.815	10.13	35.57	37.38	×
VI	3.1	4.6	6.8	1.86	9.502	4.83	12.63	14.43	×
VJ									•
VM									•
VO									•
VT	4.8	8.5	9.8	2.59	13.159	7.70	25.04	26.85	×
W	3.6	4.4	3.4	0.53	1.908	3.80	8.15	9.96	×
WE									•
WH	1.2	0.9	1.3	0.21	0.591	1.13	-3.40	-1.59	
WO	2.1	3.0	3.1	0.55	1.908	2.73	3.53	5.34	⇑
WR	2.0	2.8	2.9	0.49	1.627	2.57	2.81	4.62	⇑
WW									•
X	2.7	2.4	2.9	0.25	0.738	2.67	3.24	5.05	⇑
XA									•
XC									•
XD									•
XF									•
XI	0.9	1.1	1.0	0.10	0.295	1.00	-3.97	-2.17	
XJ									•
XK									•
XL	2.0	2.0	2.1	0.06	0.148	2.03	0.50	2.31	
XM	1.6	1.2	1.1	0.26	0.738	1.30	-2.67	-0.87	
XN									•
XP									•
XQ									•
XT									•
Y									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
0.97		CS	1.13		WH	1.23		U
1.00		XI	1.13		P	1.23		JS

• ≡ No data submitted
∅ ≡ Insufficient data

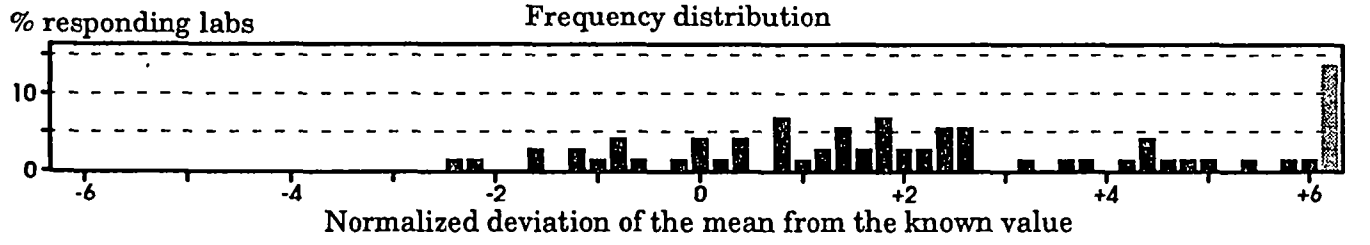
TAG SYMBOLS
× ≡ Determined to be an outlier

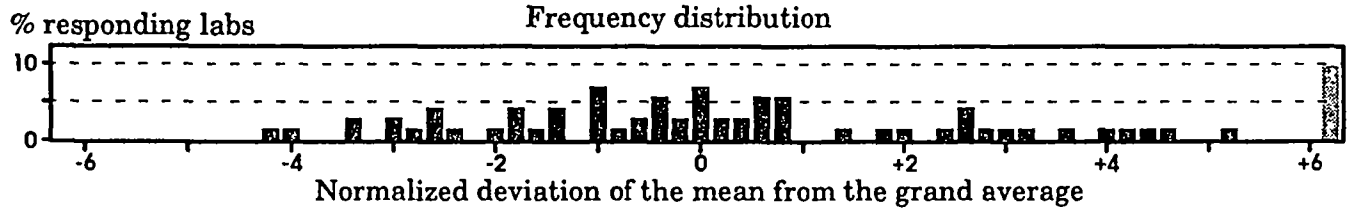
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Radium-228

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.27		EL	1.83		BO	2.23	⇑	GQ
1.30		XM	1.83		BK	2.33	⇑	Q
1.30		BA	1.83		A	2.37	⇑	FN
1.30		AL	1.87		SM	2.47	⇑	HP
1.37		RZ	1.87		EO	2.50	⇑	S
1.47		AZ	1.90		L	2.50	⇑	BH
1.50		TN	1.90		CJ	2.53	⇑	DZ
1.50		O	1.90		ID	2.57	⇑	WR
1.50		HL	1.93		DB	2.60	⇑	CE
1.57		QZ	1.93		AF	2.67	⇑	X
1.60		TD	1.97		MF	2.73	⇑	WO
1.60		NJ	1.97		EB	2.83	⇑	BC
1.60		C	2.00		T	2.87	⇑	AW
1.67		TQ	2.00		QT	2.93	⇑	RD
1.67		SX	2.03		XL	2.97	⇑	SD
1.67		RK	2.03		HK	3.10	⇑	QU
1.67		DT	2.07		AJ	3.80	×	W
1.70		AE	2.07		I	4.30	×	CA
1.73		DE	2.10		K	4.83	×	VI
1.77		SS	2.10		UQ	7.70	×	VT
1.77		AK	2.10		UP	8.37	×	SI
1.83		E	2.10		BM	10.13	×	VH
						15.70	×	VA





• ≡ No data submitted
Ø ≡ Insufficient data

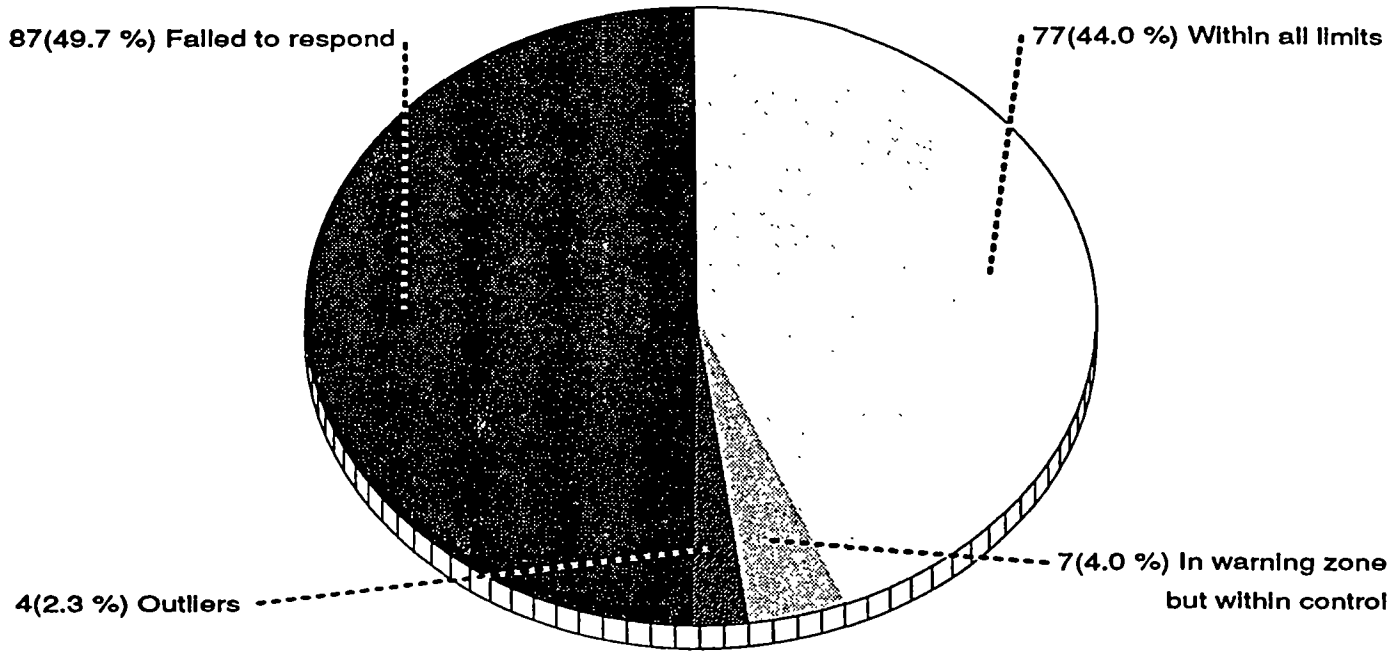
TAG SYMBOLS

× ≡ Determined to be an outlier

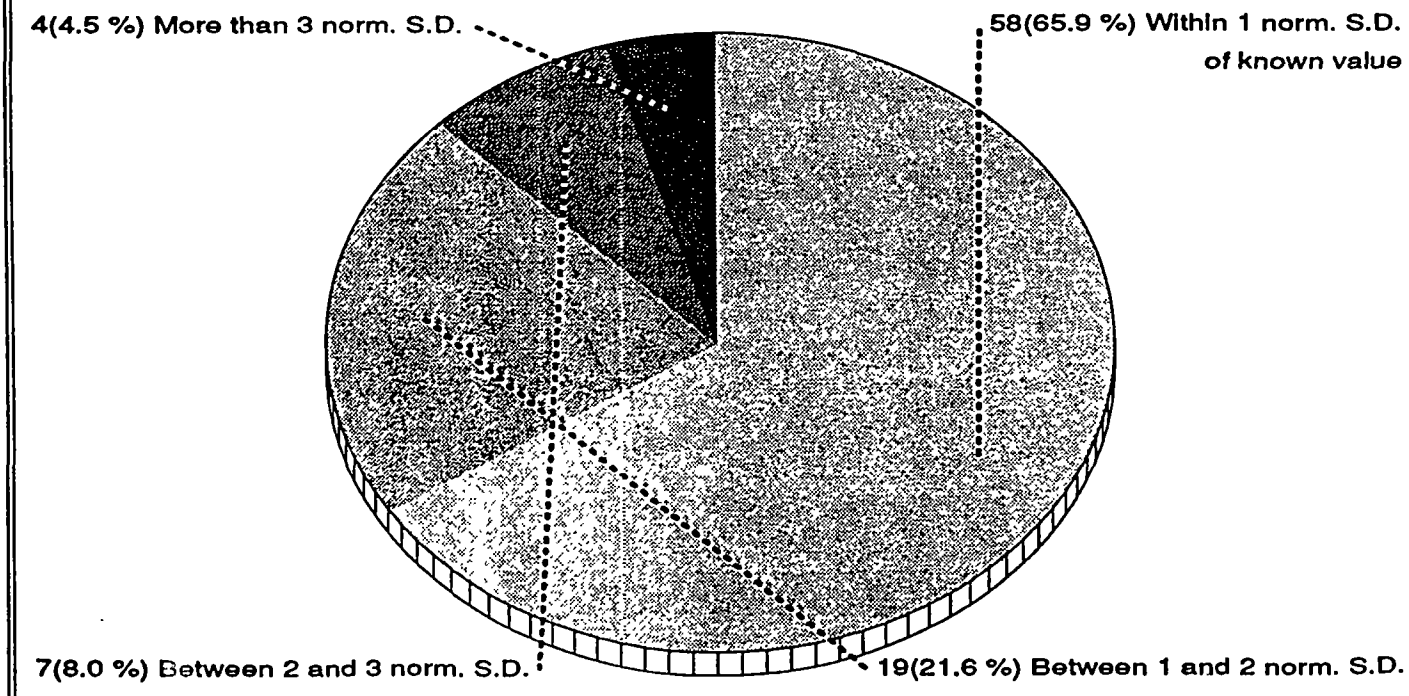
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural) Statistical Summary 175 Participants

The known value of this nuclide is 18.1 pCi/l with an expected precision of 3.0; the control limits are 12.9 to 23.3; the warning regions are 12.9 to 14.6 and 21.6 to 23.3



Statistic	Respondents	Non-outliers
Mean	17.46	**Grand Avg 17.30**
Std. Dev.	3.47	1.68
Variance	12.01	2.81
% Coef. of Var.	19.85	9.70
% deviation of mean from known value	-3.53	-4.40
Norm. dev. of mean from known value	-0.18	-0.48
Median	17.43	17.43
% deviation of median from known value	-3.68	-3.68
Norm. dev. of median from known value	-0.19	-0.40



Uranium (Natural)

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	17.1	16.9	17.4	0.25	0.098	17.13	-0.10	-0.56	
AE	14.2	14.7	16.9	1.44	0.532	15.27	-1.18	-1.64	
AF	19.5	20.2	17.7	1.29	0.492	19.13	1.06	0.60	
AH									•
AJ									•
AK	19.3	20.3	19.5	0.53	0.197	19.70	1.38	0.92	
AL	18.0	17.3	17.3	0.40	0.138	17.53	0.13	-0.33	
AP									•
AR	16.5	16.3	16.0	0.25	0.098	16.27	-0.60	-1.06	
AU									•
AW	17.9	18.2	17.8	0.21	0.079	17.97	0.38	-0.08	
AZ	17.8	17.0	18.9	0.95	0.374	17.90	0.34	-0.12	
BA	19.8	17.4	18.0	1.25	0.473	18.40	0.63	0.17	
BB	15.2	15.5	15.4	0.15	0.059	15.37	-1.12	-1.58	
BC	17.9	18.5	17.7	0.42	0.158	18.03	0.42	-0.04	
BG									•
BH	13.6	14.5	15.2	0.80	0.315	14.43	-1.66	-2.12	
BK	17.1	17.0	17.1	0.06	0.020	17.07	-0.14	-0.60	
BL									•
BM	17.7	15.1	16.8	1.32	0.512	16.53	-0.44	-0.90	
BN	14.6	14.5	13.3	0.72	0.256	14.13	-1.83	-2.29	
BO	18.6	18.6	18.5	0.06	0.020	18.57	0.73	0.27	
BS									•
C	17.8	16.9	16.4	0.71	0.276	17.03	-0.16	-0.62	
CA	15.9	16.3	16.2	0.21	0.079	16.13	-0.68	-1.14	
CC									•
CE	17.9	18.8	18.4	0.45	0.177	18.37	0.61	0.15	
CJ	20.0	18.0	19.0	1.00	0.394	19.00	0.98	0.52	
CO	15.8	15.1	16.4	0.65	0.256	15.77	-0.89	-1.35	
CP									•
CS	15.6	15.6	15.6	0.01	0.000	15.60	-0.98	-1.44	
CX	19.5	20.2	19.1	0.56	0.217	19.60	1.33	0.87	
D	18.4	20.1	19.2	0.85	0.335	19.23	1.11	0.65	
DB	15.4	16.4	13.0	1.75	0.669	14.93	-1.37	-1.83	
DD									•
DE	26.9	26.9	27.0	0.06	0.020	26.93	5.56	5.10	×
DI									•
DO	16.7	16.4	16.8	0.21	0.079	16.63	-0.39	-0.85	
DT	17.9	16.6	17.4	0.66	0.256	17.30	0.00	-0.46	
DZ	15.4	15.7	15.6	0.15	0.059	15.57	-1.00	-1.46	
E	16.1	16.3	17.6	0.81	0.295	16.67	-0.37	-0.83	
EB	13.0	14.2	15.2	1.10	0.433	14.13	-1.83	-2.29	
EL	13.3	13.6	14.4	0.57	0.217	13.77	-2.04	-2.50	
EO									•
ER									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ 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
EV									
EX									
FE									
FF									
FJ	17.1	17.8	17.9	0.44	0.158	17.60	0.17	-0.29	
FL									
FN	14.0	14.0	15.0	0.58	0.197	14.33	-1.71	-2.17	
GI									
GQ	17.5	17.6	17.7	0.10	0.039	17.60	0.17	-0.29	
GZ									
HI									
HK	41.0	38.8	41.4	1.40	0.512	40.40	13.34	12.87	×
HL	15.0	13.9	15.7	0.91	0.354	14.87	-1.41	-1.87	
HP	20.7	20.8	20.9	0.10	0.039	20.80	2.02	1.56	
I	17.9	15.0	16.2	1.46	0.571	16.37	-0.54	-1.00	
ID	17.6	18.0	17.7	0.21	0.079	17.77	0.27	-0.19	
IU									
J									
JE	17.0	16.7	17.5	0.40	0.158	17.07	-0.14	-0.60	
JG									
JM									
JN	16.6	15.2	17.9	1.35	0.532	16.57	-0.42	-0.89	
JQ									
JS	18.0	17.6	17.8	0.20	0.079	17.80	0.29	-0.17	
JX									
JY									
K	13.2	18.0	18.2	2.83	0.984	16.47	-0.48	-0.94	
KE									
KT	20.5	19.5	20.0	0.50	0.197	20.00	1.56	1.10	
KX									
L	20.6	19.2	19.2	0.81	0.276	19.67	1.36	0.90	
LE									
LF	18.3	17.5	17.0	0.66	0.256	17.60	0.17	-0.29	
LL									
LR									
M									
MF									
MP									
MT									
MV									
MY									
N									
NA	18.0	18.0	19.0	0.58	0.197	18.33	0.59	0.13	
NH	15.4	13.9	15.7	0.96	0.354	15.00	-1.33	-1.79	
NJ	16.0	16.8	17.3	0.66	0.256	16.70	-0.35	-0.81	

• ≡ 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
NK									•
NO									•
O									•
OB	19.9	18.0	18.3	1.02	0.374	18.73	0.83	0.37	
OF									•
OM									•
OS	17.7	18.0	17.6	0.21	0.079	17.77	0.27	-0.19	
OY									•
P	16.0	16.7	17.5	0.75	0.295	16.73	-0.33	-0.79	
PB									•
PD									•
PG									•
PM									•
PW									•
Q	17.7	18.2	18.6	0.45	0.177	18.17	0.50	0.04	
QM	20.9	20.4	20.3	0.32	0.118	20.53	1.87	1.40	
QP									•
QQ	16.3	17.3	16.9	0.50	0.197	16.83	-0.27	-0.73	
QT									•
QU	16.8	17.0	20.5	2.08	0.728	18.10	0.46	0.00	
QW									•
QX									•
QZ	17.7	17.6	17.9	0.15	0.059	17.73	0.25	-0.21	
RB									•
RD	5.6	5.6	5.6	0.00	0.000	5.60	6.76	-7.22	×
RG	17.5	17.6	17.6	0.06	0.020	17.57	0.15	-0.31	
RI									•
RK	17.5	14.7	14.5	1.68	0.591	15.57	-1.00	-1.46	
RP	17.6	17.5	17.5	0.06	0.020	17.53	0.13	-0.33	
RR									•
RU									•
RZ	16.4	16.6	15.3	0.70	0.256	16.10	-0.69	-1.15	
S	17.4	16.7	17.0	0.35	0.138	17.03	-0.16	-0.62	
SD	20.0	19.6	19.8	0.20	0.079	19.80	1.44	0.98	
SF									•
SG									•
SI	18.5	18.7	19.7	0.64	0.236	18.97	0.96	0.50	
SL	13.4	15.8	12.5	1.71	0.650	13.90	-1.96	-2.42	
SM	16.2	15.9	17.0	0.57	0.217	16.37	-0.54	-1.00	
SN									•
SO	14.6	14.6	17.2	1.50	0.512	15.47	-1.06	-1.52	
SR									•
SS	17.8	17.5	17.2	0.30	0.118	17.50	0.11	-0.35	
SX	17.4	17.0	16.9	0.26	0.098	17.10	-0.12	-0.58	
T	20.5	20.5	17.8	1.56	0.532	19.60	1.33	0.87	

• ≡ 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
TD	16.8	17.2	17.2	0.23	0.079	17.07	-0.14	-0.60	
TL									
TN									
TQ	18.4	18.4	18.1	0.17	0.059	18.30	0.58	0.12	
TY									
U	10.1	10.0	10.5	0.26	0.098	10.20	-4.10	-4.56	×
UA									
UM									
UP	16.5	16.7	16.0	0.36	0.138	16.40	-0.52	-0.98	
UQ									
UY									
VA									
VC									
VH	21.3	22.4	24.7	1.73	0.669	22.80	3.17	2.71	
VI	17.3	17.6	17.7	0.21	0.079	17.53	0.13	-0.33	
VJ									
VM									
VO	17.6	17.9	18.3	0.35	0.138	17.93	0.36	-0.10	
VT									
W	17.3	18.0	18.1	0.44	0.158	17.80	0.29	-0.17	
WE									
WH	15.8	16.3	17.2	0.71	0.276	16.43	-0.50	-0.96	
WO	17.2	17.1	17.4	0.15	0.059	17.23	-0.04	-0.50	
WR	18.0	18.2	18.5	0.25	0.098	18.23	0.54	0.08	
WW									
X	20.9	14.6	18.2	3.16	1.458	17.90	0.34	-0.12	
XA	19.0	16.6	16.5	1.42	0.492	17.37	0.04	-0.42	
XC									
XD									
XF									
XI	19.0	21.0	19.0	1.15	0.394	19.67	1.36	0.90	
XJ									
XK									
XL	16.0	16.6	16.3	0.30	0.118	16.30	-0.58	-1.04	
XM	17.8	17.7	17.5	0.15	0.059	17.67	0.21	-0.25	
XN									
XP									
XQ									
XT									
Y									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.60	×	RD	13.77		EL	14.13		EB
10.20	×	U	13.90		SL	14.13		BN

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

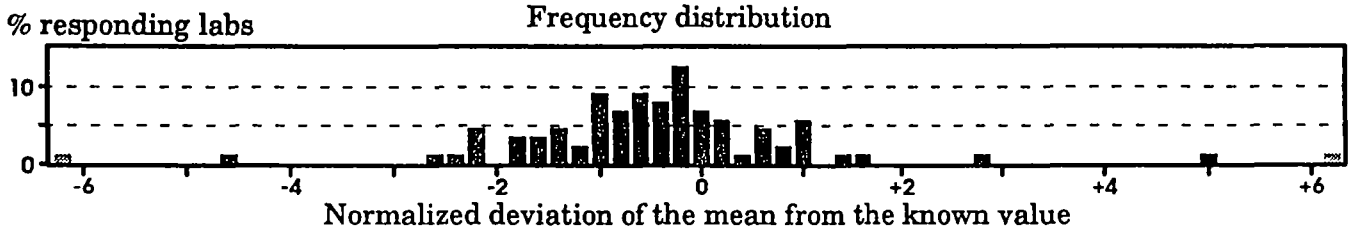
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Uranium (Natural)

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
14.33		FN	16.83		QQ	17.93		VO
14.43		BH	17.03		C	17.97		AW
14.87		HL	17.03		S	18.03		BC
14.93		DB	17.07		TD	18.10		QU
15.00		NH	17.07		JE	18.17		Q
15.27		AE	17.07		BK	18.23		WR
15.37		BB	17.10		SX	18.30		TQ
15.47		SO	17.13		A	18.33		NA
15.57		RK	17.23		WO	18.37		CE
15.57		DZ	17.30		DT	18.40		BA
15.60		CS	17.37		XA	18.57		BO
15.77		CO	17.50		SS	18.73		OB
16.10		RZ	17.53		AL	18.97		SI
16.13		CA	17.53		VI	19.00		CJ
16.27		AR	17.53		RP	19.13		AF
16.30		XL	17.57		RG	19.23		D
16.37		SM	17.60		LF	19.60		T
16.37		I	17.60		GQ	19.60		CX
16.40		UP	17.60		FJ	19.67		XI
16.43		WH	17.67		XM	19.67		L
16.47		K	17.73		QZ	19.70		AK
16.53		BM	17.77		OS	19.80		SD
16.57		JN	17.77		ID	20.00		KT
16.63		DO	17.80		W	20.53		QM
16.67		E	17.80		JS	20.80		HP
16.70		NJ	17.90		X	22.80		VH
16.73		P	17.90		AZ	26.93	×	DE
						40.40	×	HK



• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

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⇑ ≡ Above control limit
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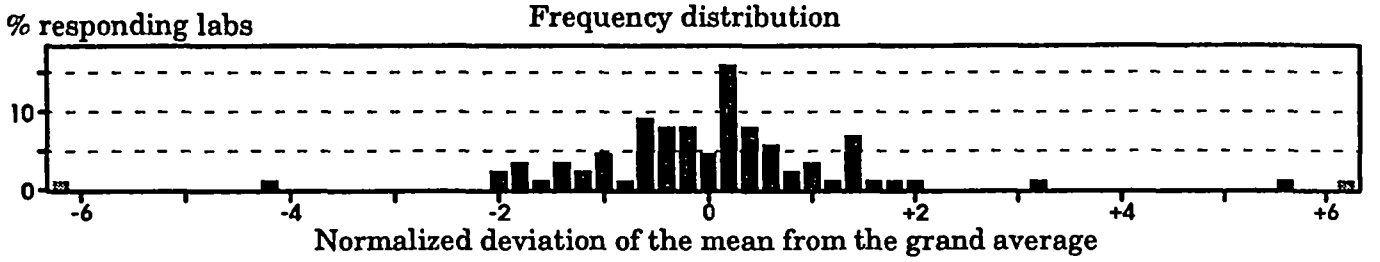
Uranium (Natural)



United States
Environmental Protection
Agency

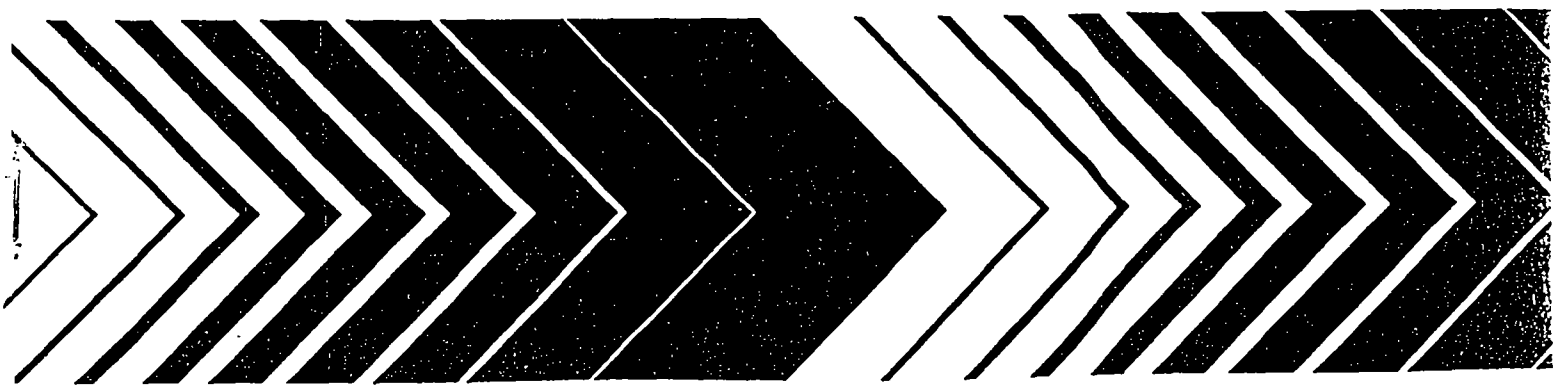
Office of Research and
Development
Washington, DC 20460

EPA/600/R-99/019
February 1999

EPA

Blind-B Performance Evaluation Study

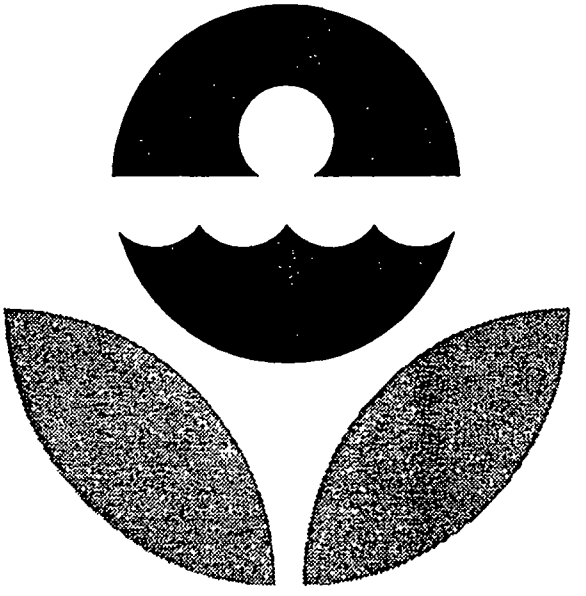
A Statistical Evaluation of the October 20, 1998 Data



Blind-B

Performance Evaluation Study

October 20, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Blind-B; October 20, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

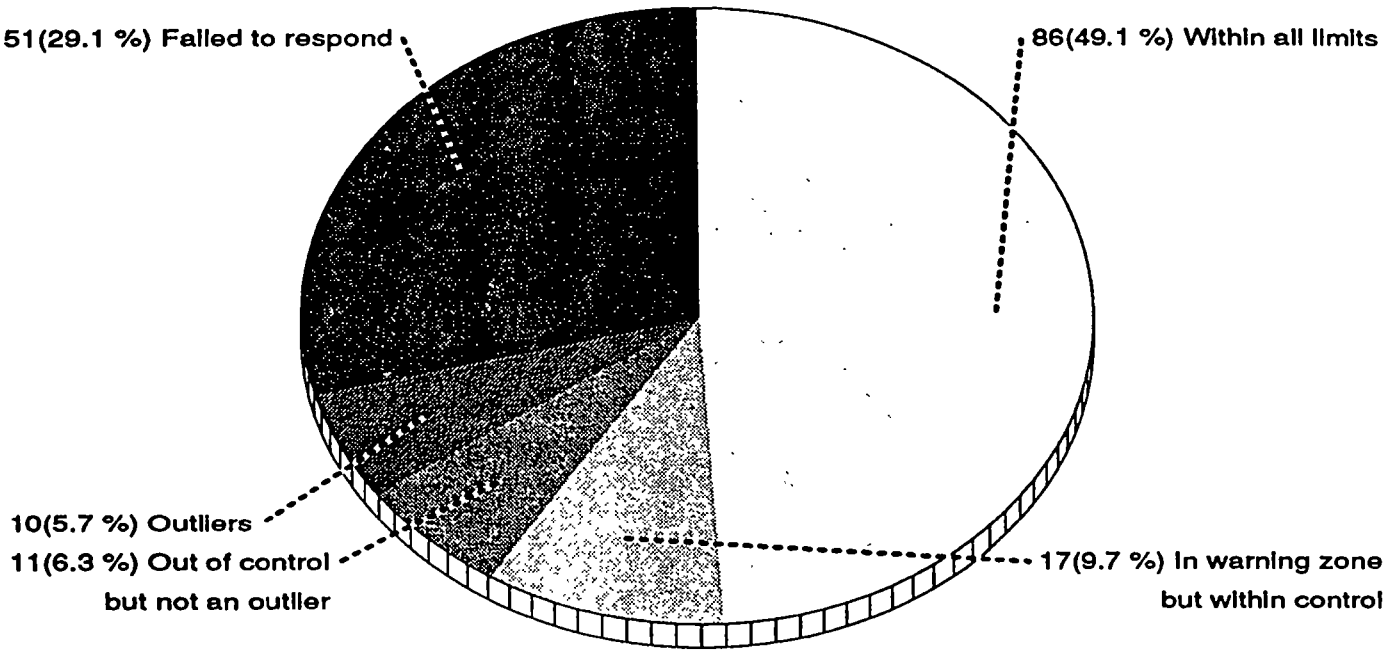
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

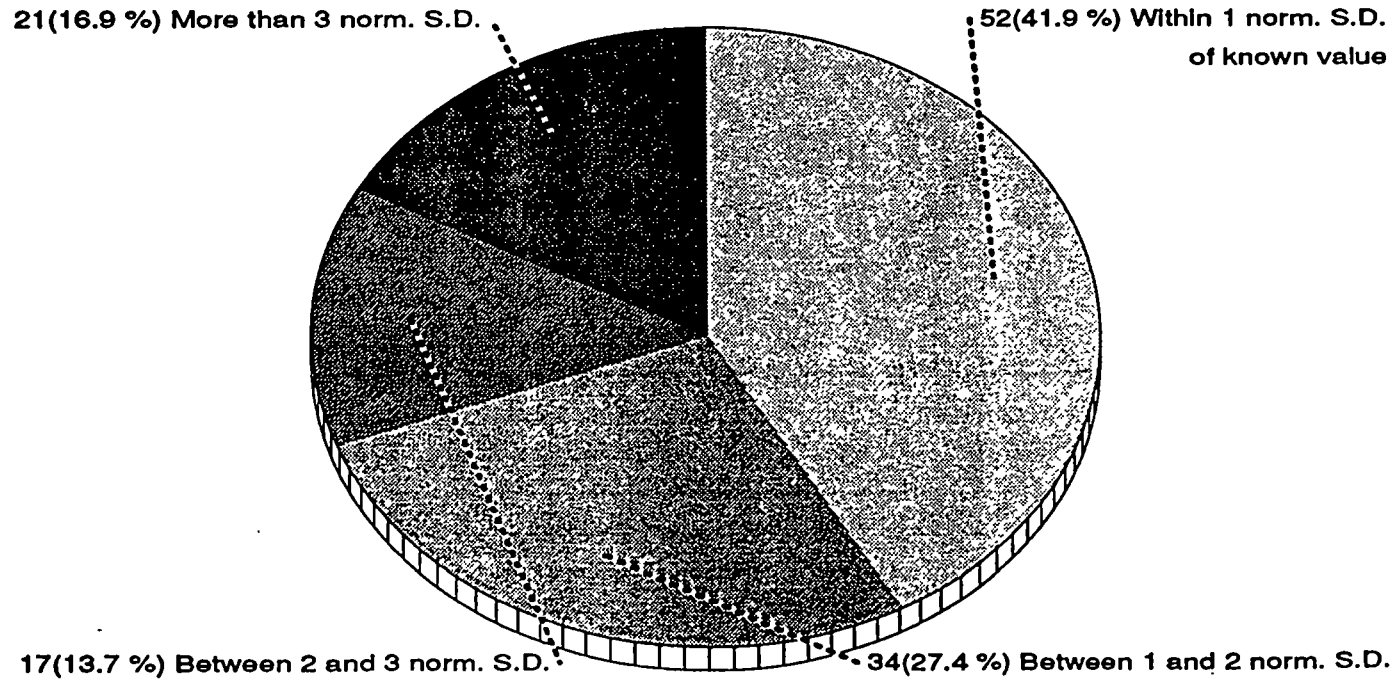
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Beta Statistical Summary 175 Participants

The known value of this nuclide is 94.0 pCi/l with an expected precision of 10.0; the control limits are 76.7 to 111.3; the warning regions are 76.7 to 82.4 and 105.6 to 111.3



Statistic	Respondents	Non-outliers
Mean	104.07	**Grand Avg 94.20**
Std. Dev.	93.80	10.64
Variance	8799.07	113.12
% Coef. of Var.	90.14	11.29
% deviation of mean from known value	10.71	0.21
Norm. dev. of mean from known value	0.11	0.02
Median	95.03	95.03
% deviation of median from known value	1.10	1.10
Norm. dev. of median from known value	0.01	0.10



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	90.6	95.4	93.6	2.42	0.284	93.20	-0.17	-0.14	
AE	86.6	86.3	88.7	1.31	0.142	87.20	-1.21	-1.18	
AF	104.1	103.7	104.4	0.35	0.041	104.07	1.71	1.74	
AH	80.7	86.0	81.9	2.78	0.313	82.87	-1.96	-1.93	
AJ	70.9	70.0	73.1	1.59	0.183	71.33	-3.96	-3.93	⇓
AK	94.8	94.3	96.4	1.10	0.124	95.17	0.17	0.20	
AL	96.2	94.2	95.7	1.04	0.118	95.37	0.20	0.24	
AP									•
AR	105.9	104.5	106.7	1.11	0.130	105.70	1.99	2.03	
AU	94.8	96.8	95.5	1.01	0.118	95.70	0.26	0.29	
AW	7.4	8.6	9.7	1.15	0.136	8.57	-14.83	-14.80	×
AZ	89.7	84.7	93.9	4.61	0.543	89.43	-0.83	-0.79	
BA	109.0	109.5	88.7	11.87	1.435	102.40	1.42	1.45	
BB	150.7	151.3	144.7	3.65	0.390	148.90	9.47	9.51	×
BC	88.4	90.1	93.8	2.76	0.319	90.77	-0.59	-0.56	
BG									•
BH	94.5	96.4	96.0	1.00	0.112	95.63	0.25	0.28	
BK	105.0	106.0	113.0	4.36	0.473	108.00	2.39	2.42	
BL									•
BM	96.7	99.4	97.0	1.48	0.159	97.70	0.61	0.64	
BN	72.2	73.0	74.1	0.95	0.112	73.10	-3.65	-3.62	⇓
BO	105.0	108.3	103.1	2.63	0.307	105.47	1.95	1.99	
BS	92.0	90.3	86.8	2.65	0.307	89.70	-0.78	-0.74	
C	99.9	97.5	95.0	2.45	0.289	97.47	0.57	0.60	
CA	95.7	88.9	94.9	3.72	0.402	93.17	-0.18	-0.14	
CC									•
CE	88.5	91.0	89.9	1.25	0.148	89.80	-0.76	-0.73	
CJ	73.0	83.0	68.0	7.64	0.886	74.67	-3.38	-3.35	⇓
CO									•
CP	684.0	767.5	713.8	42.32	8.490	721.77	108.70	108.73	×
CS	875.0	900.0	925.0	25.00	4.721	900.00	139.57	139.60	×
CX	88.7	86.9	84.0	2.37	0.278	86.53	-1.33	-1.29	
D	100.4	96.9	95.1	2.70	0.313	97.47	0.57	0.60	
DB	100.0	101.0	100.0	0.58	0.059	100.33	1.06	1.10	
DD	92.9	89.0	88.3	2.48	0.272	90.07	-0.72	-0.68	
DE	94.0	95.0	96.0	1.00	0.118	95.00	0.14	0.17	
DI									•
DO									•
DT	92.6	90.4	91.7	1.11	0.130	91.57	-0.46	-0.42	
DZ	90.5	93.3	99.8	4.77	0.549	94.53	0.06	0.09	
E	96.4	94.4	95.0	1.03	0.118	95.27	0.18	0.22	
EB	160.0	160.0	160.0	0.00	0.000	160.00	11.40	11.43	×
EL									•
EO	96.0	99.0	93.0	3.00	0.354	96.00	0.31	0.35	
ER									•

• ≡ 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
EV	111.7	99.8	106.4	5.96	0.703	105.97	2.04	2.07	
EX	101.1	92.2	89.2	6.19	0.703	94.17	-0.01	0.03	
FE									•
FF	76.7	76.8	77.8	0.61	0.065	77.10	-2.96	-2.93	
FJ									•
FL	82.0	88.0	88.0	3.46	0.354	86.00	-1.42	-1.39	
FN	4.0	4.0	6.0	1.15	0.118	4.67	-15.51	-15.47	×
GI									•
GQ	92.2	91.5	93.1	0.80	0.095	92.27	-0.34	-0.30	
GZ	104.5	103.8	100.8	1.97	0.219	103.03	1.53	1.56	
HI	37.3	35.7	36.4	0.80	0.095	36.47	-10.00	-9.97	×
HK	104.0	101.0	106.0	2.52	0.295	103.67	1.64	1.67	
HL	94.3	97.7	96.9	1.78	0.201	96.30	0.36	0.40	
HP	90.8	94.1	90.9	1.88	0.195	91.93	-0.39	-0.36	
I	97.4	100.3	96.5	1.99	0.224	98.07	0.67	0.70	
ID	84.4	85.2	82.0	1.67	0.189	83.87	-1.79	-1.76	
IU									•
J									•
JE	98.1	96.7	98.0	0.78	0.083	97.60	0.59	0.62	
JG									•
JM	98.1	98.8	101.2	1.63	0.183	99.37	0.89	0.93	
JN	113.0	109.0	104.0	4.51	0.532	108.67	2.51	2.54	
JQ	121.2	127.5	124.2	3.15	0.372	124.30	5.21	5.25	⇑
JS	101.0	102.6	103.3	1.18	0.136	102.30	1.40	1.44	
JX									•
JY									•
K	87.8	89.8	88.4	1.03	0.118	88.67	-0.96	-0.92	
KE	42.7	45.0	44.4	1.19	0.136	44.03	-8.69	-8.65	×
KT	80.0	82.5	79.0	1.80	0.207	80.50	-2.37	-2.34	
KX	106.4	105.9	106.7	0.40	0.047	106.33	2.10	2.14	
L	107.6	107.8	106.0	0.99	0.106	107.13	2.24	2.27	
LE									•
LF	87.0	86.0	81.0	3.21	0.354	84.67	-1.65	-1.62	
LL	116.9	113.7	114.6	1.65	0.189	115.07	3.61	3.65	⇑
LR	102.0	105.0	106.0	2.08	0.236	104.33	1.75	1.79	
M									•
MF	105.7	105.7	104.4	0.75	0.077	105.27	1.92	1.95	
MP									•
MT									•
MV	122.7	118.5	120.0	2.13	0.248	120.40	4.54	4.57	⇑
MY									•
N									•
NA	99.5	99.6	94.7	2.80	0.289	97.93	0.65	0.68	
NH	68.0	79.0	92.0	12.01	1.795	79.67	-2.52	-2.48	
NJ	91.3	91.0	90.5	0.40	0.047	90.93	-0.57	-0.53	

• ≡ 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)	(known)	Tag
NK									•
NO									•
O	89.9	91.4	94.5	2.35	0.272	91.93	-0.39	-0.36	
OB									•
OF	81.6	78.0	88.5	5.34	0.620	82.70	-1.99	-1.96	
OM									•
OS	84.0	84.0	81.0	1.73	0.177	83.00	-1.94	-1.91	
OY									•
P	98.6	120.8	106.7	11.23	1.593	108.70	2.51	2.55	
PB									•
PD									•
PG	105.3	103.1	105.3	1.27	0.130	104.57	1.80	1.83	
PM	95.8	97.6	101.3	2.80	0.325	98.23	0.70	0.73	
PW									•
Q	103.0	101.5	104.7	1.60	0.189	103.07	1.54	1.57	
QM	62.2	63.5	73.8	6.36	0.685	66.50	-4.80	-4.76	⇓
QP	89.8	78.9	87.2	5.69	0.644	85.30	-1.54	-1.51	
QQ	94.8	96.7	92.9	1.90	0.224	94.80	0.10	0.14	
QT	96.8	90.8	91.5	3.28	0.354	93.03	-0.20	-0.17	
QU	96.7	94.5	102.0	3.86	0.443	97.73	0.61	0.65	
QW	99.9	99.9	95.6	2.48	0.254	98.47	0.74	0.77	
QX	95.3	95.9	95.9	0.35	0.035	95.70	0.26	0.29	
QZ	74.5	78.6	78.4	2.31	0.242	77.17	-2.95	-2.92	
RB	103.0	106.0	102.0	2.08	0.236	103.67	1.64	1.67	
RD	3.1	4.8	4.8	0.98	0.100	4.23	-15.58	-15.55	×
RG									•
RI	100.6	100.8	102.7	1.16	0.124	101.37	1.24	1.28	
RK	91.0	78.4	82.8	6.39	0.744	84.07	-1.76	-1.72	
RP									•
RR									•
RU									•
RZ	92.1	94.7	94.9	1.56	0.165	93.90	-0.05	-0.02	
S	117.6	120.9	119.5	1.66	0.195	119.33	4.35	4.39	⇑
SD	98.0	104.1	105.8	4.10	0.461	102.63	1.46	1.50	
SF	114.4	109.0	107.0	3.83	0.437	110.13	2.76	2.79	
SG	104.9	97.1	96.1	4.82	0.520	99.37	0.89	0.93	
SI	79.0	82.7	81.9	1.95	0.219	81.20	-2.25	-2.22	
SL	70.7	72.5	72.0	0.93	0.106	71.73	-3.89	-3.86	⇓
SM	87.3	88.8	87.8	0.76	0.089	87.97	-1.08	-1.05	
SN	97.2	95.4	94.8	1.25	0.142	95.80	0.28	0.31	
SO	92.1	89.2	92.6	1.84	0.201	91.30	-0.50	-0.47	
SR									•
SS	84.9	87.6	82.6	2.50	0.295	85.03	-1.59	-1.55	
SX	95.3	101.1	100.6	3.21	0.343	99.00	0.83	0.87	
T	95.5	95.3	99.7	2.48	0.260	96.83	0.46	0.49	

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)	Normalized deviation (known)	Tag
TD	92.1	95.7	99.8	3.85	0.455	95.87	0.29	0.32	
TL									
TN	65.6	70.9	74.4	4.43	0.520	70.30	-4.14	-4.10	⇓
TQ	85.4	87.2	90.8	2.75	0.319	87.80	-1.11	-1.07	
TY	95.6	94.8	94.8	0.46	0.047	95.07	0.15	0.18	
U	103.5	97.9	100.4	2.81	0.331	100.60	1.11	1.14	
UA									
UM									
UP	98.0	105.0	101.0	3.51	0.413	101.33	1.24	1.27	
UQ	101.0	97.0	104.0	3.51	0.413	100.67	1.12	1.15	
UY									
VA									
VC									
VH	117.5	102.8	107.0	7.57	0.868	109.10	2.58	2.62	
VI	81.1	83.9	81.9	1.44	0.165	82.30	-2.06	-2.03	
VJ	87.9	92.4	91.5	2.38	0.266	90.60	-0.62	-0.59	
VM									
VO	96.2	100.0	88.2	6.02	0.697	94.80	0.10	0.14	
VT	122.5	146.9	140.7	12.68	1.840	136.70	7.36	7.40	×
W	91.2	85.0	85.6	3.42	0.366	87.27	-1.20	-1.17	
WE	110.0	107.0	107.0	1.73	0.177	108.00	2.39	2.42	
WH	92.6	95.4	102.5	5.10	0.585	96.83	0.46	0.49	
WO	92.5	101.0	109.0	8.25	0.975	100.83	1.15	1.18	
WR	90.3	90.6	95.0	2.63	0.278	91.97	-0.39	-0.35	
WW	76.0	78.6	84.6	4.41	0.508	79.73	-2.51	-2.47	
X	94.9	93.6	89.4	2.87	0.325	92.63	-0.27	-0.24	
XA									
XC									
XD									
XF	90.5	91.4	92.4	0.95	0.112	91.43	-0.48	-0.44	
XI	90.0	92.0	91.0	1.00	0.118	91.00	-0.55	-0.52	
XJ									
XK	77.7	94.8	86.7	8.55	1.019	86.40	-1.35	-1.32	
XL	87.5	91.4	95.4	3.95	0.467	91.43	-0.48	-0.44	
XM	86.7	85.1	86.9	0.99	0.106	86.23	-1.38	-1.35	
XN	74.0	71.1	71.9	1.50	0.171	72.33	-3.79	-3.75	⇓
XP									
XQ									
XT									
Y									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
4.23	×	RD	8.57	×	AW	44.03	×	KE
4.67	×	FN	36.47	×	HI	66.50	⇓	QM

• ≡ 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
70.30	⇓	TN	91.43		XL	99.00		SX
71.33	⇓	AJ	91.43		XF	99.37		SG
71.73	⇓	SL	91.57		DT	99.37		JM
72.33	⇓	XN	91.93		O	100.33		DB
73.10	⇓	BN	91.93		HP	100.60		U
74.67	⇓	CJ	91.97		WR	100.67		UQ
77.10		FF	92.27		GQ	100.83		WO
77.17		QZ	92.63		X	101.33		UP
79.67		NH	93.03		QT	101.37		RI
79.73		WW	93.17		CA	102.30		JS
80.50		KT	93.20		A	102.40		BA
81.20		SI	93.90		RZ	102.63		SD
82.30		VI	94.17		EX	103.03		GZ
82.70		OF	94.53		DZ	103.07		Q
82.87		AH	94.80		VO	103.67		RB
83.00		OS	94.80		QQ	103.67		HK
83.87		ID	95.00		DE	104.07		AF
84.07		RK	95.07		TY	104.33		LR
84.67		LF	95.17		AK	104.57		PG
85.03		SS	95.27		E	105.27		MF
85.30		QP	95.37		AL	105.47		BO
86.00		FL	95.63		BH	105.70		AR
86.23		XM	95.70		QX	105.97		EV
86.40		XK	95.70		AU	106.33		KX
86.53		CX	95.80		SN	107.13		L
87.20		AE	95.87		TD	108.00		WE
87.27		W	96.00		EO	108.00		BK
87.80		TQ	96.30		HL	108.67		JN
87.97		SM	96.83		WH	108.70		P
88.67		K	96.83		T	109.10		VH
89.43		AZ	97.47		D	110.13		SF
89.70		BS	97.47		C	115.07	⇑	LL
89.80		CE	97.60		JE	119.33	⇑	S
90.07		DD	97.70		BM	120.40	⇑	MV
90.60		VJ	97.73		QU	124.30	⇑	JQ
90.77		BC	97.93		NA	136.70	×	VT
90.93		NJ	98.07		I	148.90	×	BB
91.00		XI	98.23		PM	160.00	×	EB
91.30		SO	98.47		QW	721.77	×	CP
						900.00	×	CS

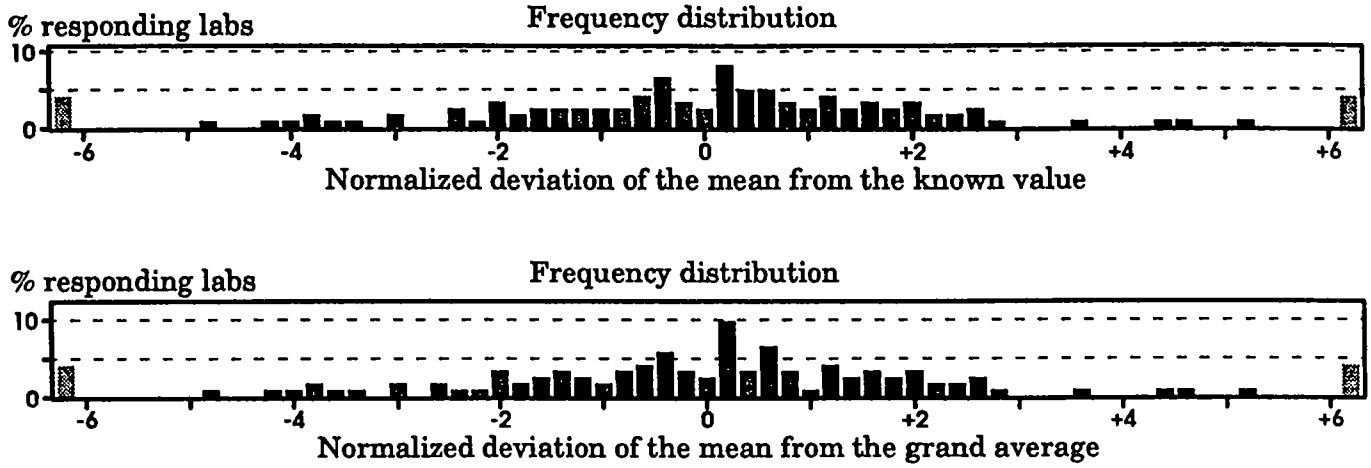
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

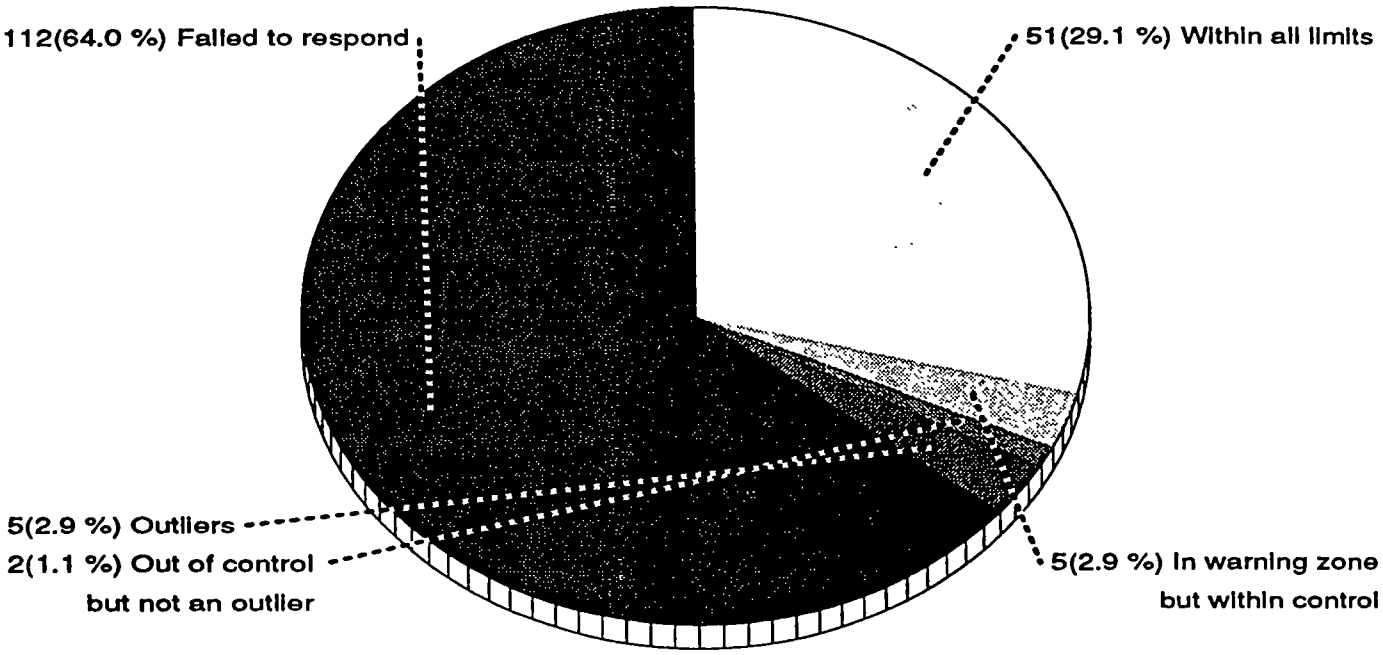
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Gross Beta

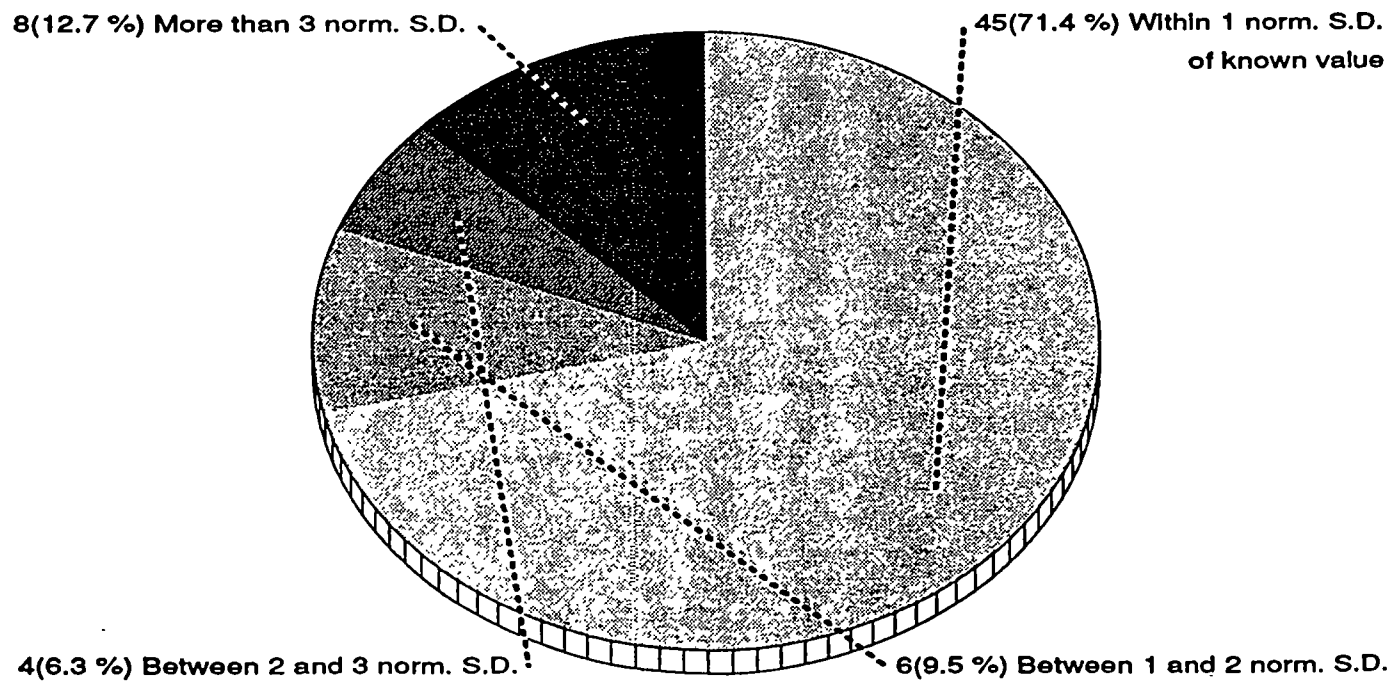

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the known value
% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Strontium-89 Statistical Summary 175 Participants

The known value of this nuclide is **19.0 pCi/l** with an expected precision of **5.0**; the control limits are 10.3 to 27.7; the warning regions are 10.3 to 13.2 and 24.8 to 27.7



Statistic	Respondents	Non-outliers
Mean	18.87	**Grand Avg 18.25**
Std. Dev.	6.43	3.33
Variance	41.34	11.10
% Coef. of Var.	34.08	18.26
% deviation of mean from known value	-0.70	-3.96
Norm. dev. of mean from known value	-0.02	-0.23
Median	18.33	18.33
% deviation of median from known value	-3.51	-3.51
Norm. dev. of median from known value	-0.10	-0.20



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	19.0	19.0	20.0	0.58	0.118	19.33	0.38	0.12	
AE	17.0	18.0	18.0	0.58	0.118	17.67	-0.20	-0.46	
AF	18.0	17.0	19.0	1.00	0.236	18.00	-0.09	-0.35	
AH									•
AJ	18.0	21.0	20.0	1.53	0.354	19.67	0.49	0.23	
AK	19.0	18.0	18.0	0.58	0.118	18.33	0.03	-0.23	
AL	19.0	20.0	18.0	1.00	0.236	19.00	0.26	0.00	
AP									•
AR									•
AU	32.0	40.0	32.0	4.62	0.945	34.67	5.69	5.43	×
AW	20.0	21.0	22.0	1.00	0.236	21.00	0.95	0.69	
AZ	18.0	19.0	18.0	0.58	0.118	18.33	0.03	-0.23	
BA	20.0	20.0	20.0	0.00	0.000	20.00	0.61	0.35	
BB									•
BC	17.0	18.0	18.0	0.58	0.118	17.67	-0.20	-0.46	
BG									•
BH	26.0	27.0	27.0	0.58	0.118	26.67	2.92	2.66	
BK									•
BL	21.0	19.0	18.0	1.53	0.354	19.33	0.38	0.12	
BM	19.0	19.0	20.0	0.58	0.118	19.33	0.38	0.12	
BN									•
BO	20.0	21.0	20.0	0.58	0.118	20.33	0.72	0.46	
BS									•
C	20.0	21.0	20.0	0.58	0.118	20.33	0.72	0.46	
CA	16.0	20.0	18.0	2.00	0.473	18.00	-0.09	-0.35	
CC									•
CE									•
CJ	20.0	17.0	18.0	1.53	0.354	18.33	0.03	-0.23	
CO	6.0	5.0	1.0	2.65	0.591	4.00	4.94	-5.20	×
CP	15.0	11.0	13.0	2.00	0.473	13.00	-1.82	-2.08	
CS	23.0	25.0	22.0	1.53	0.354	23.33	1.76	1.50	
CX	39.0	28.0	41.0	7.00	2.020	36.00	6.15	5.89	×
D	18.0	18.0	15.0	1.73	0.354	17.00	-0.43	-0.69	
DB									•
DD	23.0	22.0	18.0	2.65	0.591	21.00	0.95	0.69	
DE	17.0	17.0	17.0	0.00	0.000	17.00	-0.43	-0.69	
DI									•
DO	19.0	22.0	18.0	2.08	0.473	19.67	0.49	0.23	
DT	17.0	16.0	17.0	0.58	0.118	16.67	-0.55	-0.81	
DZ									•
E	18.0	21.0	20.0	1.53	0.354	19.67	0.49	0.23	
EB	21.0	21.0	21.0	0.00	0.000	21.00	0.95	0.69	
EL	19.0	18.0	18.0	0.58	0.118	18.33	0.03	-0.23	
EO									•
ER									•

• ≡ 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
EV									
EX									
FE	22.0	19.0	18.0	2.08	0.473	19.67	0.49	0.23	
FF									
FJ									
FL									
FN									
GI									
GQ	52.0	50.0	48.0	2.00	0.473	50.00	11.00	10.74	×
GZ									
HI									
HK	19.0	19.0	19.0	0.00	0.000	19.00	0.26	0.00	
HL									
HP	12.0	13.0	13.0	0.58	0.118	12.67	-1.93	-2.19	
I	19.0	20.0	21.0	1.00	0.236	20.00	0.61	0.35	
ID									
IU									
J									
JE	22.0	20.0	21.0	1.00	0.236	21.00	0.95	0.69	
JG									
JM									
JN									
JQ									
JS	17.0	16.0	18.0	1.00	0.236	17.00	-0.43	-0.69	
JX									
JY									
K	16.0	18.0	19.0	1.53	0.354	17.67	-0.20	-0.46	
KE									
KT									
KX									
L	18.0	19.0	19.0	0.58	0.118	18.67	0.15	-0.12	
LE									
LF	20.0	19.0	18.0	1.00	0.236	19.00	0.26	0.00	
LL									
LR									
M									
MF									
MP									
MT									
MV									
MY									
N									
NA									
NH									
NJ	20.0	15.0	13.0	3.61	0.827	16.00	-0.78	-1.04	

• ≡ 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)	(known)	Tag
NK									
NO									
O									
OB									
OF									
OM									
OS									
OY									
P									
PB									
PD									
PG									
PM									
PW									
Q	25.0	23.0	19.0	3.06	0.709	22.33	1.42	1.15	
QM	11.0	10.0	10.0	0.58	0.118	10.33	-2.74	-3.00	
QP									
QQ									
QT									
QU	15.0	17.0	18.0	1.53	0.354	16.67	-0.55	-0.81	
QW	15.0	16.0	18.0	1.53	0.354	16.33	-0.66	-0.92	
QX									
QZ									
RB									
RD									
RG									
RI									
RK									
RP									
RR									
RU									
RZ									
S	17.0	17.0	18.0	0.58	0.118	17.33	-0.32	-0.58	
SD	19.0	22.0	20.0	1.53	0.354	20.33	0.72	0.46	
SF									
SG									
SI									
SL									
SM	12.0	13.0	13.0	0.58	0.118	12.67	-1.93	-2.19	
SN									
SO									
SR									
SS	15.0	13.0	14.0	1.00	0.236	14.00	-1.47	-1.73	
SX									
T	16.0	17.0	19.0	1.53	0.354	17.33	-0.32	-0.58	

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

Ø ≡ 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
TD	17.0	16.0	20.0	2.08	0.473	17.67	-0.20	-0.46	
TL									•
TN									•
TQ	18.0	18.0	18.0	0.00	0.000	18.00	-0.09	-0.35	
TY									•
U	20.0	20.0	19.0	0.58	0.118	19.67	0.49	0.23	
UA									•
UM									•
UP	8.0	8.0	9.0	0.58	0.118	8.33	-3.43	-3.70	⇓
UQ									•
UY									•
VA									•
VC									•
VH	21.0	16.0	19.0	2.52	0.591	18.67	0.15	-0.12	
VI									•
VJ									•
VM									•
VO	10.0	8.0	9.0	1.00	0.236	9.00	-3.20	-3.46	⇓
VT									•
W	17.0	19.0	18.0	1.00	0.236	18.00	-0.09	-0.35	
WE									•
WH									•
WO									•
WR									•
WW									•
X	16.0	17.0	17.0	0.58	0.118	16.67	-0.55	-0.81	
XA									•
XC									•
XD									•
XF									•
XI	5.0	6.0	6.0	0.58	0.118	5.67	-4.36	-4.62	×
XJ									•
XK	26.0	25.0	20.0	3.21	0.709	23.67	1.88	1.62	
XL	23.0	24.0	25.0	1.00	0.236	24.00	1.99	1.73	
XM	19.0	22.0	24.0	2.52	0.591	21.67	1.18	0.92	
XN									•
XP									•
XQ									•
XT									•
Y	19.0	16.0	16.0	1.73	0.354	17.00	-0.43	-0.69	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
4.00	×	CO	8.33	⇓	UP	10.33		QM
5.67	×	XI	9.00	⇓	VO	12.67		SM

• ≡ No data submitted
Ø ≡ Insufficient data

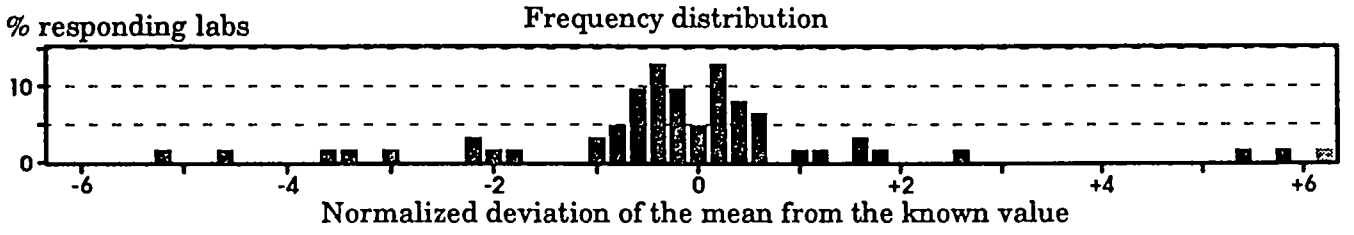
TAG SYMBOLS
× ≡ Determined to be an outlier

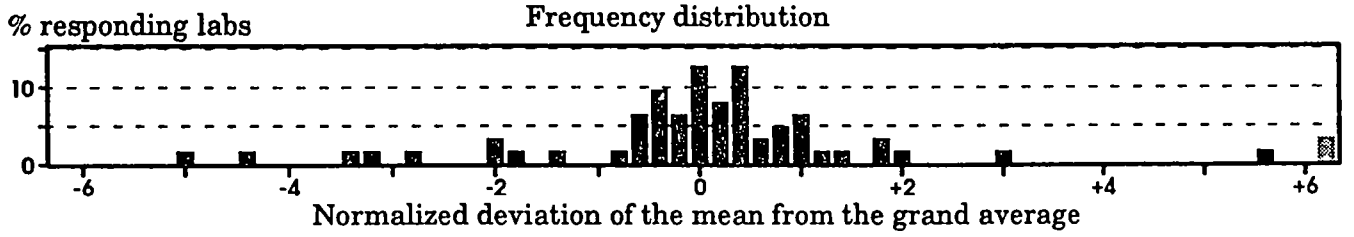
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-89

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
12.67		HP	18.00		TQ	19.67		AJ
13.00		CP	18.00		CA	20.00		I
14.00		SS	18.00		AF	20.00		BA
16.00		NJ	18.33		EL	20.33		SD
16.33		QW	18.33		CJ	20.33		C
16.67		X	18.33		AZ	20.33		BO
16.67		QU	18.33		AK	21.00		JE
16.67		DT	18.67		VH	21.00		EB
17.00		Y	18.67		L	21.00		DD
17.00		JS	19.00		LF	21.00		AW
17.00		DE	19.00		HK	21.67		XM
17.00		D	19.00		AL	22.33		Q
17.33		T	19.33		BM	23.33		CS
17.33		S	19.33		BL	23.67		XK
17.67		TD	19.33		A	24.00		XL
17.67		K	19.67		U	26.67		BH
17.67		BC	19.67		FE	34.67	×	AU
17.67		AE	19.67		E	36.00	×	CX
18.00		W	19.67		DO	50.00	×	GQ





• ≡ No data submitted
∅ ≡ Insufficient data

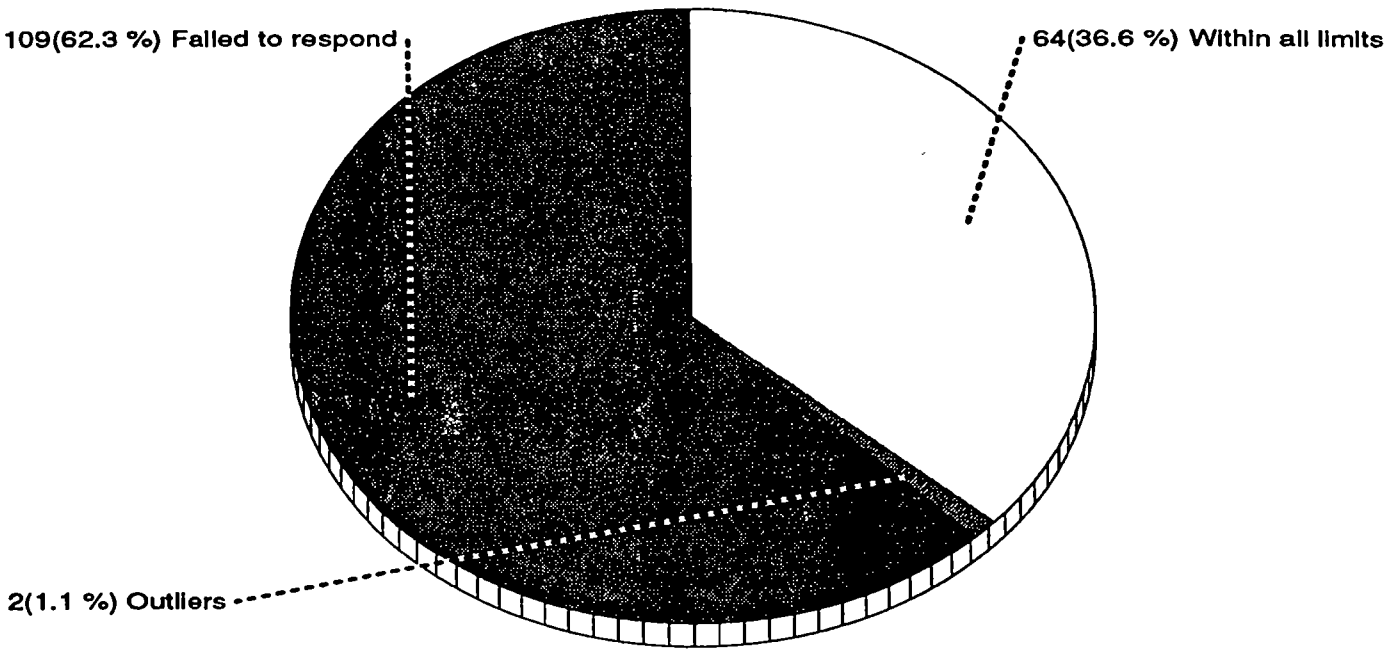
TAG SYMBOLS

× ≡ Determined to be an outlier

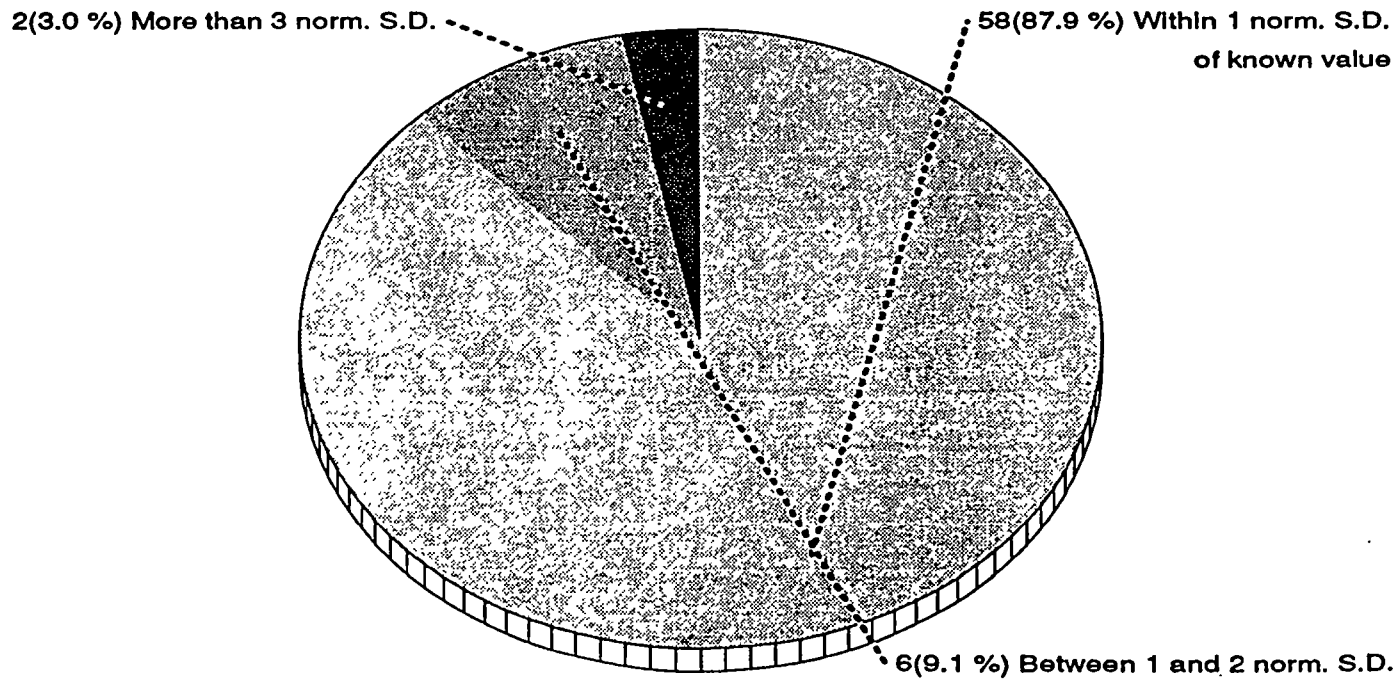
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90 Statistical Summary 175 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	7.66	**Grand Avg 7.24**
Std. Dev.	2.84	1.61
Variance	8.04	2.60
% Coef. of Var.	37.04	22.27
% deviation of mean from known value	-4.29	-9.44
Norm. dev. of mean from known value	-0.12	-0.47
Median	7.33	7.33
% deviation of median from known value	-8.33	-8.33
Norm. dev. of median from known value	-0.24	-0.41



Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
AE	7.0	7.0	6.0	0.58	0.118	6.67	-0.20	-0.46	
AF	8.0	8.0	8.0	0.00	0.000	8.00	0.26	0.00	
AH									•
AJ	8.0	7.0	8.0	0.58	0.118	7.67	0.15	-0.12	
AK	7.0	8.0	7.0	0.58	0.118	7.33	0.03	-0.23	
AL	8.0	8.0	8.0	0.00	0.000	8.00	0.26	0.00	
AP									•
AR									•
AU	6.0	4.0	12.0	4.16	0.945	7.33	0.03	-0.23	
AW	8.0	8.0	8.0	0.00	0.000	8.00	0.26	0.00	
AZ	7.0	8.0	7.0	0.58	0.118	7.33	0.03	-0.23	
BA	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
BB	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
BC	5.0	5.0	6.0	0.58	0.118	5.33	-0.66	-0.92	
BG									•
BH	8.0	9.0	10.0	1.00	0.236	9.00	0.61	0.35	
BK									•
BL	7.0	8.0	9.0	1.00	0.236	8.00	0.26	0.00	
BM	7.0	8.0	9.0	1.00	0.236	8.00	0.26	0.00	
BN									•
BO	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
BS									•
C	8.0	9.0	9.0	0.58	0.118	8.67	0.49	0.23	
CA	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
CC									•
CE	7.0	6.0	7.0	0.58	0.118	6.67	-0.20	-0.46	
CJ	7.0	9.0	9.0	1.15	0.236	8.33	0.38	0.12	
CO	2.0	2.0	4.0	1.15	0.236	2.67	-1.59	-1.85	
CP	6.0	8.0	8.0	1.15	0.236	7.33	0.03	0.23	
CS	21.0	23.0	20.0	1.53	0.354	21.33	4.88	4.62	×
CX	2.0	4.0	2.0	1.15	0.236	2.67	-1.59	-1.85	
D	8.0	7.0	8.0	0.58	0.118	7.67	0.15	-0.12	
DB									•
DD	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
DE	8.0	8.0	8.0	0.00	0.000	8.00	0.26	0.00	
DI									•
DO	6.0	6.0	7.0	0.58	0.118	6.33	-0.32	-0.58	
DT	9.0	8.0	8.0	0.58	0.118	8.33	0.38	0.12	
DZ	10.0	11.0	11.0	0.58	0.118	10.67	1.19	0.92	
E	8.0	8.0	8.0	0.00	0.000	8.00	0.26	0.00	
EB	7.0	6.0	6.0	0.58	0.118	6.33	-0.32	-0.58	
EL	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
EO									•
ER									•

• ≡ 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)	(known)	Tag
EV									•
EX									•
FE	7.0	7.0	8.0	0.58	0.118	7.33	0.03	-0.23	
FF									•
FJ									•
FL									•
FN									•
GI									•
GQ	3.0	3.0	2.0	0.58	0.118	2.67	-1.59	-1.85	
GZ									•
HI									•
HK	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
HL									•
HP	9.0	7.0	7.0	1.15	0.236	7.67	0.15	-0.12	
I	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
ID									•
IU									•
J									•
JE	8.0	9.0	9.0	0.58	0.118	8.67	0.49	0.23	
JG									•
JM									•
JN									•
JQ									•
JS	7.0	8.0	7.0	0.58	0.118	7.33	0.03	-0.23	
JX									•
JY									•
K	8.0	8.0	8.0	0.00	0.000	8.00	0.26	0.00	
KE									•
KT									•
KX									•
L	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
LE									•
LF	5.0	5.0	5.0	0.00	0.000	5.00	-0.78	-1.04	
LL									•
LR									•
M									•
MI									•
MI									•
MT									•
MV									•
MT									•
N									•
NA									•
NI									•
NJ	5.0	6.0	8.0	1.53	0.354	6.33	-0.32	-0.58	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-B, 20-Oct-1998

Strontium-90

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NK									•
NO									•
O									•
OB									•
OF									•
OM									•
OS									•
OY									•
P									•
PB									•
PD									•
PG									•
PM									•
PW									•
Q	9.0	8.0	11.0	1.53	0.354	9.33	0.72	0.46	
QM	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
QP									•
QQ									•
QT									•
QU	7.0	6.0	4.0	1.53	0.354	5.67	-0.55	-0.81	
QW	6.0	6.0	7.0	0.58	0.118	6.33	-0.32	-0.58	
QX									•
QZ									•
RB									•
RD									•
RG									•
RI									•
RK									•
RP									•
RR									•
RU									•
RZ									•
S	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
SD	9.0	9.0	8.0	0.58	0.118	8.67	0.49	0.23	
SF									•
SG									•
SI									•
SL									•
SM	5.0	6.0	5.0	0.58	0.118	5.33	-0.66	-0.92	
SN									•
SO									•
SR									•
SS	8.0	9.0	9.0	0.58	0.118	8.67	0.49	0.23	
SX									•
T	6.0	7.0	6.0	0.58	0.118	6.33	-0.32	-0.58	

• ≡ 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
TD	6.0	6.0	6.0	0.00	0.000	6.00	-0.43	-0.69	
TL									•
TN									•
TQ	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
TY									•
U	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
UA									•
UM									•
UP	19.0	24.0	18.0	3.21	0.709	20.33	4.53	4.27	×
UQ									•
UY									•
VA									•
VC									•
VH	8.0	11.0	9.0	1.53	0.354	9.33	0.72	0.46	
VI									•
VJ									•
VM									•
VO									•
VT									•
W	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
WE									•
WH									•
WO									•
WR	8.0	8.0	9.0	0.58	0.118	8.33	0.38	0.12	
WW									•
X	8.0	7.0	7.0	0.58	0.118	7.33	0.03	-0.23	
XA									•
XC									•
XD									•
XF									•
XI	11.0	12.0	13.0	1.00	0.236	12.00	1.65	1.39	
XJ									•
XK	5.0	4.0	4.0	0.58	0.118	4.33	-1.01	-1.27	
XL	7.0	7.0	7.0	0.00	0.000	7.00	-0.08	-0.35	
XM	7.0	6.0	7.0	0.58	0.118	6.67	-0.20	-0.46	
XN									•
XP									•
XQ									•
XT									•
Y	11.0	10.0	9.0	1.00	0.236	10.00	0.95	0.69	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.67		GQ	2.67		CO	5.00		LF
2.67		CX	4.33		XK	5.33		SM

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
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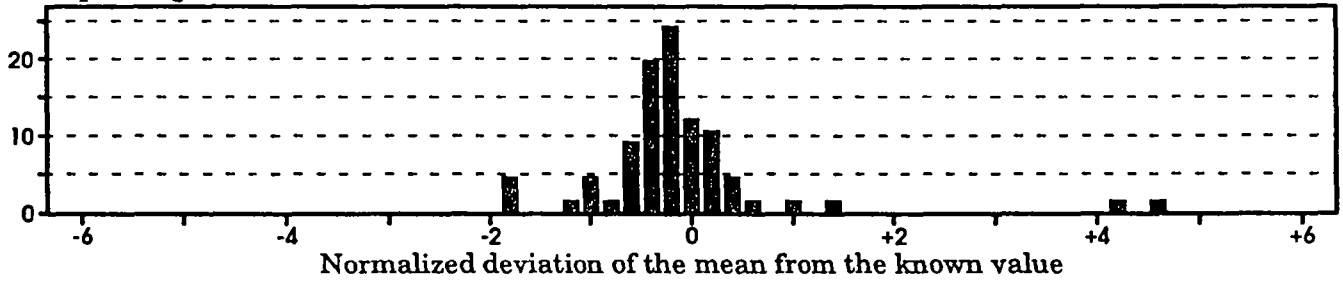
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.33		BC	7.00		BB	8.00		BM
5.67		QU	7.33		X	8.00		BL
6.00		TD	7.33		W	8.00		AW
6.33		T	7.33		JS	8.00		AL
6.33		QW	7.33		I	8.00		AF
6.33		NJ	7.33		FE	8.33		WR
6.33		EB	7.33		CP	8.33		DT
6.33		DO	7.33		CA	8.33		CJ
6.67		XM	7.33		BO	8.67		SS
6.67		CE	7.33		BA	8.67		SD
6.67		AE	7.33		AZ	8.67		JE
7.00		XL	7.33		AU	8.67		C
7.00		U	7.33		AK	9.00		BH
7.00		TQ	7.33		A	9.33		VH
7.00		S	7.67		HP	9.33		Q
7.00		QM	7.67		D	10.00		Y
7.00		L	7.67		AJ	10.67		DZ
7.00		HK	8.00		K	12.00		XI
7.00		EL	8.00		E	20.33	×	UP
7.00		DD	8.00		DE	21.33	×	CS



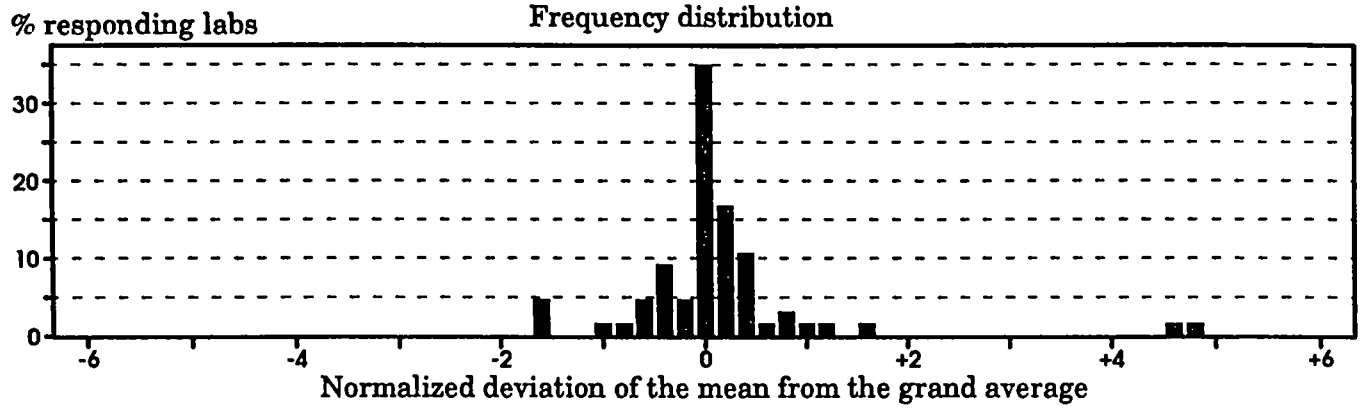
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

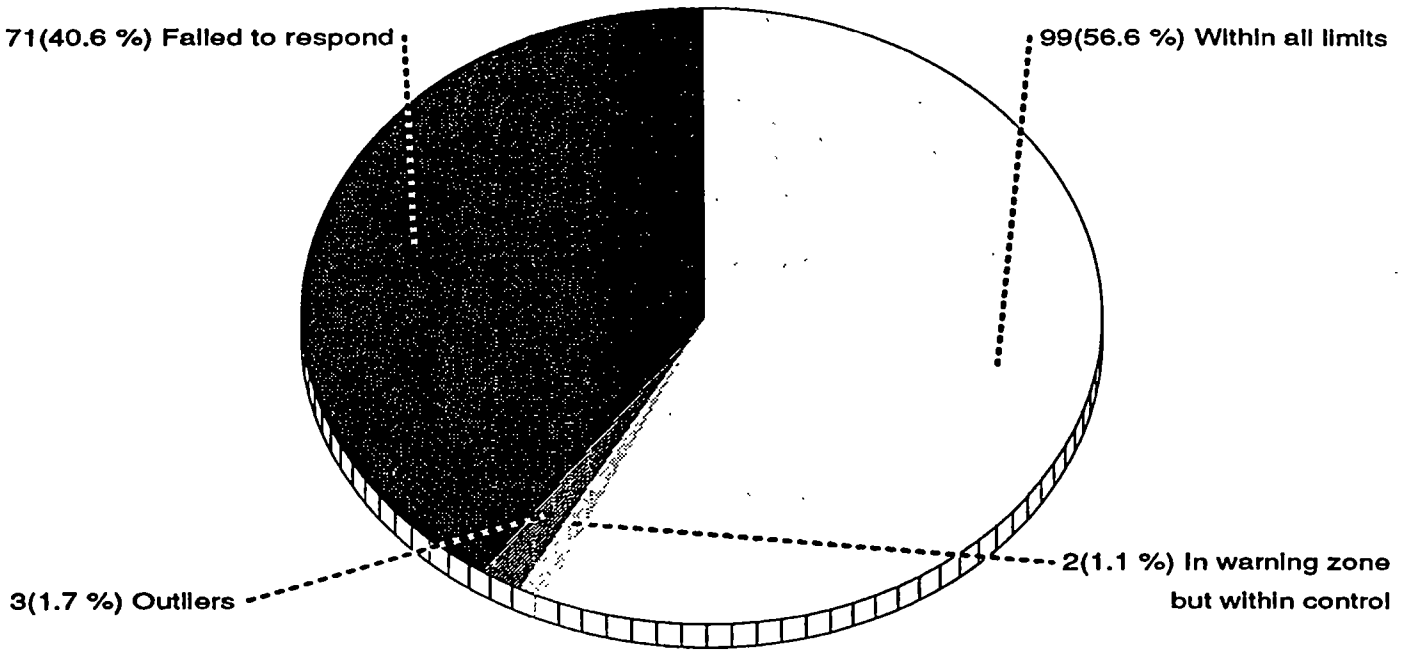
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Strontium-90

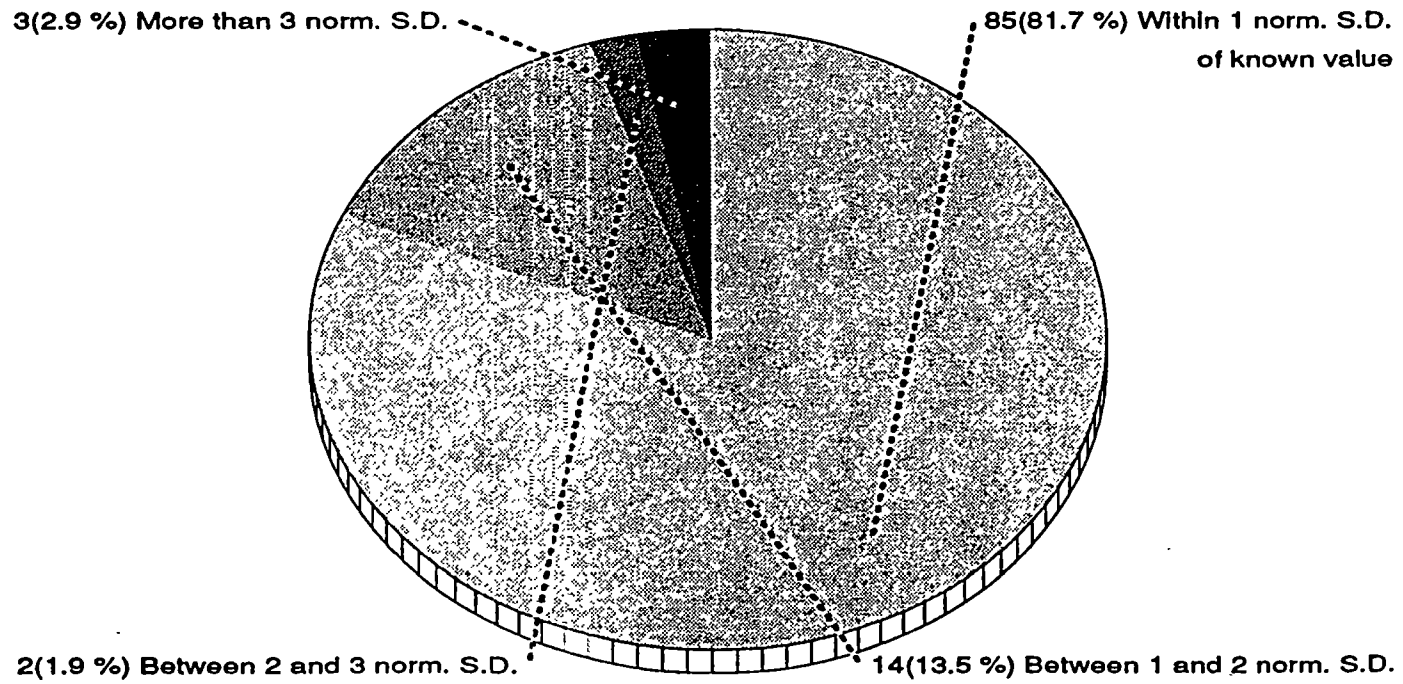


Cobalt-60 Statistical Summary 175 Participants

The known value of this nuclide is 21.0 pCi/l with an expected precision of 5.0; the control limits are 12.3 to 29.7; the warning regions are 12.3 to 15.2 and 26.8 to 29.7



Statistic	Respondents	Non-outliers
Mean	21.93	**Grand Avg 21.77**
Std. Dev.	3.59	2.03
Variance	12.92	4.13
% Coef. of Var.	16.39	9.33
% deviation of mean from known value	4.43	3.68
Norm. dev. of mean from known value	0.26	0.38
Median	21.67	21.67
% deviation of median from known value	3.17	3.17
Norm. dev. of median from known value	0.19	0.33



ESD-LV Performance Evaluation: Blind-B, 20-Oct-1998

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	22.0	21.0	22.0	0.58	0.118	21.67	-0.04	0.23	
AE	23.0	22.0	25.0	1.53	0.354	23.33	0.54	0.81	
AF	21.0	20.0	21.0	0.58	0.118	20.67	-0.38	-0.12	
AH	20.0	20.0	17.0	1.73	0.354	19.00	-0.96	-0.69	
AJ	24.0	24.0	23.0	0.58	0.118	23.67	0.66	0.92	
AK	30.0	30.0	32.0	1.15	0.236	30.67	3.08	3.35	×
AL	25.0	24.0	25.0	0.58	0.118	24.67	1.00	1.27	
AP									•
AR									•
AU	22.0	22.0	21.0	0.58	0.118	21.67	-0.04	0.23	
AW	19.0	19.0	20.0	0.58	0.118	19.33	-0.84	-0.58	
AZ	20.0	16.0	18.0	2.00	0.473	18.00	-1.31	-1.04	
BA	19.0	23.0	23.0	2.31	0.473	21.67	-0.04	0.23	
BB	22.0	20.0	22.0	1.15	0.236	21.33	-0.15	0.12	
BC	21.0	21.0	21.0	0.00	0.000	21.00	-0.27	0.00	
BG									•
BH	21.0	24.0	22.0	1.53	0.354	22.33	0.19	0.46	
BK	23.0	23.0	23.0	0.00	0.000	23.00	0.43	0.69	
BL	23.0	21.0	21.0	1.15	0.236	21.67	-0.04	0.23	
BM	23.0	21.0	22.0	1.00	0.236	22.00	0.08	0.35	
BN	21.0	20.0	21.0	0.58	0.118	20.67	-0.38	-0.12	
BO	21.0	21.0	24.0	1.73	0.354	22.00	0.08	0.35	
BS									•
C	25.0	27.0	23.0	2.00	0.473	25.00	1.12	1.39	
CA	19.0	21.0	22.0	1.53	0.354	20.67	-0.38	-0.12	
CC									•
CE	21.0	22.0	20.0	1.00	0.236	21.00	-0.27	0.00	
CJ	23.0	21.0	23.0	1.15	0.236	22.33	0.19	0.46	
CO	6.0	4.0	6.0	1.15	0.236	5.33	5.69	-5.43	×
CP	25.0	21.0	23.0	2.00	0.473	23.00	0.43	0.69	
CS	21.0	22.0	21.0	0.58	0.118	21.33	-0.15	0.12	
CX	20.0	24.0	24.0	2.31	0.473	22.67	0.31	0.58	
D	21.0	22.0	21.0	0.58	0.118	21.33	-0.15	0.12	
DB									•
DD	18.0	21.0	20.0	1.53	0.354	19.67	-0.73	-0.46	
DE	23.0	23.0	24.0	0.58	0.118	23.33	0.54	0.81	
DI									•
DO	21.0	21.0	22.0	0.58	0.118	21.33	-0.15	0.12	
DT	21.0	22.0	24.0	1.53	0.354	22.33	0.19	0.46	
DZ									•
E	23.0	21.0	22.0	1.00	0.236	22.00	0.08	0.35	
EB	24.0	24.0	25.0	0.58	0.118	24.33	0.89	1.15	
EL	20.0	22.0	21.0	1.00	0.236	21.00	-0.27	0.00	
EO									•
ER									•

• ≡ 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
EV									
EX	22.0	21.0	20.0	1.00	0.236	21.00	-0.27	0.00	
FE	21.0	21.0	18.0	1.73	0.354	20.00	-0.61	-0.35	
FF									
FJ	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
FL	22.0	23.0	23.0	0.58	0.118	22.67	0.31	0.58	
FN									
GI									
GQ	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
GZ									
HI	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
HK	23.0	23.0	22.0	0.58	0.118	22.67	0.31	0.58	
HL	24.0	23.0	22.0	1.00	0.236	23.00	0.43	0.69	
HP	21.0	21.0	21.0	0.00	0.000	21.00	-0.27	0.00	
I	22.0	22.0	21.0	0.58	0.118	21.67	-0.04	0.23	
ID									
IU									
J									
JE	21.0	21.0	22.0	0.58	0.118	21.33	-0.15	0.12	
JG	26.0	26.0	30.0	2.31	0.473	27.33	1.93	2.19	
JM	22.0	20.0	20.0	1.15	0.236	20.67	-0.38	-0.12	
JN									
JQ									
JS	21.0	21.0	22.0	0.58	0.118	21.33	-0.15	0.12	
JX									
JY									
K	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
KE									
KT									
KX	22.0	23.0	24.0	1.00	0.236	23.00	0.43	0.69	
L	23.0	20.0	20.0	1.73	0.354	21.00	-0.27	0.00	
LE									
LF	23.0	20.0	25.0	2.52	0.591	22.67	0.31	0.58	
LL									
LR	18.0	22.0	20.0	2.00	0.473	20.00	-0.61	-0.35	
M	22.0	21.0	22.0	0.58	0.118	21.67	-0.04	0.23	
MF									
MP	20.0	18.0	19.0	1.00	0.236	19.00	-0.96	-0.69	
MT									
MV	18.0	13.0	16.0	2.52	0.591	15.67	-2.12	-1.85	
MY									
N									
NA									
NH	20.0	20.0	21.0	0.58	0.118	20.33	-0.50	-0.23	
NJ	21.0	21.0	21.0	0.00	0.000	21.00	-0.27	0.00	

• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Blind-B, 20-Oct-1998

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
NK									•
NO									•
O	23.0	23.0	23.0	0.00	0.000	23.00	0.43	0.69	
OB	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
OF									•
OM	21.0	22.0	23.0	1.00	0.236	22.00	0.08	0.35	
OS									•
OY									•
P	30.0	25.0	25.0	2.89	0.591	26.67	1.70	1.96	
PB									•
PD	45.0	46.0	46.0	0.58	0.118	45.67	8.28	8.54	×
PG									•
PM	22.0	23.0	33.0	6.08	1.570	26.00	1.46	1.73	
PW									•
Q	21.0	21.0	22.0	0.58	0.118	21.33	-0.15	0.12	
QM	25.0	22.0	24.0	1.53	0.354	23.67	0.66	0.92	
QP	20.0	21.0	23.0	1.53	0.354	21.33	-0.15	0.12	
QQ									•
QT	20.0	19.0	19.0	0.58	0.118	19.33	-0.84	-0.58	
QU	21.0	20.0	20.0	0.58	0.118	20.33	-0.50	-0.23	
QW	23.0	21.0	19.0	2.00	0.473	21.00	-0.27	0.00	
QX	14.0	16.0	16.0	1.15	0.236	15.33	-2.23	-1.96	
QZ	26.0	21.0	23.0	2.52	0.591	23.33	0.54	0.81	
RB									•
RD	29.0	29.0	29.0	0.00	0.000	29.00	2.50	2.77	
RG									•
RI									•
RK	23.0	23.0	23.0	0.00	0.000	23.00	0.43	0.69	
RP									•
RR									•
RU									•
RZ	17.0	16.0	17.0	0.58	0.118	16.67	-1.77	-1.50	
S	21.0	22.0	21.0	0.58	0.118	21.33	-0.15	0.12	
SD	21.0	21.0	21.0	0.00	0.000	21.00	-0.27	0.00	
SF	21.0	23.0	21.0	1.15	0.236	21.67	-0.04	0.23	
SG									•
SI	22.0	21.0	25.0	2.08	0.473	22.67	0.31	0.58	
SL									•
SM	24.0	21.0	26.0	2.52	0.591	23.67	0.66	0.92	
SN	22.0	19.0	20.0	1.53	0.354	20.33	-0.50	-0.23	
SO									•
SR									•
SS	21.0	25.0	24.0	2.08	0.473	23.33	0.54	0.81	
SX	19.0	23.0	21.0	2.00	0.473	21.00	-0.27	0.00	
T	22.0	20.0	23.0	1.53	0.354	21.67	-0.04	0.23	

• ≡ 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
TD	24.0	25.0	24.0	0.58	0.118	24.33	0.89	1.15	
TL									
TN									
TQ	21.0	17.0	20.0	2.08	0.473	19.33	-0.84	-0.58	
TY									
U	21.0	23.0	22.0	1.00	0.236	22.00	0.08	0.35	
UA									
UM									
UP	22.0	20.0	21.0	1.00	0.236	21.00	-0.27	0.00	
UQ									
UY									
VA									
VC									
VH	22.0	20.0	20.0	1.15	0.236	20.67	-0.38	-0.12	
VI	27.0	26.0	19.0	4.36	0.945	24.00	0.77	1.04	
VJ									
VM									
VO	16.0	23.0	23.0	4.04	0.827	20.67	-0.38	-0.12	
VT	23.0	25.0	26.0	1.53	0.354	24.67	1.00	1.27	
W	21.0	22.0	21.0	0.58	0.118	21.33	-0.15	0.12	
WE									
WH									
WO	18.0	18.0	18.0	0.00	0.000	18.00	-1.31	-1.04	
WR	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
WW	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
X	21.0	27.0	24.0	3.00	0.709	24.00	0.77	1.04	
XA	23.0	21.0	22.0	1.00	0.236	22.00	0.08	0.35	
XC									
XD	22.0	23.0	24.0	1.00	0.236	23.00	0.43	0.69	
XF	22.0	20.0	20.0	1.15	0.236	20.67	-0.38	-0.12	
XI	21.0	22.0	21.0	0.58	0.118	21.33	-0.15	0.12	
XJ									
XK	22.0	22.0	22.0	0.00	0.000	22.00	0.08	0.35	
XL									
XM									
XN									
XP									
XQ									
XT	21.0	22.0	21.0	0.58	0.118	21.33	-0.15	0.12	
Y									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.33	×	CO	15.67		MV	18.00		WO
15.33		QX	16.67		RZ	18.00		AZ

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

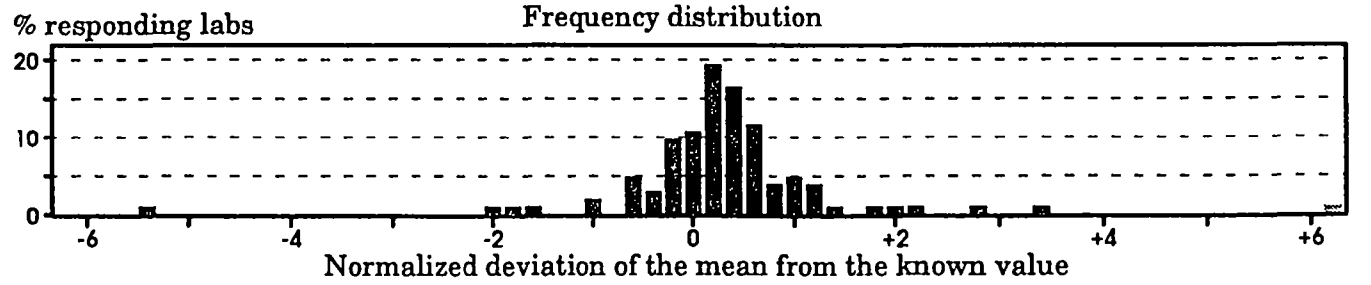
⇑ ≡ Above control limit

⇓ ≡ Below control limit

Cobalt-60

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
19.00		MP	21.33		S	22.33		BH
19.00		AH	21.33		QP	22.67		SI
19.33		TQ	21.33		Q	22.67		LF
19.33		QT	21.33		JS	22.67		HK
19.33		AW	21.33		JE	22.67		FL
19.67		DD	21.33		DO	22.67		CX
20.00		LR	21.33		D	23.00		XD
20.00		FE	21.33		CS	23.00		RK
20.33		SN	21.33		BB	23.00		O
20.33		QU	21.67		T	23.00		KX
20.33		NH	21.67		SF	23.00		HL
20.67		XF	21.67		M	23.00		CP
20.67		VO	21.67		I	23.00		BK
20.67		VH	21.67		BL	23.33		SS
20.67		JM	21.67		BA	23.33		QZ
20.67		CA	21.67		AU	23.33		DE
20.67		BN	21.67		A	23.33		AE
20.67		AF	22.00		XK	23.67		SM
21.00		UP	22.00		XA	23.67		QM
21.00		SX	22.00		WW	23.67		AJ
21.00		SD	22.00		WR	24.00		X
21.00		QW	22.00		U	24.00		VI
21.00		NJ	22.00		OM	24.33		TD
21.00		L	22.00		OB	24.33		EB
21.00		HP	22.00		K	24.67		VT
21.00		EX	22.00		HI	24.67		AL
21.00		EL	22.00		GQ	25.00		C
21.00		CE	22.00		FJ	26.00		PM
21.00		BC	22.00		E	26.67		P
21.33		XT	22.00		BO	27.33		JG
21.33		XI	22.00		BM	29.00		RD
21.33		W	22.33		DT	30.67	×	AK
			22.33		CJ	45.67	×	PD

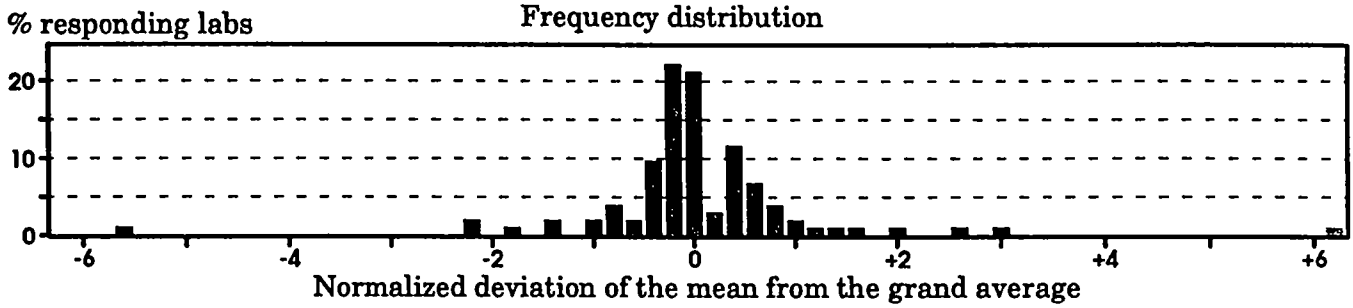


• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

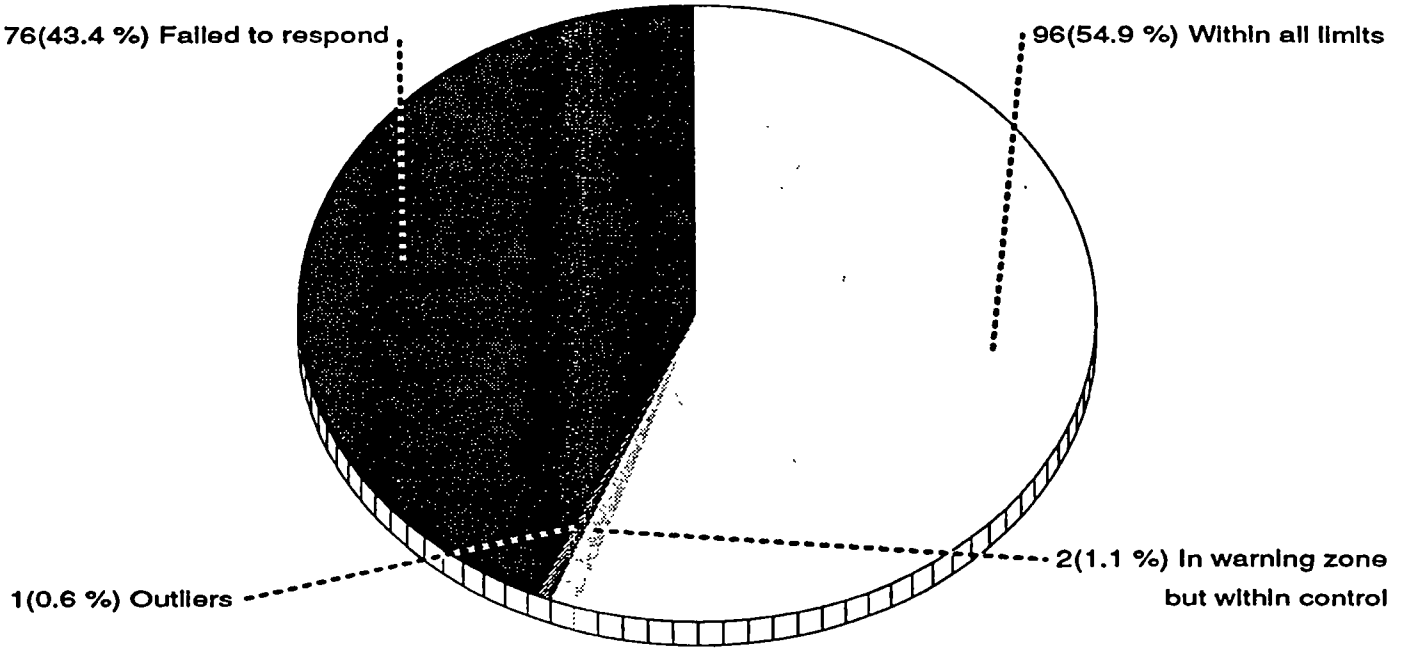
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cobalt-60

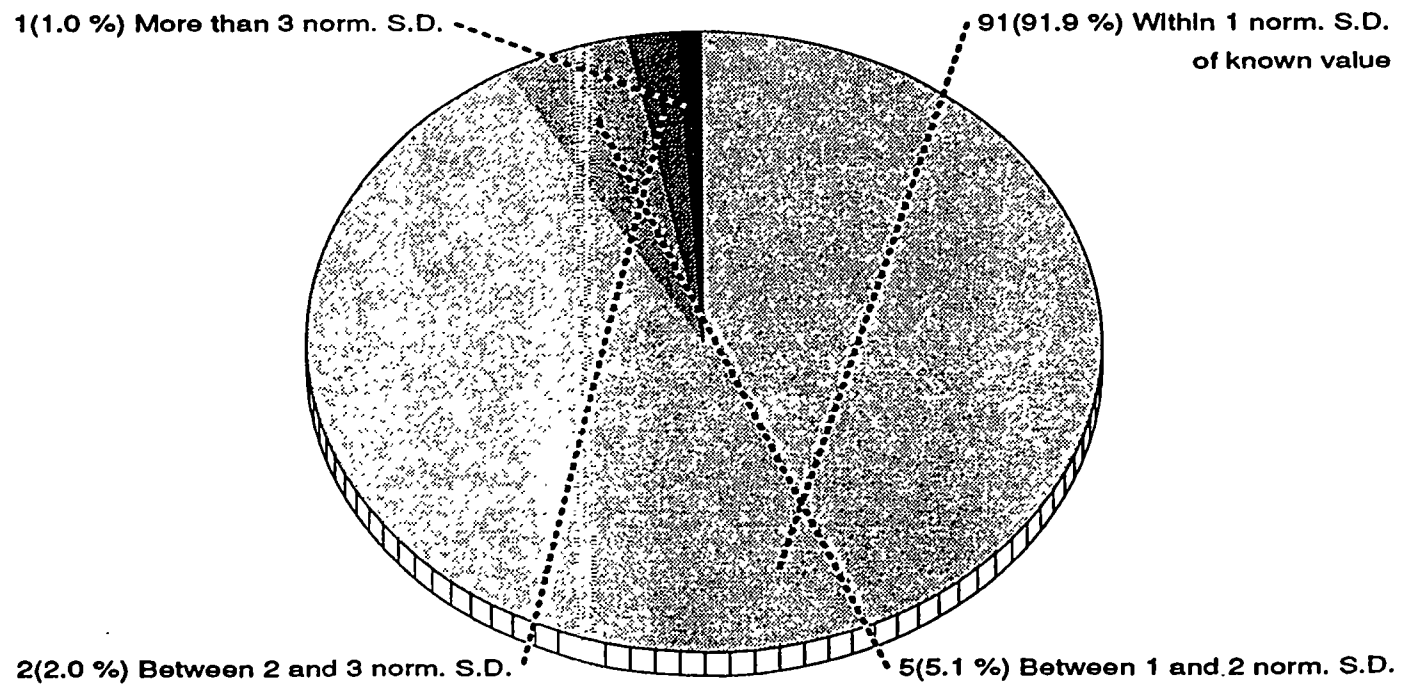

% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-134 Statistical Summary 175 Participants

The known value of this nuclide is **6.0 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 14.7; the warning regions are 0.0 to 0.2 and 11.8 to 14.7



Statistic	Respondents	Non-outliers
Mean	6.49	**Grand Avg 6.40**
Std. Dev.	1.84	1.57
Variance	3.37	2.46
% Coef. of Var.	28.27	24.54
% deviation of mean from known value	8.25	6.63
Norm. dev. of mean from known value	0.27	0.25
Median	6.33	6.33
% deviation of median from known value	5.56	5.56
Norm. dev. of median from known value	0.18	0.21



Cesium-134

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	6.0	7.0	6.0	0.58	0.118	6.33	-0.02	0.12	
AE	7.0	7.0	7.0	0.00	0.000	7.00	0.21	0.35	
AF	5.0	6.0	5.0	0.58	0.118	5.33	-0.37	-0.23	
AH									•
AJ	5.0	5.0	6.0	0.58	0.118	5.33	-0.37	-0.23	
AK	14.0	13.0	16.0	1.53	0.354	14.33	2.75	2.89	
AL	10.0	6.0	13.0	3.51	0.827	9.67	1.13	1.27	
AP									•
AR									•
AU	4.0	6.0	5.0	1.00	0.236	5.00	-0.48	-0.35	
AW	8.0	8.0	8.0	0.00	0.000	8.00	0.55	0.69	
AZ	14.0	8.0	9.0	3.21	0.709	10.33	1.36	1.50	
BA	5.0	6.0	6.0	0.58	0.118	5.67	-0.25	-0.12	
BB	5.0	7.0	5.0	1.15	0.236	5.67	-0.25	-0.12	
BC	7.0	6.0	6.0	0.58	0.118	6.33	-0.02	0.12	
BG									•
BH	6.0	7.0	8.0	1.00	0.236	7.00	0.21	0.35	
BK	6.0	7.0	6.0	0.58	0.118	6.33	-0.02	0.12	
BL	7.0	7.0	7.0	0.00	0.000	7.00	0.21	0.35	
BM	7.0	7.0	7.0	0.00	0.000	7.00	0.21	0.35	
BN	6.0	5.0	6.0	0.58	0.118	5.67	-0.25	-0.12	
BO	8.0	7.0	8.0	0.58	0.118	7.67	0.44	0.58	
BS									•
C	7.0	7.0	6.0	0.58	0.118	6.67	0.09	0.23	
CA	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
CC									•
CE	7.0	6.0	7.0	0.58	0.118	6.67	0.09	0.23	
CJ	7.0	6.0	7.0	0.58	0.118	6.67	0.09	0.23	
CO	2.0	1.0	2.0	0.58	0.118	1.67	-1.64	-1.50	
CP	7.0	7.0	5.0	1.15	0.236	6.33	-0.02	0.12	
CS	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
CX	7.0	6.0	7.0	0.58	0.118	6.67	0.09	0.23	
D	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
DB									•
DD	6.0	7.0	7.0	0.58	0.118	6.67	0.09	0.23	
DE	10.0	10.0	10.0	0.00	0.000	10.00	1.25	1.39	
DI									•
DO	6.0	5.0	7.0	1.00	0.236	6.00	-0.14	0.00	
DT	7.0	7.0	8.0	0.58	0.118	7.33	0.32	0.46	
DZ									•
E	5.0	7.0	6.0	1.00	0.236	6.00	-0.14	0.00	
EB	6.0	7.0	6.0	0.58	0.118	6.33	-0.02	0.12	
EL	6.0	6.0	7.0	0.58	0.118	6.33	-0.02	0.12	
EO									•
ER									•

• ≡ 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)	Normalized deviation (known)	Tag
EV	•								
EX	7.0	5.0	6.0	1.00	0.236	6.00	-0.14	0.00	
FE	6.0	3.0	4.0	1.53	0.354	4.33	-0.72	-0.58	
FF	•								
FJ	5.0	5.0	5.0	0.00	0.000	5.00	-0.48	-0.35	
FL	7.0	8.0	6.0	1.00	0.236	7.00	0.21	0.35	
FN	•								
GI	•								
GQ	7.0	7.0	6.0	0.58	0.118	6.67	0.09	0.23	
GZ	•								
HI	6.0	7.0	7.0	0.58	0.118	6.67	0.09	0.23	
HK	7.0	6.0	7.0	0.58	0.118	6.67	0.09	0.23	
HL	7.0	9.0	8.0	1.00	0.236	8.00	0.55	0.69	
HP	5.0	6.0	6.0	0.58	0.118	5.67	-0.25	-0.12	
I	5.0	6.0	7.0	1.00	0.236	6.00	-0.14	0.00	
ID	•								
IU	•								
J	•								
JE	7.0	6.0	6.0	0.58	0.118	6.33	-0.02	0.12	
JG	16.0	16.0	16.0	0.00	0.000	16.00	3.33	3.46	×
JM	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
JN	•								
JQ	•								
JS	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
JX	•								
JY	•								
K	7.0	7.0	5.0	1.15	0.236	6.33	-0.02	0.12	
KE	•								
KT	•								
KX	6.0	7.0	6.0	0.58	0.118	6.33	-0.02	0.12	
L	8.0	6.0	7.0	1.00	0.236	7.00	0.21	0.35	
LE	•								
LF	7.0	6.0	7.0	0.58	0.118	6.67	0.09	0.23	
LL	•								
LR	3.0	5.0	6.0	1.53	0.354	4.67	-0.60	-0.46	
M	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
MF	•								
MP	6.0	5.0	5.0	0.58	0.118	5.33	-0.37	-0.23	
MT	•								
MV	4.0	5.0	5.0	0.58	0.118	4.67	-0.60	-0.46	
MY	•								
N	•								
NA	•								
NH	6.0	6.0	7.0	0.58	0.118	6.33	-0.02	0.12	
NJ	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	

• ≡ 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
NK									•
NO									•
O	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
OB									•
OF									•
OM	5.0	5.0	6.0	0.58	0.118	5.33	-0.37	-0.23	
OS									•
OY									•
P									•
PB									•
PD	13.0	13.0	13.0	0.00	0.000	13.00	2.29	2.42	
PG									•
PM	4.0	8.0	7.0	2.08	0.473	6.33	-0.02	0.12	
PW									•
Q	7.0	6.0	6.0	0.58	0.118	6.33	-0.02	0.12	
QM	4.0	5.0	4.0	0.58	0.118	4.33	-0.72	-0.58	
QP	5.0	5.0	5.0	0.00	0.000	5.00	-0.48	-0.35	
QQ									•
QT	6.0	5.0	6.0	0.58	0.118	5.67	-0.25	-0.12	
QU	6.0	7.0	6.0	0.58	0.118	6.33	-0.02	0.12	
QW	6.0	6.0	5.0	0.58	0.118	5.67	-0.25	-0.12	
QX									•
QZ	7.0	7.0	4.0	1.73	0.354	6.00	-0.14	0.00	
RB									•
RD									•
RG									•
RI									•
RK	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
RP									•
RR									•
RU									•
RZ	6.0	6.0	7.0	0.58	0.118	6.33	-0.02	0.12	
S	5.0	5.0	5.0	0.00	0.000	5.00	-0.48	-0.35	
SD	6.0	6.0	5.0	0.58	0.118	5.67	-0.25	-0.12	
SF	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
SG									•
SI	6.0	7.0	7.0	0.58	0.118	6.67	0.09	0.23	
SL									•
SM	7.0	7.0	5.0	1.15	0.236	6.33	-0.02	0.12	
SN	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
SO									•
SR									•
SS	9.0	8.0	7.0	1.00	0.236	8.00	0.55	0.69	
SX	6.0	7.0	7.0	0.58	0.118	6.67	0.09	0.23	
T	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	

• ≡ 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
TD	6.0	8.0	7.0	1.00	0.236	7.00	0.21	0.35	
TL									
TN									
TQ	6.0	4.0	7.0	1.53	0.354	5.67	-0.25	-0.12	
TY									
U	7.0	8.0	8.0	0.58	0.118	7.67	0.44	0.58	
UA									
UM									
UP	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
UQ									
UY									
VA									
VC									
VH	7.0	9.0	8.0	1.00	0.236	8.00	0.55	0.69	
VI	7.0	6.0	6.0	0.58	0.118	6.33	-0.02	0.12	
VJ									
VM									
VO	8.0	6.0	7.0	1.00	0.236	7.00	0.21	0.35	
VT	6.0	7.0	8.0	1.00	0.236	7.00	0.21	0.35	
W	8.0	5.0	6.0	1.53	0.354	6.33	-0.02	0.12	
WE									
WH									
WO	2.0	3.0	3.0	0.58	0.118	2.67	-1.29	-1.15	
WR	7.0	7.0	7.0	0.00	0.000	7.00	0.21	0.35	
WW	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
X	5.0	5.0	8.0	1.73	0.354	6.00	-0.14	0.00	
XA	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
XC									
XD	5.0	6.0	8.0	1.53	0.354	6.33	-0.02	0.12	
XF	5.0	4.0	5.0	0.58	0.118	4.67	-0.60	-0.46	
XI	5.0	6.0	6.0	0.58	0.118	5.67	-0.25	-0.12	
XJ									
XK	6.0	6.0	7.0	0.58	0.118	6.33	-0.02	0.12	
XL									
XM									
XN									
XP									
XQ									
XT	6.0	6.0	6.0	0.00	0.000	6.00	-0.14	0.00	
Y									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.67		CO	4.33		QM	4.67		XF
2.67		WO	4.33		FE	4.67		MV

• ≡ No data submitted
Ø ≡ Insufficient data

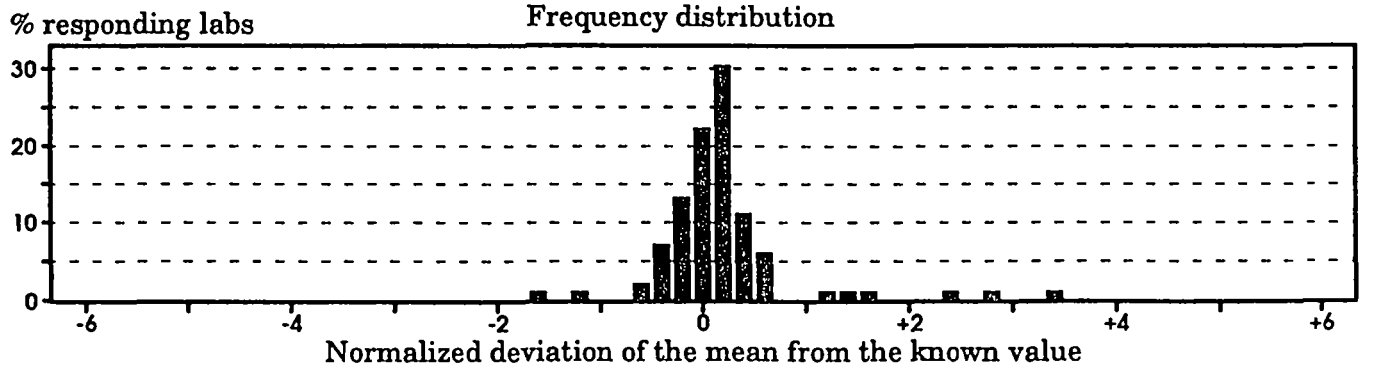
TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
4.67		LR	6.00		JS	6.67		HK
5.00		S	6.00		JM	6.67		HI
5.00		QP	6.00		I	6.67		GQ
5.00		FJ	6.00		EX	6.67		DD
5.00		AU	6.00		E	6.67		CX
5.33		OM	6.00		DO	6.67		CJ
5.33		MP	6.00		D	6.67		CE
5.33		AJ	6.00		CS	6.67		C
5.33		AF	6.00		CA	7.00		WR
5.67		XI	6.33		XK	7.00		VT
5.67		TQ	6.33		XD	7.00		VO
5.67		SD	6.33		W	7.00		TD
5.67		QW	6.33		VI	7.00		L
5.67		QT	6.33		SM	7.00		FL
5.67		HP	6.33		RZ	7.00		BM
5.67		BN	6.33		QU	7.00		BL
5.67		BB	6.33		Q	7.00		BH
5.67		BA	6.33		PM	7.00		AE
6.00		XT	6.33		NH	7.33		DT
6.00		XA	6.33		KX	7.67		U
6.00		X	6.33		K	7.67		BO
6.00		WW	6.33		JE	8.00		VH
6.00		UP	6.33		EL	8.00		SS
6.00		T	6.33		EB	8.00		HL
6.00		SN	6.33		CP	8.00		AW
6.00		SF	6.33		BK	9.67		AL
6.00		RK	6.33		BC	10.00		DE
6.00		QZ	6.33		A	10.33		AZ
6.00		O	6.67		SX	13.00		PD
6.00		NJ	6.67		SI	14.33		AK
6.00		M	6.67		LF	16.00	×	JG



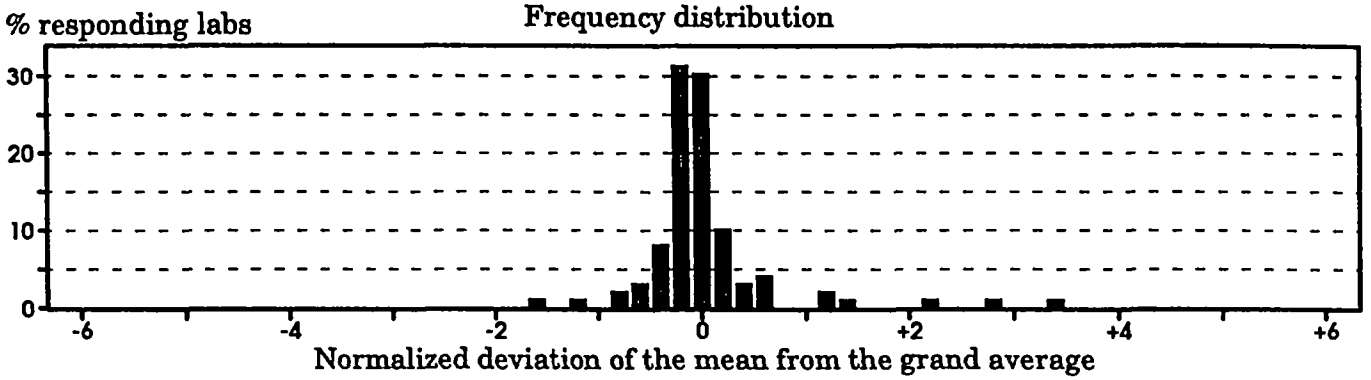
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

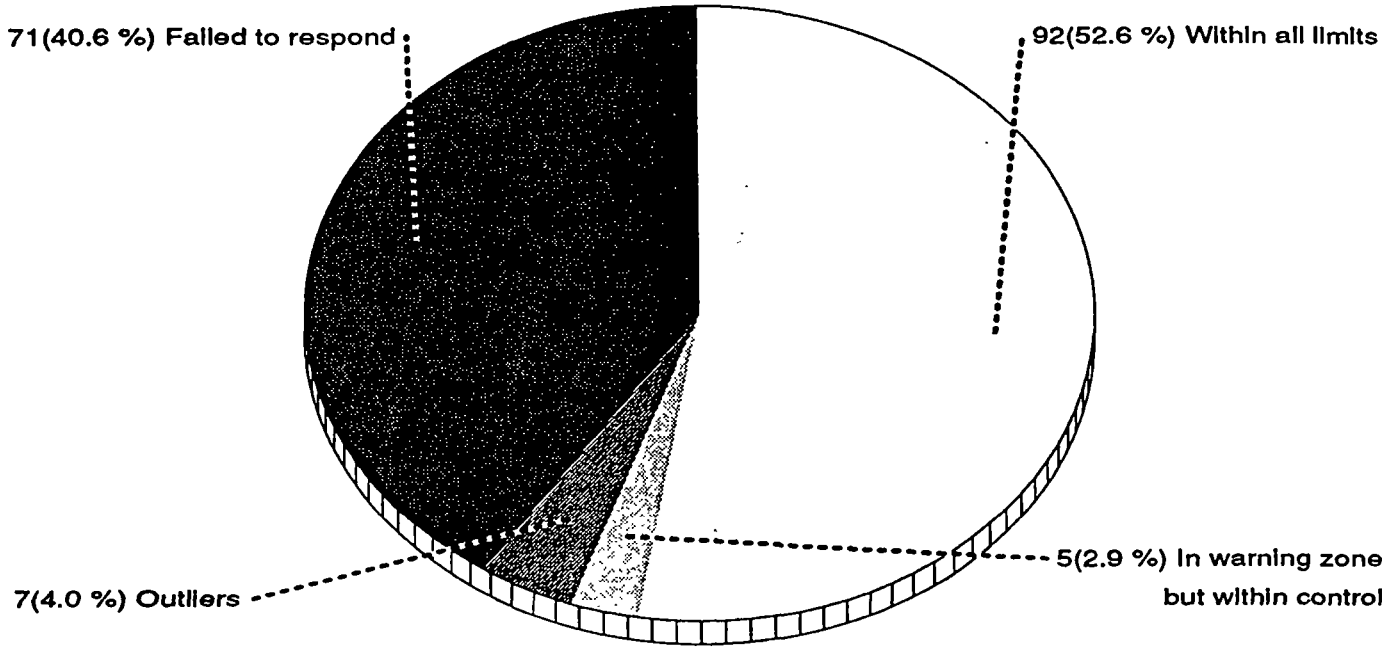
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

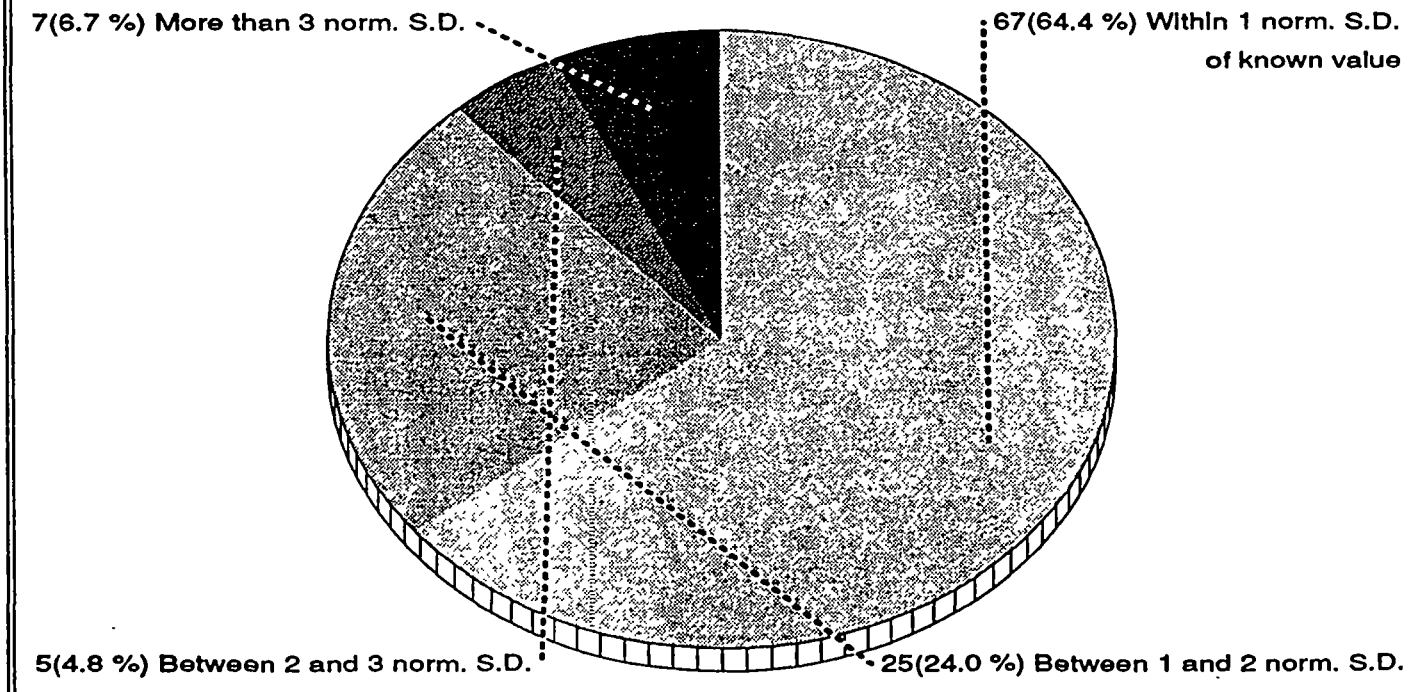

% responding labs
Frequency distribution
30
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-137 Statistical Summary 175 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	50.98	**Grand Avg 50.88**
Std. Dev.	7.33	2.72
Variance	53.73	7.39
% Coef. of Var.	14.38	5.34
% deviation of mean from known value	1.96	1.77
Norm. dev. of mean from known value	0.13	0.32
Median	51.00	51.00
% deviation of median from known value	2.00	2.00
Norm. dev. of median from known value	0.14	0.37



Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	52.0	52.0	53.0	0.58	0.118	52.33	0.50	0.81	
AE	46.0	48.0	52.0	3.06	0.709	48.67	-0.77	-0.46	
AF	52.0	49.0	52.0	1.73	0.354	51.00	0.04	0.35	
AH	53.0	51.0	58.0	3.61	0.827	54.00	1.08	1.39	
AJ	52.0	50.0	51.0	1.00	0.236	51.00	0.04	0.35	
AK	45.0	45.0	45.0	0.00	0.000	45.00	-2.04	-1.73	
AL	62.0	52.0	54.0	5.29	1.345	56.00	1.77	2.08	
AP									•
AR									•
AU	46.0	49.0	49.0	1.73	0.354	48.00	-1.00	-0.69	
AW	48.0	49.0	49.0	0.58	0.118	48.67	-0.77	-0.46	
AZ	50.0	47.0	53.0	3.00	0.709	50.00	-0.31	0.00	
BA	52.0	47.0	48.0	2.65	0.591	49.00	-0.65	-0.35	
BB	48.0	50.0	49.0	1.00	0.236	49.00	-0.65	-0.35	
BC	53.0	53.0	54.0	0.58	0.118	53.33	0.85	1.15	
BG									•
BH	53.0	51.0	53.0	1.15	0.236	52.33	0.50	0.81	
BK	56.0	55.0	55.0	0.58	0.118	55.33	1.54	1.85	
BL	50.0	49.0	53.0	2.08	0.473	50.67	-0.07	0.23	
BM	50.0	50.0	51.0	0.58	0.118	50.33	-0.19	0.12	
BN	50.0	51.0	53.0	1.53	0.354	51.33	0.16	0.46	
BO	53.0	52.0	52.0	0.58	0.118	52.33	0.50	0.81	
BS									•
C	48.0	49.0	46.0	1.53	0.354	47.67	-1.11	-0.81	
CA	44.0	49.0	50.0	3.21	0.709	47.67	-1.11	-0.81	
CC									•
CE	52.0	52.0	51.0	0.58	0.118	51.67	0.27	0.58	
CJ	52.0	58.0	59.0	3.79	0.827	56.33	1.89	2.19	
CO	13.0	13.0	14.0	0.58	0.118	13.33	13.01	-12.70	×
CP	46.0	45.0	50.0	2.65	0.591	47.00	-1.35	-1.04	
CS	52.0	54.0	52.0	1.15	0.236	52.67	0.62	0.92	
CX	51.0	54.0	52.0	1.53	0.354	52.33	0.50	0.81	
D	50.0	51.0	50.0	0.58	0.118	50.33	-0.19	0.12	
DB									•
DD	52.0	50.0	48.0	2.00	0.473	50.00	-0.31	0.00	
DE	49.0	50.0	50.0	0.58	0.118	49.67	-0.42	-0.12	
DI									•
DO	53.0	55.0	50.0	2.52	0.591	52.67	0.62	0.92	
DT	50.0	52.0	49.0	1.53	0.354	50.33	-0.19	0.12	
DZ									•
E	51.0	50.0	54.0	2.08	0.473	51.67	0.27	0.58	
EB	64.0	64.0	64.0	0.00	0.000	64.00	4.54	4.85	×
EL	49.0	51.0	49.0	1.15	0.236	49.67	-0.42	0.12	
EO									•
ER									•

• ≡ 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
EV									•
EX	47.0	44.0	47.0	1.73	0.354	46.00	-1.69	-1.39	
FE	49.0	48.0	54.0	3.21	0.709	50.33	-0.19	0.12	
FF									•
FJ	56.0	55.0	55.0	0.58	0.118	55.33	1.54	1.85	
FL	52.0	54.0	51.0	1.53	0.354	52.33	0.50	0.81	
FN									•
GI									•
GQ	49.0	49.0	49.0	0.00	0.000	49.00	-0.65	-0.35	
GZ									•
HI	50.0	49.0	48.0	1.00	0.236	49.00	-0.65	-0.35	
HK	54.0	53.0	54.0	0.58	0.118	53.67	0.96	1.27	
HL	54.0	52.0	54.0	1.15	0.236	53.33	0.85	1.15	
HP	49.0	48.0	49.0	0.58	0.118	48.67	-0.77	-0.46	
I	51.0	50.0	54.0	2.08	0.473	51.67	0.27	0.58	
ID									•
IU									•
J									•
JE	51.0	51.0	52.0	0.58	0.118	51.33	0.16	0.46	
JG	64.0	58.0	68.0	5.03	1.345	63.33	4.31	4.62	×
JM	50.0	50.0	50.0	0.00	0.000	50.00	-0.31	0.00	
JN									•
JQ									•
JS	50.0	51.0	51.0	0.58	0.118	50.67	-0.07	0.23	
JX									•
JY									•
K	50.0	52.0	53.0	1.53	0.354	51.67	0.27	0.58	
KE									•
KT									•
KX	56.0	51.0	58.0	3.61	0.827	55.00	1.43	1.73	
L	49.0	51.0	51.0	1.15	0.236	50.33	-0.19	0.12	
LE									•
LF	54.0	56.0	51.0	2.52	0.591	53.67	0.96	1.27	
LL									•
LR	41.0	50.0	49.0	4.93	1.120	46.67	-1.46	-1.15	
M	50.0	52.0	51.0	1.00	0.236	51.00	0.04	0.35	
MF									•
MP	46.0	46.0	49.0	1.73	0.354	47.00	-1.35	-1.04	
MT									•
MV	46.0	46.0	45.0	0.58	0.118	45.67	-1.81	-1.50	
MY									•
N									•
NA									•
NH	49.0	49.0	48.0	0.58	0.118	48.67	-0.77	-0.46	
NJ	53.0	52.0	51.0	1.00	0.236	52.00	0.39	0.69	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø = 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)	Normalized deviation (known)	Tag
NK									•
NO									•
O	54.0	54.0	54.0	0.00	0.000	54.00	1.08	1.39	
OB	53.0	52.0	52.0	0.58	0.118	52.33	0.50	0.81	
OF									•
OM	53.0	52.0	50.0	1.53	0.354	51.67	0.27	0.58	
OS									•
OY									•
P	38.0	35.0	40.0	2.52	0.591	37.67	-4.58	-4.27	×
PB									•
PD	101.0	95.0	99.0	3.06	0.709	98.33	16.44	16.74	×
PG									•
PM	50.0	51.0	54.0	2.08	0.473	51.67	0.27	0.58	
PW									•
Q	52.0	49.0	50.0	1.53	0.354	50.33	-0.19	0.12	
QM	42.0	43.0	45.0	1.53	0.354	43.33	-2.62	-2.31	
QP	52.0	55.0	47.0	4.04	0.945	51.33	0.16	0.46	
QQ									•
QT	50.0	48.0	49.0	1.00	0.236	49.00	-0.65	-0.35	
QU	44.0	46.0	47.0	1.53	0.354	45.67	-1.81	-1.50	
QW	48.0	46.0	48.0	1.15	0.236	47.33	-1.23	-0.92	
QX	29.0	23.0	31.0	4.16	0.945	27.67	-8.04	-7.74	×
QZ	50.0	53.0	54.0	2.08	0.473	52.33	0.50	0.81	
RB									•
RD	57.0	57.0	57.0	0.00	0.000	57.00	2.12	2.42	
RG									•
RI									•
RK	50.0	49.0	52.0	1.53	0.354	50.33	-0.19	0.12	
RP									•
RR									•
RU									•
RZ	56.0	55.0	53.0	1.53	0.354	54.67	1.31	1.62	
S	49.0	51.0	51.0	1.15	0.236	50.33	-0.19	0.12	
SD	49.0	49.0	55.0	3.46	0.709	51.00	0.04	0.35	
SF	43.0	50.0	46.0	3.51	0.827	46.33	-1.58	-1.27	
SG									•
SI	57.0	52.0	52.0	2.89	0.591	53.67	0.96	1.27	
SL									•
SM	49.0	51.0	50.0	1.00	0.236	50.00	-0.31	0.00	
SN	49.0	51.0	52.0	1.53	0.354	50.67	-0.07	0.23	
SO									•
SR									•
SS	51.0	54.0	54.0	1.73	0.354	53.00	0.73	1.04	
SX	52.0	53.0	51.0	1.00	0.236	52.00	0.39	0.69	
T	48.0	45.0	47.0	1.53	0.354	46.67	-1.46	-1.15	

• ≡ 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)	Normalized deviation (known)	Tag
TD	53.0	53.0	52.0	0.58	0.118	52.67	0.62	0.92	
TL									
TN									
TQ	50.0	47.0	51.0	2.08	0.473	49.33	-0.54	-0.23	
TY									
U	50.0	51.0	52.0	1.00	0.236	51.00	0.04	0.35	
UA									
UM									
UP	52.0	55.0	53.0	1.53	0.354	53.33	0.85	1.15	
UQ									
UY									
VA									
VC									
VH	52.0	51.0	54.0	1.53	0.354	52.33	0.50	0.81	
VI	51.0	49.0	53.0	2.00	0.473	51.00	0.04	0.35	
VJ									
VM									
VO	49.0	51.0	47.0	2.00	0.473	49.00	-0.65	-0.35	
VT	60.0	62.0	64.0	2.00	0.473	62.00	3.85	4.16	×
W	47.0	48.0	57.0	5.51	1.345	50.67	0.07	0.23	
WE									
WH									
WO	54.0	55.0	56.0	1.00	0.236	55.00	1.43	1.73	
WR	50.0	50.0	54.0	2.31	0.473	51.33	0.16	0.46	
WW	53.0	53.0	55.0	1.15	0.236	53.67	0.96	1.27	
X	57.0	49.0	55.0	4.16	0.945	53.67	0.96	1.27	
XA	48.0	49.0	45.0	2.08	0.473	47.33	-1.23	-0.92	
XC									
XD	53.0	50.0	50.0	1.73	0.354	51.00	0.04	0.35	
XF	49.0	51.0	50.0	1.00	0.236	50.00	-0.31	0.00	
XI	50.0	50.0	51.0	0.58	0.118	50.33	-0.19	0.12	
XJ									
XK	61.0	61.0	52.0	5.20	1.120	58.00	2.47	2.77	
XL									
XM									
XN									
XP									
XQ									
XT	50.0	51.0	50.0	0.58	0.118	50.33	-0.19	0.12	
Y									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
13.33	×	CO	37.67	×	P	45.00		AK
27.67	×	QX	43.33		QM	45.67		QU

• ≡ No data submitted
Ø ≡ Insufficient data

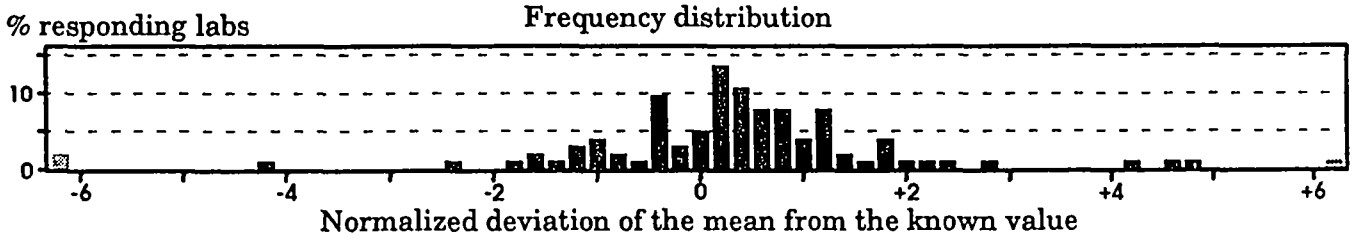
TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
45.67		MV	50.33		S	52.33		OB
46.00		EX	50.33		RK	52.33		FL
46.33		SF	50.33		Q	52.33		CX
46.67		T	50.33		L	52.33		BO
46.67		LR	50.33		FE	52.33		BH
47.00		MP	50.33		DT	52.33		A
47.00		CP	50.33		D	52.67		TD
47.33		XA	50.33		BM	52.67		DO
47.33		QW	50.67		W	52.67		CS
47.67		CA	50.67		SN	53.00		SS
47.67		C	50.67		JS	53.33		UP
48.00		AU	50.67		BL	53.33		HL
48.67		NH	51.00		XD	53.33		BC
48.67		HP	51.00		VI	53.67		X
48.67		AW	51.00		U	53.67		WW
48.67		AE	51.00		SD	53.67		SI
49.00		VO	51.00		M	53.67		LF
49.00		QT	51.00		AJ	53.67		HK
49.00		HI	51.00		AF	54.00		O
49.00		GQ	51.33		WR	54.00		AH
49.00		BB	51.33		QP	54.67		RZ
49.00		BA	51.33		JE	55.00		WO
49.33		TQ	51.33		BN	55.00		KX
49.67		EL	51.67		PM	55.33		FJ
49.67		DE	51.67		OM	55.33		BK
50.00		XF	51.67		K	56.00		AL
50.00		SM	51.67		I	56.33		CJ
50.00		JM	51.67		E	57.00		RD
50.00		DD	51.67		CE	58.00		XK
50.00		AZ	52.00		SX	62.00	×	VT
50.33		XT	52.00		NJ	63.33	×	JG
50.33		XI	52.33		VH	64.00	×	EB
			52.33		QZ	98.33	×	PD



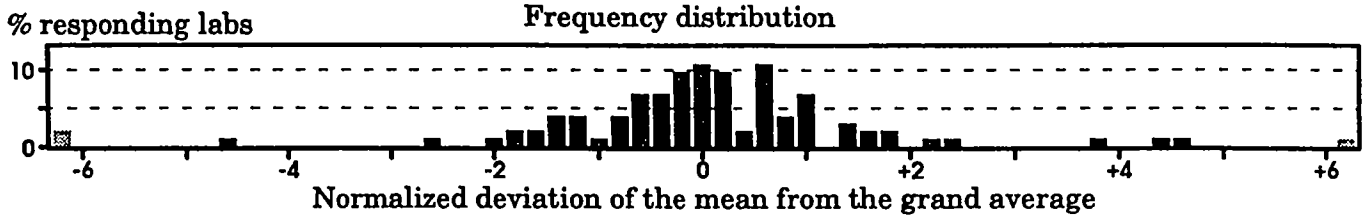
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ 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

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/600/R-99/020
February 1999

EPA

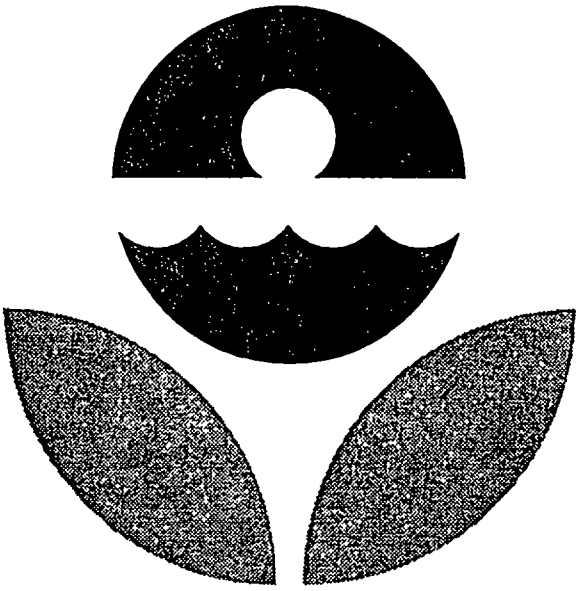
Gamma in Water Performance Evaluation Study

A Statistical Evaluation of the November 6, 1998 Data

Gamma in Water

Performance Evaluation Study

November 6, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Gamma in Water; November 6, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

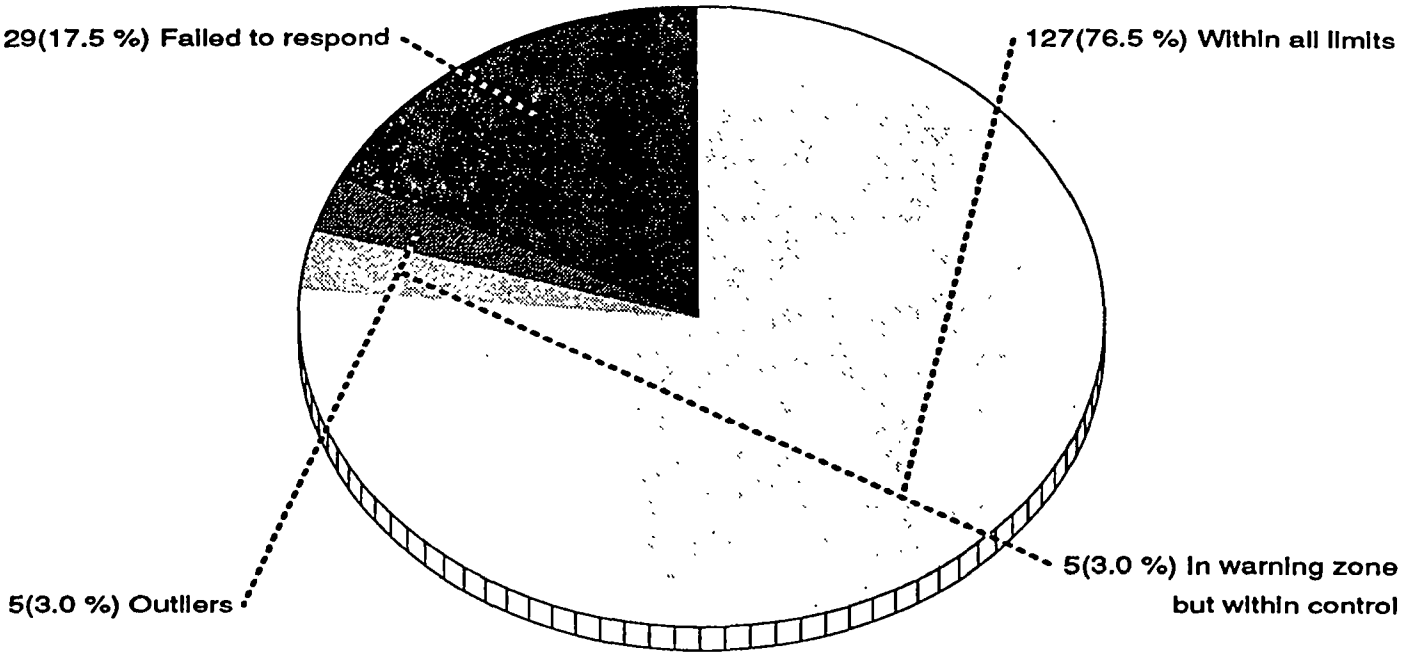
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

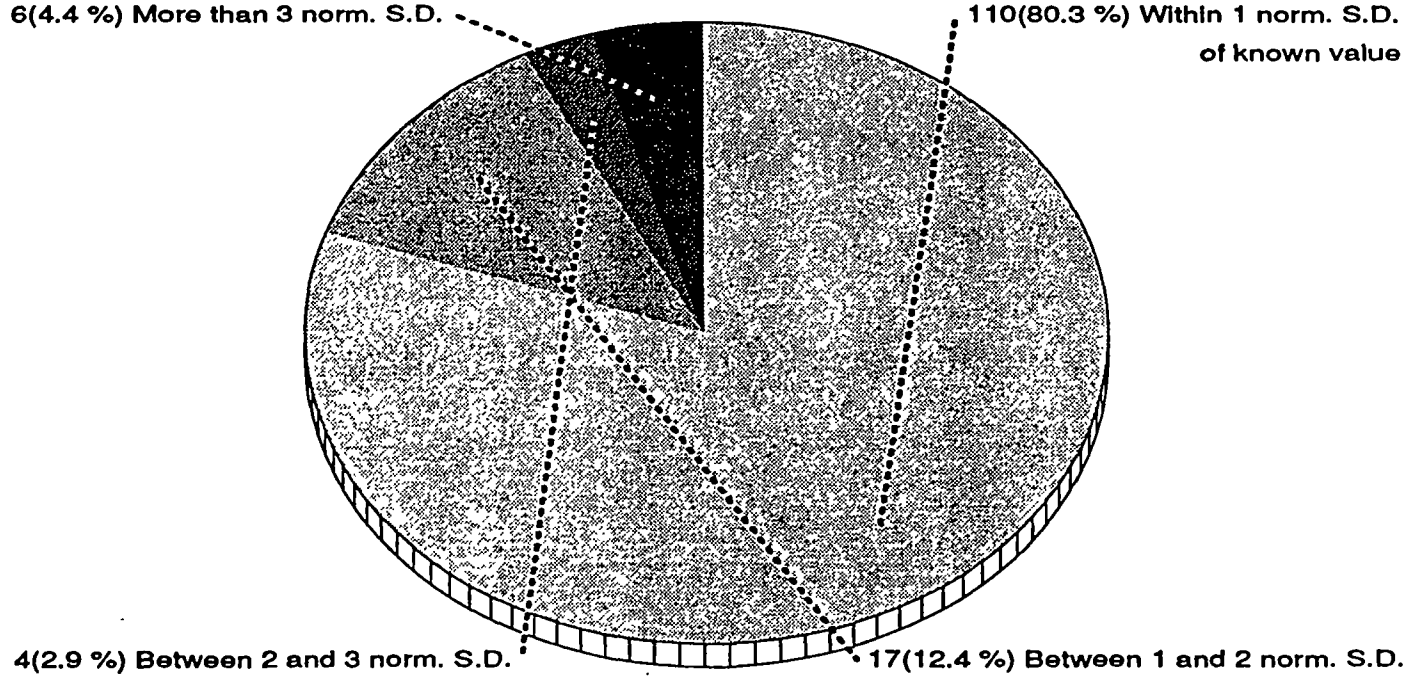
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Cobalt-60 Statistical Summary 166 Participants

The known value of this nuclide is 38.0 pCi/l with an expected precision of 5.0; the control limits are 29.3 to 46.7; the warning regions are 29.3 to 32.2 and 43.8 to 46.7



Statistic	Respondents	Non-outliers
Mean	44.12	**Grand Avg 38.17**
Std. Dev.	67.92	2.38
Variance	4613.47	5.67
% Coef. of Var.	153.96	6.24
% deviation of mean from known value	16.10	0.44
Norm. dev. of mean from known value	0.09	0.07
Median	38.00	38.00
% deviation of median from known value	0.00	0.00
Norm. dev. of median from known value	0.00	0.00



ESD-LV Performance Evaluation: Gamma in Water, 6-Nov-1998

Cobalt-60

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	40.0	39.0	39.0	0.58	0.118	39.33	0.40	0.46	
AE	39.0	41.0	37.0	2.00	0.473	39.00	0.29	0.35	
AF	41.0	39.0	39.0	1.15	0.236	39.67	0.52	0.58	
AH	37.0	33.0	31.0	3.06	0.709	33.67	-1.56	-1.50	
AI									•
AJ	46.0	41.0	43.0	2.52	0.591	43.33	1.79	1.85	
AK	39.0	39.0	38.0	0.58	0.118	38.67	0.17	0.23	
AL	43.0	44.0	38.0	3.21	0.709	41.67	1.21	1.27	
AP									•
AU	38.0	37.0	35.0	1.53	0.354	36.67	-0.52	-0.46	
AW	37.0	37.0	37.0	0.00	0.000	37.00	-0.40	-0.35	
AY	34.0	34.0	33.0	0.58	0.118	33.67	-1.56	-1.50	
AZ	36.0	35.0	32.0	2.08	0.473	34.33	-1.33	-1.27	
BA	36.0	37.0	34.0	1.53	0.354	35.67	-0.87	-0.81	
BB	39.0	38.0	39.0	0.58	0.118	38.67	0.17	0.23	
BC	35.0	35.0	35.0	0.00	0.000	35.00	-1.10	-1.04	
BG									•
BH	38.0	37.0	38.0	0.58	0.118	37.67	-0.17	-0.12	
BK	40.0	40.0	41.0	0.58	0.118	40.33	0.75	0.81	
BL	42.0	44.0	37.0	3.61	0.827	41.00	0.98	1.04	
BM	37.0	38.0	38.0	0.58	0.118	37.67	-0.17	-0.12	
BN	45.0	37.0	35.0	5.29	1.345	39.00	0.29	0.35	
BO	38.0	38.0	37.0	0.58	0.118	37.67	-0.17	-0.12	
C	37.0	35.0	35.0	1.15	0.236	35.67	-0.87	-0.81	
CA	40.0	38.0	37.0	1.53	0.354	38.33	0.06	0.12	
CC									•
CE	36.0	40.0	37.0	2.08	0.473	37.67	-0.17	-0.12	
CJ	42.0	40.0	37.0	2.52	0.591	39.67	0.52	0.58	
CO	38.0	46.0	41.0	4.04	0.945	41.67	1.21	1.27	
CP	37.0	40.0	39.0	1.53	0.354	38.67	0.17	0.23	
CS	38.0	37.0	37.0	0.58	0.118	37.33	-0.29	-0.23	
CX	21.0	21.0	19.0	1.15	0.236	20.33	-6.18	-6.12	×
D	38.0	38.0	36.0	1.15	0.236	37.33	-0.29	-0.23	
DD	38.0	37.0	35.0	1.53	0.354	36.67	-0.52	-0.46	
DE	36.0	37.0	37.0	0.58	0.118	36.67	-0.52	-0.46	
DH	38.0	36.0	37.0	1.00	0.236	37.00	-0.40	-0.35	
DO	40.0	36.0	39.0	2.08	0.473	38.33	0.06	0.12	
DR	41.0	36.0	40.0	2.65	0.591	39.00	0.29	0.35	
DT	35.0	40.0	36.0	2.65	0.591	37.00	-0.40	-0.35	
E	38.0	40.0	38.0	1.15	0.236	38.67	0.17	0.23	
EA									•
EB	43.0	44.0	43.0	0.58	0.118	43.33	1.79	1.85	
EL	38.0	37.0	36.0	1.00	0.236	37.00	-0.40	-0.35	
EW									•
EX	35.0	38.0	34.0	2.08	0.473	35.67	-0.87	-0.81	

TAG SYMBOLS

• ≡ No data submitted
Ø ≡ Insufficient data
× ≡ 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
FE	37.0	37.0	40.0	1.73	0.354	38.00	-0.06	0.00	
FJ	38.0	38.0	38.0	0.00	0.000	38.00	-0.06	0.00	
FL	35.0	39.0	38.0	2.08	0.473	37.33	-0.29	-0.23	
GI									•
GL	38.0	37.0	38.0	0.58	0.118	37.67	-0.17	-0.12	
GQ	38.0	38.0	38.0	0.00	0.000	38.00	-0.06	0.00	
HE	38.0	36.0	38.0	1.15	0.236	37.33	-0.29	-0.23	
HI	36.0	40.0	36.0	2.31	0.473	37.33	-0.29	-0.23	
HK	38.0	39.0	37.0	1.00	0.236	38.00	-0.06	0.00	
HL	40.0	40.0	40.0	0.00	0.000	40.00	0.64	0.69	
HP									•
I	35.0	35.0	37.0	1.15	0.236	35.67	-0.87	-0.81	
IU	38.0	39.0	38.0	0.58	0.118	38.33	0.06	0.12	
J									•
JE	40.0	38.0	38.0	1.15	0.236	38.67	0.17	0.23	
JG	45.0	41.0	44.0	2.08	0.473	43.33	1.79	1.85	
JM	37.0	37.0	38.0	0.58	0.118	37.33	-0.29	-0.23	
JS	38.0	38.0	38.0	0.00	0.000	38.00	-0.06	0.00	
JY	40.0	39.0	40.0	0.58	0.118	39.67	0.52	0.58	
K	39.0	37.0	37.0	1.15	0.236	37.67	-0.17	-0.12	
KH	38.0	40.0	41.0	1.53	0.354	39.67	0.52	0.58	
KL	38.0	38.0	37.0	0.58	0.118	37.67	-0.17	-0.12	
KX	37.0	39.0	37.0	1.15	0.236	37.67	-0.17	-0.12	
L	40.0	37.0	37.0	1.73	0.354	38.00	-0.06	0.00	
LE	38.0	38.0	47.0	5.20	1.120	41.00	0.98	1.04	
LF	39.0	38.0	37.0	1.00	0.236	38.00	-0.06	0.00	
LR	36.0	37.0	37.0	0.58	0.118	36.67	-0.52	-0.46	
M	34.0	39.0	40.0	3.21	0.709	37.67	-0.17	-0.12	
MP	41.0	41.0	38.0	1.73	0.354	40.00	0.64	0.69	
MT	38.0	38.0	38.0	0.00	0.000	38.00	-0.06	0.00	
MV	40.0	41.0	38.0	1.53	0.354	39.67	0.52	0.58	
MX	37.0	38.0	37.0	0.58	0.118	37.33	-0.29	-0.23	
N	40.0	39.0	38.0	1.00	0.236	39.00	0.29	0.35	
NH	36.0	35.0	37.0	1.00	0.236	36.00	-0.75	-0.69	
NJ	38.0	37.0	37.0	0.58	0.118	37.33	-0.29	-0.23	
NK									•
NO	45.0	51.0	58.0	6.51	2.020	51.33	4.56	4.62	×
NP	34.0	37.0	37.0	1.73	0.354	36.00	-0.75	-0.69	
O	39.0	40.0	40.0	0.58	0.118	39.67	0.52	0.58	
OA	73.0	75.0	75.0	1.15	0.236	74.33	12.53	12.59	×
OB	38.0	39.0	37.0	1.00	0.236	38.00	-0.06	0.00	
OM	46.0	45.0	45.0	0.58	0.118	45.33	2.48	2.54	
OT	38.0	36.0	39.0	1.53	0.354	37.67	-0.17	-0.12	
P	38.0	38.0	41.0	1.73	0.354	39.00	0.29	0.35	
PB									•

• ≡ 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
PD	38.0	40.0	40.0	1.15	0.236	39.33	0.40	0.46	
PE									•
PM	38.0	37.0	40.0	1.53	0.354	38.33	0.06	0.12	
PW	36.0	36.0	36.0	0.00	0.000	36.00	-0.75	-0.69	
PX	39.0	32.0	39.0	4.04	0.827	36.67	-0.52	-0.46	
Q	39.0	42.0	41.0	1.53	0.354	40.67	0.87	0.92	
QM	37.0	39.0	40.0	1.53	0.354	38.67	0.17	0.23	
QP	37.0	34.0	32.0	2.52	0.591	34.33	-1.33	-1.27	
QT	35.0	34.0	36.0	1.00	0.236	35.00	-1.10	-1.04	
QU	34.0	32.0	37.0	2.52	0.591	34.33	-1.33	-1.27	
QW	33.0	33.0	34.0	0.58	0.118	33.33	-1.67	-1.62	
QX	40.0	40.0	41.0	0.58	0.118	40.33	0.75	0.81	
QZ	40.0	40.0	38.0	1.15	0.236	39.33	0.40	0.46	
R	38.0	39.0	38.0	0.58	0.118	38.33	0.06	0.12	
RK	42.0	36.0	37.0	3.21	0.709	38.33	0.06	0.12	
RO	36.0	36.0	37.0	0.58	0.118	36.33	-0.64	-0.58	
RR									•
RU									•
RX	40.0	41.0	39.0	1.00	0.236	40.00	0.64	0.69	
RZ	31.0	27.0	27.0	2.31	0.473	28.33	-3.41	-3.35	×
S	36.0	37.0	37.0	0.58	0.118	36.67	-0.52	-0.46	
SD	36.0	38.0	37.0	1.00	0.236	37.00	-0.40	-0.35	
SF	40.0	36.0	35.0	2.65	0.591	37.00	-0.40	-0.35	
SI	37.0	44.0	41.0	3.51	0.827	40.67	0.87	0.92	
SM	42.0	36.0	42.0	3.46	0.709	40.00	0.64	0.69	
SN	37.0	36.0	32.0	2.65	0.591	35.00	-1.10	-1.04	
SR	38.0	32.0	36.0	3.06	0.709	35.33	-0.98	-0.92	
SS	38.0	41.0	39.0	1.53	0.354	39.33	0.40	0.46	
SV	39.0	39.0	38.0	0.58	0.118	38.67	0.17	0.23	
SX	37.0	40.0	38.0	1.53	0.354	38.33	0.06	0.12	
T	38.0	37.0	37.0	0.58	0.118	37.33	-0.29	-0.23	
TC	37.0	38.0	37.0	0.58	0.118	37.33	-0.29	-0.23	
TD	38.0	49.0	41.0	5.69	1.570	42.67	1.56	1.62	
TF									•
TO	29.0	54.0	50.0	13.43	4.721	44.33	2.14	2.19	
TQ	37.0	37.0	34.0	1.73	0.354	36.00	-0.75	-0.69	
TR	30.0	30.0	28.0	1.15	0.236	29.33	-3.06	-3.00	
TW	44.0	41.0	51.0	5.13	1.345	45.33	2.48	2.54	
U	40.0	40.0	38.0	1.15	0.236	39.33	0.40	0.46	
UM									•
UP	40.0	38.0	37.0	1.53	0.354	38.33	0.06	0.12	
UR									•
UV	37.0	37.0	36.0	0.58	0.118	36.67	-0.52	-0.46	
UX	36.0	39.0	37.0	1.53	0.354	37.33	-0.29	-0.23	
UY									•

• ≡ 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
VA									•
VC	41.0	40.0	41.0	0.58	0.118	40.67	0.87	0.92	
VE	37.0	37.0	37.0	0.00	0.000	37.00	-0.40	-0.35	
VH	39.0	37.0	40.0	1.53	0.354	38.67	0.17	0.23	
VI	40.0	41.0	39.0	1.00	0.236	40.00	0.64	0.69	
VM									•
VO	31.0	42.0	40.0	5.86	1.570	37.67	-0.17	-0.12	
VS	37.0	39.0	37.0	1.15	0.236	37.67	-0.17	-0.12	
W	36.0	38.0	36.0	1.15	0.236	36.67	-0.52	-0.46	
WD	37.0	38.0	38.0	0.58	0.118	37.67	-0.17	-0.12	
WI									•
WJ									•
WK									•
WO									•
WR	36.0	37.0	39.0	1.53	0.354	37.33	-0.29	-0.23	
WS									•
WW	37.0	39.0	38.0	1.00	0.236	38.00	-0.06	0.00	
WX									•
X	42.0	50.0	44.0	4.16	0.945	45.33	2.48	2.54	
XA	40.0	41.0	41.0	0.58	0.118	40.67	0.87	0.92	
XB	37.0	37.0	36.0	0.58	0.118	36.67	-0.52	-0.46	
XC									•
XD	41.0	39.0	41.0	1.15	0.236	40.33	0.75	0.81	
XF	35.0	38.0	37.0	1.53	0.354	36.67	-0.52	-0.46	
XG									•
XI	36.0	37.0	37.0	0.58	0.118	36.67	-0.52	-0.46	
XK	38.0	42.0	42.0	2.31	0.473	40.67	0.87	0.92	
XQ									•
XT	37.0	38.0	36.0	1.00	0.236	37.00	-0.40	-0.35	
XU	848.0	823.0	824.0	14.15	4.721	831.67	274.88	274.93	×
Y	38.0	35.0	36.0	1.53	0.354	36.33	-0.64	-0.58	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
20.33	×	CX	35.00		BC	36.33		RO
28.33	×	RZ	35.33		SR	36.67		XI
29.33		TR	35.67		I	36.67		XF
33.33		QW	35.67		EX	36.67		XB
33.67		AY	35.67		C	36.67		W
33.67		AH	35.67		BA	36.67		UV
34.33		QU	36.00		TQ	36.67		S
34.33		QP	36.00		PW	36.67		PX
34.33		AZ	36.00		NP	36.67		LR
35.00		SN	36.00		NH	36.67		DE
35.00		QT	36.33		Y	36.67		DD

• ≡ 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

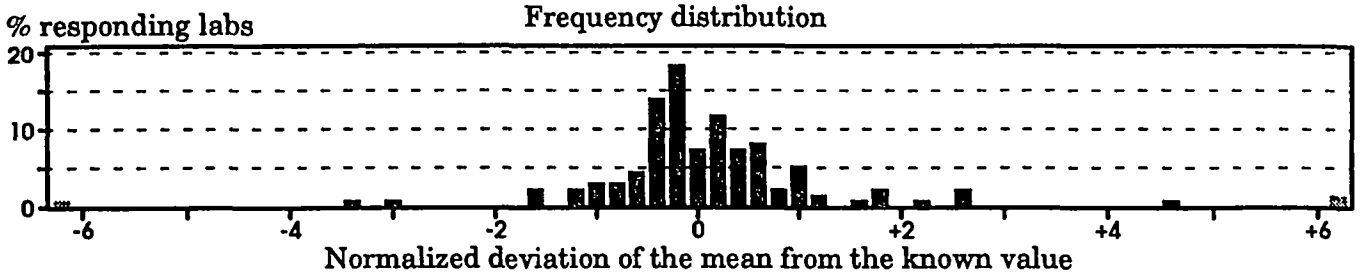
Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
36.67		AU	38.00		WW	39.33		A
37.00		XT	38.00		OB	39.67		O
37.00		VE	38.00		MT	39.67		MV
37.00		SF	38.00		LF	39.67		KH
37.00		SD	38.00		L	39.67		JY
37.00		EL	38.00		JS	39.67		CJ
37.00		DT	38.00		HK	39.67		AF
37.00		DH	38.00		GQ	40.00		VI
37.00		AW	38.00		FJ	40.00		SM
37.33		WR	38.00		FE	40.00		RX
37.33		UX	38.33		UP	40.00		MP
37.33		TC	38.33		SX	40.00		HL
37.33		T	38.33		RK	40.33		XD
37.33		NJ	38.33		R	40.33		QX
37.33		MX	38.33		PM	40.33		BK
37.33		JM	38.33		IU	40.67		XK
37.33		HI	38.33		DO	40.67		XA
37.33		HE	38.33		CA	40.67		VC
37.33		FL	38.67		VH	40.67		SI
37.33		D	38.67		SV	40.67		Q
37.33		CS	38.67		QM	41.00		LE
37.67		WD	38.67		JE	41.00		BL
37.67		VS	38.67		E	41.67		CO
37.67		VO	38.67		CP	41.67		AL
37.67		OT	38.67		BB	42.67		TD
37.67		M	38.67		AK	43.33		JG
37.67		KX	39.00		P	43.33		EB
37.67		KL	39.00		N	43.33		AJ
37.67		K	39.00		DR	44.33		TO
37.67		GL	39.00		BN	45.33		X
37.67		CE	39.00		AE	45.33		TW
37.67		BO	39.33		U	45.33		OM
37.67		BM	39.33		SS	51.33	×	NO
37.67		BH	39.33		QZ	74.33	×	OA
			39.33		PD	831.67	×	XU

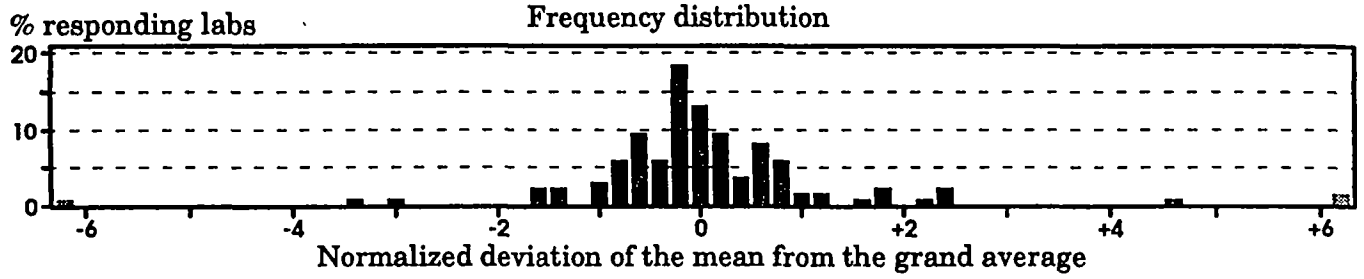
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS
× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

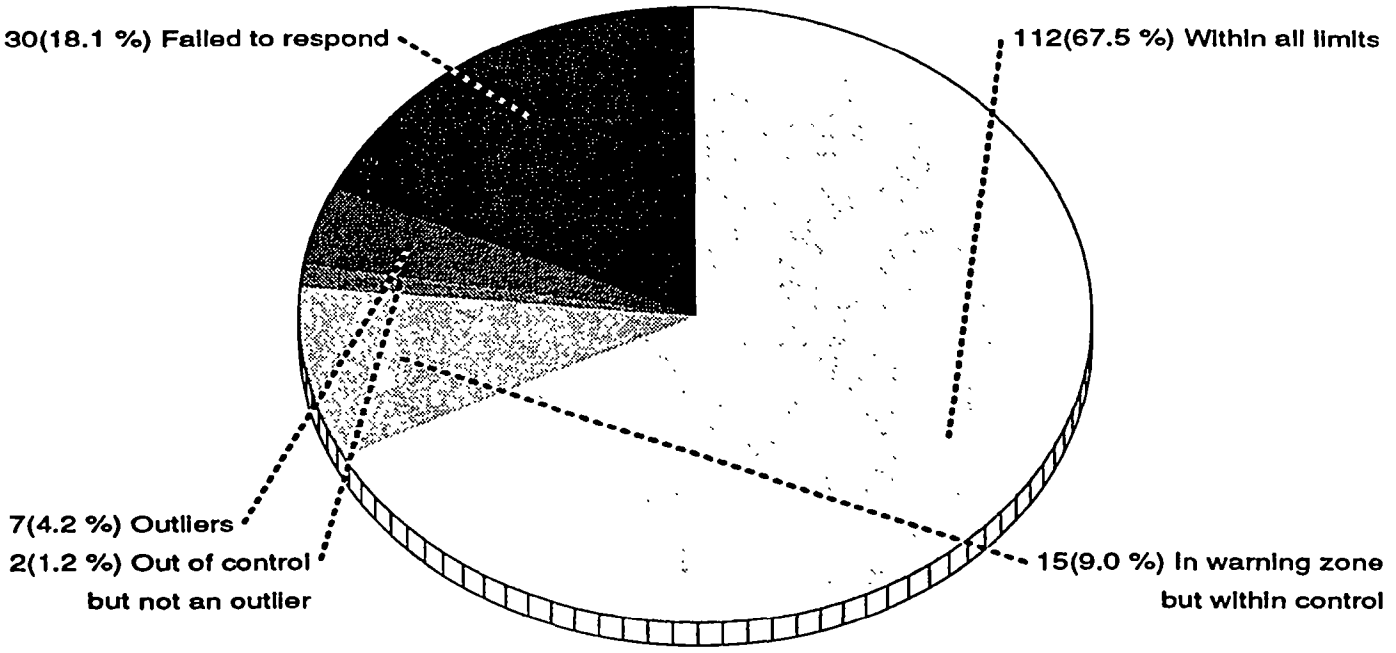
Cobalt-60


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

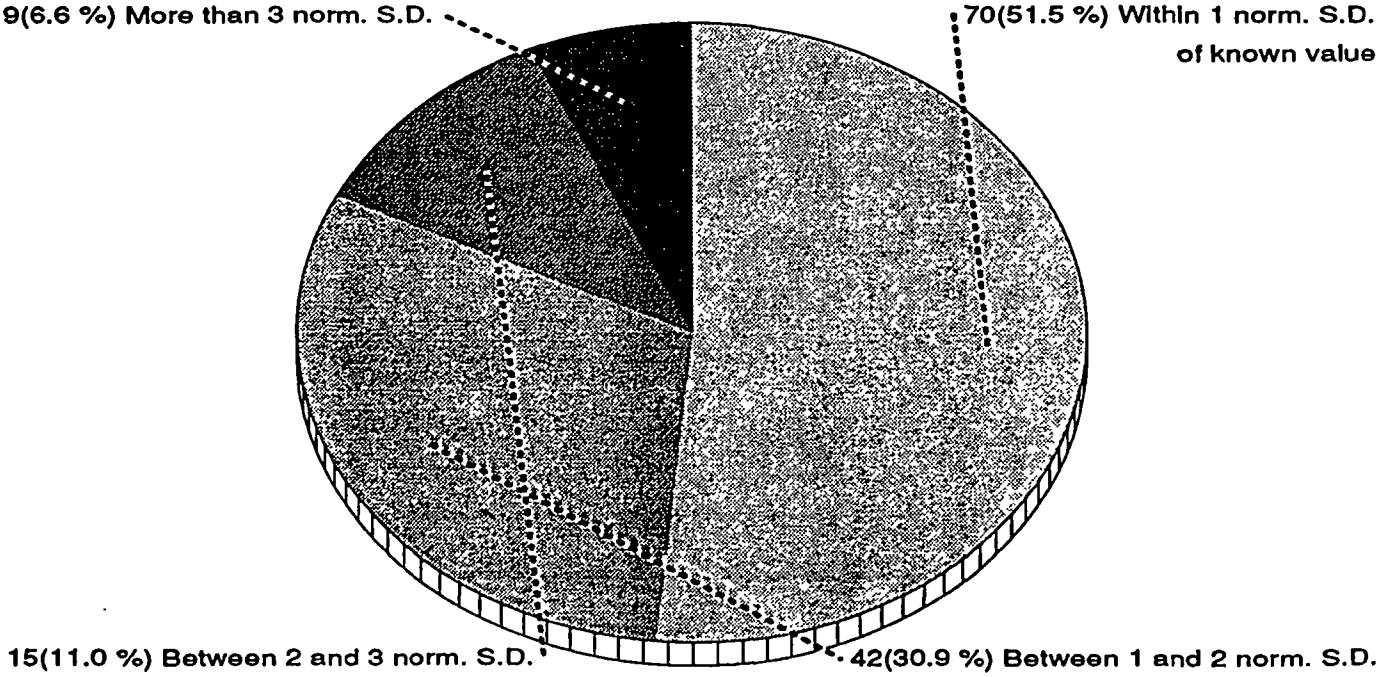

% responding labs
Frequency distribution
20
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Zinc-65 Statistical Summary 166 Participants

The known value of this nuclide is **131.0 pCi/l** with an expected precision of **13.0**; the control limits are 108.4 to 153.6; the warning regions are 108.4 to 116.0 and 146.0 to 153.6



Statistic	Respondents	Non-outliers
Mean	163.02	**Grand Avg 137.21**
Std. Dev.	303.49	7.65
Variance	92103.49	58.45
% Coef. of Var.	186.16	5.57
% deviation of mean from known value	24.44	4.74
Norm. dev. of mean from known value	0.11	0.81
Median	137.33	137.33
% deviation of median from known value	4.83	4.83
Norm. dev. of median from known value	0.02	0.83



Zinc-65

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	141.0	143.0	140.0	1.53	0.136	141.33	0.55	1.38	
AE	134.0	130.0	140.0	5.03	0.454	134.67	-0.34	0.49	
AF	139.0	143.0	140.0	2.08	0.182	140.67	0.46	1.29	
AH	118.0	139.0	121.0	11.36	0.954	126.00	-1.49	-0.67	
AI									•
AJ	153.0	135.0	135.0	10.39	0.818	141.00	0.51	1.33	
AK	133.0	136.0	137.0	2.08	0.182	135.33	-0.25	0.58	
AL	129.0	127.0	131.0	2.00	0.182	129.00	-1.09	-0.27	
AP									•
AU	122.0	133.0	131.0	5.86	0.500	128.67	-1.14	-0.31	
AW	135.0	132.0	130.0	2.52	0.227	132.33	-0.65	0.18	
AY	135.0	134.0	127.0	4.36	0.363	132.00	-0.69	0.13	
AZ	132.0	139.0	134.0	3.61	0.318	135.00	-0.29	0.53	
BA	120.0	128.0	130.0	5.29	0.454	126.00	-1.49	-0.67	
BB	145.0	143.0	143.0	1.15	0.091	143.67	0.86	1.69	
BC	139.0	138.0	138.0	0.58	0.045	138.33	0.15	0.98	
BG									•
BH	154.0	151.0	155.0	2.08	0.182	153.33	2.15	2.98	
BK	152.0	152.0	152.0	0.00	0.000	152.00	1.97	2.80	
BL	130.0	130.0	137.0	4.04	0.318	132.33	-0.65	0.18	
BM	135.0	134.0	140.0	3.21	0.273	136.33	-0.12	0.71	
BN	136.0	150.0	132.0	9.45	0.818	139.33	0.28	1.11	
BO	136.0	136.0	130.0	3.46	0.273	134.00	-0.43	0.40	
C	130.0	139.0	133.0	4.58	0.409	134.00	-0.43	0.40	
CA	116.0	117.0	130.0	7.81	0.636	121.00	-2.16	-1.33	
CC									•
CE	138.0	134.0	140.0	3.06	0.273	137.33	0.02	0.84	
CJ	153.0	132.0	137.0	10.97	0.954	140.67	0.46	1.29	
CO	145.0	162.0	150.0	8.74	0.772	152.33	2.02	2.84	
CP	143.0	154.0	142.0	6.66	0.545	146.33	1.22	2.04	
CS	140.0	141.0	142.0	1.00	0.091	141.00	0.51	1.33	
CX	70.0	72.0	71.0	1.00	0.091	71.00	-8.82	-7.99	×
D	140.0	138.0	137.0	1.53	0.136	138.33	0.15	0.98	
DD	137.0	140.0	135.0	2.52	0.227	137.33	0.02	0.84	
DE	134.0	135.0	135.0	0.58	0.045	134.67	-0.34	0.49	
DH	127.0	128.0	125.0	1.53	0.136	126.67	-1.40	-0.58	
DO	146.0	141.0	122.0	12.66	1.172	136.33	-0.12	0.71	
DR	138.0	144.0	130.0	7.02	0.636	137.33	0.02	0.84	
DT	144.0	136.0	141.0	4.04	0.363	140.33	0.42	1.24	
E	140.0	143.0	142.0	1.53	0.136	141.67	0.59	1.42	
EA									•
EB	170.0	170.0	170.0	0.00	0.000	170.00	4.37	5.20	×
EL	133.0	128.0	132.0	2.65	0.227	131.00	-0.83	0.00	
EW									•
EX	130.0	118.0	136.0	9.17	0.818	128.00	-1.23	-0.40	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

∅ ≡ 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
FE	120.0	130.0	140.0	10.00	0.909	130.00	-0.96	-0.13	
FJ	143.0	140.0	136.0	3.51	0.318	139.67	0.33	1.15	
FL	137.0	139.0	145.0	4.16	0.363	140.33	0.42	1.24	
GI									•
GL	141.0	135.0	136.0	3.21	0.273	137.33	0.02	0.84	
GQ	139.0	139.0	139.0	0.00	0.000	139.00	0.24	1.07	
HE	134.0	134.0	136.0	1.15	0.091	134.67	-0.34	0.49	
HI	130.0	126.0	125.0	2.65	0.227	127.00	-1.36	-0.53	
HK	141.0	139.0	144.0	2.52	0.227	141.33	0.55	1.38	
HL	131.0	135.0	134.0	2.08	0.182	133.33	-0.52	0.31	
HP									•
I	131.0	134.0	133.0	1.53	0.136	132.67	-0.61	0.22	
IU	14.0	13.0	14.0	0.58	0.045	13.67	-16.46	-15.63	×
J									•
JE	145.0	143.0	143.0	1.15	0.091	143.67	0.86	1.69	
JG	160.0	162.0	159.0	1.53	0.136	160.33	3.08	3.91	⇑
JM	132.0	135.0	135.0	1.73	0.136	134.00	-0.43	0.40	
JS	137.0	141.0	139.0	2.00	0.182	139.00	0.24	1.07	
JY	146.0	150.0	151.0	2.65	0.227	149.00	1.57	2.40	
K	138.0	136.0	138.0	1.15	0.091	137.33	0.02	0.84	
KH	127.0	130.0	130.0	1.73	0.136	129.00	-1.09	-0.27	
KL	138.0	139.0	137.0	1.00	0.091	138.00	0.11	0.93	
KX	140.0	137.0	126.0	7.37	0.636	134.33	-0.38	0.44	
L	141.0	128.0	136.0	6.56	0.591	135.00	-0.29	0.53	
LE	180.0	135.0	145.0	23.63	2.990	153.33	2.15	2.98	
LF	150.0	140.0	150.0	5.77	0.454	146.67	1.26	2.09	
LR	134.0	138.0	135.0	2.08	0.182	135.67	-0.21	0.62	
M	144.0	146.0	152.0	4.16	0.363	147.33	1.35	2.18	
MP	134.0	130.0	137.0	3.51	0.318	133.67	-0.47	0.36	
MT	142.0	144.0	138.0	3.06	0.273	141.33	0.55	1.38	
MV	140.0	133.0	141.0	4.36	0.363	138.00	0.11	0.93	
MX	120.0	126.0	124.0	3.06	0.273	123.33	-1.85	-1.02	
N	134.0	136.0	142.0	4.16	0.363	137.33	0.02	0.84	
NH	145.0	146.0	148.0	1.53	0.136	146.33	1.22	2.04	
NJ	137.0	135.0	136.0	1.00	0.091	136.00	-0.16	0.67	
NK									•
NO	150.0	155.0	160.0	5.00	0.454	155.00	2.37	3.20	⇑
NP	131.0	141.0	133.0	5.29	0.454	135.00	-0.29	0.53	
O	140.0	142.0	142.0	1.15	0.091	141.33	0.55	1.38	
OA	276.0	276.0	271.0	2.89	0.227	274.33	18.27	19.10	×
OB									•
OM	141.0	145.0	148.0	3.51	0.318	144.67	0.99	1.82	
OT	129.0	119.0	142.0	11.53	1.086	130.00	-0.96	-0.13	
P	131.0	127.0	125.0	3.06	0.273	127.67	-1.27	-0.44	
PB									•

• ≡ 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)	(known)	Tag
PD	140.0	139.0	125.0	8.39	0.682	134.67	-0.34	0.49	
PE									•
PM	147.0	128.0	144.0	10.21	0.863	139.67	0.33	1.15	
PW	133.0	130.0	131.0	1.53	0.136	131.33	-0.78	0.04	
PX	127.0	128.0	132.0	2.65	0.227	129.00	-1.09	-0.27	
Q	129.0	129.0	125.0	2.31	0.182	127.67	-1.27	-0.44	
QM	138.0	146.0	143.0	4.04	0.363	142.33	0.68	1.51	
QP	130.0	134.0	127.0	3.51	0.318	130.33	-0.92	-0.09	
QT	134.0	135.0	134.0	0.58	0.045	134.33	-0.38	0.44	
QU	116.0	118.0	119.0	1.53	0.136	117.67	-2.60	-1.78	
QW	116.0	120.0	116.0	2.31	0.182	117.33	-2.65	-1.82	
QX	142.0	138.0	136.0	3.06	0.273	138.67	0.19	1.02	
QZ	143.0	144.0	144.0	0.58	0.045	143.67	0.86	1.69	
R	141.0	144.0	142.0	1.53	0.136	142.33	0.68	1.51	
RK	150.0	130.0	140.0	10.00	0.909	140.00	0.37	1.20	
RO	153.0	134.0	157.0	12.29	1.086	148.00	1.44	2.26	
RR									•
RU									•
RX	124.0	123.0	125.0	1.00	0.091	124.00	-1.76	-0.93	
RZ	126.0	139.0	148.0	11.06	1.000	137.67	0.06	0.89	
S	134.0	135.0	133.0	1.00	0.091	134.00	-0.43	0.40	
SD	141.0	137.0	142.0	2.65	0.227	140.00	0.37	1.20	
SF	135.0	126.0	133.0	4.73	0.409	131.33	-0.78	0.04	
SI	146.0	152.0	141.0	5.51	0.500	146.33	1.22	2.04	
SM	144.0	133.0	143.0	6.08	0.500	140.00	0.37	1.20	
SN	137.0	134.0	116.0	11.36	0.954	129.00	-1.09	-0.27	
SR	134.0	139.0	132.0	3.61	0.318	135.00	-0.29	0.53	
SS	137.0	151.0	148.0	7.37	0.636	145.33	1.08	1.91	
SV	143.0	130.0	137.0	6.51	0.591	136.67	-0.07	0.75	
SX	150.0	145.0	135.0	7.64	0.682	143.33	0.82	1.64	
T	120.0	140.0	139.0	11.27	0.909	133.00	-0.56	0.27	
TC	130.0	128.0	130.0	1.15	0.091	129.33	-1.05	-0.22	
TD	128.0	146.0	143.0	9.64	0.818	139.00	0.24	1.07	
TF									•
TO	130.0	166.0	155.0	18.45	2.211	150.33	1.75	2.58	
TQ	134.0	136.0	143.0	4.73	0.409	137.67	0.06	0.89	
TR	123.0	123.0	134.0	6.35	0.500	126.67	-1.40	-0.58	
TW	153.0	161.0	182.0	14.98	1.605	165.33	3.75	4.57	×
U	134.0	135.0	134.0	0.58	0.045	134.33	-0.38	0.44	
UM									•
UP	137.0	139.0	140.0	1.53	0.136	138.67	0.19	1.02	
UR									•
UV	133.0	115.0	123.0	9.02	0.818	123.67	-1.80	-0.98	
UX	140.0	145.0	136.0	4.51	0.409	140.33	0.42	1.24	
UY									•

• ≡ 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)	(known)	Tag
VA									•
VC	151.0	144.0	147.0	3.51	0.318	147.33	1.35	2.18	
VE	141.0	151.0	157.0	8.08	0.727	149.67	1.66	2.49	
VH	145.0	145.0	144.0	0.58	0.045	144.67	0.99	1.82	
VI	146.0	147.0	144.0	1.53	0.136	145.67	1.13	1.95	
VM									•
VO	136.0	118.0	139.0	11.36	0.954	131.00	-0.83	0.00	
VS	135.0	137.0	134.0	1.53	0.136	135.33	-0.25	0.58	
W	126.0	127.0	130.0	2.08	0.182	127.67	-1.27	-0.44	
WD	130.0	135.0	128.0	3.61	0.318	131.00	-0.83	0.00	
WI									•
WJ									•
WK									•
WO									•
WR	105.0	105.0	112.0	4.04	0.318	107.33	-3.98	-3.15	×
WS									•
WW	130.0	134.0	145.0	7.77	0.682	136.33	-0.12	0.71	
WX									•
X	135.0	115.0	147.0	16.17	1.865	132.33	-0.65	0.18	
XA	156.0	157.0	126.0	17.62	1.778	146.33	1.22	2.04	
XB	149.0	148.0	137.0	6.66	0.545	144.67	0.99	1.82	
XC									•
XD	138.0	146.0	143.0	4.04	0.363	142.33	0.68	1.51	
XF	129.0	145.0	138.0	8.02	0.727	137.33	0.02	0.84	
XG									•
XI	140.0	140.0	140.0	0.00	0.000	140.00	0.37	1.20	
XK	146.0	139.0	148.0	4.73	0.409	144.33	0.95	1.78	
XQ									•
XT	137.0	143.0	136.0	3.79	0.318	138.67	0.19	1.02	
XU	3676.0	3660.0	3672.0	8.33	0.727	3669.33	470.60	471.43	×
Y	134.0	126.0	128.0	4.16	0.363	129.33	-1.05	-0.22	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
13.67	×	IU	126.67		TR	129.00		AL
71.00	×	CX	126.67		DH	129.33		Y
107.33	×	WR	127.00		HI	129.33		TC
117.33		QW	127.67		W	130.00		OT
117.67		QU	127.67		Q	130.00		FE
121.00		CA	127.67		P	130.33		QP
123.33		MX	128.00		EX	131.00		WD
123.67		UV	128.67		AU	131.00		VO
124.00		RX	129.00		SN	131.00		EL
126.00		BA	129.00		PX	131.33		SF
126.00		AH	129.00		KH	131.33		PW

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

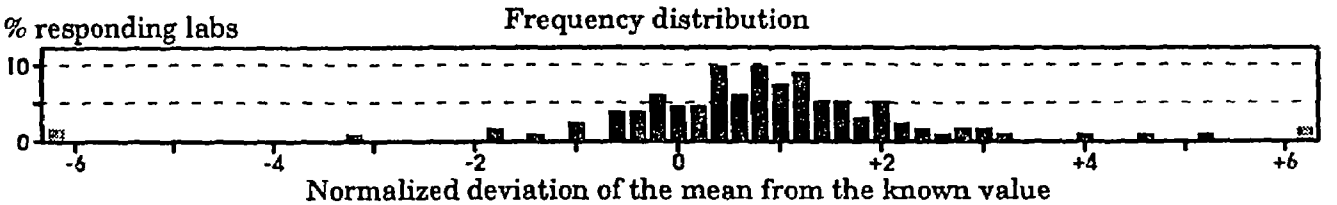
× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Zinc-65

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
132.00		AY	137.33		GL	141.67		E
132.33		X	137.33		DR	142.33		XD
132.33		BL	137.33		DD	142.33		R
132.33		AW	137.33		CE	142.33		QM
132.67		I	137.67		TQ	143.33		SX
133.00		T	137.67		RZ	143.67		QZ
133.33		HL	138.00		MV	143.67		JE
133.67		MP	138.00		KL	143.67		BB
134.00		S	138.33		D	144.33		XK
134.00		JM	138.33		BC	144.67		XB
134.00		C	138.67		XT	144.67		VH
134.00		BO	138.67		UP	144.67		OM
134.33		U	138.67		QX	145.33		SS
134.33		QT	139.00		TD	145.67		VI
134.33		KX	139.00		JS	146.33		XA
134.67		PD	139.00		GQ	146.33		SI
134.67		HE	139.33		BN	146.33		NH
134.67		DE	139.67		PM	146.33		CP
134.67		AE	139.67		FJ	146.67		LF
135.00		SR	140.00		XI	147.33		VC
135.00		NP	140.00		SM	147.33		M
135.00		L	140.00		SD	148.00		RO
135.00		AZ	140.00		RK	149.00		JY
135.33		VS	140.33		UX	149.67		VE
135.33		AK	140.33		FL	150.33		TO
135.67		LR	140.33		DT	152.00		BK
136.00		NJ	140.67		CJ	152.33		CO
136.33		WW	140.67		AF	153.33		LE
136.33		DO	141.00		CS	153.33		BH
136.33		BM	141.00		AJ	155.00	⇑	NO
136.67		SV	141.33		O	160.33	⇑	JG
137.33		XF	141.33		MT	165.33	×	TW
137.33		N	141.33		HK	170.00	×	EB
137.33		K	141.33		A	274.33	×	OA
						3669.33	×	XU



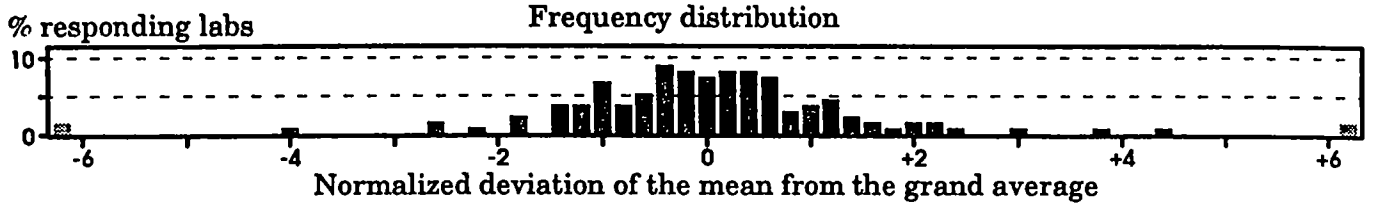
• ≡ No data submitted
⌀ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

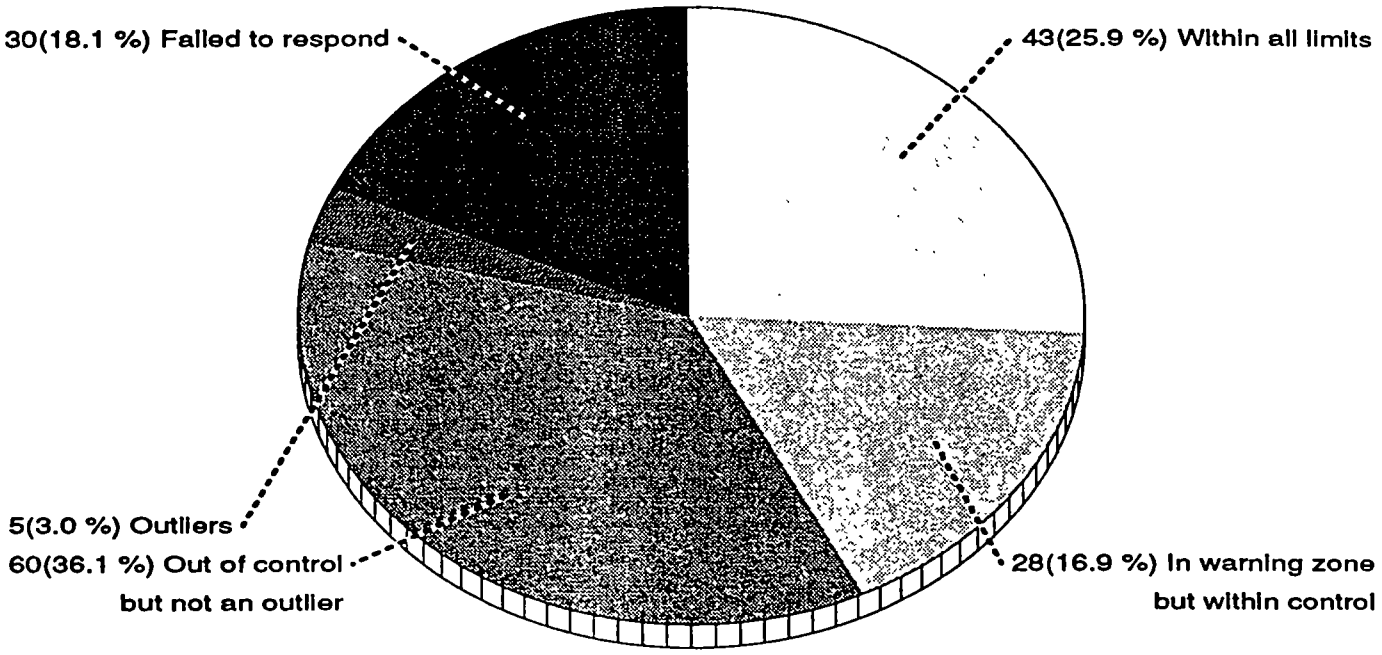
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Zinc-65

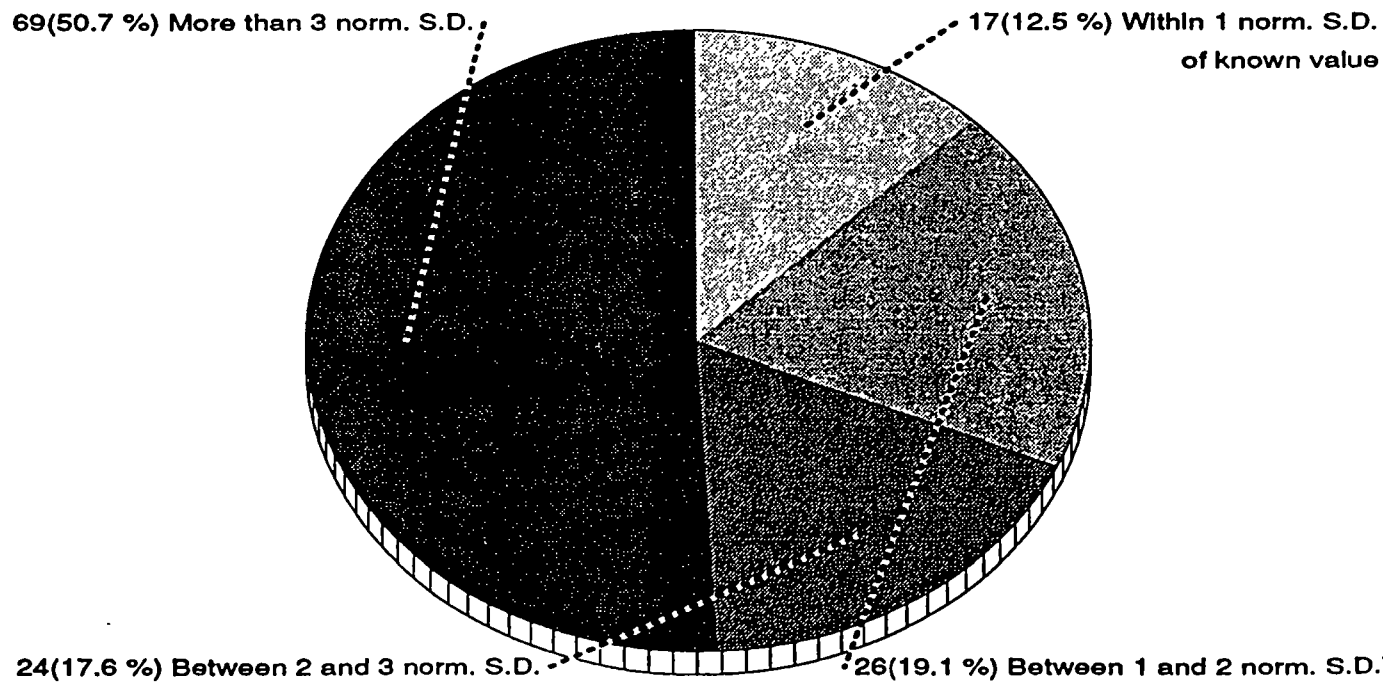

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-134 Statistical Summary 166 Participants

The known value of this nuclide is **105.0 pCi/l** with an expected precision of **5.0**; the control limits are 96.3 to 113.7; the warning regions are 96.3 to 99.2 and 110.8 to 113.7



Statistic	Respondents	Non-outliers
Mean	105.32	**Grand Avg 97.11**
Std. Dev.	98.90	6.14
Variance	9781.94	37.67
% Coef. of Var.	93.91	6.32
% deviation of mean from known value	0.30	-7.52
Norm. dev. of mean from known value	0.00	-1.29
Median	96.67	96.67
% deviation of median from known value	-7.94	-7.94
Norm. dev. of median from known value	-0.08	-1.36



ESD-LV Performance Evaluation: Gamma in Water, 6-Nov-1998

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	106.0	108.0	107.0	1.00	0.236	107.00	3.43	0.69	
AE	102.0	102.0	97.0	2.89	0.591	100.33	1.12	-1.62	
AF	100.0	100.0	94.0	3.46	0.709	98.00	0.31	-2.42	
AH	99.0	104.0	93.0	5.51	1.570	98.67	0.54	-2.19	
AI									•
AJ	95.0	95.0	95.0	0.00	0.000	95.00	-0.73	-3.46	⇓
AK	94.0	94.0	94.0	0.00	0.000	94.00	-1.08	-3.81	⇓
AL	112.0	124.0	110.0	7.57	2.245	115.33	6.31	3.58	⇑
AP									•
AU	95.0	97.0	99.0	2.00	0.473	97.00	-0.04	-2.77	
AW	94.0	94.0	94.0	0.00	0.000	94.00	-1.08	-3.81	⇓
AY	91.0	94.0	93.0	1.53	0.354	92.67	-1.54	-4.27	⇓
AZ	101.0	108.0	103.0	3.61	0.827	104.00	2.39	-0.35	
BA	98.0	97.0	96.0	1.00	0.236	97.00	-0.04	-2.77	
BB	102.0	102.0	103.0	0.58	0.118	102.33	1.81	-0.92	
BC	96.0	96.0	96.0	0.00	0.000	96.00	-0.38	-3.12	⇓
BG									•
BH	104.0	97.0	93.0	5.57	1.570	98.00	0.31	-2.42	
BK	105.0	106.0	104.0	1.00	0.236	105.00	2.73	0.00	
BL	94.0	94.0	94.0	0.00	0.000	94.00	-1.08	-3.81	⇓
BM	101.0	103.0	101.0	1.15	0.236	101.67	1.58	-1.15	
BN	95.0	100.0	91.0	4.51	1.120	95.33	-0.61	-3.35	⇓
BO	111.0	109.0	103.0	4.16	0.945	107.67	3.66	0.92	
C	98.0	105.0	98.0	4.04	0.827	100.33	1.12	-1.62	
CA	85.0	91.0	97.0	6.00	1.795	91.00	-2.12	-4.85	⇓
CC									•
CE	103.0	104.0	96.0	4.36	0.945	101.00	1.35	-1.39	
CJ	103.0	101.0	105.0	2.00	0.473	103.00	2.04	-0.69	
CO	93.0	96.0	98.0	2.52	0.591	95.67	-0.50	-3.23	⇓
CP	101.0	100.0	98.0	1.53	0.354	99.67	0.89	-1.85	
CS	95.0	97.0	94.0	1.53	0.354	95.33	-0.61	-3.35	⇓
CX	46.0	50.0	54.0	4.00	0.945	50.00	-16.32	-19.05	×
D	103.0	99.0	102.0	2.08	0.473	101.33	1.46	-1.27	
DD	105.0	107.0	104.0	1.53	0.354	105.33	2.85	0.12	
DE	99.0	100.0	100.0	0.58	0.118	99.67	0.89	-1.85	
DH	102.0	103.0	101.0	1.00	0.236	102.00	1.70	-1.04	
DO	96.0	98.0	100.0	2.00	0.473	98.00	0.31	-2.42	
DR	91.0	92.0	97.0	3.21	0.709	93.33	-1.31	-4.04	⇓
DT	88.0	94.0	93.0	3.21	0.709	91.67	-1.88	-4.62	⇓
E	98.0	101.0	98.0	1.73	0.354	99.00	0.66	-2.08	
EA									•
EB	100.0	100.0	100.0	0.00	0.000	100.00	1.00	-1.73	
EL	104.0	104.0	101.0	1.73	0.354	103.00	2.04	-0.69	
EW									•
EX	89.0	99.0	90.0	5.51	1.345	92.67	-1.54	-4.27	⇓

• ≡ 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
FE	97.0	110.0	94.0	8.50	2.695	100.33	1.12	-1.62	
FJ	94.0	93.0	94.0	0.58	0.118	93.67	-1.19	-3.93	⇓
FL	98.0	96.0	96.0	1.15	0.236	96.67	-0.15	-2.89	
GI									•
GL	90.0	89.0	85.0	2.65	0.591	88.00	-3.15	-5.89	⇓
GQ	108.0	108.0	108.0	0.00	0.000	108.00	3.77	1.04	
HE	108.0	107.0	106.0	1.00	0.236	107.00	3.43	0.69	
HI	93.0	94.0	96.0	1.53	0.354	94.33	-0.96	-3.70	⇓
HK	100.0	98.0	101.0	1.53	0.354	99.67	0.89	-1.85	
HL	102.0	98.0	101.0	2.08	0.473	100.33	1.12	-1.62	
HP									•
I	95.0	95.0	95.0	0.00	0.000	95.00	-0.73	-3.46	⇓
IU	95.0	101.0	99.0	3.06	0.709	98.33	0.42	-2.31	
J									•
JE	101.0	97.0	100.0	2.08	0.473	99.33	0.77	-1.96	
JG	108.0	113.0	111.0	2.52	0.591	110.67	4.70	1.96	
JM	90.0	91.0	89.0	1.00	0.236	90.00	-2.46	-5.20	⇓
JS	99.0	100.0	98.0	1.00	0.236	99.00	0.66	-2.08	
JY	92.0	92.0	91.0	0.58	0.118	91.67	-1.88	-4.62	⇓
K	101.0	103.0	102.0	1.00	0.236	102.00	1.70	-1.04	
KH	84.0	83.0	84.0	0.58	0.118	83.67	-4.66	-7.39	⇓
KL	98.0	102.0	96.0	3.06	0.709	98.67	0.54	-2.19	
KX	101.0	100.0	100.0	0.58	0.118	100.33	1.12	-1.62	
L	97.0	97.0	99.0	1.15	0.236	97.67	0.19	-2.54	
LE	106.0	104.0	116.0	6.43	1.795	108.67	4.00	1.27	
LF	100.0	110.0	99.0	6.08	1.570	103.00	2.04	-0.69	
LR	91.0	88.0	96.0	4.04	0.945	91.67	-1.88	-4.62	⇓
M	97.0	96.0	96.0	0.58	0.118	96.33	-0.27	-3.00	
MP	97.0	93.0	96.0	2.08	0.473	95.33	-0.61	-3.35	⇓
MT	91.0	93.0	94.0	1.53	0.354	92.67	-1.54	-4.27	⇓
MV	100.0	101.0	97.0	2.08	0.473	99.33	0.77	-1.96	
MX	46.0	45.0	47.0	1.00	0.236	46.00	-17.70	-20.44	×
N	99.0	101.0	100.0	1.00	0.236	100.00	1.00	-1.73	
NH	90.0	91.0	89.0	1.00	0.236	90.00	-2.46	-5.20	⇓
NJ	93.0	92.0	91.0	1.00	0.236	92.00	-1.77	-4.50	⇓
NK									•
NO	99.0	105.0	111.0	6.00	1.795	105.00	2.73	0.00	
NP	90.0	88.0	100.0	6.43	1.795	92.67	-1.54	-4.27	⇓
O	99.0	99.0	100.0	0.58	0.118	99.33	0.77	-1.96	
OA	183.0	194.0	194.0	6.35	1.570	190.33	32.29	29.56	×
OB									•
OM	98.0	99.0	100.0	1.00	0.236	99.00	0.66	-2.08	
OT	91.0	87.0	92.0	2.65	0.591	90.00	-2.46	-5.20	⇓
P	88.0	85.0	78.0	5.13	1.345	83.67	-4.66	-7.39	⇓
PB									•

• ≡ 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
PD	96.0	98.0	93.0	2.52	0.591	95.67	-0.50	-3.23	⇓
PE									•
PM	90.0	94.0	91.0	2.08	0.473	91.67	-1.88	-4.62	⇓
PW	93.0	96.0	93.0	1.73	0.354	94.00	-1.08	-3.81	⇓
PX	106.0	107.0	110.0	2.08	0.473	107.67	3.66	0.92	
Q	87.0	91.0	93.0	3.06	0.709	90.33	-2.35	-5.08	⇓
QM	71.0	77.0	74.0	3.00	0.709	74.00	-8.00	-10.74	×
QP	101.0	104.0	109.0	4.04	0.945	104.67	2.62	-0.12	
QT	97.0	95.0	96.0	1.00	0.236	96.00	-0.38	-3.12	⇓
QU	95.0	97.0	99.0	2.00	0.473	97.00	-0.04	-2.77	
QW	96.0	97.0	98.0	1.00	0.236	97.00	-0.04	-2.77	
QX	97.0	97.0	95.0	1.15	0.236	96.33	-0.27	-3.00	
QZ	90.0	93.0	91.0	1.53	0.354	91.33	-2.00	-4.73	⇓
R	98.0	100.0	98.0	1.15	0.236	98.67	0.54	-2.19	
RK	96.0	85.0	91.0	5.51	1.570	90.67	-2.23	-4.97	⇓
RO	96.0	93.0	93.0	1.73	0.354	94.00	-1.08	-3.81	⇓
RR									•
RU									•
RX	102.0	101.0	103.0	1.00	0.236	102.00	1.70	-1.04	
RZ	111.0	112.0	114.0	1.53	0.354	112.33	5.27	2.54	
S	96.0	97.0	97.0	0.58	0.118	96.67	-0.15	-2.89	
SD	91.0	88.0	87.0	2.08	0.473	88.67	-2.92	-5.66	⇓
SF	82.0	84.0	81.0	1.53	0.354	82.33	-5.12	-7.85	⇓
SI	104.0	110.0	98.0	6.00	1.795	104.00	2.39	-0.35	
SM	90.0	88.0	89.0	1.00	0.236	89.00	-2.81	-5.54	⇓
SN	98.0	95.0	106.0	5.69	1.570	99.67	0.89	-1.85	
SR	97.0	99.0	96.0	1.53	0.354	97.33	0.08	-2.66	
SS	105.0	103.0	104.0	1.00	0.236	104.00	2.39	-0.35	
SV	83.0	85.0	82.0	1.53	0.354	83.33	-4.77	-7.51	⇓
SX	100.0	100.0	102.0	1.15	0.236	100.67	1.23	-1.50	
T	99.0	93.0	95.0	3.06	0.709	95.67	-0.50	-3.23	⇓
TC	78.0	79.0	75.0	2.08	0.473	77.33	-6.85	-9.58	⇓
TD	88.0	101.0	100.0	7.23	2.020	96.33	-0.27	-3.00	
TF									•
TO	98.0	123.0	113.0	12.58	4.721	111.33	4.93	2.19	
TQ	95.0	93.0	88.0	3.61	0.827	92.00	-1.77	-4.50	⇓
TR	88.0	89.0	90.0	1.00	0.236	89.00	-2.81	-5.54	⇓
TW	103.0	94.0	104.0	5.51	1.345	100.33	1.12	-1.62	
U	103.0	102.0	103.0	0.58	0.118	102.67	1.93	-0.81	
UM									•
UP	97.0	98.0	99.0	1.00	0.236	98.00	0.31	-2.42	
UR									•
UV	85.0	87.0	93.0	4.16	0.945	88.33	-3.04	-5.77	⇓
UX	98.0	88.0	90.0	5.29	1.345	92.00	-1.77	-4.50	⇓
UY									•

• ≡ 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
VA									•
VC	103.0	103.0	102.0	0.58	0.118	102.67	1.93	-0.81	
VE	92.0	94.0	93.0	1.00	0.236	93.00	-1.42	-4.16	⇓
VH	97.0	99.0	101.0	2.00	0.473	99.00	0.66	-2.08	
VI	93.0	91.0	91.0	1.15	0.236	91.67	-1.88	-4.62	⇓
VM									•
VO	93.0	94.0	92.0	1.00	0.236	93.00	-1.42	-4.16	⇓
VS	93.0	94.0	92.0	1.00	0.236	93.00	-1.42	-4.16	⇓
W	96.0	98.0	94.0	2.00	0.473	96.00	-0.38	-3.12	⇓
WD	98.0	96.0	94.0	2.00	0.473	96.00	-0.38	-3.12	⇓
WI									•
WJ									•
WK									•
WO									•
WR	94.0	97.0	98.0	2.08	0.473	96.33	-0.27	-3.00	
WS									•
WW	95.0	94.0	96.0	1.00	0.236	95.00	-0.73	-3.46	⇓
WX									•
X	98.0	92.0	94.0	3.06	0.709	94.67	-0.85	-3.58	⇓
XA	94.0	96.0	97.0	1.53	0.354	95.67	-0.50	-3.23	⇓
XB	100.0	103.0	100.0	1.73	0.354	101.00	1.35	-1.39	
XC									•
XD	99.0	100.0	98.0	1.00	0.236	99.00	0.66	-2.08	
XF	94.0	94.0	94.0	0.00	0.000	94.00	-1.08	-3.81	⇓
XG									•
XI	93.0	89.0	91.0	2.00	0.473	91.00	-2.12	-4.85	⇓
XK	88.0	102.0	100.0	7.57	2.245	96.67	-0.15	-2.89	
XQ									•
XT	93.0	94.0	93.0	0.58	0.118	93.33	-1.31	-4.04	⇓
XU	1175.0	1232.0	1319.0	72.52	31.498	1242.00	396.60	393.87	×
Y	96.0	93.0	93.0	1.73	0.354	94.00	-1.08	-3.81	⇓

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
46.00	×	MX	89.00	⇓	TR	91.67	⇓	PM
50.00	×	CX	89.00	⇓	SM	91.67	⇓	LR
74.00	×	QM	90.00	⇓	OT	91.67	⇓	JY
77.33	⇓	TC	90.00	⇓	NH	91.67	⇓	DT
82.33	⇓	SF	90.00	⇓	JM	92.00	⇓	UX
83.33	⇓	SV	90.33	⇓	Q	92.00	⇓	TQ
83.67	⇓	P	90.67	⇓	RK	92.00	⇓	NJ
83.67	⇓	KH	91.00	⇓	XI	92.67	⇓	NP
88.00	⇓	GL	91.00	⇓	CA	92.67	⇓	MT
88.33	⇓	UV	91.33	⇓	QZ	92.67	⇓	EX
88.67	⇓	SD	91.67	⇓	VI	92.67	⇓	AY

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

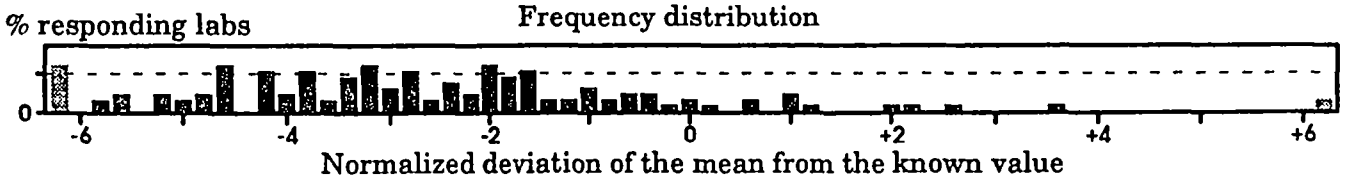
× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Cesium-134

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
93.00	⇓	VS	96.67		S	100.33		C
93.00	⇓	VO	96.67		FL	100.33		AE
93.00	⇓	VE	97.00		QW	100.67		SX
93.33	⇓	XT	97.00		QU	101.00		XB
93.33	⇓	DR	97.00		BA	101.00		CE
93.67	⇓	FJ	97.00		AU	101.33		D
94.00	⇓	Y	97.33		SR	101.67		BM
94.00	⇓	XF	97.67		L	102.00		RX
94.00	⇓	RO	98.00		UP	102.00		K
94.00	⇓	PW	98.00		DO	102.00		DH
94.00	⇓	BL	98.00		BH	102.33		BB
94.00	⇓	AW	98.00		AF	102.67		VC
94.00	⇓	AK	98.33		IU	102.67		U
94.33	⇓	HI	98.67		R	103.00		LF
94.67	⇓	X	98.67		KL	103.00		EL
95.00	⇓	WW	98.67		AH	103.00		CJ
95.00	⇓	I	99.00		XD	104.00		SS
95.00	⇓	AJ	99.00		VH	104.00		SI
95.33	⇓	MP	99.00		OM	104.00		AZ
95.33	⇓	CS	99.00		JS	104.67		QP
95.33	⇓	BN	99.00		E	105.00		NO
95.67	⇓	XA	99.33		O	105.00		BK
95.67	⇓	T	99.33		MV	105.33		DD
95.67	⇓	PD	99.33		JE	107.00		HE
95.67	⇓	CO	99.67		SN	107.00		A
96.00	⇓	WD	99.67		HK	107.67		PX
96.00	⇓	W	99.67		DE	107.67		BO
96.00	⇓	QT	99.67		CP	108.00		GQ
96.00	⇓	BC	100.00		N	108.67		LE
96.33		WR	100.00		EB	110.67		JG
96.33		TD	100.33		TW	111.33		TO
96.33		QX	100.33		KX	112.33		RZ
96.33		M	100.33		HL	115.33	⇑	AL
96.67		XK	100.33		FE	190.33	×	OA
						1242.00	×	XU



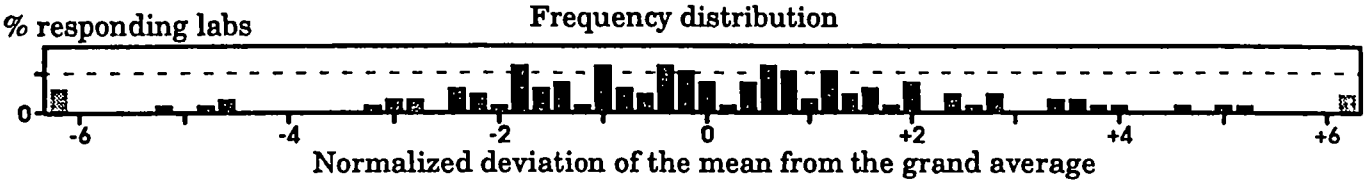
• ≡ No data submitted
Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

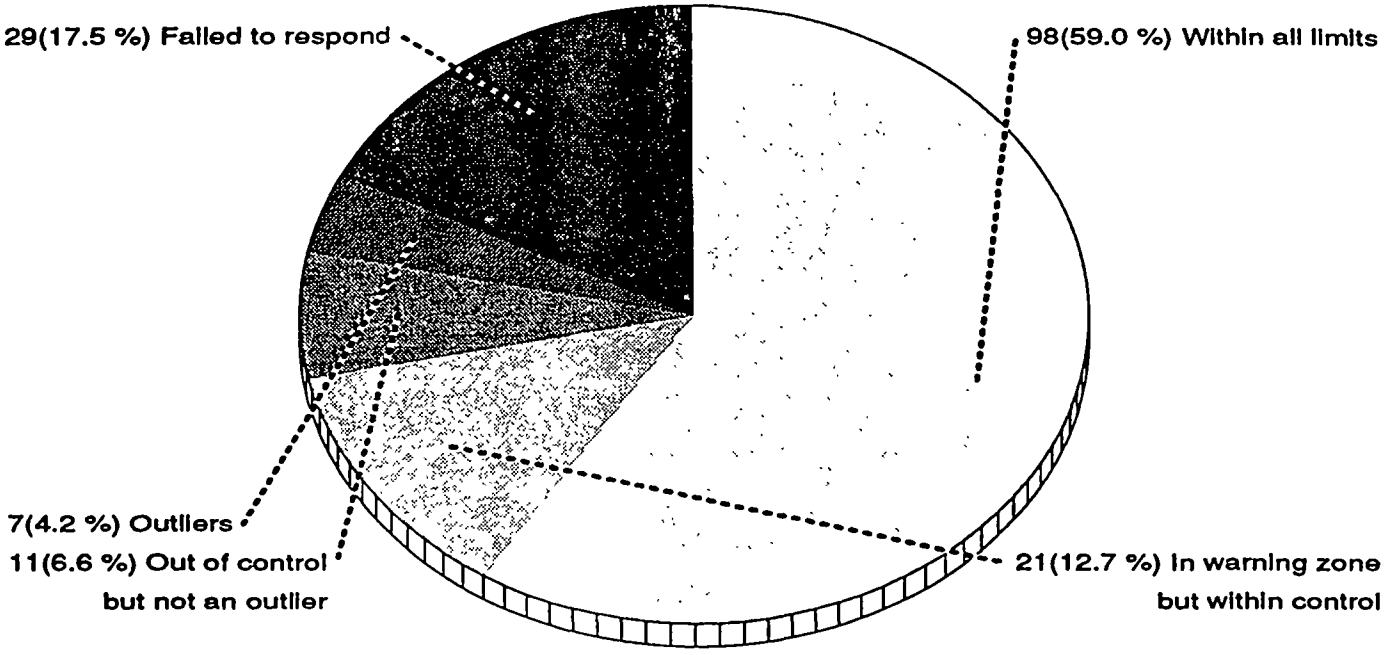
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-134

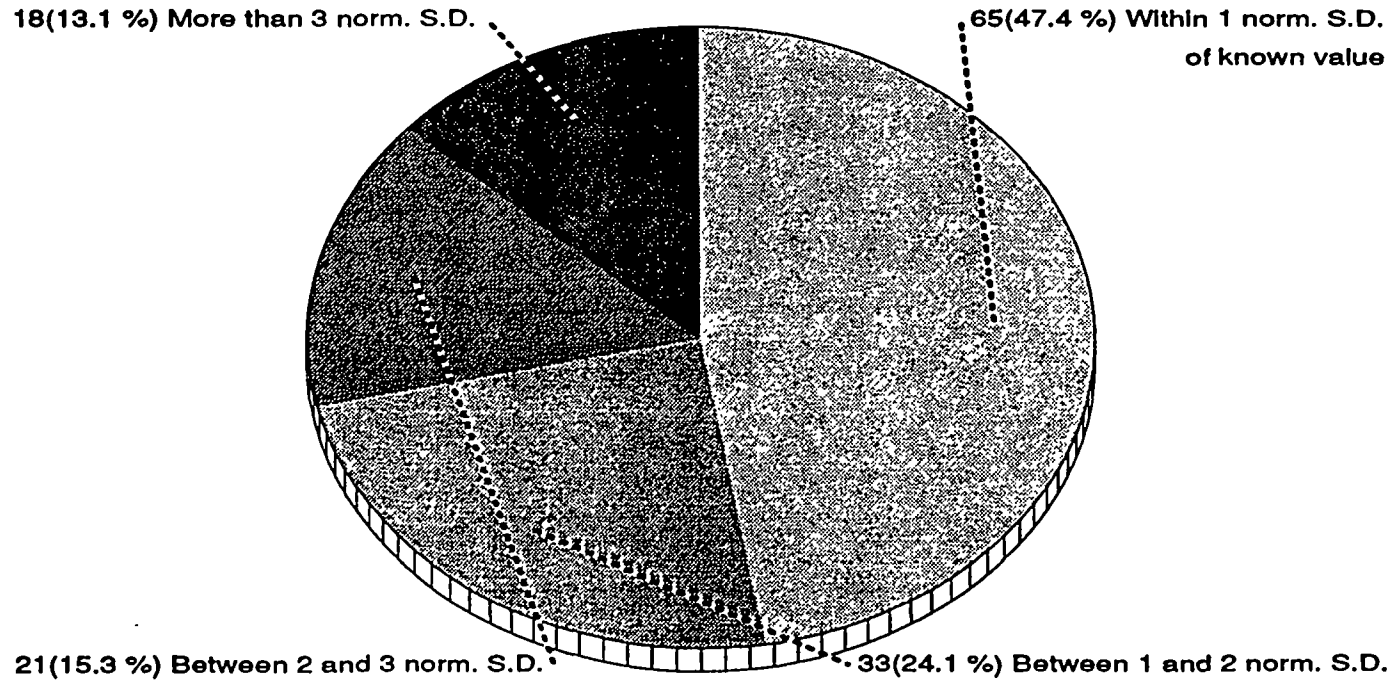

% responding labs
Frequency distribution
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Cesium-137 Statistical Summary 166 Participants

The known value of this nuclide is **111.0 pCi/l** with an expected precision of **6.0**; the control limits are 100.6 to 121.4; the warning regions are 100.6 to 104.1 and 117.9 to 121.4



Statistic	Respondents	Non-outliers
Mean	129.91	**Grand Avg 113.38**
Std. Dev.	190.93	5.42
Variance	36455.89	29.43
% Coef. of Var.	146.97	4.78
% deviation of mean from known value	17.04	2.15
Norm. dev. of mean from known value	0.10	0.44
Median	113.33	113.33
% deviation of median from known value	2.10	2.10
Norm. dev. of median from known value	0.01	0.43



Cesium-137

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	115.0	116.0	117.0	1.00	0.197	116.00	0.76	1.44	
AE	114.0	115.0	115.0	0.58	0.098	114.67	0.37	1.06	
AF	122.0	114.0	118.0	4.00	0.788	118.00	1.33	2.02	
AH	107.0	120.0	117.0	6.81	1.533	114.67	0.37	1.06	
AI									•
AJ	120.0	125.0	121.0	2.65	0.492	122.00	2.49	3.18	⇑
AK	110.0	111.0	111.0	0.58	0.098	110.67	-0.78	-0.10	
AL	91.0	96.0	94.0	2.52	0.492	93.67	-5.69	-5.00	×
AP									•
AU	112.0	113.0	111.0	1.00	0.197	112.00	-0.40	0.29	
AW	112.0	112.0	106.0	3.46	0.591	110.00	-0.98	-0.29	
AY	96.0	96.0	103.0	4.04	0.689	98.33	-4.34	-3.66	⇓
AZ	111.0	108.0	106.0	2.52	0.492	108.33	-1.46	-0.77	
BA	110.0	103.0	110.0	4.04	0.689	107.67	-1.65	-0.96	
BB	114.0	114.0	107.0	4.04	0.689	111.67	-0.50	0.19	
BC	112.0	113.0	113.0	0.58	0.098	112.67	-0.21	0.48	
BG									•
BH	119.0	120.0	120.0	0.58	0.098	119.67	1.81	2.50	
BK	123.0	125.0	125.0	1.15	0.197	124.33	3.16	3.85	⇑
BL	109.0	104.0	110.0	3.21	0.591	107.67	-1.65	-0.96	
BM	112.0	111.0	113.0	1.00	0.197	112.00	-0.40	0.29	
BN	122.0	116.0	121.0	3.21	0.591	119.67	1.81	2.50	
BO	113.0	112.0	112.0	0.58	0.098	112.33	-0.30	0.38	
C	100.0	110.0	100.0	5.77	0.984	103.33	-2.90	-2.21	
CA	103.0	113.0	113.0	5.77	0.984	109.67	-1.07	-0.38	
CC									•
CE	123.0	120.0	118.0	2.52	0.492	120.33	2.01	2.69	
CJ	114.0	115.0	117.0	1.53	0.295	115.33	0.56	1.25	
CO	117.0	113.0	118.0	2.65	0.492	116.00	0.76	1.44	
CP	111.0	116.0	114.0	2.52	0.492	113.67	0.08	0.77	
CS	112.0	112.0	114.0	1.15	0.197	112.67	-0.21	0.48	
CX	55.0	59.0	63.0	4.00	0.788	59.00	-15.70	-15.01	×
D	112.0	111.0	106.0	3.21	0.591	109.67	-1.07	-0.38	
DD	123.0	119.0	121.0	2.00	0.394	121.00	2.20	2.89	
DE	113.0	114.0	114.0	0.58	0.098	113.67	0.08	0.77	
DH	113.0	111.0	112.0	1.00	0.197	112.00	-0.40	0.29	
DO	118.0	117.0	113.0	2.65	0.492	116.00	0.76	1.44	
DR	112.0	114.0	113.0	1.00	0.197	113.00	-0.11	0.58	
DT	116.0	114.0	119.0	2.52	0.492	116.33	0.85	1.64	
E	114.0	117.0	119.0	2.52	0.492	116.67	0.95	1.64	
EA									•
EB	140.0	140.0	140.0	0.00	0.000	140.00	7.68	8.37	×
EL	113.0	111.0	109.0	2.00	0.394	111.00	-0.69	0.00	
EW									•
EX	103.0	98.0	102.0	2.65	0.492	101.00	-3.57	-2.89	

TAG SYMBOLS

• ≡ No data submitted
∅ ≡ Insufficient data
× ≡ 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)	Normalized deviation (known)	Tag
FE	110.0	120.0	130.0	10.00	2.846	120.00	1.91	2.60	
FJ	110.0	110.0	110.0	0.00	0.000	110.00	-0.98	-0.29	
FL	116.0	118.0	117.0	1.00	0.197	117.00	1.04	1.73	
GI									•
GL	110.0	109.0	109.0	0.58	0.098	109.33	-1.17	-0.48	
GQ	108.0	108.0	108.0	0.00	0.000	108.00	-1.55	-0.87	
HE	111.0	111.0	113.0	1.15	0.197	111.67	-0.50	0.19	
HI	109.0	109.0	110.0	0.58	0.098	109.33	-1.17	-0.48	
HK	121.0	115.0	118.0	3.00	0.591	118.00	1.33	2.02	
HL	119.0	119.0	112.0	4.04	0.689	116.67	0.95	1.64	
HP									•
I	114.0	114.0	113.0	0.58	0.098	113.67	0.08	0.77	
IU	111.0	117.0	114.0	3.00	0.591	114.00	0.18	0.87	
J									•
JE	117.0	114.0	115.0	1.53	0.295	115.33	0.56	1.25	
JG	117.0	136.0	119.0	10.44	2.658	124.00	3.07	3.75	⇑
JM	107.0	108.0	111.0	2.08	0.394	108.67	-1.36	-0.67	
JS	116.0	115.0	112.0	2.08	0.394	114.33	0.27	0.96	
JY	114.0	117.0	116.0	1.53	0.295	115.67	0.66	1.35	
K	116.0	120.0	121.0	2.65	0.492	119.00	1.62	2.31	
KH	114.0	111.0	114.0	1.73	0.295	113.00	-0.11	0.58	
KL	115.0	116.0	118.0	1.53	0.295	116.33	0.85	1.54	
KX	115.0	117.0	115.0	1.15	0.197	115.67	0.66	1.35	
L	112.0	111.0	111.0	0.58	0.098	111.33	-0.59	0.10	
LE	134.0	126.0	149.0	11.68	3.408	136.33	6.63	7.31	×
LF	120.0	110.0	120.0	5.77	0.984	116.67	0.95	1.64	
LR	109.0	108.0	119.0	6.08	1.158	112.00	-0.40	0.29	
M	119.0	118.0	119.0	0.58	0.098	118.67	1.53	2.21	
MP	117.0	106.0	118.0	6.66	1.345	113.67	0.08	0.77	
MT	110.0	111.0	111.0	0.58	0.098	110.67	-0.78	-0.10	
MV	126.0	122.0	116.0	5.03	0.984	121.33	2.30	2.98	
MX	54.0	57.0	55.0	1.53	0.295	55.33	16.76	-16.07	×
N	110.0	114.0	115.0	2.65	0.492	113.00	-0.11	0.58	
NH	110.0	109.0	110.0	0.58	0.098	109.67	-1.07	-0.38	
NJ	114.0	111.0	117.0	3.00	0.591	114.00	0.18	0.87	
NK									•
NO	119.0	123.0	127.0	4.00	0.788	123.00	2.78	3.46	⇑
NP	108.0	108.0	117.0	5.20	0.886	111.00	-0.69	0.00	
O	119.0	119.0	118.0	0.58	0.098	118.67	1.53	2.21	
OA	231.0	225.0	239.0	7.02	1.720	231.67	34.15	34.83	×
OB	116.0	114.0	113.0	1.53	0.295	114.33	0.27	0.96	
OM	120.0	120.0	122.0	1.15	0.197	120.67	2.10	2.79	
OT	117.0	99.0	114.0	9.64	2.470	110.00	-0.98	-0.29	
P	99.0	93.0	95.0	3.06	0.591	95.67	-5.11	-4.43	⇓
PB									•

• ≡ 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
PD	118.0	120.0	116.0	2.00	0.394	118.00	1.33	2.02	
PE									•
PM	111.0	110.0	117.0	3.79	0.689	112.67	-0.21	0.48	
PW	111.0	110.0	111.0	0.58	0.098	110.67	-0.78	-0.10	
PX	106.0	108.0	107.0	1.00	0.197	107.00	-1.84	-1.15	
Q	106.0	105.0	107.0	1.00	0.197	106.00	-2.13	-1.44	
QM	97.0	105.0	101.0	4.00	0.788	101.00	-3.57	-2.89	
QP	113.0	112.0	116.0	2.08	0.394	113.67	0.08	0.77	
QT	107.0	109.0	114.0	3.61	0.689	110.00	-0.98	-0.29	
QU	110.0	110.0	112.0	1.15	0.197	110.67	-0.78	-0.10	
QW	113.0	108.0	109.0	2.65	0.492	110.00	-0.98	-0.29	
QX	115.0	116.0	115.0	0.58	0.098	115.33	0.56	1.25	
QZ	111.0	114.0	114.0	1.73	0.295	113.00	-0.11	0.58	
R	120.0	119.0	119.0	0.58	0.098	119.33	1.72	2.41	
RK	116.0	102.0	110.0	7.02	1.720	109.33	-1.17	-0.48	
RO	119.0	119.0	114.0	2.89	0.492	117.33	1.14	1.83	
RR									•
RU									•
RX	112.0	113.0	113.0	0.58	0.098	112.67	-0.21	0.48	
RZ	127.0	121.0	123.0	3.06	0.591	123.67	2.97	3.66	⇑
S	111.0	110.0	112.0	1.00	0.197	111.00	-0.69	0.00	
SD	106.0	109.0	111.0	2.52	0.492	108.67	-1.36	-0.67	
SF	101.0	101.0	104.0	1.73	0.295	102.00	-3.29	-2.60	
SI	122.0	127.0	116.0	5.51	1.158	121.67	2.39	3.08	⇑
SM	112.0	114.0	118.0	3.06	0.591	114.67	0.37	1.06	
SN	113.0	117.0	117.0	2.31	0.394	115.67	0.66	1.35	
SR	106.0	110.0	107.0	2.08	0.394	107.67	-1.65	-0.96	
SS	118.0	123.0	120.0	2.52	0.492	120.33	2.01	2.69	
SV	108.0	105.0	100.0	4.04	0.788	104.33	-2.61	-1.92	
SX	119.0	136.0	112.0	12.34	3.596	122.33	2.58	3.27	⇑
T	106.0	106.0	104.0	1.15	0.197	105.33	-2.32	-1.64	
TC	109.0	110.0	108.0	1.00	0.197	109.00	-1.26	-0.58	
TD	110.0	110.0	116.0	3.46	0.591	112.00	-0.40	0.29	
TF									•
TO	119.0	128.0	127.0	4.93	0.886	124.67	3.26	3.95	⇑
TQ	115.0	114.0	117.0	1.53	0.295	115.33	0.56	1.25	
TR	111.0	109.0	101.0	5.29	0.984	107.00	-1.84	-1.15	
TW	114.0	113.0	117.0	2.08	0.394	114.67	0.37	1.06	
U	115.0	115.0	116.0	0.58	0.098	115.33	0.56	1.25	
UM									•
UP	112.0	114.0	115.0	1.53	0.295	113.67	0.08	0.77	
UR									•
UV	105.0	103.0	105.0	1.15	0.197	104.33	-2.61	-1.92	
UX	112.0	113.0	101.0	6.66	1.345	108.67	-1.36	-0.67	
UY									•

• ≡ 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)	Normalized deviation (known)	Tag
VA									•
VC	118.0	117.0	118.0	0.58	0.098	117.67	1.24	1.92	
VE	110.0	111.0	108.0	1.53	0.295	109.67	-1.07	-0.38	
VH	121.0	119.0	122.0	1.53	0.295	120.67	2.10	2.79	
VI	118.0	116.0	115.0	1.53	0.295	116.33	0.85	1.54	
VM									•
VO	107.0	116.0	118.0	5.86	1.158	113.67	0.08	0.77	
VS	108.0	109.0	109.0	0.58	0.098	108.67	-1.36	-0.67	
W	112.0	116.0	112.0	2.31	0.394	113.33	-0.01	0.67	
WD	117.0	115.0	116.0	1.00	0.197	116.00	0.76	1.44	
WI									•
WJ									•
WK									•
WO									•
WR	110.0	110.0	117.0	4.04	0.689	112.33	-0.30	0.38	
WS									•
WW	118.0	115.0	114.0	2.08	0.394	115.67	0.66	1.35	
WX									•
X	123.0	118.0	120.0	2.52	0.492	120.33	2.01	2.69	
XA	111.0	111.0	113.0	1.15	0.197	111.67	-0.50	0.19	
XB	110.0	109.0	112.0	1.53	0.295	110.33	-0.88	-0.19	
XC									•
XD	118.0	114.0	119.0	2.65	0.492	117.00	1.04	1.73	
XF	110.0	114.0	108.0	3.06	0.591	110.67	-0.78	-0.10	
XG									•
XI	110.0	110.0	110.0	0.00	0.000	110.00	-0.98	-0.29	
XK	129.0	124.0	125.0	2.65	0.492	126.00	3.64	4.33	⇑
XQ									•
XT	113.0	116.0	111.0	2.52	0.492	113.33	-0.01	0.67	
XU	2238.0	2359.0	2431.0	97.53	35.285	2342.67	643.54	644.23	×
Y	113.0	108.0	109.0	2.65	0.492	110.00	-0.98	-0.29	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
55.33	×	MX	105.33		T	108.67		SD
59.00	×	CX	106.00		Q	108.67		JM
93.67	×	AL	107.00		TR	109.00		TC
95.67	⇓	P	107.00		PX	109.33		RK
98.33	⇓	AY	107.67		SR	109.33		HI
101.00		QM	107.67		BL	109.33		GL
101.00		EX	107.67		BA	109.67		VE
102.00		SF	108.00		GQ	109.67		NH
103.33		C	108.33		AZ	109.67		D
104.33		UV	108.67		VS	109.67		CA
104.33		SV	108.67		UX	110.00		Y

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

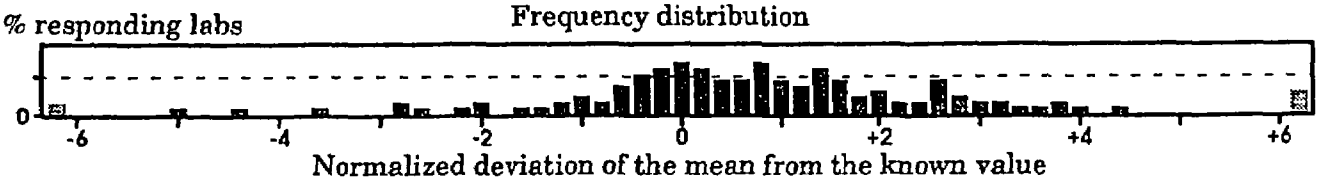
⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gamma in Water, 6-Nov-1998

Cesium-137

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
110.00		XI	113.33		XT	116.67		E
110.00		QW	113.33		W	117.00		XD
110.00		QT	113.67		VO	117.00		FL
110.00		OT	113.67		UP	117.33		RO
110.00		FJ	113.67		QP	117.67		VC
110.00		AW	113.67		MP	118.00		PD
110.33		XB	113.67		I	118.00		HK
110.67		XF	113.67		DE	118.00		AF
110.67		QU	113.67		CP	118.67		O
110.67		PW	114.00		NJ	118.67		M
110.67		MT	114.00		IU	119.00		K
110.67		AK	114.33		OB	119.33		R
111.00		S	114.33		JS	119.67		BN
111.00		NP	114.67		TW	119.67		BH
111.00		EL	114.67		SM	120.00		FE
111.33		L	114.67		AH	120.33		X
111.67		XA	114.67		AE	120.33		SS
111.67		HE	115.33		U	120.33		CE
111.67		BB	115.33		TQ	120.67		VH
112.00		TD	115.33		QX	120.67		OM
112.00		LR	115.33		JE	121.00		DD
112.00		DH	115.33		CJ	121.33		MV
112.00		BM	115.67		WW	121.67	⇑	SI
112.00		AU	115.67		SN	122.00	⇑	AJ
112.33		WR	115.67		KX	122.33	⇑	SX
112.33		BO	115.67		JY	123.00	⇑	NO
112.67		RX	116.00		WD	123.67	⇑	RZ
112.67		PM	116.00		DO	124.00	⇑	JG
112.67		CS	116.00		CO	124.33	⇑	BK
112.67		BC	116.00		A	124.67	⇑	TO
113.00		QZ	116.33		VI	126.00	⇑	XK
113.00		N	116.33		KL	136.33	×	LE
113.00		KH	116.33		DT	140.00	×	EB
113.00		DR	116.67		LF	231.67	×	OA
			116.67		HL	2342.67	×	XU



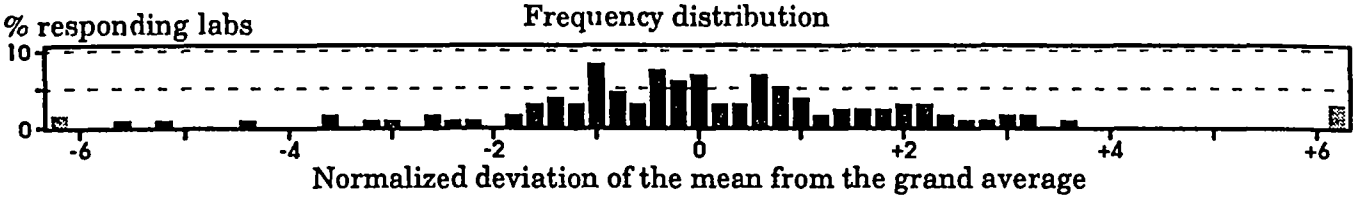
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

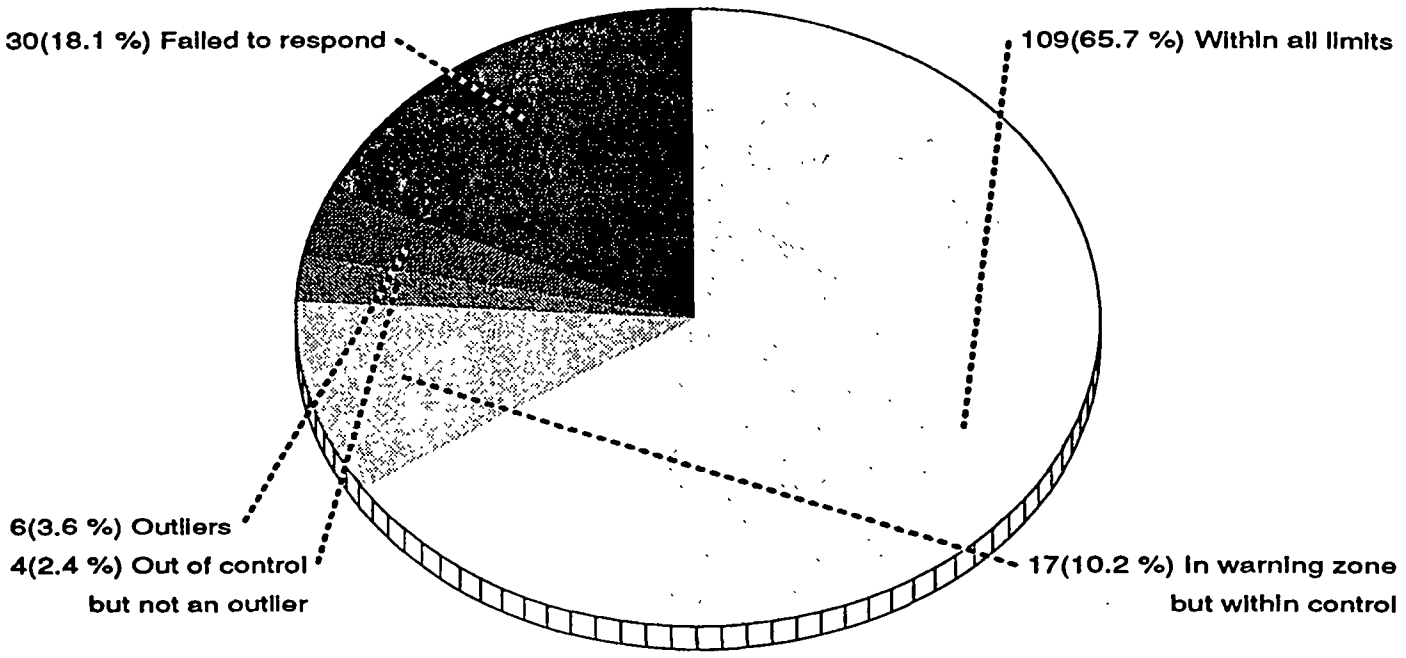
⇑ ≡ Above control limit
⇓ ≡ Below control limit

Cesium-137

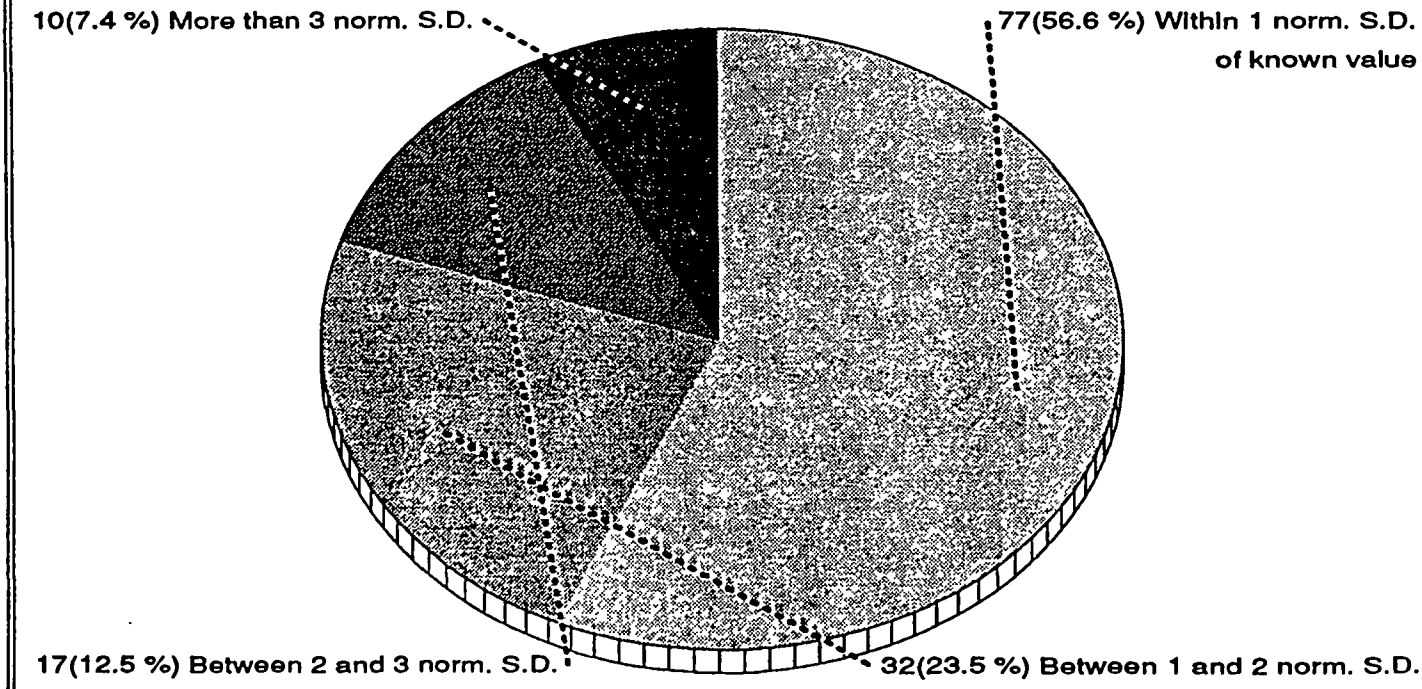

% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average

Barium-133 Statistical Summary 166 Participants

The known value of this nuclide is **56.0 pCi/l** with an expected precision of **6.0**; the control limits are 45.6 to 66.4; the warning regions are 45.6 to 49.1 and 62.9 to 66.4



Statistic	Respondents	Non-outliers
Mean	72.55	**Grand Avg 53.11**
Std. Dev.	228.21	3.64
Variance	52079.28	13.23
% Coef. of Var.	314.55	6.85
% deviation of mean from known value	29.56	-5.16
Norm. dev. of mean from known value	0.07	-0.80
Median	53.67	53.67
% deviation of median from known value	-4.17	-4.17
Norm. dev. of median from known value	-0.01	-0.64



Barium-133

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	56.0	55.0	53.0	1.53	0.295	54.67	0.45	-0.38	
AE	54.0	57.0	55.0	1.53	0.295	55.33	0.64	-0.19	
AF	53.0	56.0	50.0	3.00	0.591	53.00	-0.03	-0.87	
AH	52.0	53.0	60.0	4.36	0.788	55.00	0.55	-0.29	
AI									•
AJ	49.0	42.0	44.0	3.61	0.689	45.00	-2.34	-3.18	⇓
AK	51.0	51.0	51.0	0.00	0.000	51.00	-0.61	-1.44	
AL	44.0	44.0	51.0	4.04	0.689	46.33	-1.96	-2.79	
AP									•
AU	53.0	52.0	50.0	1.53	0.295	51.67	-0.42	-1.25	
AW	54.0	52.0	53.0	1.00	0.197	53.00	-0.03	-0.87	
AY	54.0	54.0	55.0	0.58	0.098	54.33	0.35	-0.48	
AZ	59.0	56.0	57.0	1.53	0.295	57.33	1.22	0.38	
BA	51.0	49.0	46.0	2.52	0.492	48.67	-1.28	-2.12	
BB	49.0	55.0	47.0	4.16	0.788	50.33	-0.80	-1.64	
BC	48.0	48.0	48.0	0.00	0.000	48.00	-1.47	-2.31	
BG									•
BH	40.0	50.0	48.0	5.29	0.984	46.00	-2.05	-2.89	
BK	52.0	50.0	50.0	1.15	0.197	50.67	-0.70	-1.54	
BL	55.0	55.0	55.0	0.00	0.000	55.00	0.55	-0.29	
BM	55.0	57.0	57.0	1.15	0.197	56.33	0.93	0.10	
BN	58.0	57.0	55.0	1.53	0.295	56.67	1.03	0.19	
BO	53.0	57.0	48.0	4.51	0.886	52.67	-0.13	-0.96	
C	54.0	53.0	53.0	0.58	0.098	53.33	0.07	-0.77	
CA	55.0	55.0	54.0	0.58	0.098	54.67	0.45	-0.38	
CC									•
CE	59.0	56.0	57.0	1.53	0.295	57.33	1.22	0.38	
CJ	46.0	44.0	49.0	2.52	0.492	46.33	-1.96	-2.79	
CO	54.0	57.0	54.0	1.73	0.295	55.00	0.55	-0.29	
CP	56.0	58.0	57.0	1.00	0.197	57.00	1.12	0.29	
CS	57.0	53.0	56.0	2.08	0.394	55.33	0.64	0.19	
CX	27.0	25.0	24.0	1.53	0.295	25.33	-8.02	8.85	×
D	56.0	54.0	52.0	2.00	0.394	54.00	0.26	0.58	
DD	60.0	60.0	57.0	1.73	0.295	59.00	1.70	0.87	
DE	55.0	56.0	56.0	0.58	0.098	55.67	0.74	-0.10	
DH	55.0	57.0	55.0	1.15	0.197	55.67	0.74	-0.10	
DO	59.0	54.0	61.0	3.61	0.689	58.00	1.41	0.58	
DR	53.0	57.0	52.0	2.65	0.492	54.00	0.26	-0.58	
DT	55.0	59.0	56.0	2.08	0.394	56.67	1.03	0.19	
E	54.0	56.0	55.0	1.00	0.197	55.00	0.55	-0.29	
EA									•
EB	58.0	58.0	58.0	0.00	0.000	58.00	1.41	0.58	
EL	53.0	56.0	52.0	2.08	0.394	53.67	0.16	-0.67	
EW									•
EX	55.0	57.0	56.0	1.00	0.197	56.00	0.83	0.00	

• ≡ No data submitted

∅ ≡ 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)	Normalized deviation (known)	Tag
FE	63.0	64.0	55.0	4.93	0.886	60.67	2.18	1.35	
FJ	51.0	54.0	52.0	1.53	0.295	52.33	-0.22	-1.06	
FL	56.0	58.0	53.0	2.52	0.492	55.67	0.74	-0.10	
GI									•
GL	49.0	46.0	54.0	4.04	0.788	49.67	-0.99	-1.83	
GQ	56.0	56.0	56.0	0.00	0.000	56.00	0.83	0.00	
HE	56.0	57.0	59.0	1.53	0.295	57.33	1.22	0.38	
HI	52.0	54.0	52.0	1.15	0.197	52.67	-0.13	-0.96	
HK	52.0	51.0	52.0	0.58	0.098	51.67	-0.42	-1.25	
HL	56.0	58.0	57.0	1.00	0.197	57.00	1.12	0.29	
HP									•
I	53.0	50.0	56.0	3.00	0.591	53.00	-0.03	-0.87	
IU	58.0	55.0	52.0	3.00	0.591	55.00	0.55	-0.29	
J									•
JE	55.0	55.0	55.0	0.00	0.000	55.00	0.55	-0.29	
JG	56.0	56.0	58.0	1.15	0.197	56.67	1.03	0.19	
JM	51.0	52.0	49.0	1.53	0.295	50.67	-0.70	-1.54	
JS	51.0	51.0	50.0	0.58	0.098	50.67	-0.70	-1.54	
JY	57.0	56.0	55.0	1.00	0.197	56.00	0.83	0.00	
K	61.0	59.0	57.0	2.00	0.394	59.00	1.70	0.87	
KH	46.0	46.0	48.0	1.15	0.197	46.67	-1.86	-2.69	
KL	51.0	50.0	55.0	2.65	0.492	52.00	-0.32	-1.15	
KX	54.0	54.0	54.0	0.00	0.000	54.00	0.26	-0.58	
L	56.0	55.0	54.0	1.00	0.197	55.00	0.55	-0.29	
LE	61.0	60.0	60.0	0.58	0.098	60.33	2.09	1.25	
LF	60.0	61.0	58.0	1.53	0.295	59.67	1.89	1.06	
LR	49.0	41.0	48.0	4.36	0.788	46.00	-2.05	-2.89	
M	52.0	53.0	50.0	1.53	0.295	51.67	-0.42	-1.25	
MP	50.0	44.0	43.0	3.79	0.689	45.67	-2.15	-2.98	
MT	45.0	45.0	45.0	0.00	0.000	45.00	-2.34	-3.18	⇓
MV	55.0	58.0	56.0	1.53	0.295	56.33	0.93	0.10	
MX	26.0	24.0	29.0	2.52	0.492	26.33	-7.73	8.56	×
N	56.0	54.0	54.0	1.15	0.197	54.67	0.45	0.38	
NH	54.0	55.0	54.0	0.58	0.098	54.33	0.35	-0.48	
NJ	51.0	54.0	53.0	1.53	0.295	52.67	-0.13	-0.96	
NK									•
NO	56.0	58.0	60.0	2.00	0.394	58.00	1.41	0.58	
NP	48.0	48.0	53.0	2.89	0.492	49.67	-0.99	-1.83	
O	54.0	54.0	54.0	0.00	0.000	54.00	0.26	-0.58	
OA	110.0	102.0	109.0	4.36	0.788	107.00	15.56	14.72	×
OB									•
OM	58.0	54.0	54.0	2.31	0.394	55.33	0.64	-0.19	
OT	51.0	48.0	39.0	6.24	1.345	46.00	-2.05	-2.89	
P	54.0	53.0	53.0	0.58	0.098	53.33	0.07	-0.77	
PB									•

• ≡ 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)	Normalized deviation (known)	Tag
PD	56.0	58.0	57.0	1.00	0.197	57.00	1.12	0.29	
PE									•
PM	51.0	51.0	53.0	1.15	0.197	51.67	-0.42	-1.25	
PW	50.0	50.0	51.0	0.58	0.098	50.33	-0.80	-1.64	
PX	55.0	58.0	58.0	1.73	0.295	57.00	1.12	0.29	
Q	52.0	53.0	52.0	0.58	0.098	52.33	-0.22	-1.06	
QM	52.0	58.0	57.0	3.21	0.591	55.67	0.74	-0.10	
QP	49.0	50.0	46.0	2.08	0.394	48.33	-1.38	-2.21	
QT	44.0	43.0	47.0	2.08	0.394	44.67	-2.44	-3.27	⇓
QU	50.0	50.0	48.0	1.15	0.197	49.33	-1.09	-1.92	
QW	49.0	50.0	46.0	2.08	0.394	48.33	-1.38	-2.21	
QX	52.0	52.0	53.0	0.58	0.098	52.33	-0.22	-1.06	
QZ	49.0	53.0	57.0	4.00	0.788	53.00	-0.03	-0.87	
R	52.0	53.0	52.0	0.58	0.098	52.33	-0.22	-1.06	
RK	47.0	42.0	45.0	2.52	0.492	44.67	-2.44	-3.27	⇓
RO	50.0	52.0	49.0	1.53	0.295	50.33	-0.80	-1.64	
RR									•
RU									•
RX	66.0	67.0	67.0	0.58	0.098	66.67	3.91	3.08	×
RZ	53.0	55.0	57.0	2.00	0.394	55.00	0.55	-0.29	
S	56.0	55.0	58.0	1.53	0.295	56.33	0.93	0.10	
SD	56.0	52.0	52.0	2.31	0.394	53.33	0.07	-0.77	
SF	46.0	48.0	48.0	1.15	0.197	47.33	-1.67	-2.50	
SI	52.0	56.0	53.0	2.08	0.394	53.67	0.16	-0.67	
SM	57.0	51.0	58.0	3.79	0.689	55.33	0.64	-0.19	
SN	55.0	51.0	45.0	5.03	0.984	50.33	-0.80	-1.64	
SR	51.0	52.0	56.0	2.65	0.492	53.00	-0.03	-0.87	
SS	56.0	48.0	49.0	4.36	0.788	51.00	-0.61	-1.44	
SV	52.0	52.0	53.0	0.58	0.098	52.33	-0.22	-1.06	
SX	59.0	55.0	56.0	2.08	0.394	56.67	1.03	0.19	
T	52.0	54.0	55.0	1.53	0.295	53.67	0.16	-0.67	
TC	24.0	25.0	25.0	0.58	0.098	24.67	-8.21	-9.05	×
TD	47.0	48.0	48.0	0.58	0.098	47.67	-1.57	-2.41	
TF									•
TO	54.0	61.0	63.0	4.73	0.886	59.33	1.80	0.96	
TQ	53.0	51.0	51.0	1.15	0.197	51.67	-0.42	-1.25	
TR	54.0	50.0	50.0	2.31	0.394	51.33	-0.51	-1.35	
TW	52.0	55.0	52.0	1.73	0.295	53.00	-0.03	-0.87	
U	55.0	55.0	53.0	1.15	0.197	54.33	0.35	-0.48	
UM									•
UP	55.0	56.0	55.0	0.58	0.098	55.33	0.64	-0.19	
UR									•
UV	50.0	48.0	49.0	1.00	0.197	49.00	-1.19	-2.02	
UX	58.0	55.0	52.0	3.00	0.591	55.00	0.55	-0.29	
UY									•

• ≡ 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
VA									•
VC	56.0	54.0	56.0	1.15	0.197	55.33	0.64	-0.19	
VE	50.0	54.0	52.0	2.00	0.394	52.00	-0.32	-1.15	
VH	55.0	56.0	52.0	2.08	0.394	54.33	0.35	-0.48	
VI	51.0	51.0	51.0	0.00	0.000	51.00	-0.61	-1.44	
VM									•
VO	53.0	59.0	59.0	3.46	0.591	57.00	1.12	0.29	
VS	56.0	54.0	54.0	1.15	0.197	54.67	0.45	-0.38	
W	52.0	58.0	55.0	3.00	0.591	55.00	0.55	-0.29	
WD	54.0	55.0	53.0	1.00	0.197	54.00	0.26	-0.58	
WI									•
WJ									•
WK									•
WO									•
WR	51.0	51.0	55.0	2.31	0.394	52.33	-0.22	-1.06	
WS									•
WW	57.0	56.0	54.0	1.53	0.295	55.67	0.74	-0.10	
WX									•
X	51.0	53.0	53.0	1.15	0.197	52.33	-0.22	-1.06	
XA	52.0	51.0	55.0	2.08	0.394	52.67	-0.13	-0.96	
XB	50.0	49.0	48.0	1.00	0.197	49.00	-1.19	-2.02	
XC									•
XD	53.0	53.0	52.0	0.58	0.098	52.67	-0.13	-0.96	
XF	48.0	50.0	50.0	1.15	0.197	49.33	-1.09	-1.92	
XG									•
XI	50.0	47.0	46.0	2.08	0.394	47.67	-1.57	-2.41	
XK	68.0	59.0	50.0	9.00	2.470	59.00	1.70	0.87	
XQ									•
XT	49.0	49.0	49.0	0.00	0.000	49.00	-1.19	-2.02	
XU	2683.0	2787.0	2669.0	64.47	21.222	2713.00	767.84	767.01	×
Y	53.0	53.0	56.0	1.73	0.295	54.00	0.26	-0.58	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
24.67	×	TC	46.33		CJ	49.00		XB
25.33	×	CX	46.33		AL	49.00		UV
26.33	×	MX	46.67		KH	49.33		XF
44.67	⇓	RK	47.33		SF	49.33		QU
44.67	⇓	QT	47.67		XI	49.67		NP
45.00	⇓	MT	47.67		TD	49.67		GL
45.00	⇓	AJ	48.00		BC	50.33		SN
45.67		MP	48.33		QW	50.33		RO
46.00		OT	48.33		QP	50.33		PW
46.00		LR	48.67		BA	50.33		BB
46.00		BH	49.00		XT	50.67		JS

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

Ø ≡ Insufficient data

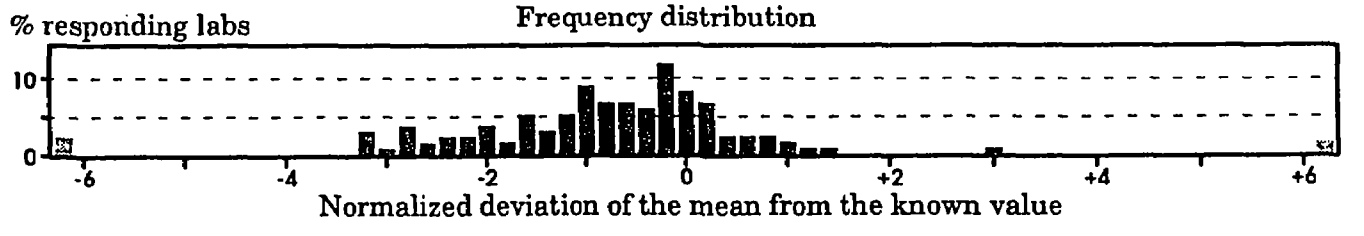
× ≡ Determined to be an outlier

⇓ ≡ Below control limit

Barium-133

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
50.67		JM	53.67		T	55.67		QM
50.67		BK	53.67		SI	55.67		FL
51.00		VI	53.67		EL	55.67		DH
51.00		SS	54.00		Y	55.67		DE
51.00		AK	54.00		WD	56.00		JY
51.33		TR	54.00		O	56.00		GQ
51.67		TQ	54.00		KX	56.00		EX
51.67		PM	54.00		DR	56.33		S
51.67		M	54.00		D	56.33		MV
51.67		HK	54.33		VH	56.33		BM
51.67		AU	54.33		U	56.67		SX
52.00		VE	54.33		NH	56.67		JG
52.00		KL	54.33		AY	56.67		DT
52.33		X	54.67		VS	56.67		BN
52.33		WR	54.67		N	57.00		VO
52.33		SV	54.67		CA	57.00		PX
52.33		R	54.67		A	57.00		PD
52.33		QX	55.00		W	57.00		HL
52.33		Q	55.00		UX	57.00		CP
52.33		FJ	55.00		RZ	57.33		HE
52.67		XD	55.00		L	57.33		CE
52.67		XA	55.00		JE	57.33		AZ
52.67		NJ	55.00		IU	58.00		NO
52.67		HI	55.00		E	58.00		EB
52.67		BO	55.00		CO	58.00		DO
53.00		TW	55.00		BL	59.00		XK
53.00		SR	55.00		AH	59.00		K
53.00		QZ	55.33		VC	59.00		DD
53.00		I	55.33		UP	59.33		TO
53.00		AW	55.33		SM	59.67		LF
53.00		AF	55.33		OM	60.33		LE
53.33		SD	55.33		CS	60.67		FE
53.33		P	55.33		AE	66.67	×	RX
53.33		C	55.67		WW	107.00	×	OA
						2713.00	×	XU



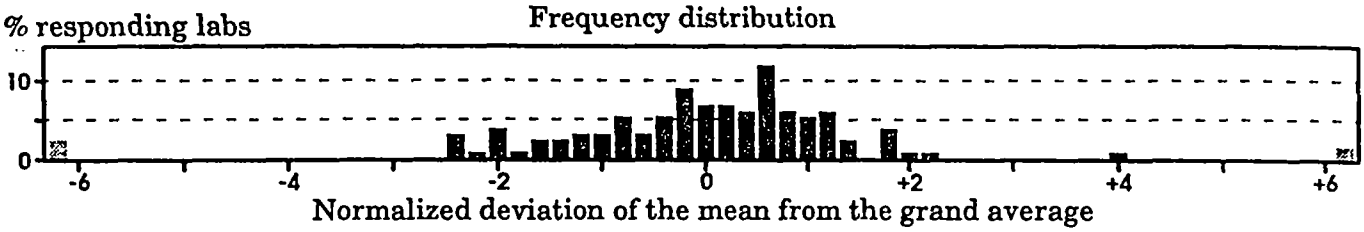
• ≡ No data submitted
∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Barium-133


% 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

Office of Research and
Development
Washington, DC 20460

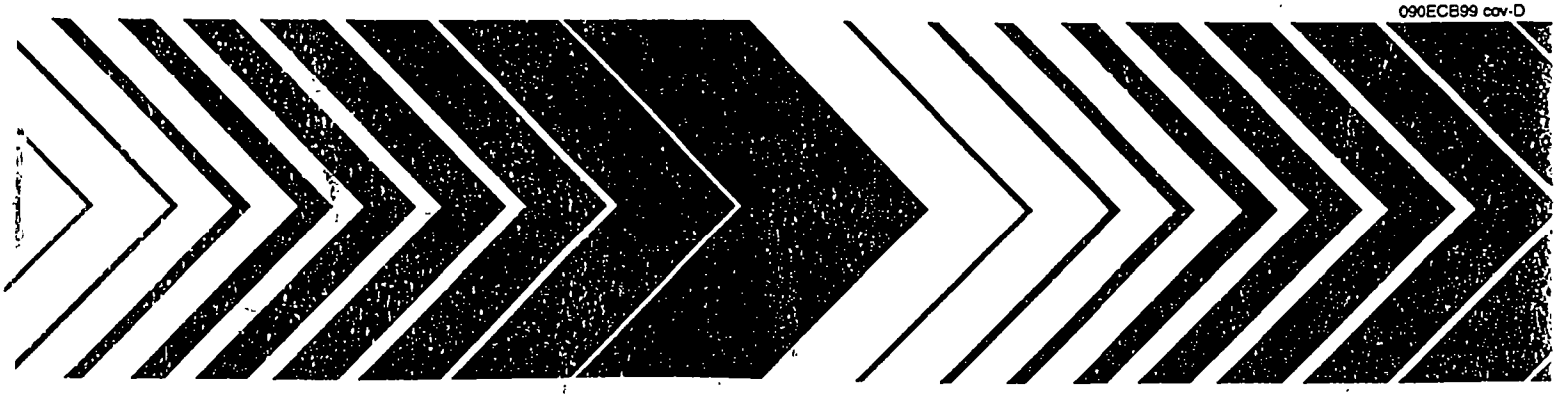
EPA/600/R-99/034
March 1999

EPA

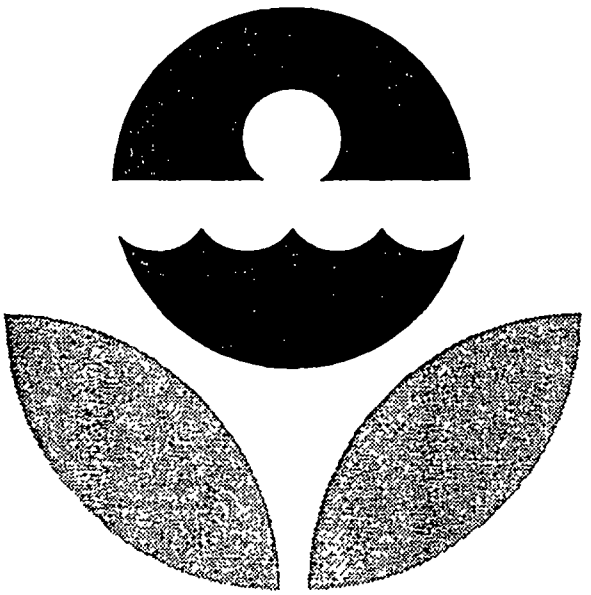
Gross Alpha-Beta in Water Performance Evaluation Study

A Statistical Evaluation of the November 13, 1998 Data

090ECB99 cov-D



Gross Alpha-Beta in Water
Performance Evaluation Study
November 13, 1998



Environmental Protection Agency
National Exposure Research Laboratory
Environmental Sciences Division
Las Vegas, Nevada

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

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Gross Alpha-Beta in Water; November 13, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-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 Stephen Pla at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pla
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. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. 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. 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.

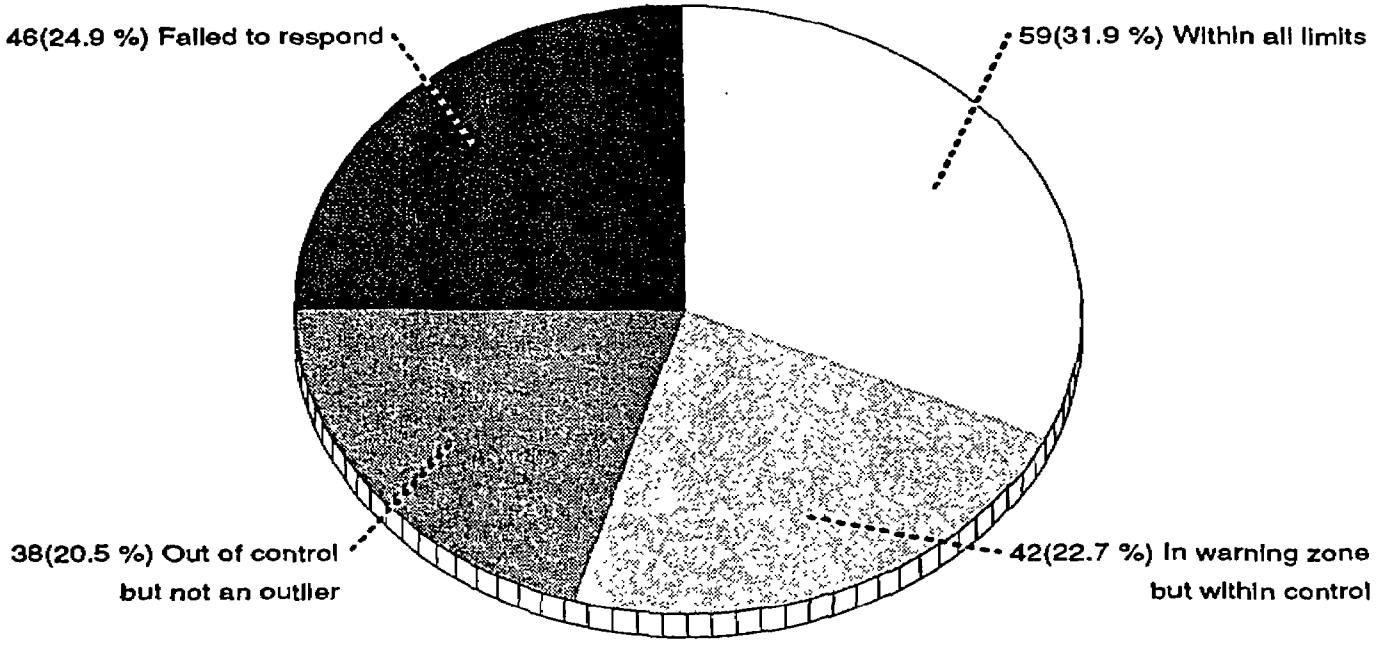
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's 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.

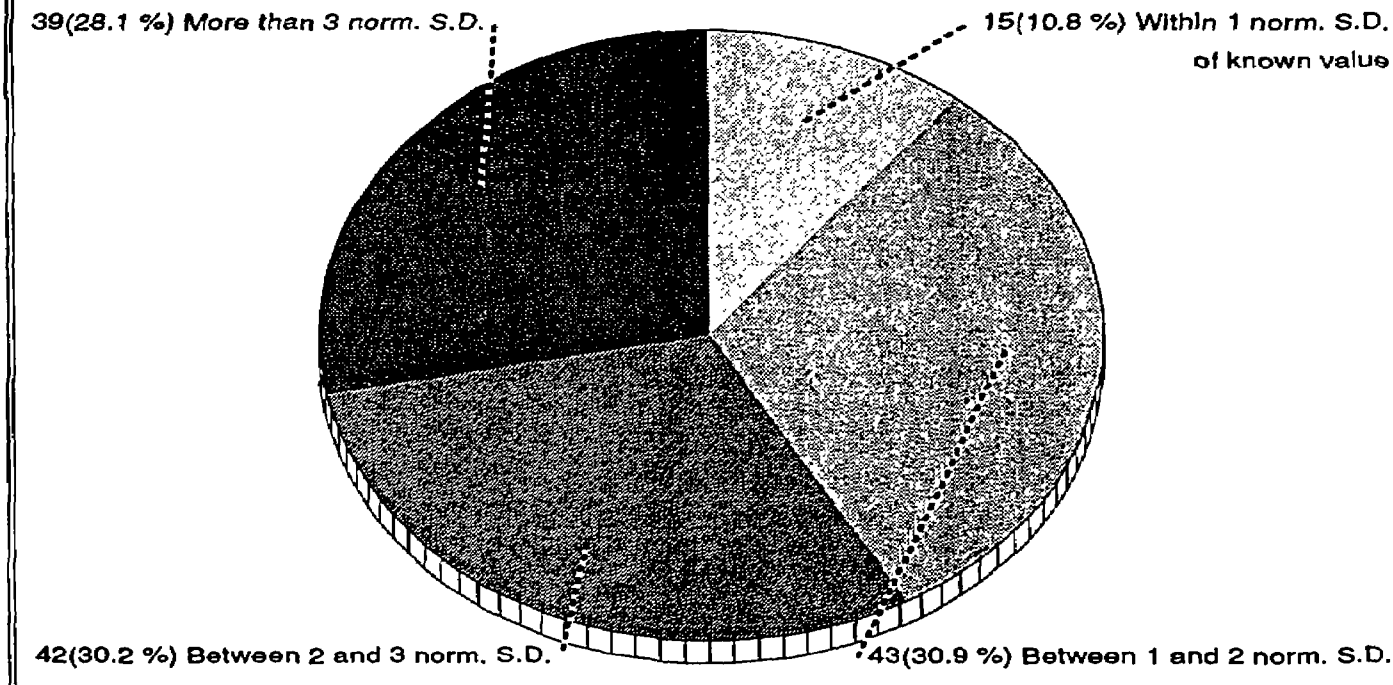
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Gross Alpha Statistical Summary 185 Participants

The known value of this nuclide is **47.2 pCi/l** with an expected precision of **11.8**; the control limits are 26.7 to 67.7; the warning regions are 26.7 to 33.5 and 60.9 to 67.7



Statistic	Respondents	Non-outliers
Mean	31.33	**Grand Avg 31.33**
Std. Dev.	9.10	9.10
Variance	82.75	82.75
% Coef. of Var.	29.04	29.04
% deviation of mean from known value	-33.62	-33.62
Norm. dev. of mean from known value	-1.74	-1.74
Median	31.33	31.33
% deviation of median from known value	-33.62	-33.62
Norm. dev. of median from known value	-1.74	-1.74



ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 13-Nov-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
A	40.7	38.2	40.3	1.34	0.125	39.73	1.23	-1.10	
AE	39.2	33.7	41.1	3.84	0.370	38.00	0.98	-1.35	
AF	29.8	26.4	29.2	1.81	0.170	28.47	-0.42	-2.75	
AH									•
AJ	17.1	25.4	21.5	4.15	0.415	21.33	-1.47	-3.80	⇓
AK	33.4	27.2	29.1	3.18	0.310	29.90	-0.21	-2.54	
AL	43.4	40.6	40.9	1.54	0.140	41.63	1.51	-0.82	
AP									•
AR	36.3	39.8	41.7	2.74	0.270	39.27	1.17	-1.16	
AU	42.2	36.3	40.1	2.99	0.295	39.53	1.20	-1.13	
AW	27.3	28.4	30.6	1.68	0.165	28.77	-0.38	-2.71	
AZ	34.9	32.4	28.9	3.01	0.300	32.07	0.11	-2.22	
BA	32.7	38.4	35.0	2.87	0.285	35.37	0.59	-1.74	
BB	20.5	22.4	25.1	2.31	0.230	22.67	-1.27	-3.60	⇓
BC	41.4	40.2	38.0	1.72	0.170	39.87	1.25	-1.08	
BG									•
BH	33.3	39.0	33.9	3.13	0.285	35.40	0.60	-1.73	
BK	36.2	34.3	33.6	1.35	0.130	34.70	0.49	-1.83	
BL	30.3	29.5	33.2	1.95	0.185	31.00	-0.05	-2.38	
BM	38.1	40.9	35.8	2.55	0.255	38.27	1.02	-1.31	
BN	25.2	27.5	24.3	1.65	0.160	25.67	-0.83	-3.16	⇓
BO	35.7	49.9	32.1	9.41	0.891	39.23	1.16	-1.17	
BS	37.4	43.6	45.5	4.24	0.405	42.17	1.59	-0.74	
C	39.0	41.9	44.2	2.61	0.260	41.70	1.52	-0.81	
CA	26.6	24.6	25.2	1.03	0.100	25.47	-0.86	-3.19	⇓
CC									•
CE	33.2	42.0	39.8	4.58	0.440	38.33	1.03	-1.30	
CJ									•
CO	19.0	24.5	24.8	3.27	0.290	22.77	-1.26	-3.59	⇓
CP	27.8	26.4	30.2	1.92	0.190	28.13	-0.47	-2.80	
CS	37.3	41.1	32.9	4.10	0.410	37.10	0.85	-1.48	
CX	23.0	17.0	21.7	3.16	0.300	20.57	-1.58	-3.91	⇓
D	34.8	39.6	36.9	2.41	0.240	37.10	0.85	-1.48	
DB	30.3	29.4	31.2	0.90	0.090	30.30	-0.15	-2.48	
DD	23.8	22.6	21.1	1.35	0.135	22.50	-1.30	-3.63	⇓
DE	30.7	30.9	31.0	0.15	0.015	30.87	-0.07	-2.40	
DH	35.6	43.0	39.0	3.70	0.370	39.20	1.16	-1.17	
DO	41.0	32.0	35.0	4.58	0.451	36.00	0.69	-1.64	
DR	8.8	8.3	10.0	0.87	0.085	9.03	-3.27	-5.60	⇓
DT	45.2	43.7	39.5	2.95	0.285	42.80	1.68	-0.65	
DZ	33.3	32.1	30.8	1.25	0.125	32.07	0.11	-2.22	
E	33.5	33.1	34.0	0.45	0.045	33.53	0.32	-2.01	
EB	33.1	40.3	34.2	3.88	0.360	35.87	0.67	-1.66	
EL									•
EO	29.0	27.0	29.0	1.15	0.100	28.33	-0.44	-2.77	

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
ER	31.3	33.9	33.3	1.36	0.130	32.83	0.22	-2.11	
EV	19.9	24.3	17.2	3.58	0.355	20.47	-1.59	-3.92	⇓
EW									•
EX	19.8	20.1	20.3	0.25	0.025	20.07	-1.65	-3.98	⇓
FE	22.0	19.0	21.0	1.53	0.150	20.67	-1.57	-3.89	⇓
FF									•
FJ									•
FL	26.9	27.1	31.3	2.48	0.220	28.43	-0.43	-2.75	
FN	47.0	48.0	40.0	4.36	0.400	45.00	2.01	-0.32	
GQ	34.3	34.9	36.0	0.86	0.085	35.07	0.55	-1.78	
GZ	36.3	32.0	44.0	6.08	0.601	37.43	0.90	-1.43	
HE	38.2	42.6	42.2	2.43	0.220	41.00	1.42	-0.91	
HI	27.2	18.8	21.5	4.29	0.420	22.50	-1.30	-3.63	⇓
HK	27.4	28.5	27.1	0.74	0.070	27.67	-0.54	-2.87	
HL	40.1	29.5	41.3	6.49	0.591	36.97	0.83	-1.50	
HP	19.4	18.0	18.4	0.72	0.070	18.60	-1.87	-4.20	⇓
I	33.5	32.8	32.0	0.75	0.075	32.77	0.21	-2.12	
ID	40.8	32.7	35.7	4.10	0.405	36.40	0.74	-1.59	
IU									•
J									•
JE	32.5	31.0	31.8	0.75	0.075	31.77	0.06	-2.27	
JG	25.0	25.2	24.5	0.36	0.035	24.90	-0.94	-3.27	⇓
JM	31.6	30.7	31.1	0.45	0.045	31.13	-0.03	-2.36	
JN	50.9	53.1	49.7	1.72	0.170	51.23	2.92	0.59	
JP	40.0	38.0	36.0	2.00	0.200	38.00	0.98	-1.35	
JQ	36.9	41.2	37.6	2.31	0.215	38.57	1.06	-1.27	
JS	32.6	26.4	26.3	3.61	0.315	28.43	-0.43	-2.75	
JY	38.3	30.4	40.4	5.27	0.501	36.37	0.74	-1.59	
K	37.4	36.0	37.9	0.98	0.095	37.10	0.85	-1.48	
KE	22.7	24.2	23.8	0.78	0.075	23.57	-1.14	-3.47	⇓
KH	26.5	28.8	27.1	1.19	0.115	27.47	-0.57	-2.90	
KT	38.0	39.0	41.0	1.53	0.150	39.33	1.17	-1.15	
KX	26.1	21.8	24.6	2.18	0.215	24.17	-1.05	-3.38	⇓
L	37.0	32.1	31.6	2.98	0.270	33.57	0.33	-2.00	
LE	28.9	30.6	28.6	1.08	0.100	29.37	-0.29	-2.62	
LF	28.0	27.0	33.0	3.21	0.300	29.33	-0.29	-2.62	
LL	37.4	44.4	32.2	6.12	0.611	38.00	0.98	-1.35	
LR	15.1	15.3	14.7	0.31	0.030	15.03	-2.39	-4.72	⇓
M									•
MF	36.3	36.4	36.7	0.21	0.020	36.47	0.75	-1.58	
MT									•
MV	28.7	27.0	32.0	2.54	0.250	29.23	-0.31	-2.64	
MX	16.5	17.1	19.2	1.42	0.135	17.60	-2.02	-4.34	⇓
N									•
NA	34.6	38.9	38.6	2.40	0.215	37.37	0.89	-1.44	

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 13-Nov-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NB									•
NH	24.0	27.0	26.0	1.53	0.150	25.67	-0.83	-3.16	⇓
NJ	20.5	26.4	29.3	4.48	0.440	25.40	-0.87	-3.20	⇓
NK									•
NO	22.3	26.5	30.7	4.20	0.420	26.50	-0.71	-3.04	⇓
NP	26.4	26.3	25.4	0.55	0.050	26.03	-0.78	-3.11	⇓
O	38.8	38.0	34.8	2.12	0.200	37.20	0.86	-1.47	
OA									•
OB	36.1	32.6	33.0	1.92	0.175	33.90	0.38	-1.95	
OF	28.0	28.6	28.8	0.42	0.040	28.47	-0.42	-2.75	
OS									•
OT									•
OY									•
P	19.5	21.7	26.5	3.58	0.350	22.57	-1.29	-3.62	⇓
PB	32.2	33.8	32.3	0.90	0.080	32.77	0.21	-2.12	
PD									•
PG	30.3	28.1	34.3	3.14	0.310	30.90	-0.06	-2.39	
PM	40.7	36.0	36.2	2.66	0.235	37.63	0.93	-1.40	
Q	21.3	21.8	21.6	0.25	0.025	21.57	-1.43	-3.76	⇓
QM	20.3	17.1	15.7	2.36	0.230	17.70	-2.00	-4.33	⇓
QP	32.7	35.3	34.6	1.35	0.130	34.20	0.42	-1.91	
QQ	36.9	37.5	36.1	0.70	0.070	36.83	0.81	-1.52	
QT	36.0	34.5	40.9	3.35	0.320	37.13	0.85	-1.48	
QU	26.5	33.5	30.1	3.50	0.350	30.03	-0.19	-2.52	
QW	32.8	29.2	30.3	1.84	0.180	30.77	-0.08	-2.41	
QX	8.4	9.7	8.3	0.78	0.070	8.80	-3.31	-5.64	⇓
QZ	31.7	32.4	34.5	1.46	0.140	32.87	0.23	-2.10	
R	16.7	17.0	16.0	0.51	0.050	16.57	-2.17	-4.50	⇓
RB	41.8	36.7	38.3	2.61	0.255	38.93	1.12	-1.21	
RD	39.2	46.0	47.1	4.28	0.395	44.10	1.87	-0.46	
RG									•
RI	37.9	28.3	27.8	5.69	0.506	31.33	0.00	-2.33	
RK									•
RR									•
RZ	39.6	36.5	36.6	1.76	0.155	37.57	0.92	-1.41	
S	41.3	40.5	41.6	0.57	0.055	41.13	1.44	-0.89	
SD	52.0	48.5	50.3	1.75	0.175	50.27	2.78	0.45	
SF	25.5	26.0	25.5	0.29	0.025	25.67	-0.83	-3.16	⇓
SG	37.3	35.5	34.9	1.25	0.120	35.90	0.67	-1.66	
SI	24.7	26.2	25.6	0.76	0.075	25.50	-0.86	-3.19	⇓
SL	25.2	24.5	24.4	0.44	0.040	24.70	-0.97	-3.30	⇓
SM	29.1	28.7	25.1	2.20	0.200	27.63	-0.54	-2.87	
SN	28.7	26.3	29.8	1.79	0.175	28.27	-0.45	-2.78	
SO	28.1	26.1	26.0	1.18	0.105	26.73	-0.67	-3.00	
SR	34.3	35.3	33.7	0.81	0.080	34.43	0.46	-1.87	

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
SS	33.1	32.5	34.0	0.75	0.075	33.20	0.27	-2.05	
SU	7.1	5.9	9.8	2.00	0.195	7.60	-3.48	-5.81	⇓
SV									•
SX	22.3	20.3	21.0	1.01	0.100	21.20	-1.49	-3.82	⇓
T									•
TD	24.1	25.0	24.1	0.52	0.045	24.40	-1.02	-3.35	⇓
TL									•
TN	44.1	40.2	44.8	2.48	0.230	43.03	1.72	-0.61	
TO									•
TQ	28.9	28.2	30.6	1.23	0.120	29.23	-0.31	-2.64	
TW	25.7	21.4	26.2	2.64	0.240	24.43	-1.01	-3.34	⇓
TX									•
TY	29.3	26.5	26.4	1.65	0.145	27.40	-0.58	-2.91	
U	30.8	30.9	28.6	1.30	0.115	30.10	-0.18	-2.51	
UA									•
UM									•
UP	38.8	31.8	33.0	3.74	0.350	34.53	0.47	-1.86	
UQ									•
UY									•
VA									•
VC									•
VH	30.8	28.2	24.6	3.11	0.310	27.87	-0.51	-2.84	
VI	28.8	35.4	29.5	3.63	0.330	31.23	-0.01	-2.34	
VJ	27.9	26.8	32.2	2.85	0.270	28.97	-0.35	-2.68	
VO	31.5	33.0	37.6	3.18	0.305	34.03	0.40	-1.93	
VT	57.9	51.1	58.6	4.14	0.375	55.87	3.60	1.27	
W	28.5	26.3	25.9	1.40	0.130	26.90	-0.65	-2.98	
WE	4.3	5.1	3.4	0.85	0.085	4.27	-3.97	-6.30	⇓
WH	38.5	35.5	39.2	1.97	0.185	37.73	0.94	-1.39	
WJ									•
WN	48.8	47.6	45.2	1.83	0.180	47.20	2.33	0.00	
WO	21.4	14.0	25.8	5.96	0.591	20.40	-1.60	-3.93	⇓
WP									•
WR	53.1	54.4	57.0	1.99	0.195	54.83	3.45	1.12	
WS									•
WW	38.1	32.5	29.8	4.23	0.415	33.47	0.31	-2.02	
WX									•
X	36.8	45.9	47.9	5.92	0.556	43.53	1.79	-0.54	
XB									•
XC									•
XD									•
XF	37.8	43.8	46.7	4.54	0.446	42.77	1.68	-0.65	
XI	32.0	20.0	24.0	6.11	0.601	25.33	-0.88	-3.21	⇓
XJ									•
XK									•

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

⊘ = Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 13-Nov-1998

Gross Alpha

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
XL	40.2	41.8	42.1	1.02	0.095	41.37	1.47	-0.86	
XM	26.1	28.9	27.5	1.40	0.140	27.50	-0.56	-2.89	
XN									•
XQ	1.8	2.2	2.6	0.40	0.040	2.20	-4.28	-6.61	⇓
XT									•

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
2.20	⇓	XQ	26.50	⇓	NO	32.77		I
4.27	⇓	WE	26.73		SO	32.83		ER
7.60	⇓	SU	26.90		W	32.87		QZ
8.80	⇓	QX	27.40		TY	33.20		SS
9.03	⇓	DR	27.47		KH	33.47		WW
15.03	⇓	LR	27.50		XM	33.53		E
16.57	⇓	R	27.63		SM	33.57		L
17.60	⇓	MX	27.67		HK	33.90		OB
17.70	⇓	QM	27.87		VH	34.03		VO
18.60	⇓	HP	28.13		CP	34.20		QP
20.07	⇓	EX	28.27		SN	34.43		SR
20.40	⇓	WO	28.33		EO	34.53		UP
20.47	⇓	EV	28.43		JS	34.70		BK
20.57	⇓	CX	28.43		FL	35.07		GQ
20.67	⇓	FE	28.47		OF	35.37		BA
21.20	⇓	SX	28.47		AF	35.40		BH
21.33	⇓	AJ	28.77		AW	35.87		EB
21.57	⇓	Q	28.97		VJ	35.90		SG
22.50	⇓	HI	29.23		TQ	36.00		DO
22.50	⇓	DD	29.23		MV	36.37		JY
22.57	⇓	P	29.33		LF	36.40		ID
22.67	⇓	BB	29.37		LE	36.47		MF
22.77	⇓	CO	29.90		AK	36.83		QQ
23.57	⇓	KE	30.03		QU	36.97		HL
24.17	⇓	KX	30.10		U	37.10		K
24.40	⇓	TD	30.30		DB	37.10		D
24.43	⇓	TW	30.77		QW	37.10		CS
24.70	⇓	SL	30.87		DE	37.13		QT
24.90	⇓	JG	30.90		PG	37.20		O
25.33	⇓	XI	31.00		BL	37.37		NA
25.40	⇓	NJ	31.13		JM	37.43		GZ
25.47	⇓	CA	31.23		VI	37.57		RZ
25.50	⇓	SI	31.33		RI	37.63		PM
25.67	⇓	SF	31.77		JE	37.73		WH
25.67	⇓	NH	32.07		DZ	38.00		JP
25.67	⇓	BN	32.07		AZ	38.00		AE
26.03	⇓	NP	32.77		PB	38.00		LL

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

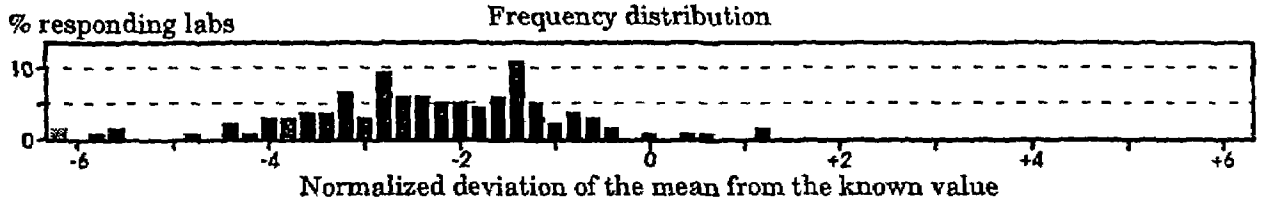
⇑ ≡ Above control limit

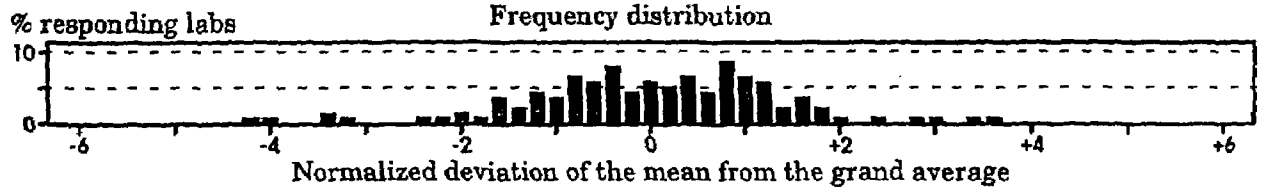
⇓ ≡ Below control limit

Gross Alpha

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
38.27		BM	39.73		A	42.80		DT
38.33		CE	39.87		BC	43.03		TN
38.57		JQ	41.00		HE	43.53		X
38.93		RB	41.13		S	44.10		RD
39.20		DH	41.37		XL	45.00		FN
39.23		BO	41.63		AL	47.20		WN
39.27		AR	41.70		C	50.27		SD
39.33		KT	42.17		BS	51.23		JN
39.53		AU	42.77		XF	54.83		WR
						55.87		VT





• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

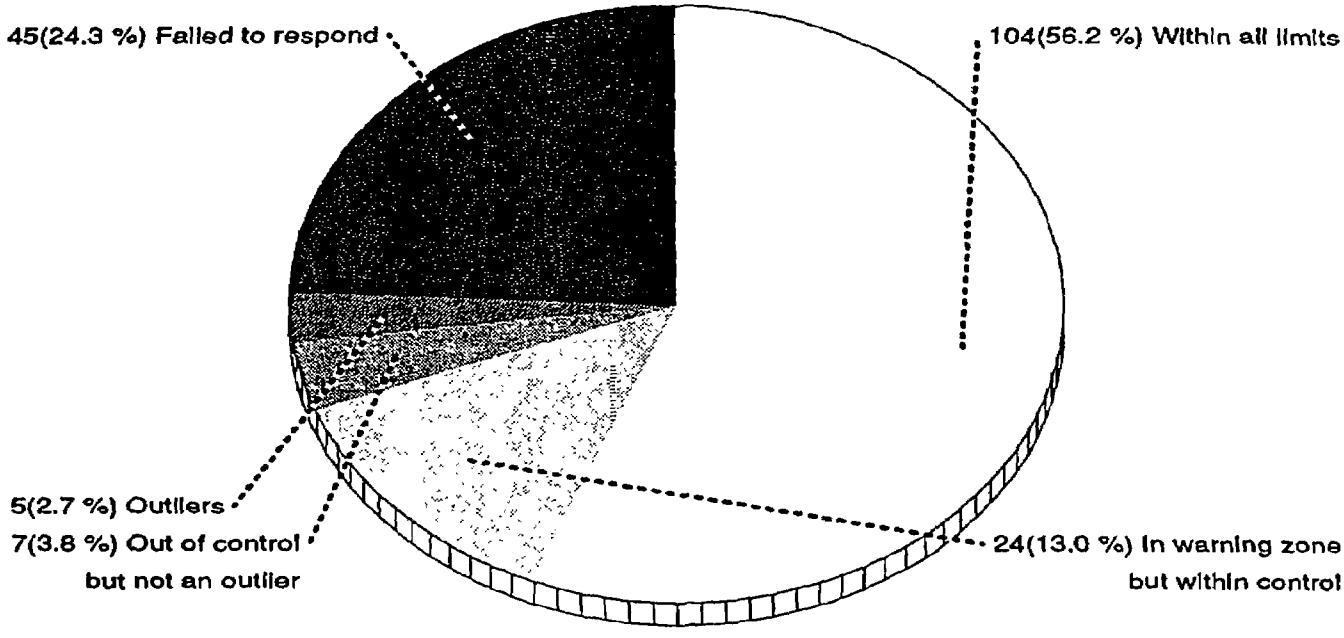
× ≡ Determined to be an outlier

⇑ ≡ Above control limit

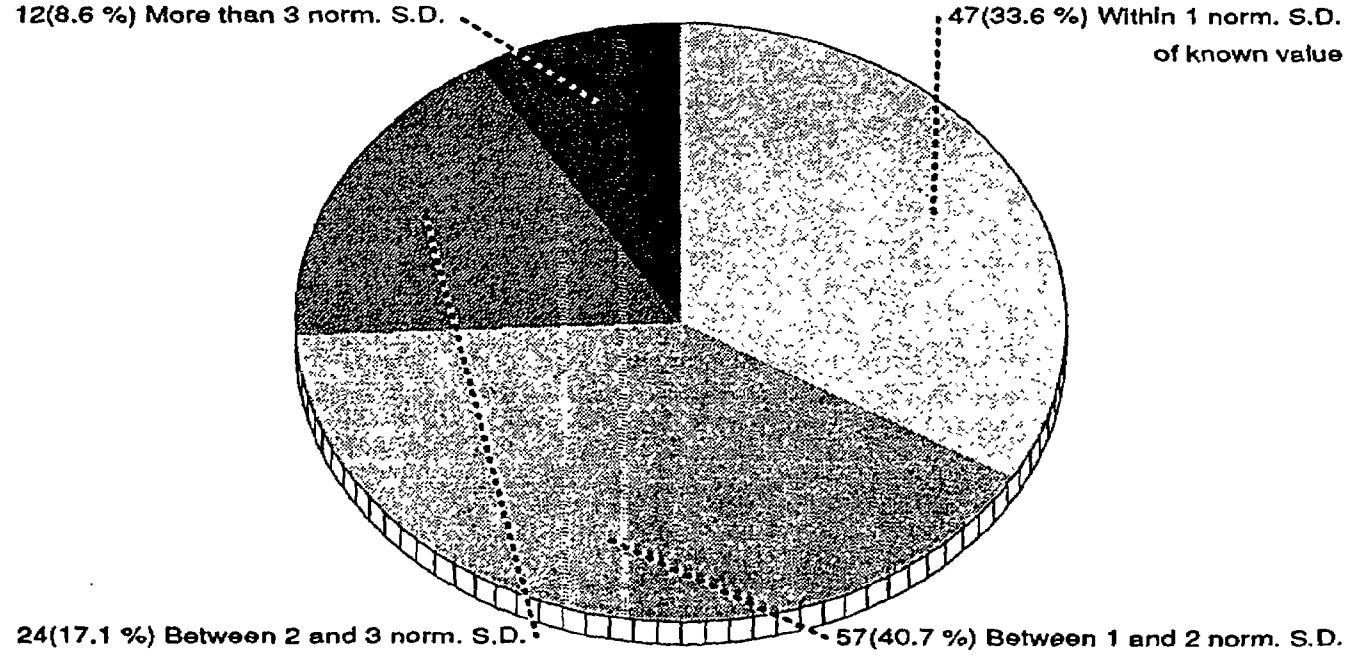
⇓ ≡ Below control limit

Gross Beta Statistical Summary 185 Participants

The known value of this nuclide is **3.5 pCi/l** with an expected precision of **5.0**; the control limits are 0.0 to 12.2; the warning regions are 0.0 to 0.0 and 9.3 to 12.2



Statistic	Respondents	Non-outliers
Mean	9.26	**Grand Avg 7.56**
Std. Dev.	11.02	2.92
Variance	121.44	8.54
% Coef. of Var.	118.96	38.66
% deviation of mean from known value	164.67	115.97
Norm. dev. of mean from known value	0.52	1.39
Median	7.67	7.43
% deviation of median from known value	119.05	112.38
Norm. dev. of median from known value	0.38	1.35



11 / 16 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 13-Nov-1998

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	5.4	5.1	4.7	0.35	0.083	5.07	-0.86	0.54	
AE	7.6	6.8	7.2	0.40	0.095	7.20	-0.12	1.28	
AF	8.6	9.0	8.7	0.21	0.047	8.77	0.42	1.82	
AH									•
AJ	8.5	5.4	4.2	2.22	0.508	6.03	-0.53	0.88	
AK	7.6	6.2	7.1	0.71	0.165	6.97	-0.21	1.20	
AL	7.2	6.8	7.3	0.26	0.059	7.10	-0.16	1.25	
AP									•
AR	12.7	9.8	9.5	1.77	0.378	10.67	1.08	2.48	
AU	2.6	6.4	6.2	2.14	0.449	5.07	-0.86	0.54	
AW	7.4	8.6	9.5	1.05	0.248	8.50	0.33	1.73	
AZ	5.8	3.9	3.9	1.10	0.224	4.53	-1.05	0.36	
BA	3.9	3.5	2.6	0.67	0.154	3.33	-1.46	-0.06	
BB	10.6	10.4	8.4	1.22	0.260	9.80	0.78	2.18	
BC	7.9	6.4	8.7	1.17	0.272	7.67	0.04	1.44	
BG									•
BH	7.6	8.4	8.4	0.46	0.095	8.13	0.20	1.61	
BK	6.8	6.5	6.9	0.21	0.047	6.73	-0.29	1.12	
BL	7.7	6.5	6.8	0.62	0.142	7.00	-0.19	1.21	
BM	5.6	6.8	6.2	0.60	0.142	6.20	-0.47	0.94	
BN	4.4	3.9	2.6	0.93	0.213	3.63	-1.36	0.05	
BQ	7.5	2.9	3.9	2.42	0.543	4.77	-0.97	0.44	
BS	8.4	8.6	8.0	0.31	0.071	8.33	0.27	1.67	
C	5.9	6.0	6.0	0.06	0.012	5.97	-0.55	0.85	
CA	95.7	88.9	94.9	3.72	0.803	93.17	29.66	31.06	×
CC									•
CE	4.5	3.8	4.7	0.47	0.106	4.33	-1.12	0.29	
CJ									•
CO	2.4	4.7	4.9	1.39	0.295	4.00	-1.23	0.17	
CP	4.1	3.8	3.7	0.21	0.047	3.87	-1.28	0.13	
CS	4.7	3.4	1.1	1.82	0.425	3.07	-1.56	-0.15	
CX	8.8	6.5	7.2	1.18	0.272	7.50	-0.02	1.39	
D	9.8	11.3	11.1	0.81	0.177	10.73	1.10	2.51	
DB	15.9	15.0	16.1	0.59	0.130	15.67	2.81	4.21	⇑
DD	4.6	5.7	5.0	0.56	0.130	5.10	-0.85	0.55	
DE	8.0	8.0	8.0	0.00	0.000	8.00	0.15	1.56	
DH	7.2	10.6	7.5	1.88	0.402	8.43	0.30	1.71	
DO	8.5	8.7	7.9	0.42	0.095	8.37	0.28	1.69	
DR	7.5	7.0	7.2	0.25	0.059	7.23	-0.11	1.29	
DT	9.0	9.2	9.0	0.12	0.024	9.07	0.52	1.93	
DZ	10.1	8.8	11.4	1.30	0.307	10.10	0.88	2.29	
E	8.2	9.2	8.2	0.58	0.118	8.53	0.34	1.74	
EB	4.9	4.5	3.8	0.56	0.130	4.40	-1.09	0.31	
EL									•
EO	8.0	8.0	7.0	0.58	0.118	7.67	0.04	1.44	

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)	Normalized deviation (known)	Tag
ER									•
EV	9.5	9.0	8.0	0.76	0.177	8.83	0.44	1.85	
EW	7.3	10.3	7.3	1.73	0.354	8.30	0.26	1.66	
EX	9.0	8.3	3.2	3.17	0.685	6.83	-0.25	1.15	
FE	3.9	4.2	4.2	0.17	0.035	4.10	-1.20	0.21	
FF									•
FJ									•
FL	12.4	9.3	9.1	1.85	0.390	10.27	0.94	2.34	
FN	24.0	24.0	18.0	3.46	0.709	22.00	5.00	6.41	×
GQ	5.7	5.7	4.3	0.81	0.165	5.23	-0.81	0.60	
GZ	10.8	14.5	17.3	3.26	0.768	14.20	2.30	3.71	⇑
HE	8.4	9.0	8.4	0.35	0.071	8.60	0.36	1.77	
HI	9.7	9.0	7.9	0.91	0.213	8.87	0.45	1.86	
HK	8.9	8.0	8.9	0.52	0.106	8.60	0.36	1.77	
HL	8.3	8.5	8.4	0.10	0.024	8.40	0.29	1.70	
HP	7.5	7.2	6.9	0.30	0.071	7.20	-0.12	1.28	
I	5.8	4.9	6.3	0.71	0.165	5.67	-0.66	0.75	
ID	12.3	7.3	10.6	2.54	0.591	10.07	0.87	2.27	
IU									•
J									•
JE	9.2	10.4	9.8	0.60	0.142	9.80	0.78	2.18	
JG	9.0	8.5	8.5	0.29	0.059	8.67	0.38	1.79	
JM	9.2	9.4	11.3	1.16	0.248	9.97	0.83	2.24	
JN	12.3	12.5	15.2	1.62	0.343	13.33	2.00	3.41	⇑
JP	2.2	2.5	1.5	0.51	0.118	2.07	-1.90	-0.50	
JQ	1.3	2.9	0.1	1.40	0.331	1.43	-2.12	-0.72	
JS	4.5	5.2	3.8	0.70	0.165	4.50	-1.06	0.35	
JY	10.7	8.1	8.2	1.47	0.307	9.00	0.50	1.91	
K	7.6	9.2	8.7	0.82	0.189	8.50	0.33	1.73	
KE	10.7	10.9	11.9	0.64	0.142	11.17	1.25	2.66	
KH	8.6	8.6	8.1	0.29	0.059	8.43	0.30	1.71	
KT	10.0	11.0	12.0	1.00	0.236	11.00	1.19	2.60	
KX	8.4	5.5	6.1	1.53	0.343	6.67	-0.31	1.10	
L	11.1	10.5	10.2	0.46	0.106	10.60	1.05	2.46	
LE	7.2	9.5	7.8	1.19	0.272	8.17	0.21	1.62	
LF	6.5	10.0	8.6	1.76	0.413	8.37	0.28	1.69	
LL	7.1	6.8	5.0	1.14	0.248	6.30	-0.44	0.97	
LR	4.9	7.5	7.8	1.59	0.343	6.73	-0.29	1.12	
M									•
MF	8.6	8.7	8.4	0.15	0.035	8.57	0.35	1.76	
MT									•
MV	10.5	6.1	4.5	3.11	0.709	7.03	-0.18	1.22	
MX	7.8	7.9	8.0	0.10	0.024	7.90	0.12	1.52	
N									•
NA	7.8	7.4	6.9	0.45	0.106	7.37	-0.07	1.34	

• ≡ No data submitted

TAG SYMBOLS

⇑ ≡ Above control limit

C ≡ Insufficient data

× ≡ Determined to be an outlier

⇓ ≡ Below control limit

13 / 16 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 13-Nov-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	(known)	Tag
NB									•
NH	9.0	9.0	8.0	0.58	0.118	8.67	0.38	1.79	
NJ	7.4	10.7	9.2	1.65	0.390	9.10	0.53	1.94	
NK									•
NO	8.4	10.7	13.0	2.30	0.543	10.70	1.09	2.49	
NP	2.2	5.1	3.0	1.50	0.343	3.43	-1.43	-0.02	
O	6.6	6.6	6.3	0.17	0.035	6.50	-0.37	1.04	
OA									•
OB	15.0	8.1	12.4	3.48	0.815	11.83	1.48	2.89	
OF	6.5	6.6	6.9	0.21	0.047	6.67	-0.31	1.10	
OS									•
OT									•
OY									•
P	4.2	4.1	6.0	1.07	0.224	4.77	-0.97	0.44	
PB	9.7	10.2	9.1	0.55	0.130	9.67	0.73	2.14	
PD	17.3	16.5	16.9	0.40	0.095	16.90	3.24	4.64	⇑
PG	7.0	7.1	7.9	0.49	0.106	7.33	-0.08	1.33	
PM	6.1	8.8	5.3	1.83	0.413	6.73	-0.29	1.12	
Q	7.0	7.3	8.0	0.51	0.118	7.43	-0.04	1.36	
QM	5.0	5.7	5.4	0.35	0.083	5.37	-0.76	0.65	
QP	2.3	2.5	2.4	0.10	0.024	2.40	-1.79	-0.38	
QQ	6.2	6.5	6.7	0.25	0.059	6.47	-0.38	1.03	
QT	5.9	3.6	4.8	1.15	0.272	4.77	-0.97	0.44	
QU	8.1	9.0	7.8	0.62	0.142	8.30	0.26	1.66	
QW	8.0	8.4	8.3	0.21	0.047	8.23	0.23	1.64	
QX	3.7	3.8	3.7	0.06	0.012	3.73	-1.33	0.08	
QZ	7.4	5.1	5.3	1.27	0.272	5.93	-0.56	0.84	
R	12.2	9.5	9.4	1.59	0.331	10.37	0.97	2.38	
RB	4.4	3.3	4.2	0.59	0.130	3.97	-1.24	0.16	
RD	27.1	20.4	12.5	7.31	2.380	20.00	4.31	5.72	×
RG									•
RI	7.0	5.8	5.3	0.87	0.201	6.03	-0.53	0.88	
RK									•
RR									•
RZ	8.9	9.2	9.2	0.17	0.035	9.10	0.53	1.94	
S	10.0	11.2	10.4	0.61	0.142	10.53	1.03	2.44	
SD	15.3	14.3	16.3	1.00	0.236	15.30	2.68	4.09	⇑
SF	4.9	5.0	4.9	0.06	0.012	4.93	-0.91	0.50	
SG	8.8	9.3	7.1	1.15	0.260	8.40	0.29	1.70	
SI	6.7	8.2	6.3	1.00	0.224	7.07	-0.17	1.24	
SL	6.2	4.5	4.4	1.01	0.213	5.03	-0.87	0.53	
SM	6.8	6.5	4.0	1.54	0.331	5.77	-0.62	0.79	
SN	5.8	5.9	6.1	0.15	0.035	5.93	-0.56	0.84	
SO	4.8	4.8	5.0	0.12	0.024	4.87	-0.93	0.47	
SR	8.0	12.2	7.5	2.58	0.555	9.23	0.58	1.99	

• ≡ 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
SS	5.9	5.6	5.7	0.15	0.035	5.73	-0.63	0.77	
SU	9.5	10.3	12.8	1.72	0.390	10.87	1.15	2.55	
SV									•
SX	9.5	10.2	11.1	0.80	0.189	10.27	0.94	2.34	
T									•
TD	1.4	2.4	4.5	1.58	0.366	2.77	-1.66	-0.25	
TL									•
TN	8.4	8.3	12.1	2.17	0.449	9.60	0.71	2.11	
TO									•
TQ	5.4	3.8	5.8	1.06	0.236	5.00	-0.89	0.52	
TW	6.6	5.6	6.1	0.50	0.118	6.10	-0.51	0.90	
TX									•
TY	3.1	4.4	3.0	0.78	0.165	3.50	-1.41	0.00	
U	10.4	8.8	12.0	1.60	0.378	10.40	0.98	2.39	
UA									•
UM									•
UP	9.2	8.8	8.9	0.21	0.047	8.97	0.49	1.89	
UQ									•
UY	10.9	10.8	11.8	0.55	0.118	11.17	1.25	2.66	
VA									•
VC									•
VH	16.6	12.1	11.1	2.93	0.650	13.27	1.98	3.38	⇑
VI	7.5	9.1	6.9	1.14	0.260	7.83	0.10	1.50	
VJ	9.6	7.1	10.3	1.68	0.378	9.00	0.50	1.91	
VO	10.3	10.5	11.0	0.36	0.083	10.60	1.05	2.46	
VT	51.4	55.8	57.3	3.07	0.697	54.83	16.38	17.78	×
W	6.9	6.0	7.1	0.59	0.130	6.67	-0.31	1.10	
WE	1.4	1.7	1.3	0.21	0.047	1.47	-2.11	-0.70	
WH	8.5	6.3	7.0	1.12	0.260	7.27	-0.10	1.30	
WJ									•
WN									•
WO	4.6	4.6	5.6	0.58	0.118	4.93	-0.91	0.50	
WP									•
WR	13.3	16.5	17.4	2.15	0.484	15.73	2.83	4.24	⇑
WS									•
WW	5.4	8.1	4.6	1.83	0.413	6.03	-0.53	0.88	
WX									•
X	3.6	3.2	4.1	0.45	0.106	3.63	-1.36	0.05	
XB									•
XC									•
XD									•
XF	6.8	3.4	2.9	2.12	0.461	4.37	-1.11	0.30	
XI	9.1	13.0	12.0	2.03	0.461	11.37	1.32	2.73	
XJ									•
XK	77.7	94.8	86.7	8.55	2.943	86.40	27.31	28.72	×

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

 ESD-LV Performance Evaluation: Gross Alpha-Beta in Water, 13-Nov-1998

Gross Beta

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
XL	10.3	9.9	9.0	0.67	0.154	9.73	0.75	2.16	
XM	4.1	3.6	5.7	1.10	0.248	4.47	-1.07	0.33	
XN									
XQ									
XT									

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
1.43		JQ	5.77		SM	8.13		BH
1.47		WE	5.93		SN	8.17		LE
2.07		JP	5.93		QZ	8.23		QW
2.40		QP	5.97		C	8.30		QU
2.77		TD	6.03		WW	8.30		EW
3.07		CS	6.03		RI	8.33		BS
3.33		BA	6.03		AJ	8.37		LF
3.43		NP	6.10		TW	8.37		DO
3.50		TY	6.20		BM	8.40		SG
3.63		X	6.30		LL	8.40		HL
3.63		BN	6.47		QQ	8.43		KH
3.73		QX	6.50		O	8.43		DH
3.87		CP	6.67		W	8.50		K
3.97		RB	6.67		OF	8.50		AW
4.00		CO	6.67		KX	8.53		E
4.10		FE	6.73		PM	8.57		MF
4.33		CE	6.73		LR	8.60		HK
4.37		XF	6.73		BK	8.60		HE
4.40		EB	6.83		EX	8.67		NH
4.47		XM	6.97		AK	8.67		JG
4.50		JS	7.00		BL	8.77		AF
4.53		AZ	7.03		MV	8.83		EV
4.77		QT	7.07		SI	8.87		HI
4.77		P	7.10		AL	8.97		UP
4.77		BO	7.20		HP	9.00		VJ
4.87		SO	7.20		AE	9.00		JY
4.93		WO	7.23		DR	9.07		DT
4.93		SF	7.27		WH	9.10		RZ
5.00		TQ	7.33		PG	9.10		NJ
5.03		SL	7.37		NA	9.23		SR
5.07		AU	7.43		Q	9.60		TN
5.07		A	7.50		CX	9.67		PB
5.10		DD	7.67		EO	9.73		XL
5.23		GQ	7.67		BC	9.80		JE
5.37		QM	7.83		VI	9.80		BB
5.67		I	7.90		MX	9.97		JM
5.73		SS	8.00		DE	10.07		ID

• ≡ No data submitted

Ø ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

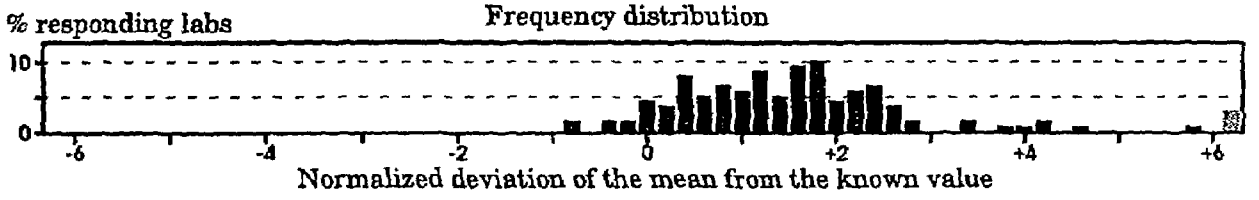
⇑ ≡ Above control limit

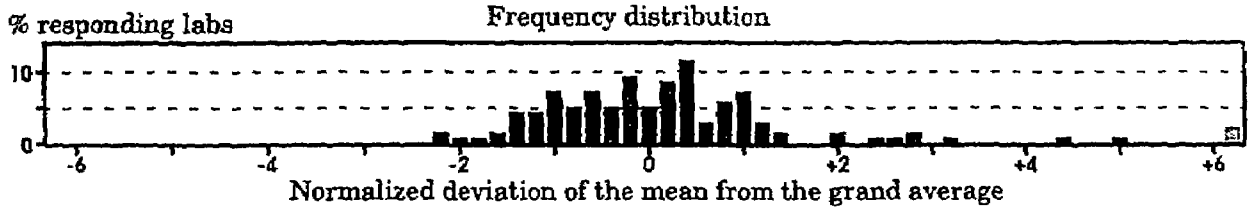
⇓ ≡ Below control limit

Gross Beta

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
10.10		DZ	10.70		NO	14.20	⇑	GZ
10.27		SX	10.73		D	15.30	⇑	SD
10.27		FL	10.87		SU	15.67	⇑	DB
10.37		R	11.00		KT	15.73	⇑	WR
10.40		U	11.17		UY	16.90	⇑	PD
10.53		S	11.17		KE	20.00	×	RD
10.60		VO	11.37		XI	22.00	×	FN
10.60		L	11.83		OB	54.83	×	VT
10.67		AR	13.27	⇑	VH	86.40	×	XK
			13.33	⇑	JN	93.17	×	CA





• ≡ No data submitted
Ø ≡ Insufficient data

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