

UNITED NUCLEAR CORPORATION RECOVERY SYSTEMS
DIVISION OF UNITED NUCLEAR CORPORATION
WOODRIVER JUNCTION, RHODE ISLAND

MACADAM AND SOIL
STATISTICAL ANALYSIS AND EVALUATION OF ANALYTICAL DATA
FOR THE DECOMMISSIONING
OF THE
WOODRIVER JUNCTION FACILITY



Controls for Environmental Pollution, Inc.
Santa Fe, New Mexico 87502

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JULY 14, 1981

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1.0 INTRODUCTION

The United Nuclear Corporation (UNC), Woodriver Junction has been performing sampling of soils and macadam in preparation for decommissioning. The data gathered and the evaluation presented in this report are to assist in determining compliance to the Nuclear Regulatory Commission's (NRC) criteria for decommissioning.

2.0 OBJECTIVES OF DATA ASSESSMENT

The NRC's Annex C provides "Guideline for Decontamination of Facilities and Equipment prior to release for Use or Termination of Licenses for By-products, Source or Special Nuclear Materials." Decontamination criteria for soil have been established by the NRC for decommissioning of the facility.

The objectives of this report are to:

- (a) prepare a graphic plot of the distribution of the isotopic concentrations by area and by depth;
- (b) perform a balanced/unbalanced analysis of isotopic concentrations;
- (c) perform a statistical evaluation of the generated data for soil decontamination to the criteria established by the NRC. This includes a tabular display of lung dose and bone dose produced by the individual data points. This addresses the criteria for the demonstration of compliance of the inhalation criteria and the same display of dose commitment by injection pathways;
- (d) determine the viability of using a gross alpha/gross beta analysis to prove compliance to the NRC soil decontamination criteria. From the statistical assessment performed on the data, a technical discussion and recommendations are presented in this report to provide information regarding compliance with the NRC criteria.

3.0 SURVEY PROCEDURE

UNC developed a decontamination procedure for surveying their facility at Woodriver Junction, Rhode Island. This procedure was presented to the Nuclear Regulatory Commission (NRC) by UNC. Soils and macadam were collected and submitted for analysis as part of that survey.

4.0 SAMPLE ANALYSIS

Samples collected and submitted by UNC for analysis were for those parameters listed in Table 4.0-1.

Table 4.0-1
Type Samples and Analysis

<u>Macadam</u>	<u>Soils</u>
Gross Alpha	Gross Alpha
Gross Beta	Gross Beta
Total Uranium	Radium-226
Uranium-235	Radium-228
	Strontium-90
	Uranium-234
	Uranium-235
	Uranium-238
	Thorium-228
	Thorium-230
	Thorium-232
	Cesium-137

A summary of the sample preparation, analytical procedures and quality assurance practice is presented in Appendix A. The quality assurance data which compliments the data generated is present in Appendix B.

5.0 METHODS OF DATA ASSESSMENT

Statistics, as a science, deals with probability. Probabilibility is a useful concept in all areas of science because no two (2) analyses or measurements give identical answers. Measurements of radioactivity are bound even more closely to statistical evaluation because of the random nature of the disintegration process. The basic question is how to determine, from a few measurements or a single measurement, the best approximation to a "true" value.

The goal of this report is to examine the data and to demonstrate what unavoidable fluctuations of random error are present. Every analytical result still has a degree of uncertainty which arises from all the measurement processes involved in the analysis (i.e., weighing, volumetric measurements, counting error, etc.)

The analytical data from the soils and macadam samples have been analyzed statistically. Graphical representations and statistical summaries, where appropriate, are presented. In addition, information such as control samples and accuracy of analytical methods have been taken into consideration in the statistical analysis.

Basic statistical analysis or an analysis of the variance for balanced or unbalanced data has been applied where appropriate. These analyses allow for insight as to the statistical character or distribution and exposure to man of the data for the UNC Wood River Junction facility as well as exposure pathways to man.

Analysis has been performed through the generation of means, standard deviations, variances, confidence intervals, ranges and distributions. The statistical distribution of activity over a given area or depth has been statistically evaluated for comparison with the NRC criteria. Specific details for statistical parameters employed are presented in Appendix A.

6.0 DATA ASSESSMENT

The data gathered thus far from the UNC Wood River Junction facility has been analyzed statistically. This study provides information regarding the extent of contamination prior to clean-up. Using this data base, conclusions can be drawn as to whether or not the area exceeds the NRC criteria for contamination and exposure to bone and lung through inhalation and/or ingestion.

The statistical analysis of the data is complicated by factors typical of the type of samples analyzed. From the following list, some or all items may apply for a given analysis.

1. Inhomogeneity of samples makes it difficult to determine true variations over an area.
2. The time interval between sampling may vary.

The data has been statistically summarized without correcting for background. As necessary throughout the presentation of this report, the background data for particular samples will be taken into consideration and discussed.

6.1 Macadam

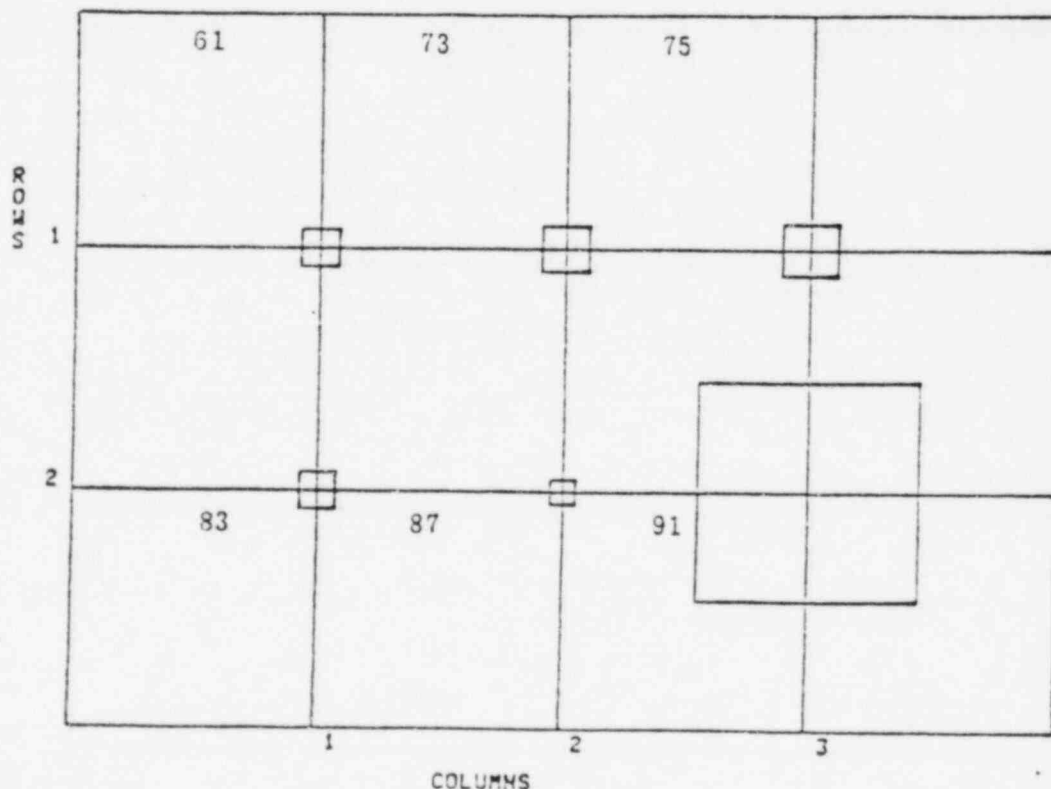
These samples were analyzed for gross alpha, gross beta, total uranium and uranium-235. The activity with their respective errors at the ninety-five percent (95%) confidence level are presented in Table 6.1-1.

Table 6.1-1
Radioactivity in Macadam Samples

Parameter	Sample Identification					
	D-061-D	D-073-D	D-075-D	D-083-D	D-087-D	D-091-D
Gross Alpha (pCi/gm)	0.9±0.5	1.3±0.6	1.6±0.6	0.86±0.53	< 0.3	9.3±1.3
Gross Beta (pCi/gm)	< 0.1	< 0.1	< 0.1	< 0.1	0.6±0.2	0.9±0.5
Total Uranium (ug/gm)	< 0.1	1.0	1.0	0.4	0.2	0.3
Uranium-235 (pCi/gm)	< 0.5	0.35±0.11	0.12±0.06	0.09±0.05	< 0.05	< 0.05

Rectangular representations of the data distribution are presented in Figures 6.1-1 through 6.1-4. These figures are not all the same scale. Their purpose is to illustrate a comparison of activity by parameter among the samples analyzed.

Figure 6.1-1
Gross Alpha
D-D Series (Macadam)
Analysis of Variance: Balanced Data



Cross Beta
D-D Series (Macadam)
Analysis of Variance Balanced Data

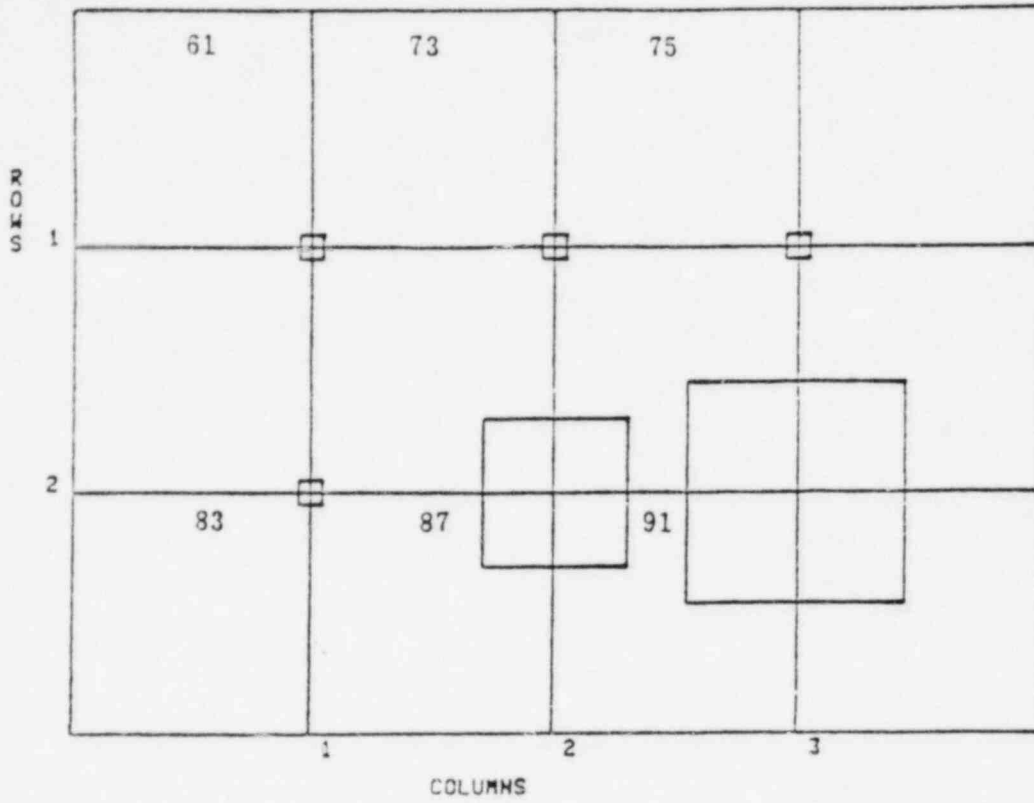


Figure 6.1-2

Total Uranium
D-D Series (Macadam)
Analysis of Variance Balanced Data

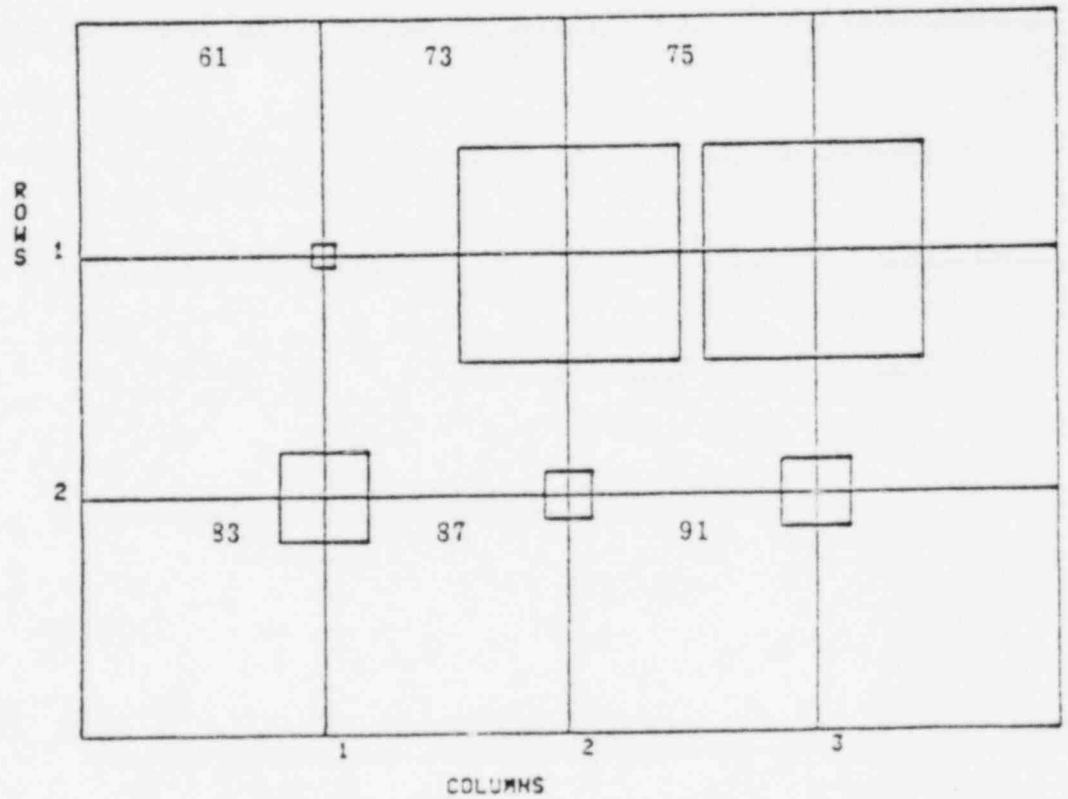


Figure 6.1-3

Uranium-235
D-D Series (Mocandam)
Analysis of Variance - Balanced Data

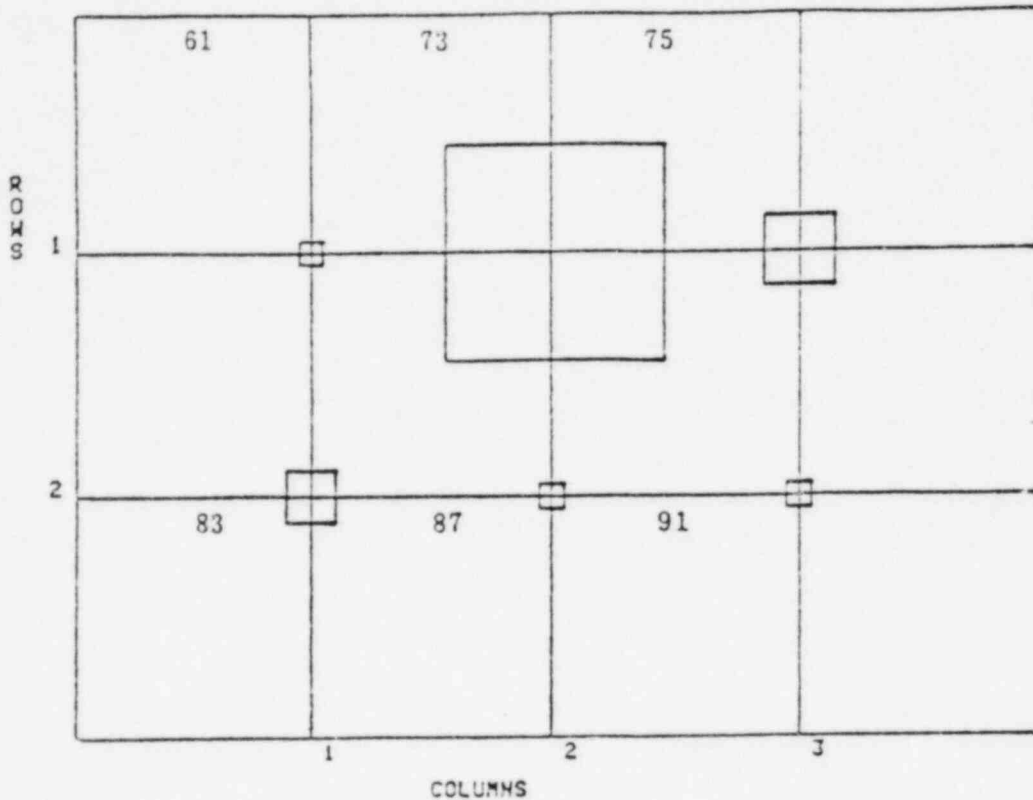


Figure 6.1-4

These figures show that the highest gross alpha and gross beta activity is reported for D-091-D. D-073-D had the maximum concentration for total uranium (1 ug/gm) and uranium-235 activity of 0.35 ± 0.11 pCi/gm. Samples demonstrating the highest activities are from the area near Lagoon "A" and the Lagoon Annex near the production area. Sample D-061-D was collected approximately one hundred and twenty (120) feet from the Lagoon "A" area.

The overall means and standard deviations for these samples is presented in Table 6.1-2.

Table 6.1-2
Radioactivity in Macadam

<u>Parameter</u>	<u>Mean</u>	<u>Standard Error of Mean</u>
Gross Alpha (pCi/gm)	2.4	1.4
Gross Beta (pCi/gm)	0.3	0.6×10^{-7}
Total Uranium (ug/gm)	0.5	0.1
Uranium-235 (pCi/gm)	0.11	0.04

6.2 Soils

6.2.1 Background Samples (1963)

Limited background characteristics of radioactivity in soil for the UNC, Woodriver Junction facility are provided from data gathered during 1963 (preoperational).⁽¹⁾ Background data was not available for thorium-232, thorium-228, radium-228, cesium-137 and strontium-90, except that gathered during the 1981 as presented in Subsection 6.2-2 of this report. This data is summarized in Table 6.2-1 along with the computer coding used for graphing the data. A graphic representation of the data is given in Figures 6.2-1 and 6.2-2.

Table 6.2-2

Pre-Operational Background Concentrations in Soil (1963)

<u>Location</u>	<u>Computer Code</u>	<u>Direction From Process Facility</u>	<u>Alpha Concentration (pCi/g)</u>	<u>Beta Concentration (pCi/g)</u>	<u>Uranium Concentration (pCi/g)</u>
Charlestown	1		3.3 ± 0.3	7.8 ± 0.6	0.10
Tuckertown	2		2.0 ± 0.3	6.6 ± 0.6	0.11
West Kingston	3		2.1 ± 0.4	4.5 ± 0.5	0.03
Drake	4		4.3 ± 0.5	4.6 ± 0.5	0.32
Woodville	5		4.1 ± 0.4	4.6 ± 0.5	0.04
Carolina	6		4.6 ± 0.5	17.3 ± 0.9	0.08
Alton	7		6.4 ± 0.5	9.7 ± 0.7	0.07
Bradford	8		5.1 ± 0.5	11.0 ± 0.7	0.15
Plant Site #1	9	S	3.8 ± 0.5	16.5 ± 0.9	0.04
Plant Site #2	10	SW	3.2 ± 0.4	7.3 ± 0.6	0.07
Plant Site #3	11	W	2.8 ± 0.4	7.5 ± 0.6	0.03
Plant Site #4	12	NW	4.0 ± 0.5	9.6 ± 0.7	0.06
Plant Site #5	13	N	3.4 ± 0.5	7.2 ± 0.6	0.04
Plant Site #6	14	NNE	5.5 ± 0.6	8.2 ± 0.6	0.05
Plant Site #7	15	NE	3.7 ± 0.5	5.8 ± 0.6	0.09
Plant Site #8	16	ENE	5.5 ± 0.6	8.0 ± 0.6	0.13

Uranium concentration includes U-238 and U-234

PREOPERATIONAL BACKGROUND DATA
 CONCENTRATIONS IN SOIL (1963)
 (O = GROSS ALPHA, X = GROSS BETA)

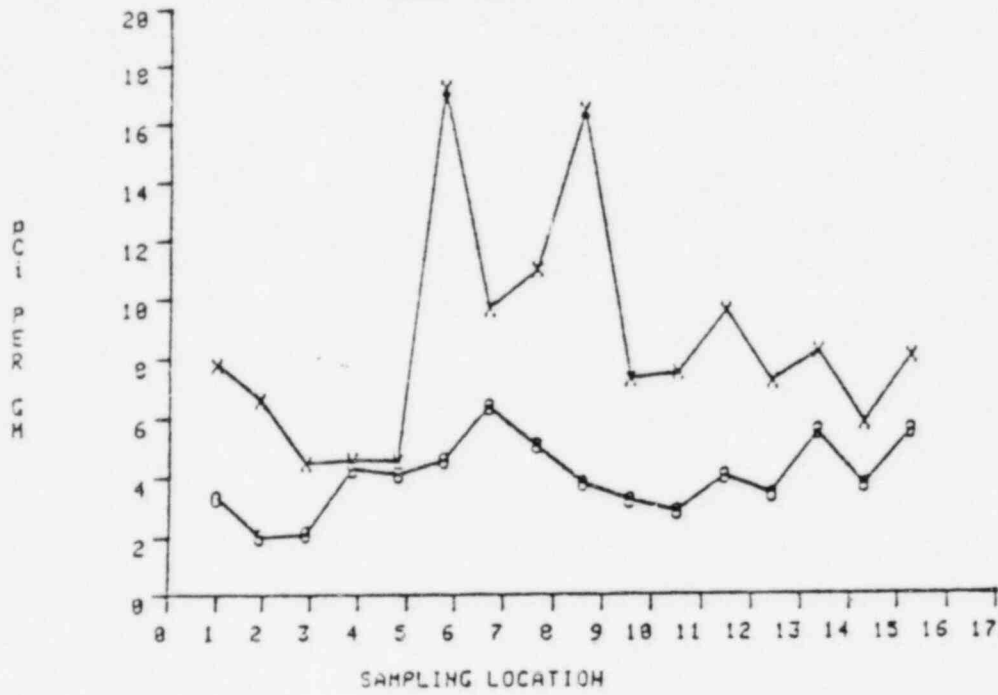


Figure 6.2-1

PREOPERATIONAL BACKGROUND DATA
 CONCENTRATIONS IN SOIL (1963)

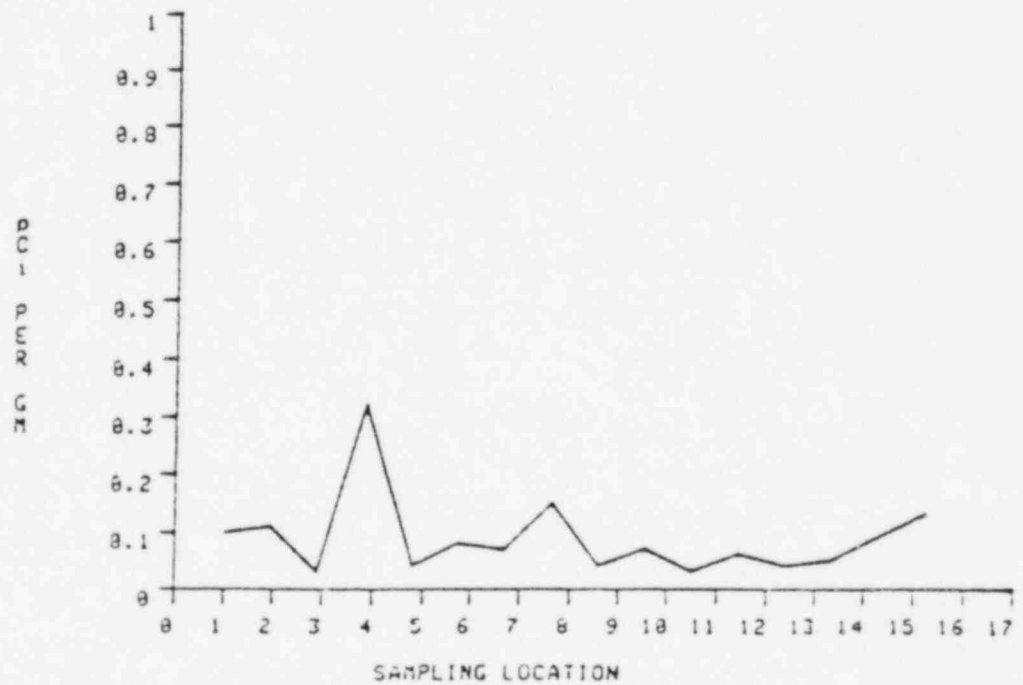
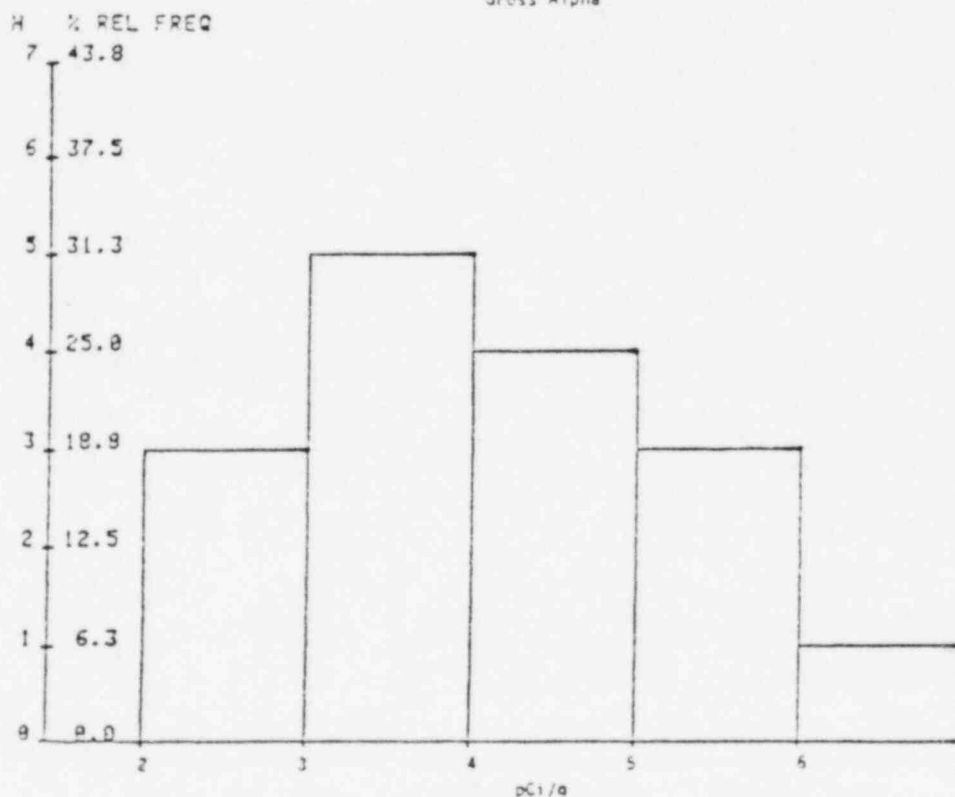


Figure 6.2-2

A summary of the description statistics of the data is presented in Table 6.2-3. The overall means for gross alpha is 3.9 pCi/gm with a standard deviation of 1.2 pCi/gm, gross beta activity has a mean of 8.5 pCi/gm and a standard deviation of 3.7 pCi/gm. A mean of 0.088 pCi/gm and standard deviation of 0.071 pCi/gm was calculated for the sum of U-238 and U-234. The distribution of the data is graphically illustrated in Figures 6.2-3 through 6.2-5 showing the relative frequency of activity occurrence.

Figure 6.2-3

Preoperational Background Data
 Concentrations in Soil (1953)
 Gross Alpha



Preoperational Background Data
 Concentrations in Soil (1963)
 Gross Beta

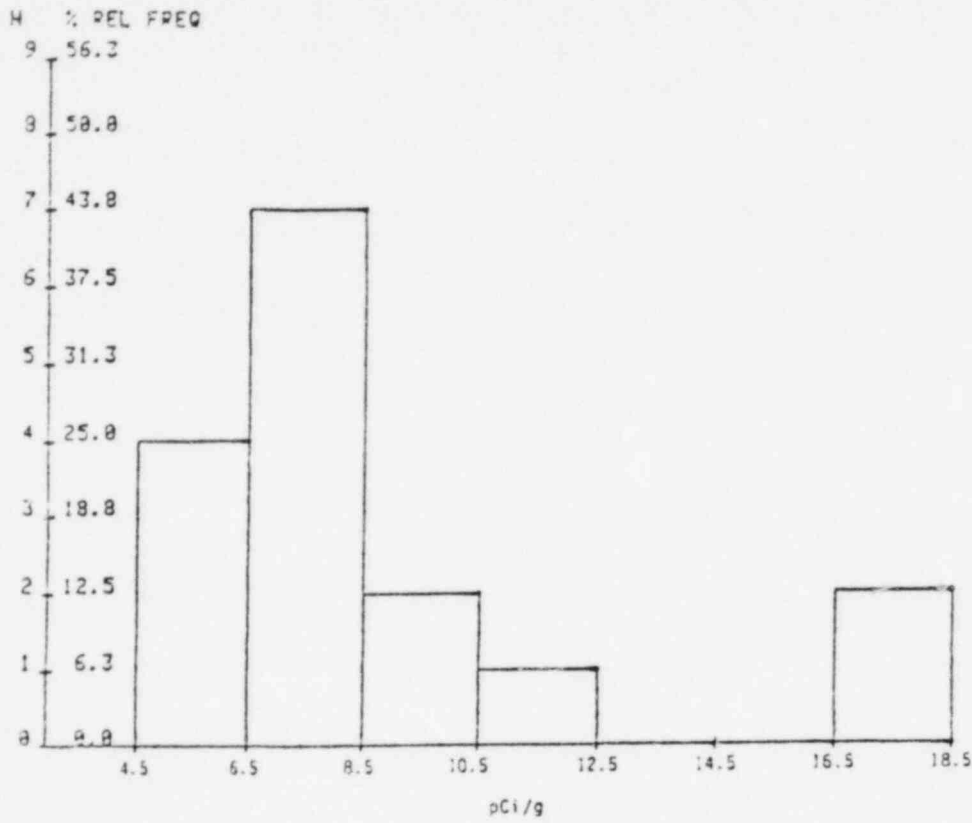


Figure 6.2-4

Preoperational Background Data
 Concentrations in Soil (1963)
 Uranium

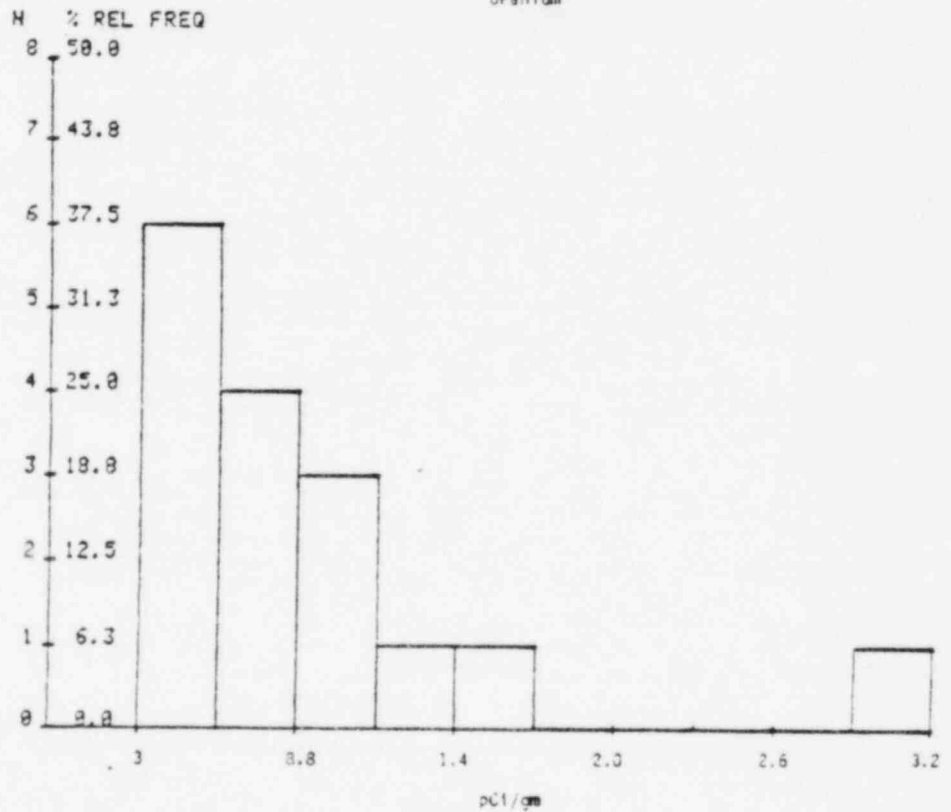


Figure 6.2-5

Table 6.2-3
Descriptive Statistics for Background
Soils (1963)

	<u>Gross Alpha</u> <u>pCi/gm</u>	<u>Gross Beta</u> <u>pCi/gm</u>	<u>Uranium(a)</u> <u>pCi/gm</u>
Mean =	3.9	8.5	0.088
Variance =	1.5	14.1	0.005
Std Dev =	1.2	3.7	0.071
Data Min =	2	4.5	0.03
Data Max =	6.4	17.3	0.32
Data Range =	4.4	12.8	0.29
Standard Err of Mean =	0.3	0.9	0.017

(a) Uranium concentration includes both U-238 and U-234.

6.2.2 NRC Background Samples(1981)

Background samples collected in 1981 outside the Woodriver Junction property fence provide additional data. These samples were analyzed for total activity as well as water soluble activity.

Table 6.2-4

STATISTICAL SUMMARY SURFACE SAMPLES

	Gross Alpha pCi/gm	Gross Beta pCi/gm	Ra-226 pCi/gm	Ra-228 pCi/gm	Sr-90 pCi/gm	U-234 pCi/gm	U-235 pCi/gm	U-238 pCi/gm	Th-228 pCi/gm	Th-230 pCi/gm	Th-232 pCi/gm	Cs-137 pCi/gm
Mean *	5.03	5.5	0.88	0.52	0.17	0.99	0.30	0.93	0.068	0.087	0.128	1.49
Variance *	4.57	12.5	0.32	0.15	0.08	0.43	0.06	0.54	0.001	0.002	0.013	2.69
Std Dev *	2.1	3.5	0.56	0.39	0.29	0.66	0.26	0.73	0.030	0.051	0.115	1.64
Data Min *	1.9	0.1	0.5	0.1	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.08
Data Max *	9.2	12	2	1.11	0.91	2.09	0.9	2.7	0.13	0.21	0.35	4.76
Data Range *	7.3	11.9	1.5	1.01	0.88	2.04	0.85	2.65	0.08	0.16	0.3	4.68
Standard Err of Mean *	0.7	1.1	0.18	0.13	0.09	0.20	0.08	0.24	0.01	0.017	0.038	0.54

Table 6.2-5

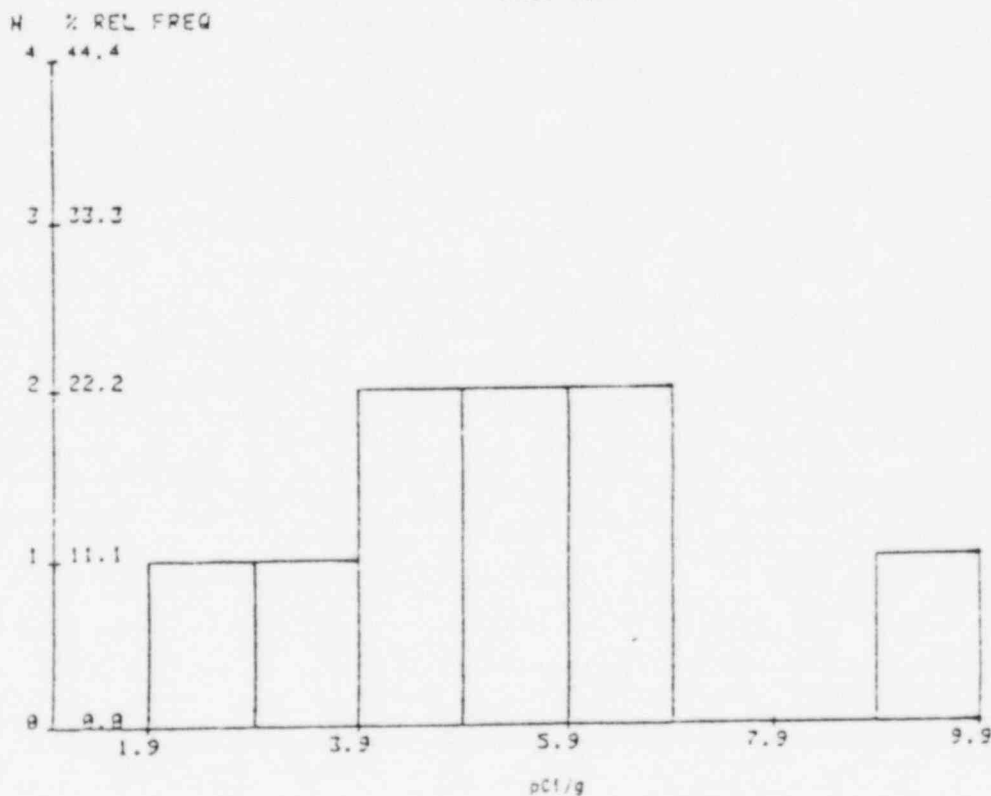
STATISTICAL SUMMARY SUB-SURFACE SAMPLES

	Gross Alpha pCi/gm	Gross Beta pCi/gm	Ra-226 pCi/gm	Ra-228 pCi/gm	Sr-90 pCi/gm	U-234 pCi/gm	U-235 pCi/gm	U-238 pCi/gm	Th-228 pCi/gm	Th-230 pCi/gm	Th-232 pCi/gm	Cs-137 pCi/gm
Mean	4.4	4.2	0.71	0.39	0.05	1.12	0.26	0.94	0.075	0.13888	0.125	0.18
Variance *	2.9	37.4	0.19	0.20	0.004	1.37	0.19	1.49	0.001	0.01126	0.003	0.01
Std Dev *	1.7	6.12	0.43	0.45	0.06	1.17	0.44	1.22	0.038	0.10611	0.054	0.11
Data Min	3.1	0.1	0.5	0.1	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.08
Data Max *	8.8	20	1.8	1.36	0.23	3.79	1.42	3.94	0.16	0.32	0.21	0.36
Data Range *	5.7	19.9	1.3	1.26	0.2	3.74	1.37	3.89	0.11	0.27	0.16	0.28
Standard Err of Mean *	0.5	2.04	0.14	0.15	0.02	0.39	0.14	0.40	0.012	0.03537	0.018	0.03

The data for these samples is presented in Appendix "D". The descriptive statistics for the surface and subsurface samples analyzed are presented in Table 6.2-4 and 6.2-5. The data gathered in 1981 for gross beta compare statistically with that gathered for 1963 (see Table 6.2-2). Uranium-234 results however, show an increase in 1981. Figures 6.2-6 and 6.2-7 are histograms showing the distribution of gross alpha activity for 1981 surface and subsurface background soil samples. As may be seen from these histograms the majority of the data (60-90%) is within a 3 to 6 pCi/gm range. A similar comparison of gross beta activity shows that the data distribution decreased for 1981. This may be seen in comparing Figures 6.2-3, 6.2-8 and 6.2-9.

Figure 6.2-6

Background Data (Surface)
 Concentration in Soil (1981)
 Gross Alpha



Background Data (Subsurface)
 Concentrations in Soil (1981)
 Gross Alpha

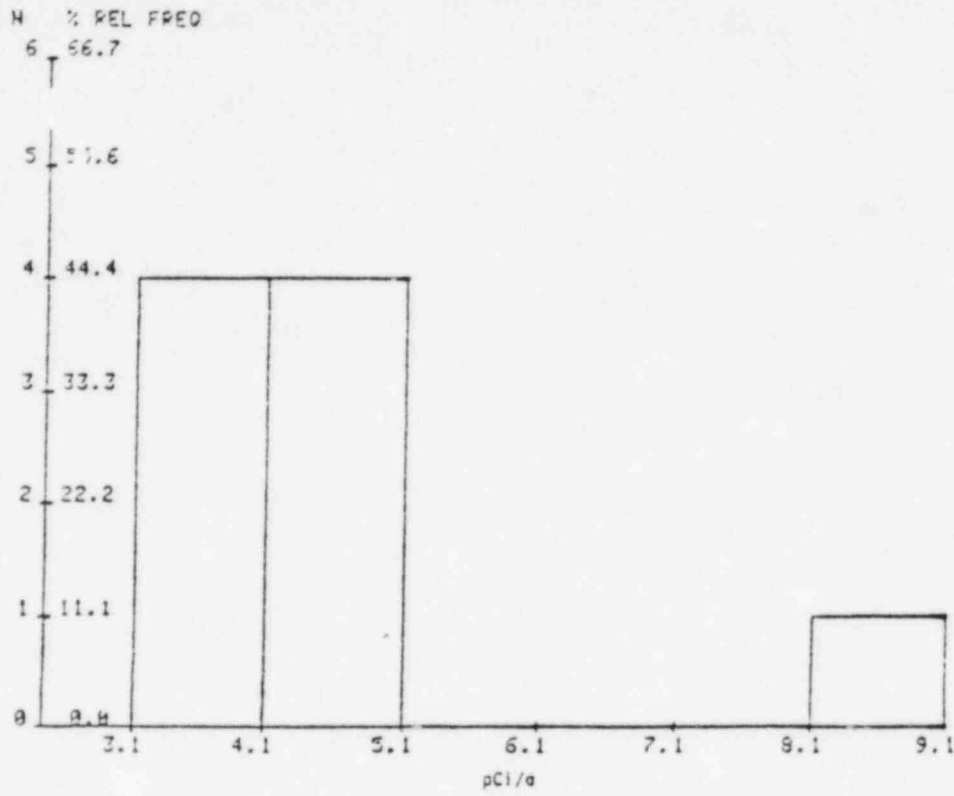


Figure 6.2-7

Background Data (Surface)
 Concentrations in Soil (1981)
 Gross Beta

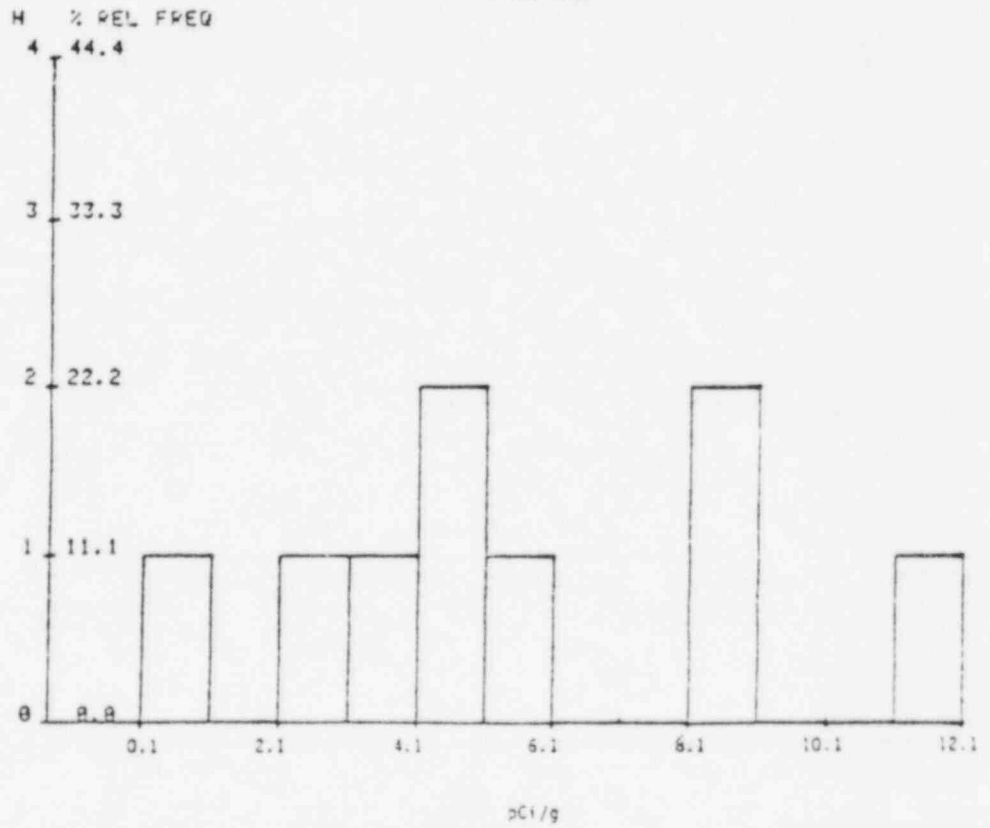
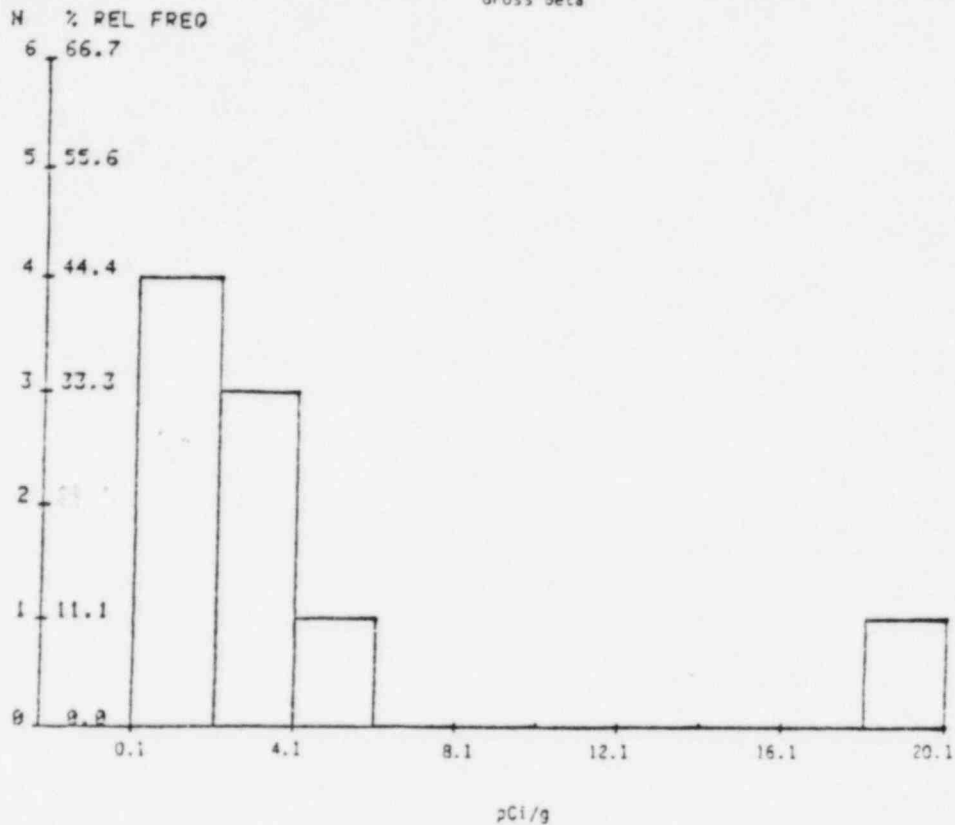


Figure 6.2-8

Figure 6.2-9

Background Data (Subsurface)
 Concentrations in Soil (1981)
 Gross Beta



Sixty-seven percent (67%) of the radium-226 results were reported with a range of less than 0.5 pCi/gm to 0.8 pCi/gm for both surface and subsurface samples. The statistics for this parameter is given in Tables 6.2-3 and 6.2-4, showing the data reported for both surface and subsurface samples compare well. An evaluation of the radium-228 data indicates that the overall mean for the surface samples is slightly higher than the subsurface samples. However, the data in Tables 6.2-3 and 6.2-4 shows the results are statistically equal. The strontium-90 and cesium-137 indicates an overall higher activity for surface samples.

This can be attributed to the ion exchange ability of the soil which limits the migration of these isotopes. The activity reported for surface and subsurface samples for isotopic uranium (U-234, U-235 and U-238) and isotopic thorium (Th-228, Th-230 and Th-232) compare statistically (see Tables 6.2-3 and 6.2-4).

The gross alpha activity for the surface, subsurface and water soluble soil samples is graphically represented in Figure 6.2-10 and 6.2-11. Figure 6.2-10 provides a comparison of the data with respect to distribution, and identifying the high activity sampling points. It also provides information on the amount of activity water leached from the soil. Figure 6.2-10 shows that sampling station E-08-S-0 has the highest gross alpha activity. It was assumed that the subsurface samples collected at stations E-02-S-6 and E-09-S-6 had been mislabeled. Figures 6.5-11 provides a graphical illustration of the gross alpha data. This figure shows that in general the subsurface samples are reported at lower activity. However, the trend for both sets of samples is comparable. Also this graph illustrates that soluble gross alpha activity was reported at less than 0.3 pCi/gm for all samples. Figure 6.2-12 provides a graphical illustration of the overall mean for the gross alpha analysis on the surface, subsurface and water soluble soil samples. The data is plotted with a ninety-five percent (95%) confidence interval. The mean and the ninety-five percent (95%) confidence interval for this data is presented in Table 6.2-6.

Table 6.2-6

Gross Alpha Means and Confidence Interval

	<u>E-S Series Soils</u>		
	<u>Mean</u>	<u>pCi/gm</u> <u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Surface	5.8	5.1	6.6
Subsurface	3.6	2.9	4.6

Gross Alpha
E-S Series (Soils)
Analysis of Variance Balanced Data

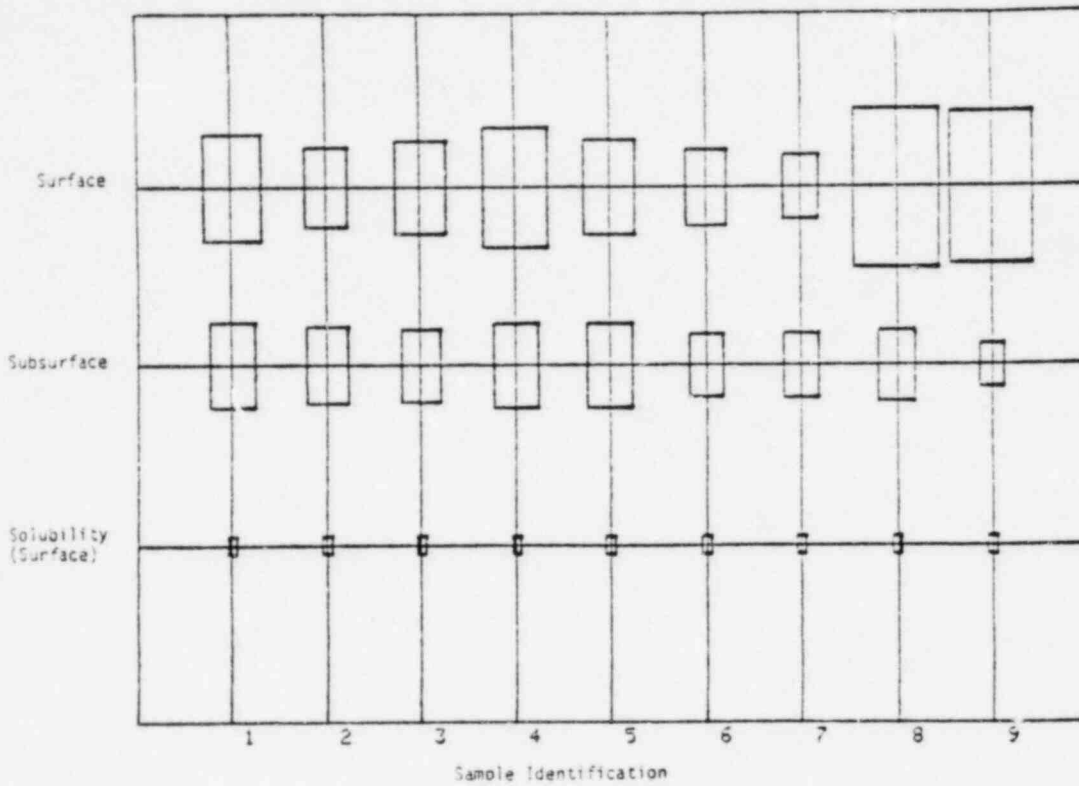
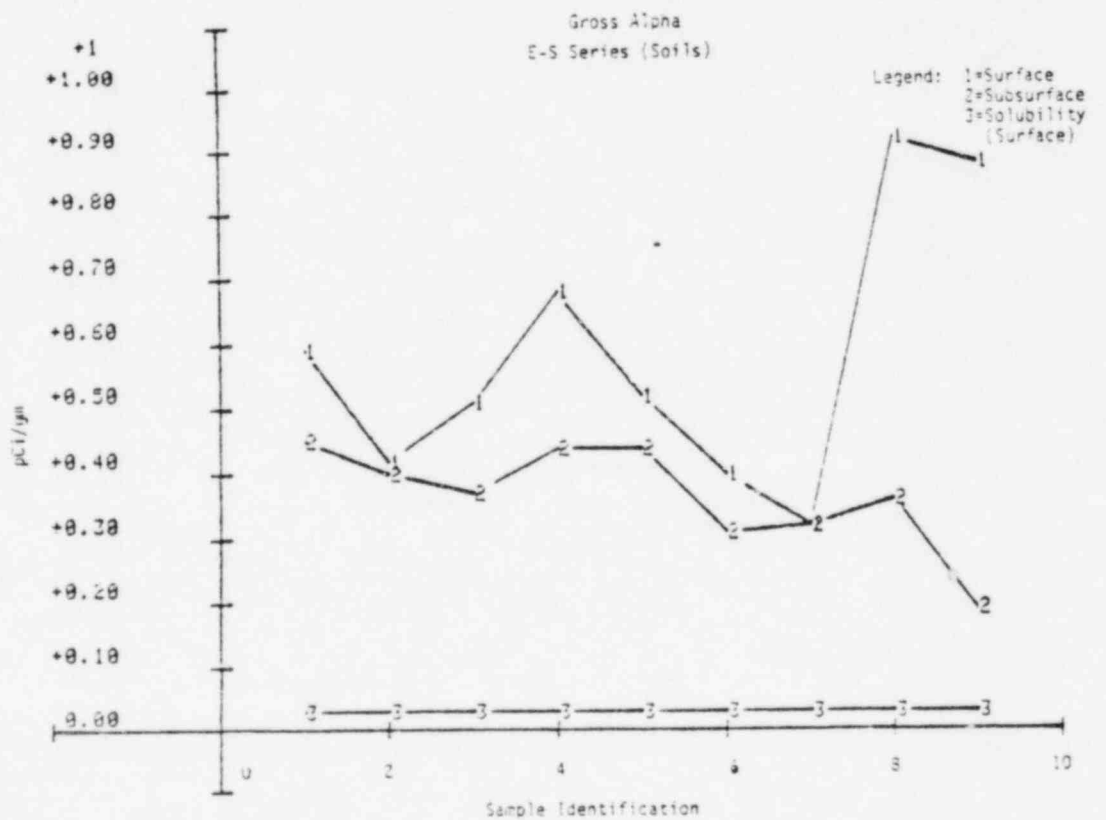


Figure 6.2-10

Figure 6.2-11



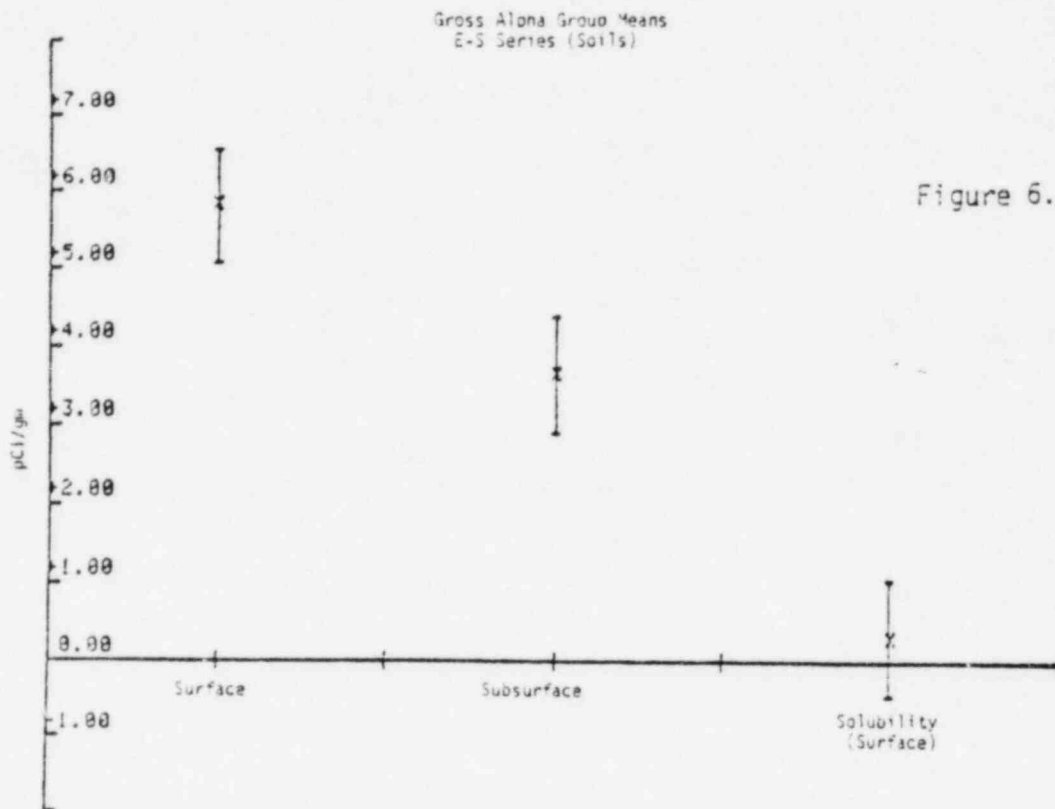


Figure 6.2-12

The data for gross beta activity is graphically illustrated in Figures 6.2-13, 6.2-14 and 6.2-15. The gross beta activity shows the same trend as the gross alpha activity. Table 6.2-7 is a tabulation of overall gross beta mean with the ninety-five percent (95%) confidence interval. Therefore, the same conclusion for gross alpha activity is applicable to gross beta activity, with the following exception; sample station E-09-S-0 shows the highest activity for all surface sample.

Gross Beta
E-S Series (Soils)
Analysis of Variance Balanced Data

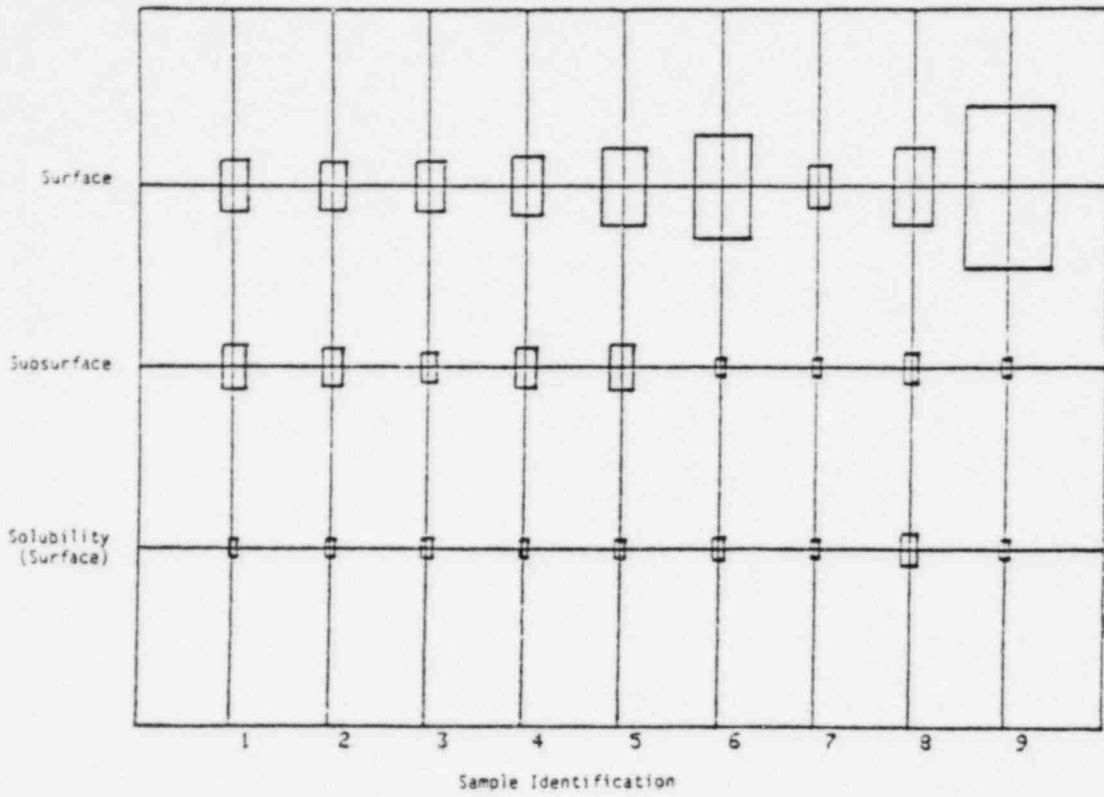


Figure 6.2-13

Gross Beta
E-S Series (Soils)

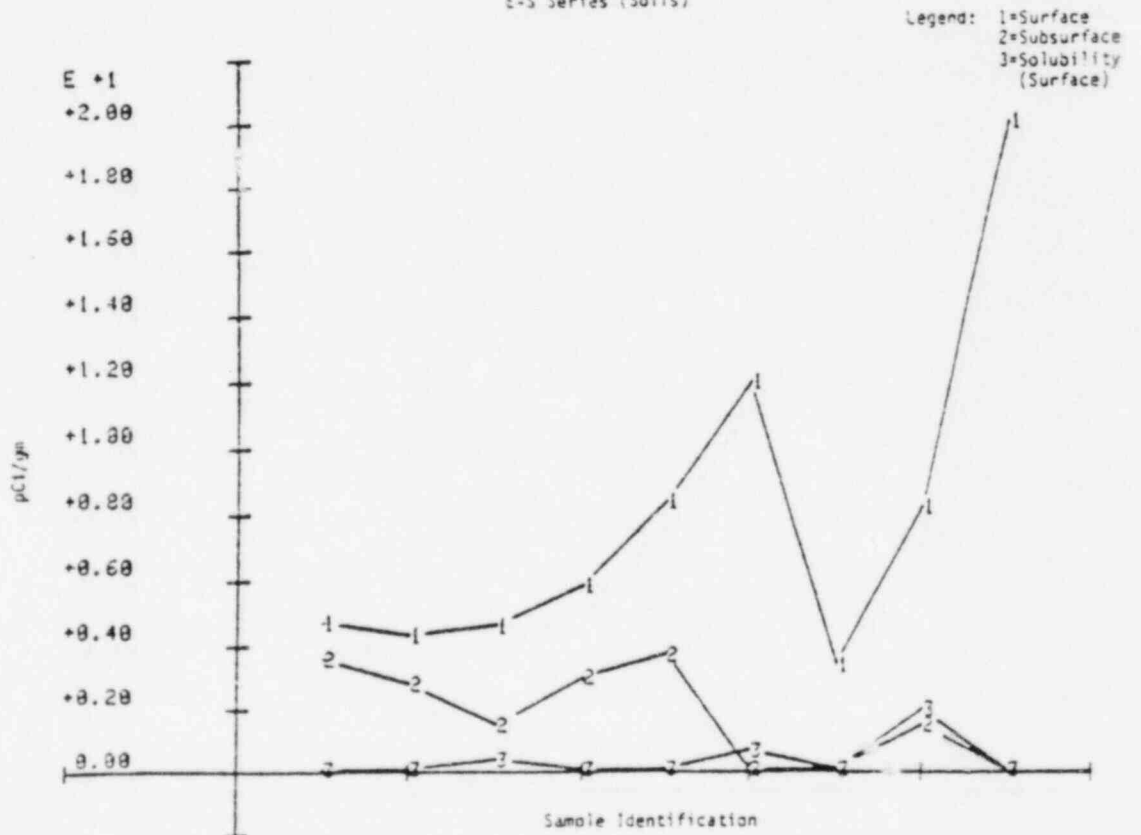


Figure 6.2-14

Figure 6.2-15

Gross Beta Group Means
E-S Series (Soils)

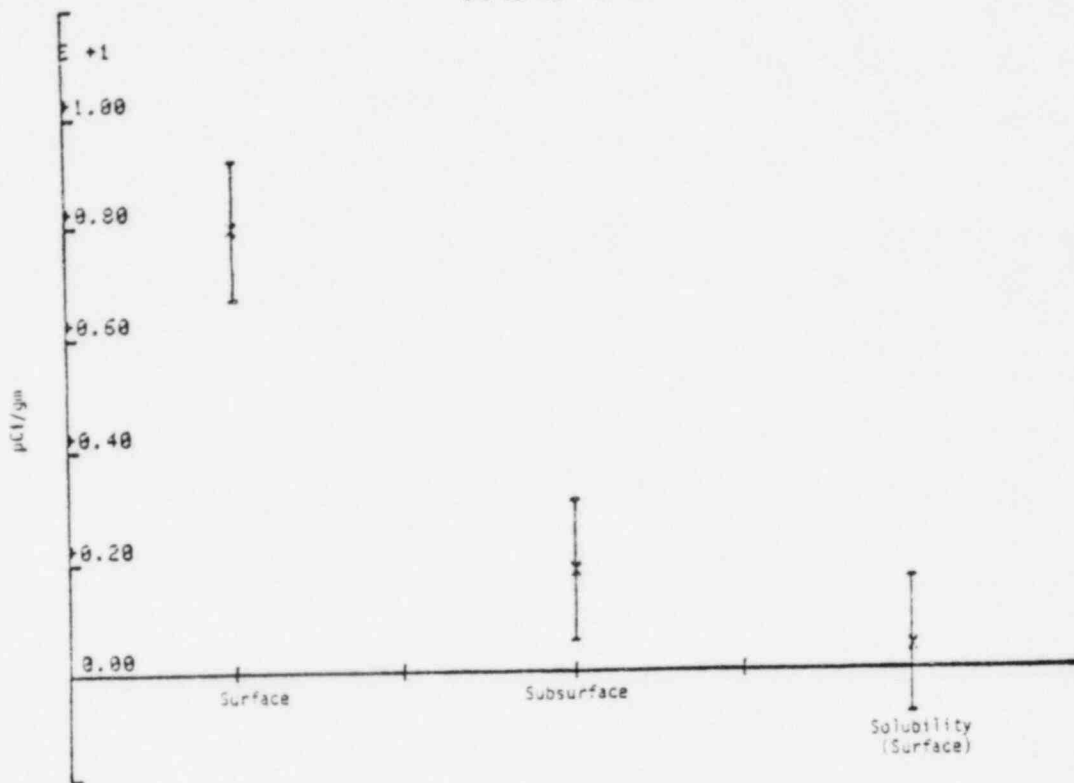


Table 6.2-7

Gross Beta Means and Confidence Interval

E-S Series Soils

	Mean	pCi/gm 95% Confidence Interval	
		Lower Limit	Upper Limit
Surface	7.9	6.7	9.2
Subsurface	1.8	0.6	3.1

As may be seen from the figures discussed above, no water soluble gross alpha activity above the lower limit of detection (0.3 pCi/gm) was detected. Gross beta activity ranged from 0.1 pCi/gm to 2 pCi/gm with a mean of 0.4 pCi/gm. Sixty-seven percent (67%) of the gross beta results were reported at 0.4 pCi/gm or less. The radium-226 data is illustrated in Figure 6.2-16. This figure shows the distribution of activity for the surface, subsurface and water solubility tests. The highest radium-226 activity reported is for E-05-S. In addition, it is also noted in this Figure, as well as Figure 6.2-17, that the radium-226 in the subsurface soil sample for Stations E-02-S, E-04-S, E-08-S and E-09-S was higher than the surface sample.

Figure 6.2-16

Radium-226
E-S Series (Soils)

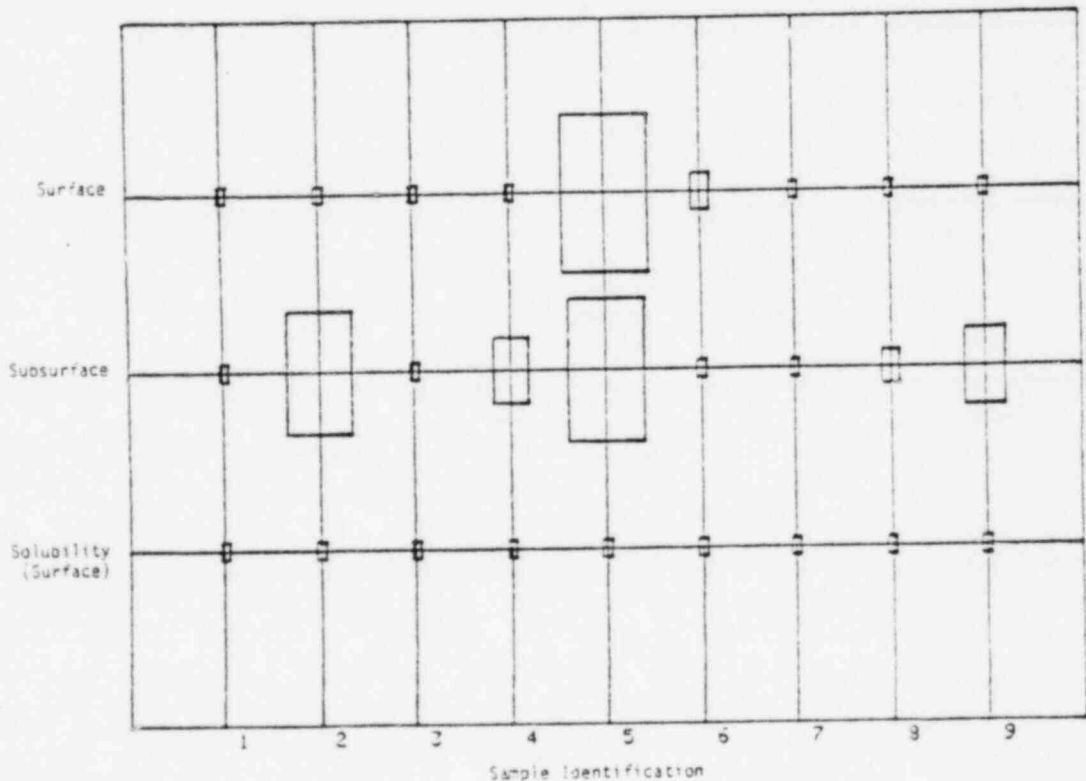
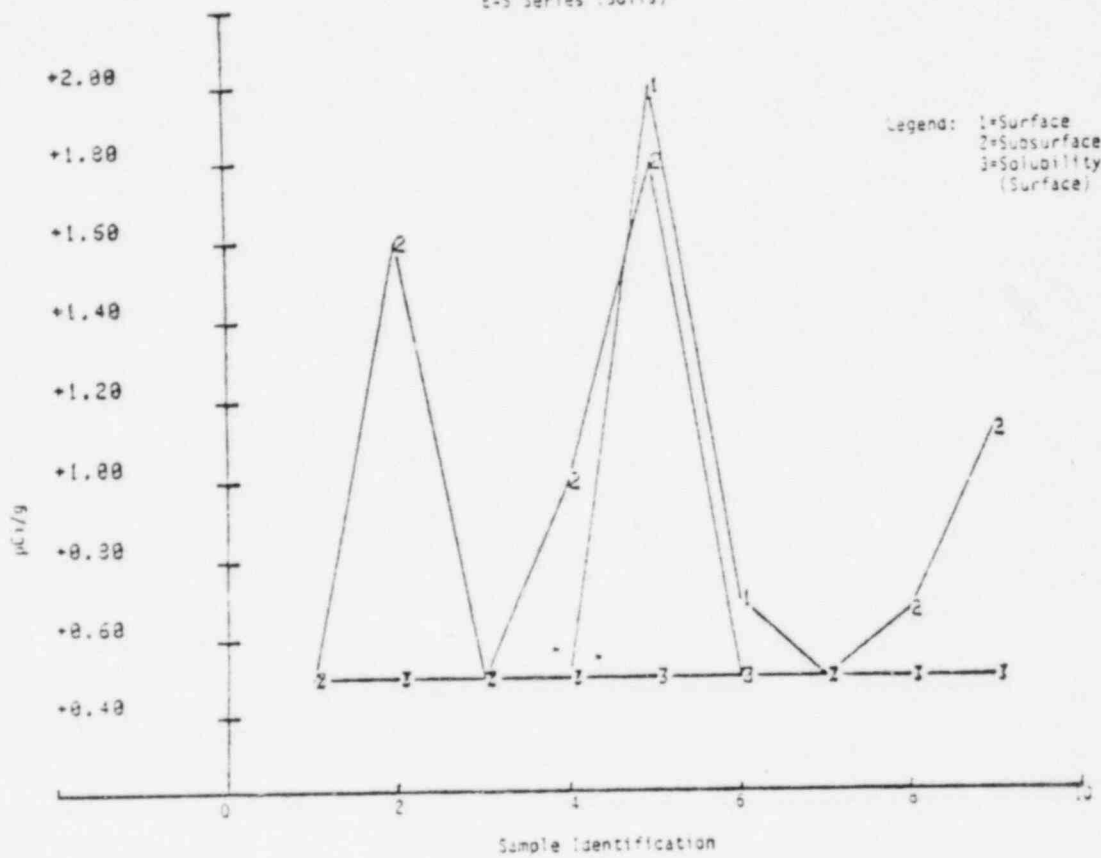
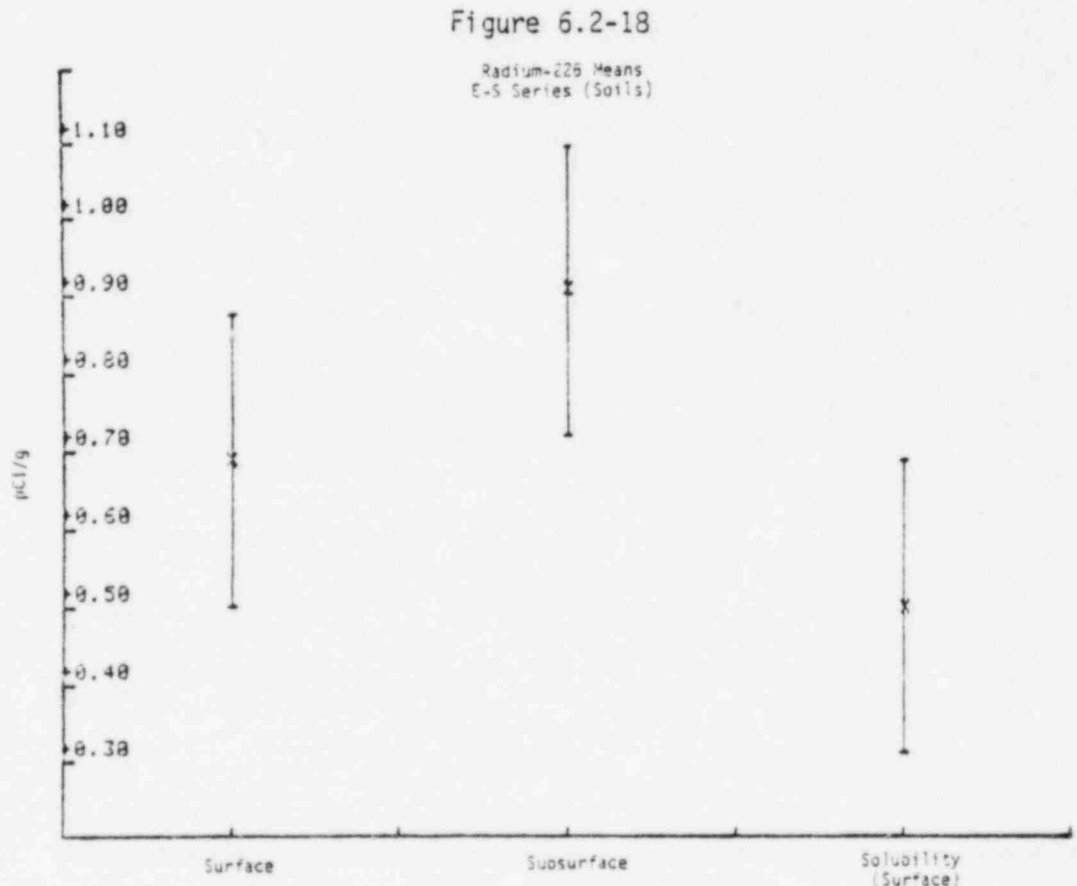


Figure 6.2-17

Radium-226
E-6 Series (Soils)



A comparison of the data illustrating the activity and further supporting the above discussion on radium-226 is presented in Figure 6.2-17. The overall means and confidence interval for each group of samples is illustrated in Figure 6.2-18 and Table 6.2-8. This figure and table illustrate the confidence intervals for the group means which show that the surface and subsurface samples are statistically comparable.



There was no activity due to radium-226 detected in the water solubility test performed on the surface samples.

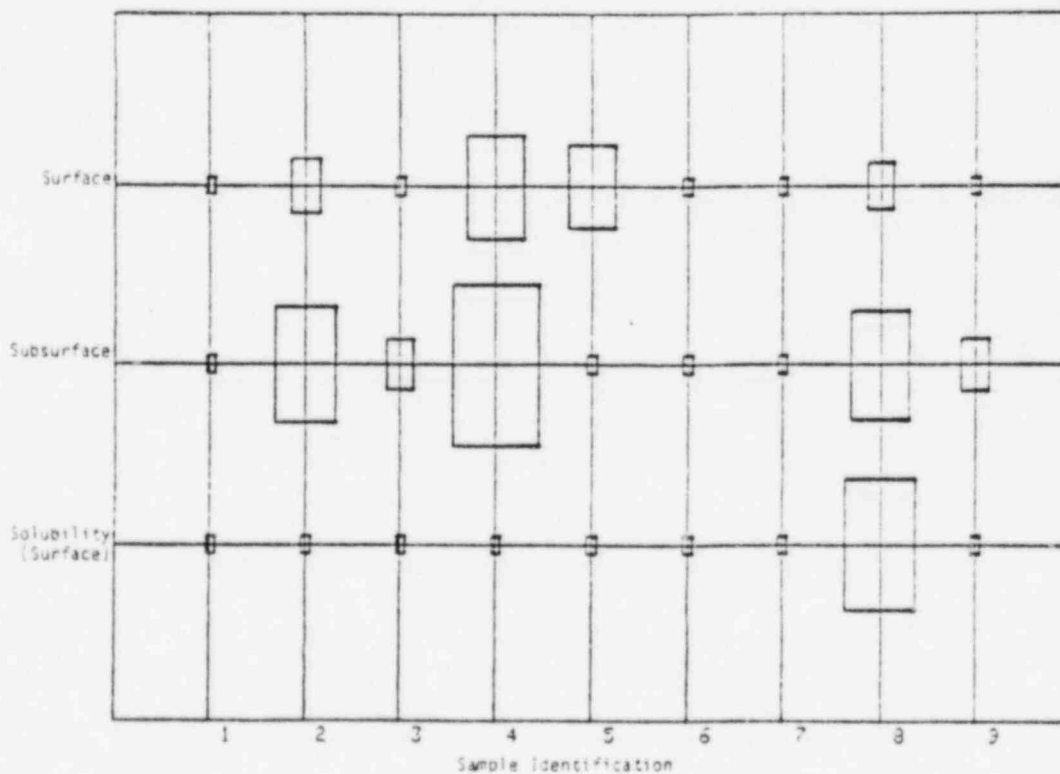
Table 6.2-8
Radium-226 Means and Confidence Interval
E-S Series Soils

	<u>Mean</u>	<u>pCi/gm</u> 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Surface	0.7	0.5	0.9
Subsurface	0.9	0.7	1.1

The range for the maximum relative frequency of occurrence of activity was from less than 0.5 pCi/gm to 0.8 pCi/gm with sixty-seven percent (~67%) of surface and seventy-eight (~78%) subsurface samples reported in this range.

Figure 6.2-19

Radium-228
 E-S Series (Soils)



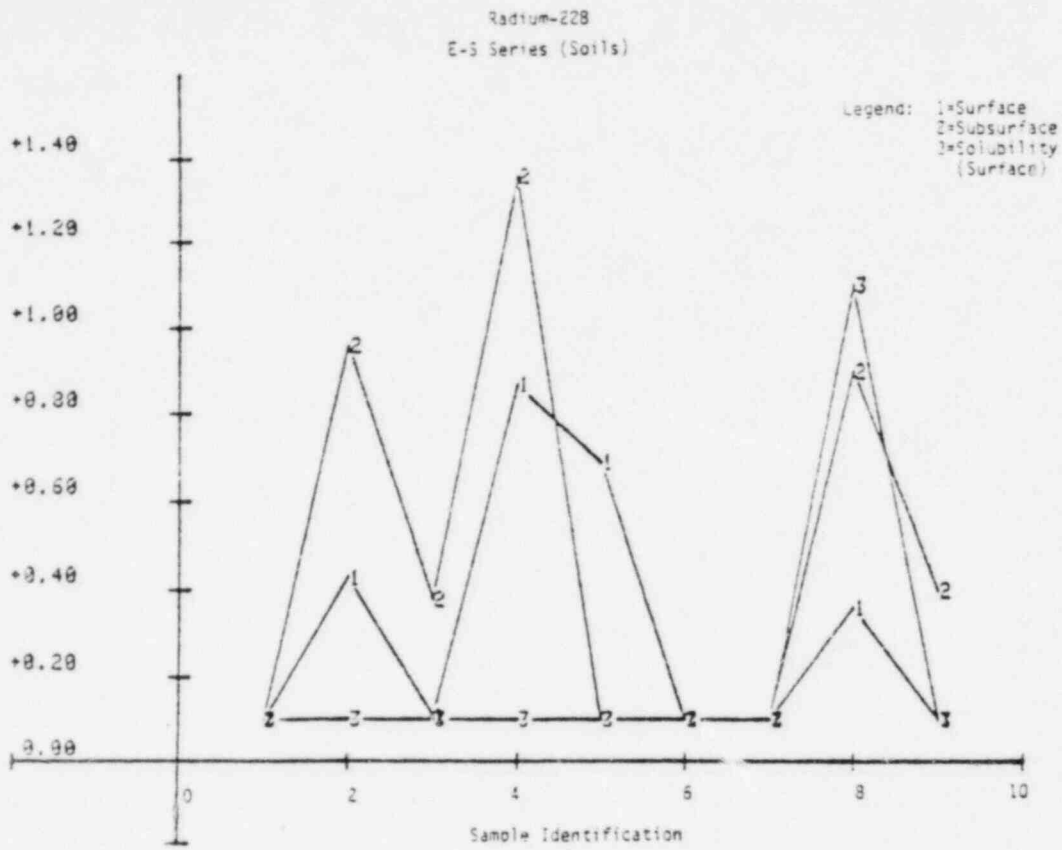
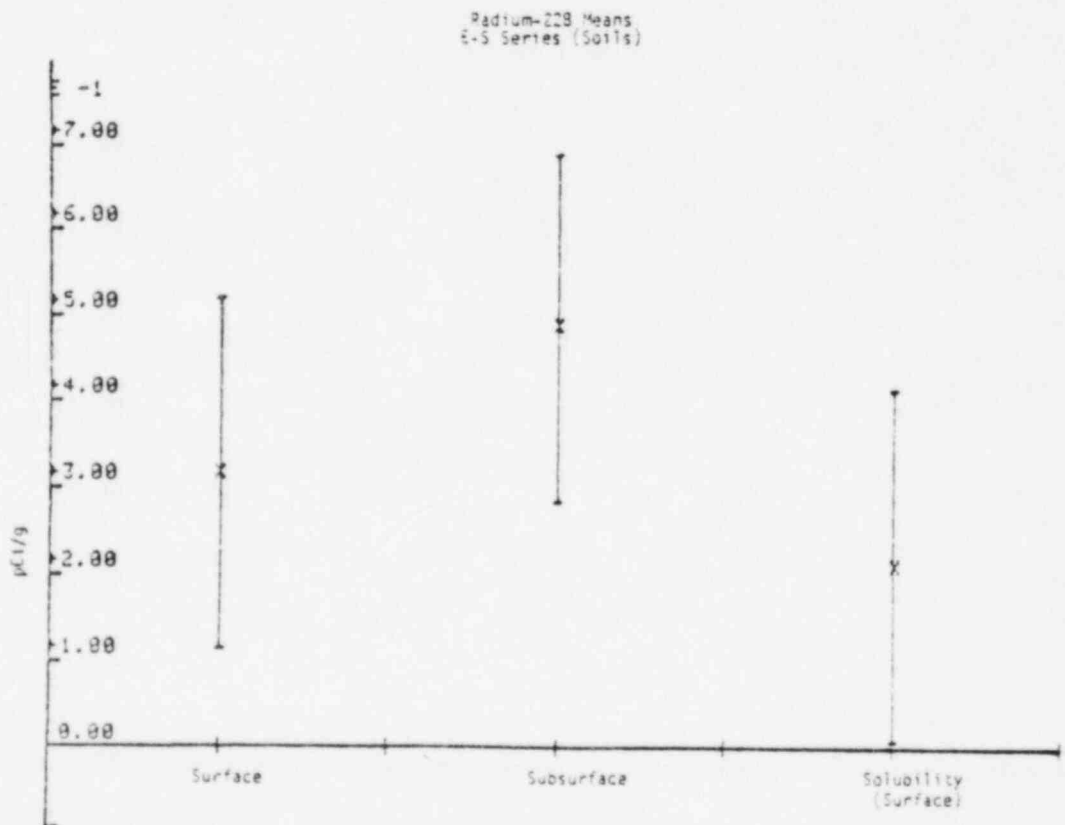


Figure 6.2-20

Figure 6.2-21



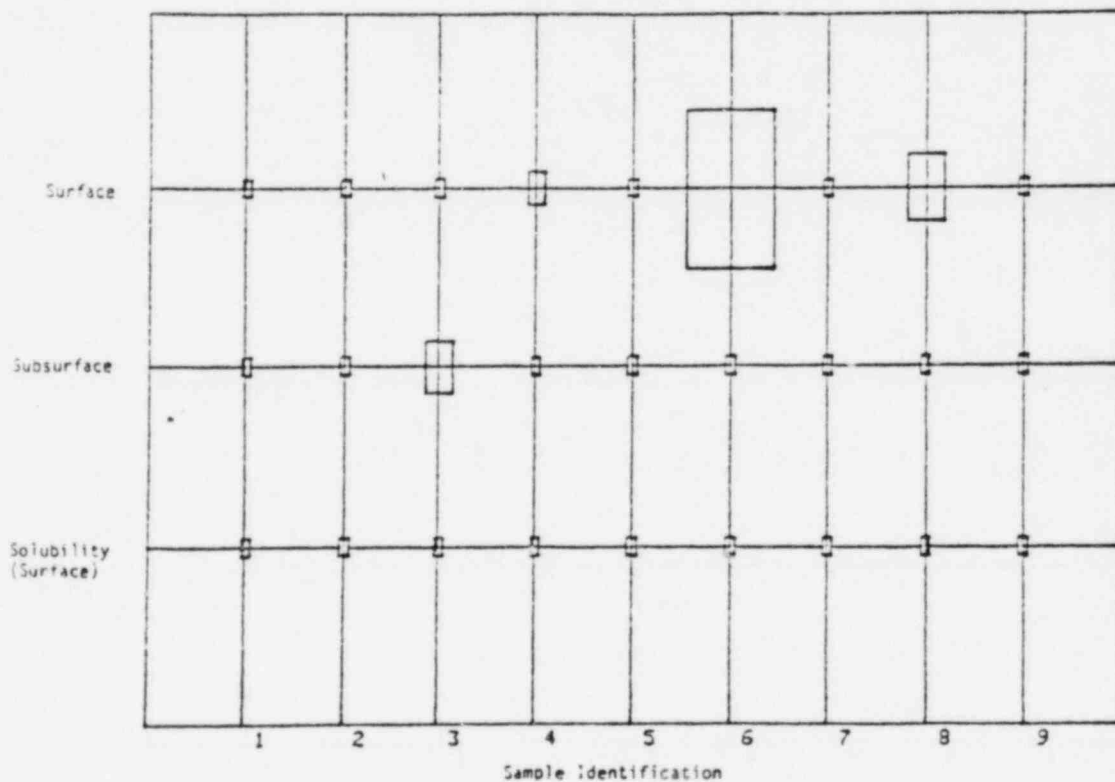
An analysis of the data distribution (Figure 6.2-19) indicates that the radium-228 data does not follow the normal trend observed for the other parameters analyzed. The subsurface results are greater than the surface samples. In addition, the water solubility test for E-08-S was higher than the surface sample tested. The higher activity reported for the water solubility test in E-08-S indicates statistically the same value reported for the surface soil. A graphical representation of this data with respect to activity is illustrated in Figure 6.2-20.

The E-08-S subsurface soil sample was reported at 0.90 ± 0.13 pCi/gm, surface soil sample at 0.36 ± 0.19 pCi/gm and water soluble sample at 1.1 ± 0.13 pCi/gm. Based on this data the values reported for the water solubility test is well within the statistics of the method used. The probability of this occurring again is illustrated in Figure 6.2-23. This is a plot of the mean for each group of data and its respective ninety-five percent (95%) confidence interval. All other samples in this series tested for water solubility were reported at less than 0.1 pCi/gm.

The strontium-90 data is graphically illustrated in Figures 6.2-22 and 6.2-23. The data ranges for the surface and subsurface samples are given in Table 6.2-3. The above mentioned figures illustrate that one of the subsurface samples had a higher activity for strontium-90 than the surface sample. The surface sample was reported at 0.04 ± 0.03 pCi/gm and the subsurface at 0.23 ± 0.11 pCi/gm. However, the mean of activity of the subsurface sample and its ninety-five percent (95%) confidence interval is less than the mean for the surface sample as illustrated in Figure 6.2-24.

Figure 6.2-22

Strontium-90
E-5 Series (Soils)



Strontium-90
E-S Series (Soils)

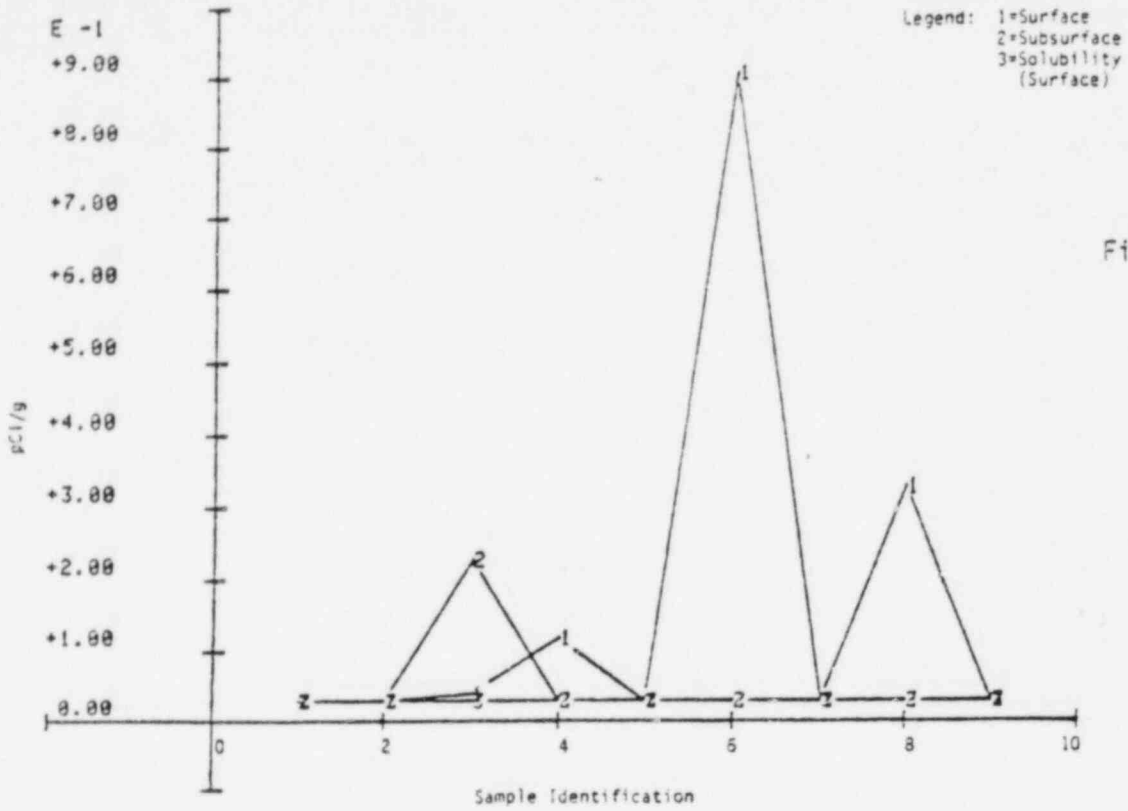


Figure 6.2-23

Strontium-90 Means
E-S Series (Soils)

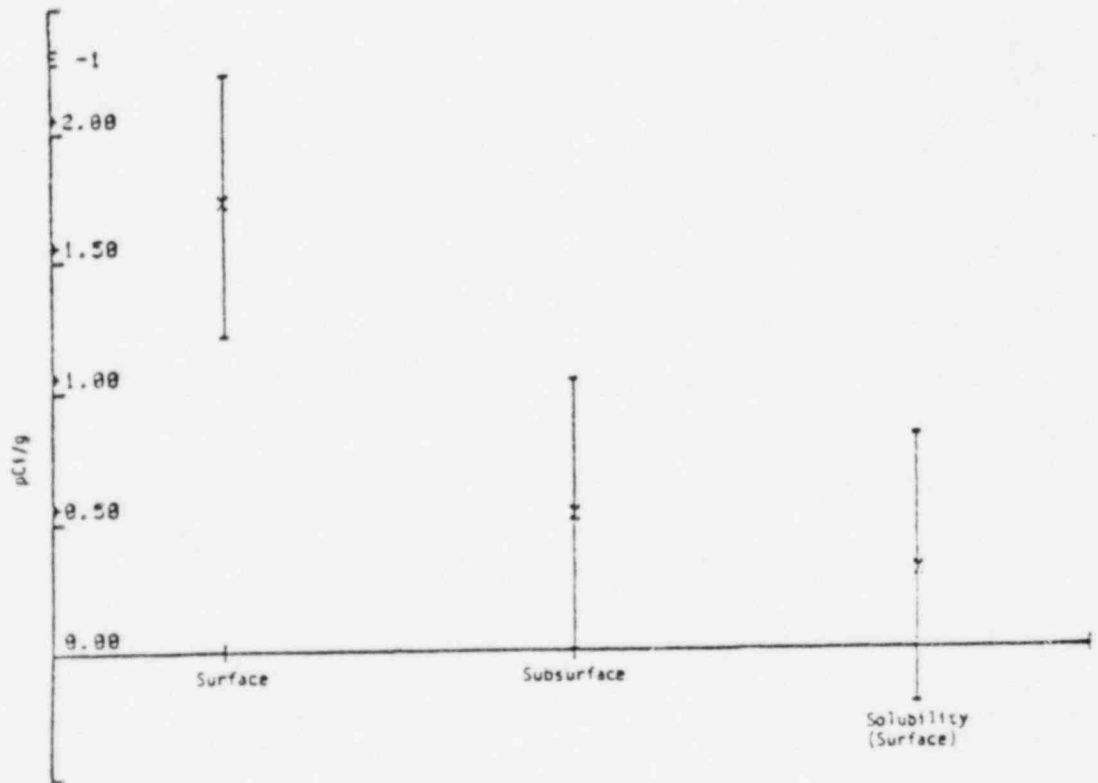


Figure 6.2-24

No strontium-90 was detected above the lower limit of detection of 0.03 pCi/gm for the water solubility tests.

The overall mean and the ninety-five percent (95%) confidence interval for the strontium-90 surface and subsurface samples is presented in Table 6.2-9.

Table 6.2-9
Strontium-90 Means and Confidence Intervals
E-S Series Soils

	<u>Mean</u>	<u>pCi/gm</u> 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Surface	0.17	0.12	0.22
Subsurface	0.05	0.0008	0.1036

A statistical analysis of the isotopic uranium data (U-234, U-235 and U-238) again shows that sample E-04-S-6 (subsurface) has a higher activity than the surface sample. The same distribution of the data is noted for (a) Uranium-234, E-03-S, E-04-S and E-09-S; (b) Uranium-235 for E-02-S, E-04-S and E-07-S; (c) Uranium-238 for E-04-S, E-07-S and E-09-S. Figures 6.2-25 through 6.2-27 illustrates this variance.

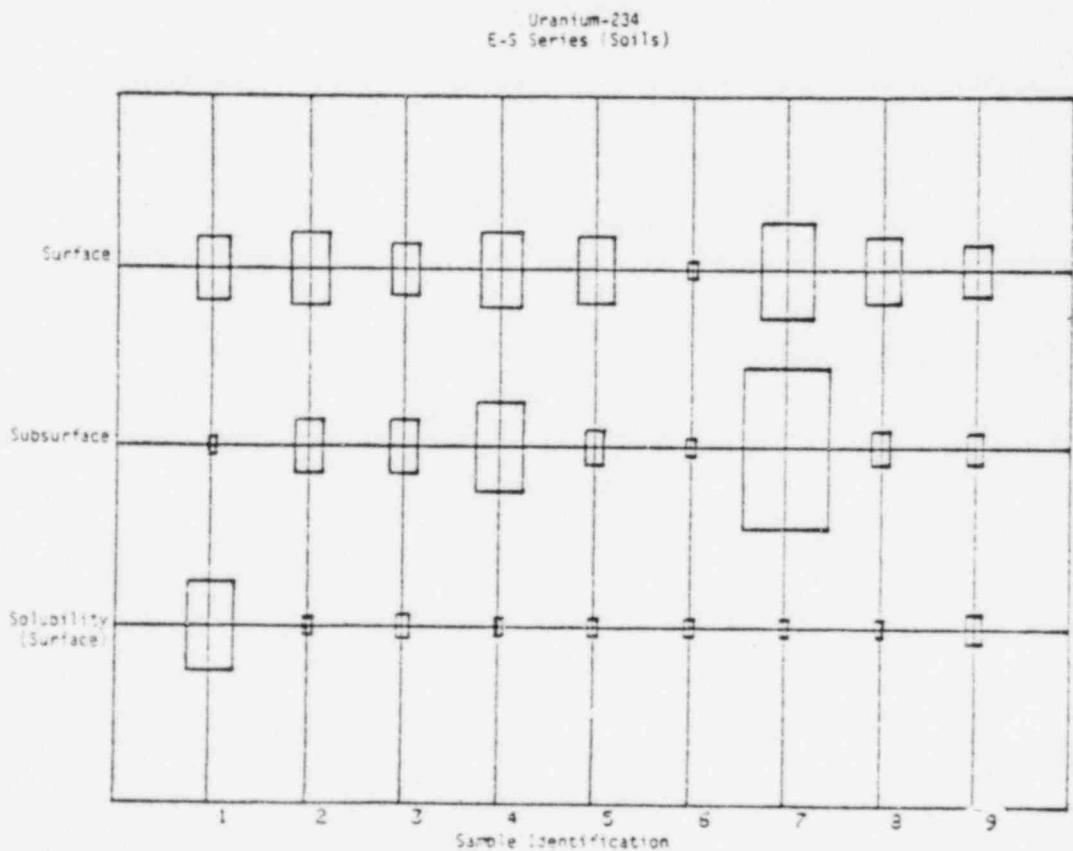


Figure 6.2-25

Uranium-238
E-S Series (Soils)

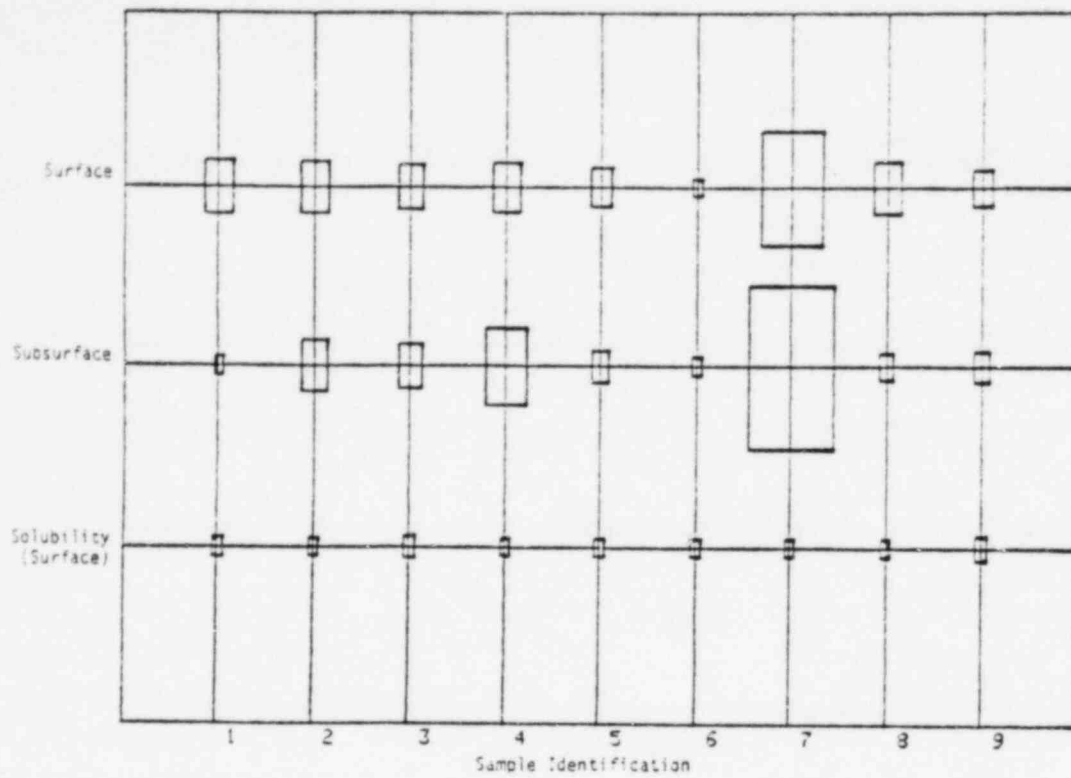


Figure 6.2-26

Uranium-235
E-S Series (Soils)

Figure 6.2-27

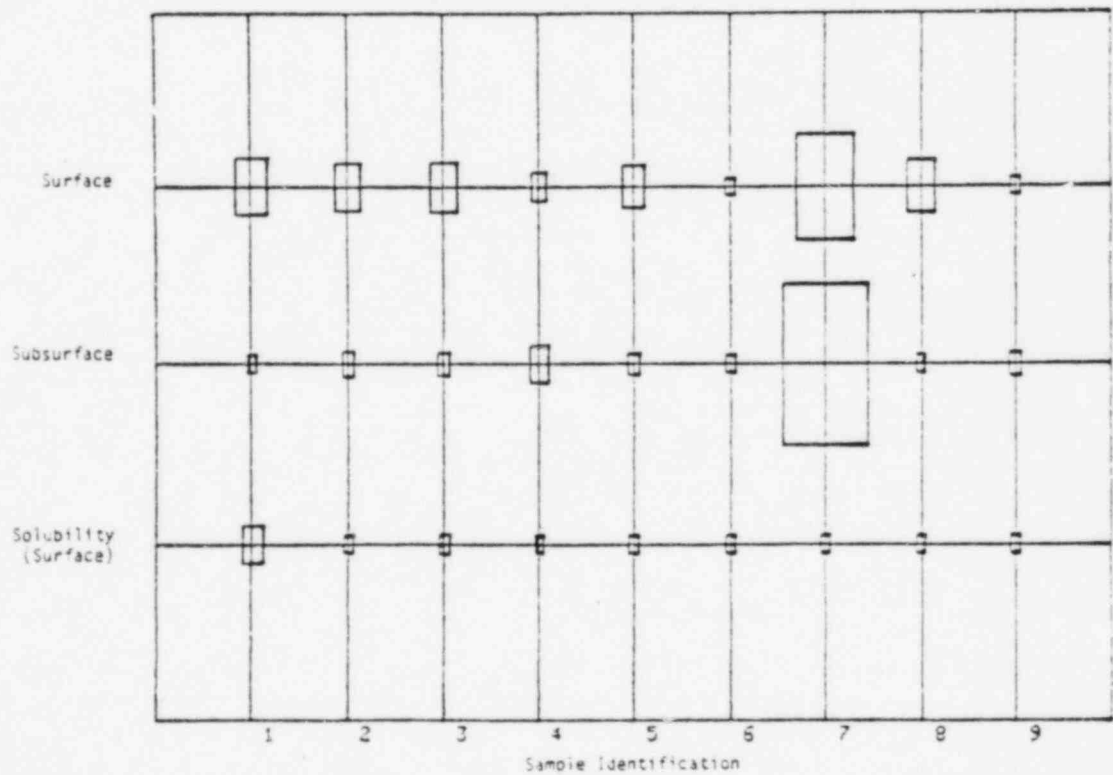
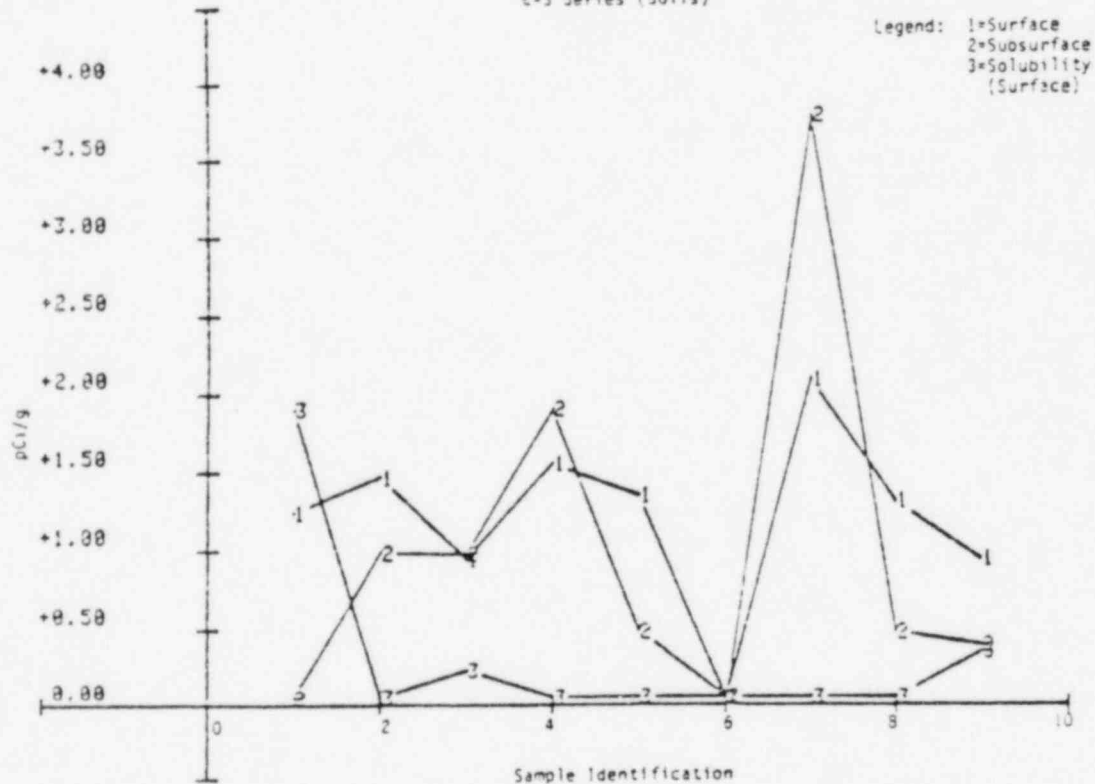


Figure 6.2-25 illustrates that the water solubility test performed on surface sample E-01-S resulted in a higher soluble uranium-234 activity as compared to the surface sample. However, this was not true for uranium-235 and uranium-238 for this test. Other samples in this series indicated that soluble uranium was present. In all cases, with the exception of E-01-S, the activity was reported at less than 0.5 pCi/gm with a lower limit of detection of 0.05 pCi/gm. This data is illustrated in Figures 6.2-28 through 6.2-30.

Figure 6.2-28

Uranium-234
E-S Series (Soils)



Uranium-235
E-S Series (Soils)

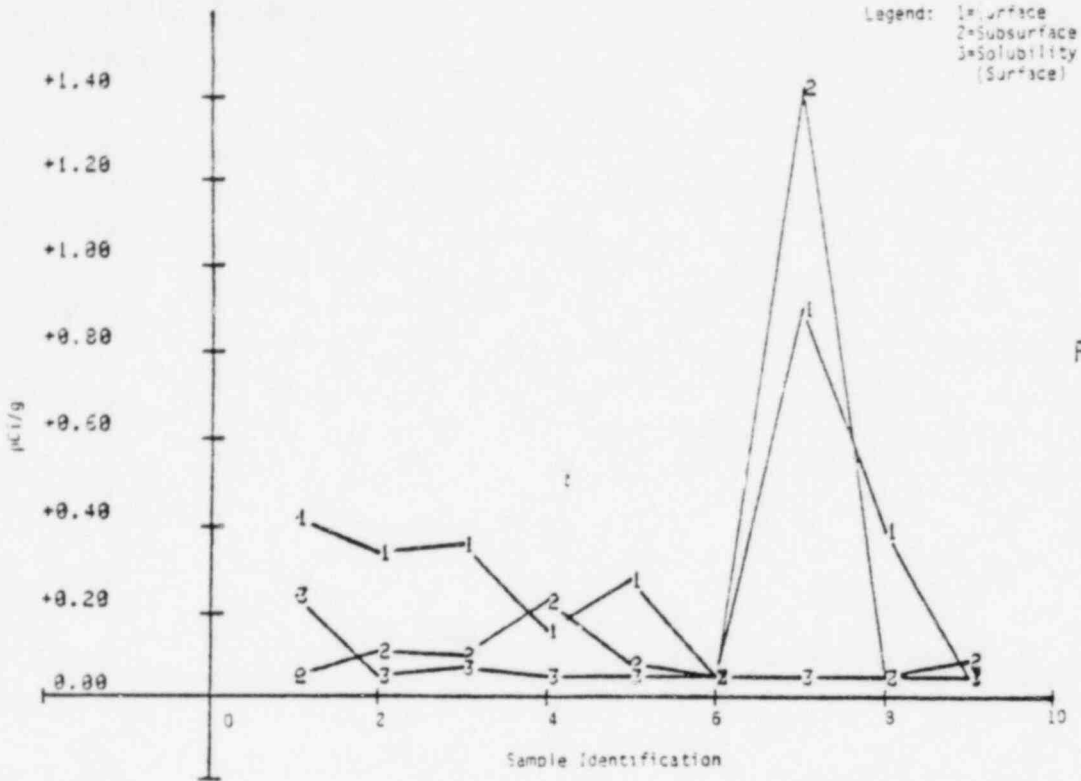


Figure 6.2-29

Uranium-238
E-S Series (Soils)

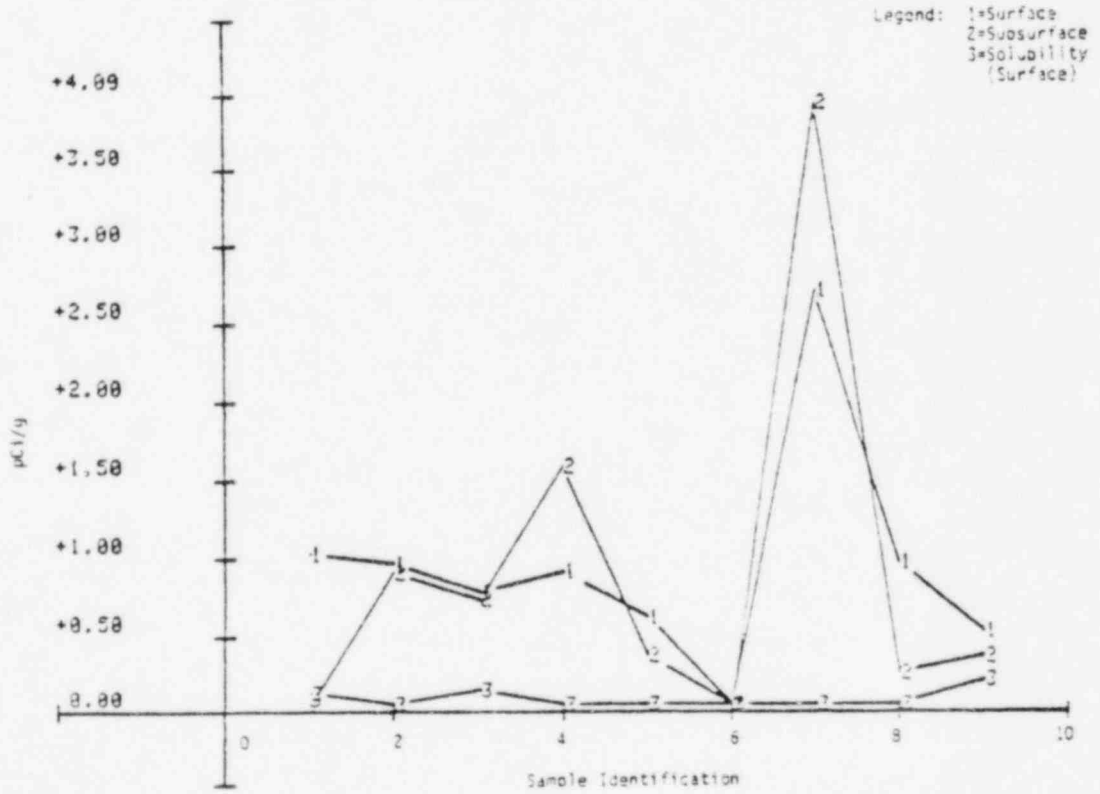


Figure 6.2-30

In addition, it can be said that although a higher activity is reported the results are statistically equal when the analytical error at the ninety-five percent (95%) confidence interval is applied. Figures 6.2-31 through 6.2-32 also illustrate the results to be statistically equal.

Figure 6.2-31

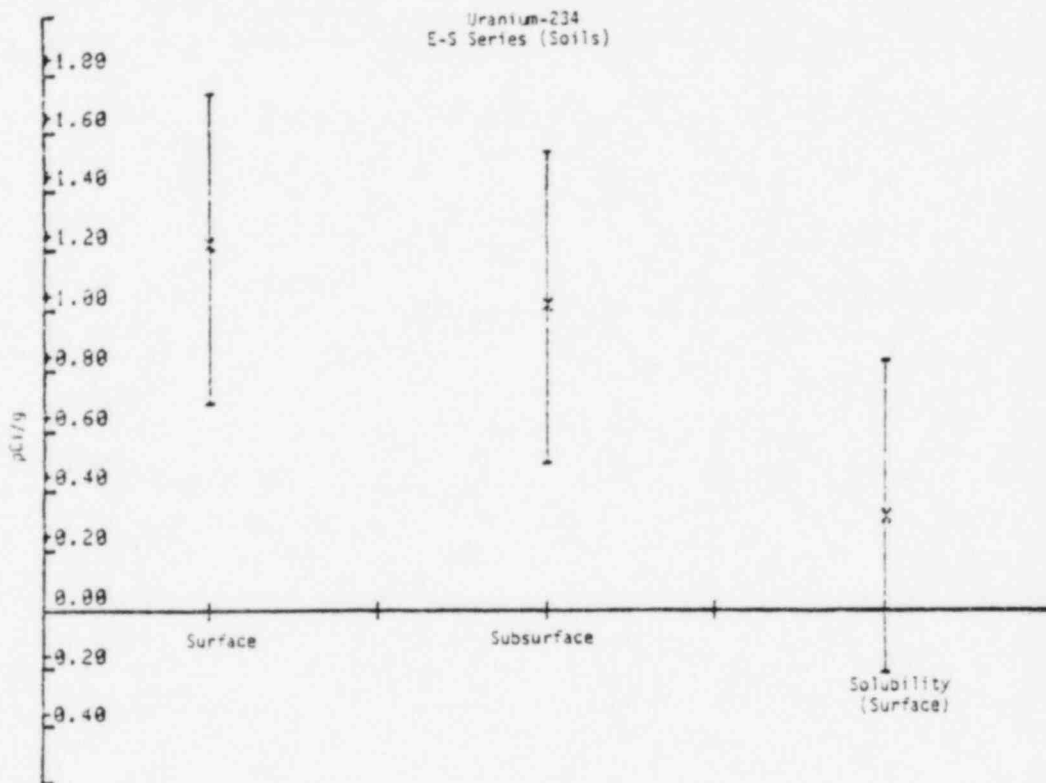
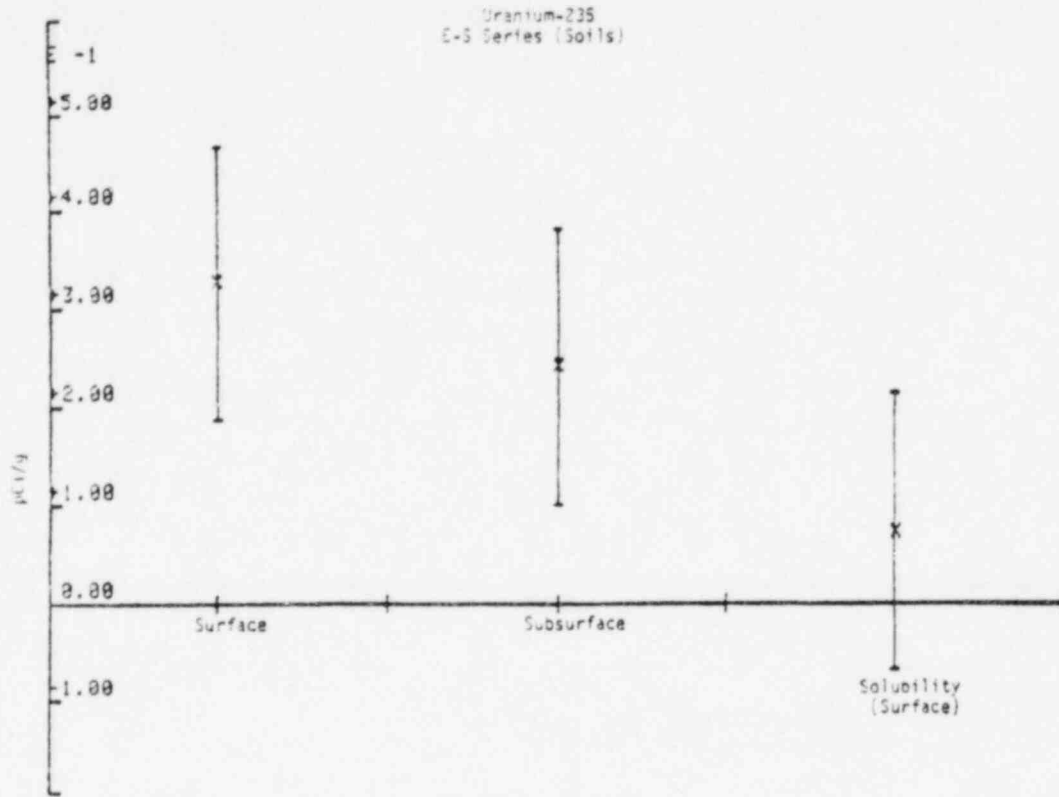


Figure 6.2-32



These figures show that the overall mean for each group of data (surface and subsurface) compare favorably. The intervals are tabulated in Table 6.2-10.

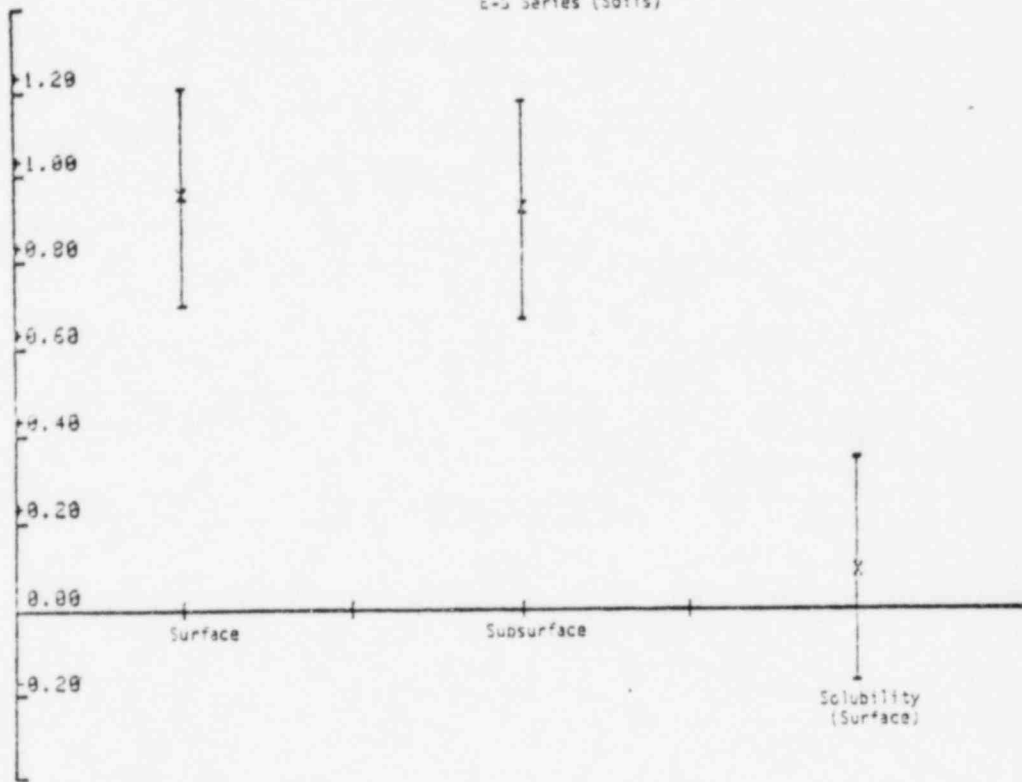
Table 6.2-10

Uranium Means and Confidence Intervals
E-S Series Soils

<u>Parameter</u>	<u>Mean</u>	<u>pCi/gm</u> <u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Lower Limit</u>
Uranium-234			
Surface	1.22	0.69	1.74
Subsurface	1.02	0.49	1.54
Uranium-235			
Surface	0.33	0.19	0.47
Subsurface	0.24	0.10	0.38
Uranium-238			
Surface	0.95	0.70	1.21
Subsurface	0.92	0.66	1.18

Figure 6.2-33

Uranium-238
E-S Series (Soils)



Thorium-230
E-S Series (Soils)

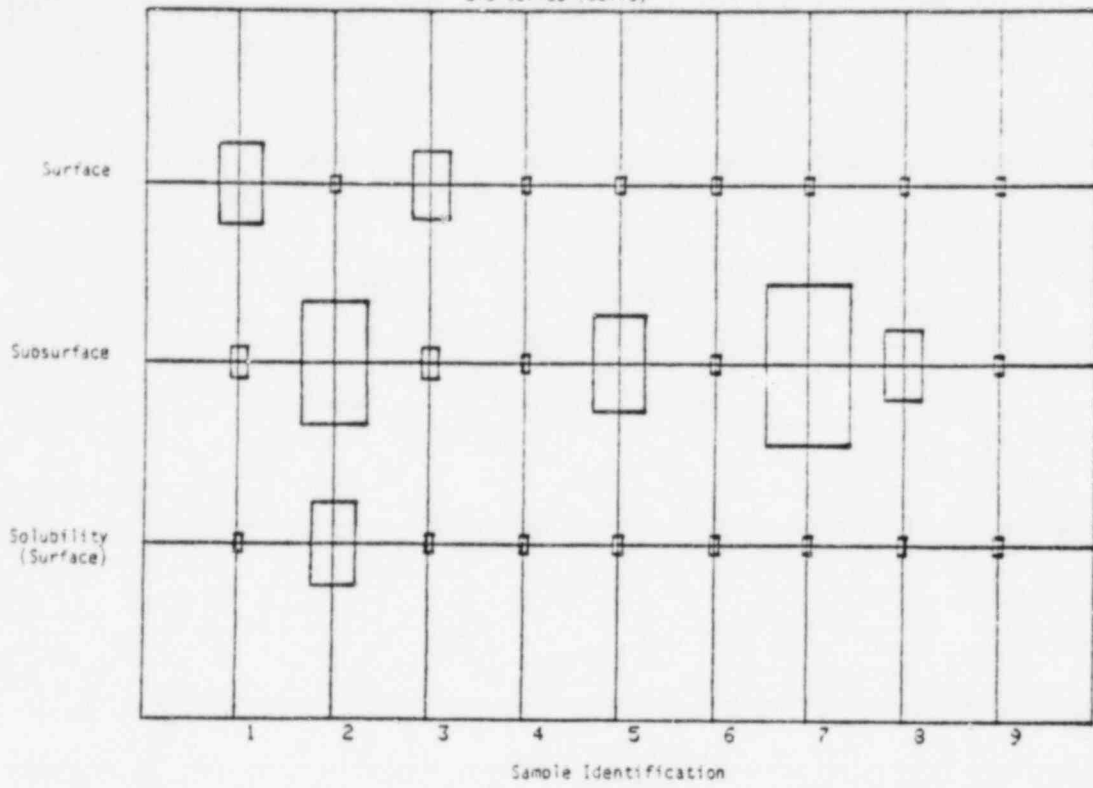


Figure 6.2-34

Thorium-230
E-S Series (Soils)

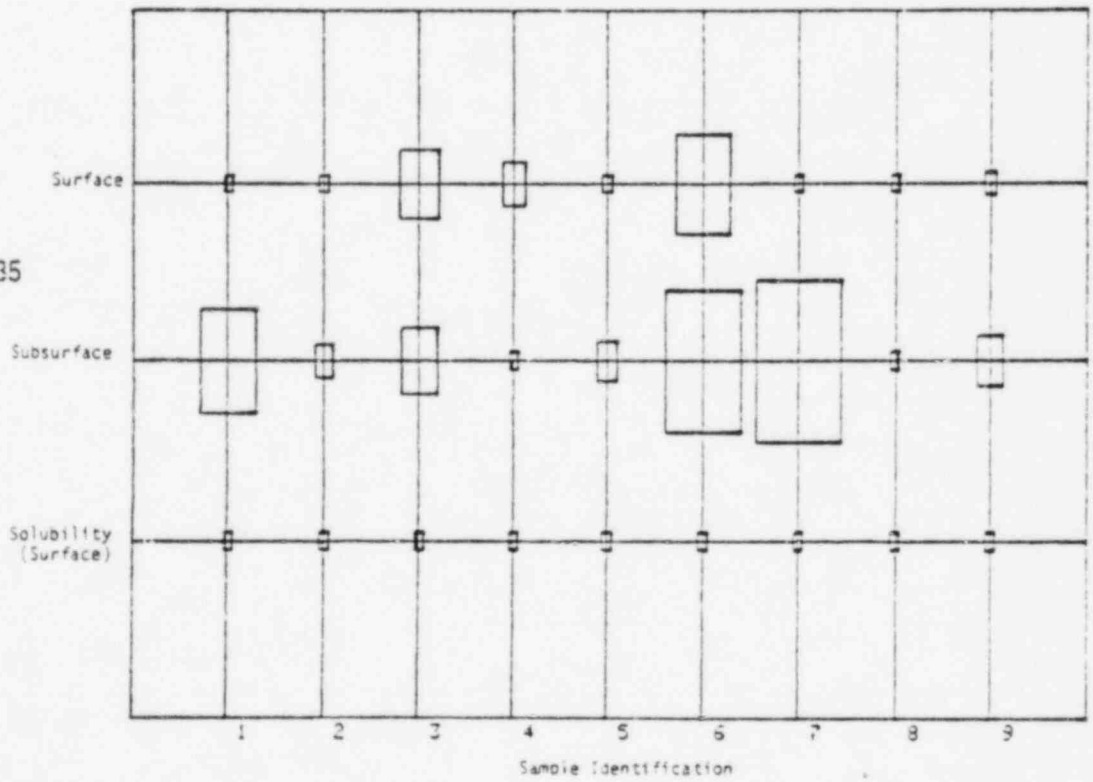


Figure 6.2-35

Thorium-232
E-S Series (Soils)

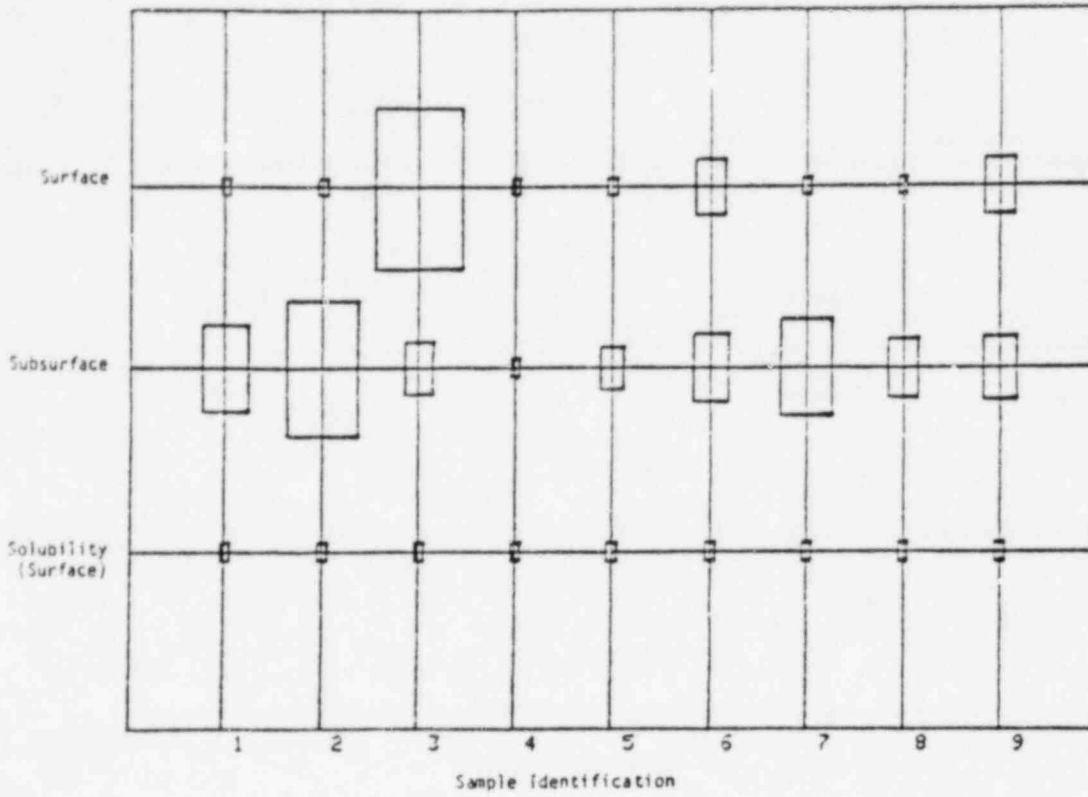


Figure 6.2-36

Thorium-228
E-S Series (Soils)

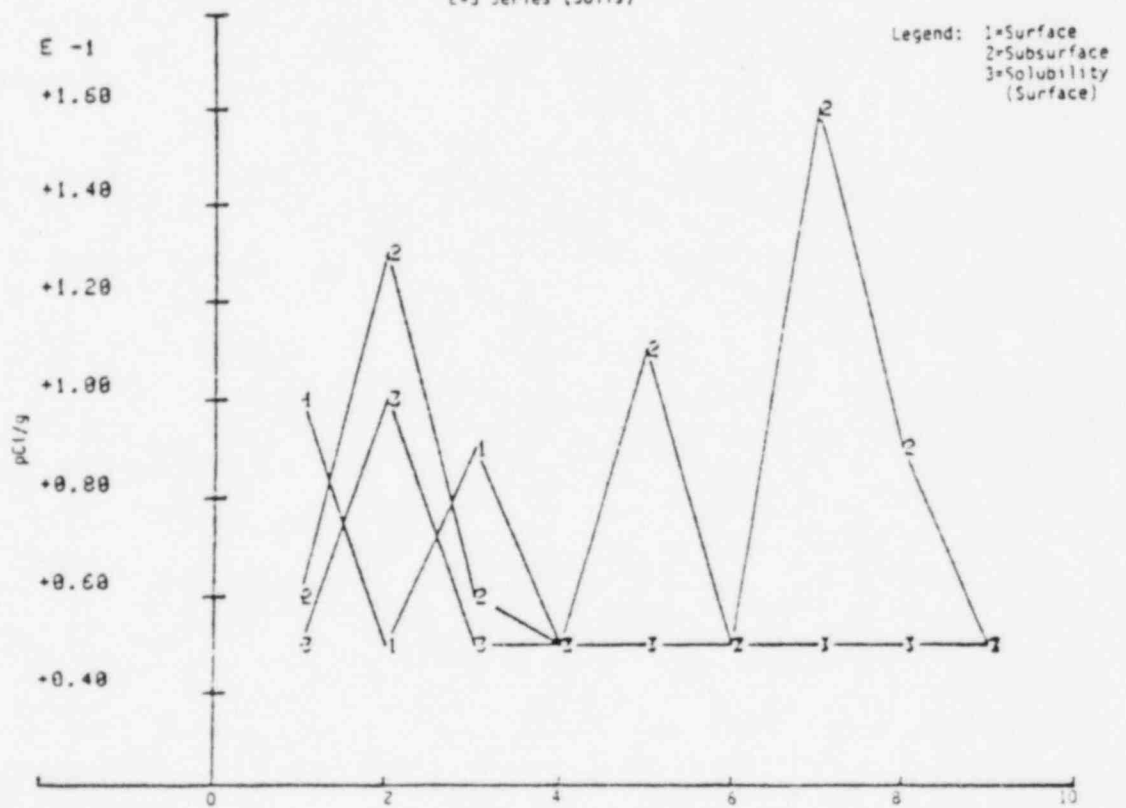
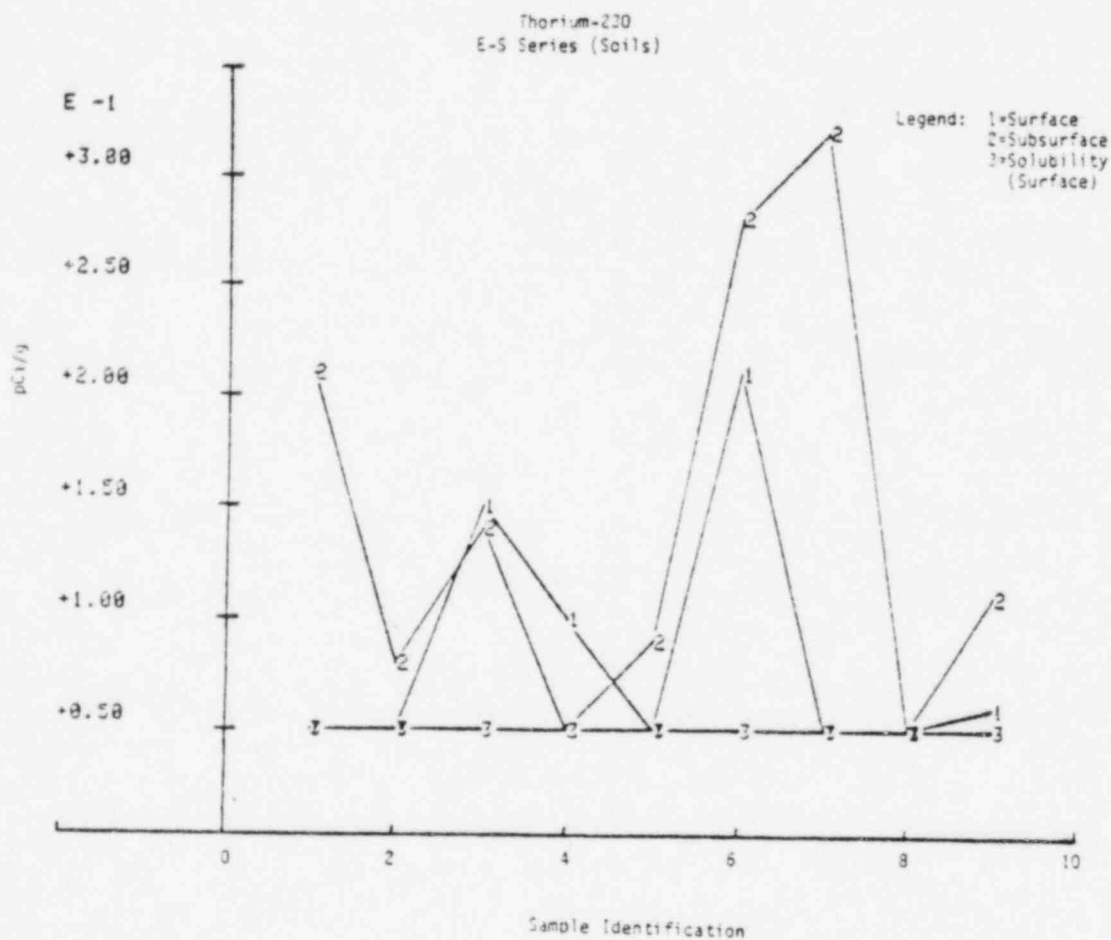


Figure 6.2-37

A graphical plot of thorium data showing a variance with respect to the reported activity is presented in Figure 6.2-34 through 6.2-39. These figures illustrate that, unlike the isotopic uranium and other parameters discussed above, the activity variation is much greater (subsurface versus surface samples).

Figure 6.2-38



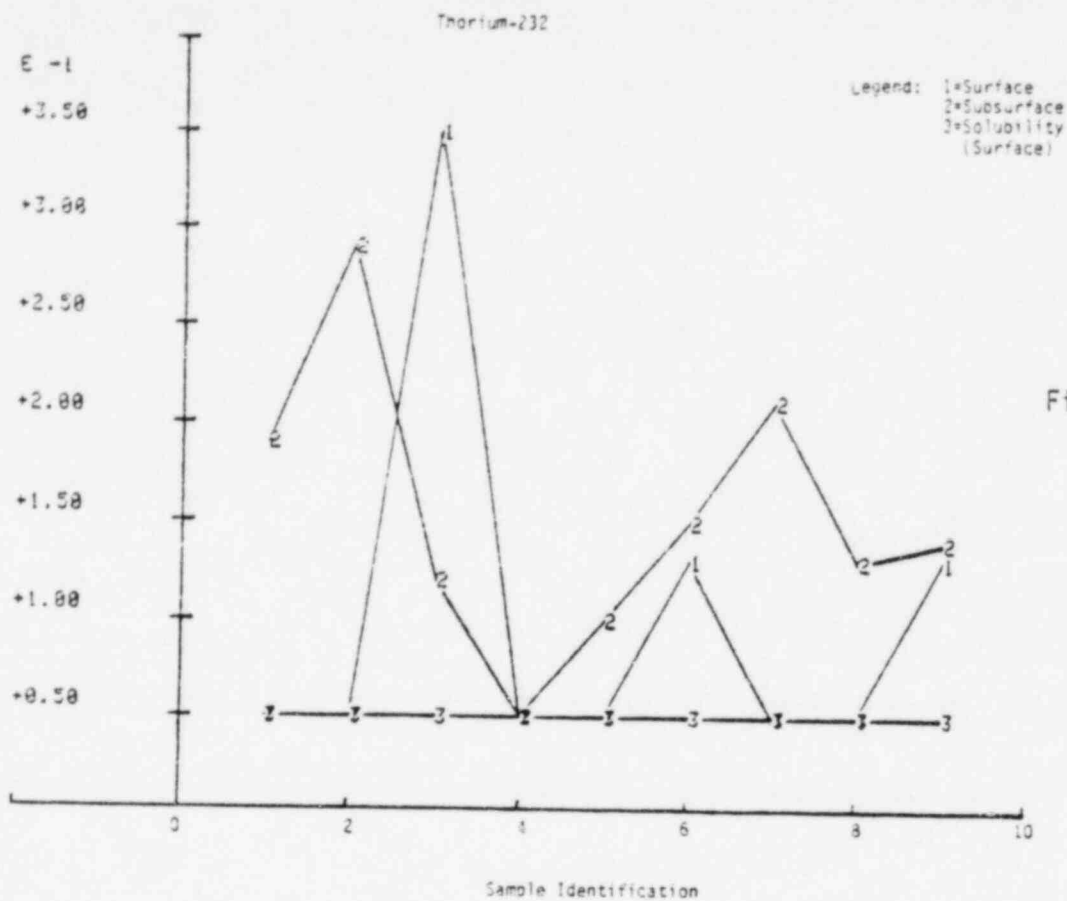
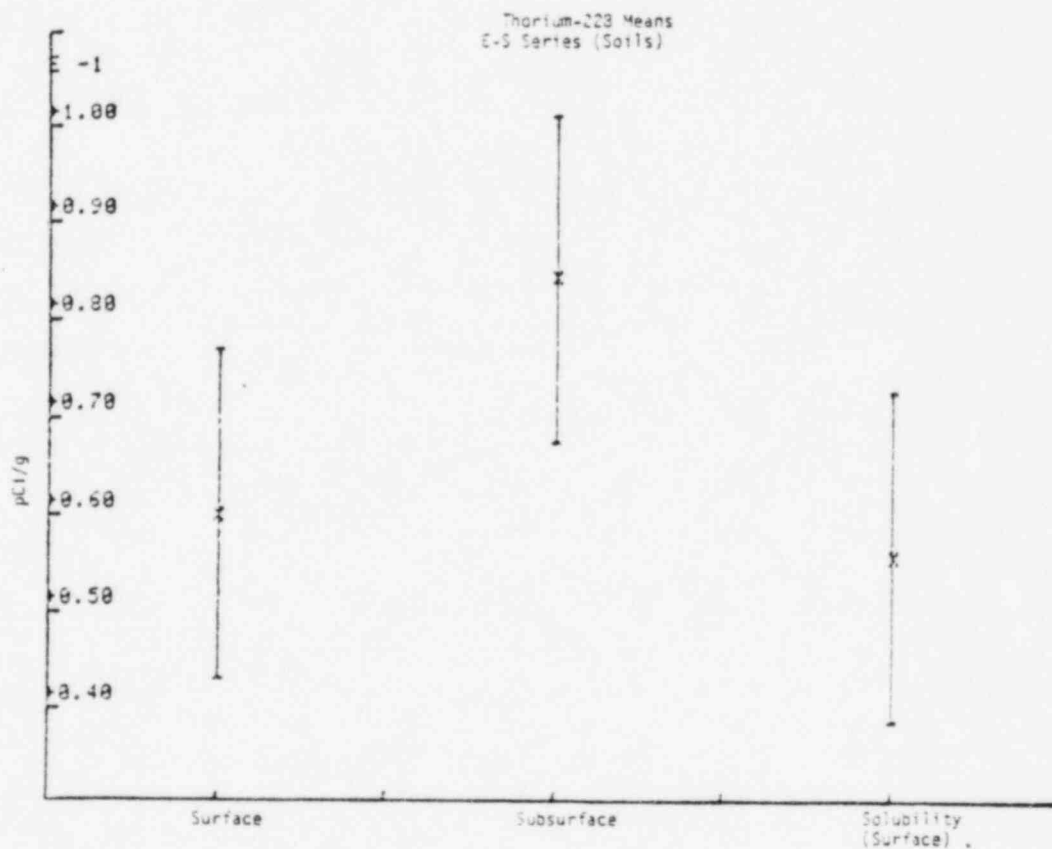


Figure 6.2-39

Figure 6.2-40



In general, the water solubility was reported at less than 0.05 pCi/gm with the exception of E-01-S, E-02-S and E-09-S. These samples were above detection limit (0.05 pCi/gm). This data is graphically illustrated in Figures 6.2-38 through 6.2-40.

The same trend of higher activity (isotopic uranium) for the subsurface samples versus surface samples is noted for isotopic thorium results. In this case subsurface samples, E-05-S, E-07-S and E-08-S for thorium-228, E-01-S, E-03-S, E-05-S, E-06-S and E-07-S for thorium-230, and E-01-S, E-05-S, E-06-S, E-07-S and E-08-S for thorium-232 were higher than surface samples. This trend is illustrated in Figures 6.2-34 through 6.2-36.

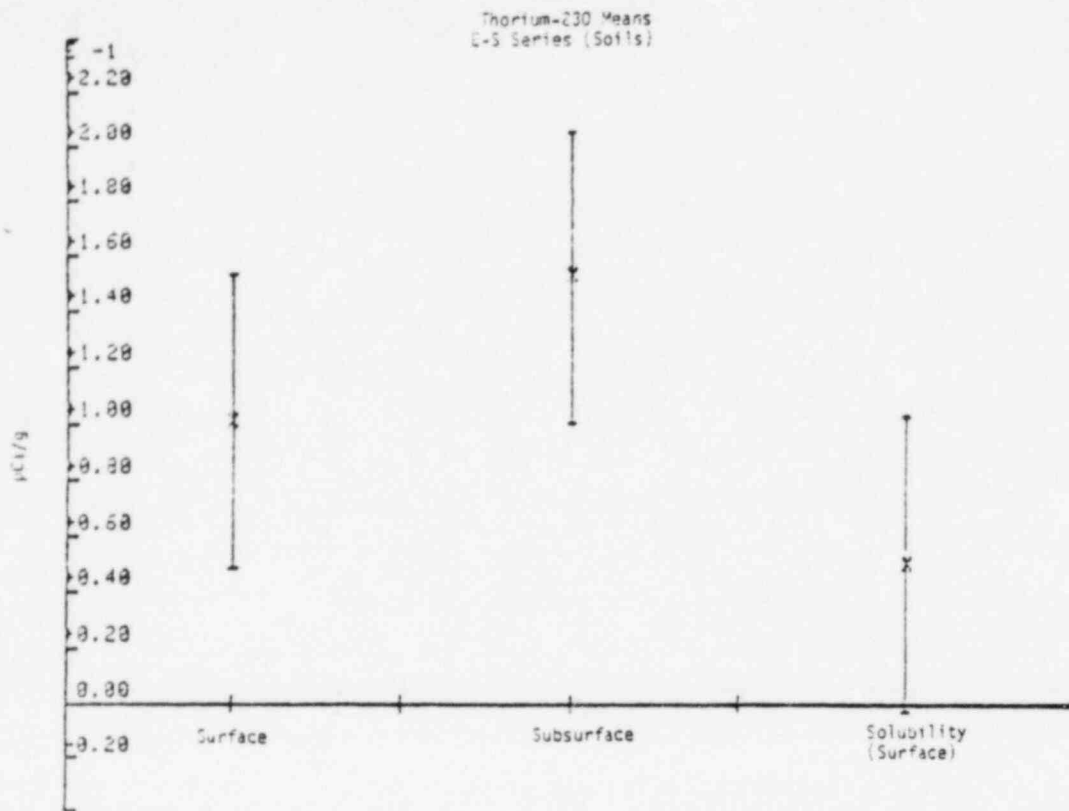
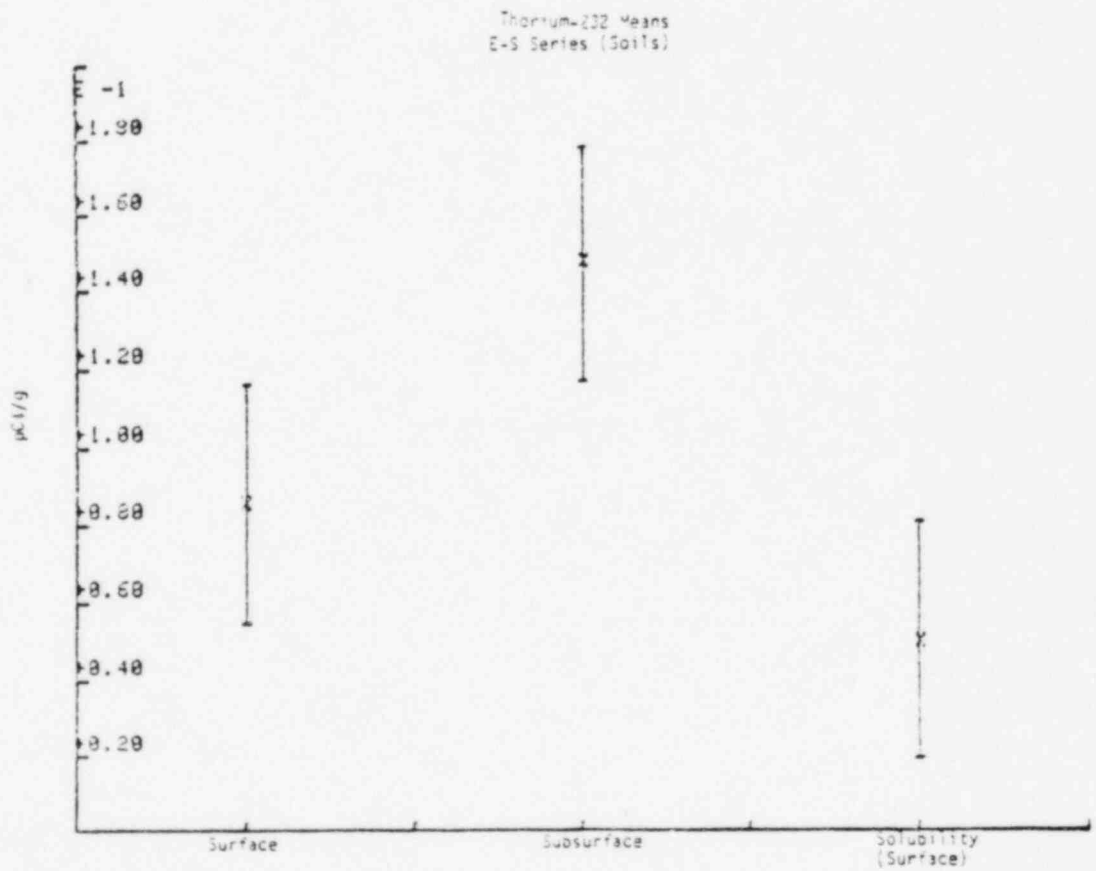


Figure 6.2-41

Figure 6.2-42



Figures 6.2-40 through 6.2-42 illustrate the overall means for each group of thorium data. The figures show that for thorium-228 and thorium-232 the overall means for the subsurface samples are statistically greater than the surface mean. Thorium-230 shows an increase in the subsurface activity which could be attributed to the high uranium-234 activity (uranium series $4n \pm 2$).

The means and ninety-five percent (95%) confidence interval for isotopic thorium are tabulated in Table 6.2-11.

Table 6.2-11
Thorium Means and Confidence Intervals
E-S Series Soils

<u>Parameter</u>	<u>Mean</u>	<u>pCi/gm</u> <u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Thorium-228			
Surface	0.07	0.04	0.08
Subsurface	0.08	0.07	0.10
Thorium-230			
Surface	0.08	0.05	0.12
Subsurface	0.15	0.12	0.13
Thorium-232			
Surface	0.10	0.05	0.15
Subsurface	0.15	0.10	0.20

Figures 6.2-43 through 6.2-45 illustrate the distribution of cesium-137 activity. In Figures 6.2-43 and 6.2-44 it may readily be seen that both the surface and subsurface samples contained activity. However, statistically the surface sample activity was greater than the subsurface. This type of distribution would be expected since cesium-137 has high solubility characteristics and does not migrate readily. It is noted that the water solubility test data was reported at the lower limit of detection (0.08 pCi/gm).

Cesium-137
E-S Series (Soils)

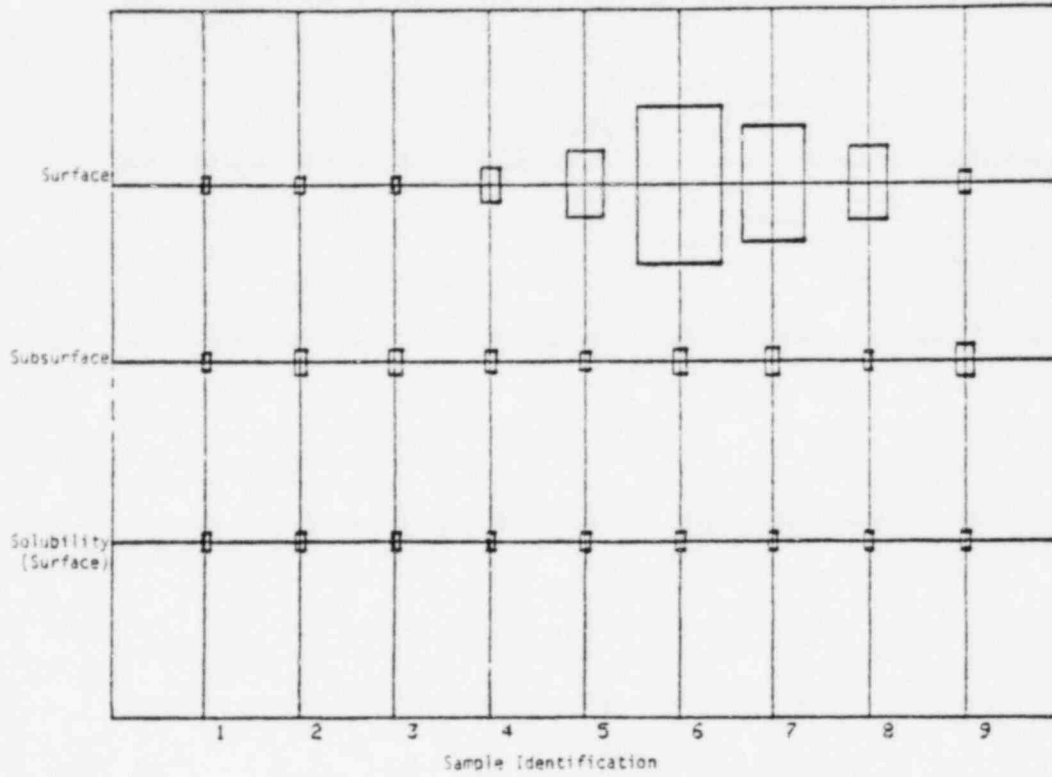


Figure 6.2-43

Cesium-137
E-S Series (Soils)

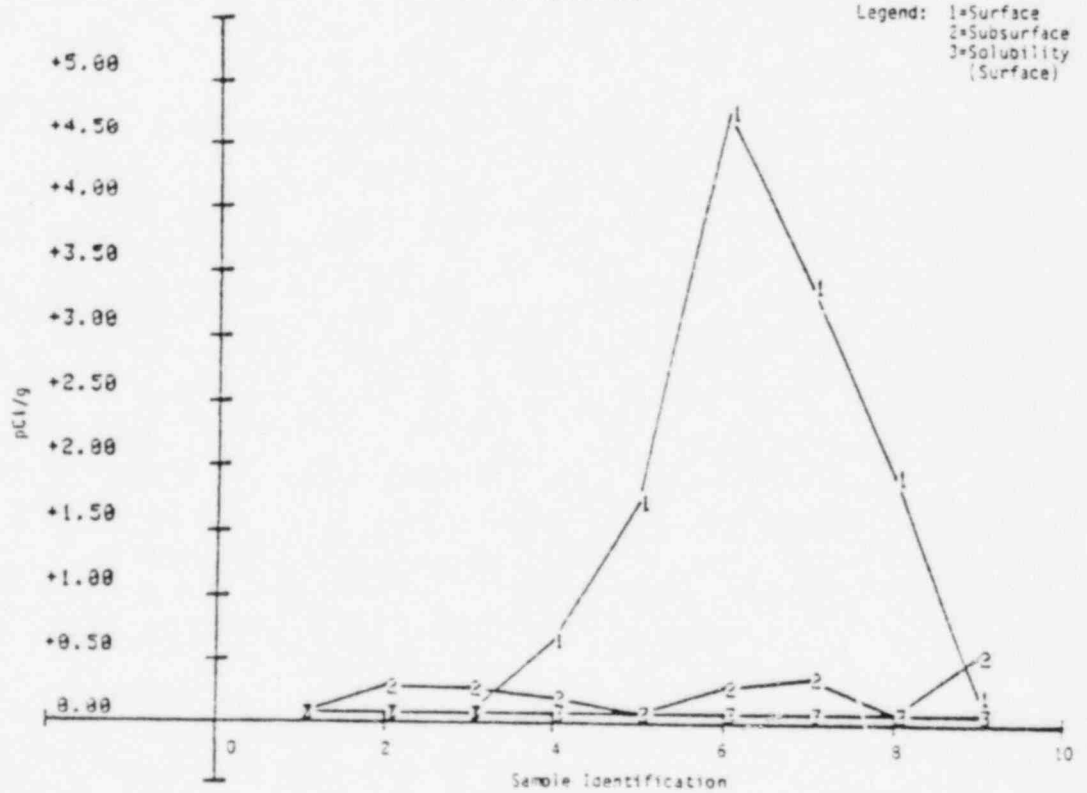


Figure 6.2-44

Table 6.2-12

	<u>Gross Alpha</u> <u>pCi/gm</u>	<u>Gross Beta</u> <u>pCi/gm</u>	<u>Ra-226</u> <u>pCi/gm</u>	<u>Ra-228</u> <u>pCi/gm</u>	<u>Sr-90</u> <u>pCi/gm</u>	<u>U-234</u> <u>pCi/gm</u>	<u>U-235</u> <u>pCi/gm</u>	<u>U-238</u> <u>pCi/gm</u>	<u>Th-228</u> <u>pCi/gm</u>	<u>Th-230</u> <u>pCi/gm</u>	<u>Th-232</u> <u>pCi/gm</u>	<u>Cs-137</u> <u>pCi/gm</u>
Mean =	2.5	5.4	0.6	1.08	0.49	1.83	0.26	0.92	0.05	0.06	0.06	4.02
Variance =	4.5	10.1	0.02	0.07	0.57	4.29	0.04	0.18	0.001	0.002	0.0002	15.16
Std Dev =	2.4	3.7	0.14	0.32	0.87	2.39	0.22	0.49	0.02	0.02	0.006	4.49
Data Min =	0.3	2.1	0.5	0.82	0.03	0.50	0.05	0.39	0.05	0.05	0.05	0.89
Data Max =	5.9	10.	0.8	1.50	1.80	5.42	0.51	1.57	0.08	0.08	0.06	10.4
Data Range =	5.6	7.9	0.3	0.68	1.77	4.92	0.46	1.18	0.03	0.03	0.01	9.51

Figure 6.2-45

Cesium-137 Means
E-5 Series (Soils)

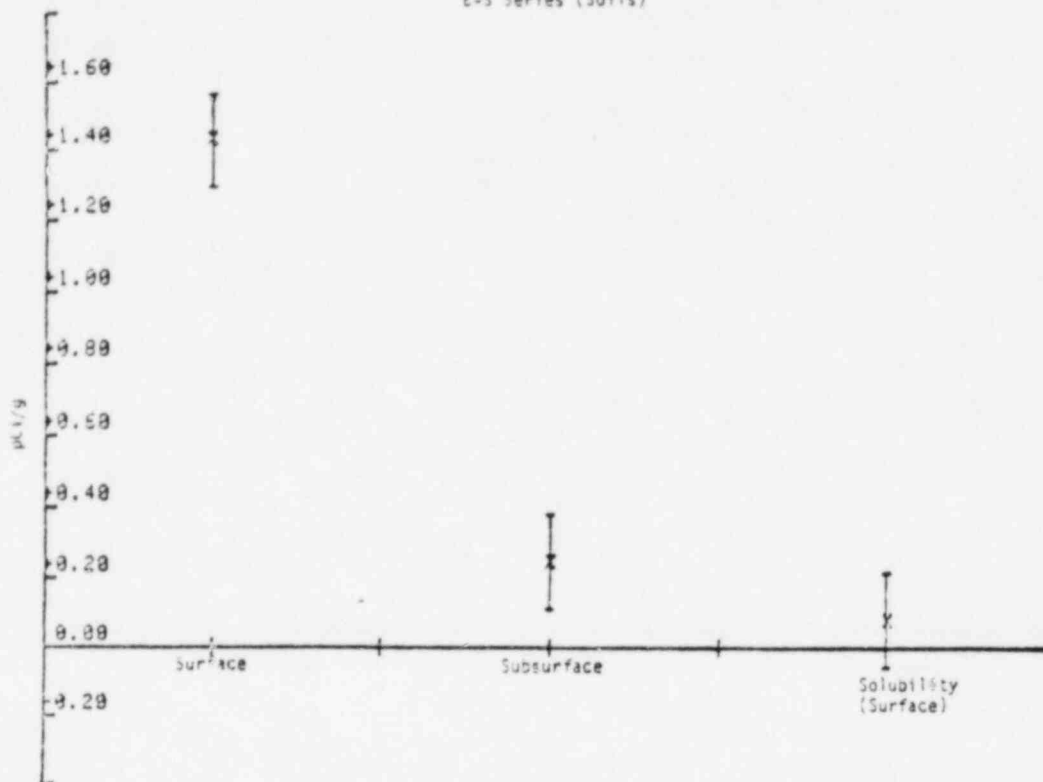


Figure 6.2-45 is a graphical representation of the means with the ninety-five percent (95%) confidence interval for the data reported. It can be concluded from this representation that if any cesium-137 is to be detected it will be in the surface samples.

Four additional background samples were collected and labeled as NRC Bkg X and NRC Bkg Y. The results reported for these samples are presented in Appendix "D". Table 6.2-12 is a statistical tabulation. A comparison of this table with Table 6.2-3 indicates the two (2) set of results are statistically unequal, with the exception of gross beta, uranium-235, uranium-238, thorium-228 and thorium-230.

A comparison of the statistical summaries in Table 6.2-11 and the pre-operational backgrounds (Table 6.2-2) indicates that the gross alpha activity is lower for the decommissioning samples. However, the gross beta and uranium activity is higher than the pre-operational sampling data gathered in 1963. (See Table 6.2-2).

It may be concluded from this evaluation of background data that variation is to be expected. However, this data does provide a statistical basis from which conclusions can be drawn for the soils to be discussed in the following section.

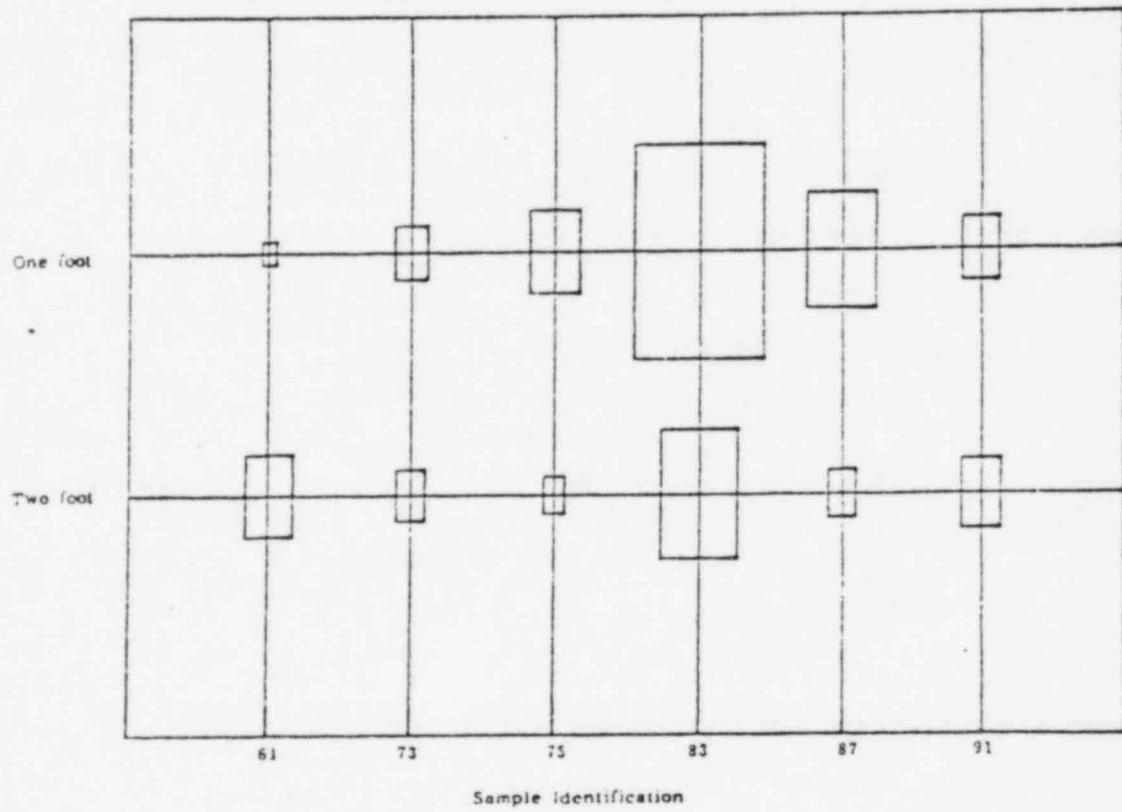
6.3 D-D Core Samples (Beneath Macadam Cores)

After collection of macadam core samples, soil core samples were collected from underneath each macadam sampling station. The depth interval was one (1) and two (2) foot intervals.

The D-D series core samples have a higher activity than those reported for the L-X core samples. Figure 6.3-1 is a rectangular plot illustrating the distribution of the gross alpha data.

Figure 6.3-1

Gross Alpha
D-D Series (Soil Cores)
Analysis of Variance



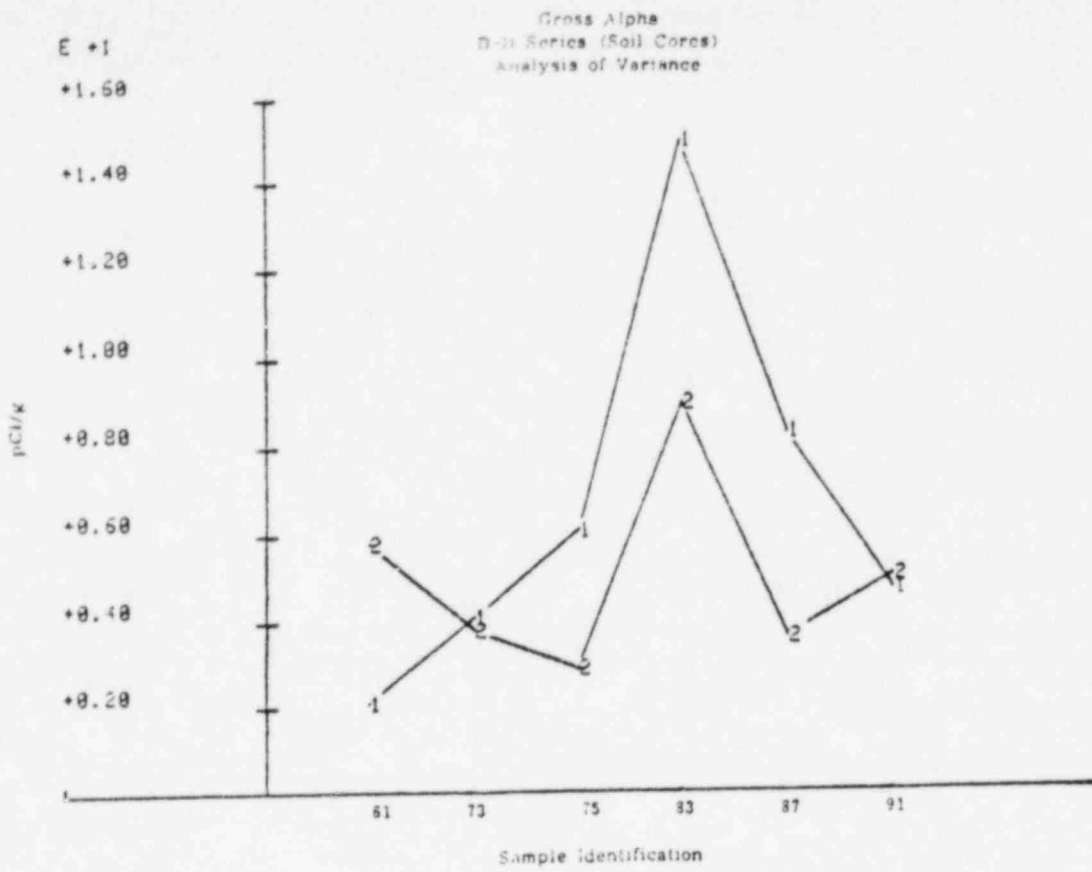
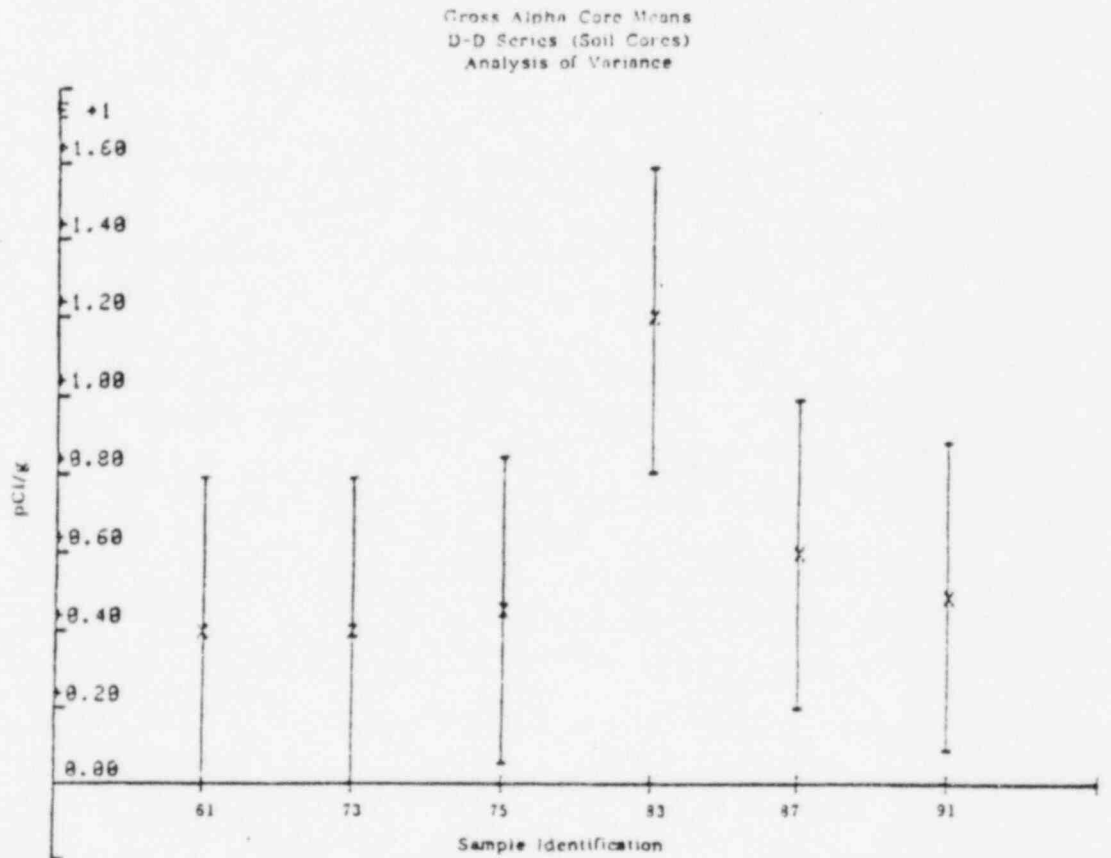


Figure 6.3-2

Figure 6.3-3



This plot shows that all one (1) foot core samples have a higher activity than the two (2) foot cores, with the exception of station D-61-0. The overall gross alpha mean was 6.7 pCi/gm with lower and upper limits at the 95% confidence interval of 4.4 pCi/gm and 9.0 pCi/gm, respectively. Figure 6.3-2 illustrates the data showing the variance in activity between the one and two foot cores. Both core samples follow the same trend with the exceptions of D-61-0 and D-91-0 where data for the two foot core is greater than the one foot core. However, it must be noted that D-73-0 and D-91-0 are statistically equal in activity. The column means and their respective 95% Confidence Intervals are illustrated in figure 6.3-3 and presented in Table 6.3-1.

Table 6.3-1
Gross Alpha Core Means

<u>D-D Series Cores</u>			
<u>Analysis of Variance</u>			
<u>Core</u>	<u>Mean</u>	<u>pCi/gm</u>	
		<u>95% Confidence Lower Limit</u>	<u>95% Confidence Upper Limit</u>
One Foot	6.7	4.4	9.0
Two foot	5.0	2.7	7.3

<u>Sample</u>	<u>Mean</u>	<u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Upper Limit</u>
61	3.9	-0.01	7.91
23	3.9	-0.01	7.91
25	4.5	0.53	8.46
83	12.0	8.03	15.96
87	5.9	1.98	9.91
91	4.8	0.88	8.81

An analysis of the variance for gross beta activity is illustrated in figure 6.3-4. This figure shows that some of the two foot core samples have a higher activity than the one foot cores. D-83-0 was reported with the highest activity at 7.3 ± 2.5 pCi/gm (also high in Gross Alpha). Figure 6.3-5 illustrates the variance observed for the data. It is noted from this graph that certain samples exceed

Gross Beta
D-D Series (Soil Cores)
Analysis of Variance

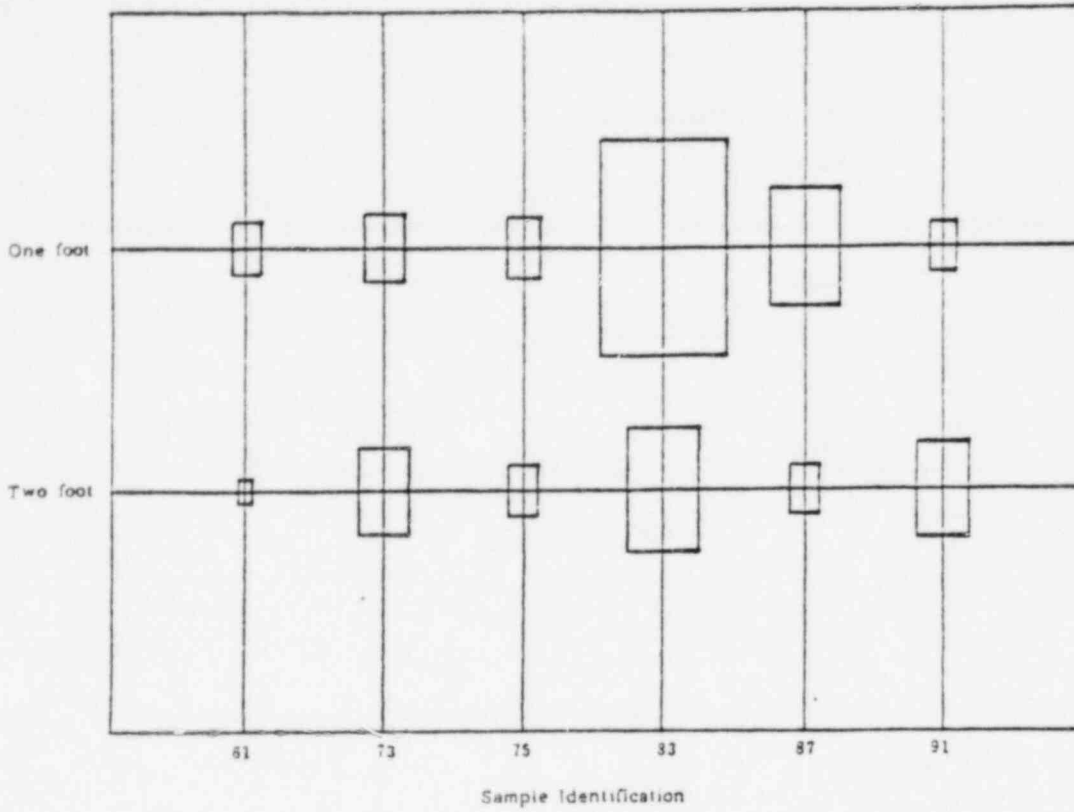


Figure 6.3-4

Gross Beta
D-D Series (Soil Cores)
Analysis of Variance

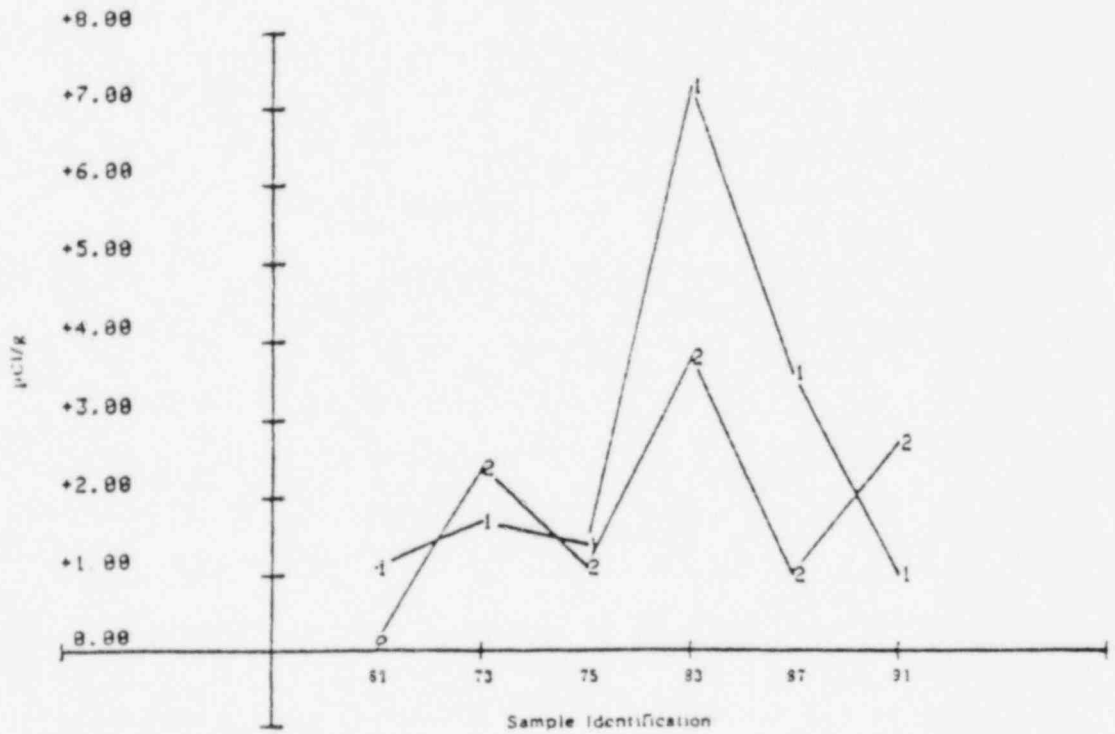
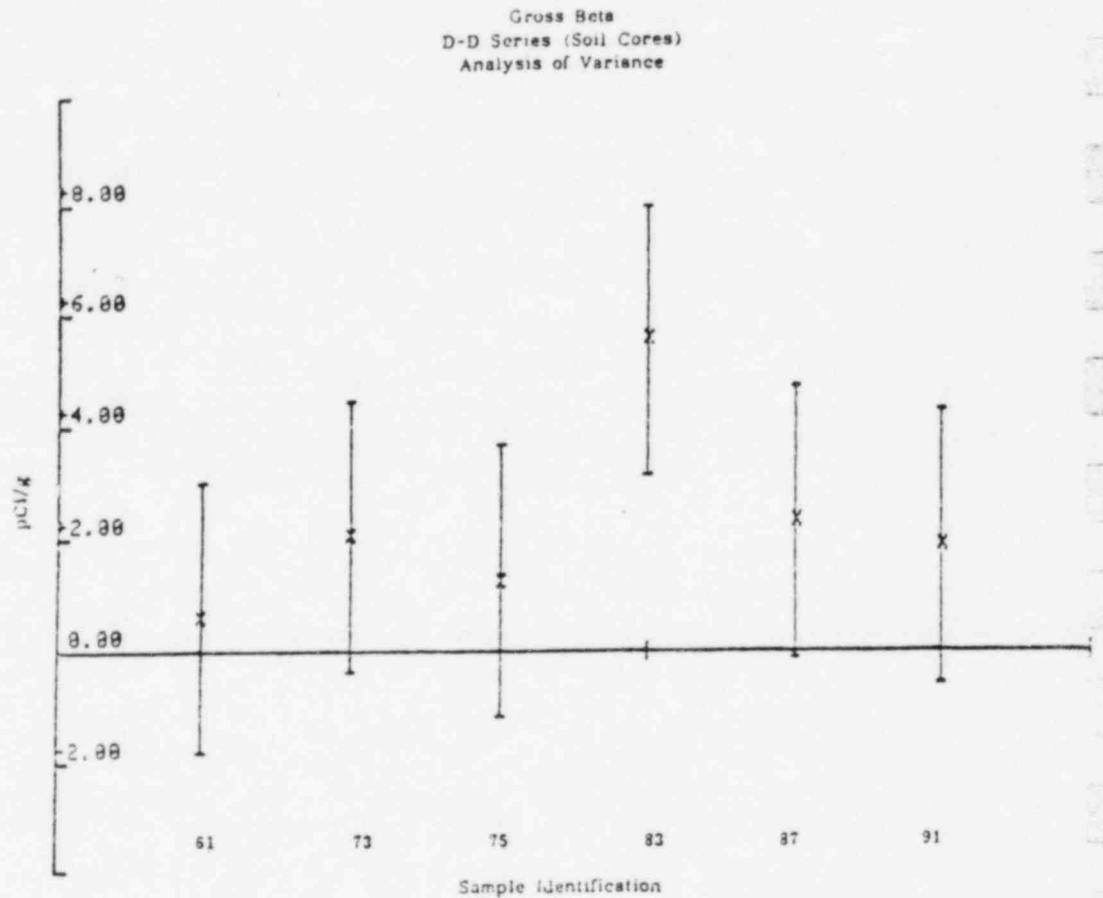


Figure 6.3-5

the overall background mean of 5.5 pCi/gm (1981) and 8.5 pCi/gm (1963). The mean gross beta activity and its respective 95% confidence interval shows that the samples compare statistically with the exception of D-83-D. (also found in the gross alpha data). This data is illustrated in figure 6.3-6.

Figure 6.3-6



It may be seen from this graph that the mean activity for D-83-D is greater than the 1963 and 1981 mean gross beta background activity.

The distribution of the Radium-226 data for these core samples is illustrated in Figure 6.3-7. This figure indicates that 50% of the two foot core sample was reported at a higher activity than the one foot cores. A graphical illustration of the data with respect to activity is shown in figure 6.3-8.

Radium-226
D-D Series (Soil Cores)
Analysis of Variance

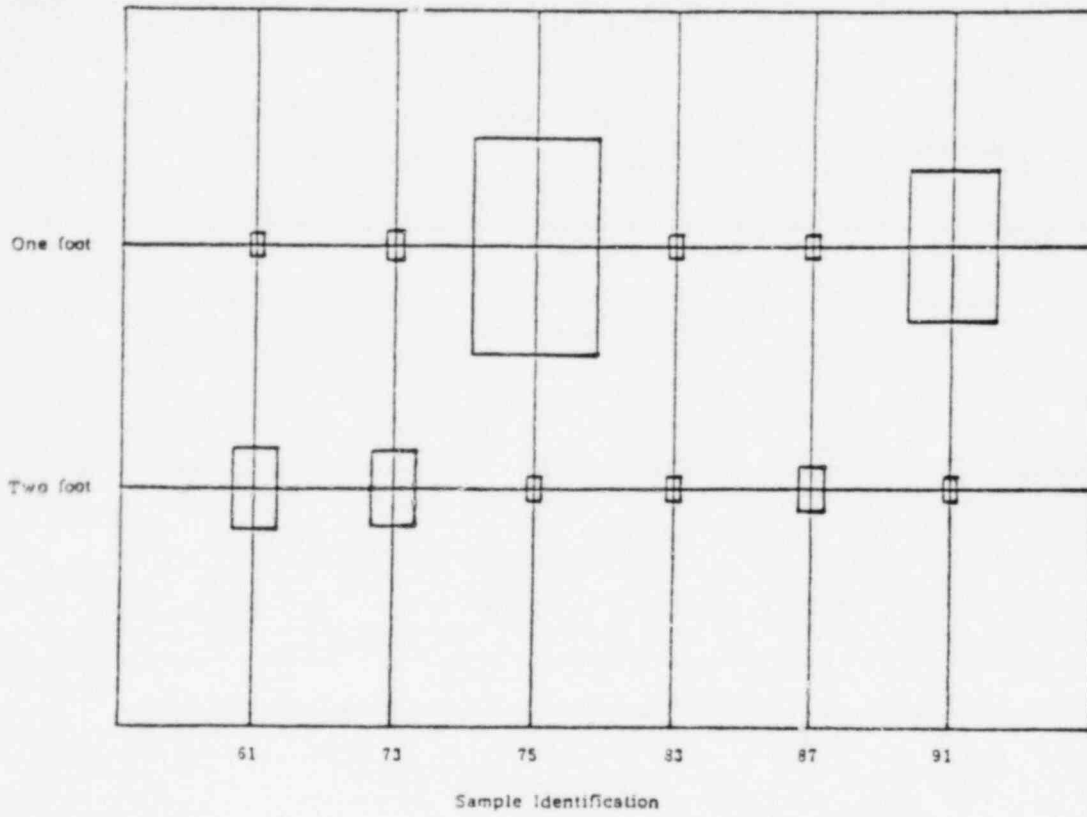


Figure 6.3-7

Radium-226
D-D Series (Soil Cores)
Analysis of Variance

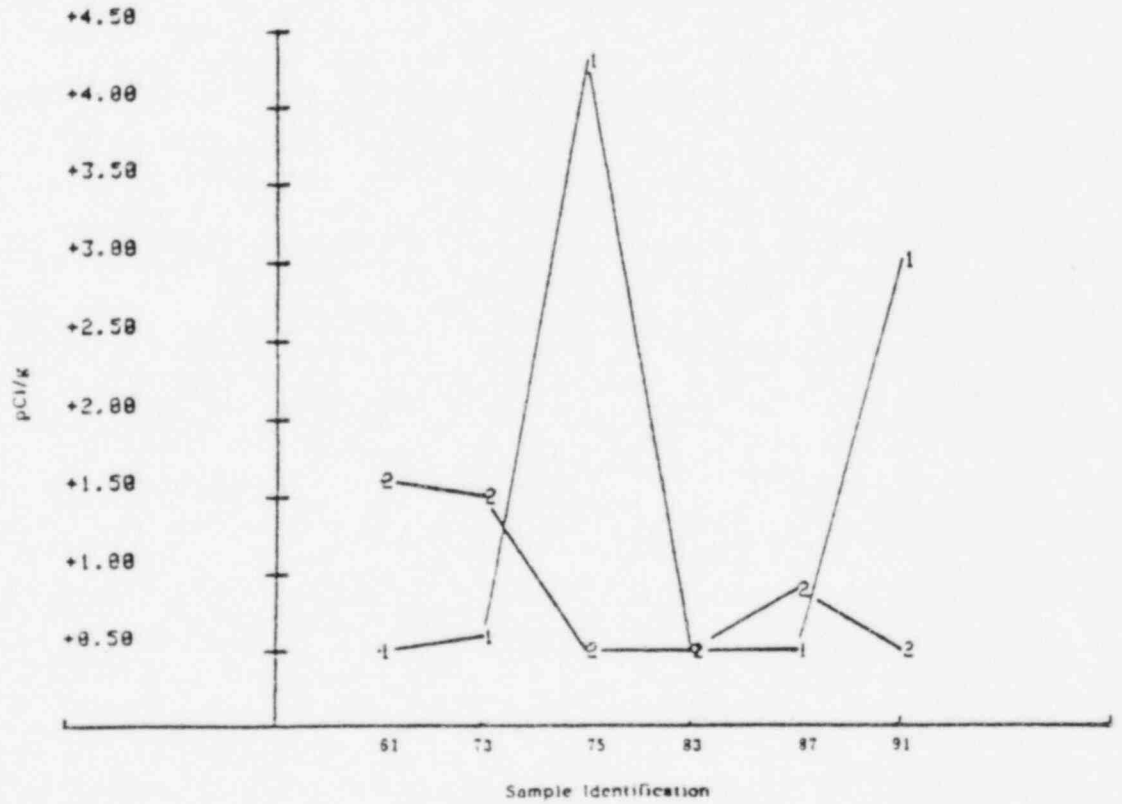


Figure 6.3-8

It should be noted that the radium-226 activity is greater than the mean activity reported for the background samples gathered in 1963 (0.88 pCi/gm).

The mean of all columns analyzed with the exception of D-75-D compares statistically. (Table 6.3-2 and Figure 6.3-9).

Figure 6.3-9

Radium-226
D-D Series (Soil Cores)
Analysis of Variance

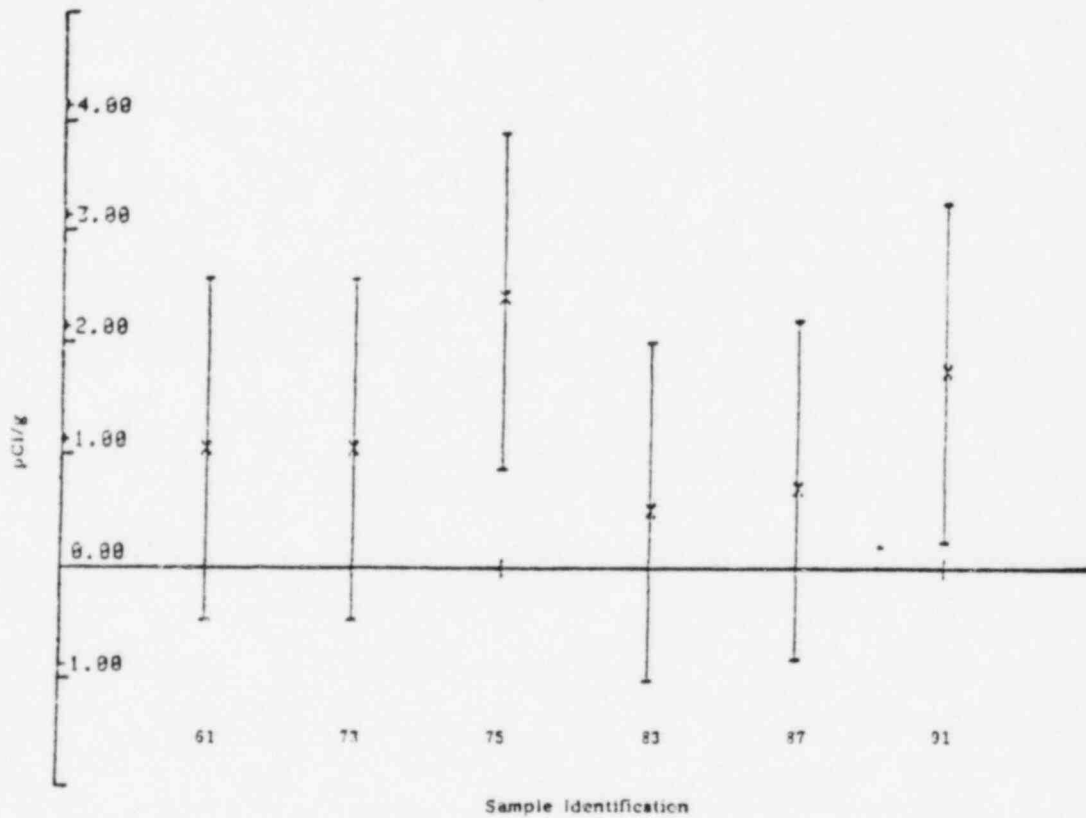


Table 6.3-2
Radium-226 Means and Confidence Intervals

		pCi/gm	
		95% Confidence Interval	
<u>Core</u>	<u>Mean</u>	<u>Lower Limit</u>	<u>Upper Limit</u>
One Foot	1.5	0.6	2.4
Two Foot	0.9	0.0	1.7

<u>Sample</u>	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
61	1.0	-0.4	2.5
73	1.0	-0.4	2.5
75	2.4	0.8	3.9
83	0.5	-1.0	2.0
87	0.7	-0.8	2.2
91	1.7	0.2	3.2

The graphic plot of the variance of Radium-228 data is illustrated in figures 6.3-5 and 6.3-11.

Figure 6.3-10
 Radium-228
 D-D Series (Soil Cores)
 Analysis of Variance

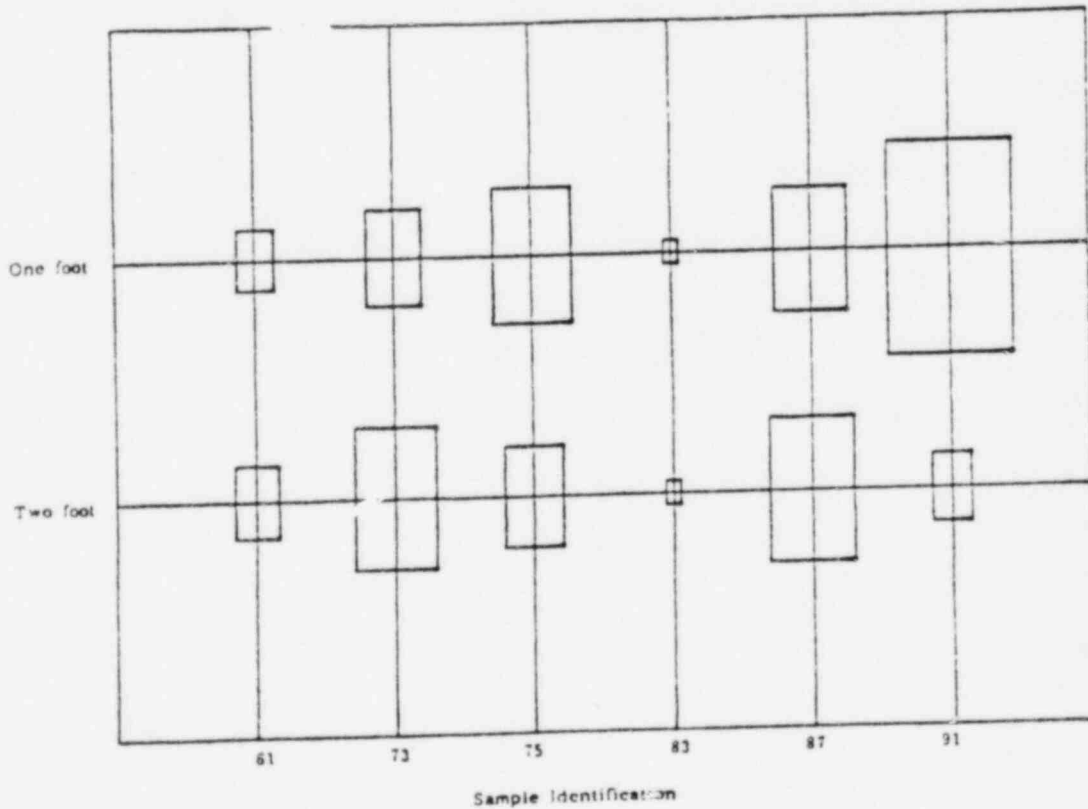
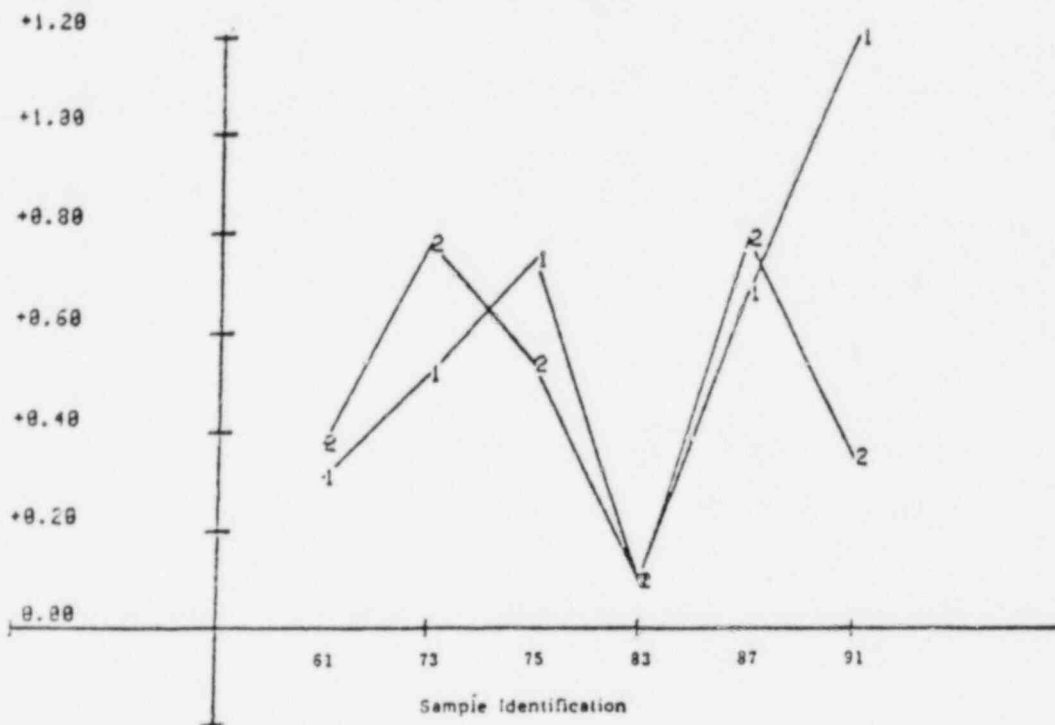


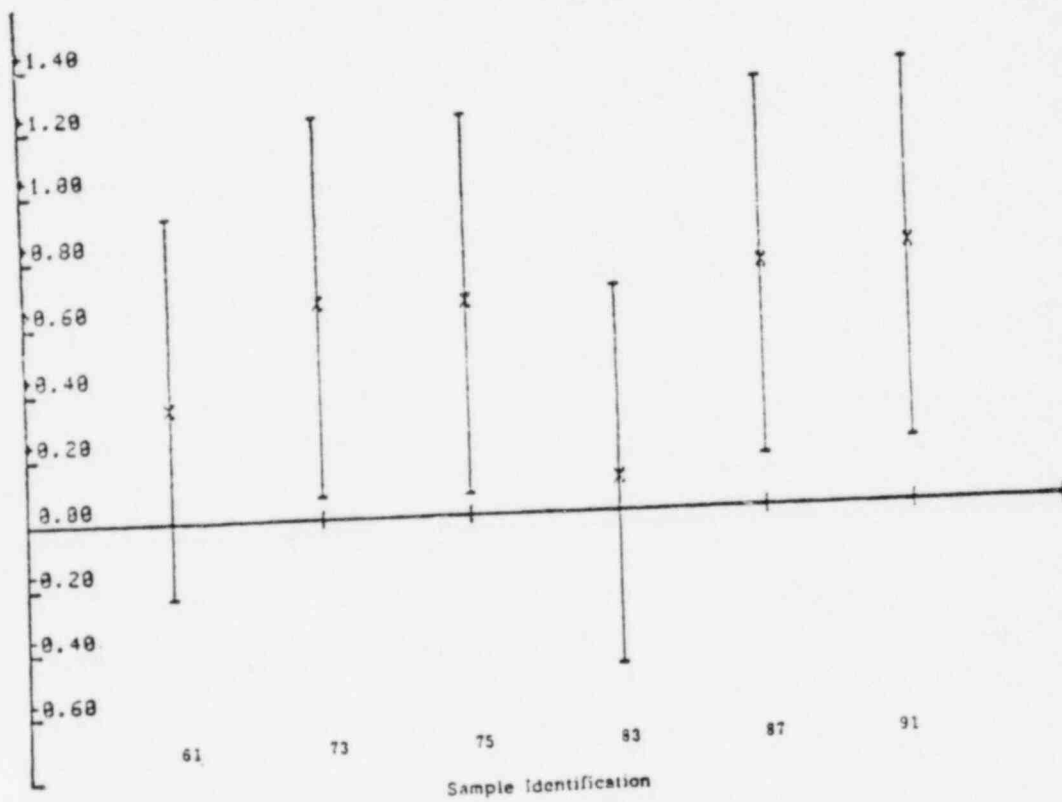
Figure 6.3-11
 Radium-228
 D-D Series (Soil Cores)
 Analysis of Variance



The only large variance observed for this data is for D-91-D. All other samples compare statistically and it can be concluded that the activity between depths is statistically equal. The activity for each core indicates that the data is statistically equal based on the mean and 95% confidence interval (Figure 6.3-12).

Figure 6.3-12

Radium-228
D-D Series (Soil Cores)
Analysis of Variance



It should be noted that D-83-D has the lowest mean. The mean and confidence interval for Radium-228 are presented in Table 6.3-3.

Table 6.3-3
Radium-228 Means and Confidence Intervals
D-D Series Cores

<u>Core</u>	<u>Mean</u>	pCi/gm 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
One Foot	0.5	0.2	0.9
Two Foot	0.4	0.1	0.8

<u>Sample</u>	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
61	0.3	-0.2	0.9
73	0.6	0.0	1.2
75	0.6	0.0	1.2
83	0.1	-0.4	0.6
87	0.7	0.1	1.3
91	0.7	0.1	1.3

The Radium-228 data compares statistically with the background sample analyzed (0.52 pCi/gm).

The Strontium-90 data for the D-D series cores, with the exception of three one foot core samples, were reported at less than 0.03 pCi/gm. (Figures 6.3-13 and 6.3-14). Those samples which were identified as having Strontium-90 compare statistically with the 1981 background data reported in Table 6.2-3.

Strontium-90
D-D Series (Soil Cores)
Analysis of Variance

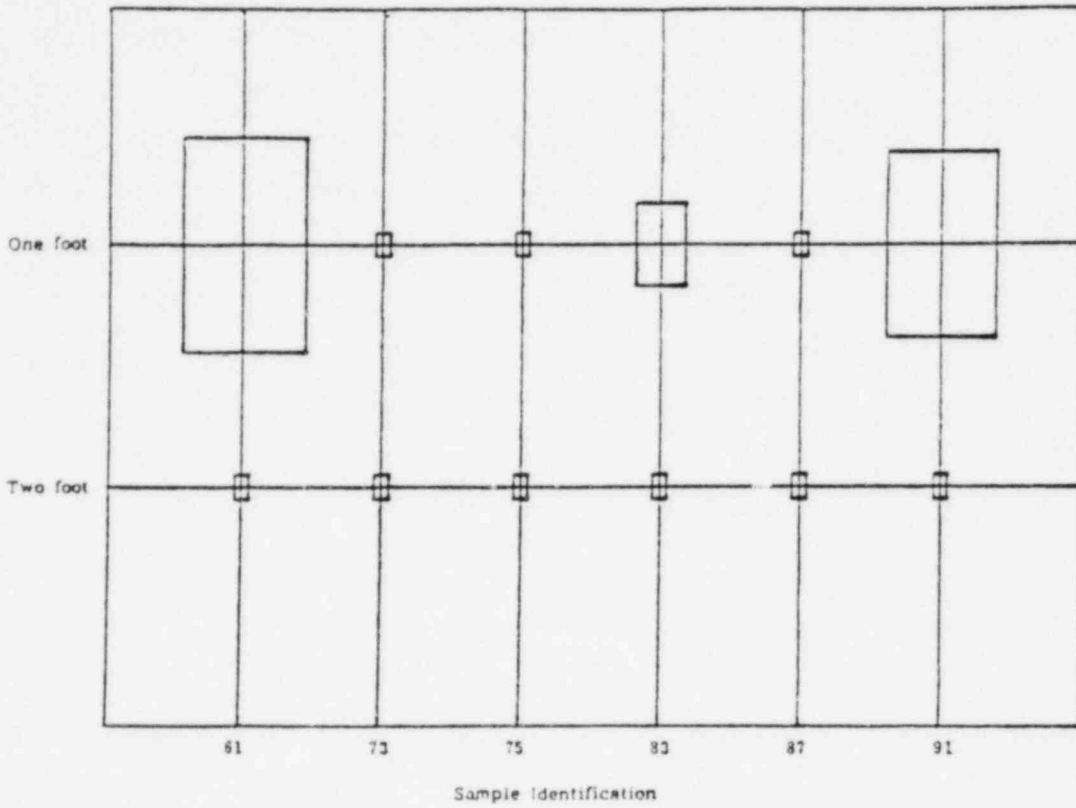


Figure 6.3-13

Strontium-90
D-D Series (Soil Cores)
Analysis of Variance

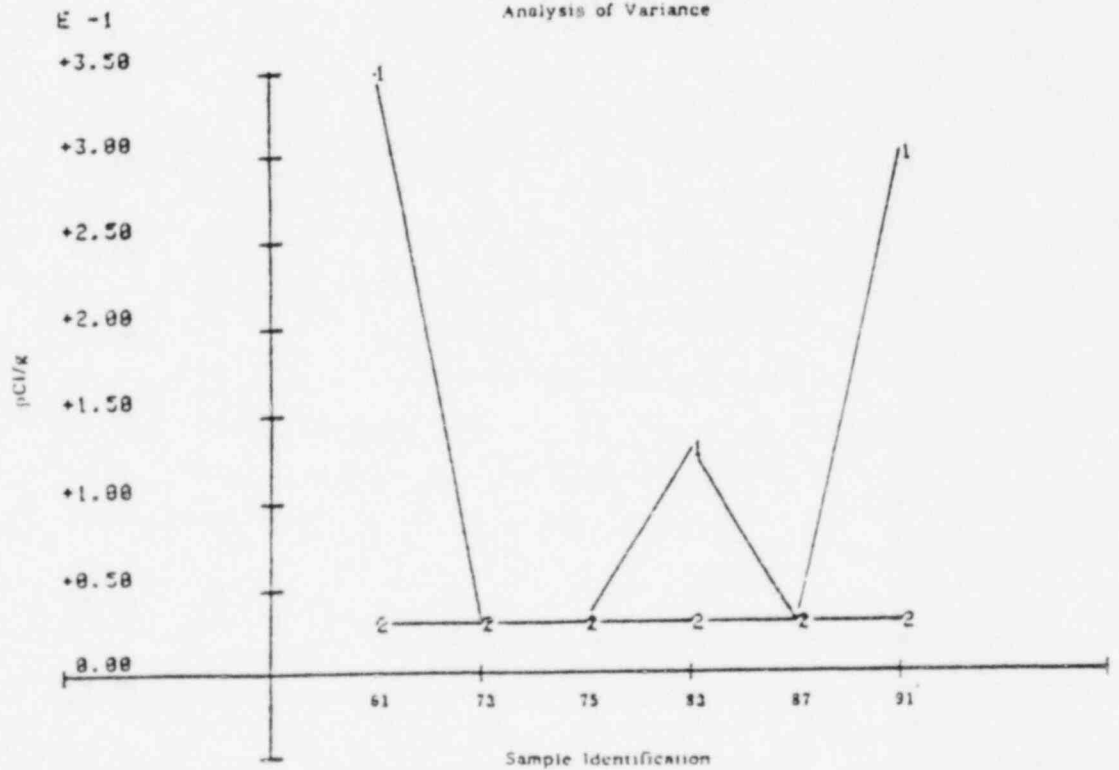


Figure 6.3-14

Isotopic uranium data for these samples compare statistically to the 1981 background samples. Statistically these samples did not exceed the overall mean activity for each of the uranium isotopes. The data for these parameters range from less than 0.05 pCi/gm to 0.81 pCi/gm. The variance in data that was noted for gross alpha and gross beta is also noted for isotopic uranium and isotopic thorium.

All cesium-137 data for these cores are reported at less than 0.08 pCi/gm.

Based on the data discussed above, it may be assumed that no contamination of the soil has occurred in the areas that were sampled under the macadam. D-83-D is a core sample located near Lagoon "A" which may be the reason why it shows the higher activity.

6.4 Soil - A Series

These soil samples were collected outside the inner security fence. A rectangular plot was created whereby the data was plotted in numerical order. The analytical data for these samples are presented in Appendix "C".

An analysis of the gross alpha data distribution, illustrated in Figure 6.4-1, shows that for some sampling points the sub-surface samples had a higher activity than the surface samples. The specific isotopes that have contributed to this increase is evident through all analytical tests performed on the samples. The highest gross alpha activity reported for surface samples was A-004-S (27 ± 5 pCi/gm) while A-003-S (18 ± 4 pCi/gm) was reported as having the highest activity for the subsurface samples. Demonstrating similar activity were A-237-S (21 ± 4 pCi/gm) for surface samples, and A-128-S (13 ± 4 pCi/gm) for sub-surface sample. Samples A-003 and A-004 are located near the emergency trailer at the southwest corner of the property, while A-237 is located at the center of the south boundary of the property and A-128 is located just outside the inner security fence north of the warehouse.

Gross Alpha
A Series (Soils)

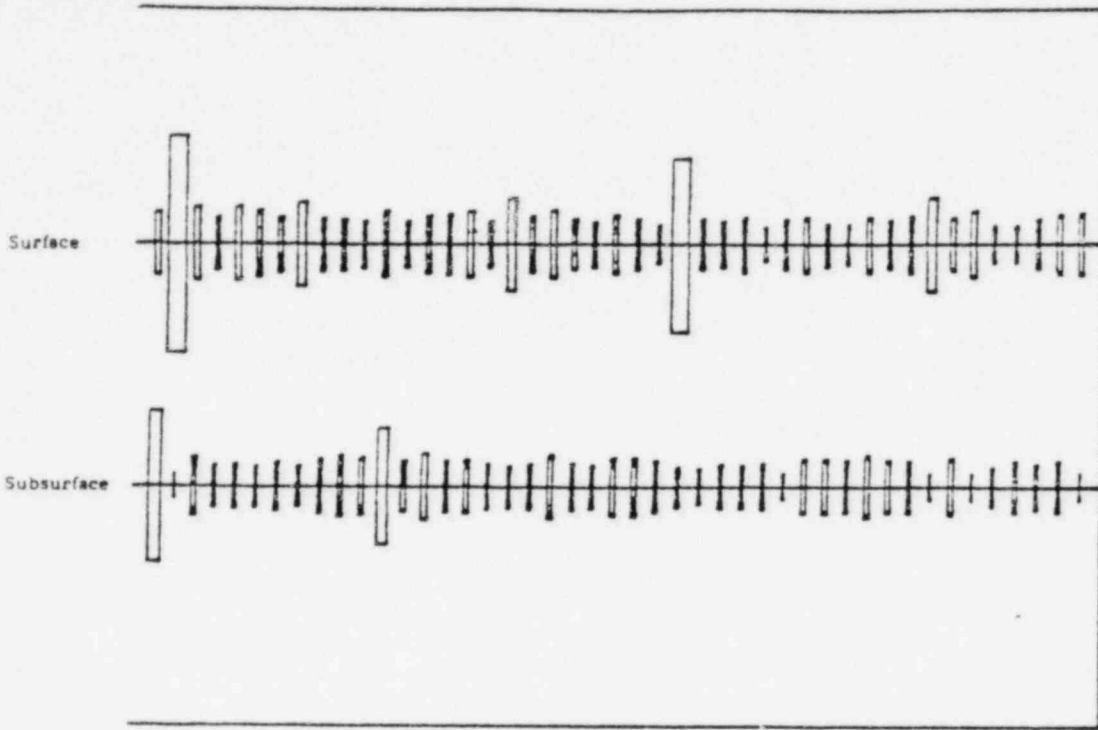


Figure 6.4-1

Samples plotted in identification increasing order from left to right.

Gross Alpha
A Series (Soils)

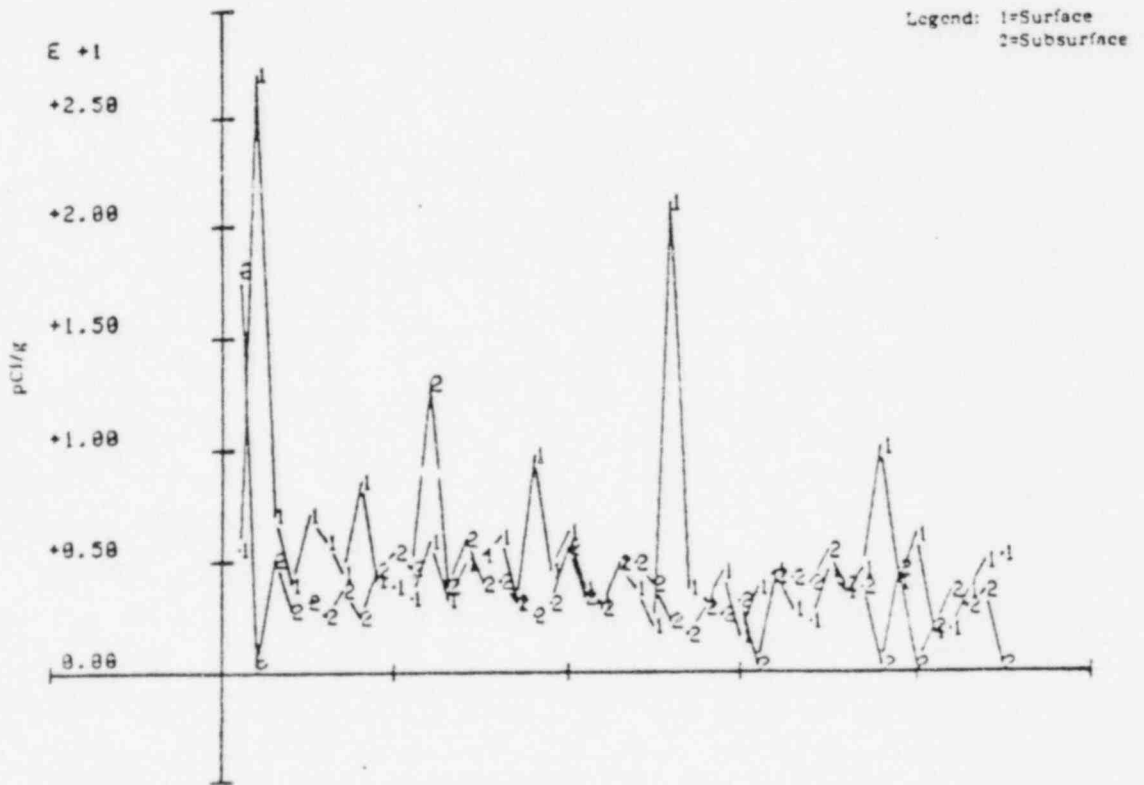


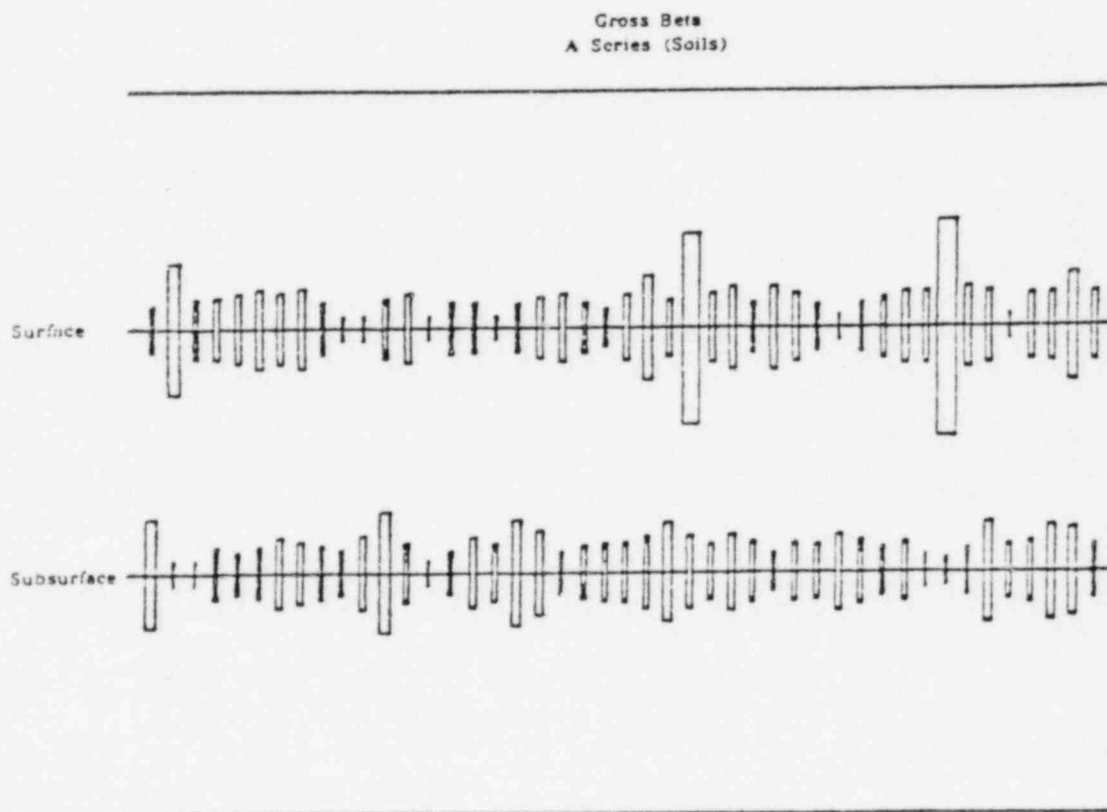
Figure 6.4-2

Samples plotted in identification increasing order from left to right.

This data is graphically illustrated in Figure 6.4-2. As may be seen, with a few exceptions, the results are generally less than 10 pCi/gm for both surface and sub-surface samples.

The mean for the surface samples is 5.5 ± 1.2 pCi/gm and 3.9 pCi/gm for the subsurface samples. A comparison of the surface and subsurface means with the background surface samples gathered in 1963 and 1981 (3.9 ± 1.2 pCi/gm and 5.0 ± 2.1 pCi/gm, respectively) indicates that the samples are statistically equal at the ninety-five (95%) confidence interval.

Figure 6.4-3



Samples plotted in identification increasing order from left to right.

A rectangular plot of the gross beta results is presented in Figure 6.4-3. This figure illustrates the distribution of the data for all sampling stations, surface and sub-surface. Similar to the gross alpha results, the gross beta results on some of the subsurface samples have a higher activity than the surface samples. Samples A-237 and A-382 had the highest gross beta activities for the surface samples (21 ± 4 pCi/gm and 10 ± 3 pCi/gm, respectively). Samples A-003 and A-117 had the highest activities for the subsurface samples (18 ± 4 pCi/gm and 13 ± 4 pCi/g, respectively).

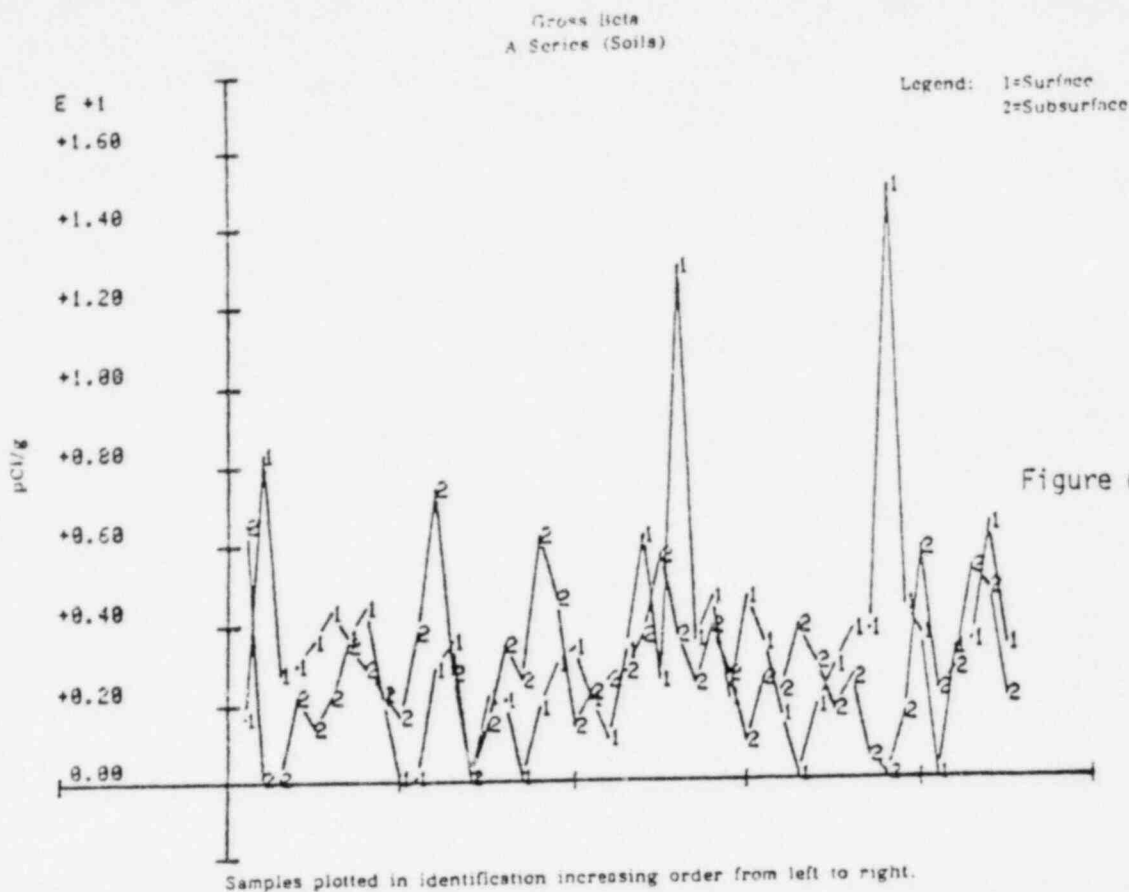


Figure 6.4-4 is another illustration of the data. Generally, the data for both the surface and sub-surface samples is less than 10 pCi/gm. The means for the gross beta results and the 95% confidence interval is presented in Table 6.4-1.

Table 6.4-1
Gross Beta Soil Means
A Series Soils

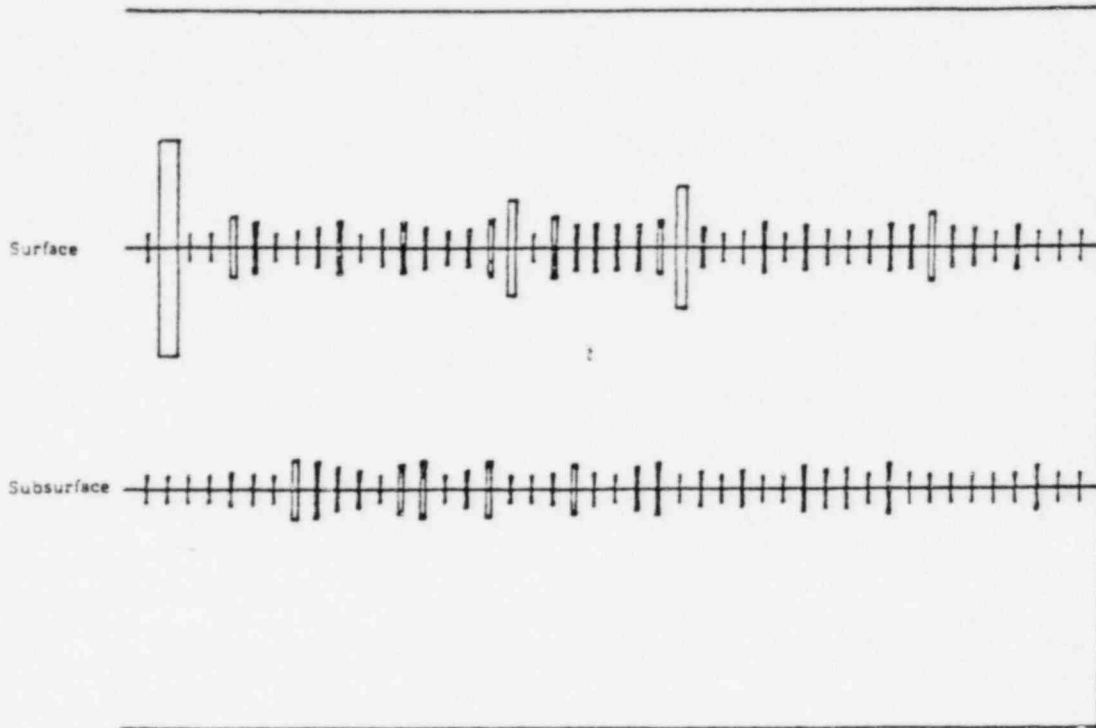
	Mean	pCi/gm 95% Confidence Interval	
		Lower Limit	Upper Limit
Surface	3.4	2.7	4.1
Sub-surface	2.8	2.1	3.5

These means are well below those reported for background samples collected in 1963 and 1981 (8.5 pCi/gm and 5.5 pCi/gm, respectively). It can be seen from Figure 6.4-4 that, in general, the data is well below the 1963 background data with the exceptions as noted above.

The radium-226 data also shows that some of the sub-surface samples have a higher activity than the surface samples. This is illustrated in Figure 6.4-5.

Figure 6.4-5

Radium-226
A Series (Soils)



Samples plotted in identification increasing order from left to right.

Surface samples A-004 and A-237 were both reported with the highest activities at 15 ± 1 pCi/gm and 7.7 ± 0.7 pCi/gm, respectively. Samples A-63 at 2.9 ± 0.4 pCi/gm and A-136 at 2.8 ± 0.4 pCi/gm were reported as having the highest radium-226 activities for the sub-surface samples.

Figure 6.4-6 illustrates the distribution of the data with respect to activity as well as the variance in data between sampling points. In general, as illustrated in Figures 6.4-6, the overall activities are less than or equal to 3 pCi/gm, with exceptions as noted above. The overall mean for the surface samples is calculated at 2.0 pCi/gm with upper and lower 95% confidence interval limits at 1.7 pCi/gm and 2.3 pCi/gm. The sub-surface samples were reported as having an overall mean of 1.1 pCi/gm with upper and lower limits at the 95% confidence interval of 0.8 pCi/gm and 1.4 pCi/gm respectively. The overall mean for the 1981 background samples was reported at 0.88 pCi/gm with a standard deviation of 0.56 pCi/gm. As may be seen from Figure 6.4-6, the mean data for radium-226 is greater than the background samples.

The radium-228 data shows a greater variance in results than did any of the other parameters analyzed in this series of samples. Figure 6.4-7 illustrates this variation. As illustrated in Figures 6.4-7 and 6.4-8 certain sub-surface samples exceed the surface sample activity. For example, the surface sample of A-415 was reported at less than 0.1 pCi/gm while the sub-surface sample was reported at 1.9 ± 0.3 pCi/gm. The overall means for the radium-228 data (surface and sub-surface) and the 95% confidence intervals are presented in Table 6.4-2.

Table 6.4-2
Radium-228 Soil Means
A Series Soil

	<u>Mean</u>	<u>pCi/gm</u> 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Surface	0.68	0.55	0.82
Sub-surface	0.64	0.51	0.78

Radium-226
A Series (Soils)

Legend: 1=Surface
2=Subsurface

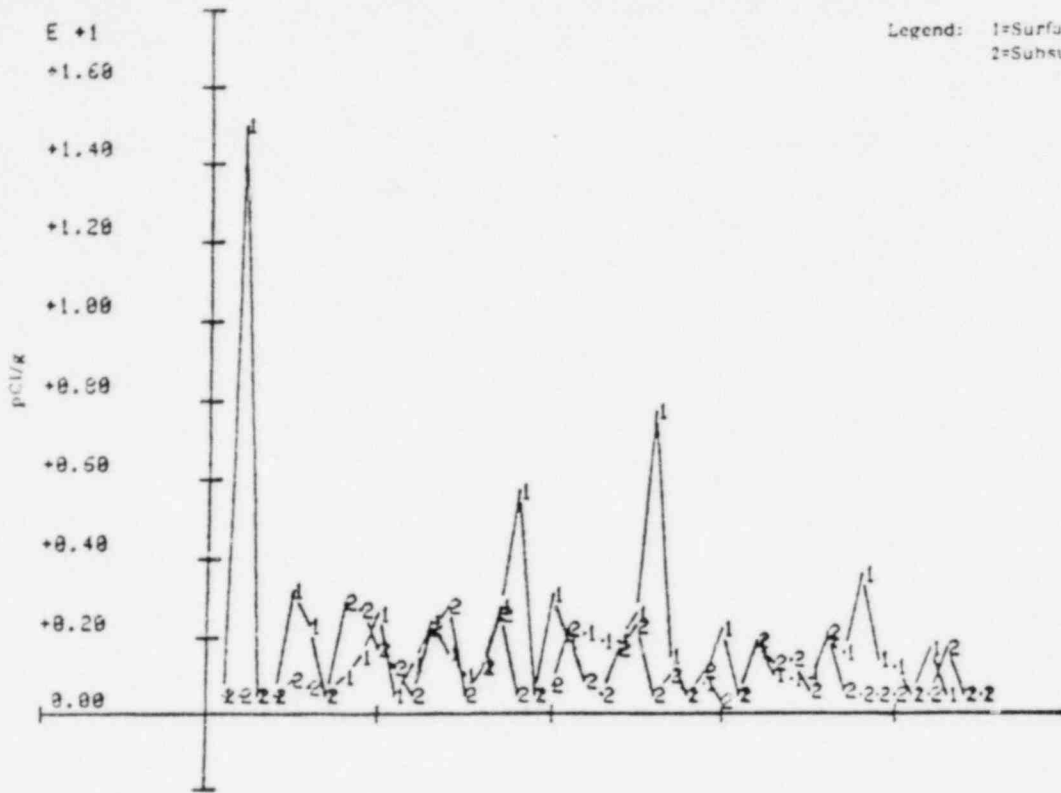


Figure 6.4-6

Samples plotted in identification increasing order from left to right.

Radium-228
A Series (Soils)

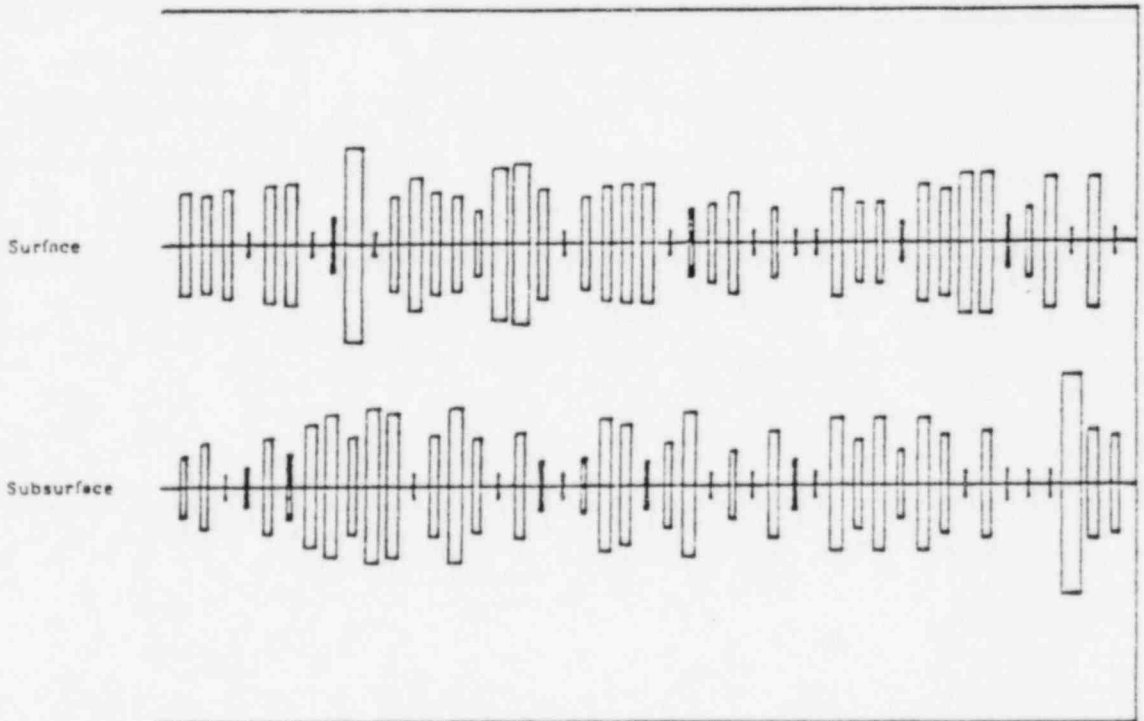
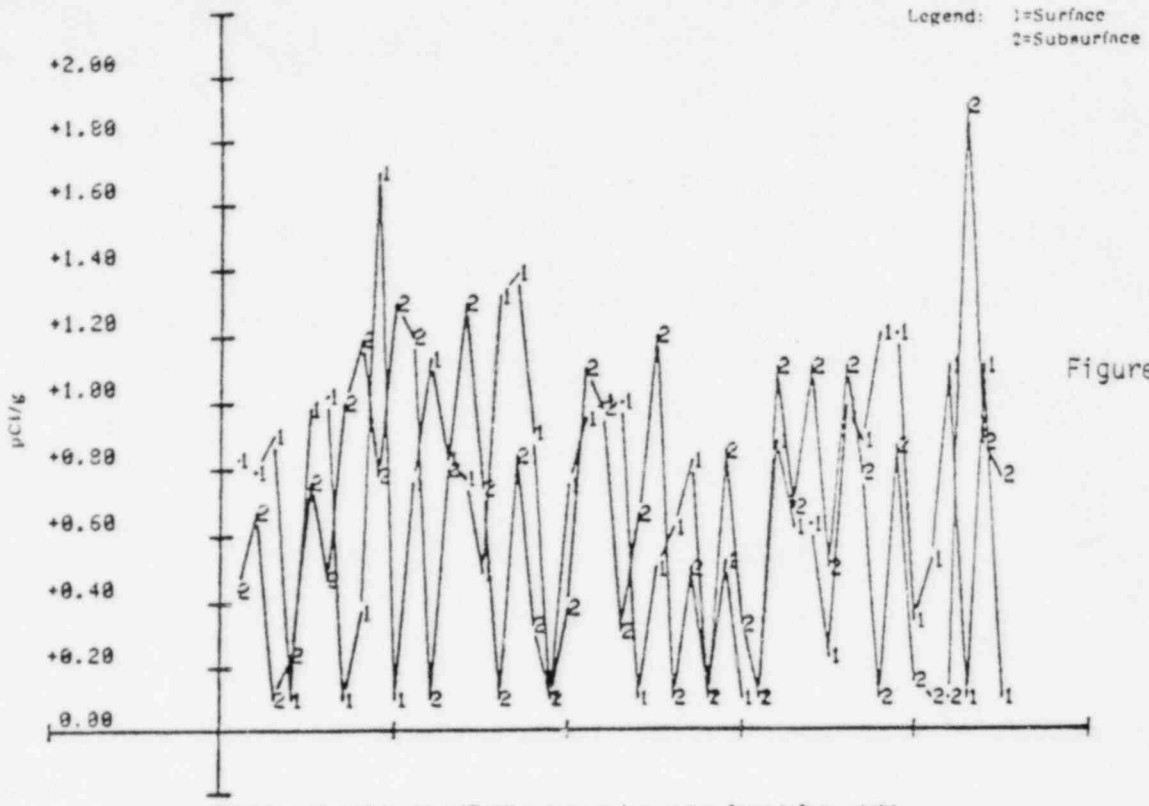


Figure 6.4-7

Samples plotted in identification increasing order from left to right.

Radium-228
A Series (Soils)



The overall mean and the standard deviation for the 1981 radium-228 background samples was 0.52 ± 0.39 pCi/gm and 0.39 ± 0.45 pCi/gm for the surface and sub-surface samples respectively. Although the overall means are slightly greater than the backgrounds, the results compare statistically (see Table 6.4-3).

The descriptive statistics for A Series Soil and the background samples are summarized in Table 6.4-3.

Table 6.4-3

Radium-228

Summary Statistics for "A" Series

	<u>"A" Series Samples</u>		<u>Background Samples</u>	
	<u>Surface</u> pCi/gm	<u>Sub-surface</u> pCi/gm	<u>Surface</u> pCi/gm	<u>Sub-surface</u> pCi/gm
N =	45	45	16	16
Mean =	0.69	0.64	0.52	0.39
Variance =	0.17	0.19	0.15	0.20
Std Dev =	0.41	0.44	0.39	0.45
Data Min =	0.1	0.1	0.1	0.1
Data Max =	1.7	1.9	1.11	1.36
Data Range =	1.6	1.8	1.01	1.26
Standard				
Err of Mean =	0.06	0.06	0.13	0.15

Strontium-90
A Series (Soils)

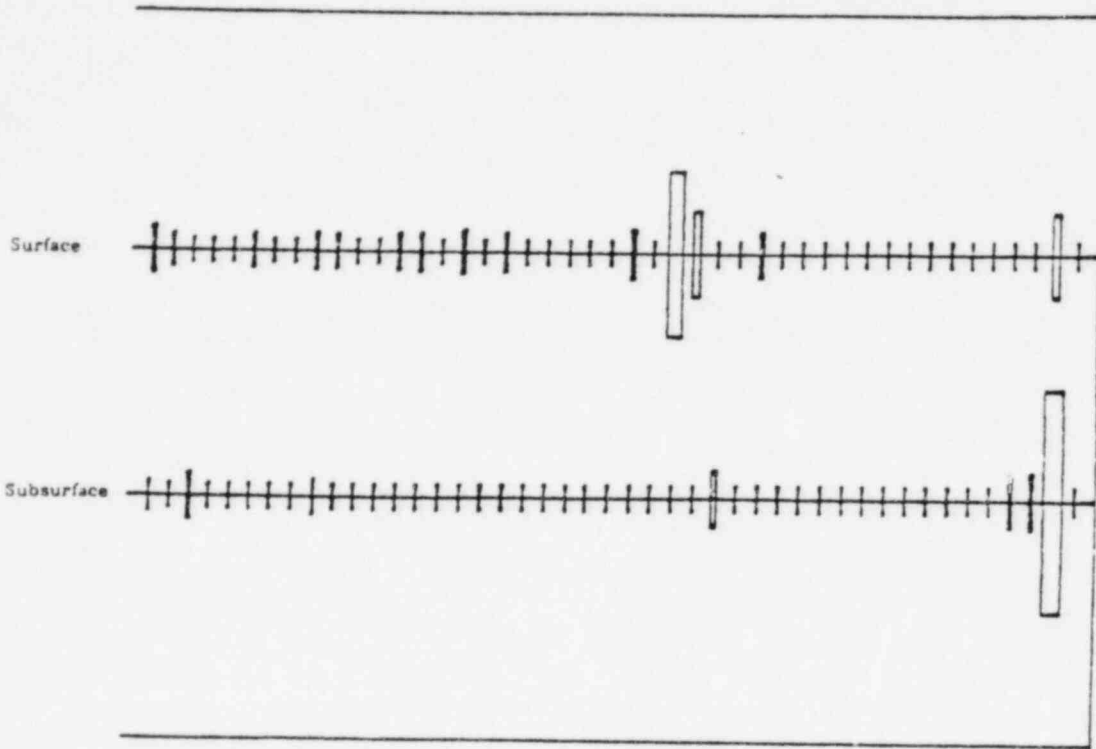
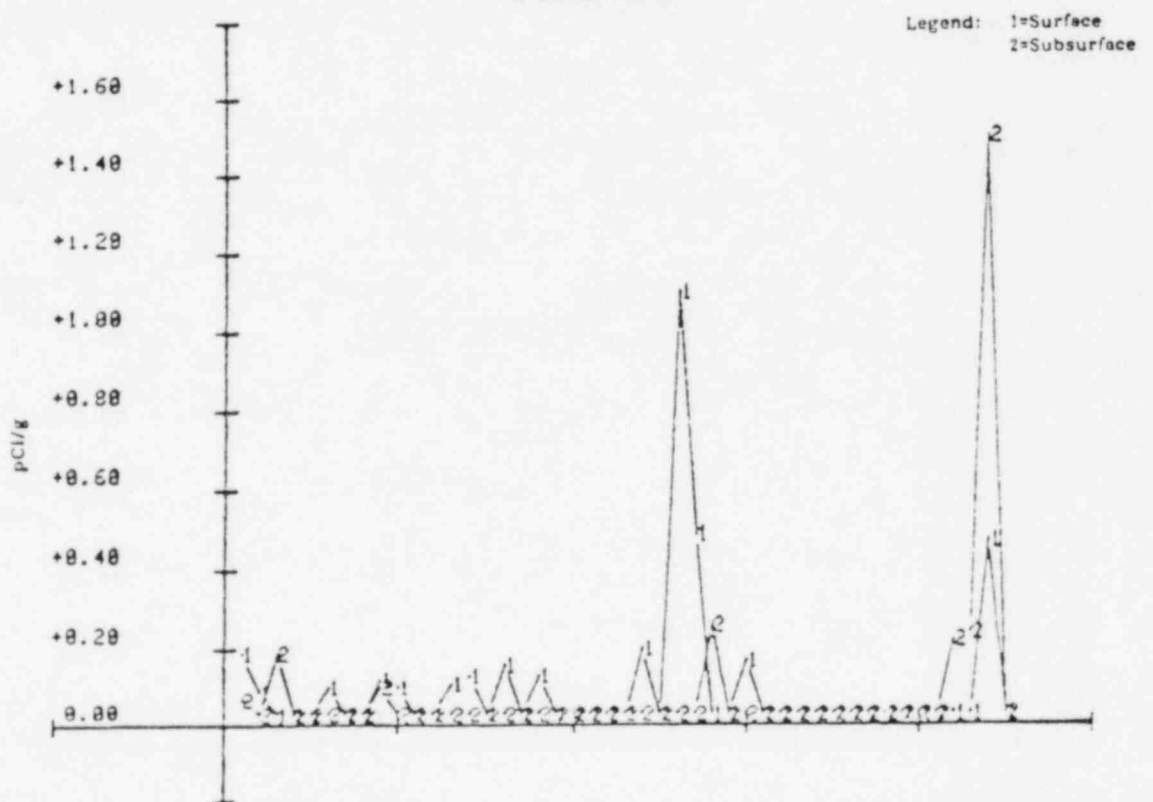


Figure 6.4-9

Samples plotted in identification increasing order from left to right.

Strontium-90
A Series (Soils)

Figure 6.4-10



Samples plotted in identification increasing order from left to right.

The strontium-90 data for the "A" series samples is graphically illustrated in Figures 6.4-9 and 6.4-10. These graphs show that generally the data is reported at less than 0.2 pCi/gm. Sample A-237 surface sample was reported with a maximum activity of 1.1 pCi/gm, whereas A-421 sub-surface sample was reported as the sample having the overall maximum activity at 1.5 pCi/gm. The overall strontium-90 means for each set of samples and their respective 95% confidence intervals is presented in Table 6.4-4.

Table 6.4-4
Strontium-90 Soil Means

	<u>A Series Soil</u>	pCi/gm	
		<u>95% Confidence Lower Limit</u>	<u>Interval Upper Limit</u>
Surface	0.09	0.04	0.15
Sub-surface	0.08	0.03	0.13

Ordinarily, the strontium-90 results compare statistically to the background samples. The surface and sub-surface samples have a range of 0.03 pCi/gm to 0.9 pCi/gm and 0.03 pCi/gm to 0.23 pCi/gm respectively. The overall strontium-90 means for the 1981 background samples are 0.17 pCi/gm and 0.05 pCi/gm for surface and sub-surface.

The isotopic uranium (U-234, U-235, and U-238) data are illustrated in Figures 6.4-11 through 6.4-15.

Uranium-234
A Series (Soils)

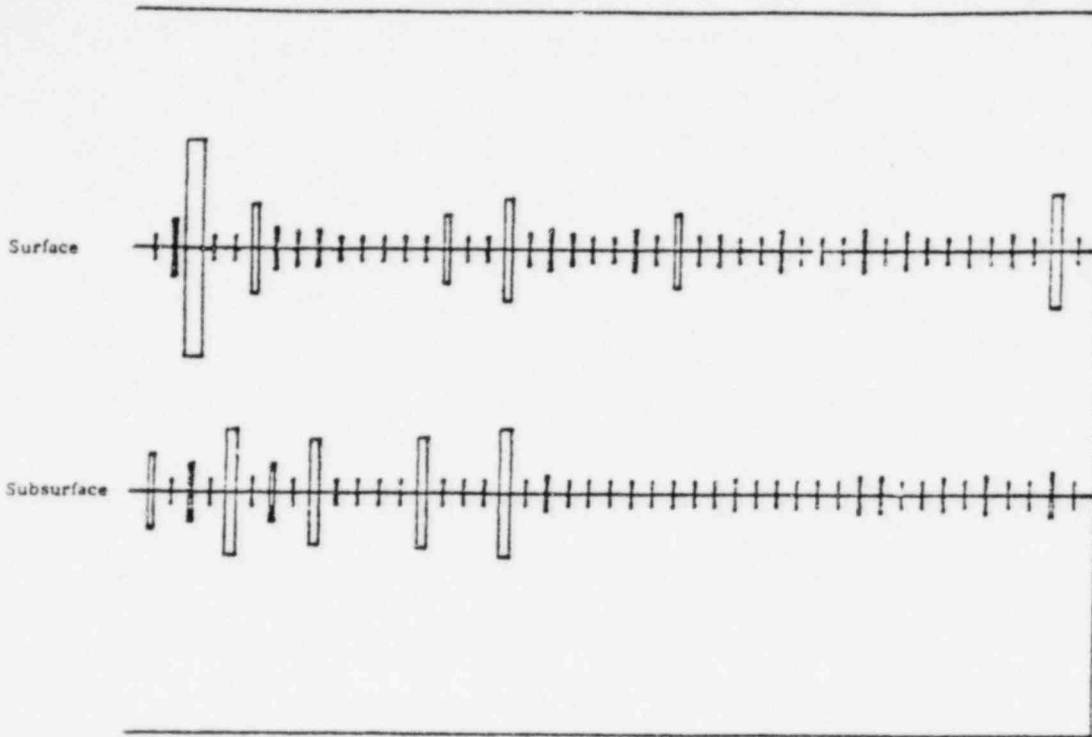


Figure 6.4-11

Samples plotted in identification increasing order from left to right.

Uranium-235
A Series (Soils)

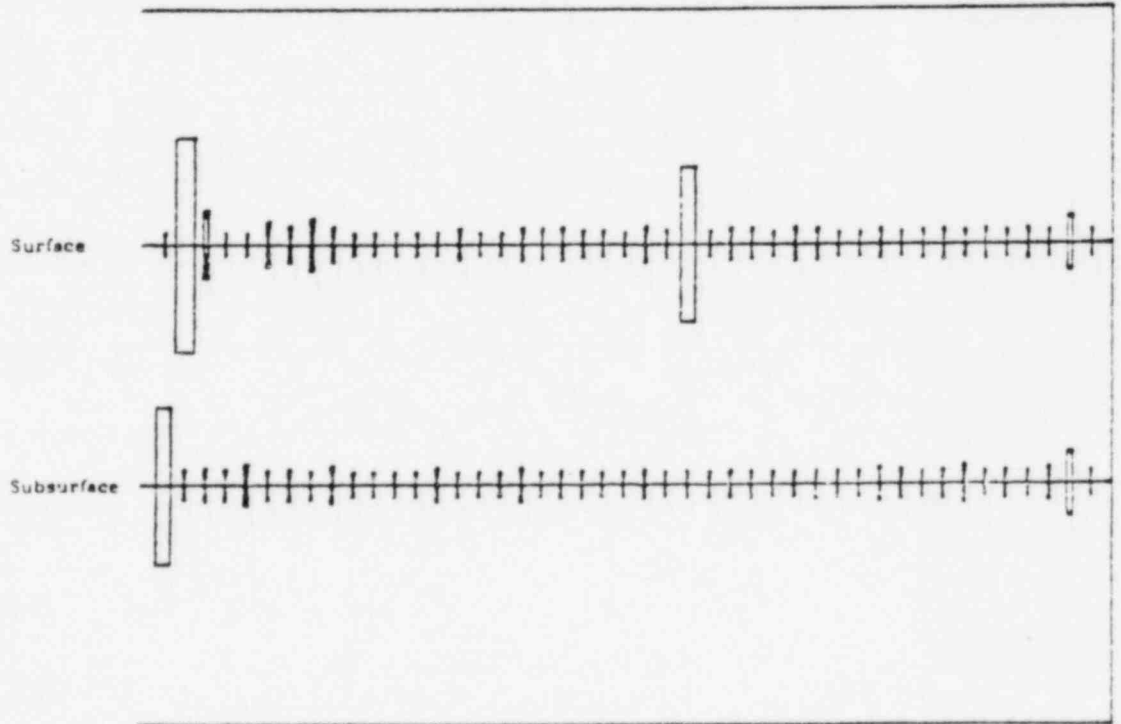
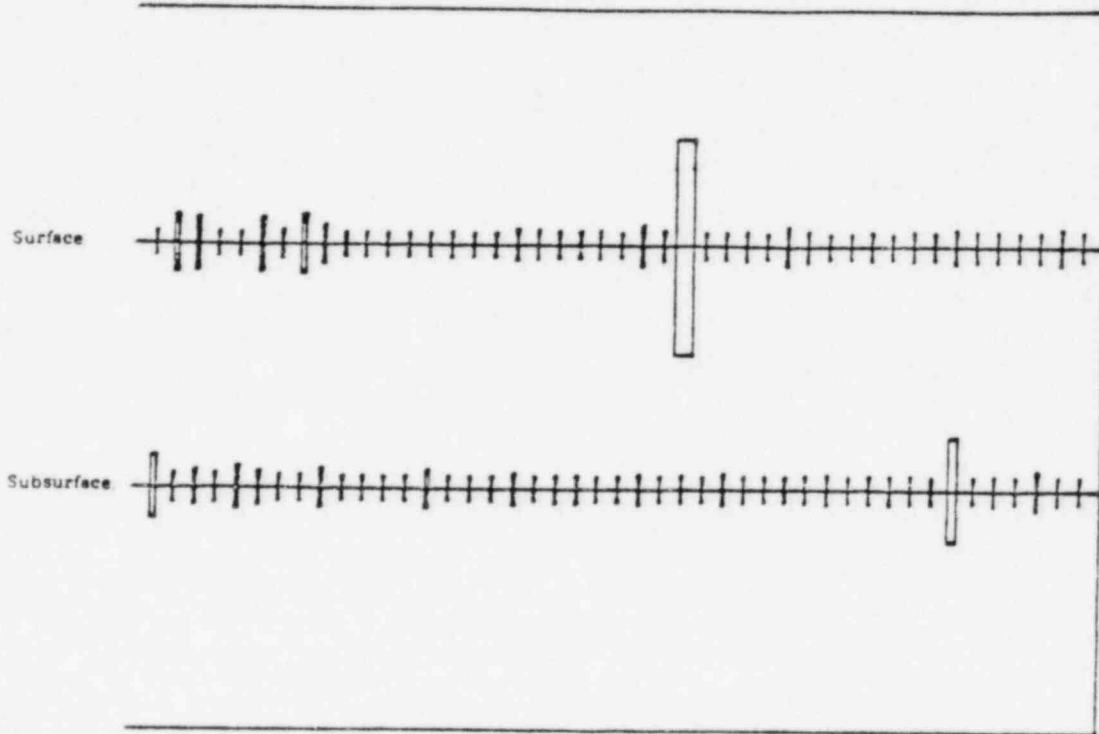


Figure 6.4-12

Samples plotted in identification increasing order from left to right.

Figure 6.4-13

Uranium-238
A Series (Soils)



Samples plotted in identification increasing order from left to right.

The variance in activity is located on the western quarter of the property. The activity of each location is plotted in Figures 6.4-14 through 6.4-16.

Uranium-234
A Series (Soils)

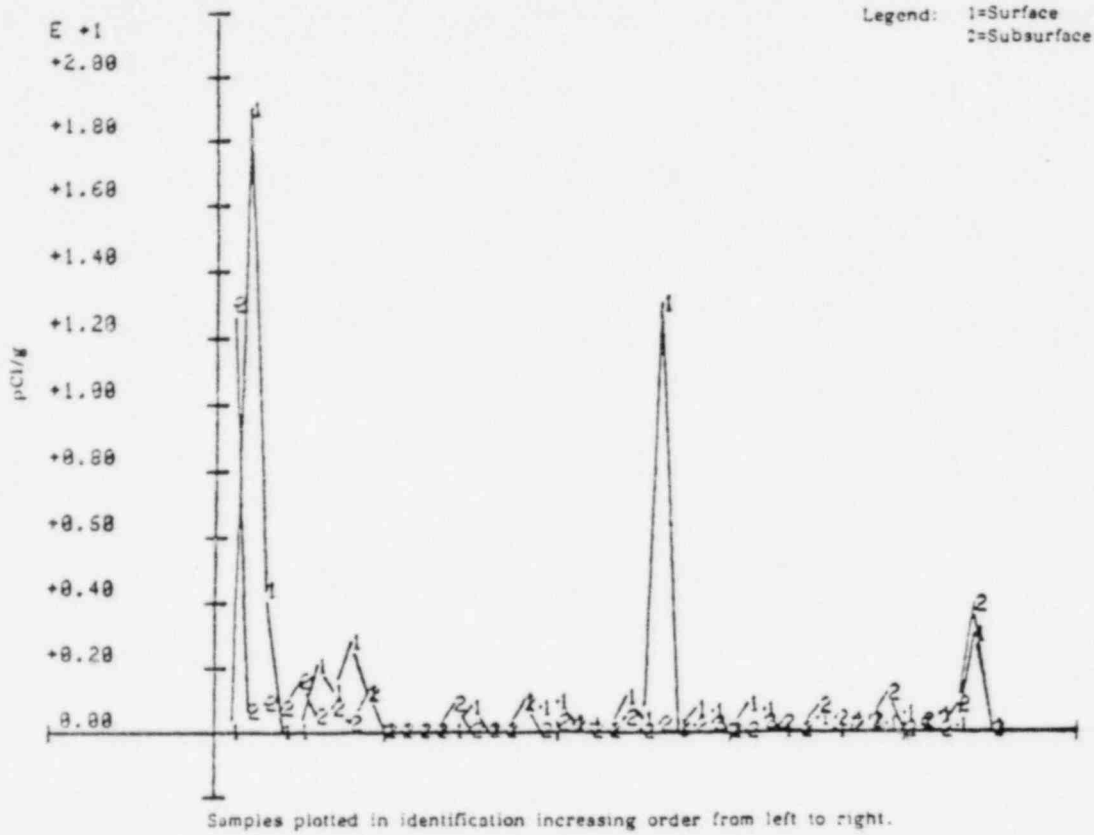


Figure 6.4-14

Uranium-235
A Series (Soils)

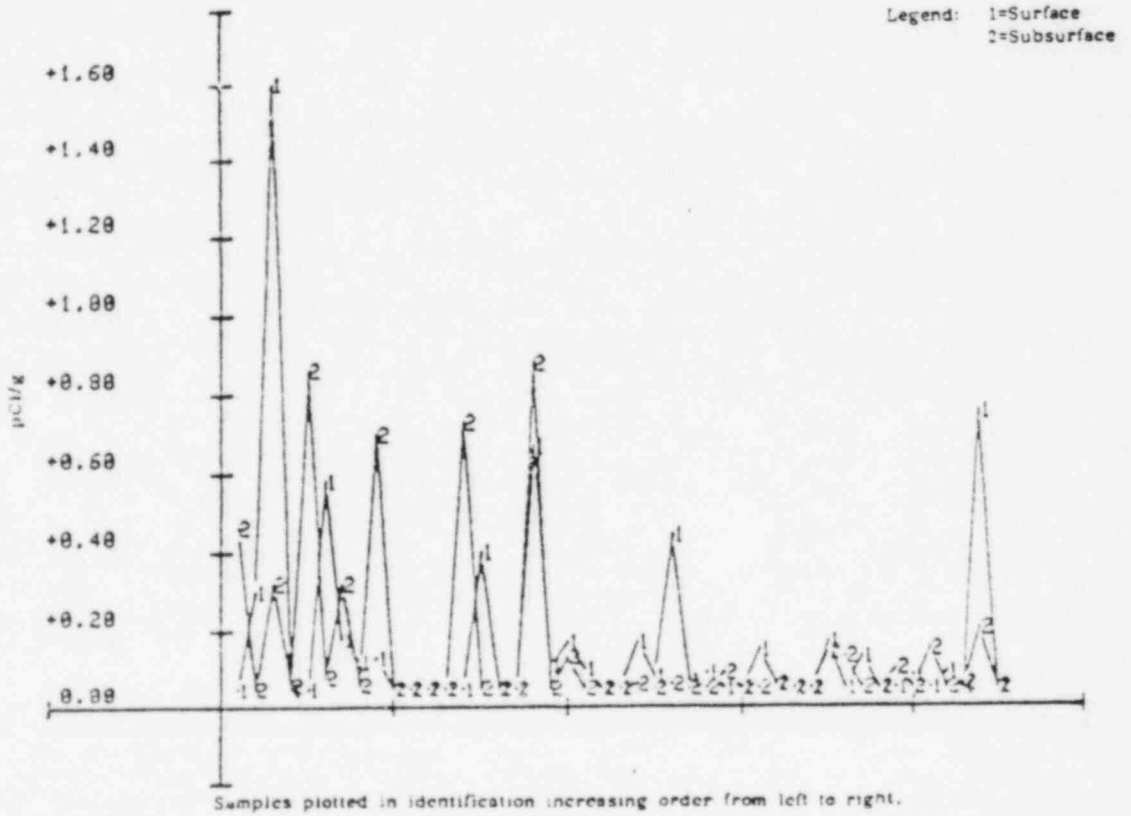
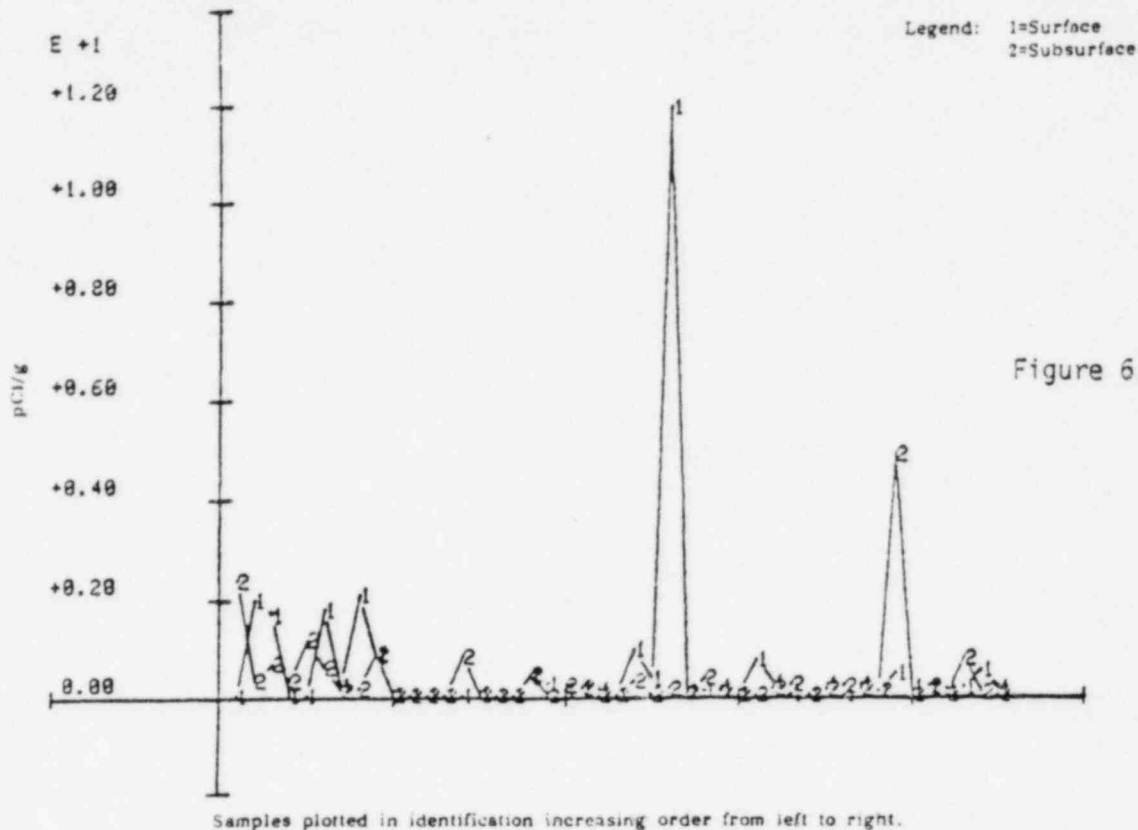


Figure 6.4-15

Uranium-238
A Series (Soils)



These figures illustrate the uranium-isotopes range from less than 0.05 pCi/gm to approximately 4 pCi/gm (surface and sub-surface samples). The means for the samples, and respective confidence intervals, and the 1981 background means are presented in Table 6.4-5.

Table 6.4-5
Means and Confidence Intervals

Isotopes	Depth	Isotopic Uranium		pCi/gm	
		Background Mean	A Series Mean	95% Confidence Lower Limit	95% Confidence Upper Limit
U-234	Surface	0.99	1.32	0.58	2.05
	Sub-surface	1.12	0.73	0.00	1.47
U-235	Surface	0.30	0.17	0.10	0.23
	Sub-surface	0.26	0.15	0.08	0.21
U-238	Surface	0.93	0.63	0.31	0.95
	Sub-surface	0.94	0.40	0.08	0.71

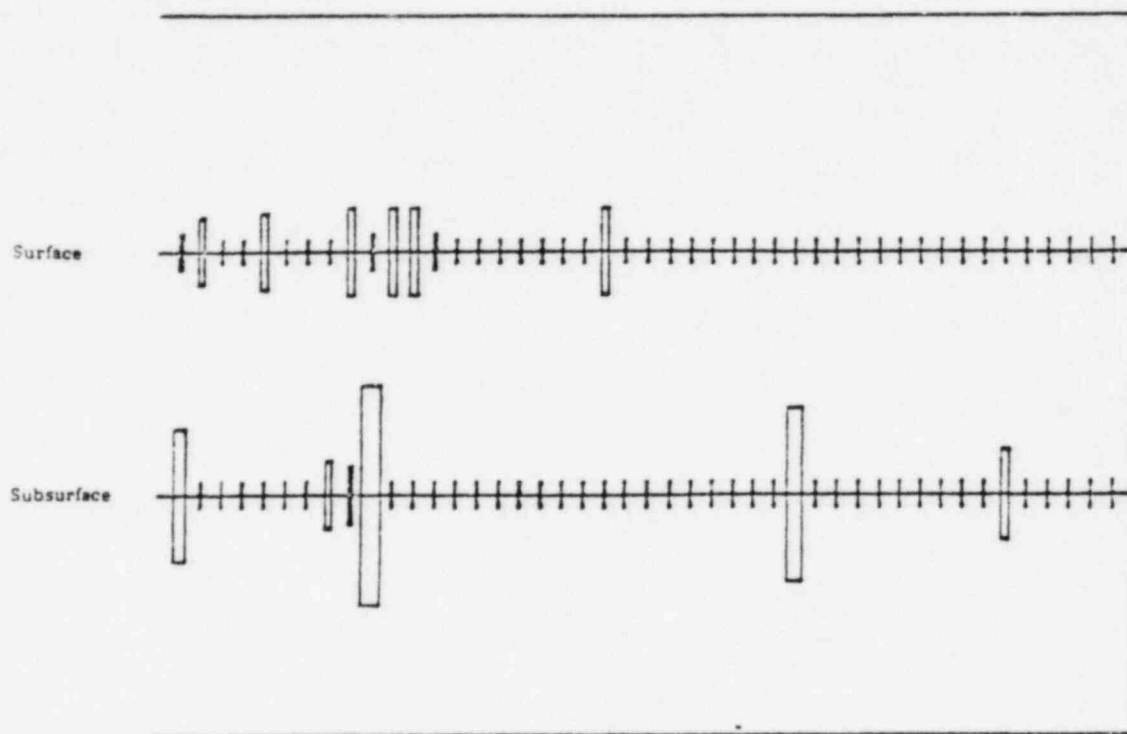
The table illustrates that the results reported are well below the background samples (1981).

A review of Figure 6.4-17 illustrates the same variance in the thorium-228 as was observed for the isotopic uranium. Again these samples are

all located in the western section of the property.

Figure 6.4-17

Thorium-228
A Series (Soils)



Samples plotted in identification increasing order from left to right.

Thorium-230 and Thorium-232 vary in all samples tested. This variance is illustrated in Figures 6.4-18 and 6.4-19. The data for Thorium-228 Thorium-230 and Thorium-232 is further illustrated in Figures 6.4-20 through 6.4-22.

Thorium-230
A Series (Soils)

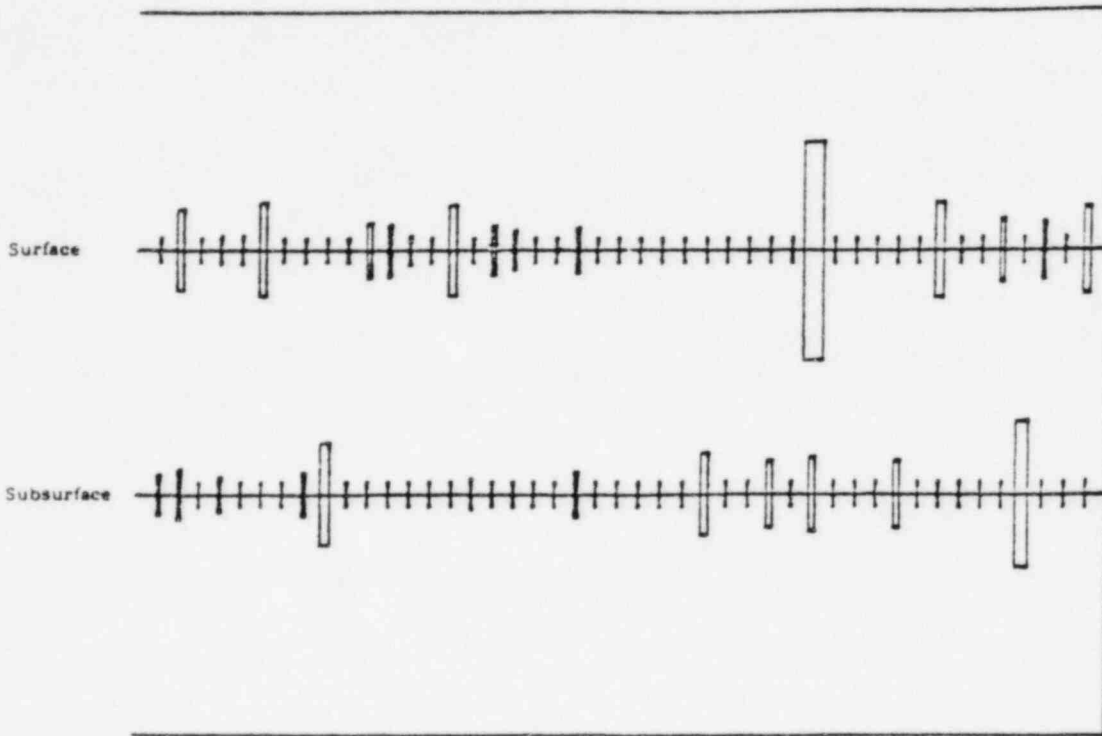


Figure 6.4-18

Samples plotted in identification increasing order from left to right.

Thorium-232
A Series (Soils)

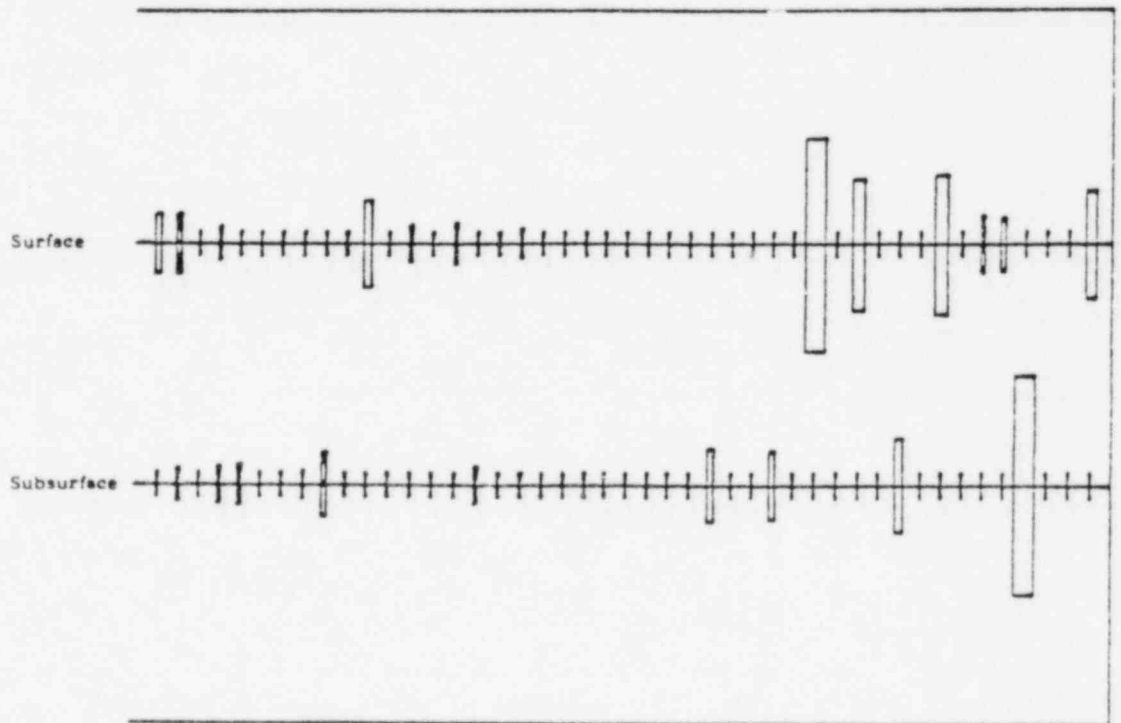


Figure 6.4-19

Samples plotted in identification increasing order from left to right.

Thorium-228
A Series (Soils)

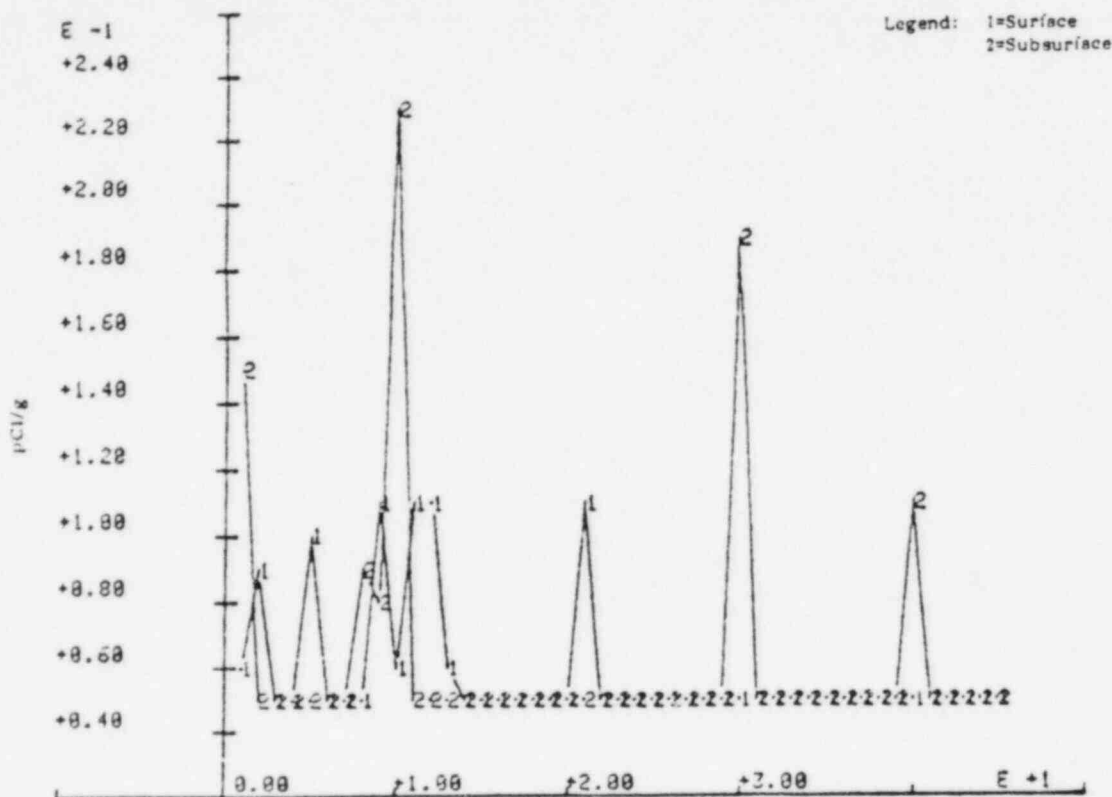


Figure 6.4-20

Samples plotted in identification increasing order from left to right.

Thorium-230
A Series (Soils)

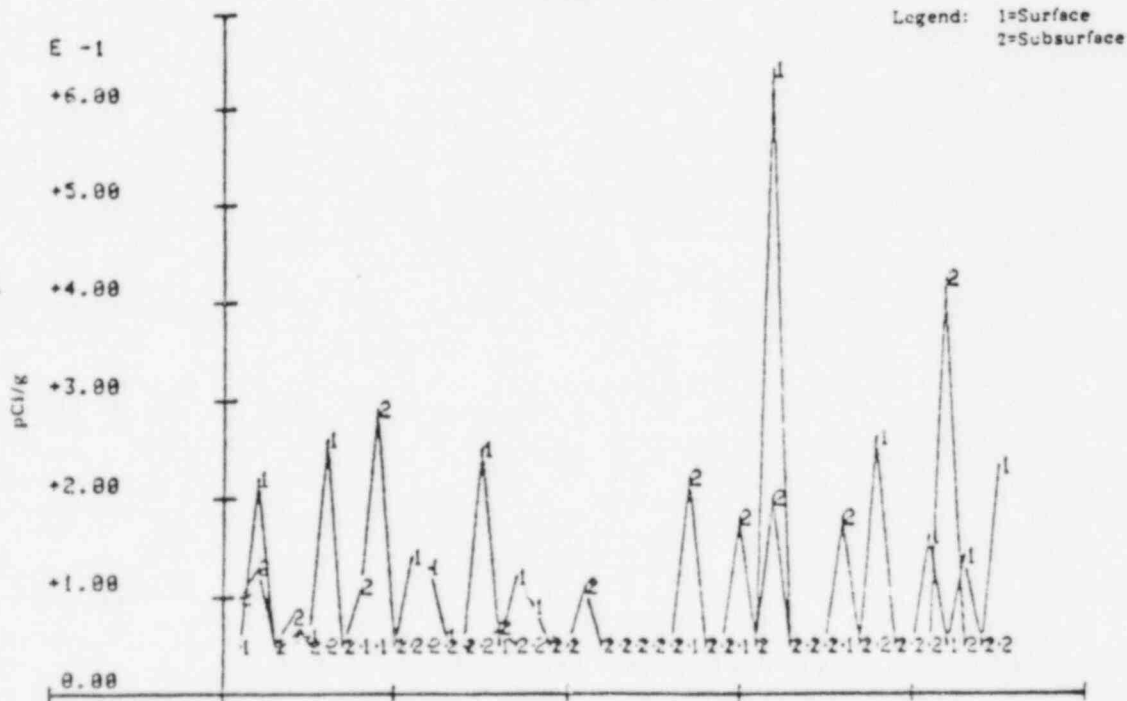
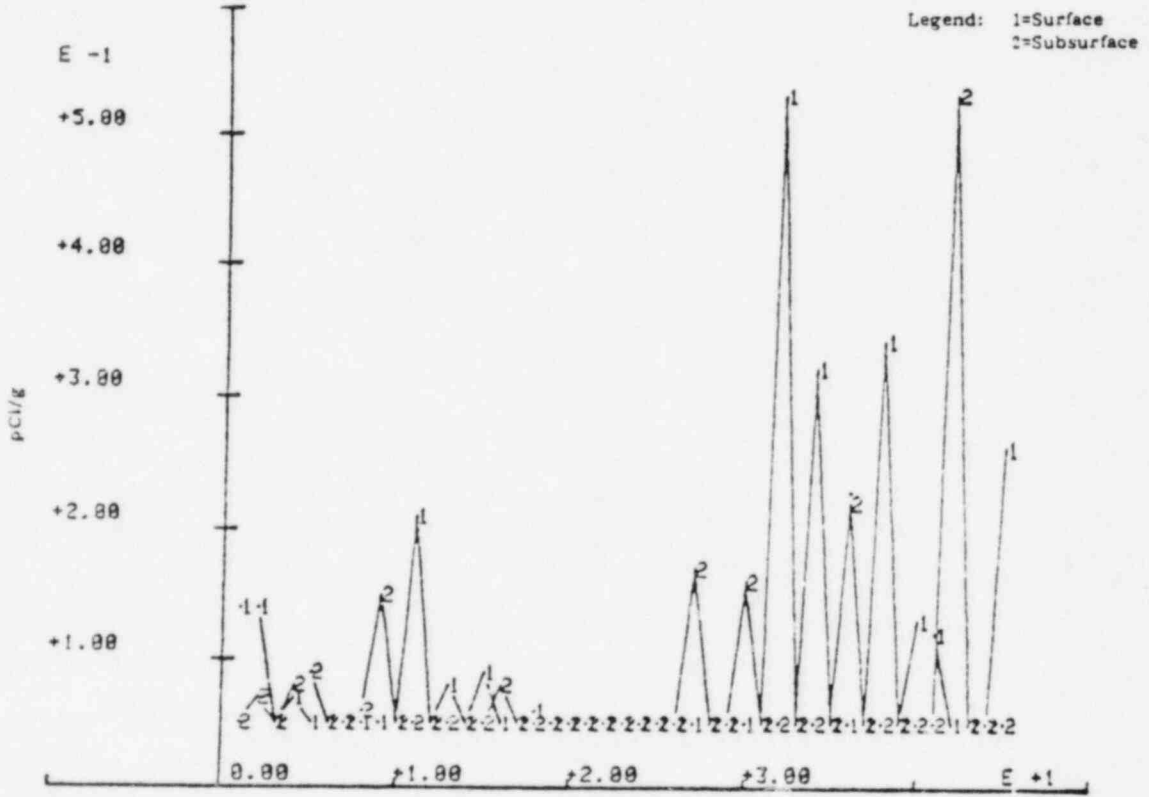


Figure 6.4-21

Samples plotted in identification increasing order from left to right.

Figure 6.4-22

Thorium-232
A Series (Soils)



Samples plotted in identification increasing order from left to right.

The thorium-228 data is normally below the 1981 mean background activity (0.068 pCi/gm - surface; 0.075 pCi/gm - sub-surface). Thorium-230 data (Figure 6.4-21) shows that approximately 25-30% of the results reported exceed 1981 mean background activity (0.087 pCi/gm - surface; 0.13 pCi/gm sub-surface). With respect to thorium-232 10-15% of the results are reported above the 1981 mean background activity (0.128 pCi/gm - surface; 0.125 pCi/gm - sub-surface). A review of the overall means for the thorium isotopes indicates the data is well below the 1981 thorium background means cited above. These means are presented in Table 6.4-6.

Table 6.4-6
Means and Confidence Intervals

Isotopes	Depth	Isotopic Thorium		pCi/gm	
		Background Mean	A Series Mean	95% Confidence Lower Limit	Interval Upper Limit
Th-228	Surface	0.068	0.090	0.063	0.118
	Sub-Surface	0.075	0.074	0.046	0.102
Th-230	Surface	0.087	0.097	0.072	0.122
	Sub-Surface	0.138	0.083	0.058	0.108
Th-232	Surface	0.128	0.058	0.050	0.065
	Sub-Surface	0.125	0.062	0.054	0.069

The cesium-137 data is illustrated in Figure 6.4-23. A-004 surface and A-003 sub-surface samples are reported as having the highest activities. A summary of the descriptive statistics for cesium-137 is presented in Table 6.4-7.

Table 6.4-7
Descriptive Statistics

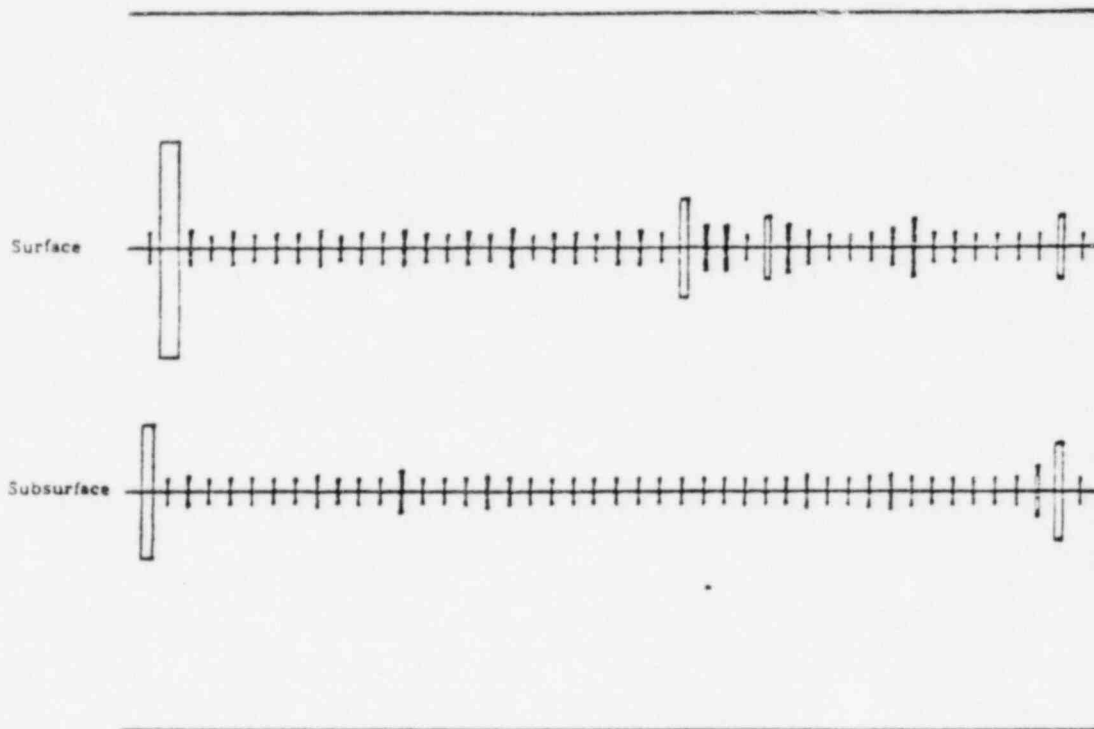
	Cesium-137	
	Surface pCi/gm	Sub-surface pCi/gm
N =	45	
Mean =	0.60	0.33
Variance =	1.58	0.61
Std Dev =	1.25	0.78
Data Min =	0.08	0.08
Data Max =	8	4.5
Data Range =	7.92	4.42
Standard err of mean =	0.18	0.11

As can be seen, the data range is large and the variance high. This variance is not clearly seen in Figures 6.4-23 and 6.4-24. However,

a close review of Figure 6.4-24 does indicate the data variability. It should be noted that approximately 89% of the surface samples are reported at less than the 1981 surface mean backgrounds (1.49 pCi/gm). Seventy-five percent (75%) of the subsurface results are reported at less than the 1981 sub-surface mean background (0.18 pCi/gm).

Figure 6.4-23

Cesium-137
A Series (Soils)

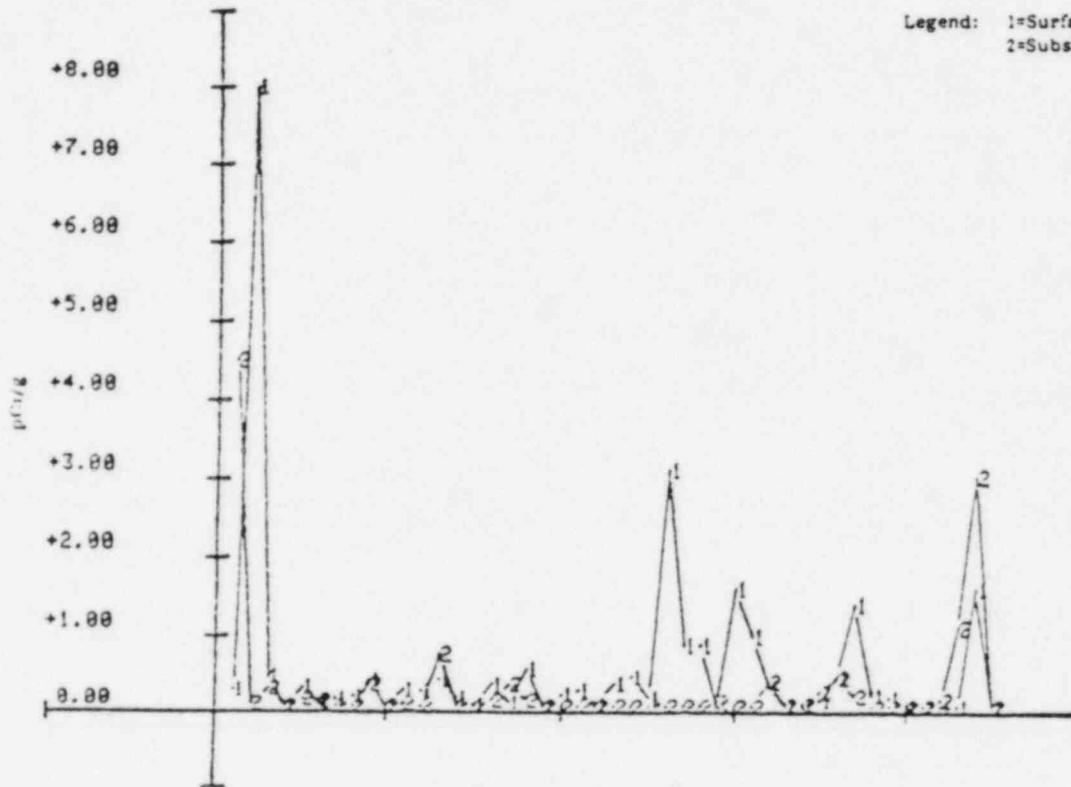


Samples plotted in identification increasing order from left to right.

Figure 6.4-24

Cesium-137
A Series (Soils)

Legend: 1=Surface
2=Subsurface



Samples plotted in identification increasing order from left to right.

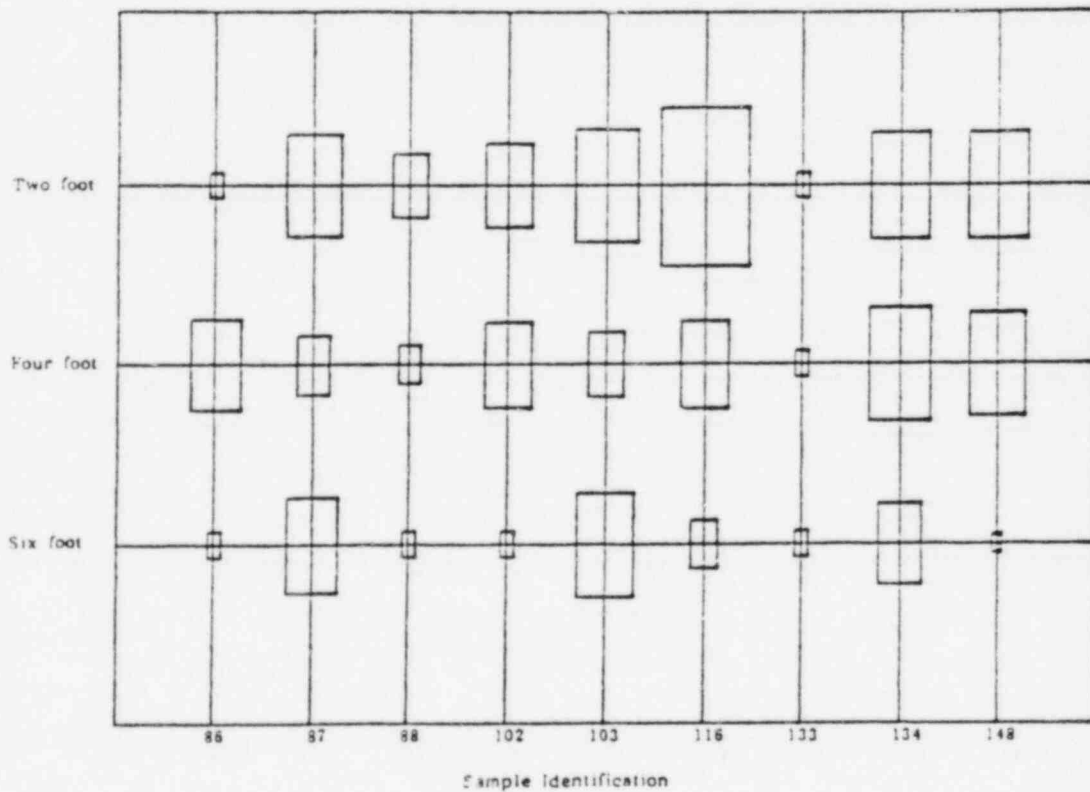
6.5 Core Samples "A" Series

The analytical data for the "A" series samples is presented in Appendix "C". A core was taken at two (2), four (4) and six (6) foot intervals and submitted for analysis.

Variance of the gross alpha and gross beta analyses is graphically illustrated in Figures 6.5-1 and 6.5-2. These figures demonstrate that the activity does not necessarily decrease with depth. The data is plotted in Figures 6.5-3 and 6.5-4.

Figure 6.5-1

Gross Alpha
A Series (Soil Cores)



Gross Beta
A Series (Soil Cores)

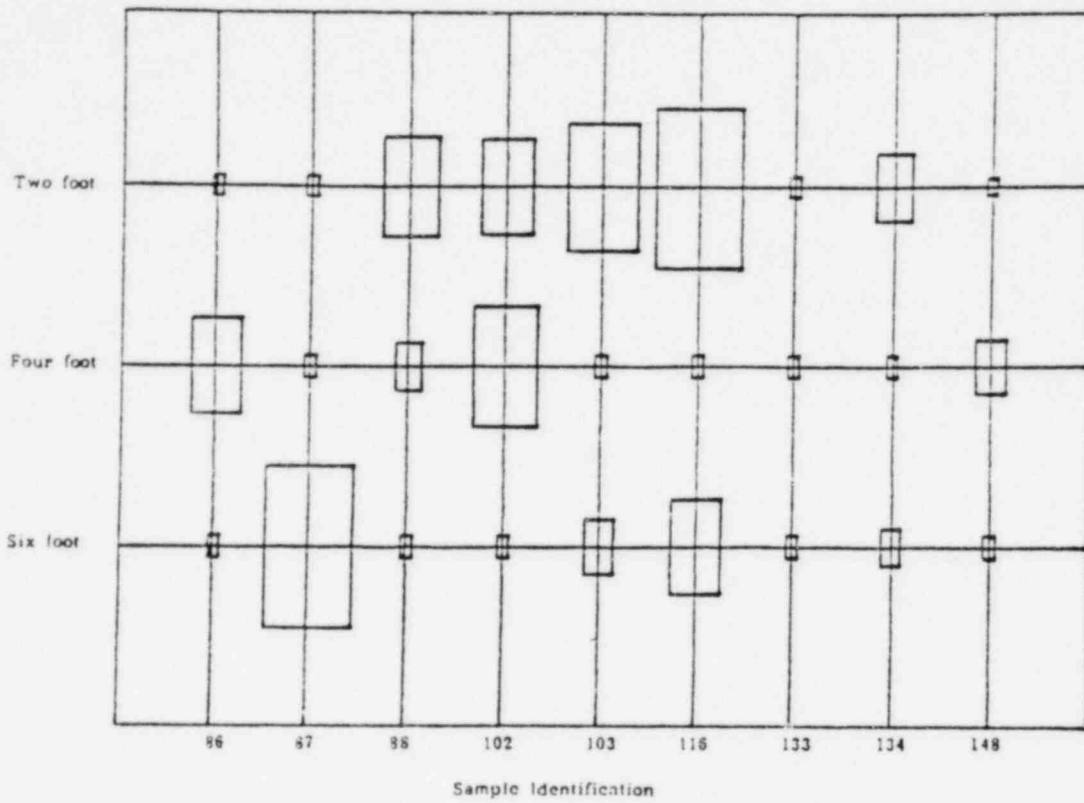


Figure 6.5-2

Gross Alpha
A Series (Soil Cores)

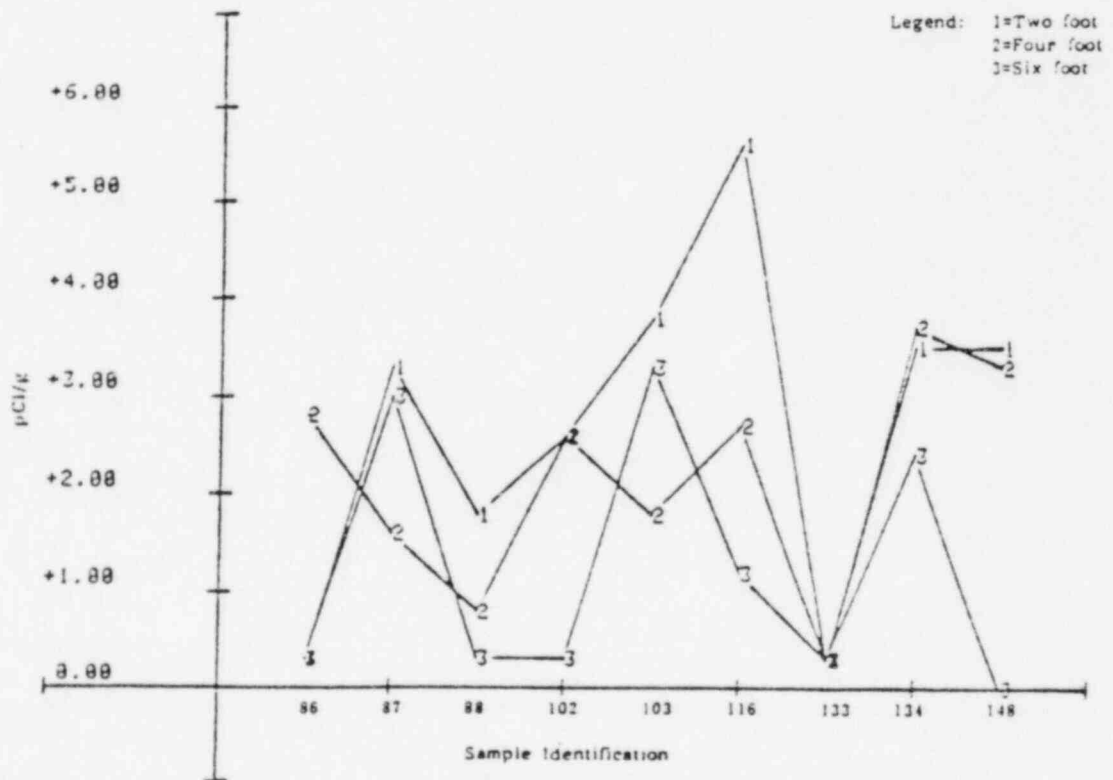
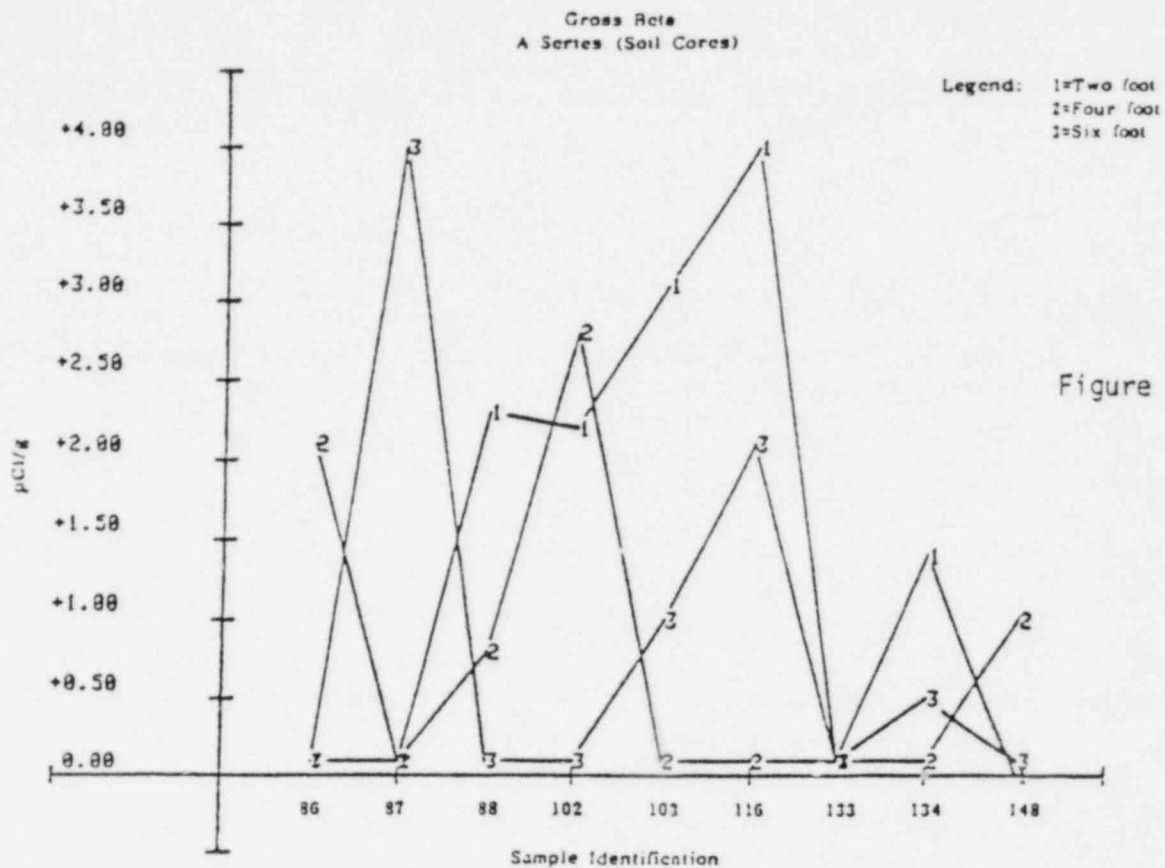


Figure 6.5-3



As may be seen (Figure 6.5-3), the gross alpha activities for the two (2) foot core samples generally are higher than those for the four (4) and six (6) foot core samples. The gross beta results as seen from Figures 6.5-2 and 6.5-4 illustrate that the two (2) foot core samples do not have the higher activity. Additionally, Figure 6.5-4 also illustrates the variance of the gross beta activity by depth and by cores.

Although the variance in data is less for gross alpha than for gross beta an analysis of the core means indicates the opposite effect. Figures 6.5-5 and 6.5-6 illustrates the core means plus or minus their respective ninety-five percent (95%) confidence intervals.

Gross Alpha
A Series (Soil Core Means)

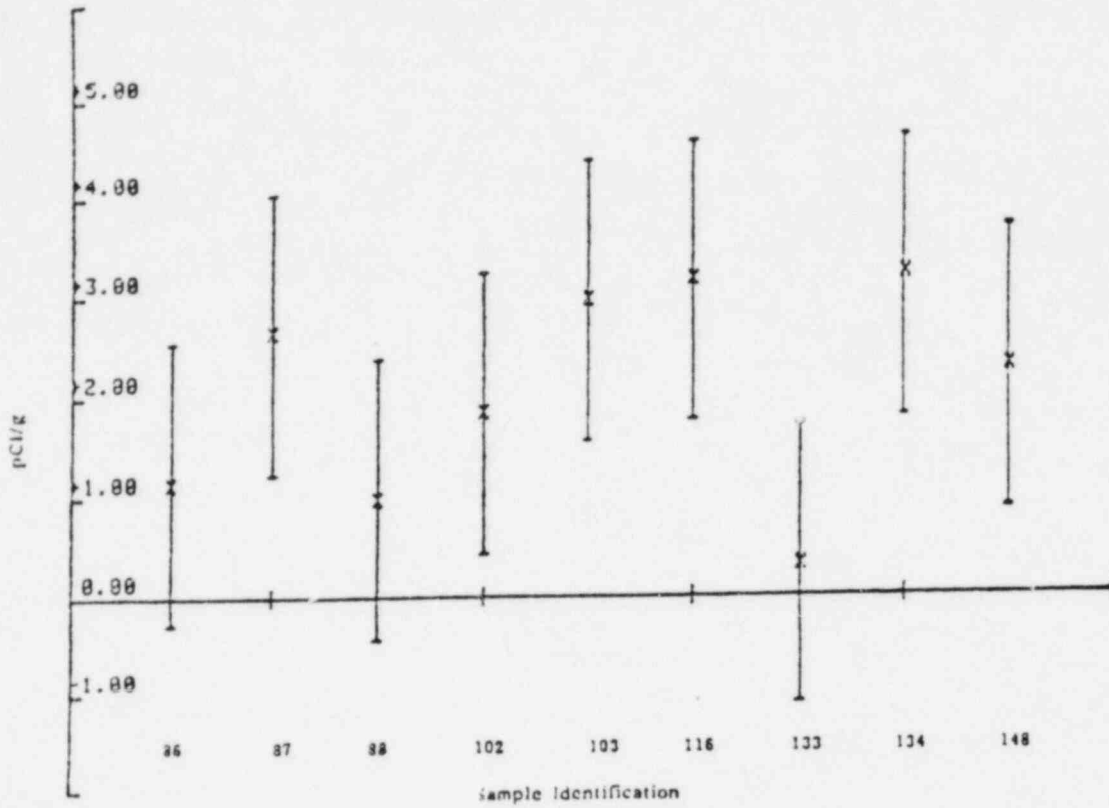


Figure 6.5-5

Gross Beta
A Series (Soil Core Means)

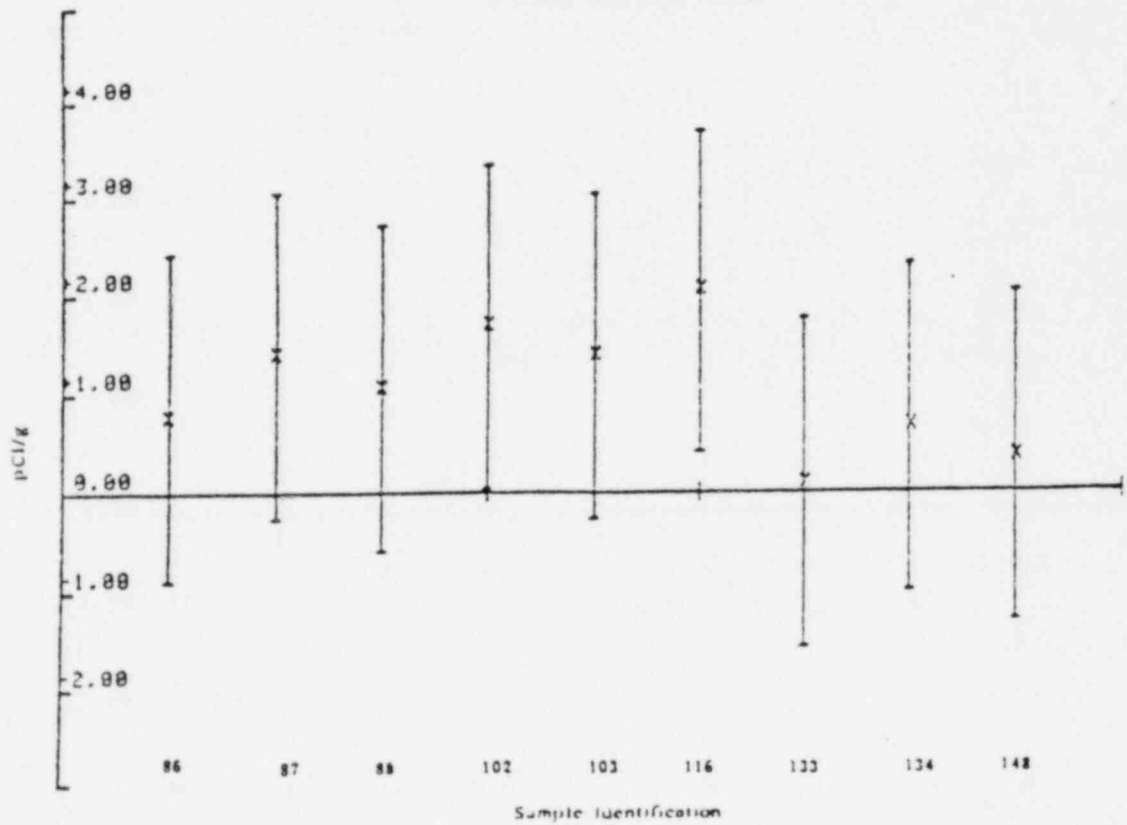
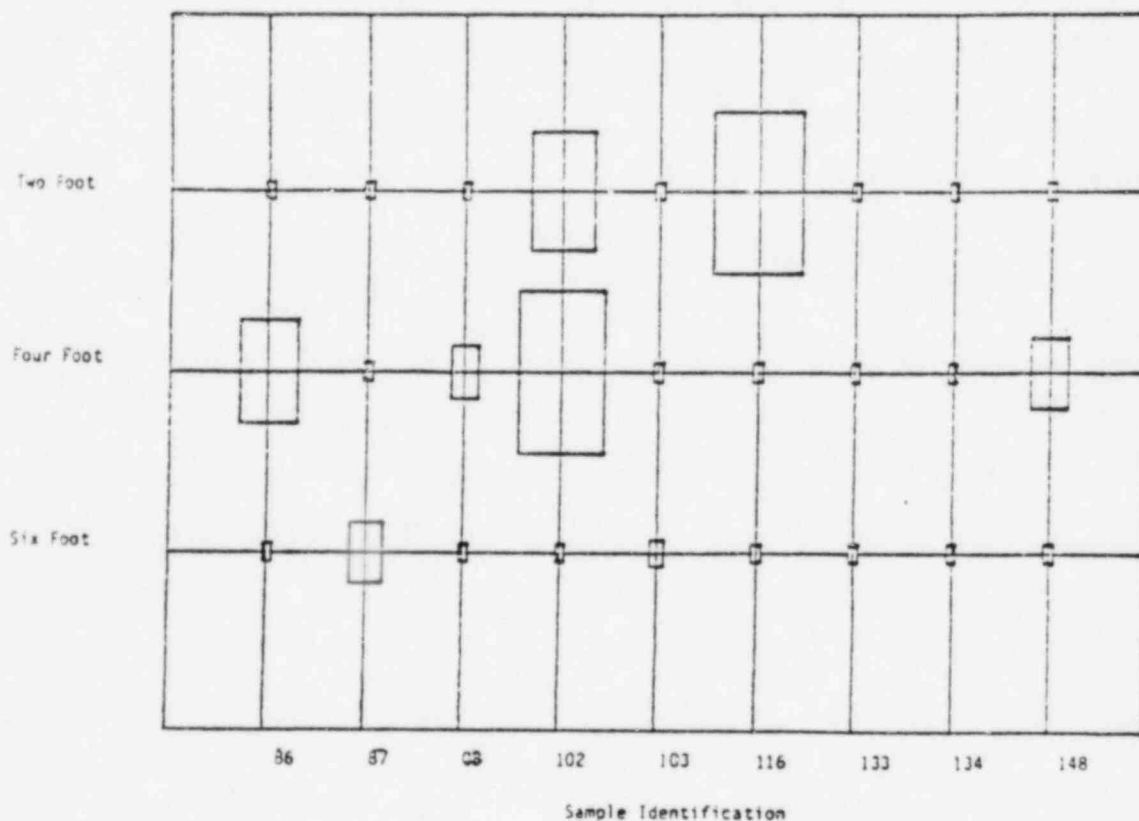


Figure 6.5-6

A review of the background data indicates that both gross alpha and gross beta core means are well below the mean backgrounds presented in Tables 6.2-2 and 6.2-3. An evaluation of the individual subsurface data results illustrates that they are also well below the 1981 subsurface mean backgrounds (4.4 pCi/gm-alpha and 4.2 pCi/gm-beta) with one exception noted for the two (2) foot core sample at Station A-116.

Figure 6.5-7

Radium-226
A series (Soil Cores)



Radium-226
A Series (Soil Cores)

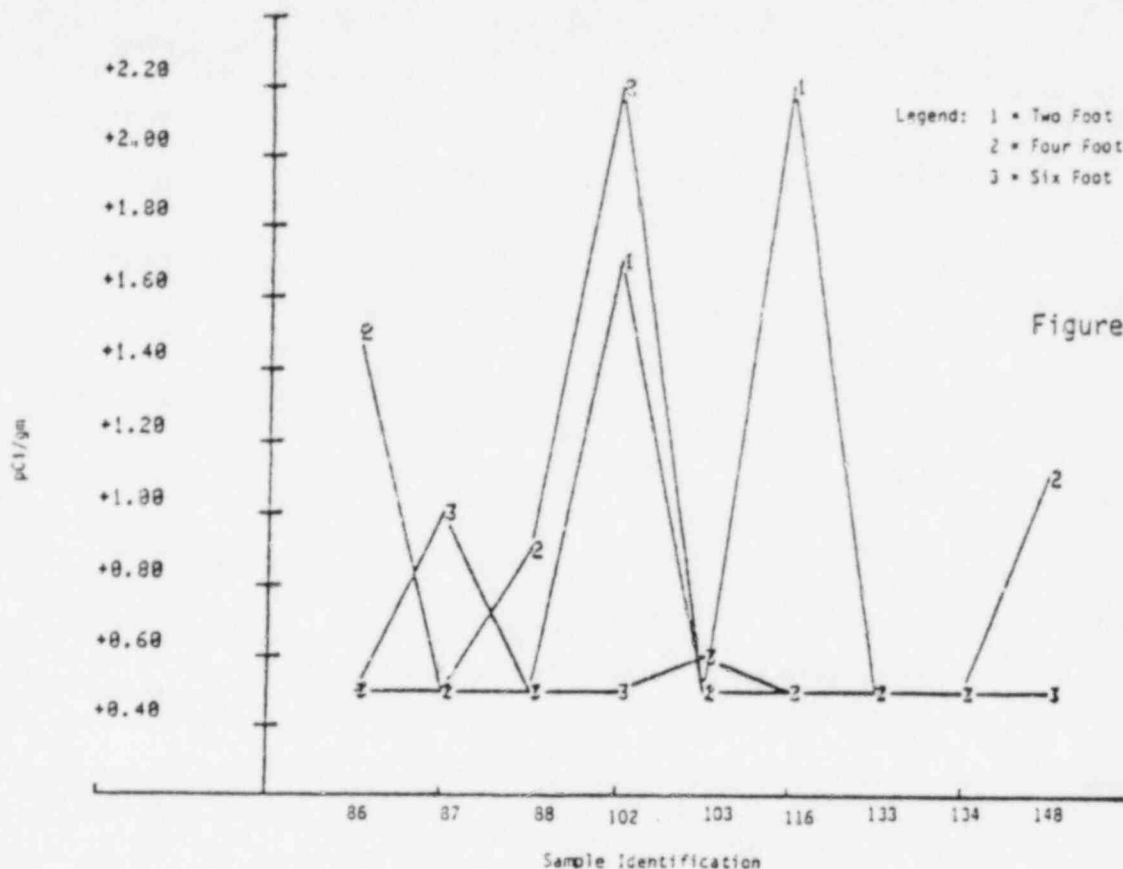


Figure 6.5-8

The radium-226 data is graphically illustrated in Figures 6.5-7 and 6.5-8. For statistical analysis the data reported at less than 0.5 pCi/gm was considered to be as 0.5 pCi/gm. As can be seen from these figures, the majority of the data was reported at or near the lower limit of detection (0.5 pCi/gm). Figure 6.5-9 illustrates the core means plus or minus their respective ninety-five percent (95%) confidence intervals. Sixty-seven percent (67%) of the core means are below the 1981 mean subsurface background (0.71 pCi/gm). As a further breakdown, seventy-seven percent (77%) of the two (2) foot, fifty-five (55%) of the four (4) foot and eighty-eight percent (88%) of the six foot cores are at or below the 1981 subsurface mean background (0.71 pCi/gm).

Radium-226
A Series (Soil Cores)

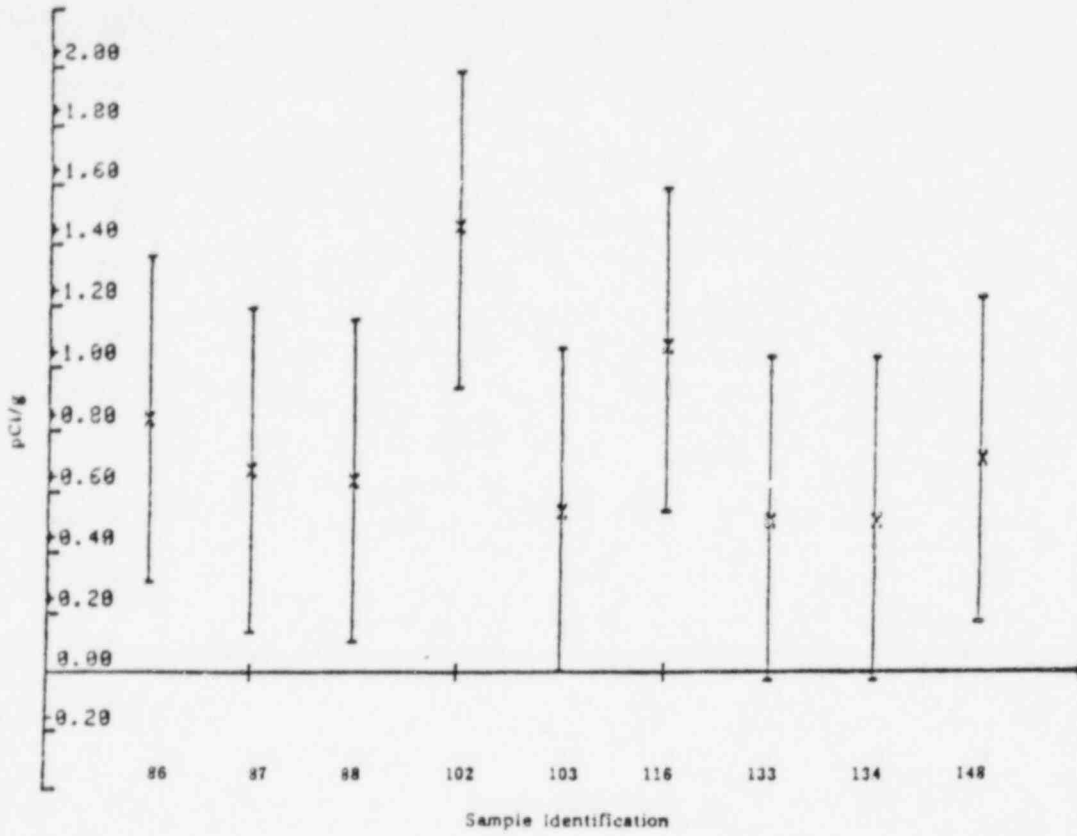


Figure 6.5-9

Radium-228
A Series (Soil Cores)

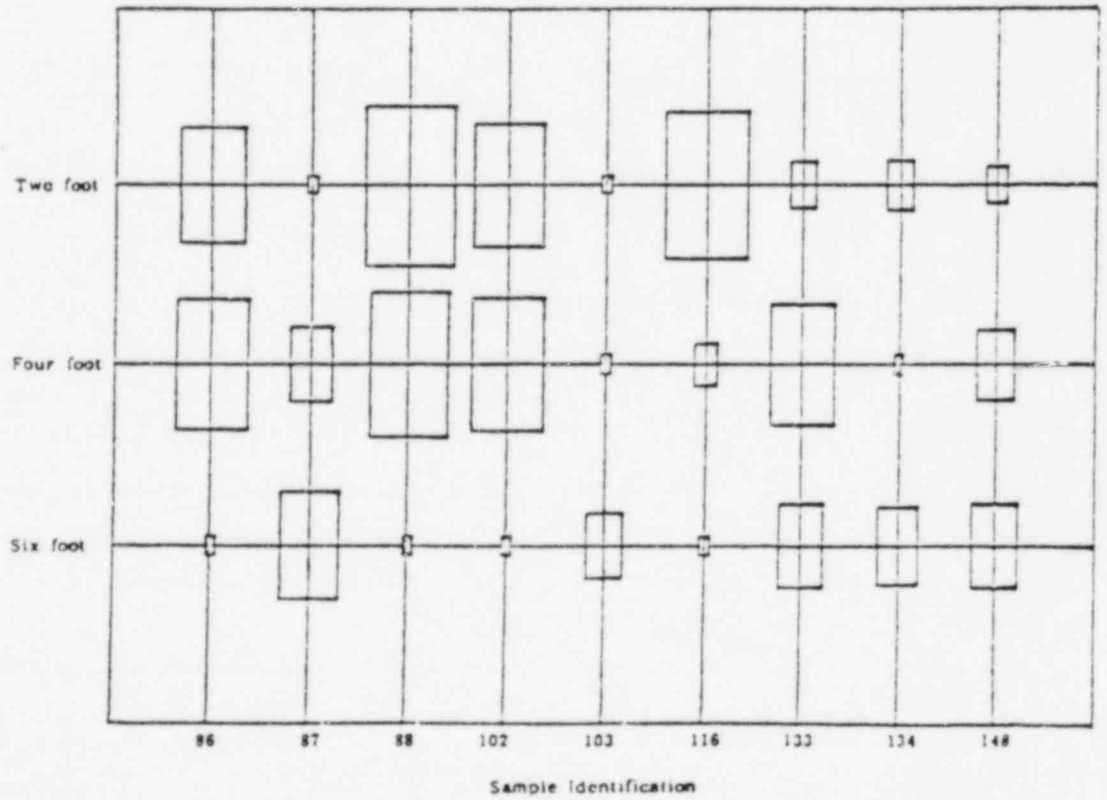


Figure 6.5-10

Radium-228
A Series (Soil Cores)

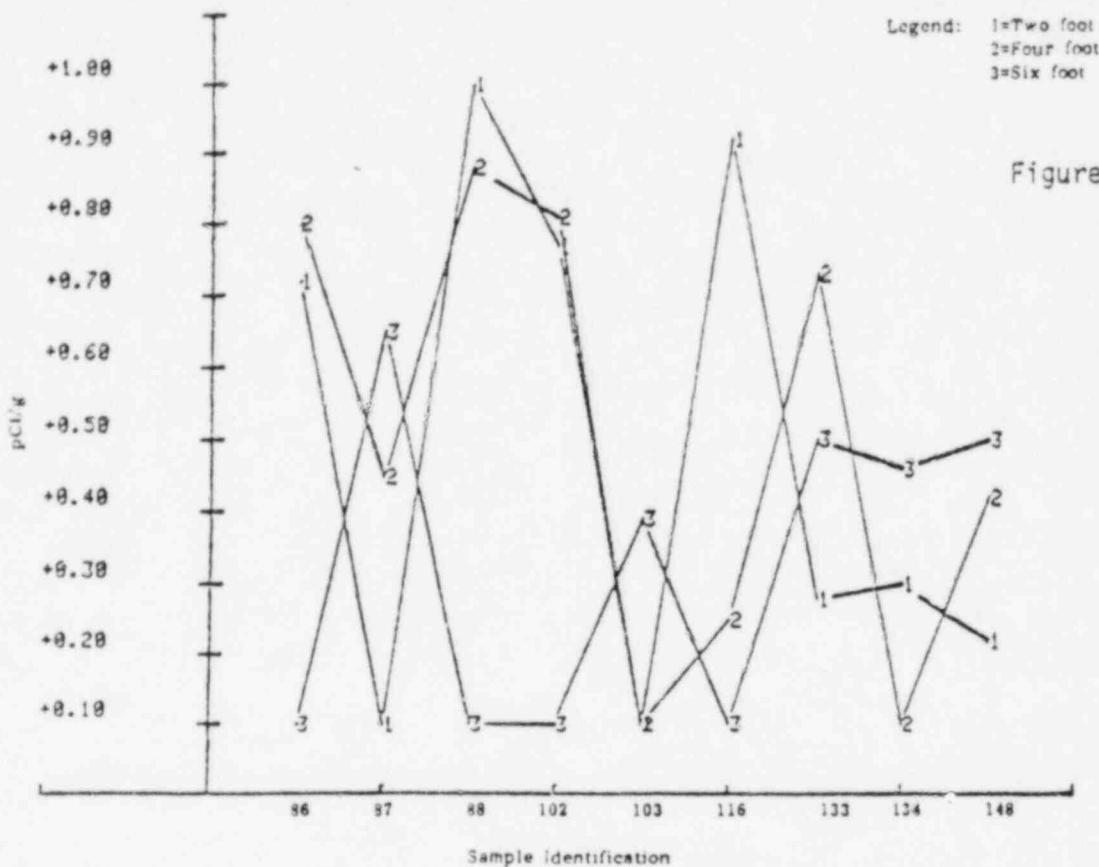


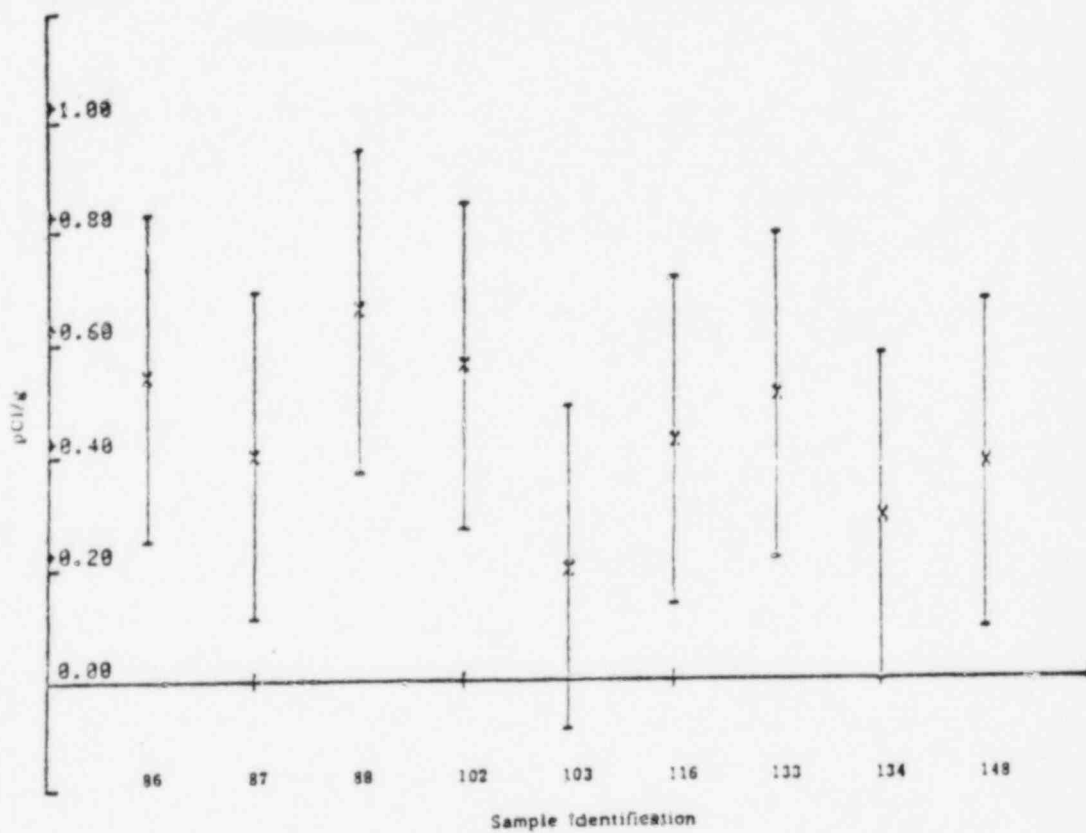
Figure 6.5-11

The data for radium-228 is illustrated in Figure 6.5-11 which shows the distribution and variance of activity by depth and core samples. The data is also plotted with the activity on the vertical scale in Figure 6.5-11. This figure also illustrates the data ranges for the cores. The 1981 mean background for subsurface soils was 0.39 pCi/gm.

It can be seen that approximately sixty-six percent (66%) of the overall core means are above the background activity (Figure 6.5-11).

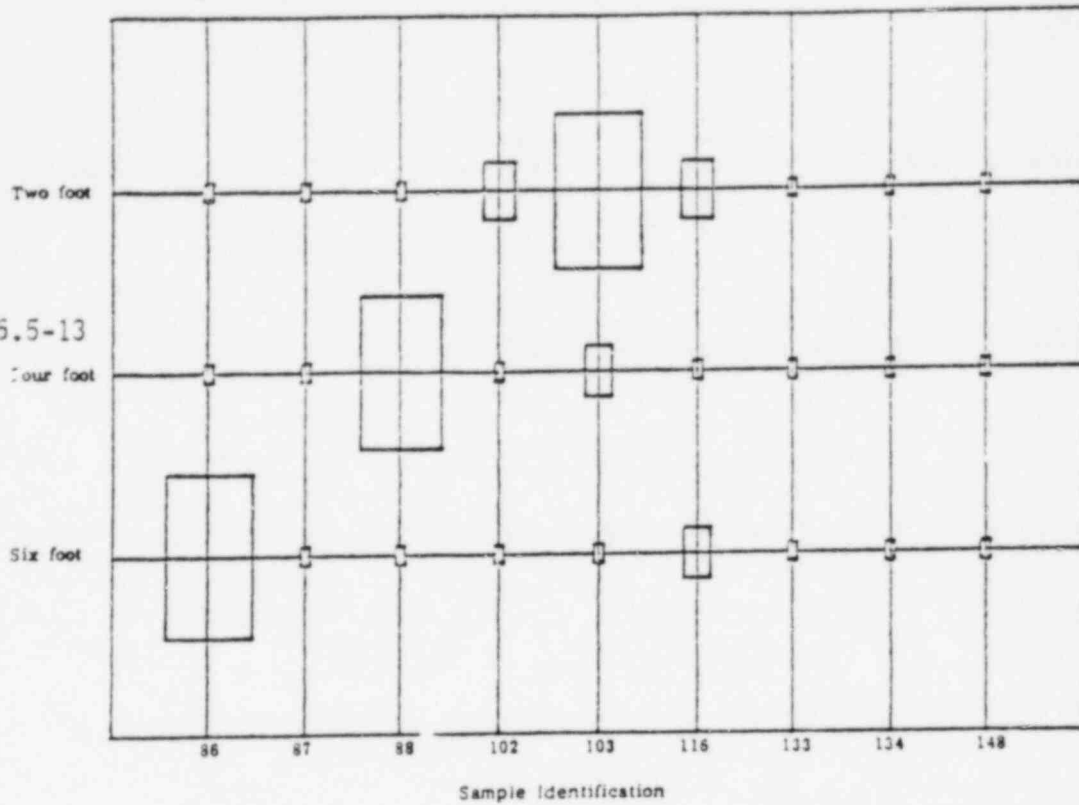
Figure 6.5-12

Radium-228
A Series (Soli Cores)



Strontium-90
A Series (Soil Cores)

Figure 6.5-13



The strontium-90 data is graphically illustrated in Figures 6.5-13. Figure 6.5-14 shows that, generally, the data is less than 0.15 pCi/gm. The data is normally well below the 1981 mean subsurface background (0.05 pCi/gm). However, a review of the overall core mean reveals that only thirty-three per cent (33%) of the cores are below the subsurface background (Figure 6.5-15).

Strontium-90
A Series (Soil Cores)

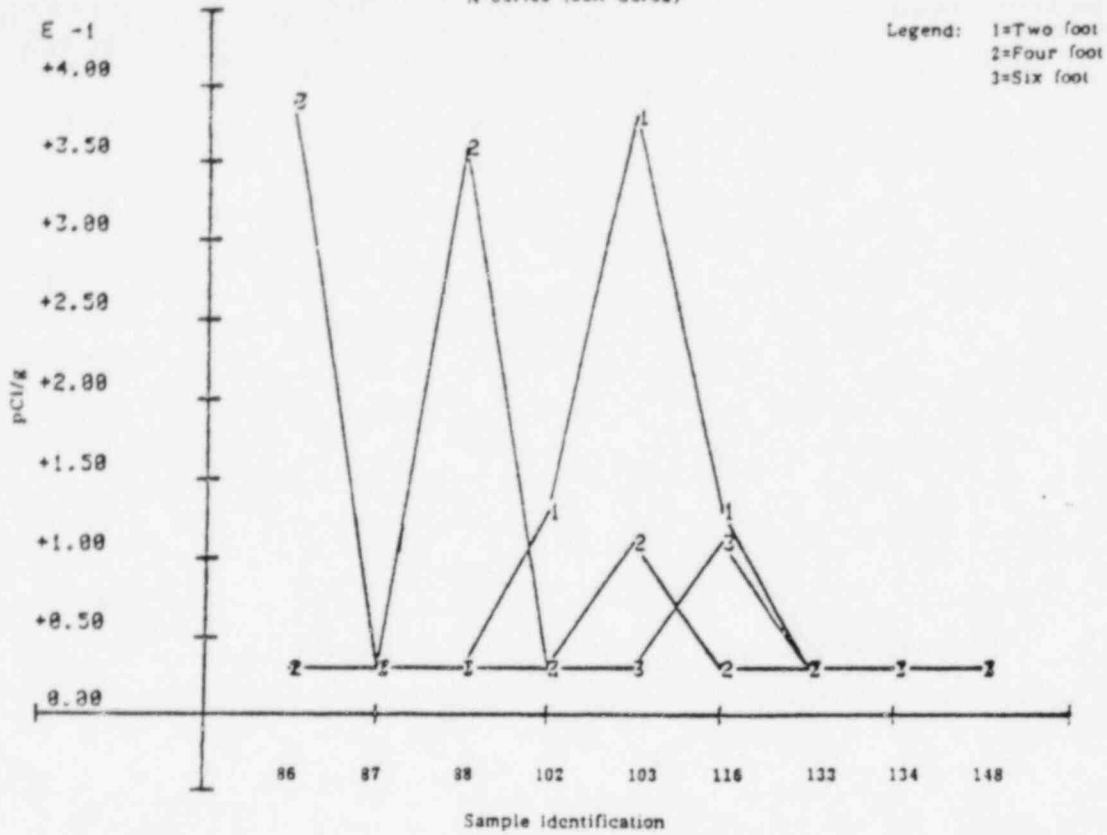
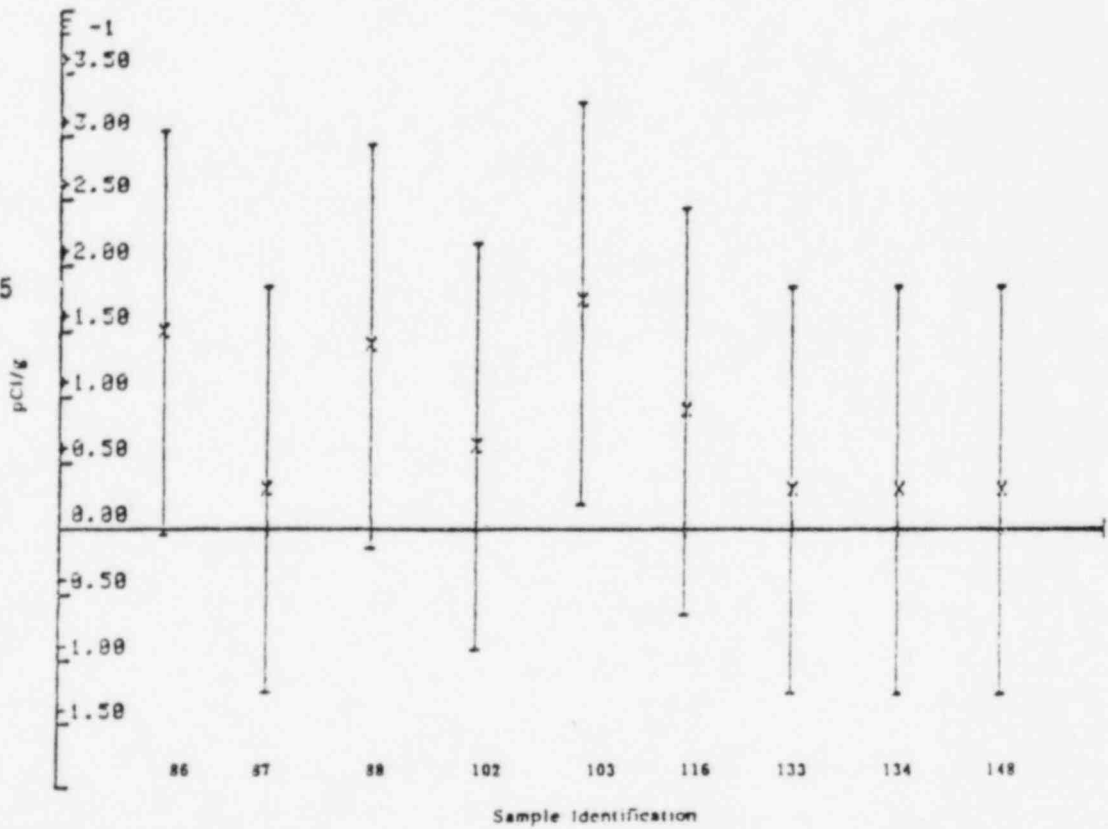
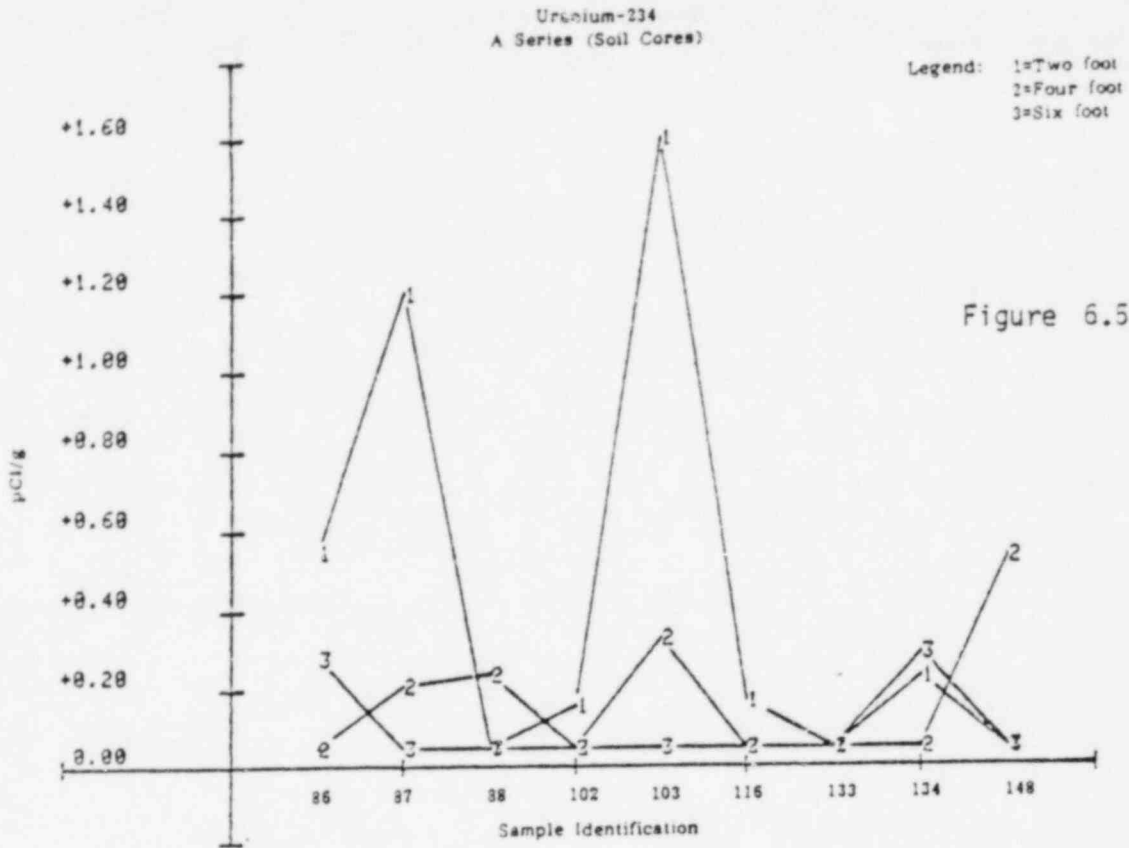


Figure 6.5-14

Strontium-90
A Series (Soil Cores)

Figure 6.5-15





The isotopic uranium data is graphically illustrated in Figures 6.5-16 through 6.5-18. These figures show that, in general, the data is well below the 1981 mean background values reported (U-234 = 1.12 pCi/gm, U-235 = 0.26 pCi/gm and U-238 = 0.94 pCi/gm).

Uranium-235
A Series (Soil Cores)

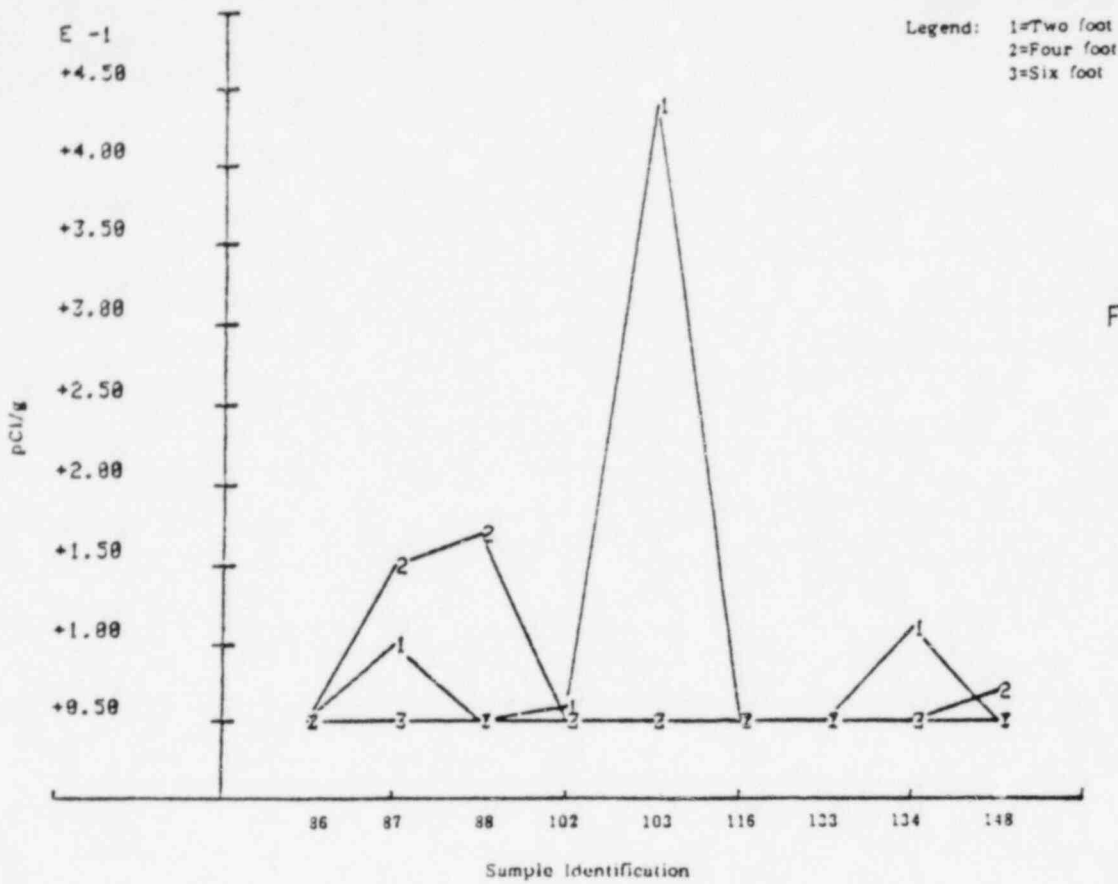


Figure 6.5-17

Uranium-238
A Series (Soil Cores)

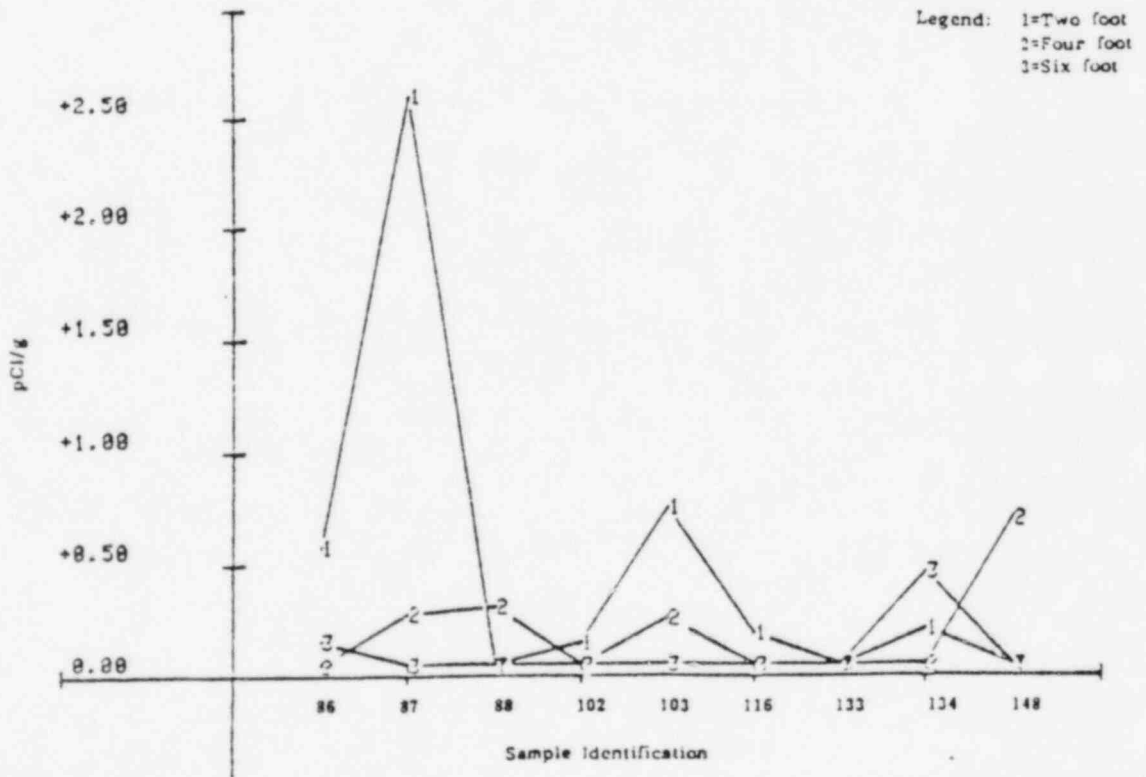


Figure 6.5-18

Uranium-234
A Series (Soil Cores)

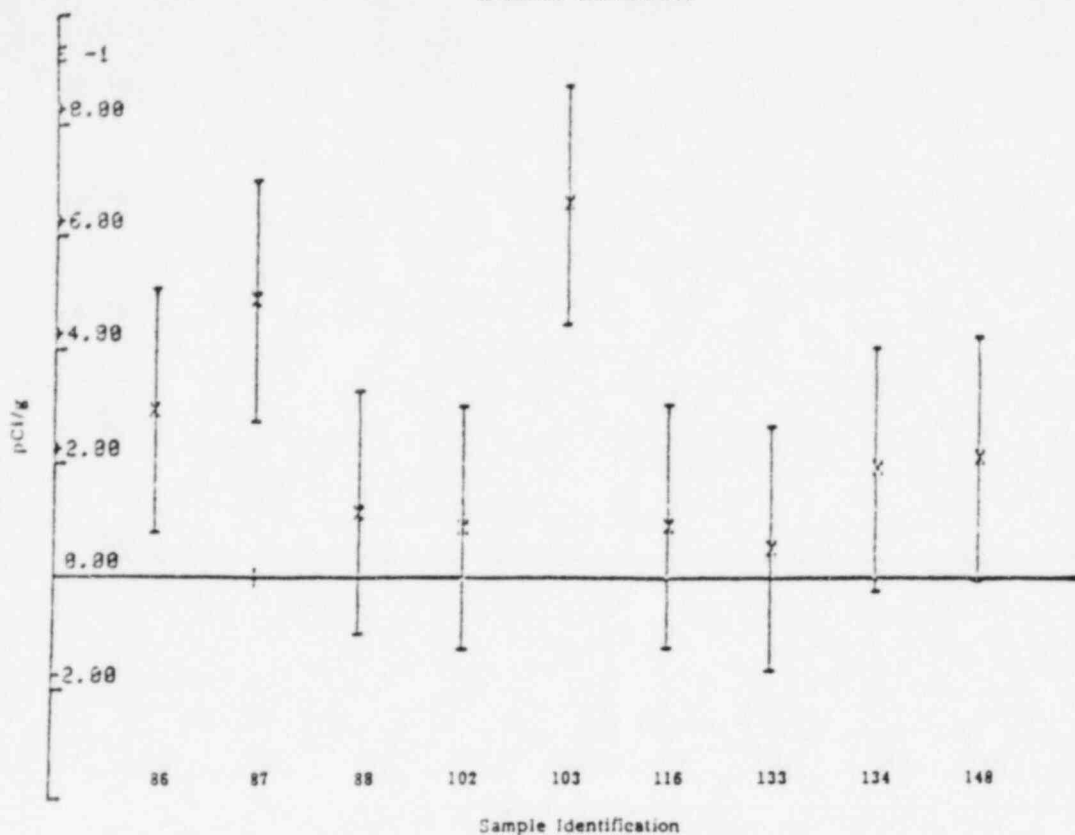


Figure 6.5-19

Uranium-235
A Series (Soil Cores)

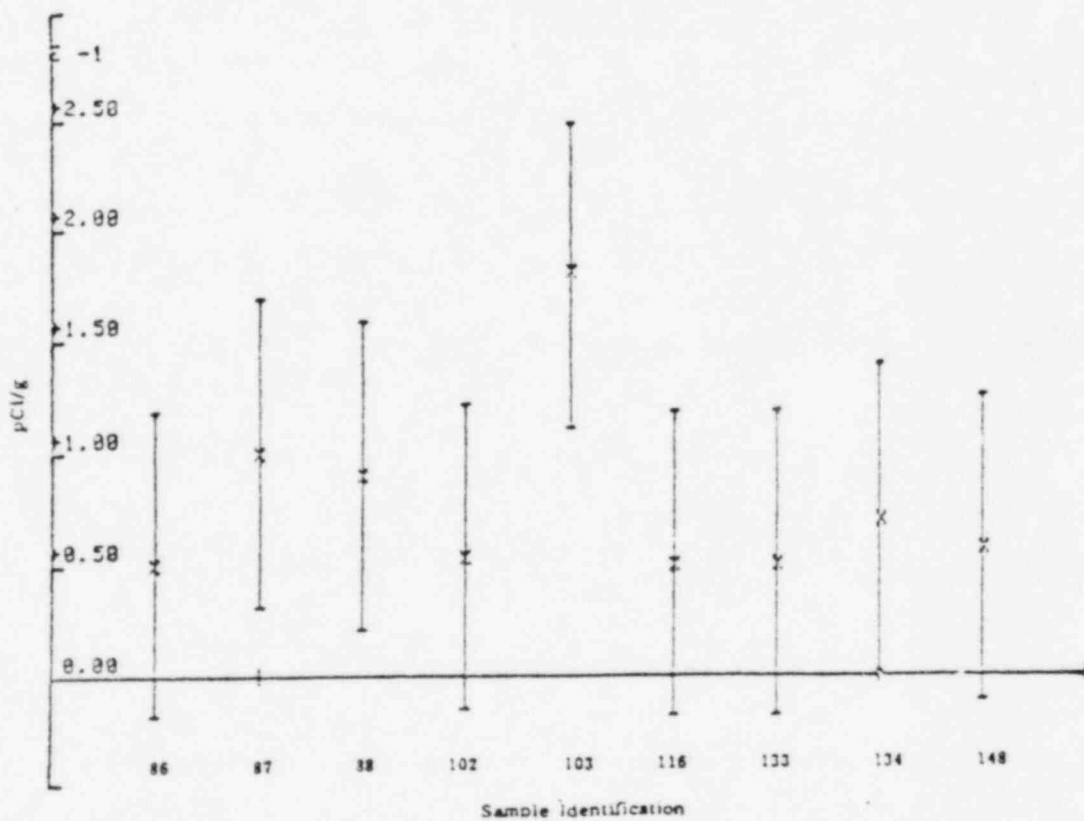


Figure 6.5-20

Uranium-238
A Series (Soil Cores)

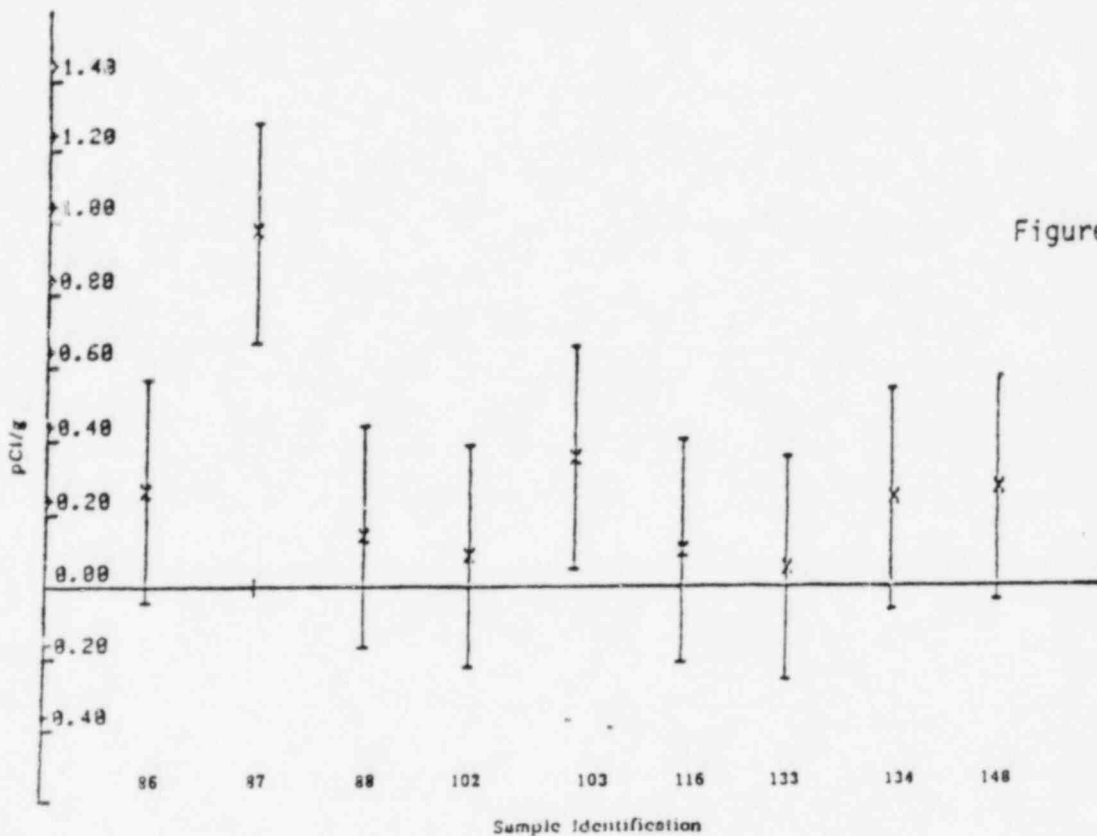


Figure 6.5-21

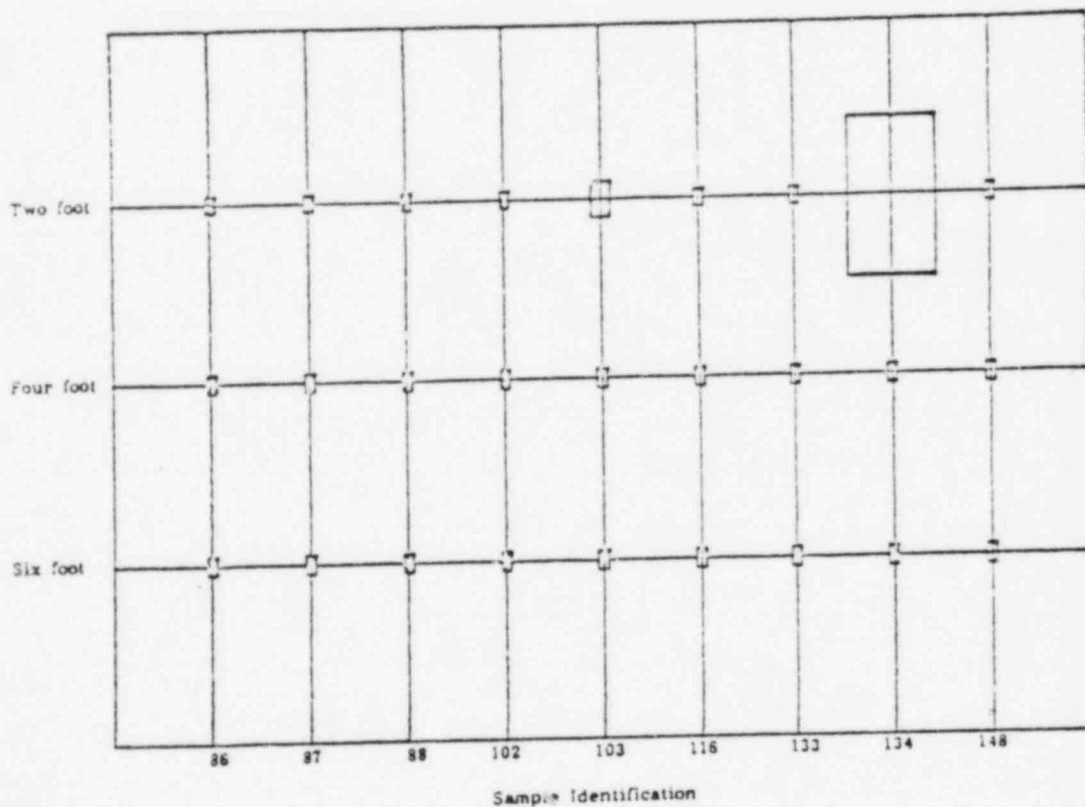
Figures 6.5-21 through 6.5-21 illustrates the core mean activities for each uranium isotope. These figures show the core means are well below the 1981 mean subsurface background activities noted above.

The thorium data illustrated in Figures 6.5-22 through 6.5-25 indicates the thorium-238 data is fairly consistent for all cores.

However, the data for thorium-230 and thorium-232 shows some variability both with respect to depth and to cores. This is illustrated in the line plots (Figures 6.5-26 through 6.5-27).

Figure 6.5-22

Thorium-228
A Series (Soil Cores)



Thorium-230
A Series (Soil Cores)

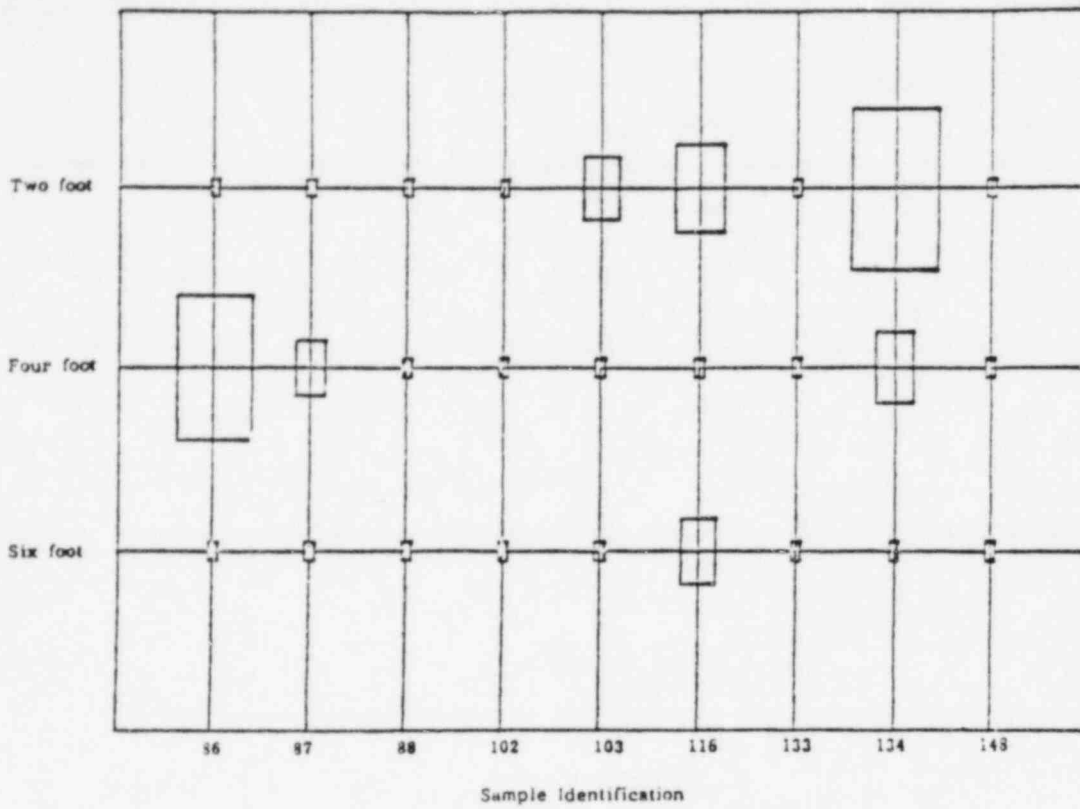


Figure 6.5-23

Thorium-230
A Series (Soil Cores)

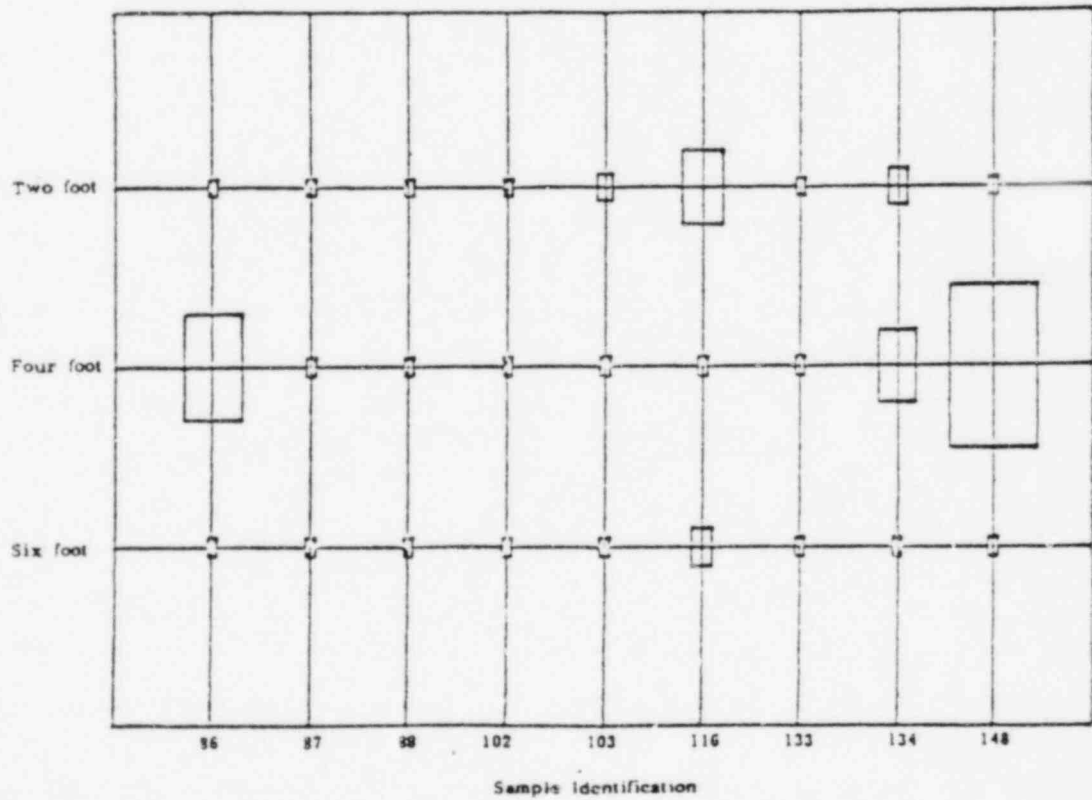


Figure 6.5-24

Thorium-228
A Series (Soil Cores)

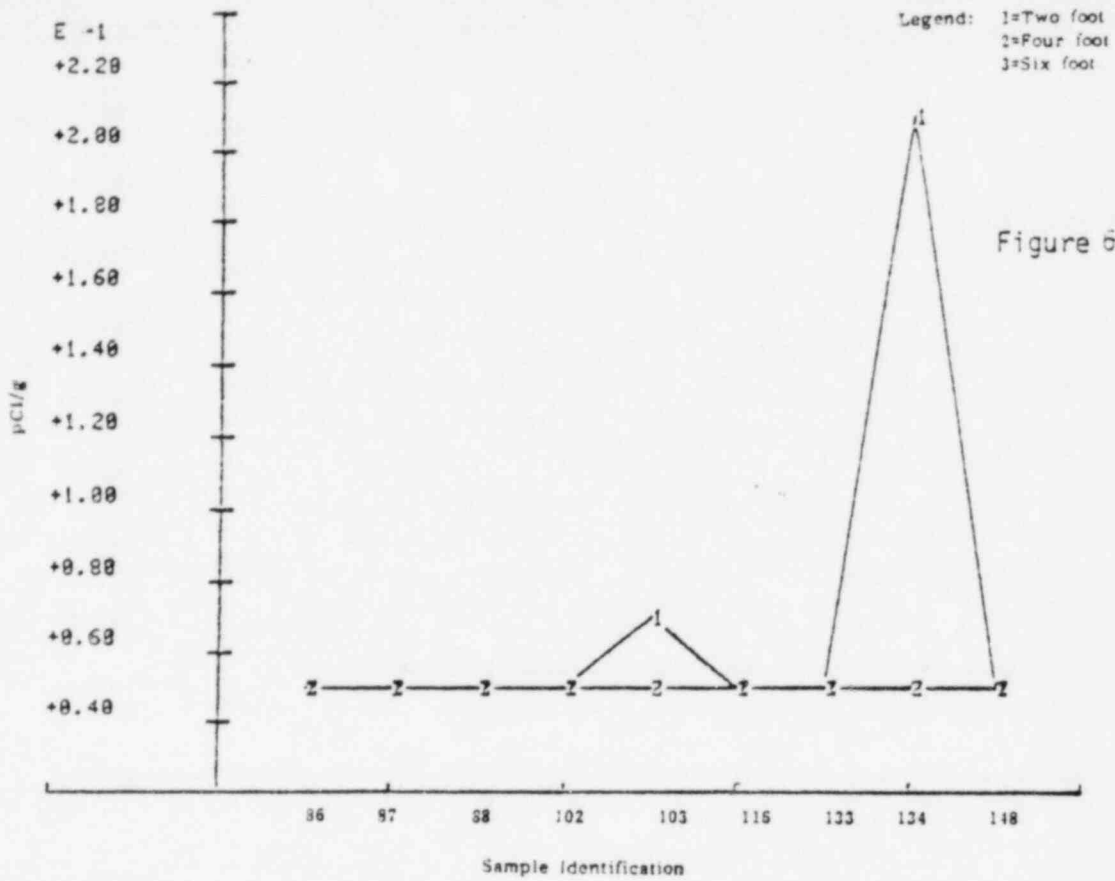


Figure 6.5-25

The 1981 mean background activities were reported in Table 6.2-3 as 0.075 pCi/gm, 0.13 pCi/gm and 0.12 pCi/gm respectively for thorium-228, thorium-230 and thorium-232. The mean activity for the cores are generally below the 1981 mean background activities as stated above. This is illustrated in Figures 6.5-28 through 6.5-30.

Thorium-230
A Series (Soil Cores)

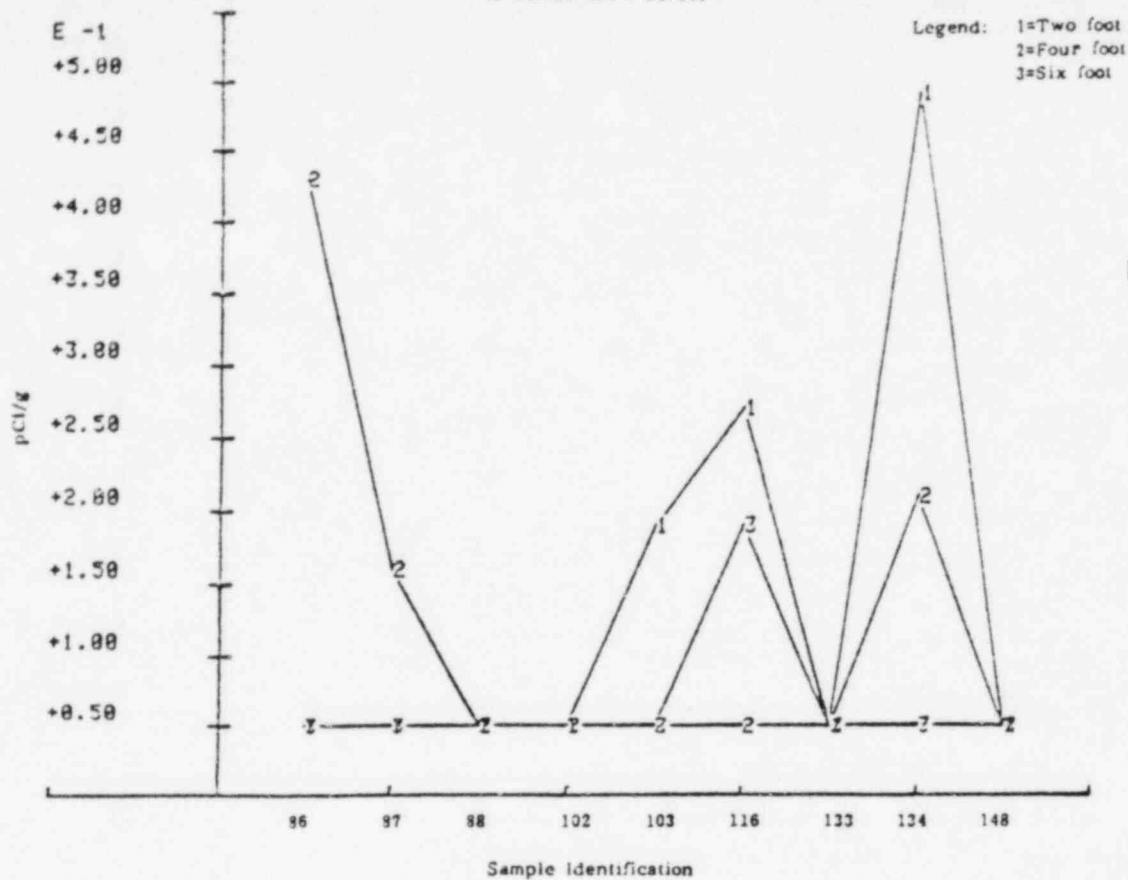


Figure 6.5-26

Thorium-232
A Series (Soil Cores)

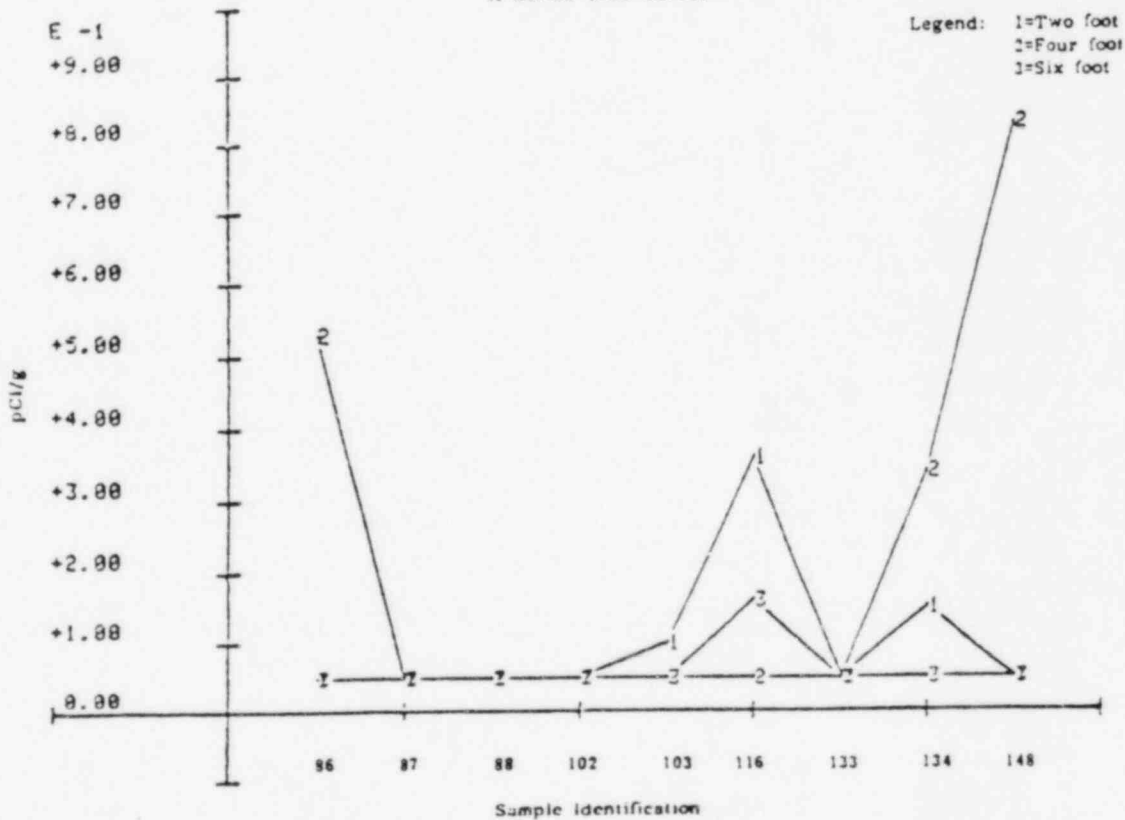


Figure 6.5-27

Thorium-230
A Series (Soil Cores)

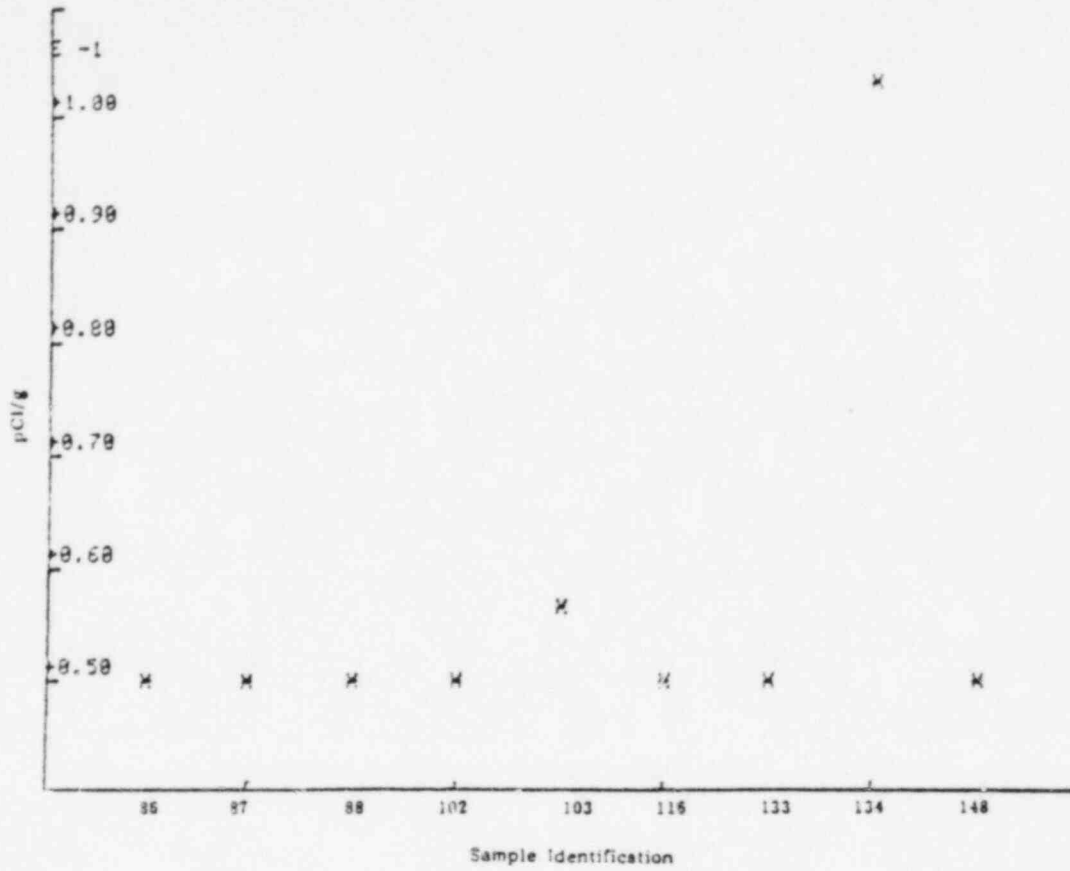


Figure 6.5-28

Thorium-230
A Series (Soil Cores)

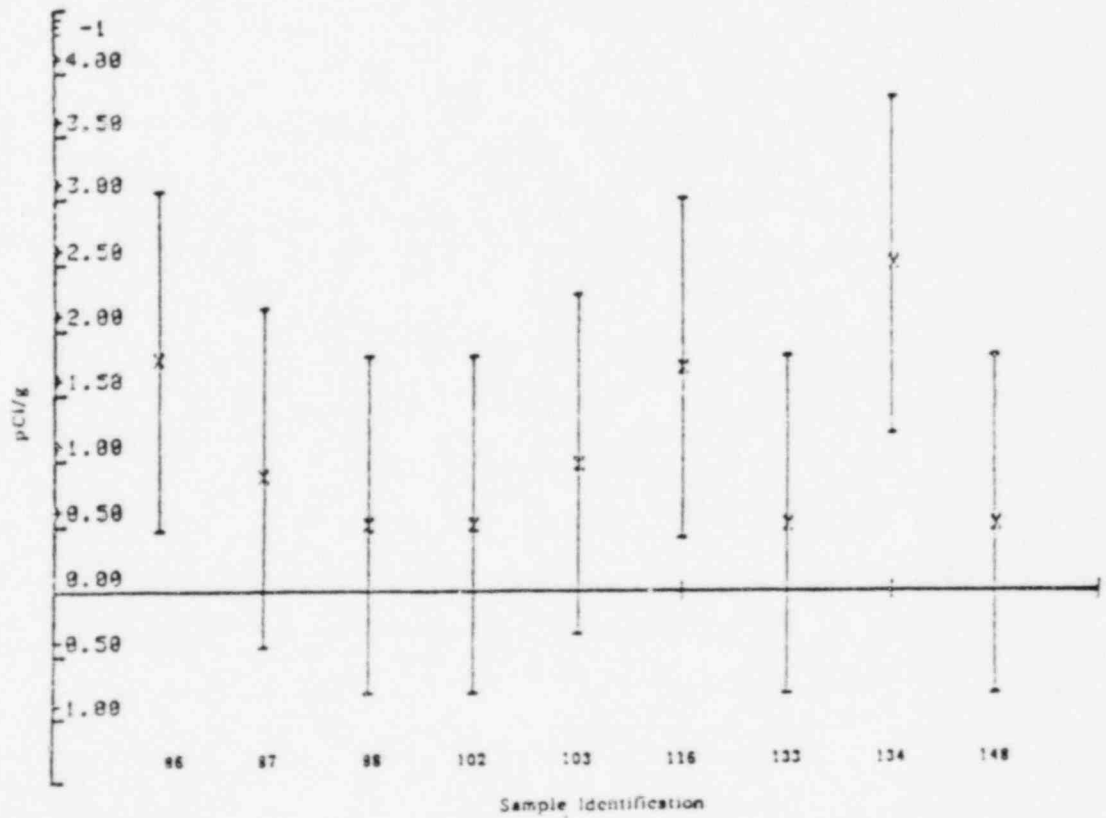
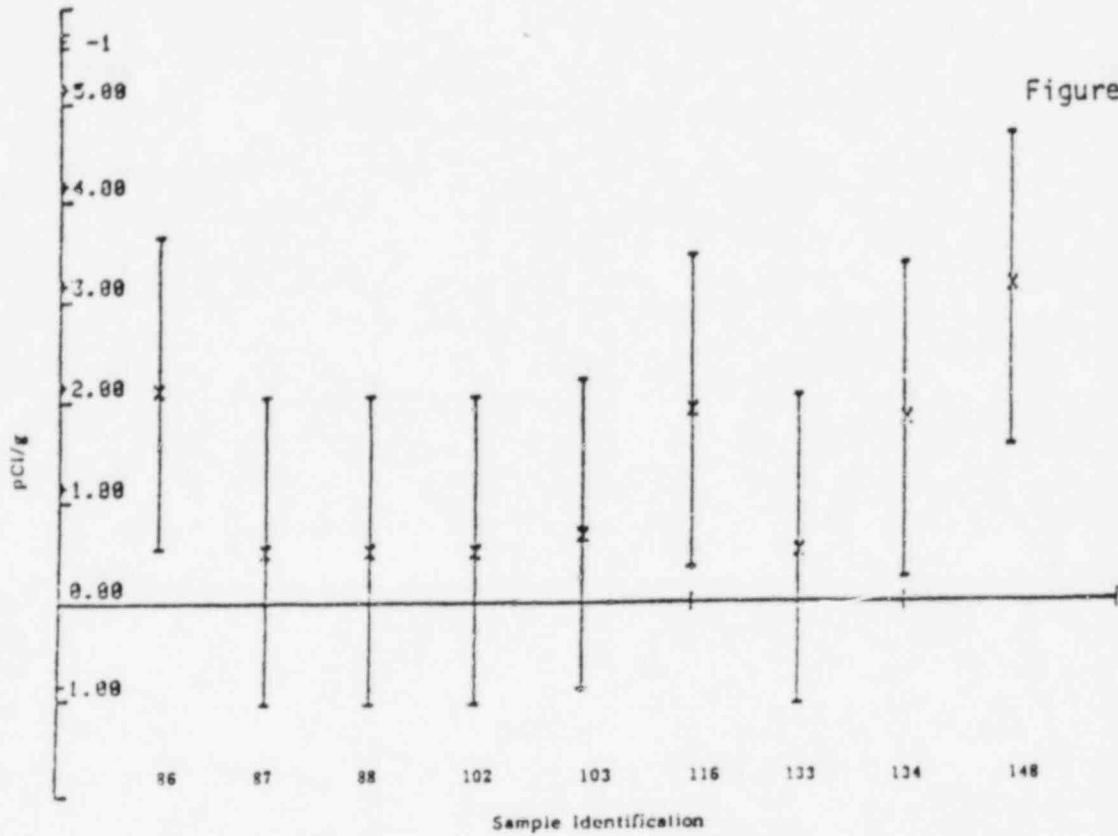


Figure 6.5-29

Thorium-232
A Series (Soil Cores)



The cesium-137 data is represented in Figure 6.5-31. This figure demonstrates that the data was generally less than 0.08 pCi/gm which is well below the 1981 mean subsurface background (0.18 pCi/gm). The core means and their respective ninety-five percent (95%) confidence intervals are well below the 1981 mean background activity (Figure 6.5-33).

Cesium-137
A Series (Soil Cores)

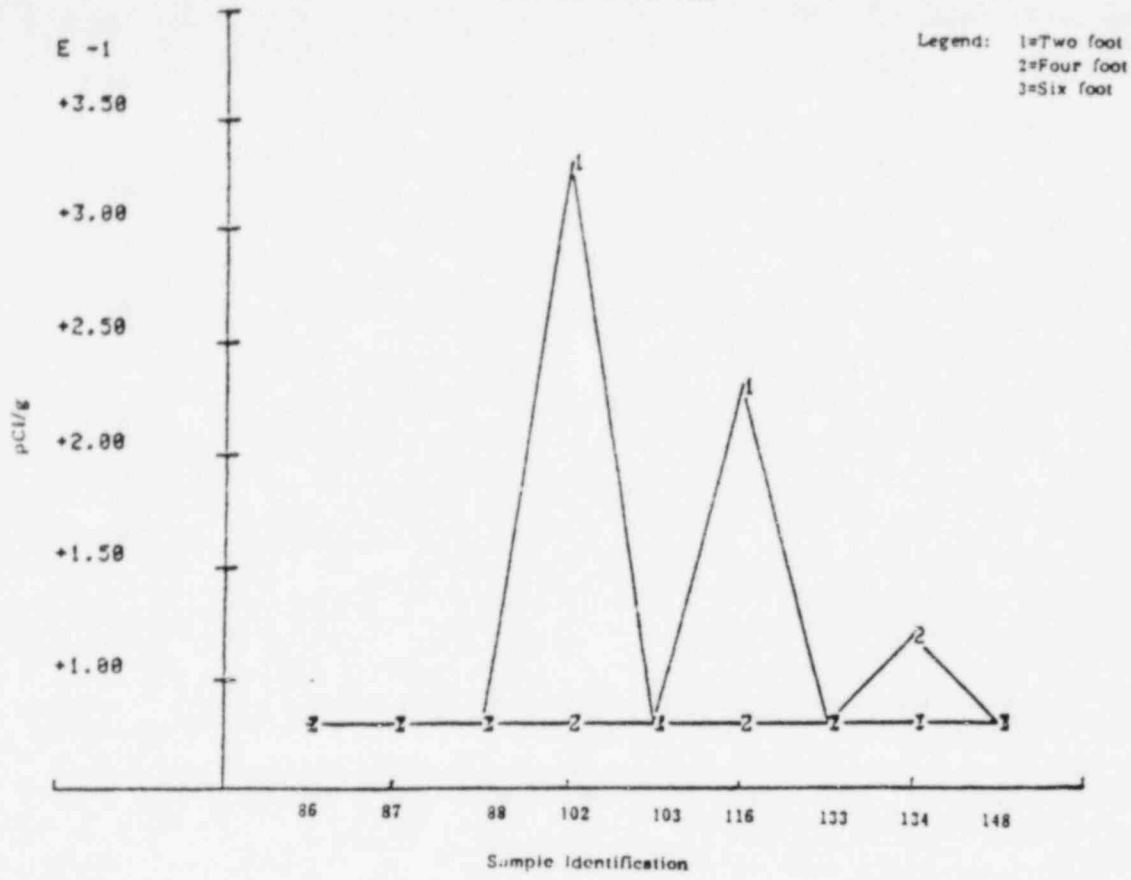


Figure 6.5-31

Cesium-137
A Series (Soil Cores)

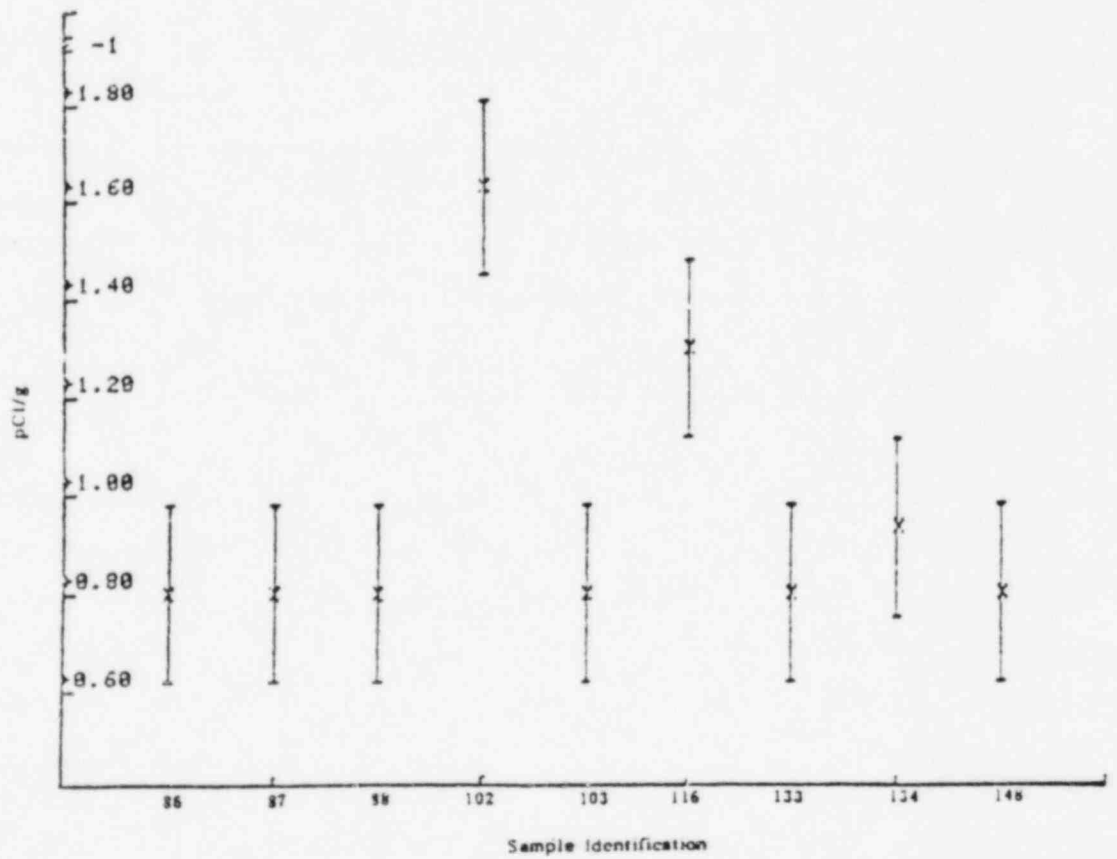


Figure 6.5-32

The solubility test data is presented in Appendix "C". A review of this data shows that the results are less than or equal to the activity in the original soil sample. Generally, the data was less than the respective isotope lower limits of detection.

6.6 Soil - B Series

These soil samples were all collected inside the inner security fence, with a large number of samples taken in a grid pattern. Therefore, the statistical analyses performed used the variance of unbalanced data. Unbalanced data was used due to several grids having structures or other objects making it impossible to collect surface and subsurface samples. Figure 6.6-1 illustrates the grid and sample identifications used for the variance of the data. In addition, due to the large number of data points, the surface and subsurface data is illustrated in separate figures throughout this section. The subsurface samples for the rectangular plots are corrected to the same scale as the surface sample for comparison purposes.

The data for the series sampled were not plotted after background correction due to the variance and amount of sample activity which would not affect the conclusions shown. The descriptive statistics for each parameter were determined and tabulated along with the uncorrected statistics. As may be seen from the tables the data for both the corrected and uncorrected are statistically equal.

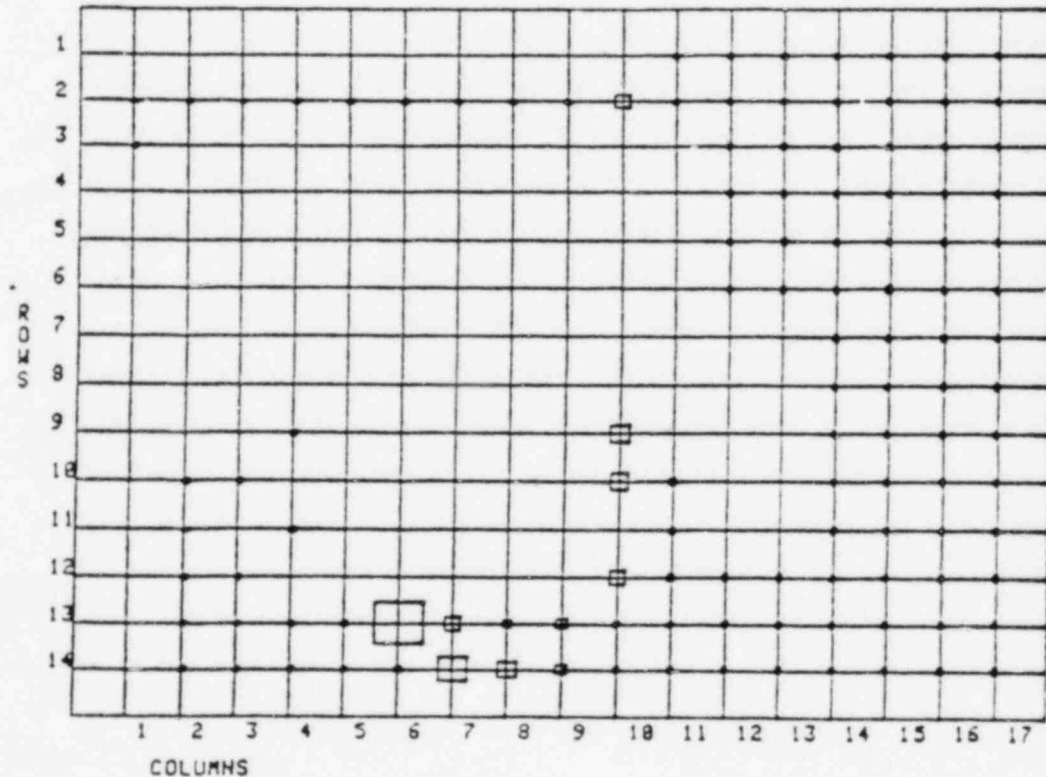
Figure 6.6-1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1																	
2	0.101	0.083	0.068	0.053	0.039	0.028	0.018	0.012	0.008	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.001
3	0.067																
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	

The variance of the data for the gross alpha is illustrated in Figures 6.6-2 and 6.6-3. Due to the high activity reported for some of the areas the results reported at 500 pCi/gm or less show small variance figures. However, these figures show that there are several sampling points reported with high alpha activity. These points are south of the production area and east of the lagoon annex. One other site noted as having high activity is directly north of Lagoon "A". This is in Figures 6.6-2 and 6.6-3 between rows 9-14 and columns 5-10. Figure 6.6-3 also illustrates that the activity for B-028 is still substantially higher than all other data reported (2980 ± 50 pCi/gm). Descriptive statistics for the data are presented in Table 6.6-1, showing the data range as well as the variance for all "B" series samples.

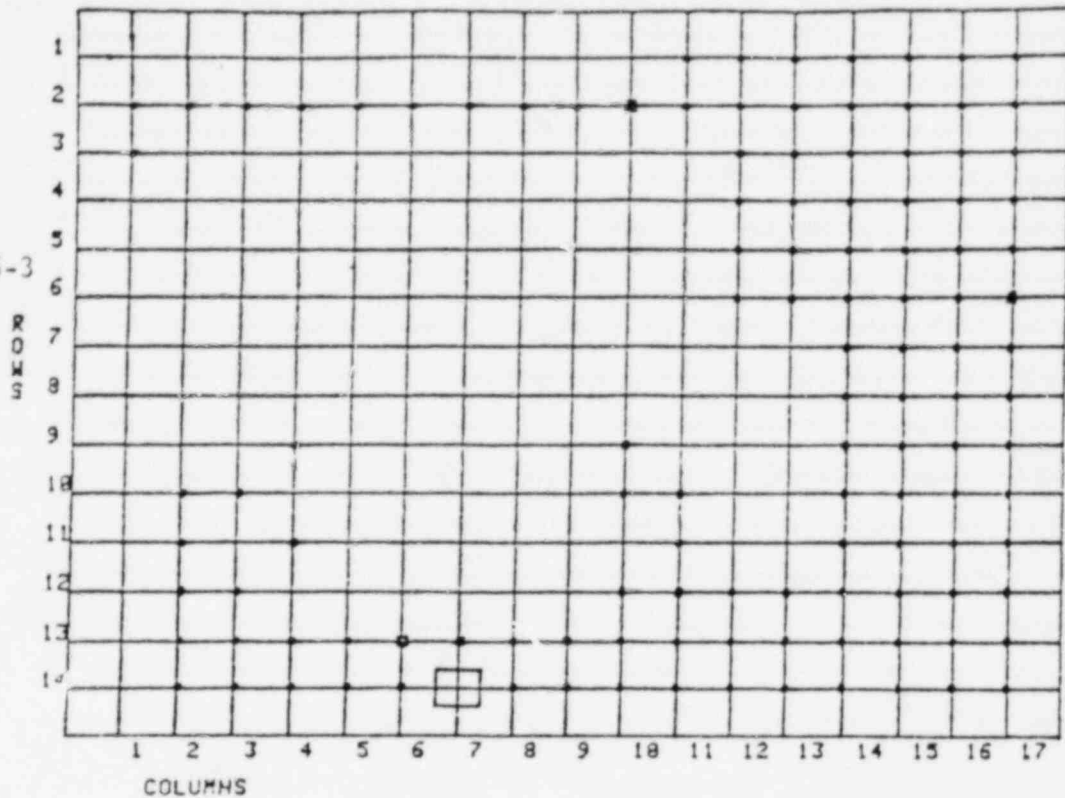
Figure 6.6-2

Gross Alpha
B-S-0 Series
Analysis of Variance Unbalanced Data



Gross Alpha
B-S-6 Series
Analysis of Variance Unbalanced Data

Figure 6.6-3



NOTE: Graph has been corrected to same scale as B-S-0 Series.

Table 6.6-1
Descriptive Statistics

Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	115	109	42.9	39.0
Variance =	160,571	157,920	76,312	74,986
Std Dev =	400	397	276	273
Data Min =	0.3	0.3	0.3	0.3
Data Max =	3,443	3,437	2,980	2,976
Data Range =	3,442.7	3,437.7	2,979.7	2,975.3
Standard Err of Mean =	36.5	24.8	25.2	36.0

(a) Uncorrected for background; (b) Corrected for background

An analysis of the data distribution shows that ninety-five percent (95%) of the data was reported in the range of 0.3 pCi/gm to 200 pCi/gm.

Gross Beta
B-S-0 Series
Analysis of Variance Unbalanced Data

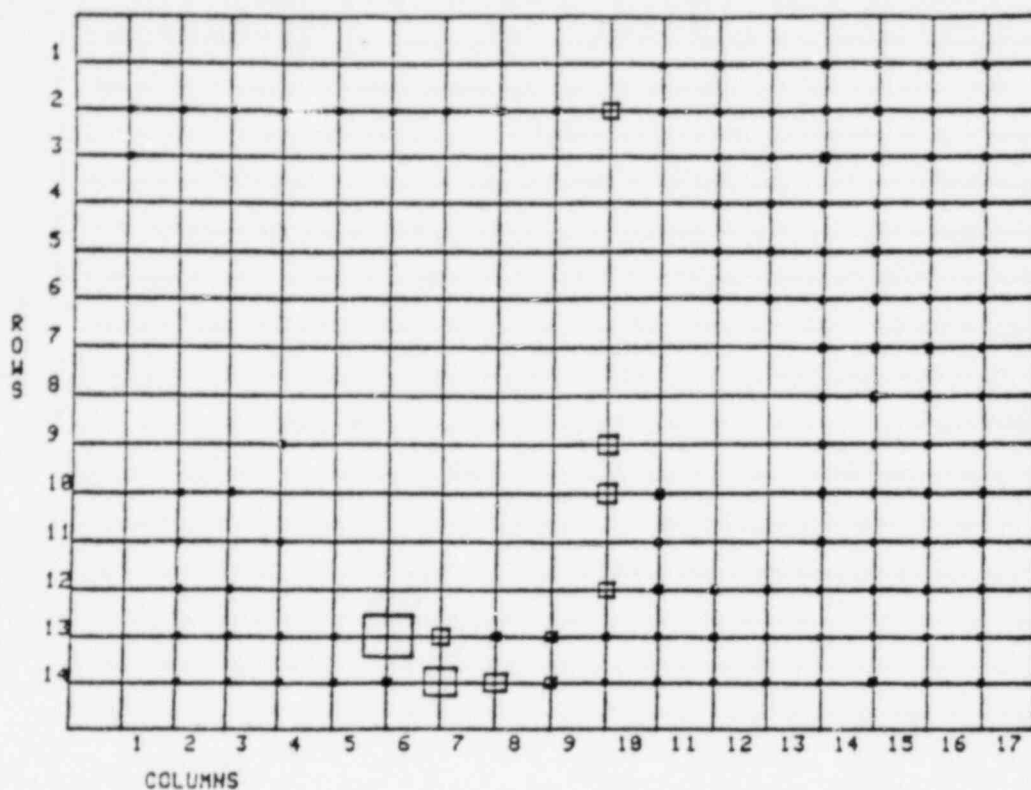


Figure 6.6-4

Gross Beta
B-S-6 Series
Analysis of Variance Unbalanced Data

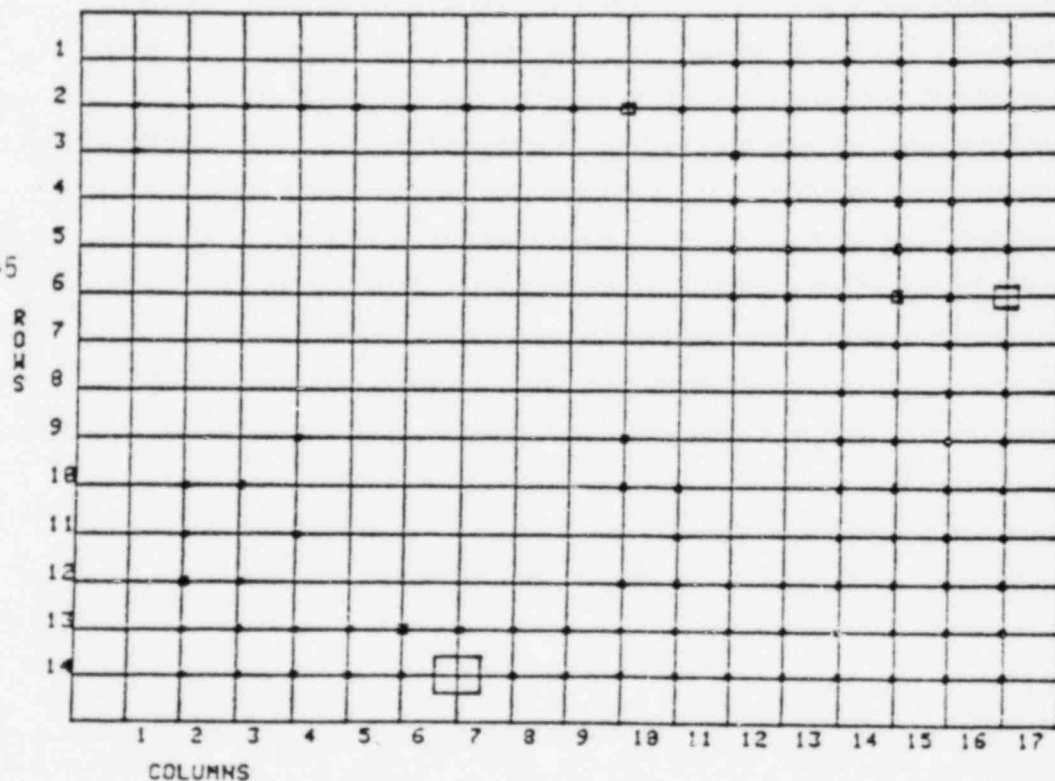


Figure 6.6-5

NOTE: Graph has been corrected to same scale as B-S-0 Series.

The gross beta results are graphically illustrated in Figures 6.6-4 and 6.6-5.

The surface samples again show a high activity in the same areas as the gross alphas (between Rows 9-14 and Columns 5-10). The maximum activity reported for surface samples was B-024 (376 ± 10 pCi/gm) and subsurface sample B-028 (337 ± 10 pCi/gm). The subsurface sample for B-028 showed an increase in activity from the surface sample (229 ± 8 pCi/gm to 337 ± 10 pCi/gm). Figures 6.6-6 and 6.6-7 illustrate the gross beta with the activity plotted on the vertical scale. A review of these two graphs show generally those sampling points having surface soil activities greater than 100 pCi/gm decreased to less than 100 pCi/gm on the subsurface soil samples. The major exception to this trend is noted on sampling points B-028 and B-099 surface samples which did show a substantial increase in activity. Other samplings showed increases, but not of the magnitude of the sampling points noted above.

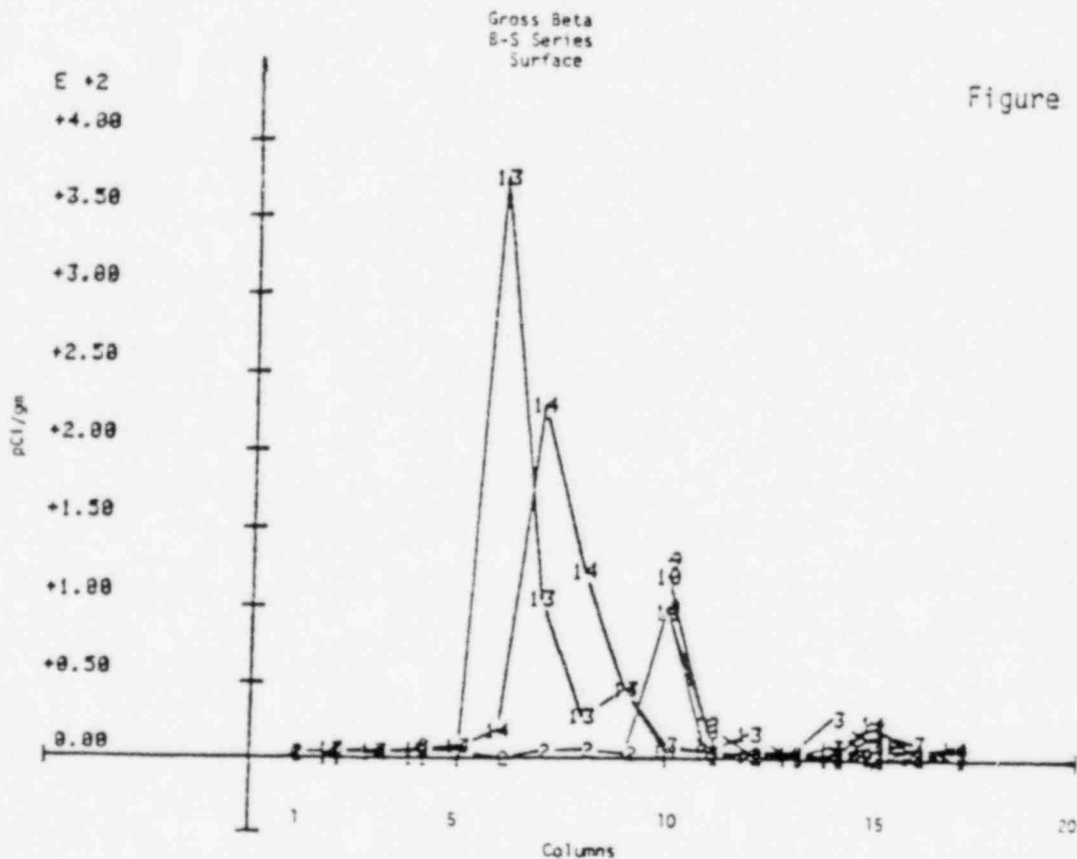


Figure 6.6-6

Note: Numbers on the line graph are the rows.

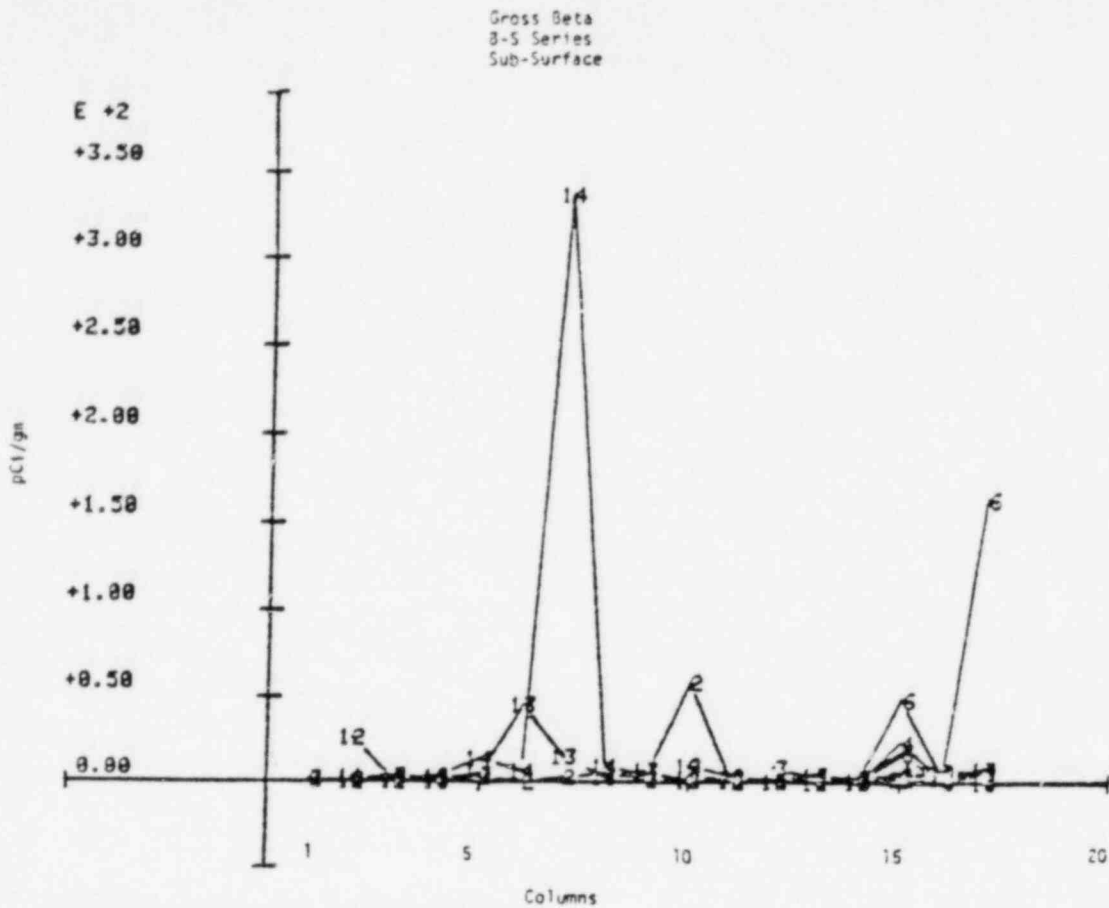


Figure 6.6-7

Radium-226
B-S-0 Series
Analysis of Variance Unbalanced Data

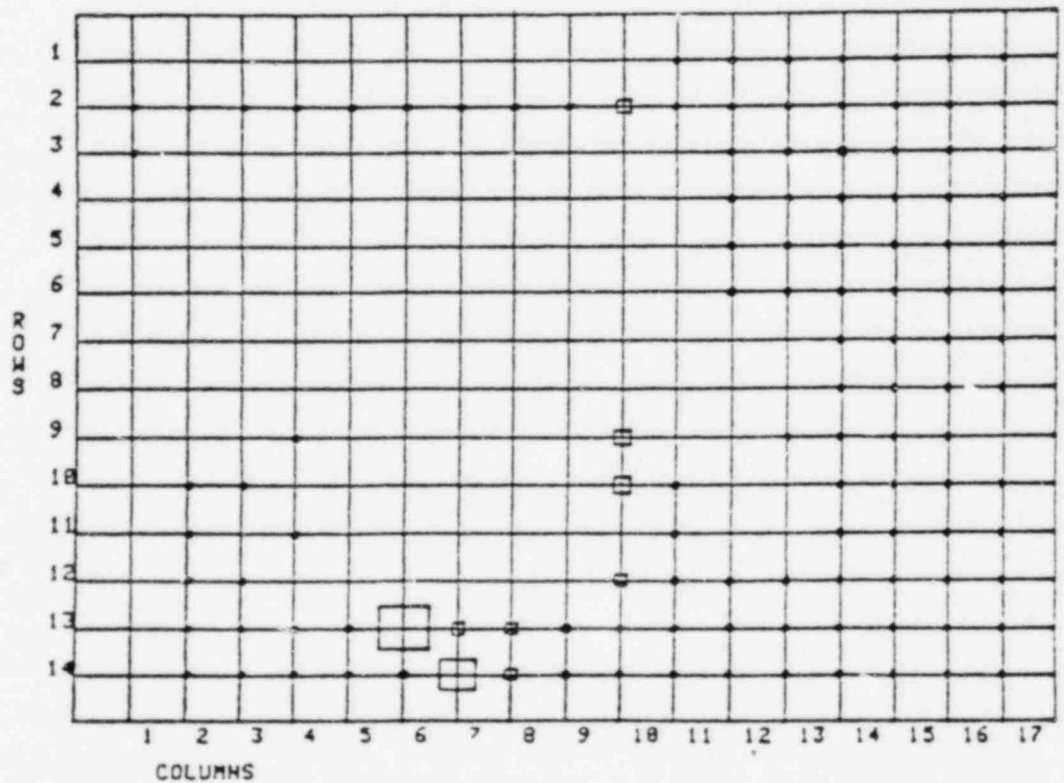
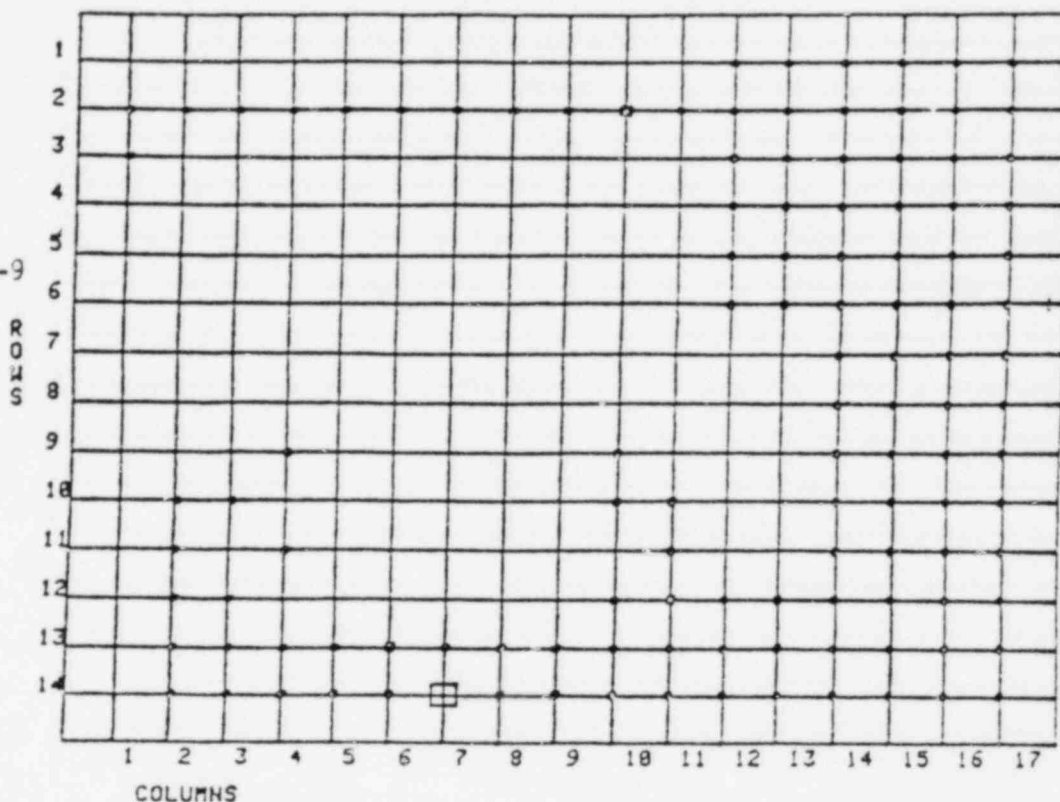


Figure 6.6-8

Radium-226
 B-S-6 Series
 Analysis of Variance Unbalanced Data

Figure 6.6-9



NOTE: Graph has been corrected to same scale as B-S-0 Series.

The highest radium-226 activity reported is for the same general area discussed above. The subsurface sample data is illustrated in Figure 6.6-8. A comparison of Figure (6.6-8) with the figure for subsurface samples (Figure 6.6-9) shows that those sites identified with high activity (greater than 500 pCi/gm) have shown a decrease for the subsurface samples.

This data is further illustrated using a line graph with the activity on the Y-axis (Figures 6.6-10 and 6.6-11). These figures show that B-024, B-027, B-028, B-030, B-031, B-035, B-036 and B-038 all show activities greater than 400 pCi/gm.

Figure 6.6-10

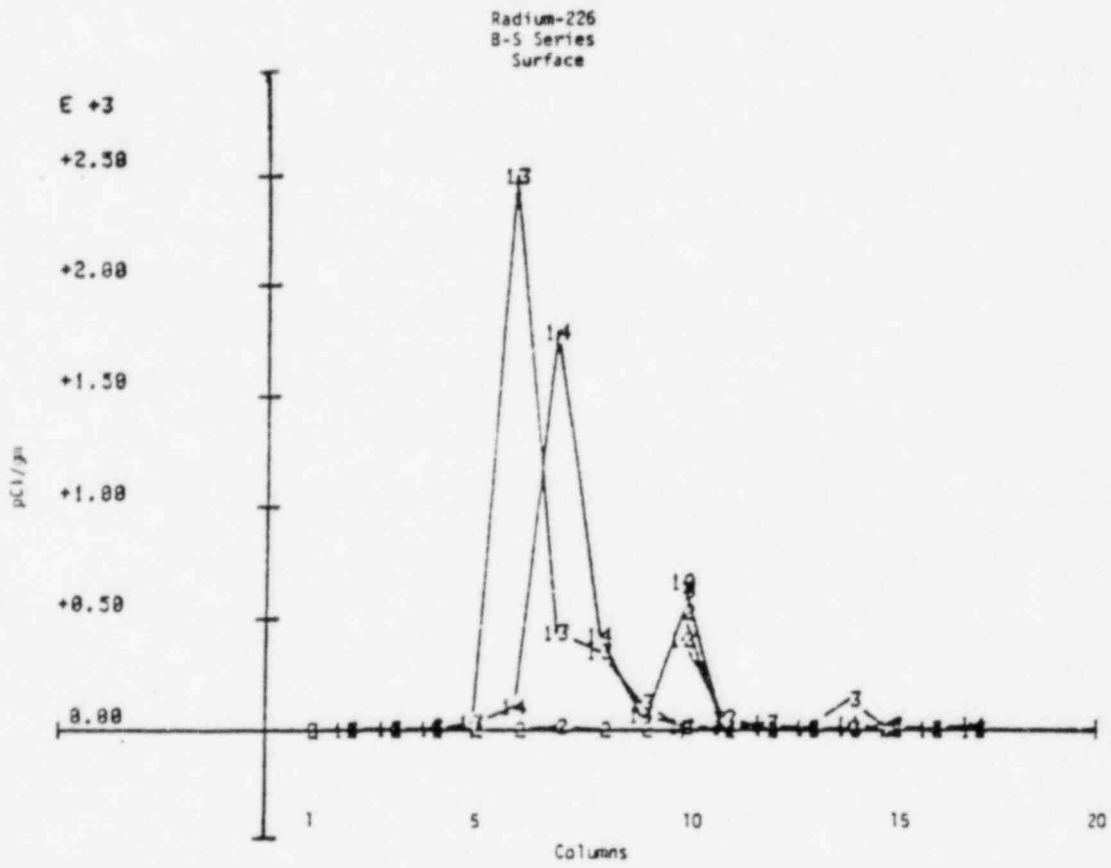
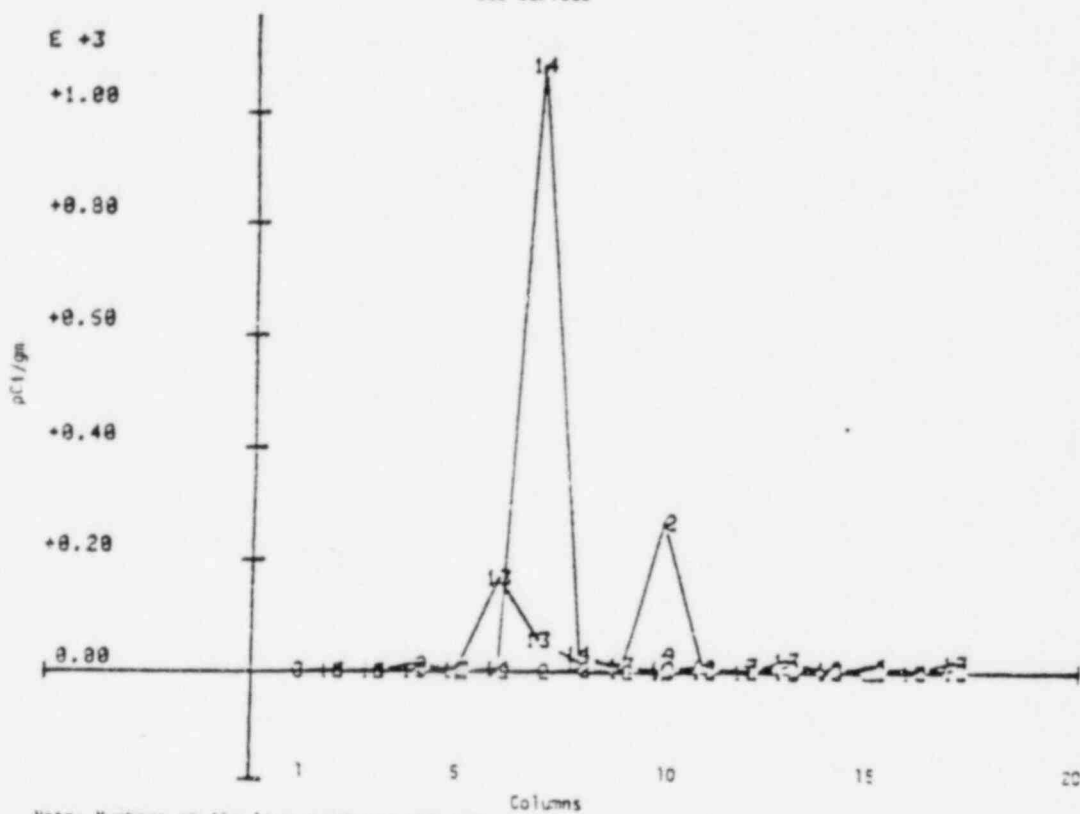


Figure 6.6-11

Radium-226
B-S Series
Sub-Surface



The same sampling points mentioned above for the subsurface samples (Figure 6.6-11) show a decrease in activity. Ninety percent (90%) of the subsurface results are below 100 pCi/gm. A statistical summary of all "S" series data is presented in Table 6.6-2.

Table 6.6-2
Radium-226
Descriptive Statistics
Soil - S Series

	<u>Surface</u> <u>(pCi/gm)</u>		<u>Subsurface</u> <u>(pCi/gm)</u>	
	(a)	(b)	(a)	(b)
Mean =	77.1	71.8	16.3	15.6
Variance =	109,341	87,878	10,699	10,427
Std Dev =	330	296	103	102
Data Min =	0.2	0.2	0.4	0.2
Data Max =	2,947	2,496.1	1,088	1,087.3
Data Range =	2,946.8	2,495.9	1,087.6	1,087.1
Standard Err of Mean =	30.1	26.8	9.4	9.2

(a) Uncorrected for background; (b) Corrected for background

The radium-228 data is illustrated in Figures 6.6-12 and 6.6-13. A review of the analytical results show that the maximum activity was reported at less than 10 pCi/gm. However, it should be noted the maximum activity area has changed from that cited earlier for the gross alpha, gross beta and radium-226 data. The highest activity areas as noted in Figures 6.6-12 and 6.6-13 are located north-northeast of the Lagoon "A" area.

Radium-228
 B-S-0 Series
 Analysis of Variance Unbalanced Data

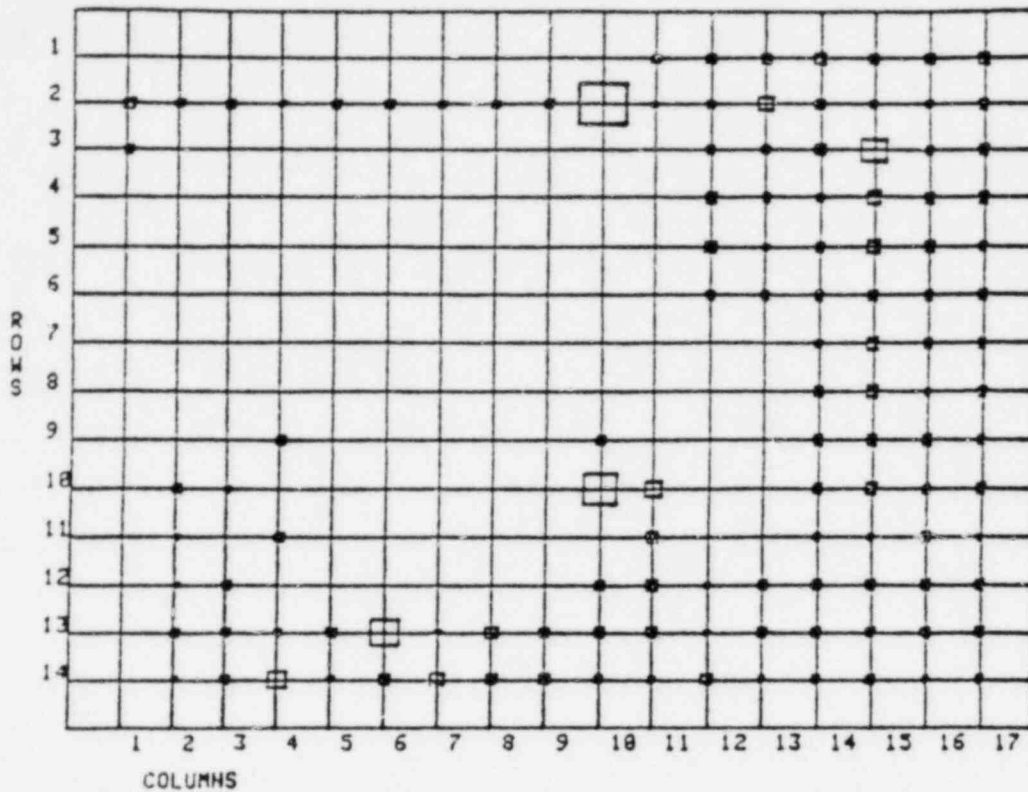


Figure 6.6-12

Radium-228
 B-S-6 Series
 Analysis of Variance Unbalanced Data

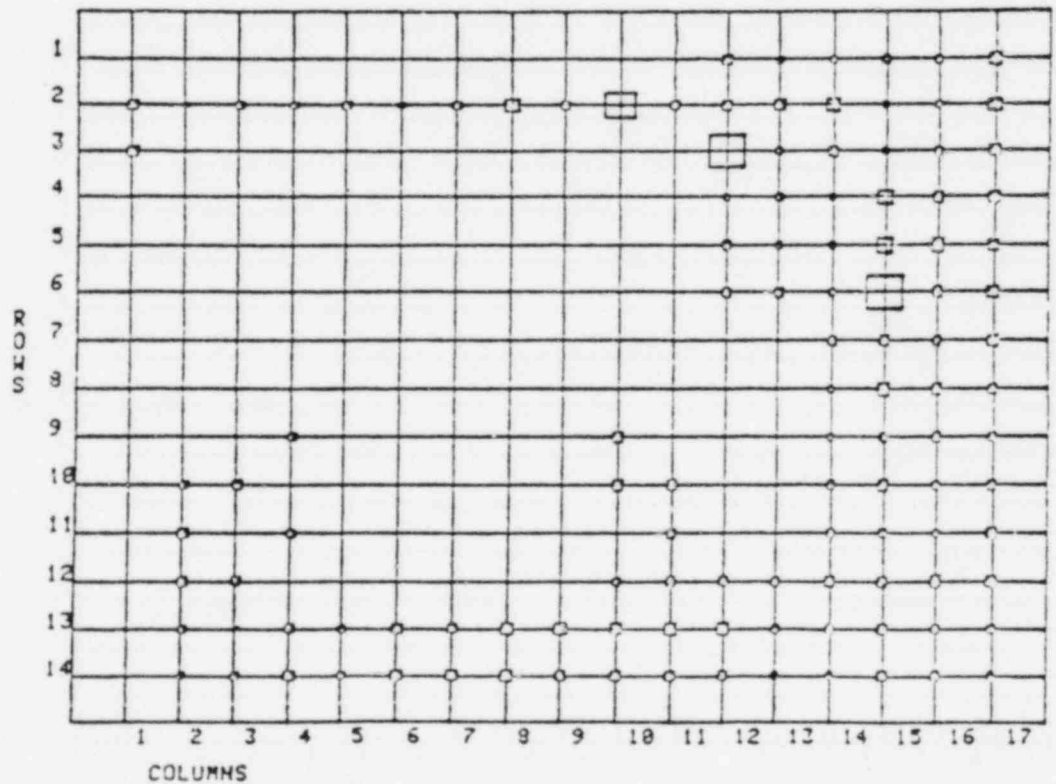


Figure 6.6-13

NOTE: Graph has been corrected to same scale as B-S-0 Series.

The data indicated a decrease in activity for the subsurface samples as illustrated in Figures 6.6-14 and 6.6-15 . A review of the data points out that approximately eighty percent (80%) of the surface samples are within the range of 0.1 pCi/gm to 1.5 pCi/gm. Approximately ninety percent (90%) of surface soil data was reported within the subsurface sample range. A statistical summary of the data is presented in Table 6.6-3.

Figure 6.6-14

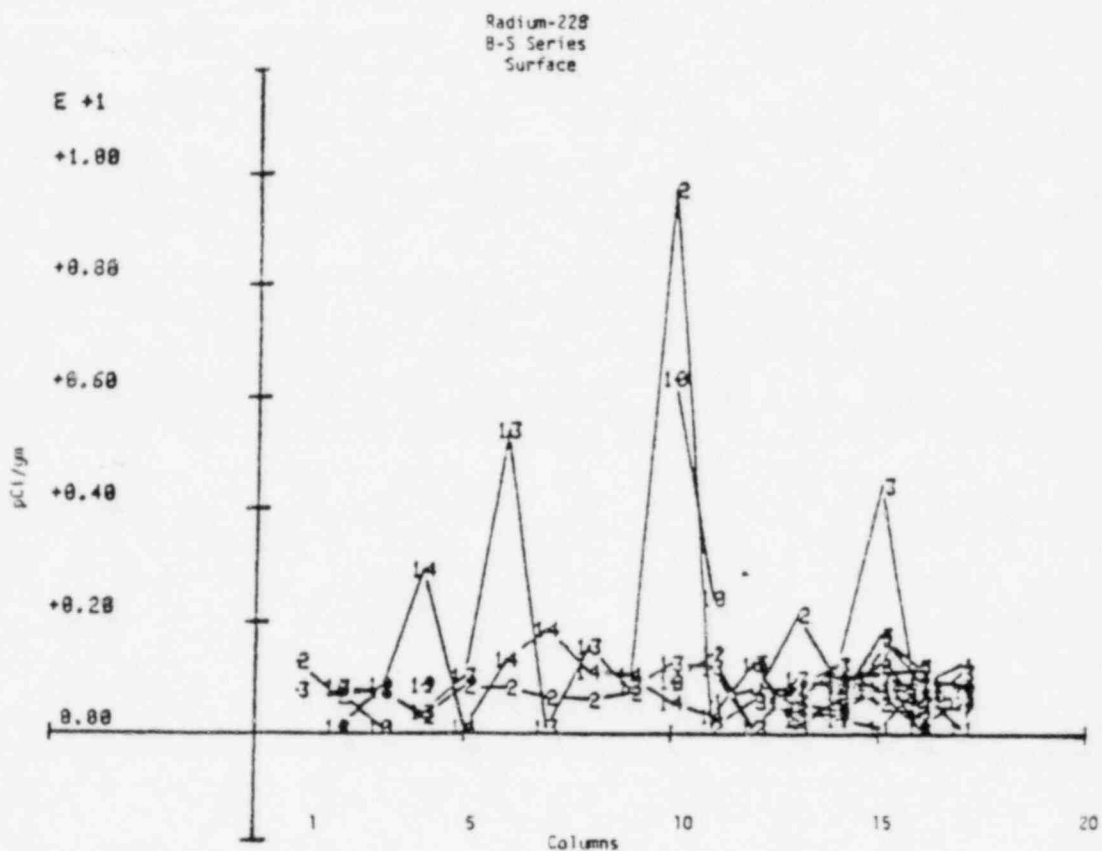


Figure 6.6-15

Radium-228
B-S Series
Sub-Surface

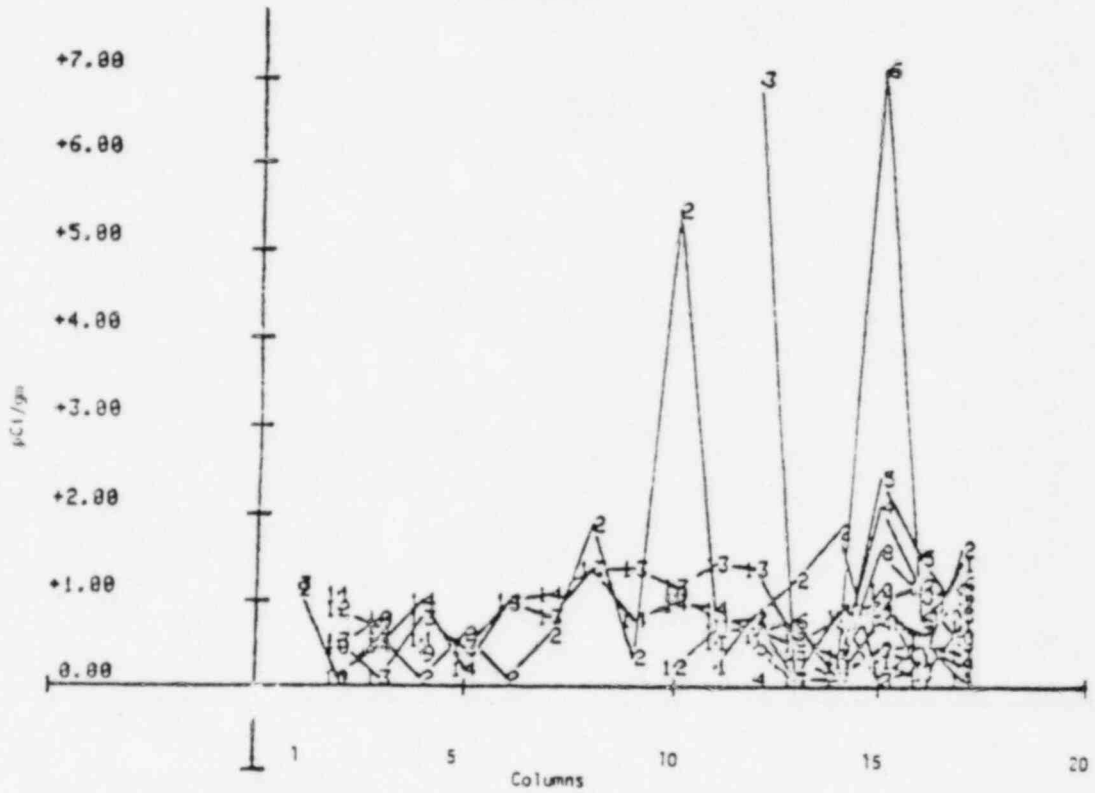


Table 6.6-3

Radium-228

Descriptive Statistics

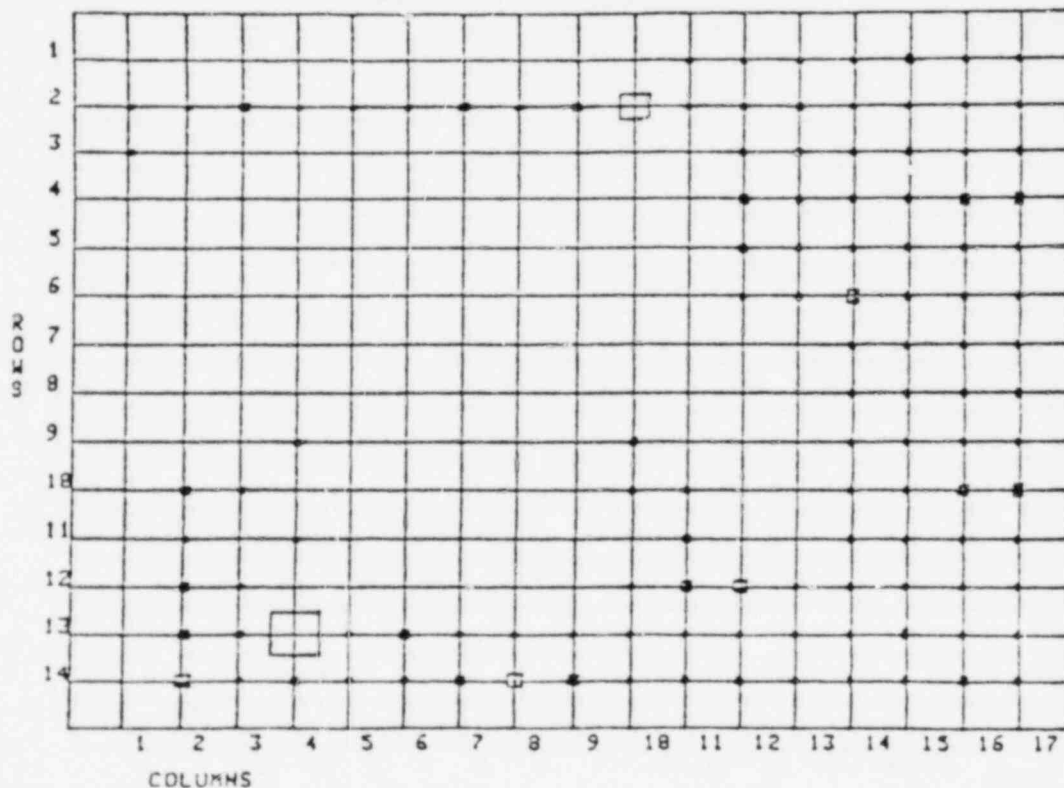
Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	1.00	0.57	0.84	0.53
Variance =	1.40	1.26	1.07	0.95
Std Dev =	1.18	1.12	1.03	0.97
Data Min =	0.1	0.1	0.1	0.1
Data Max =	9.71	9.20	7.09	6.70
Data Range =	9.61	9.10	6.99	6.60
Standard Err of Mean =	0.10	0.10	0.09	0.09

(a) Uncorrected for background; (b) Corrected for background

Figure 6.6-16

Strontium-90
B-S-0 Series
Analysis of Variance Unbalanced Data



The variance of the strontium-90 activity in the surface soils is illustrated in Figure 6.6-16. The high activity areas are noted at the southwest corner of the production area building, east of the incinerator building and north of Lagoon "A". A review of the statistics for the samples indicates the range and variance decreased for the subsurface samples. The means for both the surface and subsurface samples are statistically equal as may be seen from Table 6.6-4. In addition, eighty to ninety percent (80-90%) of the data for both surface and subsurface samples were reported in the range from less than 0.03 pCi/gm to 0.15 pCi/gm.

Table 6.6-4

STRONTIUM-90

Descriptive Statistics

Soil - B Series

	<u>Surface</u> <u>(pCi/gm)</u>		<u>Subsurface</u> <u>(pCi/gm)</u>	
	(a)	(b)	(a)	(b)
Mean =	0.09	0.06	0.06	0.05
Variance =	0.04	0.03	0.01	0.01
Std Dev =	0.21	0.19	0.11	0.10
Data Min =	0.03	0.03	0.03	0.03
Data Max =	2.02	1.85	0.98	0.93
Data Range =	1.99	1.82	0.95	0.90
Standard Err of Mean =	0.01	0.02	0.01	0.01

(a) Uncorrected for background; (b) Corrected for background

Uranium-235
B-S Series
Surface

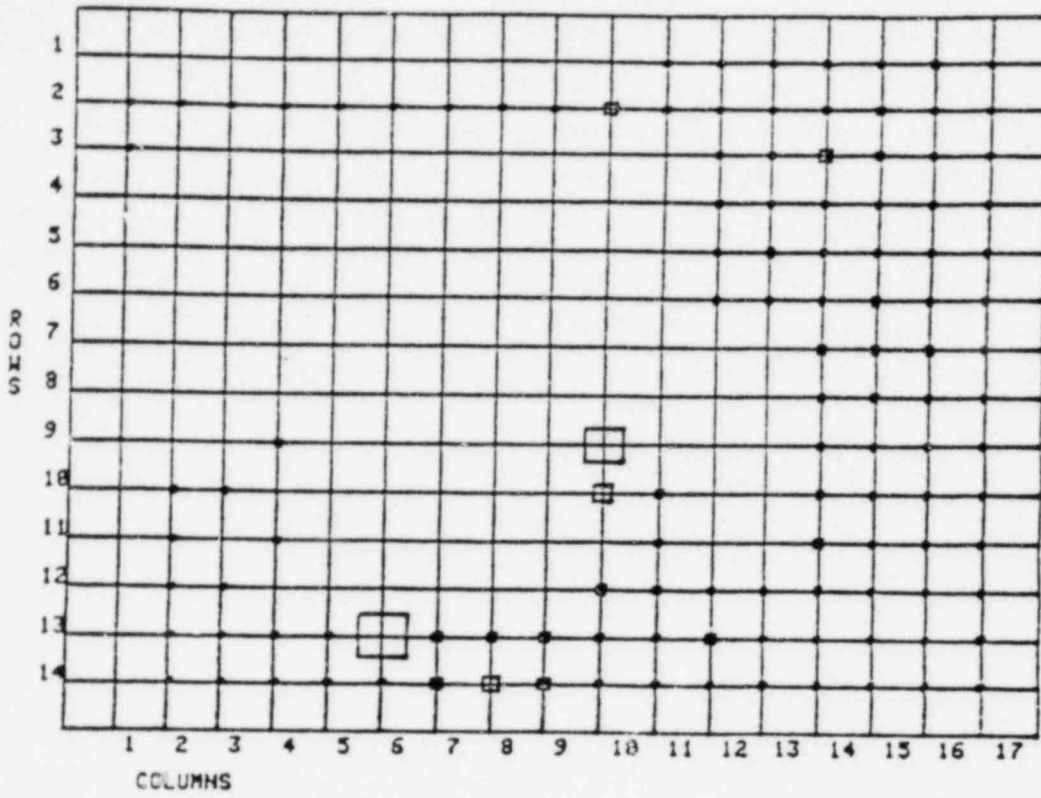


Figure 6.6-17

Uranium-238
B-S-0 Series
Analysis of Variance Unbalanced Data

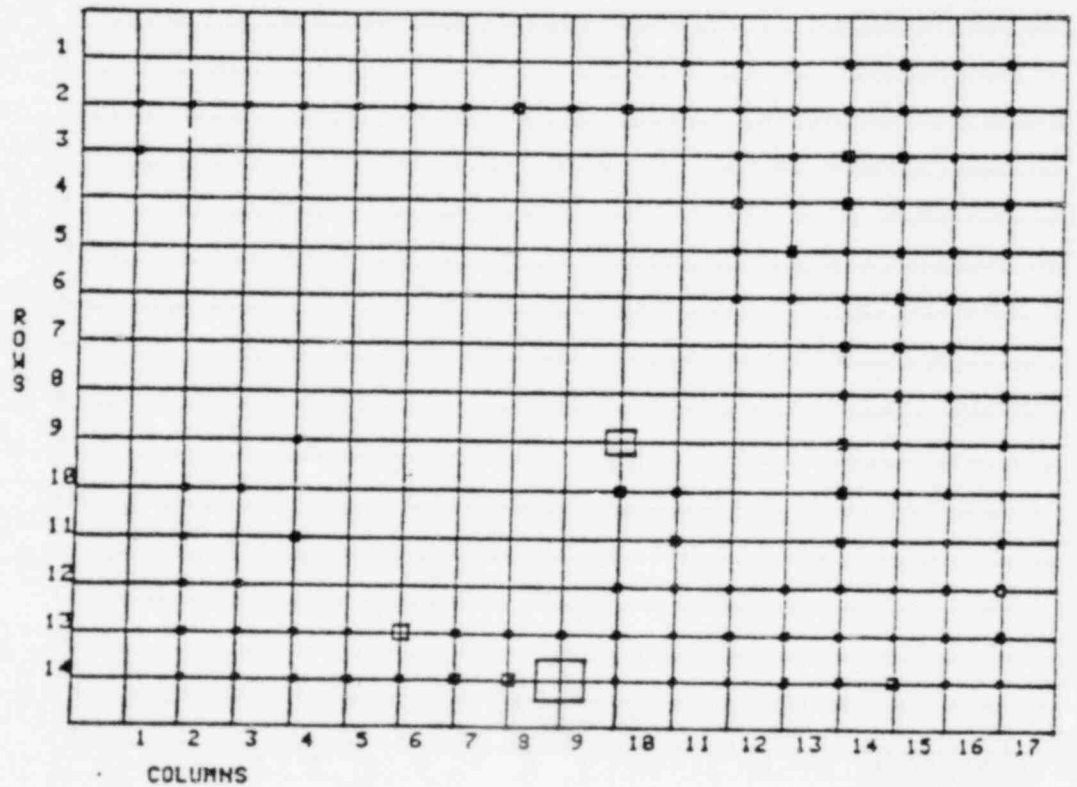


Figure 6.6-18

Uranium-234
 B-5-0 Series
 Analysis of Variance Unbalanced Data

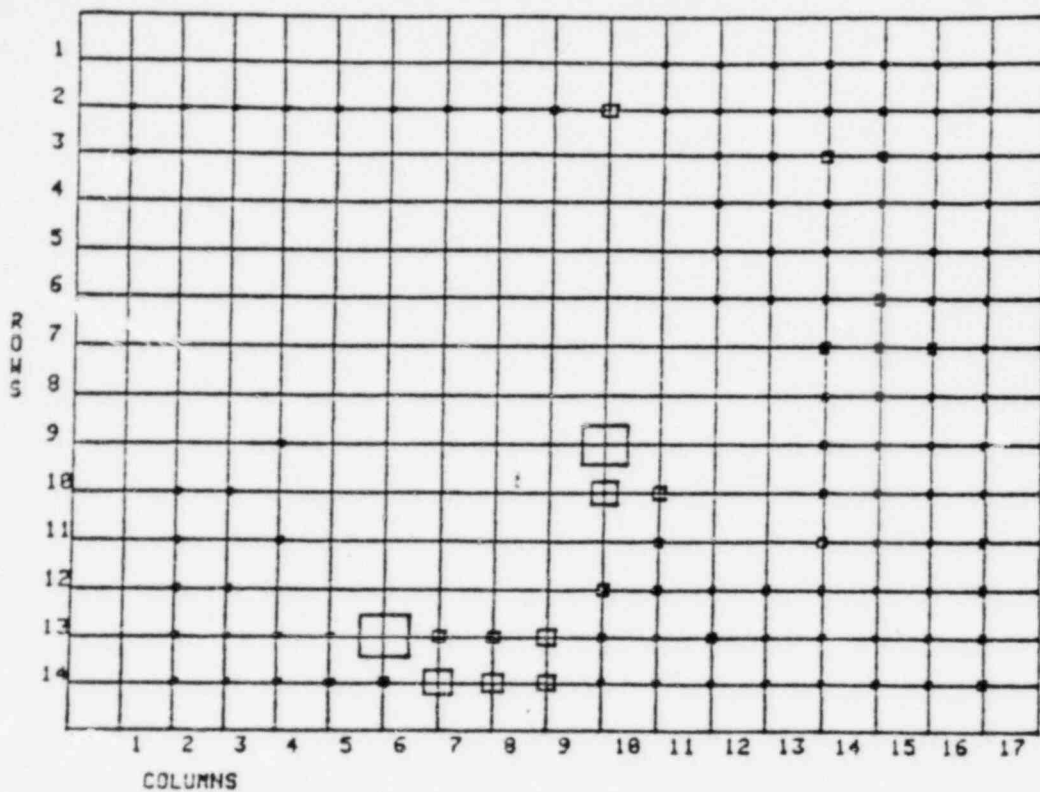


Figure 6.6-19

Uranium-235
 B-5-6 Series

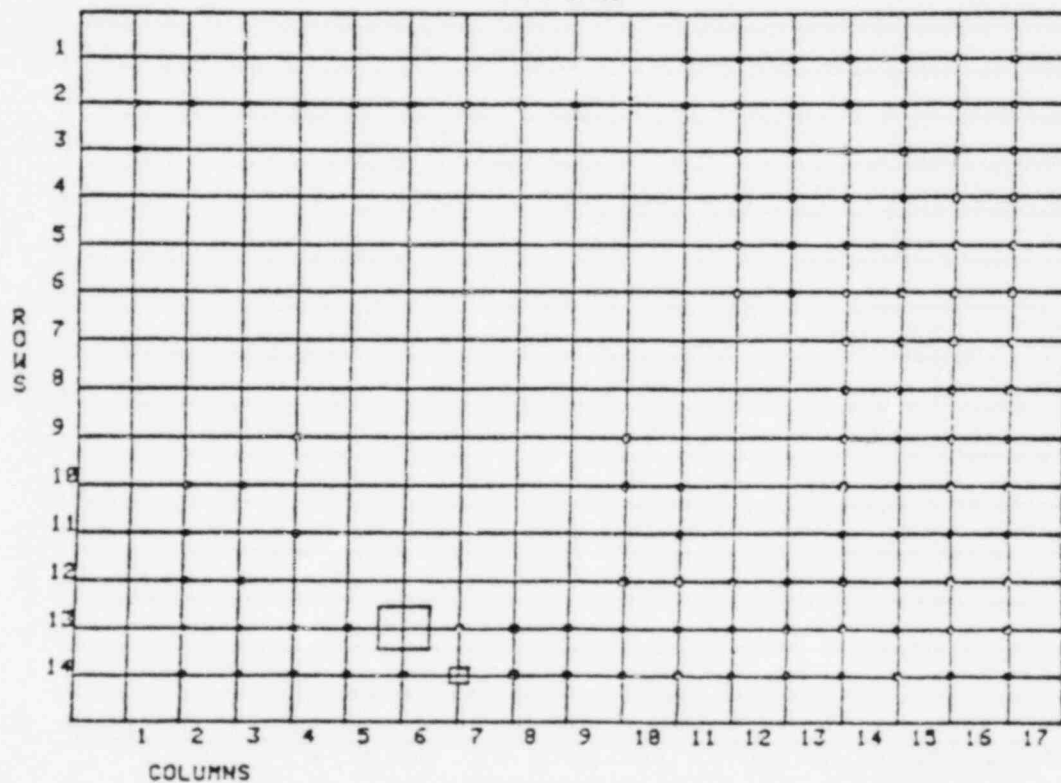


Figure 6.6-20

Note: Graph has been corrected to same scale as B-5-0 Series.

Uranium-238
 B-S-6 Series
 Analysis of Variance Unbalanced Data

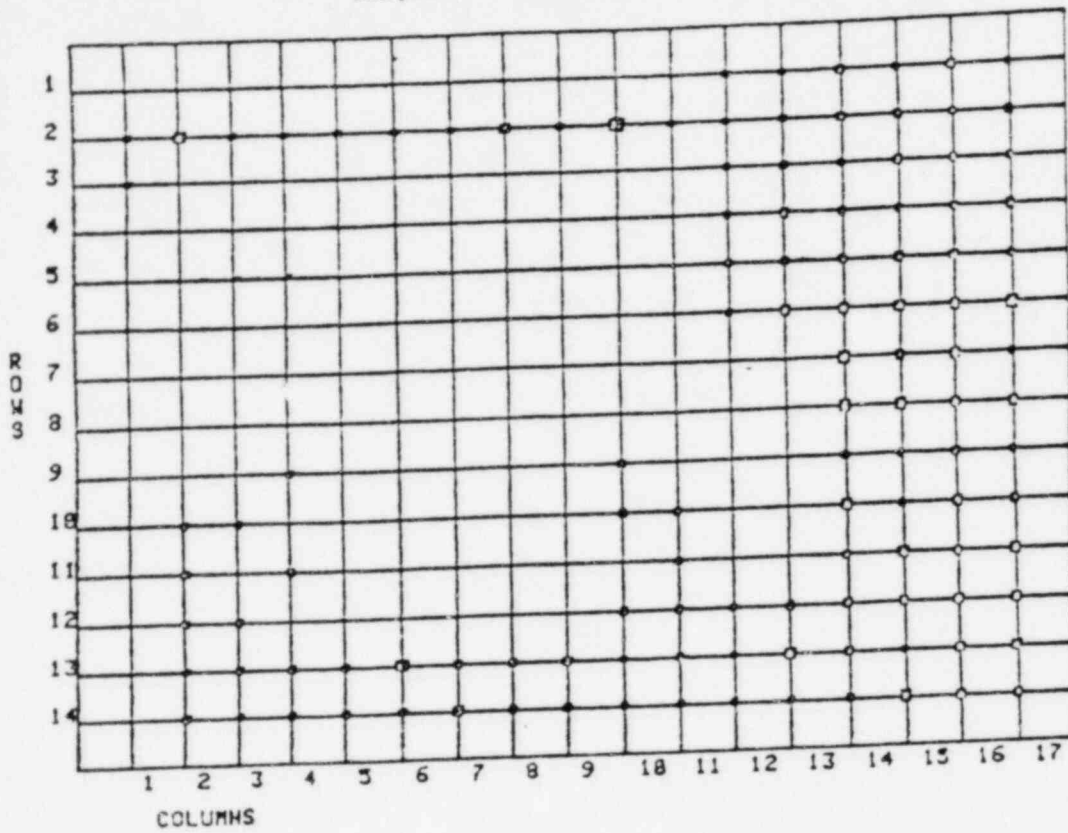


Figure 6.6-

NOTE: Graph has been corrected to same scale as B-S-0 Series.

Uranium-234
 B-S-6 Series
 Analysis of Variance Unbalanced Data

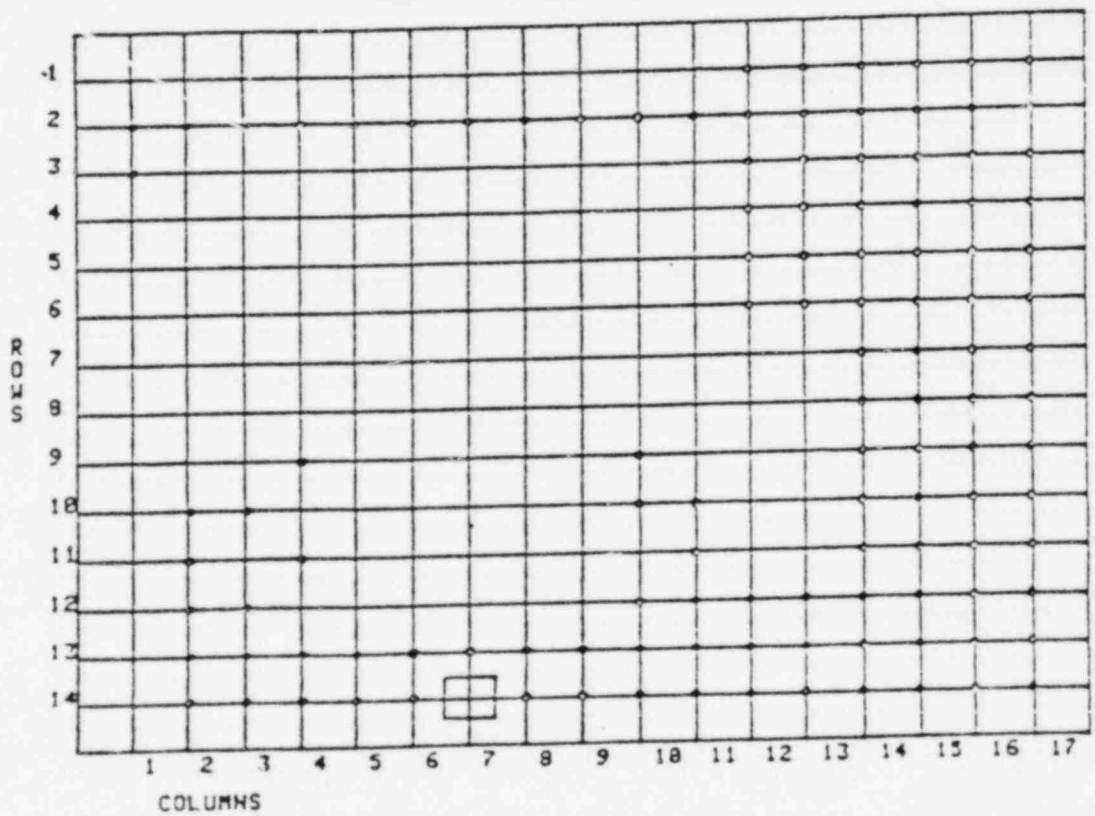


Figure 6.6-22

NOTE: Graph has been corrected to same scale as B-S-0 Series.

The variance and distribution of isotopic uranium (U-234, U-235, U-238) is graphically illustrated in Figures 6.6-13 through 6.6-22 (surface and subsurface samples). A review of these plots points out that generally the activity is uniformly distributed throughout the area sampled with the exception of some high activity areas (same as those noted for gross alpha and radium-226). Generally, it can be seen that the activity decreased for the subsurface samples. However, some samples revealed an increase. The data is further illustrated in Figures 6.6-23 through 6.6-28. These figures illustrate the variance in activity between the surface and subsurface samples. As seen in these figures, the uranium-234 activity (Figures 6.6-23 and 6.6-24) show an increase, particularly with respect to sample B-028 (309 ± 4 pCi/gm to 3309 ± 146 pCi/gm). The descriptive statistics for these samples are presented in Table 6.6-5.

Table 6.6-5

Uranium-234

Descriptive Statistics

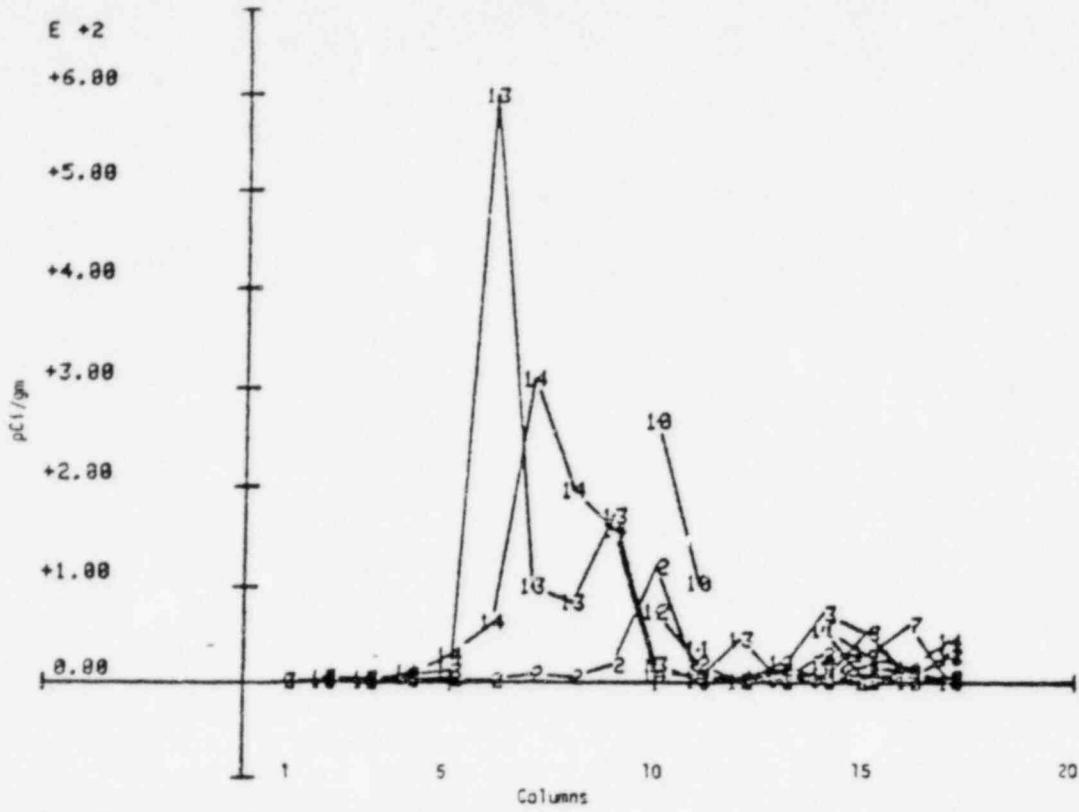
Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	32.5	31.1	33.7	32.4
Variance =	7,295	7,181	91,209	89,700
Std Dev =	85.4	84.7	302	299
Data Min =	0.05	0.05	0.05	0.05
Data Max =	600	599	3,309	3,308
Data Range =	599	599	3,308	3,308
Standard Err of Mean =	7.7	7.7	27.5	27.1

(a) Uncorrected for background; (b) Corrected for background

Uranium-234
B-S-0 Series
Surface

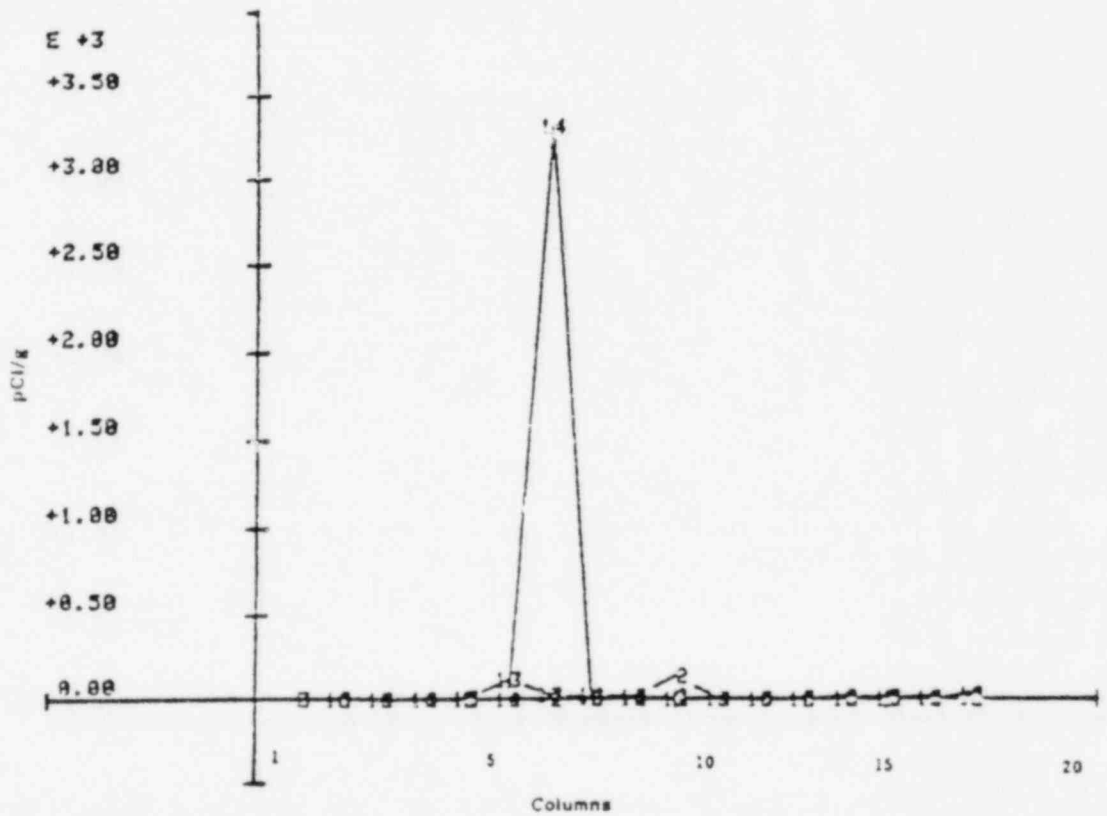
Figure 6.6-23



Note: Numbers on the line graph are the rows.

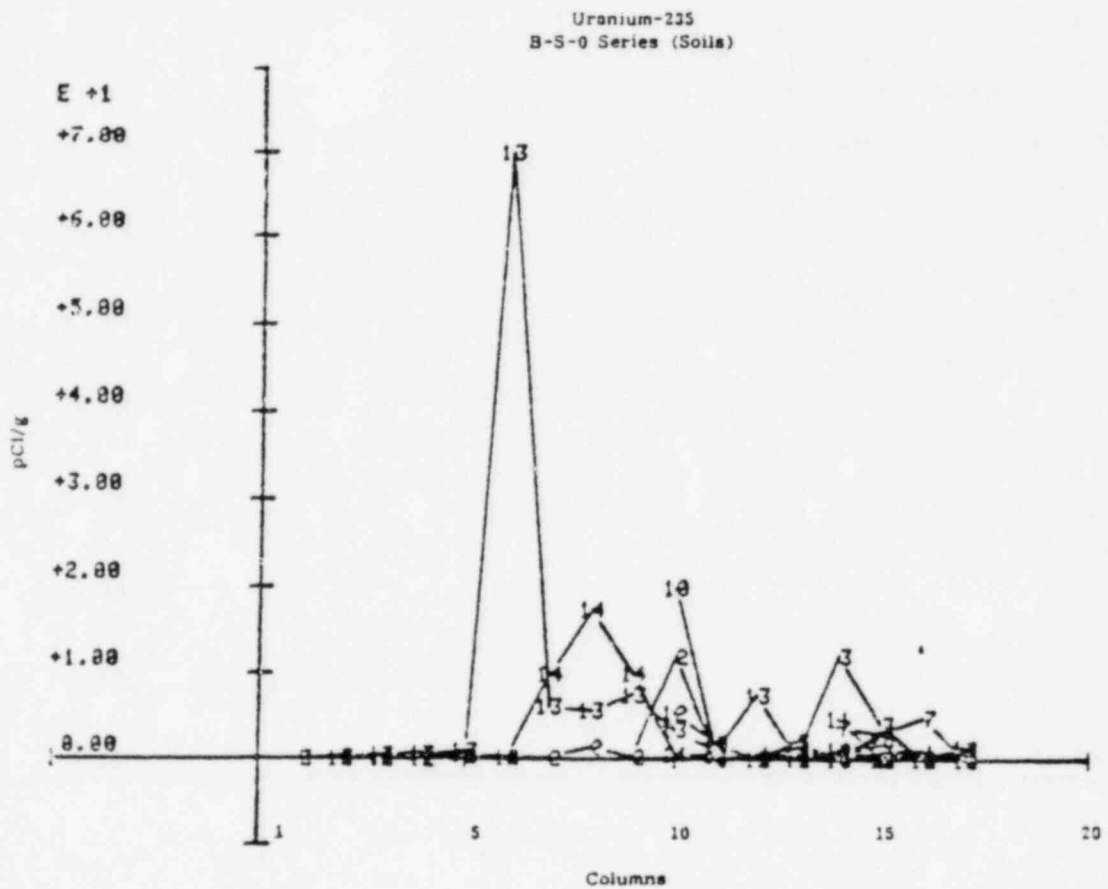
Uranium-234
B-S-6 Series (Soils)

Figure 6.6-24



This table indicates a high variability of activity through this group of data. However, the high variance is predominantly due to a few areas. The overall data distribution indicates that eighty to ninety-five percent (80-95%) of the data is within the range of 0.05 pCi/gm to 150 pCi/gm.

Figure 6.6-25



The uranium-235 data is illustrated in Figures 6.6-25 and 6.6-26 and shows an overall decrease in activity. However, for some sampling points, the subsurface samples show a higher activity than for the surface samples (B-028 and B-035). All other samples were statistically at the same activity. A statistical summary of this data is given in Table 6.10-6.

Table 6.6-6
Uranium-235
Descriptive Statistics
Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	2.53	2.32	1.10	0.93
Variance =	69.6	68.1	26.2	25.6
Std Dev =	8.34	8.25	5.12	5.06
Data Min =	0.05	0.05	0.05	0.05
Data Max =	70	69.7	52.6	52.3
Data Range =	69.95	69.95	52.55	52.29
Standard Err of Mean =	0.76	0.75	0.46	0.46

(a) Uncorrected for background; (b) Corrected for background

The uranium-238 data shows a slight increase in activity with subsurface samples being erratic (less than or greater than the surface samples). However, in general, the data was statistically equal for both sets of samples. This data is illustrated in Figures 6.6-27 and 6.6-28.

Uranium-235
B-S-6 Series (Soils)

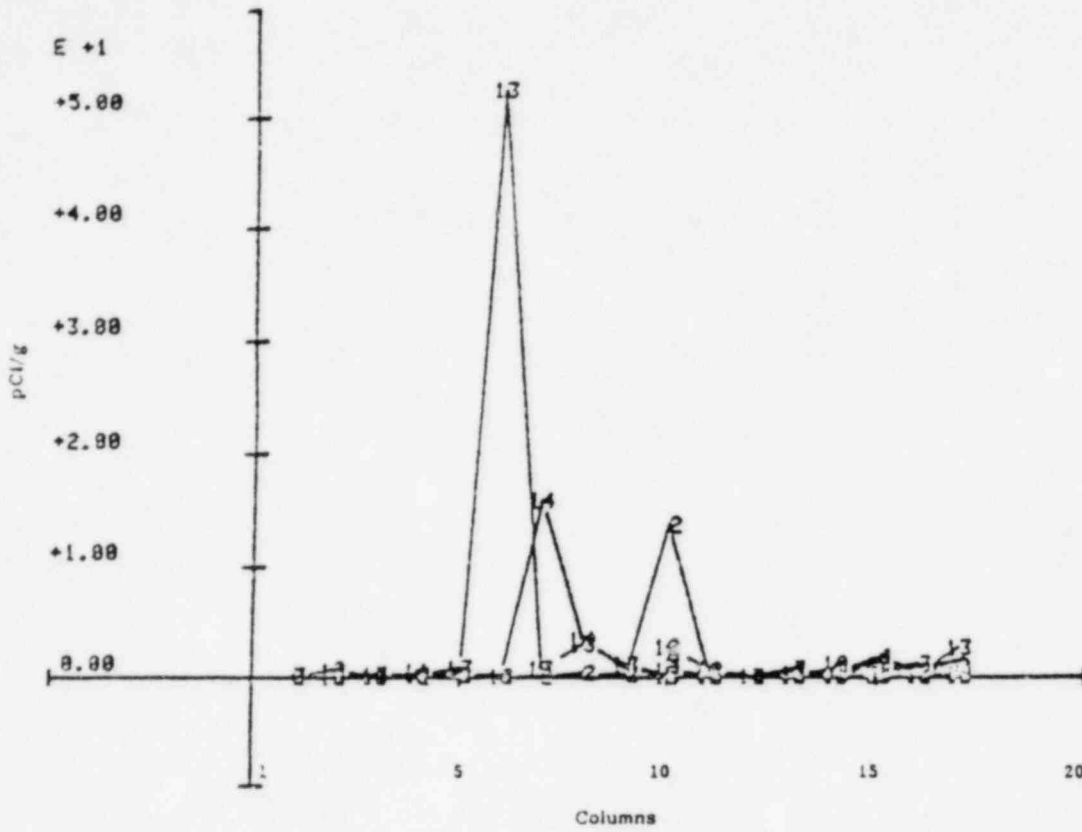


Figure 6.6-26

Uranium-238
B-S-0 Series (Soils)

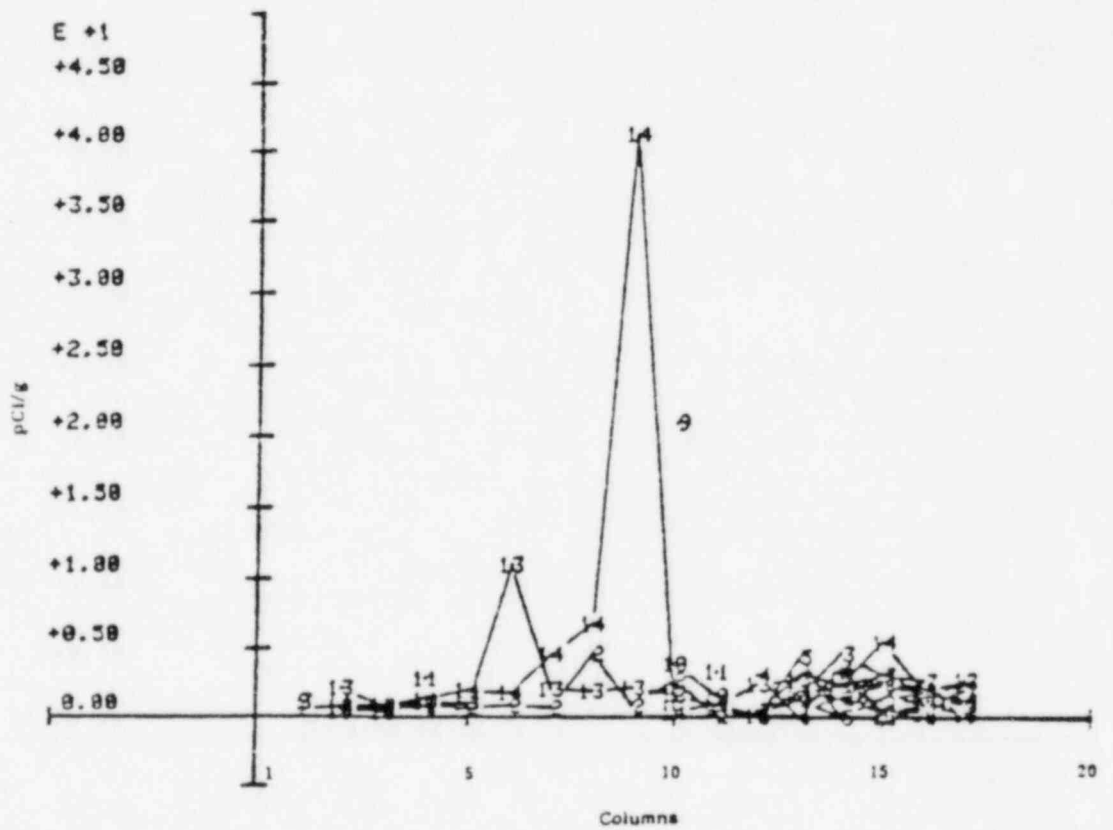


Figure 6.6-27

The descriptive statistics for these samples is supportive of the above discussion. The statistical summary is presented in Table 6.6-7.

Table 6.6-7

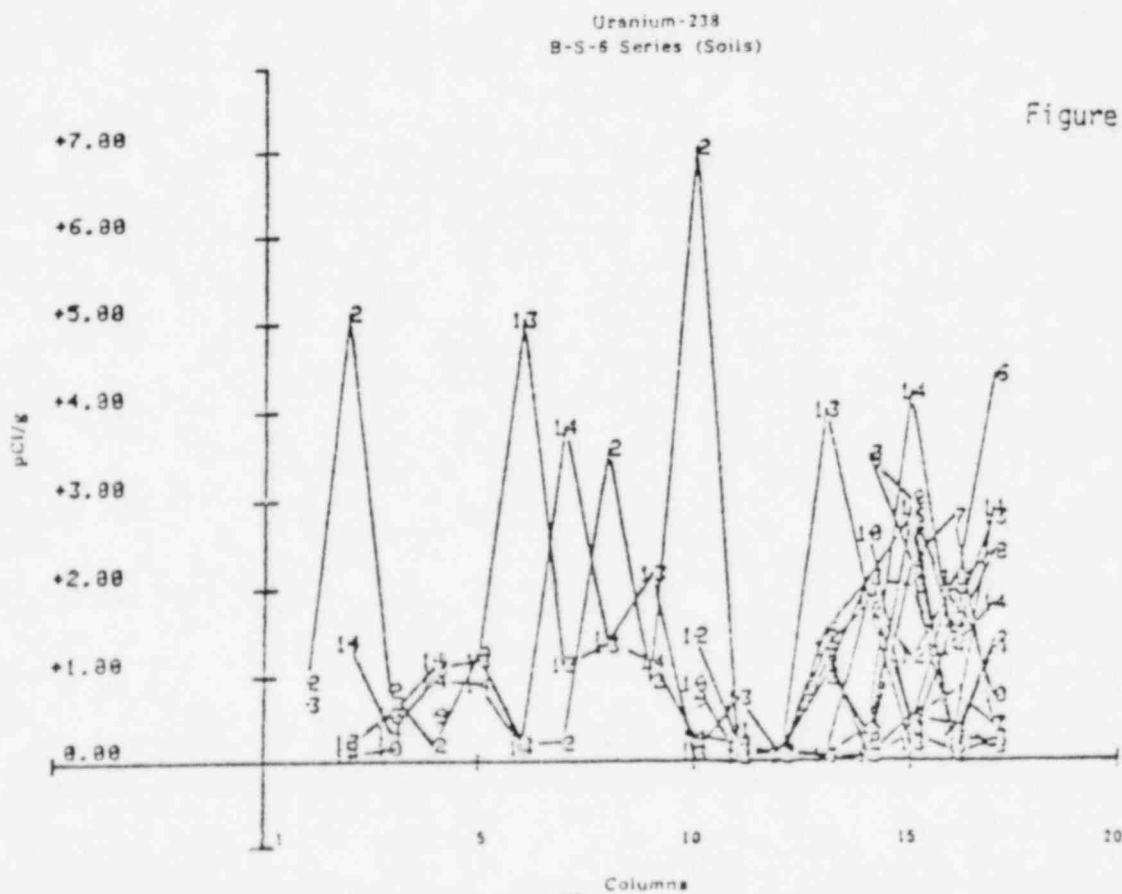
Uranium-238

Descriptive Statistics

Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	2.11	1.40	1.22	0.63
Variance =	18.47	17.47	1.71	1.10
Std Dev =	4.29	4.18	1.30	1.05
Data Min =	0.05	0.05	0.05	0.05
Data Max =	41.2	40.3	6.99	6.10
Data Range =	41.15	40.2	6.99	6.05
Standard Err of Mean =	0.39	0.38	0.11	0.09

(a) Uncorrected for background; (b) Corrected for background



Thorium-228
B-S-0 Series
Analysis of Variance Unbalanced Data

Figure 6.6-29

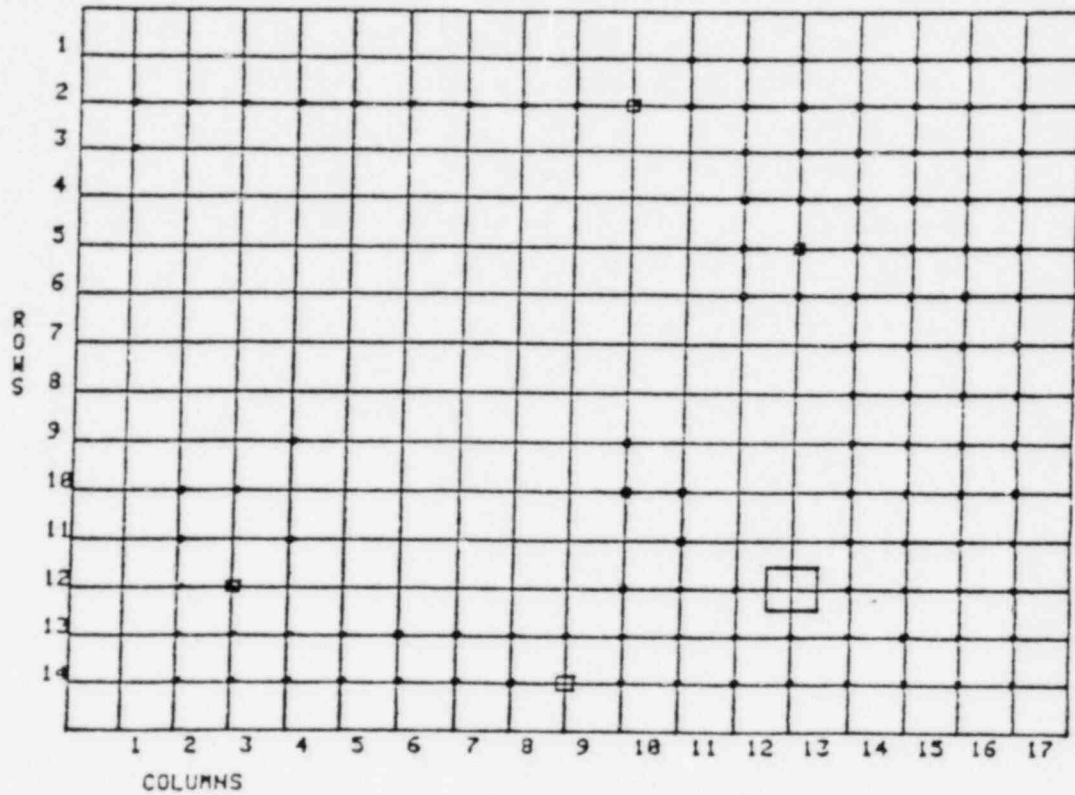


Table 6.6-3

Thorium-228

Descriptive Statistics

Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	0.14	0.12	0.08	0.07
Variance =	0.24	0.23	0.01	0.01
Std Dev =	0.49	0.48	0.12	0.11
Data Min =	0.05	0.04	0.05	0.05
Data Max =	5.2	5.13	1.1	1.03
Data Range =	5.25	5.09	1.05	0.98
Standard Err of Mean =	0.04	0.04	0.01	0.01

(a) Uncorrected for background; (b) Corrected for background

The isotopic thorium (Th-228, Th,230, Th-232) data with some exceptions, (see Figures 6.6-29 through 6.6-33) show a decrease or equal (statistically) activity between the surface to subsurface samples. The descriptive statistics are presented in Table 6.6-8 through 6.6-10).

Table 6.6-9

Thorium-230

Descriptive Statistics

Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	0.94	0.89	0.21	0.17
Variance =	11.6	11.4	0.62	0.50
Std Dev =	3.4	3.4	0.79	0.77
Data Min =	0.05	0.05	0.05	0.05
Data Max =	29	28.9	8.28	8.14
Data Range =	28.95	28.8	8.23	8.09
Standard Err of Mean =	0.31	0.3	0.07	0.07

(a) Uncorrected for background; (b) Corrected for background

Table 6.6-10
 Thorium-232
Descriptive Statistics
Soil - B Series

	<u>Surface</u> (pCi/gm)		<u>Subsurface</u> (pCi/gm)	
	(a)	(b)	(a)	(b)
Mean =	0.17	0.14	0.09	0.06
Variance =	0.44	0.42	0.007	0.003
Std Dev =	0.66	0.65	0.08	0.06
Data Min =	0.05	0.05	0.05	0.05
Data Max =	7.2	7.07	0.73	0.66
Data Range =	7.15	7.02	0.73	0.61
Standard Err of Mean =	0.06	0.06	0.007	0.005

(a) Uncorrected for background; (b) Corrected for background

Thorium-228
 B-S-6 Series
 Analysis of Variance Unbalanced Data

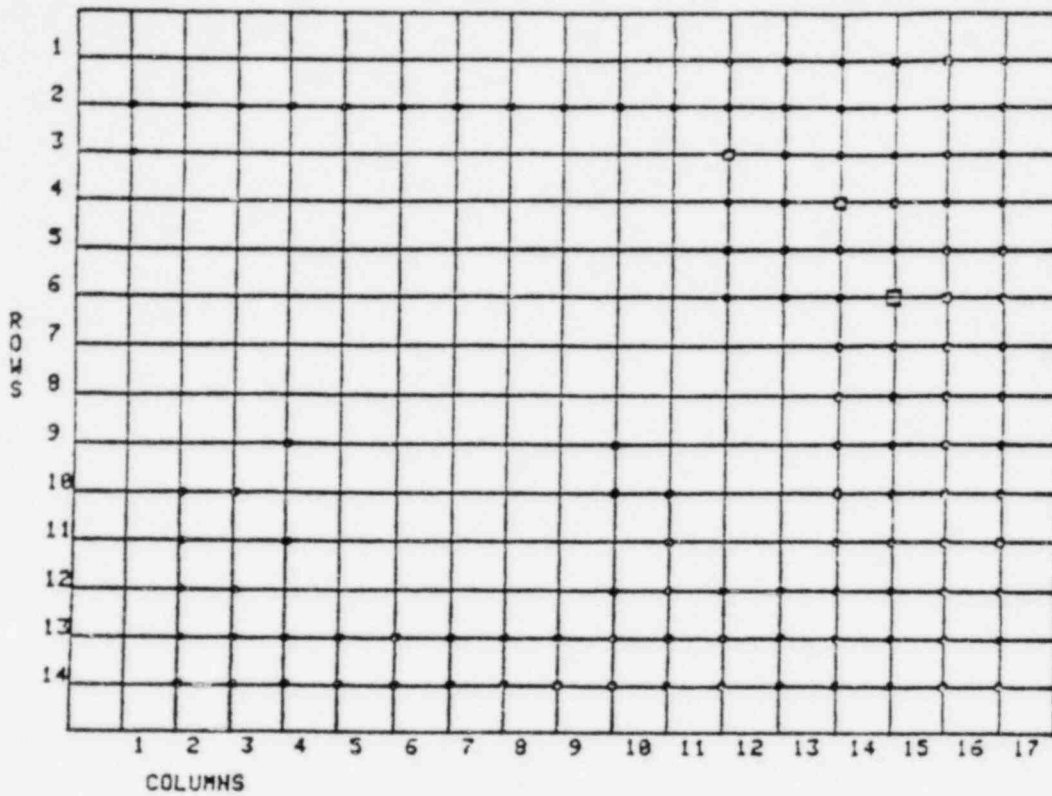


Figure 6.6-30

NOTE: Graph has been corrected to same scale as B-S-0 Series.

Thorium-230
 B-S-0 Series
 Analysis of Variance Unbalanced Data

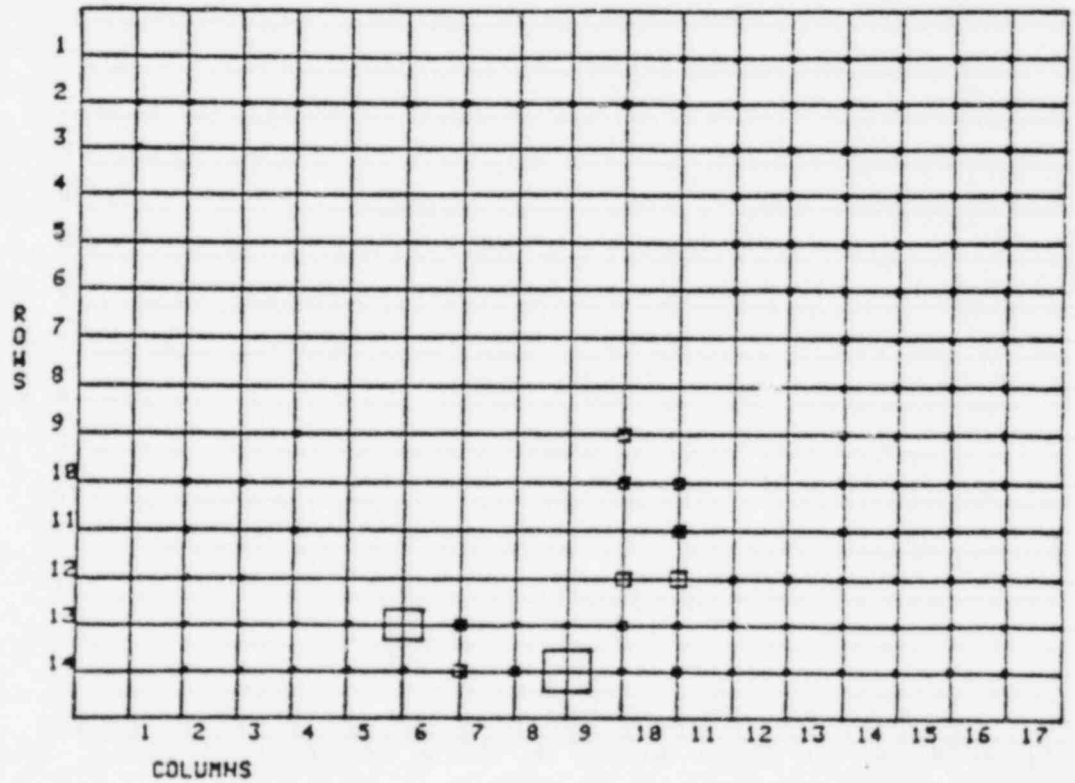


Figure 6.6-31

Thorium-230
 B-S-6 Series
 Analysis of Variance Unbalanced Data

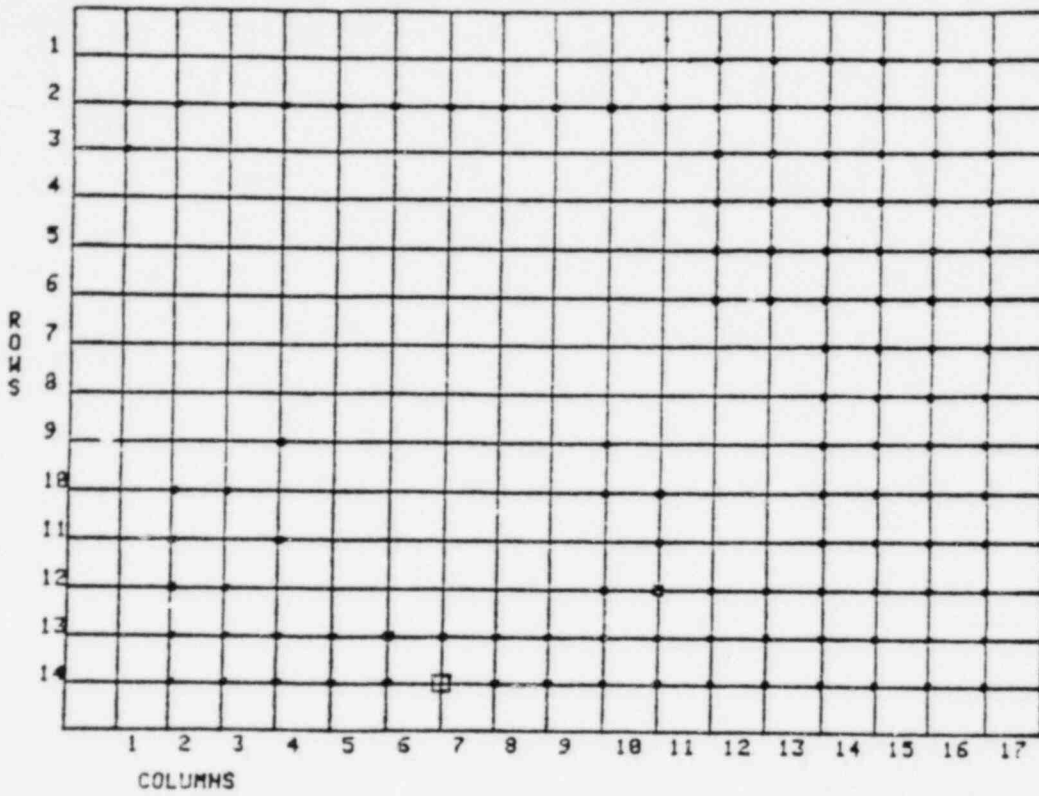


Figure 6.6-32

NOTE: Graph has been corrected to same scale as B-S-0 Series.

Thorium-232
 B-S-0 Series
 Analysis of Variance Unbalanced Data

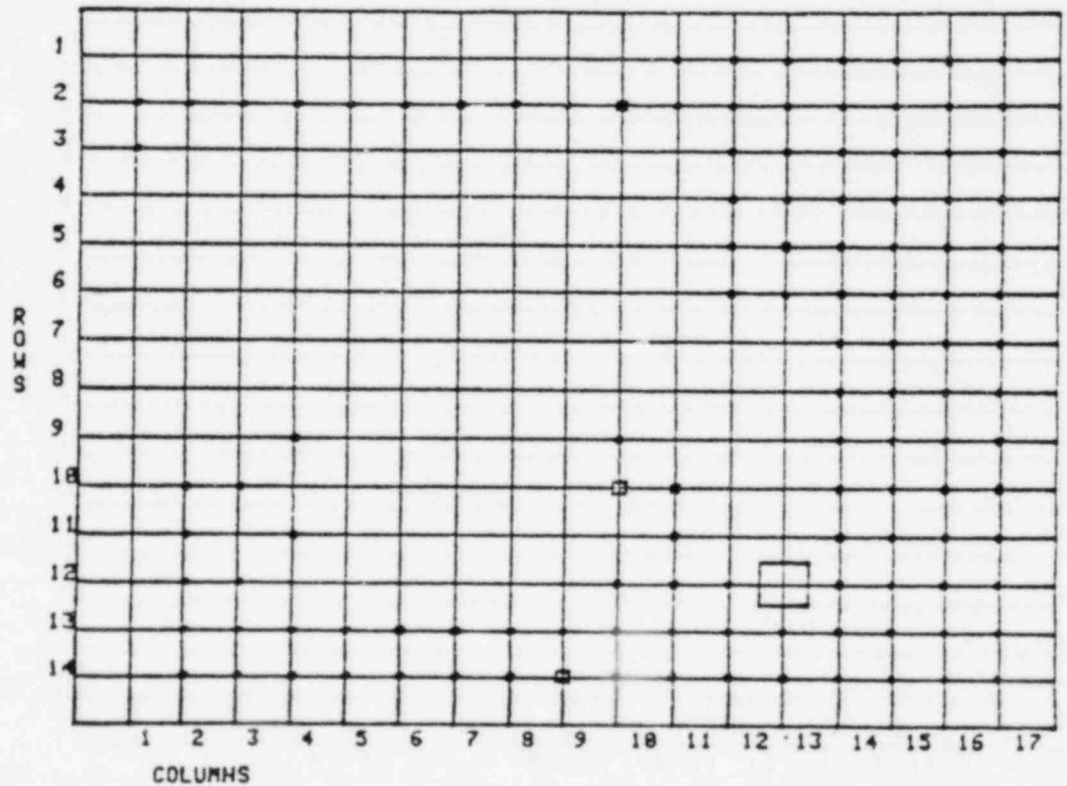


Figure 6.6-33

Thorium-232
 B-S-6 Series
 Analysis of Variance Unbalanced Data

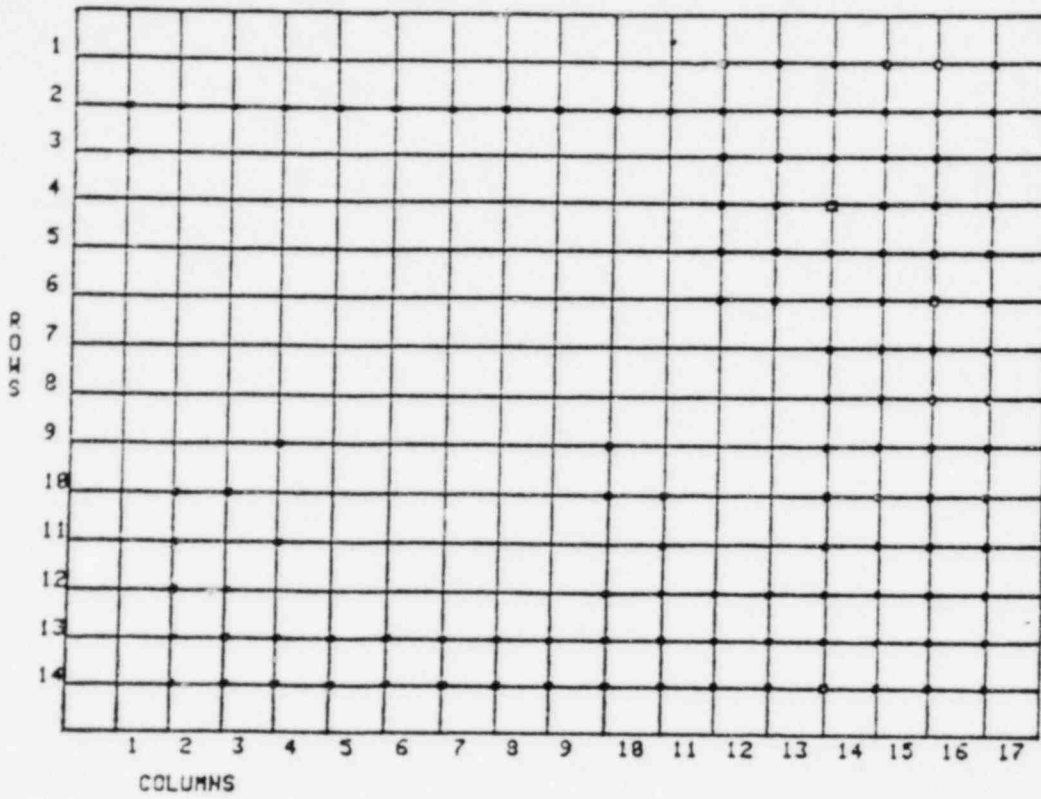


Figure 6.6-34

NOTE: Graph has been corrected to same scale as B-S-0 Series.

Cesium-137
 B-S-0 Series
 Analysis of Variance Unbalanced Data

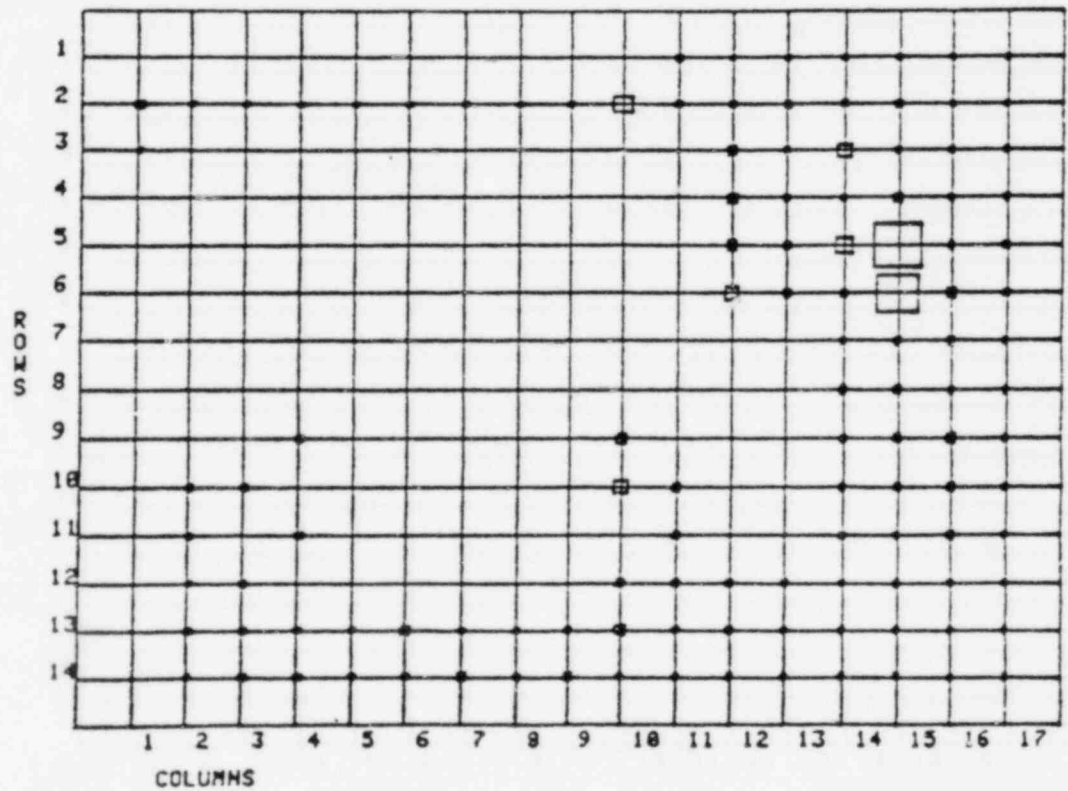
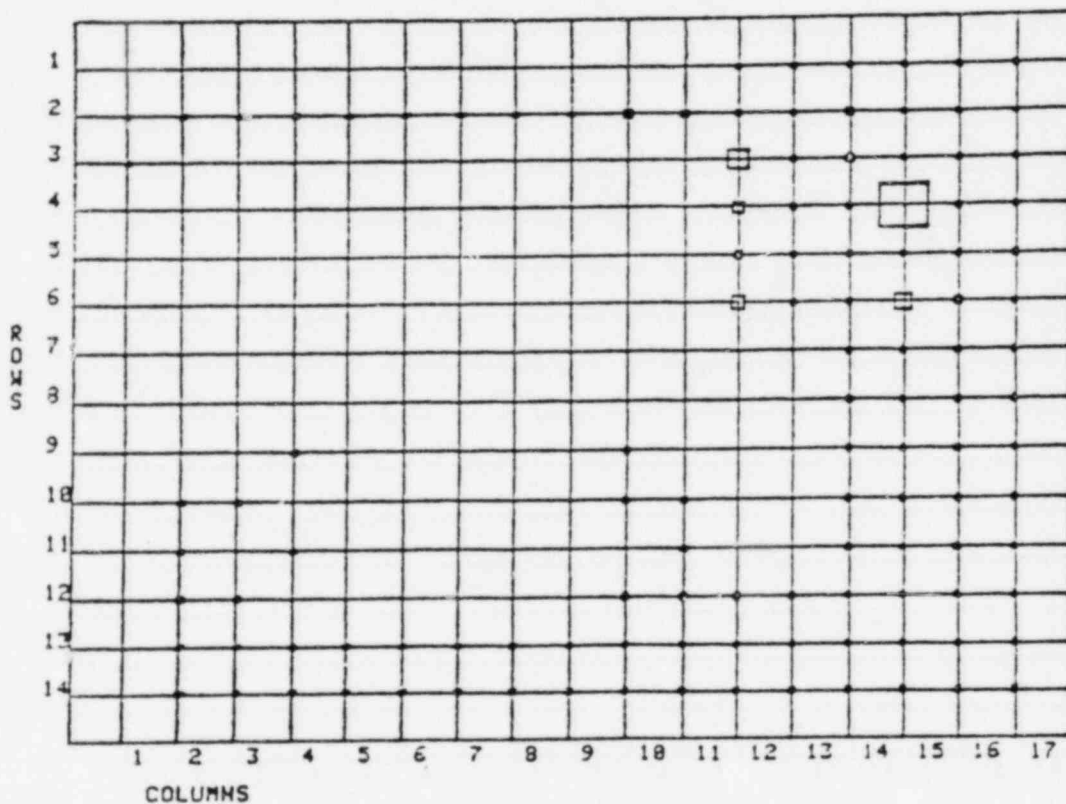


Figure 6.6-35

Generally, the cesium-137 data shows a decrease for the subsurface samples as compared to the surface samples with the exceptions of B-050 and B-083. This data is illustrated by a rectangular plot in Figures 6.7-35 and 6.7-36.

Figure 6.6-36

Cesium-137
B-S-6 Series
Analysis of Variance Unbalanced Data



NOTE: Graph has been corrected to same scale as B-S-0 Series.

An analysis of the data distribution points out that the range of activity for the subsurface samples has increased. Eighty to ninety percent (80-90%) of the results reported were in the range of 0.05 pCi/gm to 2 pCi/gm for both surface and subsurface samples. The overall means for the surface and subsurface samples were 0.96 pCi/gm and 0.92 pCi/gm with standard deviations of 2.50 pCi/gm and 4.06 pCi/gm respectively.

6.7 Core Soil Samples - B Series

Four (4) foot and six (6) foot core samples were collected from eight (8) of the "B" series sampling stations.

The gross alpha variance and distribution of activity is illustrated in Figures 6.7-1 through 6.7-3. As may be seen from these figures, the means of the activities for the cores are generally below the 1981 gross alpha background data (5.0 ± 2.1 pCi/gm surface and 4.4 ± 1.7 pCi/gm subsurface). However, the individual data results show that approximately fifty percent (50%) of the results exceed the 1981 backgrounds. In addition, the data is higher than that for the D-D core samples discussed earlier in this report. The overall means for the data is presented in Table 6.7-1.

Table 6.7-1
Gross Alpha
B Series Cores

	<u>Mean</u>	<u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Four Foot	5.0	4.0	6.1
Six Foot	5.6	4.5	6.6

Table 6.7-1 (Cont'd)

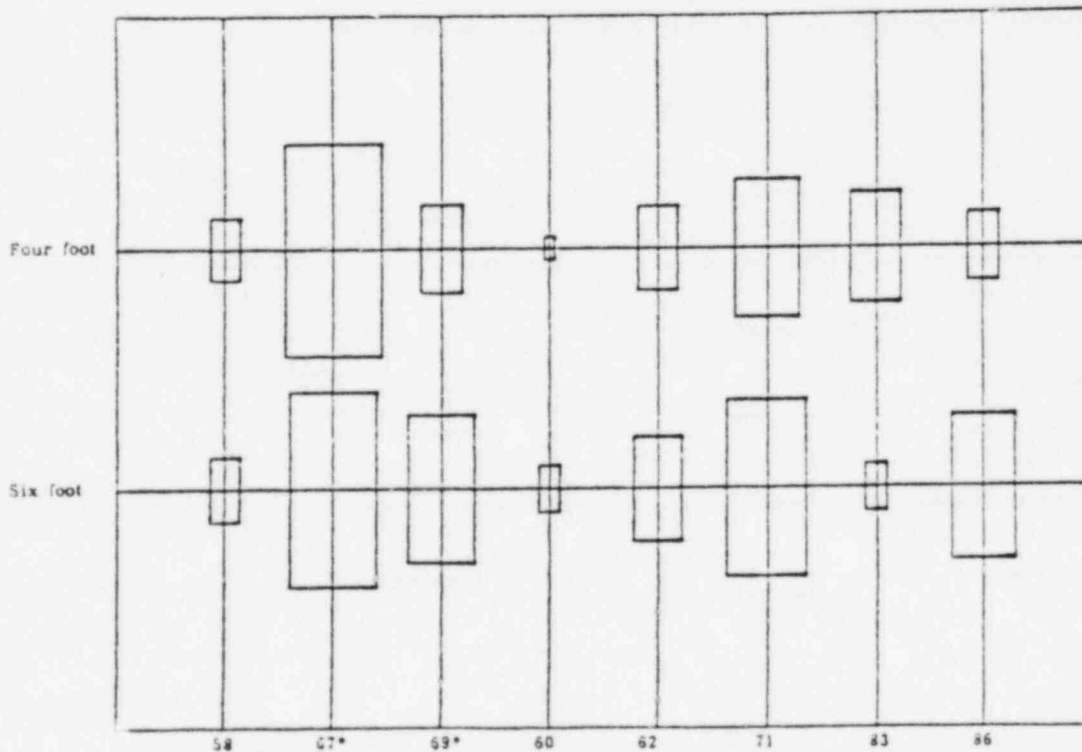
Gross Alpha
B Series Cores

Core	Mean	pCi/gm 95% Confidence Interval	
		Lower Limit	Upper Limit
56	3.8	1.7	5.8
67*	8.8	6.7	10.8
69*	5.7	3.6	7.7
60	2.8	0.7	4.8
62	4.9	2.8	6.9
71	7.1	5.0	9.1
83	4.3	2.2	6.4
84	5.3	3.2	7.3

*These samples were apparently mislabeled (by UNC). An assumption was made that one is 67 and the other 69.

Figure 6.7-1

Gross Alpha
B Series (Soil Cores)



*These samples were mislabeled, an assumption has been made that one is 67 and the other 69.

Gross Alpha
B Series (Soil Cores)

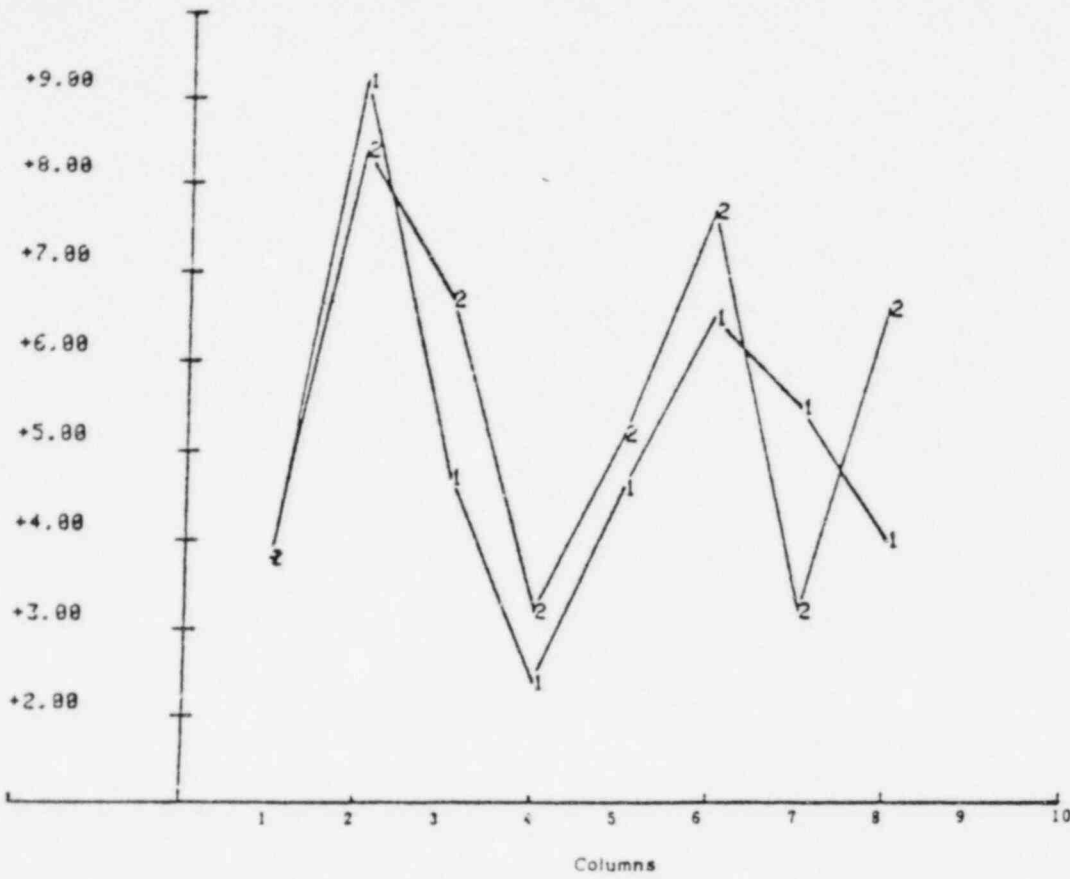


Figure 6.7-2

Gross Alpha
B Series (Soil Cores)

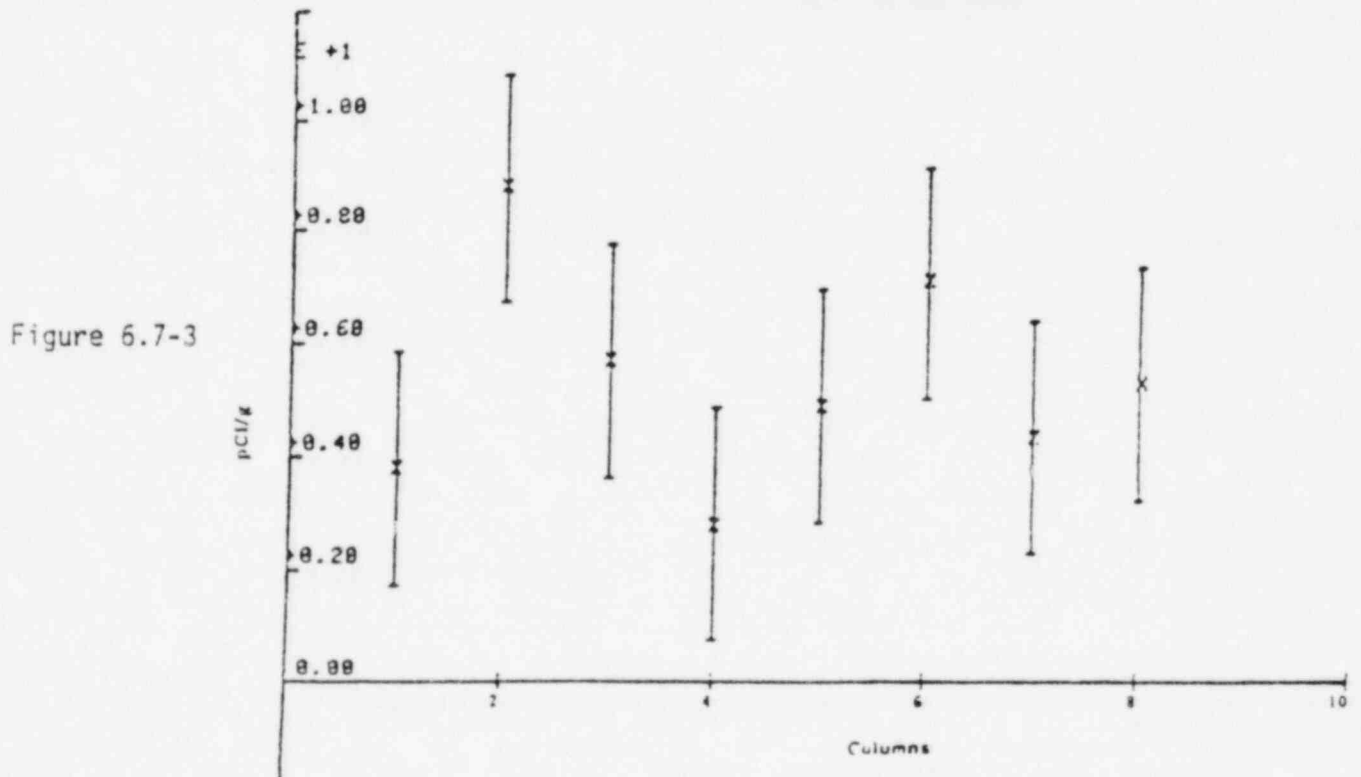
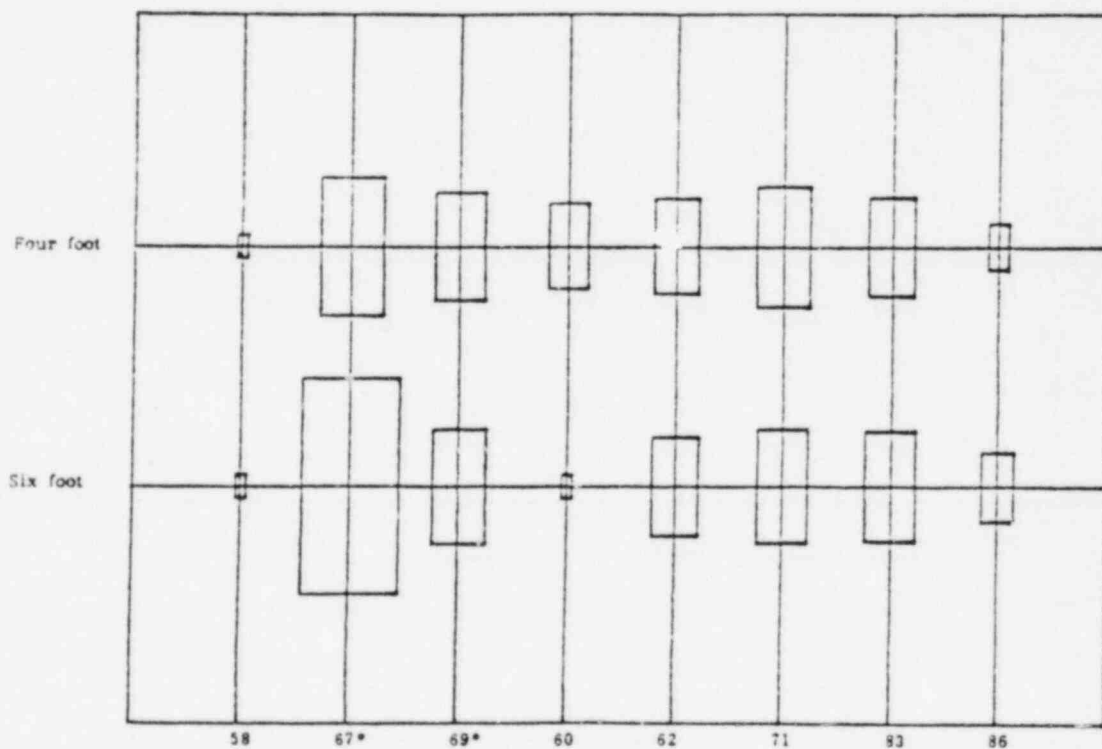


Figure 6.7-3

The gross beta activity variance is illustrated in Figure 6.7-4 . This figure points out that the highest activity was reported for the B-67 six (6) foot core sample due to mislabeling. Figure 6.7-5 illustrates the individual data points and generally indicates that the results are statistically equal to the 1981 background samples (5.5 ± 3.5 pCi/gm and 4.2 ± 6.12 pCi/gm) surface and subsurface respectively. This is also true of the core means as illustrated in Figure 6.7-6.

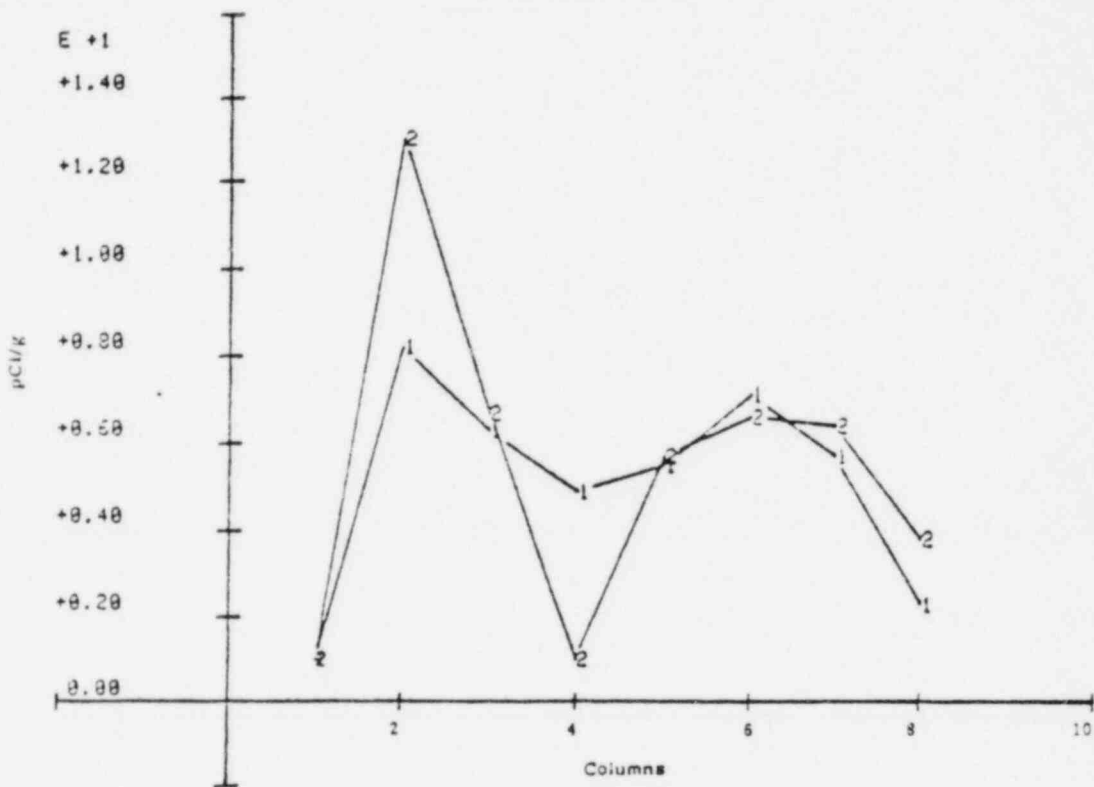
Figure 6.7-4
Gross Beta
B Series (Soil Cores)



*These samples were mislabeled, an assumption has been made that on 57 and the other 69.

Figure 6.7-5

Gross Beta
B Series (Soil Cores)



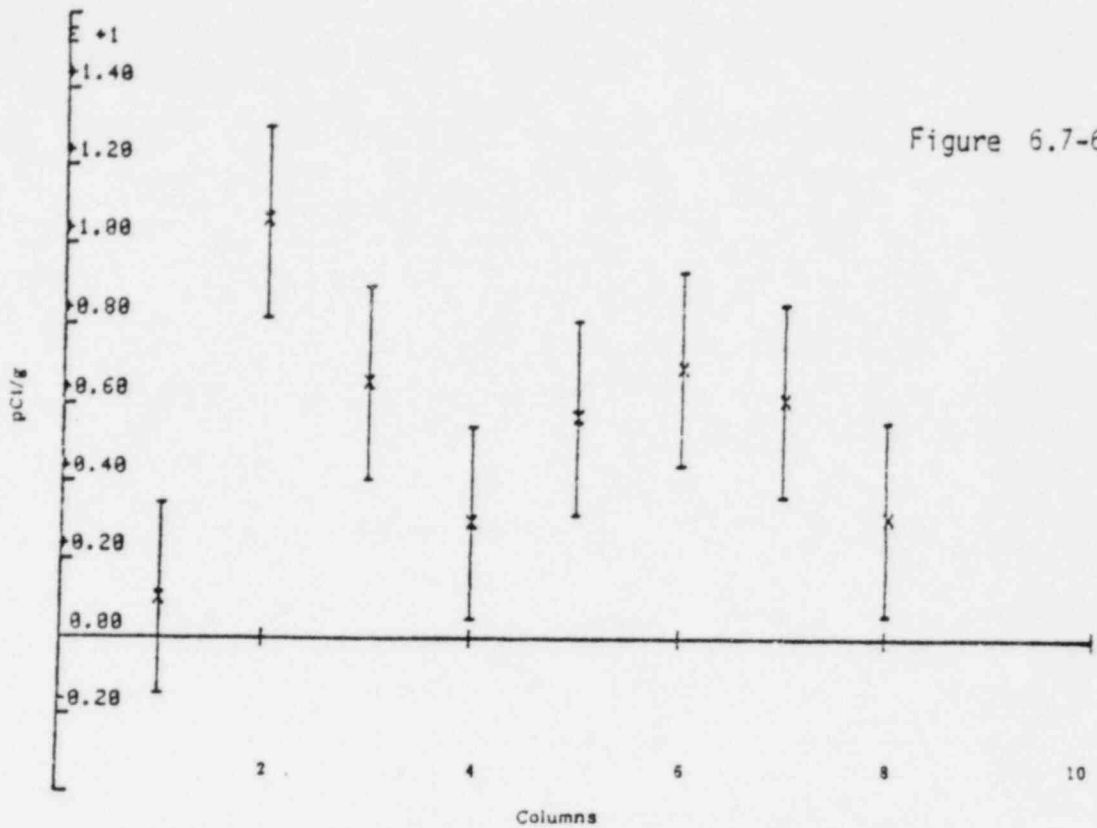


Figure 6.7-6

The data means and ninety-five percent (95%) confidence intervals are presented in Table 6.7-2.

Table 6.7-2

Gross Beta

Soil Cores - B Series

	<u>Mean</u>	<u>pCi/gm</u> 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Four Foot	5.1	3.8	6.3
Six Foot	5.5	4.2	6.7
<u>Core</u>	<u>Mean</u>	<u>Lower Limit</u>	<u>Upper Limit</u>
58	1.0	-1.4	3.4
67*	10.6	8.1	13.0
69*	6.5	4.0	8.9
60	2.9	0.4	5.4
62	5.6	3.1	8.0
71	6.8	4.3	9.3
83	6.0	3.5	8.5
84	3.0	0.5	5.5

*These samples were apparently mislabeled (by UNC). A assumption was made that one (1) is 67 and the other 69.

The radium-226 data shows the B-067* six (6) foot core sample demonstrated the highest activity (see Figure 6.7-7). A review of the data in Figure 6.7-8 points out that the data is statistically equal to the 1981 subsurface background activity (0.71 ± 0.43 pCi/gm). This is also true of the core means as is illustrated in Figure 6.7-9. The core means and their respective ninety-five percent (95%) confidence intervals are presented in Table 6.7-3.

Table 6.7-3

Radium-226

Soil Core - B Series

	<u>Mean</u>	pCi/gm 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Four Foot	0.6	0.34	0.85
Six Foot	0.96	0.70	1.21

<u>Core</u>	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
58	0.90	0.39	1.40
67*	1.50	0.99	2.00
69*	0.75	0.24	1.25
60	0.65	0.14	1.15
62	0.50	-0.007	1.00
71	0.95	0.44	1.45
83	0.50	0.00	1.00
84	0.50	0.00	1.00

*These samples were apparently mislabeled (by UNC). A assumption was made that one (1) is 67 and the other 69.

Radium-226
B Series (Soil Cores)

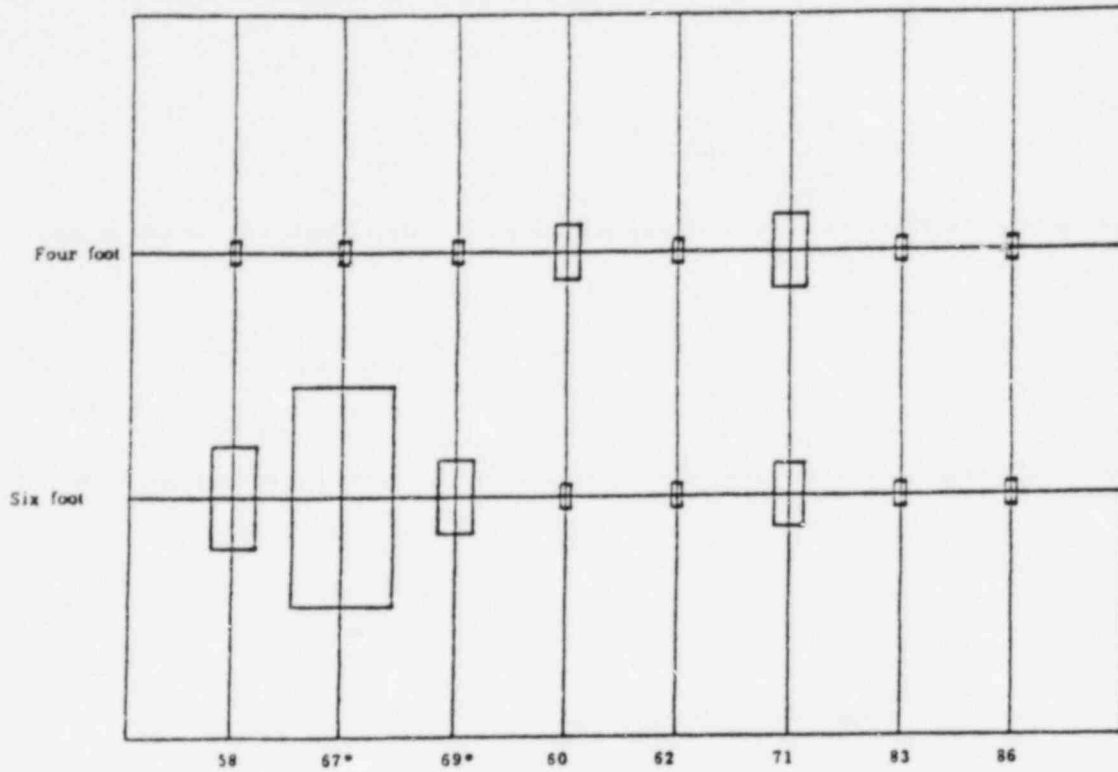


Figure 6.7-7

*These samples were mislabeled, an assumption has been made that one is 67 and the other 69.

Radium-226
B Series (Soil Cores)

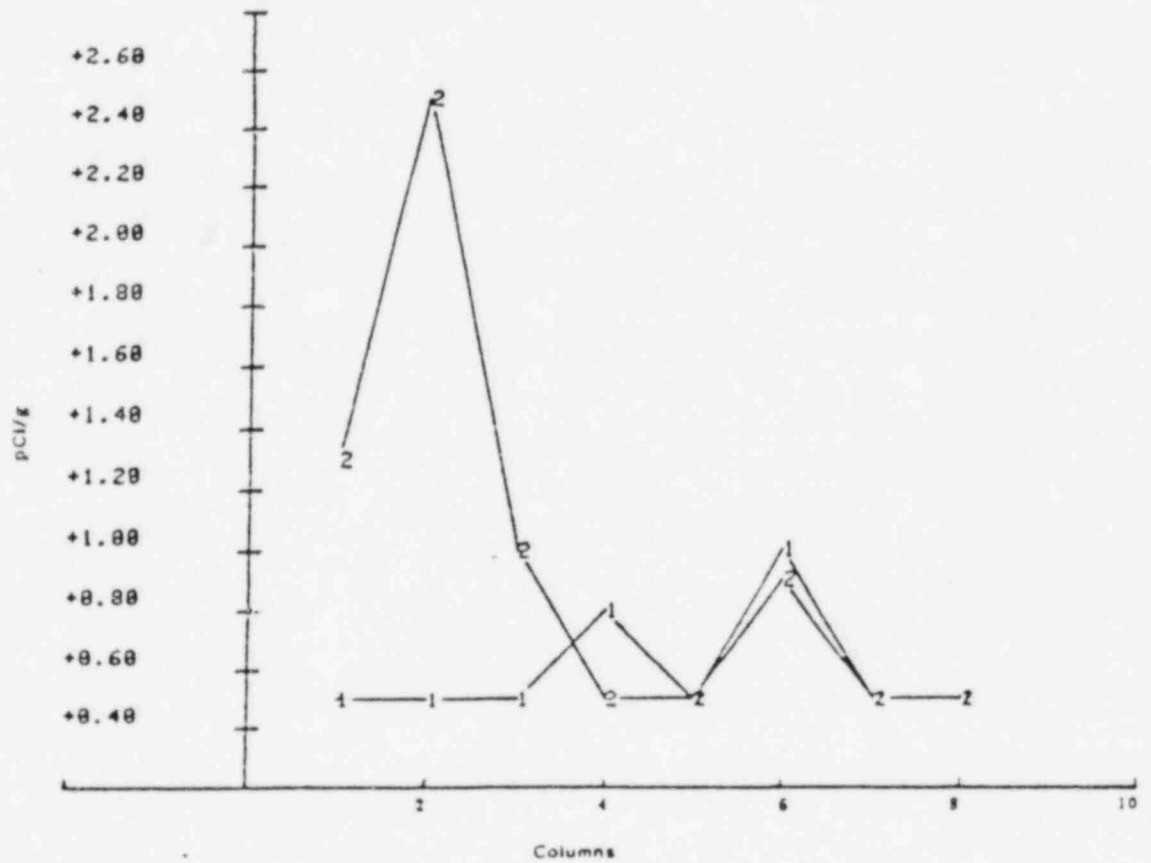


Figure 6.7-8

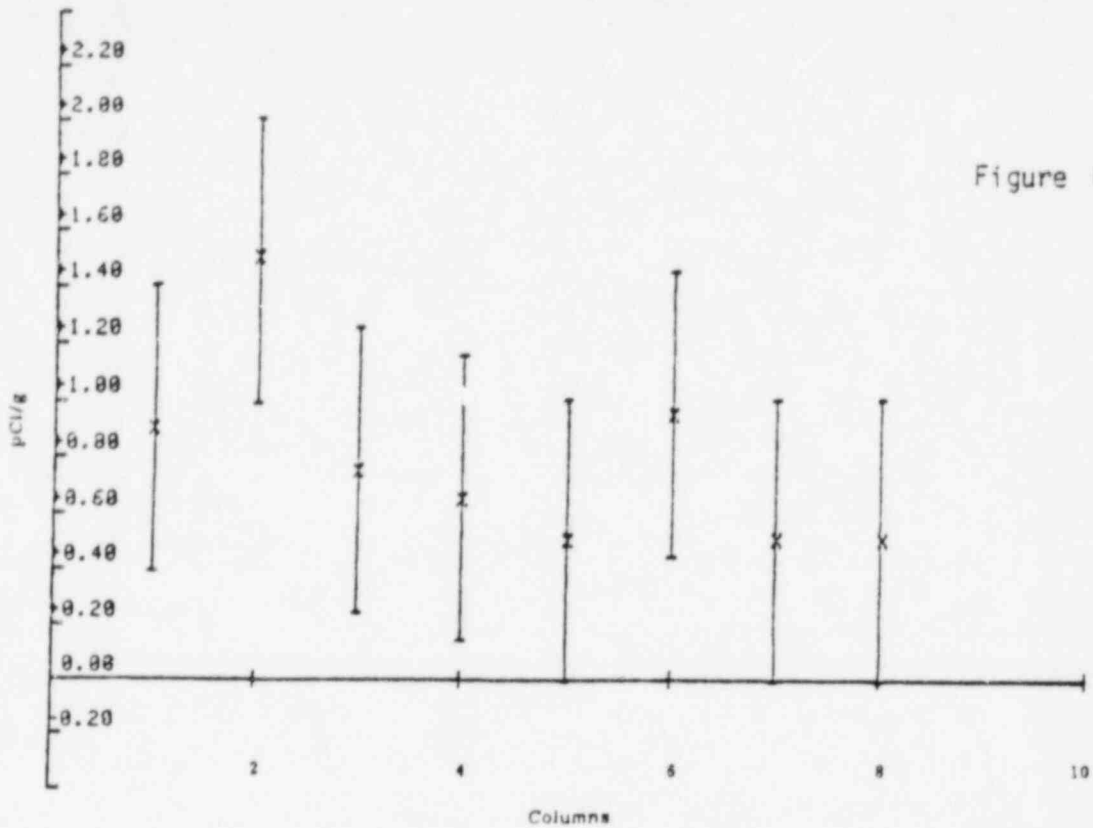


Figure 6.7-9

An illustration of the variance for Radium-228 is presented in Figures 6.7-10 and 6.7-11. These figures indicate core and depth data fluctuations. In addition, it is noted from Figures 6.7-11 and 6.7-12 that results generally exceed the 1981 background data for subsurface samples (0.39 ± 0.45 pCi/gm). The means and ninety-five percent (95%) confidence intervals are presented in Table 6.7-4.

Table 6.7-4
Radium-228
Soil Core - B Series

	Mean	pCi/gm 95% Confidence Interval	
		Lower Limit	Upper limit
Four Foot	0.42	0.14	0.69
Six Foot	0.73	0.46	1.01

Radium-228
R Series (Soil Cores)

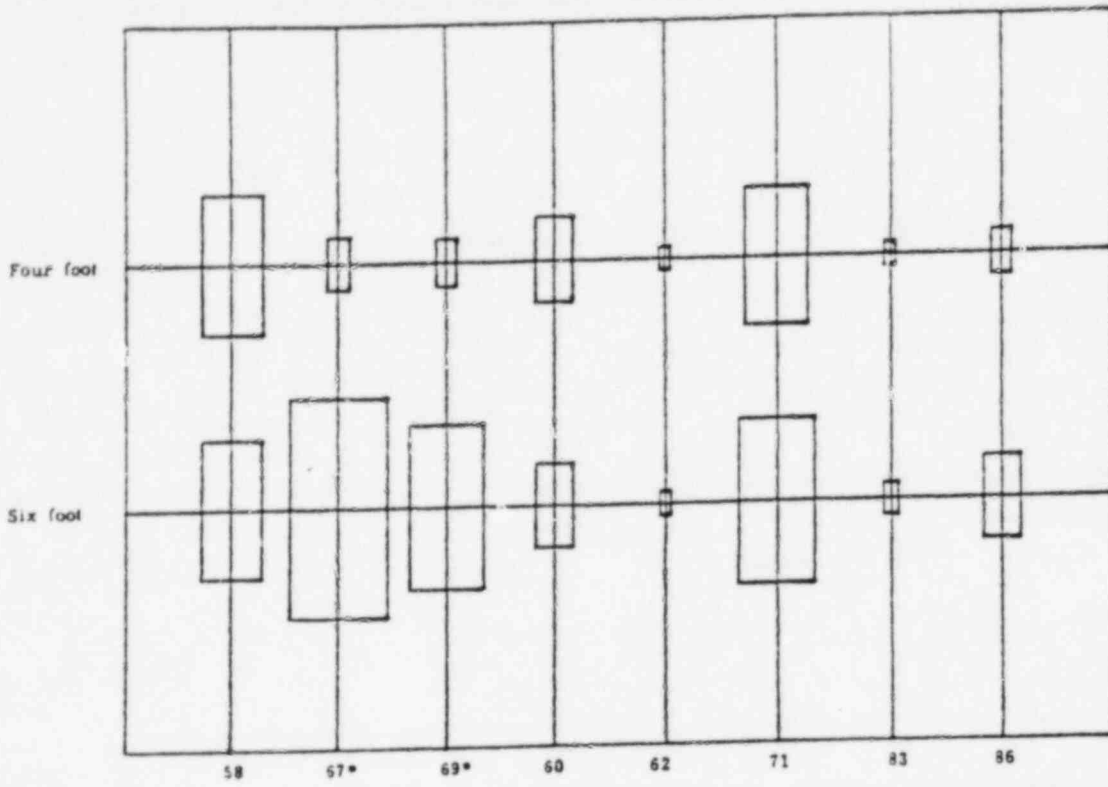


Figure 6.7-10

*These samples were mislabeled, an assumption has been made that one is 67 and the other 69.

Radium-228
B Series (Soil Cores)

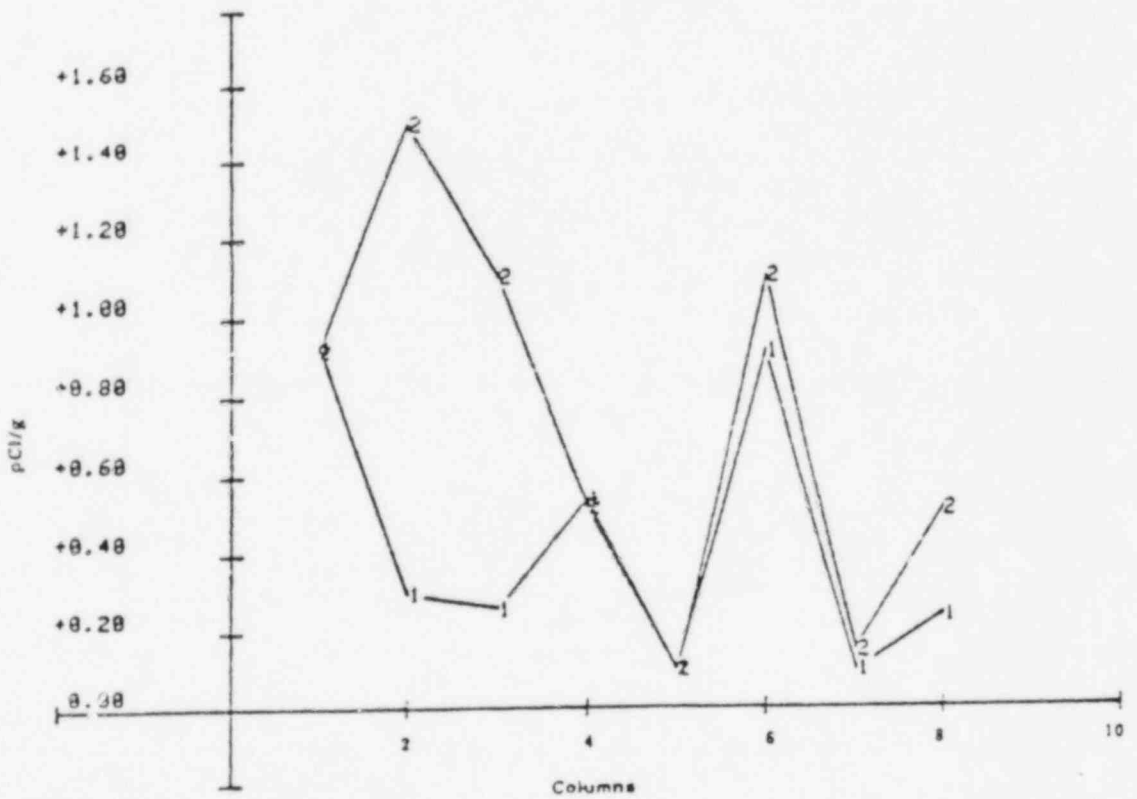


Figure 6.7-11

Table 6.7-4 (Cont'd)

Radium-228

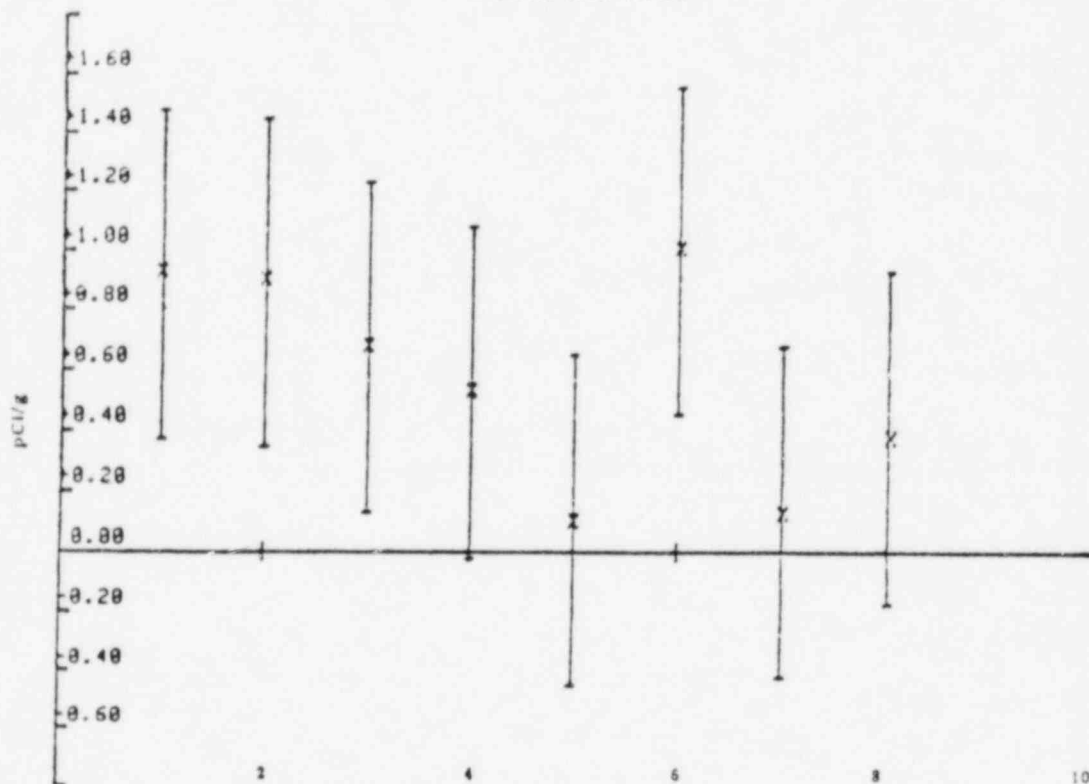
Soil Core - B Series

<u>Core</u>	<u>Mean</u>	<u>pCi/gm</u> 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
58	0.92	0.37	1.47
67*	0.90	0.34	1.45
69*	0.68	0.12	1.23
60	0.53	-0.02	1.08
62	0.10	-0.45	0.65
71	1.00	0.45	1.55
83	0.12	-0.42	0.67
84	0.37	-0.17	0.92

*These samples were apparently mislabeled (by UNC). A assumption was made that one was 67 and the other 69.

Figure 6.7-12

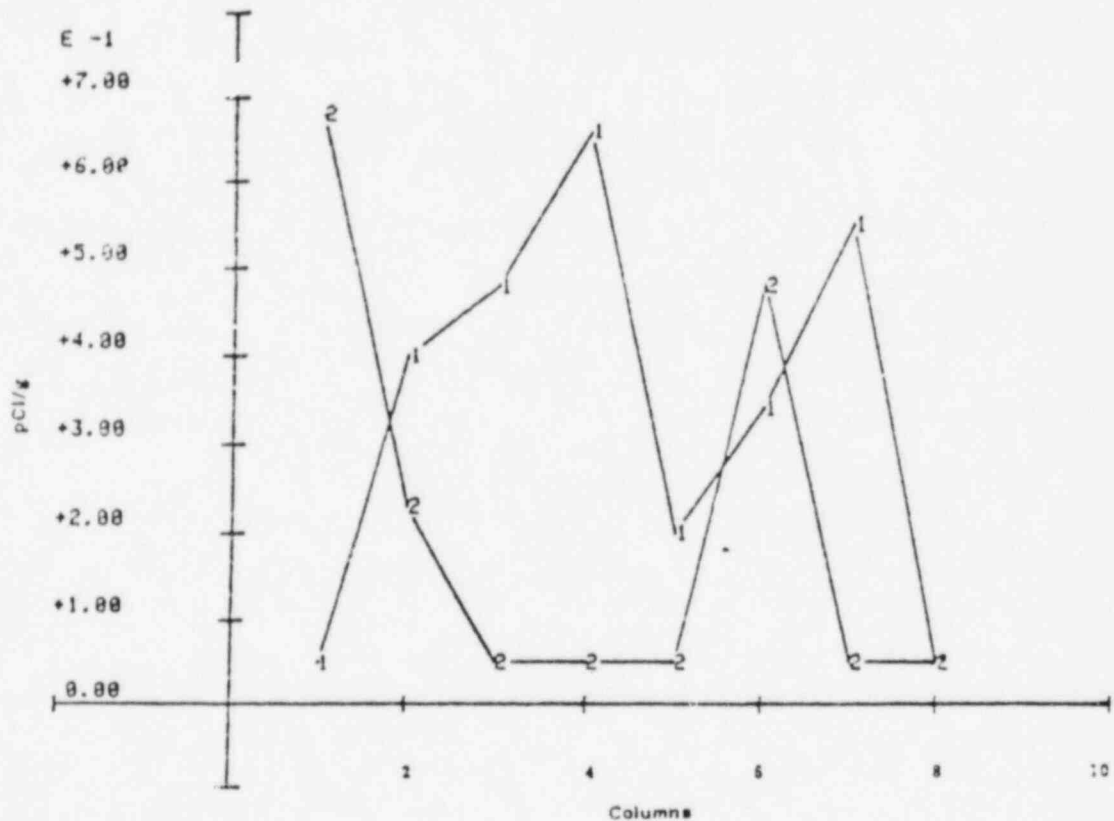
Radium-228
B Series (Soil Cores)



The isotopic uranium (U-234, U-235, U-238) data are graphically illustrated in Figures 6.7-17 through 6.7-18. These figures show that the overall activities are below the 1981 background means for subsurface samples (U-234 = 1.12 ± 1.17 pCi/gm, U-235 = 0.26 ± 0.44 pCi/gm and U-238 = 0.94 ± 1.22 pCi/gm).

Figure 6.7-13

Uranium-234
B Series (Soil Cores)



Uranium-235
B Series (Soil Cores)

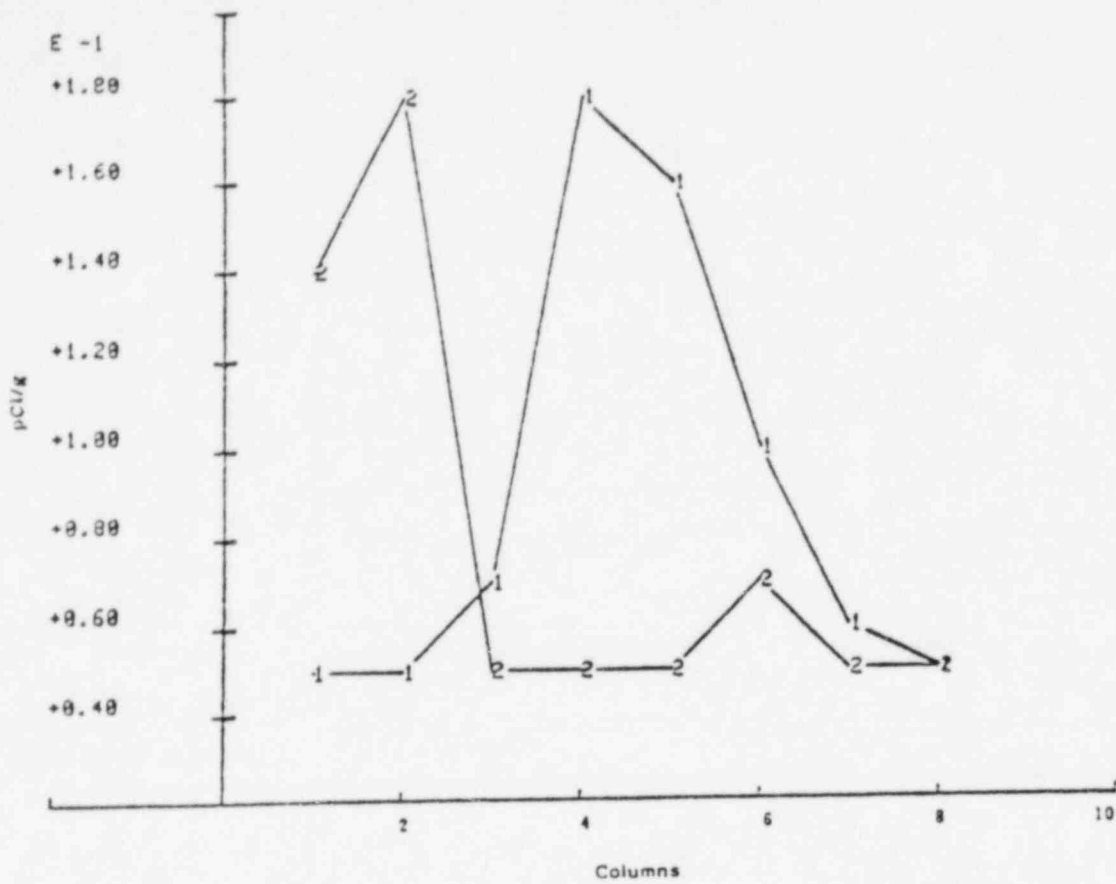


Figure 6.7-14

Uranium-238
B Series (Soil Cores)

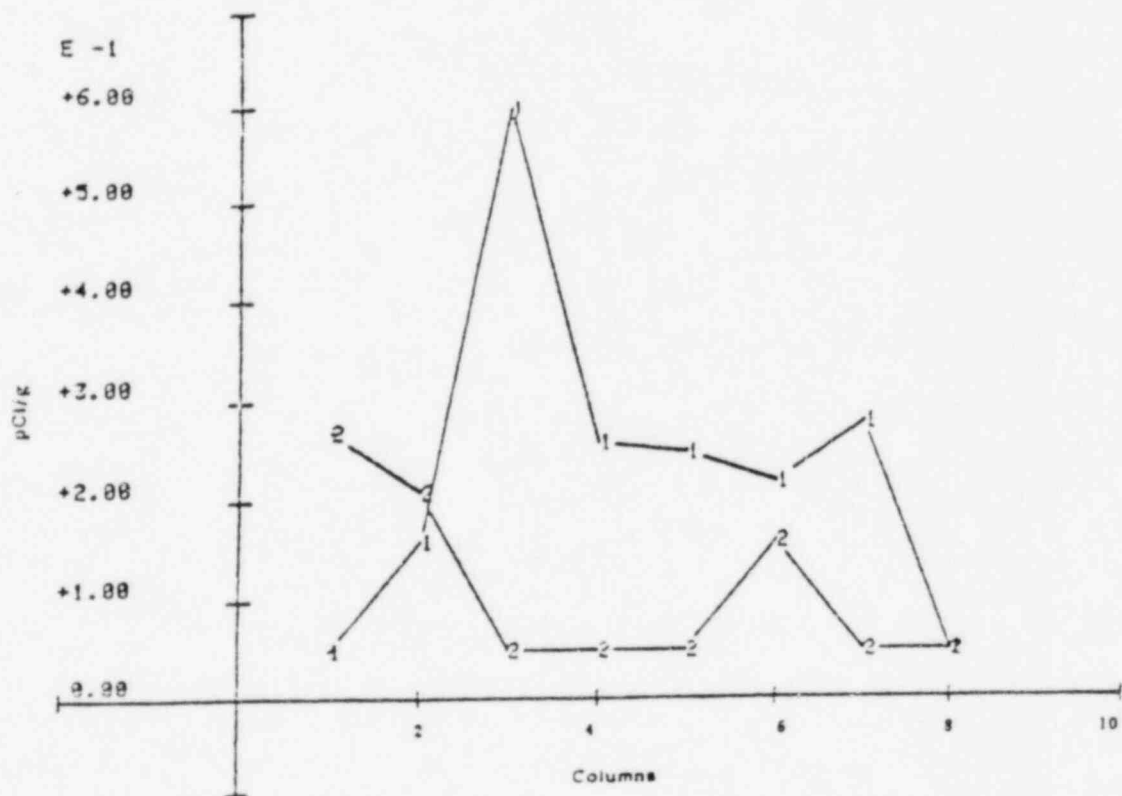


Figure 6.7-15

Uranium-234
B Series (Soil Cores)

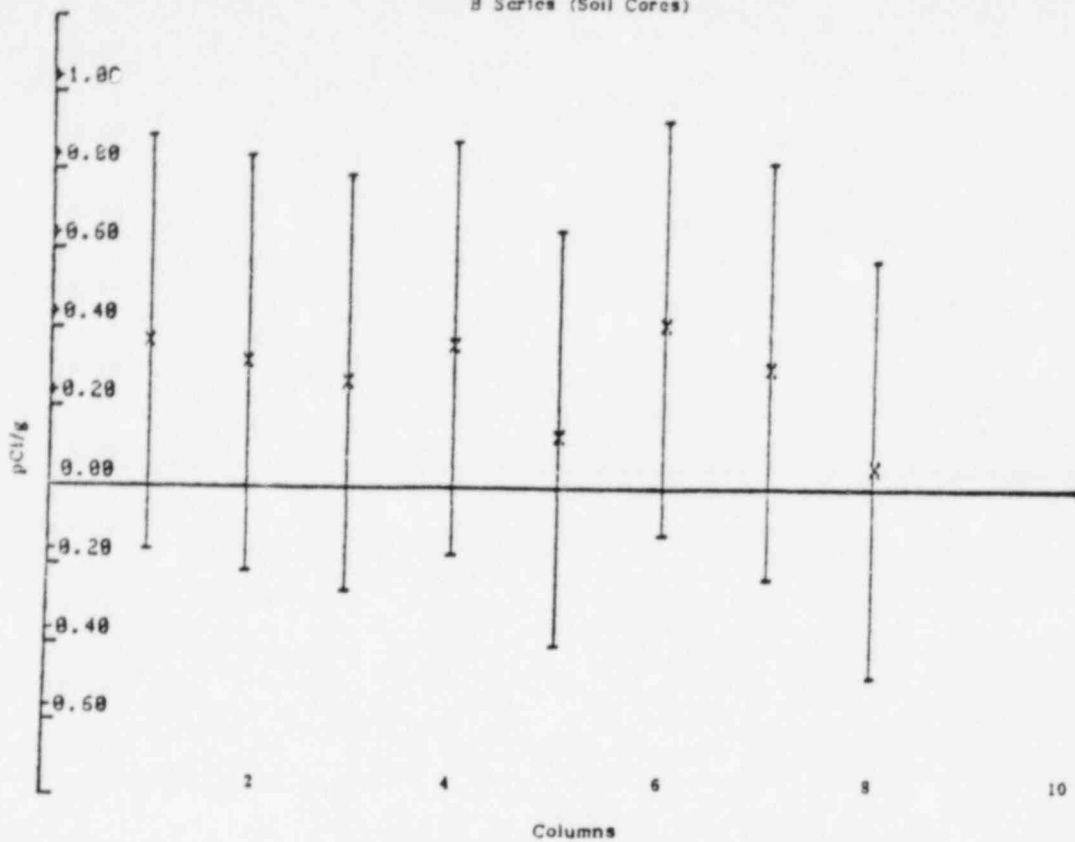


Figure 6.7-16

Uranium-235
B Series (Soil Cores)

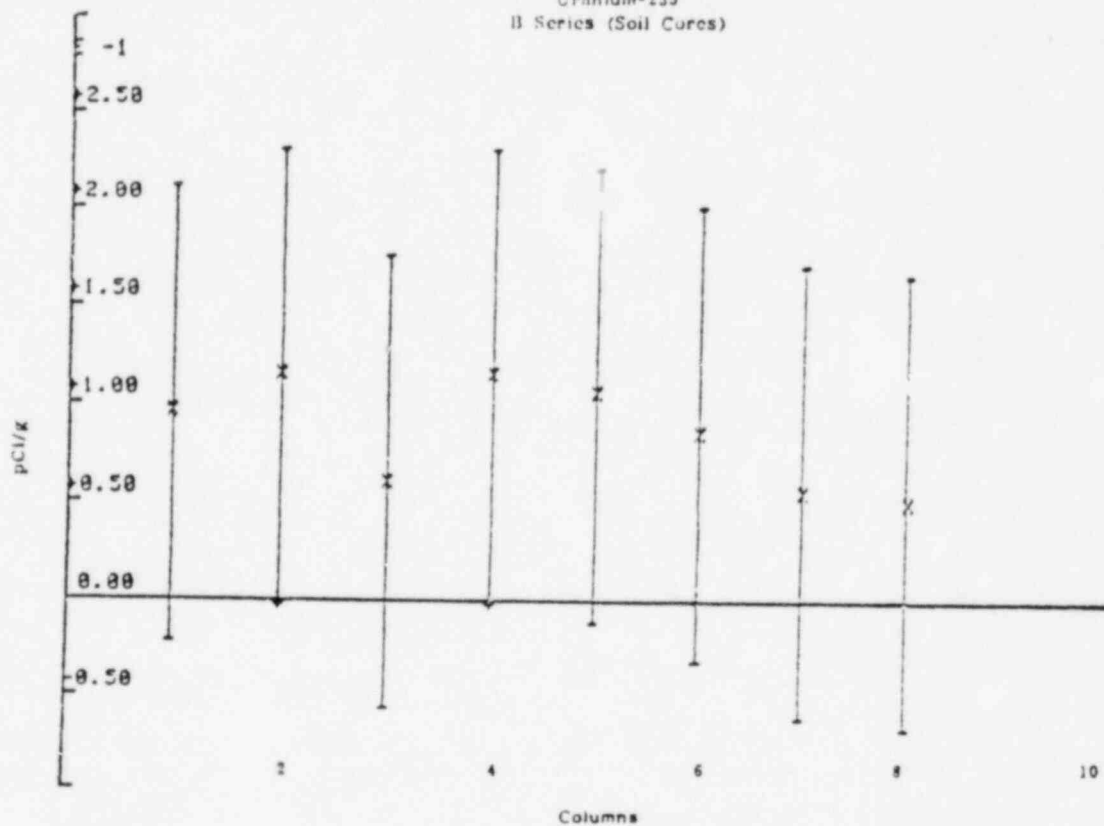
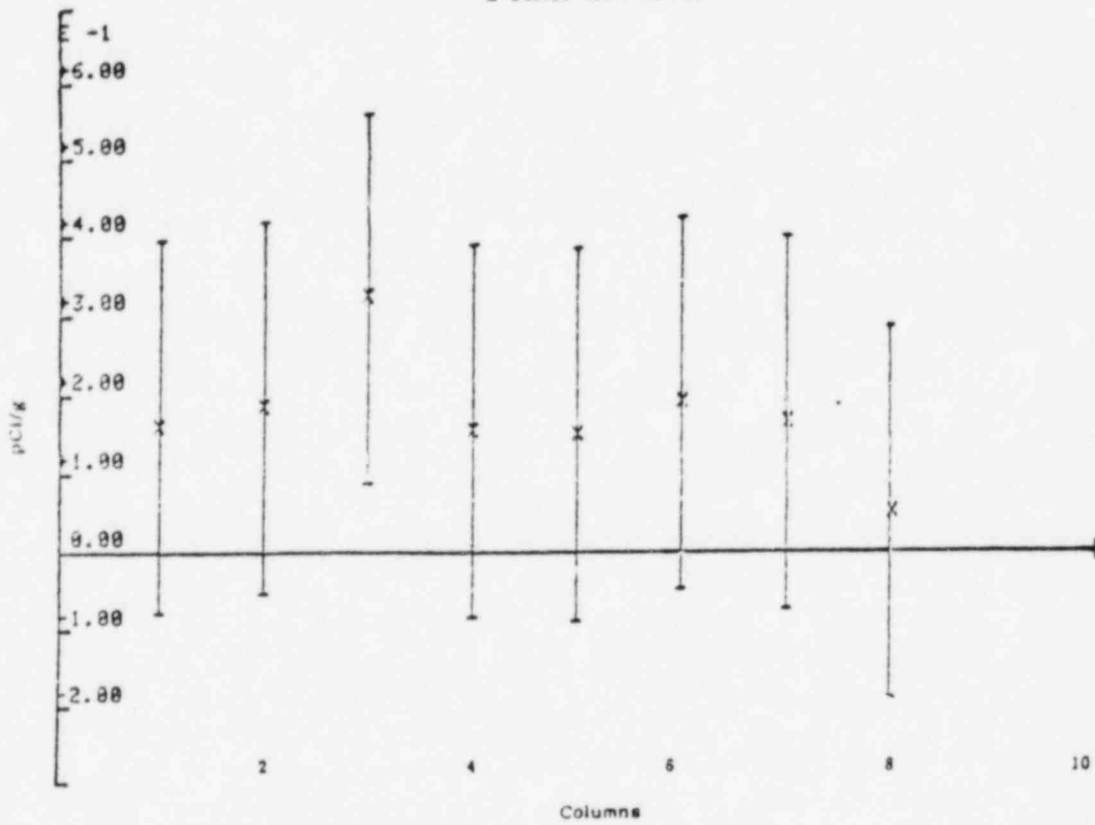


Figure 6.7-17

Figure 6.7-18

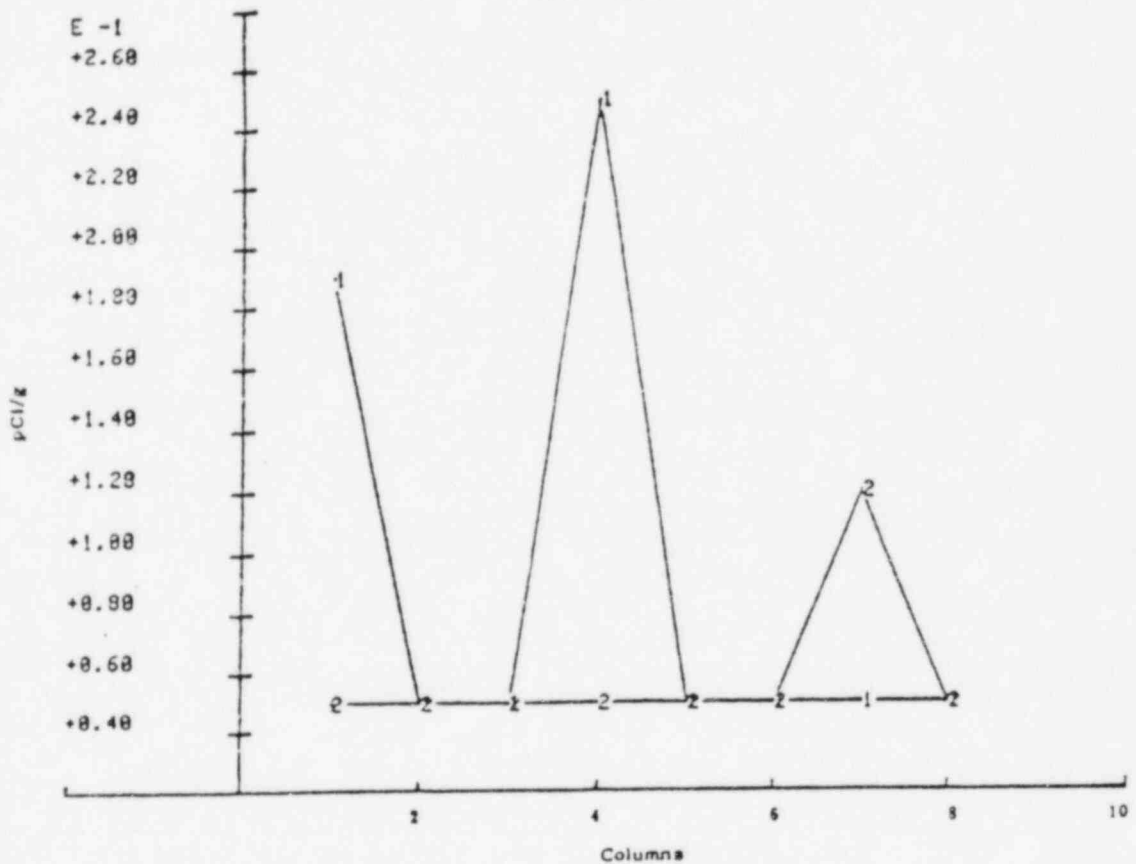
Uranium-238
B Series (Soil Cores)



Statistical evaluation of the isotopic thorium data points that, generally, the four (4) foot core sample data are below the 1981 mean backgrounds (Th-228 = 0.025 ± 0.038 pCi/gm and Th-230 = 0.13 ± 0.11 pCi/gm).

Figure 6.7-19

Thorium-228
B Series (Soil Cores)



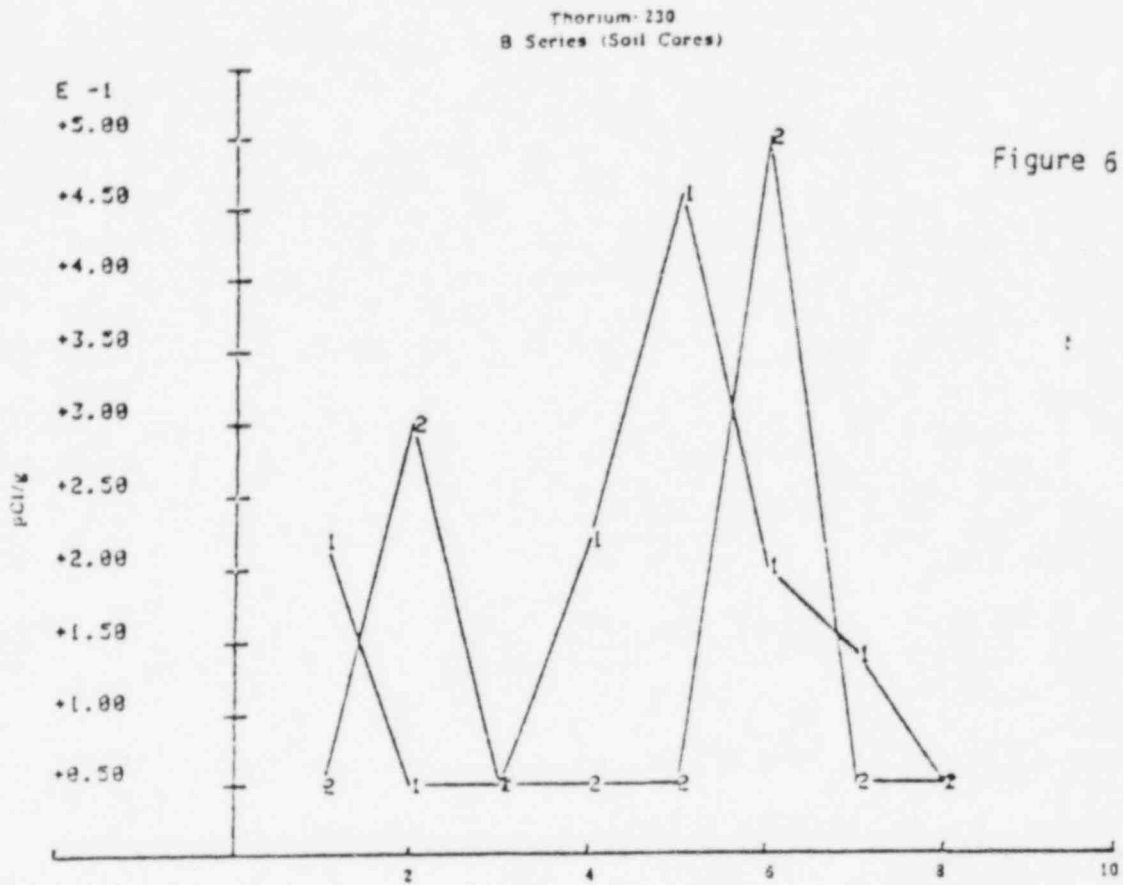


Figure 6.7-20

The thorium data is presented in Figures 6.7-19 through 6.7-21. The thorium-232 results illustrated in Figure 6.11-21 shows that fifty percent (50%) of the four (4) foot cores exceed the 1981 background of 0.12 ± 0.05 pCi/gm. The core means and their respective confidence intervals are presented in Table 6.7-5 through 6.7-7. In general the core means are statistically equal to the 1981 background means with the exception of B-060 for thorium-228 and B-071 for thorium-230 and thorium-232.

Figure 6.7-21

Thorium-232
B Series (Soil Cores)

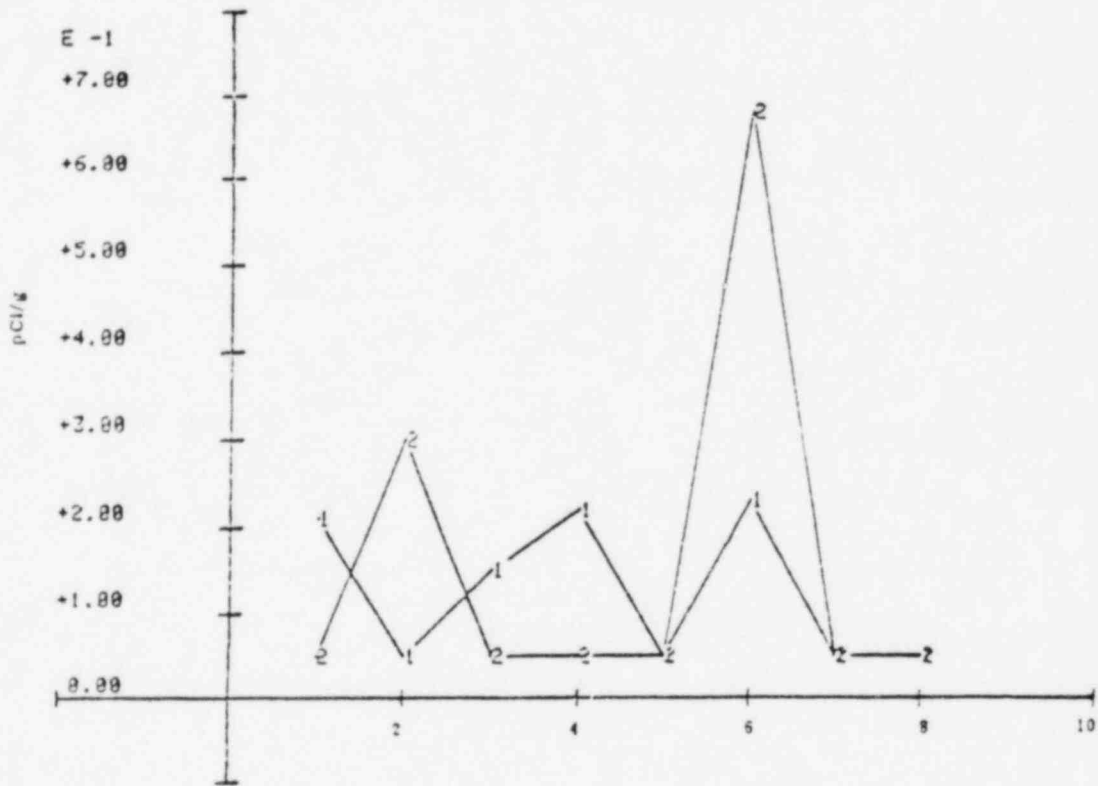


Table 6.7-5
Thorium-228
Soil Core - B Series

	<u>Mean</u>	pCi/gm 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Four Foot	0.09	0.05	0.12
Six Foot	0.05	0.02	0.09

<u>Core</u>	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
58	0.12	0.05	0.18
67*	0.05	-0.01	0.11
69*	0.05	-0.01	0.11
60	0.15	-0.08	0.21
62	0.05	-0.01	0.11
71	0.05	-0.01	0.11
83	0.08	0.01	0.15
84	0.05	-0.01	0.11

*These samples were apparently mislabeled (by UNC). A assumption was made that one was 67 and the other 69.

Table 6.7-6
Thorium-230
Soil Core - B Series

	<u>Mean</u>	pCi/gm 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Four Foot	0.17	0.02	0.32
Six Foot	0.13	-0.01	0.28

Table 6.7-6 (Cont'd)

Thorium-230Soil Core - B Series

<u>Core</u>	<u>Mean</u>	pCi/gm 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
58	0.13	-0.16	0.43
67*	0.17	-0.12	0.47
69*	0.05	-0.24	0.34
60	0.13	-0.16	0.43
62	0.25	-0.04	0.55
71	0.35	0.05	0.64
83	0.09	-0.20	0.39
84	0.05	-0.24	0.34

*These samples were apparently mislabeled (by UNC). A assumption was made that one was 67 and the other 69.

Table 6.7-7

Thorium-232Soil Core - B Series

	<u>Mean</u>	pCi/gm 95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Four Foot	0.12	0.03	0.21
Six Foot	0.16	0.07	0.24

<u>Core</u>	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
58	0.13	-0.04	0.30
67*	0.17	-0.00	0.35
69*	0.10	-0.07	0.27
60	0.13	-0.04	0.31
62	0.05	-0.12	0.22
71	0.45	0.27	0.63
83	0.05	-0.12	0.22
84	0.05	-0.12	0.22

*These samples were apparently mislabeled (by UNC). An assumption was made that one was 67 the other 69.

The cesium-137 data is illustrated in Figures 6.7-22 and 6.7-23 are statistically equal to or less than the 1981 mean background activity (0.18 ± 0.11 pCi/gm).

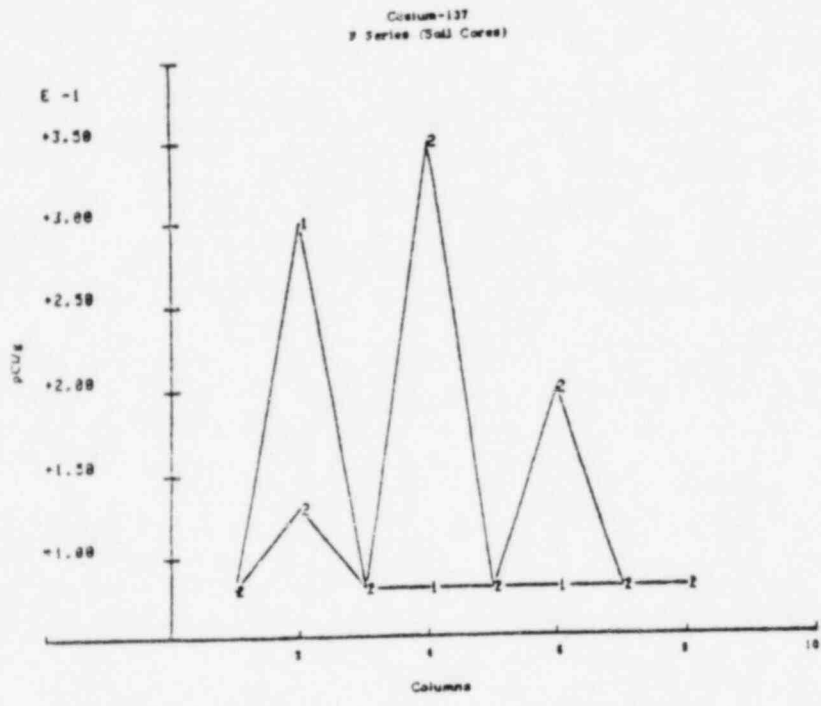
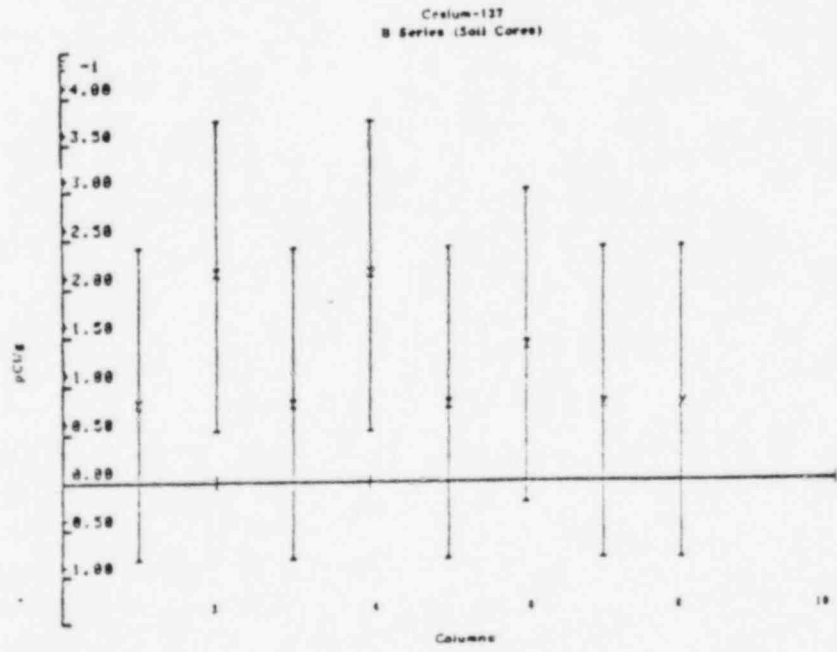


Figure 6.7-22

Figure 6.7-23



6.8 Soil Water Solubility Tests - "B" Series

The gross alpha water solubility tests revealed no gross alpha activity detected above the lower limit of detection (0.3 pCi/gm) for the surface and subsurface samples tested with the exception of B-024 and B-034. Less than one percent (1%) of the total activity detected in the original samples was soluble (B-024 and B-034).

The gross beta analyses showed no water soluble activity except for the surface samples. Surface samples B-024 and B-059 had activities of 2.2 ± 0.4 pCi/gm and 0.8 ± 0.3 pCi/gm, respectively. This represents less than one percent (1%) and nineteen percent (19%) of the activity detected in the original samples. All others were reported at less than 0.1 pCi/gm.

All surface and subsurface samples analyzed for water soluble radium-226 were reported at less than 0.5 pCi/gm, except for B-024 surface sample. The activity reported for the B-024 surface sample was 16.2 ± 1.8 pCi/gm. This represents less than one percent (1%) of the activity in the original sample.

All water soluble radium-228 results for both surface and subsurface samples were reported at less than 0.1 pCi/gm except for surface sample B-059. The water soluble activity was reported at 0.79 ± 0.44 pCi/gm which is statistically equal to the activity determined for the original sample.

Surface samples for strontium-90 were all reported at less than 0.03 pCi/gm with the exception of B-034. B-073 subsurface sample showed an activity statistically equal to the activity of the original samples.

The surface samples analyzed for water soluble isotopic uranium were reported as less than 0.05 pCi/gm except for B-024, B-034 and B-076. These were reported at five to ten percent (5-10%) less than the original sample activity.

The isotopic thorium data for surface and subsurface water solubility tests were all reported as statistically equal to the activity of the original sample or less than 0.05 pCi/gm.

All cesium-137 data for surface and subsurface water soluble tests were reported at less than 0.08 pCi/gm.

7.0 Gross Alpha/Beta Viability Discussion

Tables 7.0-1 through 7.0-9 summarize the Gross Alpha/Alpha Emitters and the Gross Beta/Beta Emitters data.

Evaluating the data presented in these tables, it can be concluded the analysis of Alpha and Beta Emitters could be eliminated in most instances. It is recommended that only Gross Alpha and Gross Beta be analyzed on all samples and specific isotopic analysis on samples exceeding ten times background. (See Table 7.0-3).

This recommendation is based on the assumption the area will require disposal of contaminated material. When an area demonstrates twice or higher background activity (See Table 7.0-3) in either Gross Alpha or Beta, selective emitters should be analyzed and quantized. Based on future use of the area in question, restricted or unrestricted, a determination on the isotopes to be analyzed can be formed.

Table 7.0-1
Alpha/Beta Evaluation

<u>Analysis</u>	<u>Macadam pCi/gm Mean</u>
Gross Alpha	<u>2.4</u>
<u>Alpha Emitters</u>	
Radium-226	
Uranium-234	
Uranium-235	0.12
Uranium-238	
Thorium-228	
Thorium-230	
Thorium-232	
Sum (Alpha Emitters)	<u>0.12</u>
Gross Beta	<u>0.3</u>
<u>Beta Emitters</u>	
Radium-228	
Strontium-90	
Cesium-137	
Sum (Beta Emitters)	None analyzed

Table 7.0-2
Alpha/Beta Evaluation
1963 Soil Background Samples

<u>Analysis</u>	<u>pCi/gm</u> <u>Mean</u>
Gross Alpha	<u>3.9</u>
<u>Alpha Emitters</u>	
Radium-226	-
Uranium-234	*0.088
Uranium-235	-
Uranium-238	-
Thorium-228	-
Thorium-230	-
Thorium-232	-
Sum (Alpha Emitters)	<u>0.088</u>
Gross Beta	8.5
<u>Beta Emitters</u>	
Radium-228	-
Strontium-90	-
Cesium-137	-
Sum (Beta Emitters)	

*Value is a summation of U-234 and U-238

Table 7.0-3

Alpha/Beta Evaluation

1981 Soil Background Samples (E-S Series)

<u>Analysis</u>	<u>Surface</u> <u>pCi/gm</u> <u>Mean</u>	<u>Sub-Surface</u> <u>pCi/gm</u> <u>Mean</u>
Gross Alpha	<u>5.0</u>	<u>4.4</u>
<u>Alpha Emitters</u>		
Radium-226	0.8	0.6
Uranium-234	0.99	1.12
Uranium-235	0.30	0.26
Uranium-238	0.93	0.94
Thorium-228	0.068	0.75
Thorium-230	0.087	0.138
Thorium-232	<u>0.126</u>	<u>0.125</u>
Sum (Alpha Emitters)	<u>3.30</u>	<u>3.26</u>
Gross Beta	<u>5.5</u>	<u>4.2</u>
<u>Beta Emitters</u>		
Radium-228	0.52	0.39
Strontium-90	0.17	0.05
Cesium-137	<u>1.49</u>	<u>0.18</u>
Sum (Beta Emitters)	<u>2.18</u>	<u>0.62</u>

Table 7.0-4
Alpha/Beta Evaluation
1981 NRC Background Samples (X, Y)

<u>Analysis</u>	<u>pCi/gm</u> <u>Mean</u>
Gross Alpha	<u>2.5</u>
<u>Alpha Emitters</u>	
Radium-226	0.6
Uranium-234	1.83
Uranium-235	0.26
Uranium-238	0.92
Thorium-228	0.05
Thorium-230	0.06
Thorium-232	<u>0.06</u>
Sum (Alpha Emitters)	<u>3.78</u>
Gross Beta	<u>5.4</u>
<u>Beta Emitters</u>	
Radium-228	1.08
Strontium-90	0.49
Cesium-137	<u>4.02</u>
Sum (Beta Emitters)	<u>5.59</u>

Table 7.0-5
 Alpha/Beta Evaluation
 Macadam
Soil Under Macadam (D-D Series)

<u>Analysis</u>	<u>1 foot Core</u> pCi/gm <u>Mean</u>	<u>2 foot core</u> pCi/gm <u>Mean</u>
Gross Alpha	<u>6.7</u>	<u>5.0</u>
<u>Alpha Emitters</u>		
Radium-226	1.5	0.9
Uranium-234	0.35	0.10
Uranium-235	0.12	0.07
Uranium-238	0.14	0.13
Thorium-228	0.05	0.07
Thorium-230	0.25	0.18
Thorium-232	<u>0.21</u>	<u>0.19</u>
Sum (Alpha Emitters)	<u>2.62</u>	<u>1.64</u>
Gross Beta	<u>2.7</u>	<u>2.2</u>
<u>Beta Emitters</u>		
Radium-228	0.5	0.4
Strontium-90	0.14	0.03
Cesium-137	<u>0.08</u>	<u>0.08</u>
Sum (Beta Emitters)	<u>0.72</u>	<u>0.51</u>

Table 7.0-6
Alpha/Beta Evaluation
Soil - A Series

<u>Analysis</u>	<u>Surface</u> pCi/gm <u>Mean</u>	<u>Sub-Surface</u> pCi/gm <u>Mean</u>
Gross Alpha	<u>5.4</u>	<u>3.9</u>
<u>Alpha Emitters</u>		
Radium-226	1.90	1.08
Uranium-234	1.32	0.73
Uranium-235	0.17	0.15
Uranium-238	0.63	0.40
Thorium-228	0.098	0.074
Thorium-230	0.097	0.083
Thorium-232	<u>0.058</u>	<u>0.062</u>
Sum (Alpha Emitters)	<u>4.27</u>	<u>2.58</u>
Gross Beta	<u>3.4</u>	<u>2.8</u>
<u>Beta Emitters</u>		
Radium-228	0.68	0.64
Strontium-90	0.09	0.08
Cesium-137	<u>0.60</u>	<u>0.33</u>
Sum (Beta Emitters)	<u>1.37</u>	<u>1.05</u>

Table 7.0-7
Alpha/Beta Evaluation
Soil Core - A Series

<u>Analysis</u>	<u>2 foot</u> <u>pCi/gm</u> <u>Mean</u>	<u>4 foot</u> <u>pCi/gm</u> <u>Mean</u>	<u>6 foot</u> <u>pCi/gm</u> <u>Mean</u>
Gross Alpha	<u>2.7</u>	<u>2.2</u>	<u>1.26</u>
<u>Alpha Emitters</u>			
Radium-226	1.06	0.91	0.67
Uranium-234	0.24	0.17	0.32
Uranium-235	0.12	0.07	0.05
Uranium-238	0.23	0.20	0.15
Thorium-228	0.07	0.05	0.08
Thorium-230	0.13	0.37	0.06
Thorium-232	<u>0.10</u>	<u>0.22</u>	<u>0.06</u>
Sum (Alpha Emitters)	<u>1.95</u>	<u>1.99</u>	<u>1.39</u>
Gross Beta	<u>1.48</u>	<u>0.80</u>	<u>0.90</u>
<u>Beta Emitters</u>			
Radium-228	0.49	0.50	0.30
Strontium-90	0.09	0.07	0.07
Cesium-137	<u>0.12</u>	<u>0.08</u>	<u>0.08</u>
Sum (Beta Emitters)	<u>0.65</u>	<u>0.65</u>	<u>0.45</u>

Table 7.0-8
Alpha/Beta Evaluation
Soil - B Series

<u>Analysis</u>	<u>Surface</u> pCi/gm <u>Mean</u>	<u>Sub-Surface</u> pCi/gm <u>Mean</u>
Gross Alpha	<u>115</u>	<u>42.9</u>
<u>Alpha Emitters</u>		
Radium-226	72.5	16.0
Uranium-234	32.0	33.2
Uranium-235	2.50	1.09
Uranium-238	2.09	1.21
Thorium-228	0.14	0.09
Thorium-230	0.93	0.22
Thorium-232	<u>0.17</u>	<u>0.09</u>
Sum (Alpha Emitters)	<u>110.33</u>	<u>51.9</u>
Gross Beta	--	--
<u>Beta Emitters</u>	16.4	8.8
Radium-228	1.0	0.84
Strontium-90	0.09	0.06
Cesium-137	<u>0.96</u>	<u>0.92</u>
Sum (Beta Emitters)	<u>2.05</u>	<u>1.82</u>

Table 7.0-9
 Alpha/Beta Evaluation
Soil Cores - B Series

<u>Analysis</u>	<u>4 foot pCi/gm Mean</u>	<u>6 foot pCi/gm Mean</u>
Gross Alpha	<u>5.0</u>	<u>5.6</u>
<u>Alpha Emitters</u>		
Radium-226	0.60	0.96
Uranium-234	0.34	0.20
Uranium-235	0.09	0.09
Uranium-238	0.23	0.11
Thorium-228	0.09	0.05
Thorium-230	0.17	0.13
Thorium-232	<u>0.12</u>	<u>0.16</u>
Sum (Alpha Emitters)	<u>1.64</u>	<u>1.70</u>
Gross Beta	<u>5.1</u>	<u>5.5</u>
<u>Beta Emitters</u>		
Radium-228	0.40	0.73
Strontium-90	0.04	0.06
Cesium-137	<u>0.11</u>	<u>0.14</u>
Sum (Beta Emitters)	<u>0.55</u>	<u>0.93</u>

8.0 DOSAGE EVALUATION

The following tables represent the mean for total bone, ingestion, total bone and ingestion, and total lung exposure (mrem/yr) and ninety-five percent (95%) confidence intervals. All dosage means (mrem/yr) on samples analyzed, with the exception of B series surface and subsurface soils, are presented in Tables 8.0-1 through 8.0-8. B-series surface and subsurface dosage means are not presented because it would give unrealistic data due to the high variance. This can be seen in Table 8.0-9 where a complete sample breakdown (dosage mrem/yr) is presented for B-series surface and subsurface samples.

Table 8.0-1

Dosage
Soil Cores - B Series (4 Foot)

	<u>mrem/yr</u>		
	<u>Mean</u>	<u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	0.84	0.56	1.11
Ingestion	6.21	5.94	6.48
Total Bone and Ingestion	7.05	6.78	7.32
Total Lung	0.92	0.65	1.19

Table 8.0-2

Dosage
Soil Cores - B Series (Six Foot)

	<u>mrem/yr</u>		
	<u>Mean</u>	<u>95% Confidence Interval</u>	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	1.05	0.57	1.52
Ingestion	11.52	11.04	12.00
Total Bone and Ingestion	12.57	12.10	13.05
Total Lung	1.40	0.93	1.88

Table 8.0-3

DosageSoil Cores - A Series (2 Foot)mrem/yr

	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	1.88	-1.48	5.25
Ingestion	10.38	7.00	13.75
Total Bone and Ingestion	12.26	8.89	15.63
Total Lung	3.75	0.38	7.12

Table 8.0-4

DosageSoil Cores - A Series (4 Foot)mrem/yr

	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	1.08	0.61	1.55
Ingestion	9.56	9.09	10.03
Total Bone and Ingestion	10.65	10.17	11.12
Total Lung	1.07	0.60	1.55

Table 8.0-5

DosageSoil Cores - A Series (6 Foot)mrem/yr

	<u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	0.25	0.07	0.42
Ingestion	3.65	3.48	3.83
Total Bone and Ingestion	3.91	3.73	4.08
Total Lung	0.45	0.27	0.62

Table 8.0-6
Dosage
Soil Core - A Series (Surface)

	mrem/yr Mean	95% Confidence Interval	
		Lower Limit	Upper Limit
Total Bone	1.39	1.12	1.77
Ingestion	24.77	24.49	25.05
Total Bone and Ingestion	25.91	25.64	26.19
Total Lung	2.77	2.49	3.04

Table 8.0-7
Dosage
Soil - A Series (Subsurface)

	mrem/yr Mean	95% Confidence Interval	
		Lower Limit	Upper Limit
Total Bone	0.79	0.65	0.93
Ingestion	13.85	13.71	14.00
Total Bone and Ingestion	14.67	14.53	14.81
Total Lung	1.64	1.50	1.79

Table 8.0-8
Dosage
Soil Core - D Series - Under Macadam (1 Foot)

	mrem/yr Mean	95% Confidence Interval	
		Lower Limit	Upper Limit
Total Bone	1.66	0.77	2.54
Ingestion	17.43	16.54	18.31
Total Bone and Ingestion	19.09	18.20	19.97
Total Lung	1.84	0.95	2.73

Table 8.0-9

DosageSoil Core - D Series - Under Macadam (2 Foot)

	mrem/yr <u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	1.33	0.52	2.15
Ingestion	10.40	9.59	11.21
Total Bone and Ingestion	11.74	10.92	12.55
Total Lung	1.25	0.43	2.06

Table 8.0-10

DosageMacadam

	mrem <u>Mean</u>	95% Confidence Interval	
		<u>Lower Limit</u>	<u>Upper Limit</u>
Total Bone	0.00167	0.00037	0.00296
Ingestion	0.18000	0.17870	0.18130
Total Bone and Ingestion	0.18167	0.18037	0.18296
Total Lung	0.03167	0.03037	0.03296

For ease of exposure data review on each sample matrices analyzed isotopically see Tables 8.0-11 through 8.0-22.

It can be concluded from review of this exposure data, that selected areas need to be analyzed and monitored extensively during and after clean-up to establish unrestrictive or restrictive use.

Table 8.0-11
Soil - A Series - Surface
mrem/yr

Sample Identification	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
A-003-S-0	0.62	5.76	6.38	0.80
A-004-S-0	8.30	185.73	194.03	21.02
A-012-S-0	0.91	20.02	20.93	3.62
A-027-S-0	0.32	0.26	0.58	0.05
A-050-S-0	1.83	33.09	34.92	3.37
A-062-S-0	1.99	35.55	37.54	4.27
A-063-S-0	0.69	20.65	21.34	2.89
A-078-S-0	1.23	26.67	27.90	3.43
A-117-S-0	1.12	24.03	25.15	2.04
A-118-S-0	1.08	4.22	5.30	0.99
A-128-S-0	1.19	16.98	18.17	2.07
A-130-S-0	1.58	26.33	27.91	2.62
A-136-S-0	0.90	18.86	19.76	1.86
A-140-S-0	2.55	14.54	17.09	1.77
A-142-S-0	0.93	18.96	19.89	2.07
A-143-S-0	1.86	31.40	33.26	3.33
A-146-S-0	3.33	60.59	63.92	5.91
A-147-S-0	0.02	2.47	2.49	0.44
A-163-S-0	1.54	33.77	35.31	3.49
A-164-S-0	1.39	22.72	24.11	2.59
A-183-S-0	1.18	24.22	25.40	1.77
A-200-S-0	1.10	21.47	22.57	2.27
A-224-S-0	0.86	21.63	11.25	2.27
A-232-S-0	0.86	4.17	5.03	0.73
A-237-S-0	4.36	133.72	138.08	15.70
A-277-S-0	0.02	3.25	3.27	0.37
A-280-S-0	0.51	11.37	11.88	1.38
A-285-S-0	0.93	21.44	22.37	1.69
A-301-S-0	0.04	3.94	3.98	0.65
A-303-S-0	3.58	24.59	28.17	2.86
A-319-S-0	0.60	11.67	12.27	1.26
A-329-S-0	1.37	11.49	12.86	1.34
A-344-S-0	0.45	10.91	11.36	1.18
A-375-S-0	1.10	21.40	22.50	2.25
A-381-S-0	0.94	20.07	21.01	2.22
A-382-S-0	3.32	39.95	43.27	3.31
A-384-S-0	0.94	19.33	20.27	2.30
A-391-S-0	0.95	14.27	15.22	1.55
A-404-S-0	1.08	3.83	4.91	0.67
A-407-S-0	1.05	21.52	22.57	2.54
A-415-S-0	0.30	1.11	1.41	0.17
A-421-S-0	0.45	18.39	18.84	2.57
A-427-S-0	1.17	1.67	2.84	0.27
A-464-S-0	0.89	22.08	22.97	2.06

Total for
(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-12
Soil - A Series Subsurface

mrem/yr

Sample Identification	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
A-003-S-6	1.02	37.38	38.40	6.84
A-004-S-6	0.69	5.57	6.26	1.01
A-012-S-6	0.06	5.62	5.68	0.71
A-027-S-6	0.50	3.89	4.39	0.74
A-050-S-6	0.94	19.08	20.02	2.67
A-062-S-6	0.47	10.91	11.38	1.36
A-063-S-6	2.03	32.70	34.73	3.57
A-078-S-6	2.53	35.13	37.66	3.00
A-117-S-6	1.21	21.03	22.24	2.62
A-118-S-6	0.86	16.06	16.92	1.91
A-128-S-6	0	0	0	0
A-130-S-6	1.16	23.34	24.50	2.34
A-136-S-6	1.65	35.78	37.43	4.09
A-140-S-6	0.11	3.31	3.42	0.61
A-142-S-6	0.89	11.04	11.93	1.03
A-143-S-6	1.35	36.97	28.32	2.68
A-146-S-6	0.17	6.12	6.29	1.08
A-147-S-6	0	0	0	0
A-163-S-6	0.45	9.73	10.18	1.14
A-164-S-6	1.51	25.64	27.15	2.81
A-183-S-6	0.64	11.86	12.50	1.48
A-200-S-6	0.09	1.38	1.47	0.25
A-224-S-6	0.94	19.89	20.83	2.17
A-232-S-6	1.33	25.83	27.16	2.75
A-237-S-6	0.01	1.13	1.14	0.19
A-264-S-6	1.48	12.54	14.02	1.42
A-277-S-6	0.02	3.63	3.65	0.23
A-280-S-6	0.73	14.73	15.46	1.73
A-285-S-6	1.13	5.00	6.13	0.83
A-301-S-6	-	-	-	-
A-303-S-6	1.59	23.62	25.21	2.68
A-319-S-6	0.76	15.87	16.63	1.82
A-329-S-6	0.91	17.40	18.31	1.98
A-344-S-6	0.42	9.98	10.40	1.29
A-375-S-6	2.18	26.16	28.34	2.97
A-381-S-6	0.48	9.59	10.07	1.21
A-382-S-6	0.01	1.00	1.01	0.18
A-384-S-6	0.45	16.12	16.57	1.77
A-391-S-6	0.09	0.71	0.80	0.24
A-404-S-6	0.01	1.49	1.50	0.26
A-407-S-6	2.27	3.90	6.17	0.36
A-415-S-6	1.33	29.44	30.77	3.48
A-421-S-6	0.42	26.68	27.10	2.43
A-427-S-6	0.22	3.44	3.66	0.63

Total for

(a) D.W. & Y

(b) D.W. & Y

NOTE: For detailed breakdown see Appendix C.

Table 8.0-13
 Soil Cores - A Series 2 Feet
 mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>		<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (a)</u>
A-086-S-2	0.24	5.62	5.86
A-087-S-2	0.14	7.81	7.95
A-088-S-2	0.50	8.92	9.42
A-102-S-2	0.95	20.54	21.49
A-103-S-2	0.76	9.69	10.45
A-116-S-2	2.69	26.89	29.58
A-133-S-2	0.08	1.25	1.33
A-134-S-2	11.56	11.72	23.28
A-148-S-2	0.06	0.98	1.04

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-14
 Soil Cores - A Series 4 Feet
 mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
A-086-S-4	3.15	18.89	22.04	2.16
A-087-S-4	0.51	3.61	4.12	0.65
A-088-S-4	0.66	16.54	17.20	1.65
A-102-S-4	1.16	23.20	24.36	2.35
A-103-S-4	0.02	2.27	2.29	0.23
A-116-S-4	0.07	1.12	1.19	0.20
A-133-S-4	0.21	3.26	3.47	0.60
A-134-S-4	1.32	1.15	2.47	0.22
A-148-S-4	2.69	16.03	18.72	1.65

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-15
 Soil - A Series - 6 feet
 mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
A-086-S-6	0.01	4.32	4.33	0.16
A-087-S-6	0.61	11.80	12.41	1.30
A-088-S-6	0	0	0	0
A-102-S-6	0	0	0	0
A-103-S-6	0.36	7.08	7.44	0.77
A-116-S-6	0.83	1.67	2.50	0.13
A-133-S-6	0.15	2.24	2.39	0.40
A-134-S-6	0.16	3.57	3.73	0.90
A-148-S-6	0.15	2.24	2.39	0.41

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-16
Soil - B Series - Surface
mrem/yr

Sample Identification	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
B-001-S-0	1.17	18.96	20.13	2.65
B-002-S-0	0.33	9.62	9.95	1.74
B-003-S-0	1.94	41.14	43.08	4.50
B-004-S-0	3.01	53.12	56.13	5.47
B-005-S-0	1.16	25.38	26.54	3.62
B-006-S-0	0.12	8.49	8.61	1.28
B-007-S-0	2.84	65.59	68.43	2.44
B-008-S-0	0.40	10.95	11.35	1.45
B-009-S-0	0.55	8.47	9.02	1.32
B-010-S-0	2.89	54.17	57.06	6.73
B-011-S-0	3.76	72.02	75.78	7.44
B-012-S-0	2.64	55.69	58.33	5.76
B-013-S-0	1.33	18.08	19.41	1.68
B-015-S-0	2.66	46.51	49.17	4.41
B-016-S-0	2.99	73.64	76.63	9.46
B-017-S-0	3.58	102.49	106.07	9.48
B-018-S-0	4.41	78.05	82.46	9.63
B-019-S-0	2.26	52.28	54.54	5.89
B-020-S-0	17.87	356.33	374.20	31.81
B-020-A-S-0	3.14	78.74	81.88	8.94
B-020-B-S-0	6.68	140.31	146.99	14.28
B-021-S-0	15.93	327.47	343.40	31.81
B-022-S-0	12.01	282.52	294.53	31.35
B-023-S-0	2.48	54.78	57.26	5.74
B-024-S-0	1139.70	23739.07	24878.77	2120.45
B-025-S-0	50.34	1106.95	1157.29	111.15
B-026-S-0	9.89	182.78	192.67	18.18
B-027-S-0	202.57	4172.26	4374.83	385.89
B-028-S-0	786.44	16600.19	17386.63	1510.72
B-029-S-0	2.14	45.05	47.19	6.12
B-030-S-0	147.66	3379.09	3526.75	313.32
B-031-S-0	198.58	4305.93	4504.51	422.42
B-032-S-0	1.52	55.21	56.73	9.21
B-033-S-0	62.55	1547.10	1609.65	174.50
B-034-S-0	104.38	1092.69	1197.07	145.10
B-035-S-0	240.16	5082.50	5322.66	467.70
B-036-S-0	298.61	6849.16	7147.77	727.29
B-037-S-0	308.56	6586.97	6895.53	638.60
B-038-S-0	192.08	3851.98	4044.06	352.87
B-039-S-0	6.73	166.82	173.55	20.41
B-040-S-0	9.70	182.20	191.90	17.99
B-041-S-0	0.19	3.78	3.97	0.67

Total for

(a) D.W. & Y.

(b) D.W. & Y. and ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-16 (Cont'd.)
Soil - B Series - Surface
mrem/yr

Sample Identification	Total Exposure to Bone		Total Exposure to Lung	
	Total (a)	Ingestion	Total (a)	
B-042-S-0	0.66	13.50	14.20	2.06
B-043-S-0	18.64	363.04	381.68	57.37
B-044-S-0	19.24	243.51	262.75	31.31
B-045-S-0	42.79	576.43	619.22	56.34
B-046-S-0	6.22	120.16	126.38	11.42
B-047-S-0	9.83	99.46	109.29	10.93
B-048-S-0	0.97	12.59	13.56	1.89
B-049-S-0	0.20	5.52	5.72	0.92
B-050-S-0	0.22	6.86	7.08	1.19
B-051-S-0	1.71	24.48	26.19	4.24
B-052-S-0	0.53	7.87	8.40	1.22
B-053-S-0	0.54	6.00	6.54	1.03
B-054-S-0	4.74	79.47	84.21	6.78
B-055-S-0	16.50	392.89	409.39	45.91
B-056-S-0	2.23	30.05	32.28	3.45
B-057-S-0	2.22	39.59	41.81	3.89
B-058-S-0	2.26	43.08	45.35	5.42
B-059-S-0	6.38	147.86	154.24	16.05
B-060-S-0	0.11	1.86	1.97	0.32
B-061-S-0	3.59	59.81	63.40	8.57
B-062-S-0	1.17	26.75	27.92	3.39
B-063-S-0	28.42	176.39	204.81	27.83
B-064-S-0	1.90	35.58	37.48	4.42
B-065-S-0	2.13	48.69	50.82	7.72
B-066-S-0	1.24	33.49	34.73	4.98
B-067-S-0	7.48	170.84	178.32	22.41
B-068-S-0	66.07	1461.22	1527.29	146.54
B-069-S-0	0.38	18.19	18.57	3.26
B-070-S-0	0.33	4.15	4.48	0.55
B-071-S-0	0.78	5.43	6.21	0.47
B-072-S-0	5.45	177.88	183.33	30.09
B-073-S-0	2.39	58.39	60.78	6.81
B-074-S-0	1.93	52.64	54.57	9.82
B-075-S-0	7.18	183.06	190.24	21.75
B-076-S-0	18.41	422.33	440.74	50.81
B-077-S-0	1.75	32.02	33.77	4.25
B-078-S-0	3.09	58.78	61.87	7.23
B-079-S-0	1.00	26.36	27.36	3.48
B-080-S-0	2.05	45.96	48.01	5.80
B-081-S-0	2.57	86.97	89.54	14.93
B-082-S-0	5.10	178.53	183.63	30.32
B-083-S-0	7.13	154.81	161.94	15.49

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-16 (Cont'd.)
Soil - B Series - Surface
mrem/yr

Sample Identification	<u>Total Exposure to Bone</u>		<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (a)</u>
B-084-S-0	3.24	83.23	86.47
B-085-S-0	13.68	357.06	370.74
B-086-S-0	8.04	210.33	218.37
B-087-S-0	6.07	149.89	155.96
B-088-S-0	1.72	37.09	38.81
B-089-S-0	1.83	37.48	39.31
B-090-S-0	0.37	9.27	9.64
B-091-S-0	1.58	32.04	33.62
B-092-S-0	2.59	33.91	36.50
B-093-S-0	2.17	90.95	93.12
B-094-S-0	1.39	26.22	27.61
B-095-S-0	0.27	12.51	12.78
B-096-S-0	0.23	8.62	8.85
B-097-S-0	1.32	28.56	29.88
B-098-S-0	1.51	38.02	39.53
B-099-S-0	0.47	16.97	17.44
B-100-S-0	2.87	150.19	153.06
B-101-S-0	1.58	41.16	42.74
B-102-S-0	2.46	51.49	53.95
B-103-S-0	3.27	77.62	80.89
B-104-S-0	0.30	6.92	7.22
B-105-S-0	3.57	63.89	67.46
B-106-S-0	0.88	26.28	27.16
B-107-S-0	1.07	36.22	37.29
B-108-S-0	2.22	30.27	32.49
B-109-S-0	1.09	24.45	25.54
B-110-S-0	0.35	7.15	7.50
B-111-S-0	1.29	37.78	39.07
B-112-S-0	0.36	12.89	15.60
B-113-S-0	0.24	5.17	5.41
B-114-S-0	0.15	2.95	3.10
B-115-S-0	1.20	19.34	20.54
B-116-S-0	1.19	16.29	17.48
B-117-S-0	2.82	44.71	47.53
B-118-S-0	1.12	64.41	65.53
B-119-S-0	2.23	78.81	81.04
B-120-S-0	1.84	73.01	74.85
B-121-S-0	13.09	313.47	326.56

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-17
 Soil Cores - B Series - 4 feet
 mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>		<u>Total Exposure to Lung</u>	
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
B-058-S-4	1.36	5.10	6.46	1.13
B-060-S-4	1.66	12.30	13.96	1.85
B-062-S-4	1.03	2.14	3.17	0.38
B-067-S-4	0.10	2.68	2.78	0.46
B-069-S-4	0.49	3.80	4.28	0.68
B-061-S-4	1.48	15.20	16.68	1.92
B-083-S-4	0.54	7.45	7.99	0.77
B-084-S-4	0.07	1.07	1.14	0.19

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-18
 Soil Core - B Series - 6 feet
 mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
B-058-S-6'	0.84	17.93	18.77	2.16
B-060-S-6'	0.15	2.40	2.55	0.43
B-062-S-6'	0	0	0	0
B-067-S-6' *	2.92	33.99	36.91	3.61
B-069-S-6' *	0.64	13.82	14.46	1.68
B-071-S-6'	3.41	16.62	20.02	2.32
B-083-S-6'	0.31	5.16	5.47	0.65
B-084-S-6'	0.15	2.28	2.43	0.42

*These samples were apparently mislabeled (by UNC). A assumption was made that one was 67 and the other 69.

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-19
Soil - B Series Subsurface
mrem/yr

Sample Identification	Total Exposure to Bone		Total Exposure to Lung
	Total (a)	Ingestion	Total (a)
B-001-S-6	2.39	34.74	37.13
B-002-S-6	0.58	8.64	9.22
B-003-S-6	1.01	35.98	36.99
B-004-S-6	0.15	2.86	3.01
B-005-S-6	0.03	2.79	2.82
B-006-S-6	1.83	21.29	23.12
B-007-S-6	0.32	8.07	8.39
B-008-S-6	0.14	6.95	7.09
B-009-S-6	0.23	6.55	6.78
B-010-S-6	1.01	22.76	23.77
B-011-S-6	1.16	6.78	7.94
B-012-S-6	0.20	6.83	7.03
B-013-S-6	6.08	127.14	133.22
B-015-S-6	1.20	15.83	17.03
B-016-S-6	1.84	41.48	43.32
B-017-S-6	0.34	10.51	10.85
B-018-S-6	0.89	19.01	19.90
B-019-S-6	1.04	25.25	26.29
B-020-S-6	4.25	78.76	83.01
B-020-A-S-6	1.05	9.89	10.94
B-020-B-S-6	0.61	7.57	8.18
B-021-S-6	3.31	73.27	76.58
B-022-S-6	1.66	22.87	24.53
B-023-S-6	0.25	3.01	3.26
B-024-S-6	83.73	888.94	972.67
B-025-S-6	2.47	47.91	50.38
B-026-S-6	0.22	4.51	4.73
B-027-S-6	28.12	583.06	611.18
B-028-S-6	609.59	16858.07	17467.66
B-029-S-6	3.36	63.34	66.70
B-030-S-6	8.54	192.87	201.41
B-031-S-6	18.85	376.08	394.93
B-032-S-6	1.26	21.70	22.96
B-033-S-6	6.84	162.07	168.91
B-034-S-6	2.88	40.42	43.30
B-035-S-6	125.53	2791.83	2917.36
B-036-S-6	15.40	328.64	344.04
B-037-S-6	4.69	99.10	103.79
B-038-S-6	3.36	74.80	78.16
B-039-S-6	1.23	18.41	19.64
B-040-S-6	1.90	23.70	25.60
B-041-S-6	0.13	1.15	1.28

Total for
(a) D.W. & Y.
(b) D.W. & Y.

NOTE: For detailed breakdown see Appendix C.

Table 8.0-19 (Cont'd.)
Soil - B Series Subsurface
mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
B-042-S-6	0.44	3.77	4.21	0.65
B-043-S-6	0.82	4.14	4.96	0.74
B-044-S-6	1.93	26.38	28.31	2.92
B-045-S-6	9.80	103.93	113.73	10.21
B-046-S-6	1.66	23.24	24.90	3.27
B-047-S-6	1.85	20.64	22.49	2.62
B-048-S-6	0.79	5.75	6.54	1.09
B-049-S-6	0.28	6.75	7.03	1.22
B-050-S-6	8.92	146.78	155.70	15.55
B-051-S-6	-	1.36	1.36	0.01
B-052-S-6	0.77	14.34	15.11	1.43
B-053-S-6	0.22	4.98	5.20	0.69
B-054-S-6	0.19	3.15	3.34	0.56
B-055-S-6	0.58	6.35	6.93	1.24
B-056-S-6	0.31	2.85	3.16	0.59
B-057-S-6	0.59	0.49	1.08	0.19
B-058-S-6	0.43	10.97	11.40	1.74
B-059-S-6	3.13	58.07	61.20	7.08
B-060-S-6	0.26	10.15	10.41	1.85
B-061-S-6	-	0.12	0.12	-
B-062-S-6	0.61	19.99	20.60	2.92
B-063-S-6	4.69	97.93	102.62	9.33
B-064-S-6	10.24	217.19	227.43	20.75
B-065-S-6	0.22	0.20	0.42	0.03
B-066-S-6	0.46	7.86	8.32	1.39
B-067-S-6	2.94	85.13	88.07	12.35
B-068-S-6	0.83	8.70	9.53	1.55
B-069-S-6	2.94	2.47	5.41	1.28
B-070-S-6	0.25	5.36	5.61	0.46
B-071-S-6	0.73	22.64	23.37	2.99
B-072-S-6	1.53	28.55	30.08	4.17
B-073-S-6	1.84	57.60	59.44	8.51
B-074-S-6	0.26	0.24	0.50	0.04
B-075-S-6	4.66	95.97	100.63	11.21
B-076-S-6	3.99	80.50	84.49	7.08
B-077-S-6	0.68	18.09	18.77	2.65
B-078-S-6	0.27	10.91	11.18	1.95
B-079-S-6	2.56	39.08	41.64	3.89
B-080-S-6	0.79	7.20	7.99	1.48
B-081-S-6	0.66	16.89	17.55	3.11
B-082-S-6	0.83	35.35	36.18	7.15

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-19 (Cont'd.)
Soil - B Series Subsurface

mrem/yr

Sample Identification	Total Exposure to Bone		Total Exposure to Lung
	Total (a)	Ingestion	Total (a)
B-083-S-6	5.78	105.33	111.11
B-084-S-6	2.66	61.93	64.59
B-085-S-6	8.36	172.58	180.94
B-086-S-6	1.25	36.57	37.82
B-087-S-6	1.58	43.44	45.02
B-086-S-6	0.55	15.08	15.66
B-089-S-6	1.56	32.07	33.63
B-090-S-6	1.25	16.82	18.07
B-091-S-6	0.59	15.80	16.39
B-092-S-6	1.57	31.13	32.64
B-093-S-6	1.20	46.64	47.84
B-094-S-6	1.61	18.80	20.41
B-095-S-6	0.08	1.94	2.02
B-096-S-6	0.15	2.28	2.43
B-097-S-6	1.08	21.68	22.76
B-098-S-6	0.47	8.70	9.17
B-099-S-6	2.52	37.77	40.29
B-100-S-6	1.46	50.62	52.08
B-101-S-6	0.79	12.53	13.32
B-102-S-6	0.15	4.96	5.11
B-103-S-6	0.60	22.22	22.82
B-104-S-6	0.01	1.62	1.63
B-105-S-6	1.32	32.62	33.94
B-106-S-6	0.27	13.55	13.82
B-107-S-6	0.71	35.34	36.05
B-108-S-6	1.31	26.18	27.49
B-109-S-6	1.06	24.03	25.09
B-110-S-6	1.11	22.64	23.75
B-111-S-6	0.72	23.52	24.24
B-112-S-6	2.88	45.78	48.66
B-113-S-6	1.45	43.45	44.90
B-114-S-6	1.64	13.93	15.57
B-115-S-6	0.37	14.35	14.72
B-116-S-6	0.53	4.04	4.57
B-117-S-6	1.47	23.57	25.04
B-118-S-6	2.66	86.39	89.05
B-119-S-6	2.52	84.24	86.76
B-120-S-6	9.18	232.04	241.22
B-121-S-6	2.37	58.04	60.41

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-20

Macadam
mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
D-061-D	0	0	0	0
D-073-D	0.01	0.68	0.69	0.12
D-075-D	0	0.23	0.23	0.04
D-083-D	0	0.17	0.17	0.03
D-087-D	0	0	0	0
D-091-D	0	0	0	0

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-21
Soil Cores under Macadam - D Series 1 Foot
mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>			<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (b)</u>	<u>Total (a)</u>
D-061-S-1	0.09	4.45	4.54	0.25
D-073-S-1	3.09	11.39	14.48	1.56
D-075-S-1	2.07	44.35	46.42	4.42
D-038-S-1	0.01	2.24	2.25	0.19
D-087-S-1	0.70	5.42	6.12	0.98
D-091-S-1	4.00	36.74	40.74	3.68

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

Table 8.0-22
 Soil cores under Macadam - 2 Feet
 mrem/yr

<u>Sample Identification</u>	<u>Total Exposure to Bone</u>		<u>Total Exposure to Lung</u>
	<u>Total (a)</u>	<u>Ingestion</u>	<u>Total (a)</u>
D-061-S-2'	4.08	19.70	23.78
D-073-S-2'	0.87	17.71	18.58
D-075-S-2'	0.36	6.86	7.22
D-083-S-2'	2.01	4.22	6.23
D-087-S-2'	0.61	11.54	12.15
D-091-S-2'	0.10	2.40	2.50

Total for

(a) D.W. & Y.

(b) D.W. & Y. and Ingestion

NOTE: For detailed breakdown see Appendix C.

APPENDIX A

Sample Preparation, Analytical Procedures
Quality Assurance Practices and Statistical
Parameters.

ANALYTICAL METHODS

The procedures used for this contract are routinely utilized by CEP in the analysis of environmental samples.

CEP's procedures have been thoroughly tested and proven on hundreds of samples for several other customers. In many cases, increased sensitivity can be obtained by modification of the analytical procedures. CEP's analytical procedures are the same as, equal to, or better than those currently used by the U.S. Public Health Service, Nuclear Regulatory Commission or Environmental Protection Agency.

SCOPE

The analytical procedures described are those used by CEP's laboratories in the analysis of the environmental samples from UNC.

SOIL METHODS

CEP used the following analytical method for analyzing Thorium-228, 230, 232, in soil: Two aliquots of the specimen were taken and Thorium-232 external tracer added to one of the aliquots. Total dissolution of the soil was performed using hydrofluoric-nitric acid mixture. The residue was dissolved in dilute hydrochloric acid. The samples were purified with an ion exchange resin column. The Thorium was electroplated and the disc was counted on a solid state alpha spectrometer and the chemical recovery was determined from the tracer peak.

ISOTOPIC URANIUM (U-234, U-235, U-238) METHOD

CEP used the following analytical method for analyzing Uranium-234, 235, 238, in soil: A suitable aliquot was spiked with Uranium-232 tracer. Total dissolution of the soil was performed, nitrated and evaporated to dryness. The residue was dissolved in concentrated nitric acid and again taken to dryness and redissolved in dilute acid. The sample was purified with an ion exchange resin column. The Uranium was electroplated and the disc counted on a solid state alpha spectrometer and the chemical recovery was determined from the Uranium-232 tracer peak.

STATISTICAL DATA

The lower limit of detection was 0.05 pCi/gm (dry). The method recovery was at least 80±10 percent at the 95 percent confidence level.

ALPHA SPECTROMETRY SYSTEMS USED FOR COUNTING THORIUM-232, 230, 228 and URANIUM-234, 235, 238

The alpha spectrometer consisted of eight (8) silicon surface barrier detectors contained in a vacuum chamber and is connected to a Northern Scientific multi-channel pulse height analyzer; also, an eight (8) input silicon surface barrier detector was connected to a second Northern Scientific system as described above.

CESIUM-137 and RADIUM-226 METHOD

CEP analyzed soil samples for Cesium-137 and Radium-226 using the following method:

The dried and pulverized sample was placed in a Marinelli beaker and counted on a 16.1 percent efficiency Ge(Li) detector having a 3.06 Kev resolution, which is coupled to a 2048 computer based, multichannel analyzer (Northern Scientific). The resulting spectrum was fed into a computer and specific nuclides, if present, were identified and quantized in terms of energy and net count rate with the aid of the computer. This method was approved by EPA to determine Radium-226 and Cesium-137 in soil

STATISTICAL DATA

The following are the detection limits based on 100 gm sample and 546 minutes counting time:

<u>Nuclides</u>	<u>Detection Limits pCi/gm</u>
Cesium-137	0.08
Radium-226	0.05

GROSS ALPHA AND BETA RADIOACTIVITY METHOD

CEP analyzed soil samples for Gross Alpha and Beta radioactivity using the following method:

A suitable aliquot of the samples was dried at 110°C for twenty-four (24) hours, ashed in a muffle furnace, dissolved in acid, and transferred to a tared planchet. The Gross Alpha and Gross Beta radioactivities were determined using a low background gas proportional counter (Beckman Wide Beta II). The Gross Alpha and Gross Beta activities were corrected for self-

absorption. The lower limit of detection was 0.3 pCi/gm, Gross Alpha was 0.1 pCi/gm, Gross Beta.

The following counting system was used to count the soil samples for Gross Alpha and Beta activity:

BECKMAN WIDE BETA II LOW BACKGROUND GAS PROPORTIONAL SYSTEM

The Beckman Wide Beta II two (2) inch detector counting system has an average of 2.5 cpm Beta background and 0.1 cpm Alpha background. The system capacity is 100 samples. The detector has an efficiency of 60% for Strontium-90 and 40% for Plutonium-239.

BECKMAN LOW BETA II LOW BACKGROUND BETA SYSTEM(CEP HAS THREE SYSTEMS)

The Beckman Low Beta II Gas Proportional two (2) inch detector counting system has an average of 3.0 cpm Beta background and 0.2 cpm Alpha background and detector efficiency of 60% for Strontium-90 and 40% for Plutonium-239. The system capacity is 100 samples.

BECKMAN WIDE BETA II LOW BACKGROUND GAS PROPORTIONAL SYSTEM

The Beckman Wide Beta II two (2) inch planchet counting system has an average of 2.5 cpm Beta background and 0.1 Alpha background. The detector has a 60% of 2.5 cpm Beta background and 0.1 Alpha background. The detector has a 60% efficiency for Strontium-90 and 40% for Plutonium-239. This system has been designed for simultaneous Alpha and Beta counting. The system capacity is 100 samples.

STRONTIUM-90 METHOD

The sample was dried in an oven, pulverized and an aliquot transferred to a plastic beaker. Internal tracer was added and the sample dissolved. Ammonium Oxalate was added to the solution and heated to dissolution on a hotplate. The oxalate was filtered through a filter paper and ashed in a muffle furnace. The residue was dissolved in concentrated HNO_3 and transferred to a beaker and ashed with H_2O_2 and concentrate HNO_3 until white and dissolved in 0.08 N HCl. The sample was purified and stripped of Y-90 with an extraction of 20% D2EHPA. The Yttrium-90 was allowed to build-up for two weeks. After two weeks the Y-90 was stripped from the sample with 5% D2EHPA, and precipitated as the oxalate and counted in a low back-

ground beta counter. The recovery of this method was determined utilizing the Strontium-85 internal tracer.

STATISTICAL DATA

The lower limit of detection was 0.03 pCi/gm (dry). The method recovery was 90±10 percent at the 95 percent confidence level.

CONCRETE CORES METHODS

GROSS ALPHA AND BETA METHODS

CEP analyzed concrete cores for Gross Alpha and Beta employing the same method for soil stated above. The statistics were the same as stated in the soil section.

URANIUM-235 METHOD

CEP analyzed concrete cores for Uranium-235 employing the isotopic Uranium method in soil stated above. The statistics was the same as stated in the soil section.

TOTAL URANIUM METHOD

CEP analyzed concrete cores for total uranium after total dissolution by the flucrometric method described in HASL Manual.

STATISTICAL DATA

The lower limits of detection was 0.05 ugU/gm (dry).

PAINT CHIPS AND ROOFING CORES METHODS

GROSS ALPHA AND BETA METHODS

CEP analyzed paint chips and roofing cores for Gross Alpha and Beta employing the same methods in soil section stated above. The statistics was the same as stated in the soil section.

DETAILED DESCRIPTION
OF
QUALITY ASSURANCE PRACTICES

PREPARED BY
CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.
P.O. BOX 5351
SANTA FE, NEW MEXICO 87502

INTRODUCTION

CEP's analytical laboratories role is to provide our clientele with precise and accurate data from which decisions can be made. CEP's quality assurance program has been designed to (1) ensure the accuracy and precision of data produced by the laboratory and, (2) maintain the quality of the laboratory data continuously.

FUNCTIONS OF QUALITY ASSURANCE DEPARTMENT

CEP's quality assurance department is a separate entity from the operating (laboratories) division reporting directly to the president. The quality assurance program implemented by CEP includes quality control as stated in regulatory guide 4.15 "quality assurance comprises all those planned and systematic action that are necessary to provide adequate confidence in the results of a monitoring program, and quality control comprises those quality assurance actions that provide a means to control and measure the characteristics of measurement equipment and processes to established requirements; therefore, quality assurance includes quality control."

The quality assurance plan (CEP-QA-1 attached) provides the policy for quality assurance program for CEP's analytical laboratories. Specific procedures have been written to be followed for certain activities. A copy of QA policies and procedures list is attached for your reference.

The department supervisors, quality assurance director and quality control officer work together in order to insure the reliability of the analytical results reported. In both design and implementation of the quality assurance program, these individuals maintain lines of communication in order to fully evaluate the accuracy and precision of the results.

As results are completed, information such as the name of the analyst who performed the work, his calculation for the samples, and all pertinent data that would allow supervisor and manager to review the data are noted on the result sheets. After all analyses are completed, the results are sent to the department manager for review and transferred to the final report form.

The responsibilities and authority of the quality assurance department are discussed in CEP-QA-1, page 2 of 11, section 2.0 (attached). In addition, the department is also responsible for the following:

1. Develops and carries out quality control programs, including statistical procedures and techniques, which will help laboratories to meet authorized quality standards at minimum cost; and advises and assists management in the installation, staffing and supervision of such programs.
2. Monitors quality control activities of the laboratory to determine conformance with authorized policy and procedures and with sound practice; and makes appropriate recommendations for correction and improvement as may be necessary.
3. Seeks out and evaluates new ideas and current developments in the field of quality control and recommends means for their application wherever advisable.
4. Advises management in reviewing technology, methods and equipment, with respect to quality aspects.
5. Advises the Purchasing Section regarding quality of purchased materials, reagents and chemicals.
6. Recommends packaging materials and procedures.
7. Performs related duties as assigned.

PERSONNEL QUALIFICATIONS

The degree of skills and training necessary for laboratory personnel is dependent upon their job responsibilities. All laboratory personnel, however, are required to be thoroughly acquainted with basic laboratory operations. He/she must learn (1) how the simple processing system of the laboratory works; (2) how each type of sample is to be treated when it arrives in the laboratory; (3) how to use routine equipment; and (4) how to clean the glassware properly.

The analyst, regardless of degree or experience, undergoes a thorough gradual on-the-job training program. This is by observing an experienced analyst at work and studying the analytical procedure thoroughly. In addition, this includes a discussion of CEP's Q.A. program. Job descriptions for each position are maintained by the personnel department.

OPERATING PROCEDURES AND INSTRUCTION

The policy in developing or implementing procedures for a monitoring program are discussed in the quality assurance plan. The procedures for specific activities are listed in the "Q.A. Manual Checklist", attached.

The methods employed for analyses are those which measure the desired constituent with precision and accuracy and meet the data needs in the presence of the interferences normally encountered. The routine analysis of spiked samples is the measurement of quality while the use of analytical grade reagents is a controls of measure. The quality control program has two primary functions. First, the program monitors the reliability of the results reported. The second function is the control of quality in order to meet the monitoring program requirements.

RECORDS

Upon arrival at the laboratory, each sample is assigned a prefixed color-coded number. This code number is placed on all apparatus used for that sample during chemical and radiometric determinations. This code number is recorded in the laboratory receiving report which is filled out at the time that the samples are received. The laboratory receiving report consists of five pages which are distributed to various departments within the company. This number is used for retrieving the raw data on any sample after analysis has been completed.

All records of analyses are kept in storage as required. This includes all raw data, calculations, quality control data and reports.

REFERENCE STANDARDS AND INSTRUMENT PERFORMANCE CHECKS

All radioactive sources and solutions used for calibration are calibrated against National Bureau of Standards' standards where possible.

All reagents, including carriers and tracer radionuclides, which are critical to the procedures in question, are standardized and checked periodically by the Quality Assurance Officer. When possible, the reagents are standardized using two different chemical procedures, e.g., Strontium carrier-gravimetrically and atomic absorption.

All personnel within the laboratory are required to run spiked samples to prove their proficiency in determining accurately the content of the spiked sample in question. Furthermore, to eliminate the possibility of preferential treatment of a spiked sample by an analyst, spiked samples are slipped into routinely analyzed samples without the knowledge of the analyst. Also, every set of samples has a spike and a blank run concurrently with it.

All instrumentation is maintained on a preventative maintenance program by the manufacturer. Each instrument is checked with a standardized source weekly. If the source check detects any anomaly from the routine performance of the instrument, no analysis is allowed to be performed by that instrument until it is functioning properly.

Calibration procedures for measuring and testing equipment have been prepared. In addition, procedures for the preparation and use of quality control charts have been written. (see "Q.A. Manual Checklist" list).

INTER- AND INTRA-LABORATORY ANALYSES

The quality assurance plan (CEP-QA-1) defines the policy in these aspects of the quality assurance program. In addition, the procedure to carry out these activities have been prepared and implemented. The specific procedures are CEP-QA-17, CEP-QA-27, CEP-QA-28, and CEP-QA-29, which include the analysis of reagent blanks, duplicates, internal lab spikes and blind spikes, as well as cross-check samples from U.S. EPA.

CERTIFICATION

CEP has received certification for the analysis of potable water samples under the Clean Water Act.

AUDITS

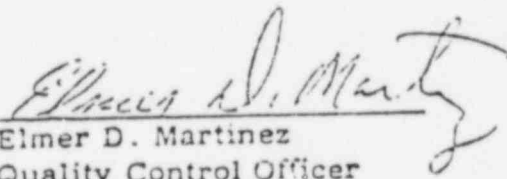
CEP's personnel has taken courses offered by EPA and/or have been trained by personnel who have received NRC certification from auditing other client's facilities to perform internal audits, surveillance and inspections as described in the quality assurance plan.


CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

QUALITY CONTROL PROGRAM

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS,
RADIOBIOASSAY, AND WATER CHEMISTRY


Elmer D. Martinez
Quality Control Officer


James J. Mueller
Director of Quality Control

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

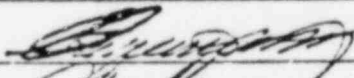
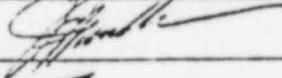
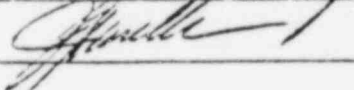
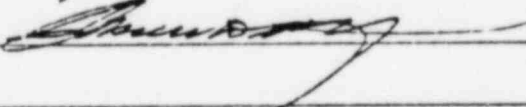
QUALITY CONTROL PROGRAM

Copy No. _____

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS

RADIOBIOASSAY, AND WATER CHEMISTRY

Date	Rev#	Reviewed by	Approved by mgr. of Q.A.	Comments
1/2/74	0			
12/13/79	1			

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.
QUALITY CONTROL PROGRAM

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS, RADIOBIOASSAY,
AND WATER CHEMISTRY

1.0 PLAN DESCRIPTION

1.1 Purpose

The purposes of this Quality Assurance Plan are: (a) to define the nature and extent of Quality Assurance for Environmental Chemistry, Nuclear Measurements, Radiobioassay and Water Chemistry; (b) to set forth the requirements for preparation of Q.A. and Q.C. procedures; and (c) to provide a general description of the methods to be used in carrying out the Quality Assurance Surveillance and audit functions.

1.2 Scope

This Quality Assurance Plan is intended primarily to cover radiochemistry and other chemistry activities associated with providing Controls for Environmental Pollution's clients a quality service.

1.3 Objectives

The overall objective of this Q.A. Plan is to (a) verify that work procedures and practices are adequate to assure that all clients are kept within the limits regulated by the State and federal agencies; (b) to coordinate an in-house Quality Control program independent of external programs to assure that Controls for Environmental Pollution, Inc. is operating at maximum efficiency; including specific objectives as follows:

- a. To verify that chemistry activities are documented and coordinated with the client's program so as to preclude surprises or apparent anomalies;
- b. To verify that all chemistry procedures and practices are correct and adequate for the intended usage and required accuracy and reliability of results;
- c. To verify that the procedures and practices conform to the Client's Specifications with respect to methods and frequency of sampling and analysis;

- d. To verify that procedures and practices are appropriate for and consistent with the Client's Specifications and other regulatory criteria;
- e. To verify that qualified personnel are provided with continued training, as necessary, for proper performance of the analytical work;
- f. To verify that records are completed and maintained for each sample and analysis conducted;
- g. To verify that procedures contain adequate Quality Control features and that such Quality Controls are practices as part of normal routine;
- h. To verify that equipment is maintained and calibrated to the extent and at the frequency necessary for accurate results.

2.0 RESPONSIBILITIES

Responsible to prepare, review or otherwise assist in developments of Quality Inspection and Quality Assurance procedures, instructions and plans. Responsible to review procedures, specifications and other control or source documents as may be required in the development of surveillance procedures or other quality assurance procedures or requirements. Responsible to perform inspections, write reports and provide follow-up action and to direct and review the analytical efforts in the accomplishment types of quality assurance activities. Responsible to evaluate tests, non-conformances, standard requirements, regulatory requirements and to make recommendations for resolution and/or further evaluations by management, other departments or outside consultants. Responsible to issue or recommend stop work orders for work which is not in compliance with requirements.

3.0 LOCATION OF WORK

Quality Assurance activities associated with Environmental Chemistry, Nuclear Measurements, Radiobioassay, and Water Chemistry work may be performed at any of the following locations as necessary to accomplish the objectives of this Q.A. Plan:

- a. Administrative offices of Controls for Environmental Pollution, Inc.
- b. Central laboratory facilities of Controls for Environmental Pollution, Inc. located in the Operational Division.
- c. Other locations of CEP laboratories.

4.0 SCHEDULING

Quality Control, Quality Assurance Surveillance, and certain activities necessary to prepare for Q.A. Audits, as further defined in Sections 5.0 and 6.0 of this Q.A. Plan, shall be performed regularly. For those types of analysis performed regularly and requiring a high degree of sensitivity and accuracy, as jointly designated by the manager or supervisor of department involved, the director of Quality Control, and Quality Control Officer.

Quality Assurance Audits shall be scheduled and performed as follows:

4.1 Chemistry (Water Quality)

- a. Internally spiked samples issued Monthly by Quality Control Officer.
- b. Spiked samples provided by the Environmental Protection Agency as cross-check samples will be submitted Quarterly.
- c. Standardization of reagents which are critical to proper results Monthly or prior to use, as appropriate.
- d. Results of spiked sample analysis reviewed and evaluated as are received by Quality Control Officer.
- e. Prompt review and evaluation of any unusual or unexpected results will be subject to rerun.

4.2 Radiobioassay

- a. Blanks and standards run Daily on each instrument in regular use or prior to use, as appropriate.
- b. Spiked or split samples issued weekly, biweekly and monthly by Quality Control Officer.
- c. Results of analysis of blanks, standards and spiked or split samples reviewed and evaluated by Quality Control Officer.
- d. Prompt review and evaluation of any unusual or unexpected analytical results, any such results will be subject to rerun.
- e. Reagents, carriers and tracer radionuclides which are in regular use and are critical to proper results standardized Monthly or prior to use, as appropriate.

4.3 Environmental Chemistry

- a. Chemistry and radiochemistry methods same as paragraphs 4.1 and 4.2 where applicable.
- b. Intercalibration by Controls for Environmental Pollution, Inc.'s laboratory with other laboratory agencies.
- c. Quarterly review of results and evaluation of any indicated probable trends.
- d. Prompt review and evaluation of any unusual or unexpected analytical results, any such results are subject to rerun.

The requirements stated above shall apply only to those analyses required by the Client's Specifications.

4.4 Gas Chemistry

- a. Checks of the gas chromatograph against certified reference standards for all primary system impurities which must be controlled within specified limits, at least Weekly or prior to use, as appropriate.

4.5 Instrument Calibration (Nuclear Measurements)

All laboratory instrumentation and equipment shall be maintained on preventive maintenance programs as appropriate for the nature and frequency of usage.

Except as indicated in paragraph 4.2 (a) of this Q.A. Plan, laboratory instruments in regular use shall be checked Weekly against standards traceable to standards issued by the National Bureau of Standards. Less frequently used instruments shall be similarly calibrated prior to use.

5.0 METHODS

The nature of Environmental Chemistry, Radiobioassay, and Water Chemistry work is such that most Quality Control and Quality Assurance measures must be built into the analytical procedures in order to be effective. Because the sample is almost always consumed or altered during the analytical processes, laboratory personnel must make certain that every step is done correctly to yield valid results.

The work procedures must include the use of standardized practices and equipment which have been demonstrated to be adequate for compliance with client's requirements as regards accuracy, sensitivity and reliability of results. Laboratory personnel must be trained on the particular methods and equipment to be used. Equipment, chemicals, samples and instrumentation must be controlled at every step to assure accuracy and reliability.

5.1 General Quality Assurance Methods

To accomplish the objectives of this Q.A. Plan, Quality Control and Quality Assurance requirements shall be implemented, through the analytical procedures and the laboratory administrative procedures and controls, utilizing the following general methods.

5.1.1 Quality Control

- a. Standardization and qualification of procedures including:
 1. Uniform step-by-step procedures (Cook book form);
 2. Training of personnel in use of procedures and equipment;
- b. Uniform instructions for reagent preparation, control, storage, use and shelf life (including appropriate labeling and dating);
- c. Proper selection of glassware, plastic containers and other analytical equipment and supplies;
- d. Regular calibration of equipment (with standards traceability to National Bureau of Standards where necessary and available);
- e. Uniform and consistent procedures for taking, controlling, preserving and using samples (including identification labels with dates and time, type and amount of preservative, and control number for all record purposes);
- f. Provisions for control of procurement, storage and use of all chemicals used in analytical procedures;
- g. Provisions for analysis of duplicate samples, including standards and blanks where such procedures are required;

- h. Independent selective review and checking of calculations, curves or other analysis of results.
- i. Standardized logs and analysis record sheets for recording sample identification, procedure used, results, and independent checks where required.

5.1.2 Quality Assurance Surveillance

Q.A. Surveillance shall be maintained by periodic, unannounced, independent spot checks using the following methods, on a schedule consistent with Section 4.0 of this Q.A. Plan.:

- a. Issuance of spiked samples for routine analysis;
- b. Inspection of reagents for proper container, labeling, storage and safety precautions;
- c. Direct observation and evaluation when work is in progress;
- d. Verification of equipment calibration;
- e. Verification of reagents and standards;
- f. Measurement of radiation background levels.

These Q.A. Surveillance checks shall be controlled by Director of Quality Control.

5.1.3 Quality Assurance Audit

Certain audit-related requirements will be implemented directly in the work procedures; other audit functions will be developed as part of the preparations for conducting Quality Assurance Audits as provided in Section 6.0 of this Q.A. Plan. The following basic methods will be used for auditing:

- a. Introduction of spiked samples (contents unknown to Controls for Environmental Pollution, Inc.'s staff);
- b. Laboratory intercalibration by use of split samples with client's laboratory;
- c. Independent review of results of selected analyses (including spiked samples);
- d. Direct inspection of laboratory and audit of work and records.

5.2 Particular Work Methods

The following basic methods shall be followed to accomplish the objectives of this Q.A. Plan.

5.2.1 Chemistry (Water Quality)

All Water Chemistry personnel shall follow the Water Chemistry Procedure Manual approved by management. All analytical results shall be recorded on approved forms after each test and signed by the Laboratory Supervisor.

On a monthly basis, spiked samples of ions commonly tested during the week shall be introduced into the laboratory operations by the Quality Control Officer. On a quarterly basis, water samples with various ion concentrations shall be presented for analyses, from a source independent of Controls for Environmental Pollution, Inc. laboratory. All such monthly and quarterly results shall be reviewed independently and, where necessary, corrective action shall be recommended to the laboratory management, with a copy to the President.

5.2.2 Radiobioassay

All Radiobioassay personnel shall follow the Radiochemistry Procedure Manual approved by management. All analytical results shall be recorded on approved forms after each isotope analysis and signed by the laboratory supervisor.

On a daily basis, all counting equipment in regular use shall be checked using blanks and standards on each instrument. Less frequently used equipment shall be similarly calibrated prior to use. On a monthly basis, unknown spiked samples shall be sent to the Controls for Environmental Pollution, Inc. laboratory for analysis. All such results shall be reviewed independently and, where necessary, corrective action shall be recommended to the laboratory management, with a copy to the Operations Manager and Director of Quality Control.

In addition to preventive maintenance, each instrument in regular use shall be checked weekly. Less frequently used instruments shall be calibrated prior to use. If any irregularity is detected in the calibrations or counting performance of any instrument, no analysis shall be performed on that instrument until it is functioning properly.

5.2.3 Environmental Chemistry

Environmental samples are analyzed in a low background laboratory which deals primarily with trace level radio-chemistry.

Environmental samples shall be collected and analyzed in the manner and on a schedule as necessary to comply with the Client's Specifications.

Results shall be formally reported to the management monthly, within ten (10) days following the end of the reporting period. Unusual, unexpected or anomalous results shall be reported immediately to the Quality Control Officer, who shall initiate appropriate action to review and evaluate the results and take corrective action if indicated.

5.2.4 Gas Chemistry

Gas Chemistry analyses shall be conducted in accordance with the Analytical Instruments Procedures Manual approved by the management.

The checks given in paragraph 4.5 of this Q.A. Plan shall be performed at the frequency indicated. Complete records shall be maintained of these checks, including the gas supplier's certification of references standards and the basis for that certification.

5.3 New Procedures

When a procedure is not available, the requirements will be evaluated and a suitable analytical method established. After satisfactory verification that the procedure provides the necessary sensitivity, accuracy and selectivity, a formal procedure will be approved by the supervisor and Director of Quality Control and included in the appropriate Procedure Manual.

6.0 PROCEDURE REQUIREMENTS

As indicated in Section 5.0 of this Q.A. Plan, the Quality Control and Quality Assurance Surveillance procedures are incorporated into the analytical work procedures and laboratory administrative procedures and instructions.

Quality Assurance Audits (QAA's) shall be performed as follows, with the numbering shown to be used for record purposes. Scheduling of these audits will be as deemed necessary by the director of QA.

- CEP-QA-3 Quality Assurance Audit, Water and Organic Chemistry
- CEP-QA-4 Quality Assurance Audit, Radiobioassay
- CEP-QA-2 Quality Assurance Audit, Environmental Chemistry
- CEP-QA-5 Quality Assurance Audit, Nuclear Measurements

Reports of these QAA's shall describe the particular activities audited; the basis and procedures for examination and evaluation of records; procedures for verifying validity and consistency of results; procedures for evaluating adequacy of Q.C. and Q.A. Surveillance Activities; and deficiencies and implementing corrective action.

7.0 REPORTS AND RECORD REQUIREMENTS

7.1 Chemistry (Water Quality)

Records and reports of analytical results of the various samples, including quantities and chemical constituency, shall be retained as permanent records.

7.2. Nuclear Measurements

All records and logs relative to data and radioactive materials prepared shall be kept as permanent records.

7.3 Radiobioassay

Records and reports shall be retained as permanent records.

7.4 Environmental Chemistry

- Detailed analytical records and quarterly reports shall be retained as permanent records. Records and reports shall be prepared as directed by CEP clients.

7.5 Gas Chemistry

Records and reports shall be retained as permanent records. In addition, records of all certified reference standards, and their correlation with analytical results, shall be retained for the time period established by the client.

7.6 Quality Assurance

Quality Assurance records shall consist of all logs, reports, results, deficiency reports and the like which are generated in the course of carrying out the requirements of the Q.A. Plan. Such Records shall be retained as permanent records in accordance with CEP's administrative requirements.

8.0 ATTACHMENTS

None

9.0 REVIEW, APPROVAL AND DISTRIBUTION

9.1 Quality Assurance Plan and Procedures

The first drafts of the completed Quality Assurance Plan and Procedures for Environmental Chemistry, Nuclear Measurements, Radiobioassay, Water Chemistry, and all subsequent drafts or changes to these Plans and Procedures shall be distributed for review, comment and approval as follows:

Manager of Nuclear Measurements	1 Copy	(For review and comment)
Manager of Radiobioassay	1 Copy	(For review and comment)
Manager of Environmental Monitoring	1 Copy	(For review and comment)
Operations Manager	1 Copy	(For review and comment)
Manager of Water Chemistry	1 Copy	(For review and comment)
Director of Quality Assurance	1 Copy	(For approval)

A marked-up copy of the Plan and Procedures, or a comment letter incorporating all comments from the reviewers, shall be returned to the issuer (Quality Control Officer) within ten to fifteen days.

After resolution of all comments, and completion of signatures required on the signature sheet, the Director of Quality Assurance will approve the Plan and Procedures and distribute copies to the controlled distribution.

9.2 Quality Control Inspection Procedures

Any Quality Control Inspection Procedures found to be necessary shall be reviewed by the Director of Quality Assurance, or his assignee.

Applicable, up-to-date QCIP's shall always be available at the Quality Control Office for use by personnel assigned specific QC duties.

A complete set of current QCIP's shall always be readily available at the Quality Control Office.

Statistical Parameters

In the context of analysis of the data to determine compliance with NMEID tentative criteria, the following methods were used.

1. Arithmetic Mean. The arithmetic mean of a set of n observed numbers is the sum of the numbers divided by n . This statement may be expressed as follows:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

where the symbol \bar{x} represents the arithmetic mean, and x_1, x_2, x_3 , etc. represent the specific observed values and n being the number of items.

2. Range. The range, the simplest of the measures of dispersion, is the difference between the minimum and maximum values in a series. It is sometimes given in the form of a statement of the minimum and maximum values themselves.
3. Standard Deviation and Variance. Standard deviation is the measure of dispersion of a frequency distribution. This is the root-mean-square deviation of the observed numbers from their average. This statement may be expressed as:

$$s = \sqrt{\frac{\Sigma (x - \bar{x})^2}{n-1}}$$

The symbol s represents the standard deviation, Σ indicates "the sum of," x represents the observed value, \bar{x} expresses the arithmetic mean and $n-1$ represents the number of items minus 1, providing an unbiased estimate of the standard deviation of the population from which the sample was drawn.

The mean of the squared deviations is the variance. It is found to be more convenient to eliminate the effect of the square root radical in the standard deviation formula, and thus the square of the standard deviation (s^2) is used as a measure of dispersion.

4. Standard Errors and 90% Confidence Interval. If the data for the samples were arranged in the form of a frequency distribution, they would be found to tend toward a normal distribution. This is called the sampling distribution of the average.

A sampling distribution is a tabulation of some specified statistical value from an infinite number of samples of a fixed size from a given population. The central limit theorem indicates that regardless of the nature of the distribution of individual values, the sampling distribution of the means will approach normality as the sample size increases.

The standard deviation of a sampling distribution of means, or of any other statistical measures computed from samples, is termed the standard error of the mean ($S_{\bar{X}}$).

The greater the number of samples included in the distribution, the smaller the error to be expected and the smaller the standard deviation (measure of sampling error) of the theoretical distribution of the means. In turn, the standard error will vary inversely with the number of samples included in the population.

When the range of the limits of variation in the population or original data is large, a greater error is to be expected in a measure computed from the data, such as when the range of values in the population is small.

The formula for the standard error of the mean (the standard deviation of the distribution of means of samples) is

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

where σ = Standard deviation of sample

n = Number of items

The probable error (P.E.) of the mean is, therefore

$$\text{P.E. } \bar{X} = 1.645 \frac{\sigma}{\sqrt{n}}$$

This enables the population reliability to be evaluated. As shown by the above equation, there are 90 chances out of 100 that the computed value from

a random sample will not be further away from one standard error of the mean from the true average activity.

Thus, the sample has a 90% assurance (confidence level) that the sample result will not be further from the true value or the value which would have been obtained if every inch had been included. The interval within which this value is contained ($\bar{x} \pm P.E.$ @ 90% confidence level) is called the confidence interval, while the outside limits so established are called the confidence limits.

The 90% confidence interval, therefore, is an assigned probability by which a range is given which we think includes the true value of some population parameters.

5. Precision: A measure of the reproducibility among replicate observations.
6. Accuracy: A measure of the agreement between observed and accepted values.
7. Systematic error: Errors that may be traced to the personal errors of the experimenter, the instrumental errors of his measuring devices, the errors that repose in the method of analysis he employs, or a combination of these. Accuracy describes this type of variability or error.
8. Random error: The necessity for making estimations is inherent in the process of collecting data for the measurement of any quantity. For this reason, any measurement will be uncertain, in an amount that depends on the relative magnitude of the estimations involved in its evaluation. Careful experimental design can reduce this uncertainty; however, small irreducible variations will remain. Since radioactive decay is a random process, any counting measurement will have a random error associated with it. Precision describes this type of variability or error.

APPENDIX B

Quality Assurance Data

Duplicates

Gross Alpha

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	5.94±2.63	3.89±2.30
	6.01±2.72	5.58±2.66
	8408.00±539.00	7902.00±5.23
	4.60±2.80	3.90±2.60
	9.00±1.80	8.30±1.80
4/81	16.20±6.80	15.80±6.80
	2.00±2.50	2.20±2.30
	2.20±1.50	1.40±1.40
	16.60±10.60	7.20±12.60
	2.00±2.60	0.25±2.23
	0.26±3.00	0.25±2.80
	8.06±5.45	5.94±5.12
	5.40±4.70	4.50±3.20
	3.80±2.51	1.90±2.30
	4.80±2.60	4.40±2.50
	3.80±2.30	5.20±2.60
	4.00±2.40	4.00±2.40
	1.80±2.00	2.20±2.10
	7.20±12.90	20.40±15.10
	4.49±0.73	5.20±0.91
1.50±0.70	1.60±0.70	
5/81	3.00±2.70	3.60±2.50
	3.00±3.43	2.75±3.73
	2.20±0.80	2.50±0.80
	720±2.80	6.30±2.70
	3301.20±75.70	2983.70±70.30
	7.80±5.00	12.30±5.70
	2.00±4.20	2.30±4.30
	10.50±5.40	13.30±5.50
0.30±0.40	0.10±0.30	

Duplicates

Gross Beta

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	3.81±2.24	3.12±2.19
	1.39±2.09	2.01±2.13
	207.21±11.26	326.04±12.16
	2.56±2.06	2.56±2.06
	2.10±2.10	2.20±2.10
	17.50±2.50	16.70±2.50
	4/81	1.40±1.60
5/81	4.30±0.60	4.80±0.60
	0.80±0.20	0.60±0.20
	2.39±2.27	1.91±2.30
	3.00±2.10	2.30±2.00
	2.10±2.00	1.70±2.00
	2.20±2.00	4.40±2.10
	1.93±0.11	2.15±0.11
	52.80±3.70	50.10±3.70
	8.70±2.10	7.10±2.10
	50.00±2.00	57.00±2.00
	2.60±2.10	2.40±2.10
	61.10±1.80	59.70±1.80
	5.30±4.40	2.10±4.20
1.50±4.10	1.80±4.10	
2.40±0.40	1.90±0.40	
8.70±0.80	7.30±0.70	
12.75±0.73	12.16±1.38	
23.20±2.70	24.40±2.80	

Duplicates

Radium-226

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.00±0.05	0.00±0.05
	2.80±1.00	2.30±0.90
	0.00±0.05	0.00±0.05
4/81	0.00±0.05	0.00±0.05
	0.30±1.20	2.40±1.30
	0.20±0.60	0.10±0.70
	0.40±0.70	0.30±0.40
5/81	0.20±0.80	0.00±0.05
	0.00±0.05	0.00±0.05
	0.37±0.08	0.44±0.09
	0.29±0.09	0.39±0.12
	0.20±0.05	0.11±0.04
	0.32±0.10	0.36±0.08
	0.73±0.11	0.25±0.06
	2.74±0.25	1.62±0.16
0.88±0.17	0.78±0.14	

Duplicates

Radium-228

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.00±0.10	0.00±0.10
	7.30±2.60	7.30±2.50
	0.00±0.10	0.00±0.10
	0.00±0.10	0.00±0.10
4/81	0.00±0.10	0.00±0.10
5/80	0.00±0.10	0.00±0.10
	0.00±0.10	0.00±0.10

Duplicates

Strontium-90

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.10±0.07	0.14±0.07
	0.12±0.09	0.02±0.09
4/81	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.12±0.08	0.10±0.10
	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03
	0.00±0.03	0.00±0.03

Duplicates

Uranium-234

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	2.99±0.99	1.89±0.52
	1.79±0.29	1.89±0.42
	4.68±1.31	4.98±0.96
4/81	0.98±0.61	0.81±0.33
	0.43±0.13	0.26±0.07
	0.19±0.08	0.25±0.10
5/81	0.01±0.14	0.07±0.04
	1.89±0.36	1.32±0.20
	0.04±0.05	0.04±0.04
	0.22±0.08	0.25±0.08
	1.14±0.24	1.39±0.13

Duplicates

Uranium-235

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.23±0.10	0.16±0.12
	1.33±0.39	1.47±0.48
	2.25±0.80	2.32±1.05
	0.69±0.53	0.61±0.41
	0.78±0.41	0.95±0.36
4/81	0.18±0.14	0.21±0.15
	0.08±0.05	0.09±0.08
	0.59±0.18	0.47±0.29
	0.68±0.20	0.24±0.12
	1.27±0.43	1.70±0.32
5/81	0.23±0.17	0.06±0.04
	1.79±0.93	2.01±0.28
	0.03±0.03	0.19±0.15
	0.50±0.12	0.08±0.17
	42.38±1.72	37.79±1.08
	0.11±0.11	0.19±0.08
	0.32±0.09	0.39±0.09

Duplicates

Uranium-238

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	1.96±0.53	2.30±0.42
	0.88±0.20	0.95±0.29
	0.85±0.32	1.96±0.55
	1.97±0.85	1.55±0.58
4/81	0.90±0.32	0.60±0.76
	0.68±0.81	0.30±0.25
	0.11±0.07	0.17±0.09
	0.04±0.09	0.41±0.11
	0.28±0.18	0.25±0.11
	0.56±0.17	0.20±0.36
5/81	0.17±0.21	0.70±0.22
	0.76±0.34	0.48±0.17
	0.19±0.20	0.05±0.04
	0.04±0.04	0.28±0.18
	0.41±0.12	0.16±0.14
	0.62±0.12	0.77±0.18
	4.74±0.58	5.55±0.41
	0.27±0.15	0.17±0.08
	0.01±0.02	0.05±0.03
	0.00±0.05	0.00±0.05
2.81±0.76	1.64±0.46	

Duplicates

Thorium-228

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.00±0.05	0.00±0.05
	0.05±0.04	0.04±0.04
	0.00±0.05	0.00±0.05
	0.05±0.03	0.06±0.03
4/81	0.07±0.04	0.04±0.03
	0.10±0.06	0.05±0.05
	0.11±0.06	0.08±0.06
	0.08±0.05	0.02±0.02
	0.06±0.04	0.04±0.04
	0.07±0.07	0.08±0.09
	0.03±0.04	0.04±0.03
5/81	0.00±0.05	0.00±0.03
	0.04±0.04	0.05±0.04
	0.06±0.05	0.10±0.07
	0.30±0.26	0.34±0.27
	0.39±0.39	0.24±0.33
	0.00±0.05	0.00±0.05
	0.02±0.02	0.02±0.02
	0.00±0.05	0.00±0.05

Duplicates

Thorium-230

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.07±0.05	0.00±0.05
	2.75±0.21	2.07±0.19
	22.04±1.94	31.18±2.54
4/81	0.09±0.05	0.11±0.05
	0.04±0.12	0.06±0.05
	0.14±0.07	0.19±0.10
	0.09±0.05	0.03±0.03
	0.14±0.11	0.17±0.10
5/81	0.07±0.05	0.03±0.03
	3.27±0.32	5.78±0.40
	3.55±0.91	2.79±0.80

Duplicates

Thorium-232

<u>Date of Analysis</u>	<u>First Value pCi/gm</u>	<u>Second Value pCi/gm</u>
3/81	0.07±0.06	0.13±0.06
	0.04±0.05	0.17±0.07
	0.12±0.06	0.16±0.05
	0.64±0.43	0.65±0.34
4/81	0.08±0.11	0.11±0.25
	0.06±0.06	0.08±0.05
	0.19±0.15	0.09±0.07
	0.21±0.09	0.13±0.08
	0.08±0.05	0.03±0.03
	0.06±0.08	0.05±0.06
	0.09±0.06	0.04±0.03
5/81	0.72±0.51	0.20±0.18
	1.53±1.03	1.80±0.85
	0.16±0.08	0.17±0.15
	3.79±0.94	4.23±1.01

APPENDIX C

Dosage Calculations

TABLE C-1

Sample Identification: D-061-D

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)		
		D	Clearance Rate		Total	D	W	Total
			W	Y	Ingestion			Clearance Rate
								Y
Radium-226								
Radium-228								
Strontium-90								
Uranium-234								
Uranium-235	< 0.05	-	-	-	-	-	-	-
Uranium-238								
Thorium-228		(a)				(a)		
Thorium-230		(a)				(a)		
Thorium-232		(a)				(a)		
Cesium-137								
Total								

Sample Identification: D-073-D

Radium-226									
Radium-228									
Strontium-90									
Uranium-234									
Uranium-235	0.35±0.11	0.01	-	-	0.01	0.68	-	0.01	0.11
Uranium-238									0.12
Thorium-228		(a)					(a)		
Thorium-230		(a)					(a)		
Thorium-232		(a)					(a)		
Cesium-137									
Total					0.01	0.68			0.12

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-1

Sample Identification: D-075-D

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226										
Radium-228										
Strontium-90										
Uranium-234										
Uranium-235	0.12±0.06	-	-	-	-	0.23	-	-	0.04	0.04
Uranium-238										
Thorium-228		(a)					(a)			
Thorium-230		(a)					(a)			
Thorium-232		(a)					(a)			
Cesium-137										
Total						0.23				0.04

Sample Identification: D-083-D

Radium-226										
Radium-228										
Strontium-90										
Uranium-234										
Uranium-235	0.09±0.05	-	-	-	-	0.17	-	-	-	0.03
Uranium-238										
Thorium-228		(a)					(a)			
Thorium-230		(a)					(a)			
Thorium-232		(a)					(a)			
Cesium-137										
Total						0.17				0.03

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-1

Sample Identification: D-087-D

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226										
Radium-228										
Strontium-90										
Uranium-234										
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238										
Thorium-228		(a)				(a)				
Thorium-230		(a)				(a)				
Thorium-232		(a)				(a)				
Cesium-137										
Total										

Sample Identification: D-091-D

Radium-226										
Radium-228										
Strontium-90										
Uranium-234										
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238										
Thorium-228		(a)				(a)				
Thorium-230		(a)				(a)				
Thorium-232		(a)				(a)				
Cesium-137										
Total										

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-2

Sample Identification: D-061-S-1

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	M	Y	Total	D	M	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.31±0.14	0.05	0.02	0.02	0.09	-	-	0.25	0.25
Strontium-90	0.35±0.08	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total		-	-	-	0.09	-	-	-	0.25

Sample Identification: D-0735-1'

Radium-226	0.6±0.2	0.22	0.02	0.01	0.25	-	-	0.44	0.46
Radium-228	0.52±0.14	0.08	0.04	0.03	0.15	-	-	0.42	0.42
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.26±0.19	-	-	-	-	-	-	0.10	0.10
Uranium-235	0.05±0.03	-	-	-	-	-	-	0.02	0.02
Uranium-238	0.38±0.26	-	-	-	-	-	0.01	0.11	0.12
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.58±0.15	(a)	0.93	0.35	1.28	(a)	0.02	0.19	0.21
Thorium-232	0.56±0.15	(a)	1.03	0.38	1.41	(a)	0.02	0.21	0.23
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total		-	-	-	3.09	-	-	-	1.56

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-2

Sample Identification:	Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)			
			D	W	Total	D	W	Total	
D-075-S-1*	Radium-226	4.3±0.4	0.12	0.11	1.84	0.16	3.15	3.31	
	Radium-228	0.75±0.15	0.06	0.04	0.21	0.01	0.60	0.61	
	Strontium-90	< 0.03	-	-	-	-	-	-	
	Thorium-234	0.81±0.19	-	0.02	0.02	0.03	0.31	0.34	
	Thorium-235	0.34±0.11	-	-	-	0.01	0.10	0.11	
	Thorium-238	0.17±0.08	-	-	-	-	0.05	0.05	
	Thorium-232	< 0.05	-	(a)	-	-	-	-	
	Thorium-230	< 0.05	-	(a)	-	-	-	-	
	Thorium-232	< 0.05	-	(a)	-	-	-	-	
	Cesium-137	< 0.08	-	(a)	-	-	-	-	
	Total				2.07			4.42	
	D-083-S-1*	Radium-226	< 0.5	-	-	-	-	-	-
		Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90		0.13±0.03	-	-	-	-	-	-	
Thorium-234		0.40±0.11	0.01	-	0.01	0.01	0.15	0.16	
Thorium-235		0.07±0.04	-	-	-	-	0.02	0.02	
Thorium-238		< 0.05±0.04	-	-	-	-	0.01	0.01	
Thorium-232		< 0.05	-	(a)	-	-	-	-	
Thorium-230		< 0.05	-	(a)	-	-	-	-	
Thorium-232		< 0.05	-	(a)	-	-	-	-	
Cesium-137		< 0.08	-	(a)	-	-	-	-	
Total					0.01			0.19	

(a) ICRP-39 classifies thorium compounds as Y and W type.

TABLE C-2

Sample ID: D-007-3-1*

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate Y	Total Ingestion	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.68±0.15	0.10	0.55	0.69	-	0.01	0.56
Strontium-90	< 0.3	-	-	-	-	-	-
Uranium-234	0.54±0.4	0.01	-	0.01	-	0.02	0.22
Uranium-235	0.16±0.09	-	-	-	-	-	0.05
Uranium-238	0.14±0.07	-	-	-	-	-	0.04
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.32±0.19	(a)	0.52	0.19	(a)	0.01	0.11
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total		-	-	0.70	-	-	0.98

Sample Identification: D-091-5-1*

Radium-226	1.0±0.4	1.12	0.08	1.27	-	0.11	2.20	2.31
Radium-228	1.2±0.2	0.18	0.10	0.35	-	0.02	0.97	0.99
Strontium-90	0.3±0.09	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-
Thorium-230	< 0.05	-	-	-	-	-	-	-
Thorium-232	0.50±0.14	(a)	-	-	(a)	-	-	-
Cesium-137	0.51±0.14	(a)	0.80	1.10	(a)	0.02	0.16	0.19
	< 0.08	(a)	0.93	1.28	(a)	0.01	0.19	0.20
Total		-	-	4.00	-	-	-	3.68

(a) ICRP-30 classifies Thorium compounds as Y and M type.

TABLE C-3

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate $\frac{H}{Y}$	Total	D	M	Clearance Rate $\frac{Y}{V}$
Sample Identification: D-061-S-2*							
Radium-226	1.6±0.3	0.60	0.04	0.60	-	1.17	1.23
Radium-228	0.38±0.2	0.06	0.02	0.11	-	0.31	0.31
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.18±0.08	-	-	-	-	-	-
Uranium-235	0.08±0.05	-	-	-	-	-	-
Uranium-238	0.21±0.08	-	-	-	-	-	-
Thorium-228	0.12±0.06	-	-	-	-	-	-
Thorium-230	0.53±0.13	(a)	0.05	0.06	(a)	0.02	0.14
Thorium-232	0.82±0.16	(a)	0.85	1.17	(a)	0.12	0.19
Cesium-137	< 0.08	(a)	1.50	2.06	(a)	0.17	0.33
Total				4.08			2.36
Sample Identification: D-073-S-2*							
Radium-226	1.5±0.2	0.56	0.04	0.65	-	1.10	1.15
Radium-228	0.78±0.09	0.12	0.06	0.23	-	0.63	0.64
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				0.87			1.79

(a) ICRP-10 classifies thorium compounds as Y and W type.

TABLE C-3

Sample Identification: 0-075-5-2*

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate H	Total	D	Clearance Rate Y	Total
Radium-226	0.5±0.2	0.19	0.01	0.21	-	0.02	0.39
Radium-228	0.54±0.13	0.08	0.03	0.15	-	0.01	0.45
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>0.36</u>			<u>0.84</u>

Sample Identification: 0-083-5-2*

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate H	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.77±0.16	0.02	-	0.02	-	0.02	0.31
Uranium-235	0.14±0.08	-	-	-	-	0.04	0.04
Uranium-238	0.30±0.11	0.01	-	0.01	-	0.08	0.09
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.40±0.18	(a)	-	0.88	(a)	0.13	0.14
Thorium-232	0.44±0.18	(a)	-	1.10	(a)	0.17	0.18
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>2.01</u>			<u>0.76</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-3

Sample Identification: D-087-S-2*

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	0.9±0.2	0.34	0.02	0.36	-	0.03	0.69
Radium-228	0.79±0.15	0.12	0.06	0.23	-	0.01	0.65
Actinium-210	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total				0.61		11.54	1.34

Sample Identification: D-091-S-2*

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.35±0.10	0.05	0.03	0.10	-	0.28	0.28
Actinium-210	< 0.03	-	-	-	-	-	-
Uranium-234	0.17±0.10	-	-	-	-	-	-
Uranium-235	0.09±0.05	-	-	-	-	-	-
Uranium-238	0.16±0.10	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	0.06
Thorium-232	< 0.05	(a)	-	-	(a)	-	0.03
Cesium-137	< 0.08	(a)	-	-	(a)	-	0.04
Total				0.10		2.40	0.41

(a) ICRP-30 classifies Thorium compounds as Y and W type.

TABLE C-4

Type of Analysis	Activity ($\mu\text{Ci/g dry}$)	Exposure to Bone ($\mu\text{rem/yr}$)				Exposure to Lung ($\mu\text{rem/yr}$)				
		D	Clearance Rate		Total Ingestion	D	Clearance Rate		Total	
			W	Y			W	Y		
Sample Identification: A-050-S-0										
Radium-226	3.2±0.5	1.20	0.09	0.08	1.37	-	-	0.12	2.34	2.46
Radium-228	0.98±0.22	0.15	0.08	0.06	0.29	-	-	0.01	0.79	0.80
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.10±0.06	(a)	0.04	-	0.04	(a)	-	0.01	0.10	0.11
Thorium-230	0.06±0.05	(a)	0.10	0.03	0.13	(a)	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-	-
Cesium-137	0.34±0.05	-	-	-	-	-	-	-	-	-
Total					<u>1.83</u>					<u>3.37</u>
Sample Identification: A-062-S-0										
Radium-226	2.3±0.5	0.85	0.06	0.06	0.97	-	-	0.08	1.68	1.76
Radium-228	1.02±0.24	0.16	0.08	0.06	0.30	-	-	0.01	0.82	0.83
Strontium-90	0.10±0.05	-	-	-	-	-	-	-	-	-
Uranium-234	2.1±0.7	0.06	0.01	-	0.07	-	-	0.06	0.80	0.86
Uranium-235	0.58±0.36	0.01	-	-	0.01	-	-	0.01	0.17	0.18
Uranium-238	1.8±0.6	0.05	0.01	-	0.06	-	-	0.05	0.51	0.56
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-	-
Thorium-230	0.26±0.10	(a)	0.42	0.16	0.58	(a)	-	-	0.08	0.08
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-	-
Cesium-137	0.11±0.03	-	-	-	-	-	-	-	-	-
Total					<u>1.99</u>					<u>4.27</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-063-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	0.97±0.30	0.36	0.03	0.02	0.41	8.63	-	0.03	0.71	0.74
Radium-228	0.37±0.18	0.06	0.03	0.02	0.11	1.65	-	-	0.30	0.30
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.8±0.6	0.08	0.02	-	0.10	6.02	-	0.09	1.06	1.15
Uranium-235	0.12±0.04	-	-	-	-	0.23	-	-	0.04	0.04
Uranium-238	2.1±0.6	0.05	0.01	0.01	0.07	4.07	-	0.06	0.60	0.66
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.22±0.05	-	-	-	-	0.05	-	-	-	-
Total					<u>0.69</u>	<u>20.65</u>				<u>2.89</u>

Sample Identification: A-078-S-0

Radium-226	1.5±0.3	0.56	0.04	0.04	0.64	13.35	-	0.05	1.10	1.15
Radium-228	1.7±0.2	0.26	0.14	0.10	0.50	7.60	-	0.02	1.36	1.38
Strontium-90	0.12±0.04	-	-	-	-	1.05	-	-	-	-
Uranium-234	1.2±0.7	0.03	-	-	0.03	2.58	-	0.03	0.45	0.48
Uranium-235	0.13±0.07	-	-	-	-	0.25	-	-	0.04	0.04
Uranium-238	0.88±0.10	0.02	-	-	0.02	1.70	-	0.02	0.25	0.27
Thorium-228	0.11±0.07	(a)	0.04	-	0.04	0.04	(a)	0.01	0.10	0.11
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.44±0.05	-	-	-	-	0.10	-	-	-	-
Total					<u>1.23</u>	<u>26.67</u>				<u>3.43</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-003-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.83±0.19	0.13	0.07	0.05	0.25	-	0.01	0.67	0.68
Strontium-90	0.19±0.06	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	0.06±0.03	(a)	0.02	-	0.02	0.01	0.06	0.06	0.07
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	0.14±0.10	(a)	0.25	0.10	0.35	-	-	0.05	0.05
Cesium-137	0.31±0.04	-	-	-	-	-	-	-	-
Total		-	-	-	0.62	-	-	-	0.10

Sample Identification: A-004-S-0

Radium-226	15±1	5.60	0.42	0.37	6.39	0.54	10.99	11.55
Radium-228	0.79±0.24	0.12	0.06	0.05	0.23	0.01	0.64	0.65
Strontium-90	0.09±0.05	-	-	-	-	-	-	-
Uranium-234	19±2	0.53	0.14	0.06	0.73	0.01	7.21	7.85
Uranium-235	0.30±0.13	0.01	-	-	0.01	0.01	0.09	0.10
Uranium-238	2.0±1.3	0.05	0.01	-	0.06	0.06	0.57	0.63
Thorium-228	0.09±0.04	(a)	0.04	-	0.04	0.01	0.09	0.10
Thorium-230	0.22±0.07	(a)	0.35	0.13	0.48	0.01	0.07	0.08
Thorium-232	0.14±0.06	(a)	0.26	0.10	0.36	-	0.05	0.05
Cesium-137	8.0±0.3	-	-	-	-	-	0.01	0.01
Total		-	-	-	8.30	-	-	21.02

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-012-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)					
		D	Clearance Rate M	Y	Total	Ingestion	B	M	Y	Clearance Rate
Radium-226	< 0.5	0.14	0.07	0.05	0.26	4.02	-	0.01	0.72	0.73
Radium-228	0.90±0.20	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	4.4±0.8	0.12	0.03	0.01	0.16	9.50	-	0.14	1.67	1.81
Uranium-235	1.6±0.5	0.04	0.01	-	0.05	3.10	-	0.05	0.50	0.55
Uranium-238	1.7±0.5	0.43	0.01	-	0.44	3.30	-	0.05	0.48	0.53
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.47±0.05	-	-	-	-	0.10	-	-	-	-
Total					0.91	20.02				3.62

Sample Identification: A-027-S-0

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.06±0.04	(a)	0.10	0.04	0.14	0.12	(a)	-	0.02	0.02
Thorium-232	0.07±0.04	(a)	0.13	0.05	0.18	0.14	(a)	-	0.03	0.03
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					0.32	0.26				0.05

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-117-S-0		Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
Type of Analysis	Activity (pCi/g dry)	D	Clearance Rate W	Total	Ingestion	D	W	Y	Total
Radium-226	2.6±0.3	0.97	0.07	1.10	23.14	-	0.09	1.90	1.99
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.10±0.05	-	-	-	0.87	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	0.06±0.04	(a)	0.02	0.02	0.02	(a)	-	0.05	0.05
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total				<u>1.12</u>	<u>24.03</u>				<u>2.04</u>
Sample Identification: A-118-S-0		Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.76±0.22	0.12	0.06	0.22	3.40	-	0.01	0.61	0.62
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	0.11±0.06	(a)	0.04	0.04	0.04	(a)	0.15	0.10	0.25
Thorium-230	0.14±0.07	(a)	0.22	0.30	0.28	(a)	-	0.04	0.04
Thorium-232	0.21±0.09	(a)	0.38	0.52	0.43	(a)	-	0.08	0.08
Cesium-137	0.31±0.06	-	-	-	0.07	-	-	-	-
Total				<u>1.08</u>	<u>4.22</u>				<u>0.99</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-128-S-0

Type of Analytes	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)					
		D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate Y
Radium-226	1.3±0.4	0.48	0.04	0.03	0.55	11.57	-	0.05	0.95	1.00
Radium-228	1.13±0.44	0.17	0.09	0.07	0.33	5.05	-	0.01	0.91	0.92
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-	-	-	-
Branium-235	< 0.05	-	-	-	-	-	-	-	-	-
Branium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.11±0.07	(a)	0.04	-	0.04	0.04	(a)	0.01	0.10	0.11
Thorium-230	0.13±0.09	(a)	0.20	0.07	0.27	0.26	(a)	-	0.04	0.04
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.29±0.05	-	-	-	-	0.06	-	-	-	-
Total					1.19	16.98				2.07

Sample Identification: A-130-S-0

Radium-226	2.4±0.2	0.89	0.06	0.05	1.00	21.36	-	0.08	1.75	1.86
Radium-228	0.83±0.08	0.13	0.06	0.05	0.24	3.71	-	0.01	0.66	0.67
Strontium-90	< 0.11±0.07	-	-	-	-	0.96	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-	-	-	-
Branium-235	< 0.05	-	-	-	-	-	-	-	-	-
Branium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.06±0.05	(a)	0.02	-	0.02	0.02	(a)	-	0.05	0.05
Thorium-230	0.06±0.05	(a)	0.09	0.04	0.13	0.12	(a)	-	0.01	0.01
Thorium-232	0.08±0.05	(a)	0.14	0.05	0.19	0.16	(a)	-	0.03	0.03
Cesium-137	0.44±0.02	-	-	-	-	-	-	-	-	-
Total					1.58	26.33				2.62

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-136-5-0

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)					
		D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate
Radium-226	1.6±0.3	0.60	0.04	0.04	0.68	14.24	-	0.06	1.17	1.23
Radium-228	0.77±0.16	0.12	0.06	0.04	0.22	3.44	-	0.01	0.62	0.63
Strontium-90	0.13±0.05	-	-	-	-	1.14	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-	-	-	-
Branium-235	< 0.05	-	-	-	-	-	-	-	-	-
Branium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.19±0.03	-	-	-	-	0.04	-	-	-	-
Total					0.90	18.86				1.86

Sample Identification: A-140-5-0

Radium-226	1.0±0.1	0.37	0.28	0.25	0.90	8.90	-	0.03	0.73	0.76
Radium-228	0.49±0.08	0.75	0.04	0.03	0.87	2.19	-	-	0.40	0.40
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Branium-234	0.82±0.34	-	-	-	-	-	-	-	-	-
Branium-235	0.40±0.26	0.01	-	-	0.01	1.76	-	0.03	0.31	0.4
Branium-238	0.11±0.17	-	-	-	-	0.77	-	0.01	0.12	0.13
Thorium-228	< 0.05	(a)	-	-	-	0.21	-	-	0.03	0.03
Thorium-230	0.25±0.08	(a)	0.40	0.15	0.55	0.50	(a)	-	-	-
Thorium-232	0.09±0.05	(a)	0.16	0.06	0.22	0.19	(a)	-	0.08	0.08
Cesium-137	0.10±0.02	-	-	-	-	0.02	(a)	-	0.03	0.03
Total					2.55	14.54				1.77

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-142-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)				
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate		Total
			W	Y					Y	Total	
Radium-226	1.3±0.3	0.48	0.04	0.03	0.55	11.57	-	0.05	0.95	1.00	
Radium-228	1.32±0.20	0.20	0.10	0.08	0.38	5.90	-	0.01	1.06	1.07	
Strontium-90	0.16±0.06	-	-	-	-	1.40	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-	
Cesium-137	0.38±0.04	-	-	-	-	0.09	-	-	-	-	
Total					<u>0.93</u>	<u>18.96</u>				<u>2.07</u>	

Sample Identification: A-143-S-0

Radium-226	2.8±0.4	1.05	0.08	0.07	1.20	24.92	-	0.10	2.05	2.15
Radium-228	1.39±0.24	0.21	0.11	0.08	0.40	6.21	-	0.02	1.12	1.14
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.12±0.06	(a)	0.19	0.07	0.26	0.24	(a)	-	0.04	0.04
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.14±0.03	-	-	-	-	0.03	-	-	-	-
Total					<u>1.86</u>	<u>31.40</u>				<u>3.33</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-146-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M/Y	Total	D	Clearance Rate Y	Total
Radium-226	5.7±0.5	2.13	0.16	2.43	-	4.17	4.37
Radium-228	0.91±0.20	0.14	0.07	0.76	-	0.73	0.74
Strontium-90	0.13±0.05	-	-	-	-	-	-
Uranium-234	0.98±0.38	0.27	-	0.27	-	0.37	0.40
Uranium-235	0.67±0.32	0.02	-	0.02	-	0.20	0.22
Uranium-238	0.43±0.30	0.01	-	0.01	-	0.12	0.13
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.09±0.06	(a)	0.14	0.19	(a)	0.03	0.03
Thorium-232	0.06±0.05	(a)	0.11	0.15	(a)	0.02	0.02
Cesium-137	0.58±0.06	-	-	-	-	-	-
Total		-	-	3.33	-	-	5.91

Sample Identification: A-147-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M/Y	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.78±0.15	0.02	-	0.02	-	0.30	0.32
Uranium-235	0.11±0.07	-	-	-	-	0.03	0.03
Uranium-238	0.30±0.10	-	-	-	-	0.09	0.09
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.02	-	-	0.44

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-163-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	3.1±0.3	1.16	0.09	1.33	-	2.27	2.38
Radium-228	0.75±0.12	0.11	0.06	0.21	-	0.60	0.61
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.97±0.17	0.03	-	-	-	0.37	0.40
Uranium-235	0.17±0.08	-	-	-	-	0.05	0.05
Uranium-238	0.19±0.08	-	-	-	-	0.05	0.05
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.24±0.02	-	-	0.05	-	-	-
Total				<u>1.54</u>			<u>3.49</u>

Sample Identification: A-164-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	1.9±0.3	0.71	0.05	0.81	-	1.39	1.46
Radium-228	0.95±0.19	0.15	0.08	0.29	-	0.77	0.78
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.31±0.10	-	-	-	-	0.42	0.43
Uranium-235	0.10±0.05	-	-	-	-	0.03	0.03
Uranium-238	0.19±0.08	-	-	-	-	0.05	0.05
Thorium-226	0.11±0.06	(a)	0.04	0.04	-	0.10	0.11
Thorium-230	0.11±0.06	(a)	0.18	0.25	(a)	0.03	0.03
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.30±0.04	-	-	-	-	-	-
Total				<u>1.39</u>			<u>2.59</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-183-5-0

Type of Analysis	Activity (pCi/q dry)	Exposure to bone (mrem/yr)			Exposure to lung (mrem/yr)					
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Clearance Rate
Radium-226	2.1±0.4	0.78	0.06	0.05	0.89	18.69	-	0.08	1.53	1.61
Radium-228	1.0±0.2	0.15	0.08	0.06	0.29	4.47	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.26±0.10	-	-	-	-	0.56	-	-	0.10	0.10
Uranium-235	0.05±0.04	-	-	-	-	0.10	-	-	0.01	0.01
Uranium-238	0.19±0.08	-	-	-	-	0.37	-	-	0.05	0.05
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.12	-	-	-	-	0.03	-	-	-	-
Total					1.16	24.22				1.77

Sample Identification: A-200-5-0

Radium-226	1.9±0.4	0.71	0.05	0.05	0.81	16.91	-	0.07	1.39	1.46
Radium-228	1.0±0.2	0.15	0.08	0.06	0.29	4.47	-	0.01	0.80	0.81
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.39±0.05	-	-	-	-	0.09	-	-	-	-
Total					1.10	21.47				2.27

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-224-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	1.9±0.5	0.71	0.05	0.81	-	0.07	1.46
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	0.20±0.10	-	-	-	-	-	-
Uranium-234	1.1±0.2	0.03	-	0.03	-	0.03	0.45
Uranium-235	0.17±0.07	-	-	-	-	-	0.05
Uranium-238	0.99±0.56	0.02	-	0.02	-	0.03	0.31
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.48±0.09	-	-	-	-	-	-
Total		-	-	0.86	-	-	2.27

Sample Identification: A-232-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.50±0.17	0.77	0.03	0.84	-	0.40	0.40
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.44±0.11	0.01	-	0.01	-	0.01	0.18
Uranium-235	0.00±0.05	-	-	0.15	-	0.02	0.02
Uranium-238	0.41±0.11	0.01	-	0.01	-	0.01	0.13
Thorium-226	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.20±0.04	-	-	-	-	-	-
Total		-	-	0.86	-	-	0.73

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-237-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	7.7±0.8	2.88	0.22	0.19	3.29	68.53	-	-	-	
Radium-228	0.62±0.33	0.09	0.05	0.03	0.17	2.77	-	0.28	5.64	
Strontium-90	1.1±0.1	-	-	-	-	9.63	-	-	0.50	
Uranium-234	13±1	0.36	0.09	0.04	0.49	27.95	-	0.43	4.94	
Uranium-235	0.44±0.14	0.01	-	-	-	0.85	-	0.01	0.13	
Uranium-238	12±1	0.30	0.08	0.03	0.41	23.28	-	0.25	3.42	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	3.1±0.2	-	-	-	-	0.71	-	-	-	
Total					<u>4.36</u>	<u>133.72</u>			<u>15.70</u>	

Sample Identification: A-277-S-0

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.75±0.15	0.02	-	-	0.02	1.61	-	0.28	0.30
Uranium-235	0.09±0.05	-	-	-	-	1.17	-	0.03	0.03
Uranium-238	0.14±0.06	-	-	-	-	0.27	-	0.04	0.04
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-
Cesium-137	0.88±0.08	-	-	-	-	0.20	-	-	-
Total					<u>0.02</u>	<u>3.25</u>			<u>0.37</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

Sample Identification: A-280-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	0.80±0.30	0.30	0.02	0.34	0.03	0.59	0.62
Radium-228	0.52±0.20	0.08	0.04	0.15	-	0.42	0.42
Strontium-90	< 0.03	-	-	-	-	-	-
Bromine-234	0.65±0.16	0.02	-	0.02	-	-	-
Uranium-235	0.05±0.03	-	-	-	0.02	0.25	0.27
Uranium-238	0.22±0.10	-	-	-	-	0.01	0.01
Thorium-228	< 0.05	(a)	-	-	-	0.06	0.06
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	<u>0.51</u>	-	-	<u>1.38</u>

Sample Identification: A-285-S-0

Radium-226	2.20±0.40	0.82	9.06	0.05	0.08	1.61	1.69
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	0.17±0.09	-	-	-	-	-	-
Bromine-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	1.60±0.10	-	-	-	-	-	-
Total		-	-	<u>0.93</u>	-	-	<u>1.69</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-301-5-0

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.50	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.88±0.20	0.02	-	1.89	0.03	-	0.36
Uranium-235	0.15±0.09	-	-	0.29	-	-	0.05
Uranium-238	0.79±0.06	0.02	-	1.53	0.02	-	0.24
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	1.0±0.1	(a)	-	0.23	-	-	-
Total			0.04	3.94			0.65

Sample Identification: A-303-5-0

Radium-226	1.8±0.3	0.68	0.05	0.04	16.02	-	1.32
Radium-228	0.83±0.16	0.13	0.07	0.05	3.93	0.01	0.72
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.67±0.20	0.01	-	-	1.44	0.02	0.27
Uranium-235	0.06±0.05	-	-	-	0.12	-	0.02
Uranium-238	0.32±0.13	-	-	-	0.62	-	0.09
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	0.64±0.14	(a)	1.03	0.39	1.29	0.02	0.23
Thorium-232	0.53±0.13	(a)	0.97	0.36	1.09	0.01	0.21
Cesium-137	0.35±0.04	-	-	-	0.08	-	-
Total			3.58	24.59			2.86

(a) ICRP-30 classifies Thorium compounds as Y and W type.

TABLE C-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	W	Clearance Rate Y
Radium-226	1.0±0.3	0.37	0.03	0.42	-	0.03	0.76
Radium-228	0.62±0.17	0.09	0.05	0.18	-	-	0.50
Strontium-90	< 0.03	-	-	-	-	-	-
Bromium-234	< 0.05	-	-	-	-	-	-
Bromium-235	< 0.05	-	-	-	-	-	-
Bromium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total		-	-	0.60	-	-	1.26
Sample Identification: A-329-S-0				11.67			
Radium-226	0.9±0.3	0.34	0.02	0.38	-	0.03	0.69
Radium-228	0.63±0.00	0.10	0.05	0.19	-	-	0.50
Strontium-90	< 0.03	-	-	-	-	-	-
Bromium-234	< 0.05	-	-	-	-	-	-
Bromium-235	< 0.05	-	-	-	-	-	-
Bromium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.32±0.17	(a)	0.59	0.80	(a)	0.03	0.15
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total		-	-	1.37	-	-	1.34

(a) ICRP-30 classifies thorium compounds as Y and W type.

Sample Identification: A-344-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M Y	Total	D	M	Clearance Rate Y Total
Radium-226	0.9±0.2	0.34	0.02	0.38	-	0.03	0.66
Radium-228	0.23±0.11	0.03	0.01	0.06	-	-	0.18
Strontium-90	0.03	-	-	-	-	-	-
Uranium-234	0.45±0.14	0.01	-	0.01	-	0.01	0.17
Uranium-235	0.17±0.10	-	-	-	-	-	0.05
Uranium-238	0.28±0.12	-	-	-	-	-	0.08
Thorium-230	0.05	(a)	-	-	(a)	-	-
Thorium-232	0.05	(a)	-	-	(a)	-	-
Cesium-137	0.17±0.03	(a)	-	-	(a)	-	-
Total		-	-	0.45	-	-	1.18

Sample Identification: A-375-S-0

Radium-226	1.9±0.3	0.71	0.05	0.81	-	0.06	1.39
Radium-228	0.93±0.16	0.15	0.08	0.29	-	0.01	0.79
Strontium-90	0.03	-	-	-	-	-	-
Uranium-234	0.05	-	-	-	-	-	-
Uranium-235	0.05	-	-	-	-	-	-
Uranium-238	0.05	-	-	-	-	-	-
Thorium-230	0.05	(a)	-	-	(a)	-	-
Thorium-232	0.05	(a)	-	-	(a)	-	-
Cesium-137	0.49±0.04	(a)	-	-	(a)	-	-
Total		-	-	1.10	-	-	2.25

(a) ICRP-30 classifies Thorium compounds as Y and H type.

TABLE C-4

Sample Identification: A-381-S-0

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (µmcm/yr)			Exposure to Lung (µmcm/yr)			
		D	Clearance Rate W	Total Ingestion	D	M	Clearance Rate Y	Total
Radium-226	1.6±0.3	0.60	0.04	0.68	-	0.06	1.17	1.23
Radium-228	0.88±0.18	0.13	0.07	0.25	-	0.01	0.71	0.72
Strontium-90	< 0.03	-	-	-	-	-	-	-
Bromine-234	0.37±0.13	0.01	-	0.01	-	0.01	0.14	0.15
Bromine-235	0.13±0.05	-	-	-	-	-	0.61	0.04
Bromine-238	0.28±0.11	-	-	-	-	-	0.08	0.08
Thorium-228	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-	-
Cesium-137	1.4±0.08	-	-	-	-	-	-	-
Total				0.94				2.22

Sample Identification: A-382-S-0

Radium-226	3.6±0.5	1.34	0.10	1.53	-	0.13	2.63	2.76
Radium-228	1.2±0.2	0.18	0.10	0.35	-	0.01	0.10	0.11
Strontium-90	< 0.03	-	-	-	-	-	-	-
Bromine-234	0.48±0.14	0.01	-	0.01	-	0.01	0.18	0.19
Bromine-235	< 0.05	-	-	-	-	-	-	-
Bromine-238	0.13±0.07	-	-	-	-	-	0.04	0.04
Thorium-228	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-230	0.26±0.08	(a)	0.42	0.58	(a)	-	0.08	0.08
Thorium-232	0.34±0.08	(a)	0.62	0.85	(a)	-	0.13	0.13
Cesium-137	0.23±0.04	-	-	-	-	-	-	-
Total				3.32				3.31

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-404-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.52±0.16	0.08	0.04	0.30	0.42	2.32	-	-	0.42	0.42
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.23±0.10	-	-	-	-	0.49	-	-	0.09	0.09
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.23±0.10	-	-	-	-	0.45	-	-	0.07	0.07
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.16±0.07	(a)	0.26	0.10	0.36	0.32	(a)	-	0.05	0.05
Thorium-232	0.12±0.06	(a)	0.22	0.08	0.30	0.25	(a)	-	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.08</u>	<u>3.83</u>				<u>0.67</u>

Sample Identification: A-407-S-0

Radium-226	1.7±0.3	0.63	0.05	0.04	0.72	15.13	-	0.06	1.24	1.30
Radium-228	1.1±0.2	0.17	0.09	0.06	0.32	4.92	-	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.53±0.14	0.01	-	-	0.01	1.14	-	0.08	0.20	0.28
Uranium-235	0.09±0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.17±0.08	-	-	-	-	0.33	-	-	0.05	0.05
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.05</u>	<u>21.52</u>				<u>2.54</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-4

Sample Identification: A-415-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		θ	Clearance Rate M Y	Total Ingestion	D	M	Clearance Rate Y Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.19±0.11	-	-	0.40	-	-	0.37
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.22±0.11	-	-	0.43	-	-	0.06
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.14±0.06	(a)	0.22	0.28	(a)	0.04	0.04
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				1.11			0.17

Sample Identification: A-421-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		θ	Clearance Rate M Y	Total Ingestion	D	M	Clearance Rate Y Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	1.1±0.2	0.17	0.09	4.92	-	0.89	0.91
Strontium-90	0.47±0.12	-	-	4.11	-	-	-
Uranium-234	3.0±0.5	0.08	0.02	6.45	-	1.14	1.24
Uranium-235	0.75±0.07	0.02	-	1.45	-	0.23	0.25
Uranium-238	0.56±0.06	0.01	-	1.09	-	0.16	0.17
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	1.6±0.1	-	-	0.37	-	-	-
Total				18.39			2.57

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-4

Sample Identification: A-427-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	< 0.10	-	-	-	-	-	-	-	-	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	
Uranium-234	0.14±0.07	-	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	0.30	-	0.05	0.05	
Uranium-238	0.19±0.08	-	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	0.37	(a)	0.05	0.05	
Thorium-230	0.23±0.11	(a)	0.37	0.14	0.51	0.46	(a)	0.07	0.07	
Thorium-232	0.26±0.10	(a)	0.48	0.18	0.66	0.54	(a)	0.10	0.10	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	
Total					<u>1.17</u>	<u>1.67</u>			<u>0.27</u>	

Sample Identification: A-464-S-0

Radium-226	1.5±0.4	0.56	0.04	0.04	0.64	13.35	-	0.05	1.10	1.15
Radium-228	0.82±0.22	0.13	0.07	0.05	0.25	3.66	-	0.01	0.66	0.67
Strontium-90	0.49±0.13	-	-	-	-	4.29	-	-	-	-
Uranium-234	0.10±0.18	-	-	-	-	0.22	-	-	-	-
Uranium-235	0.07±0.04	-	-	-	-	0.13	-	-	0.21	0.21
Uranium-238	0.12±0.06	-	-	-	-	0.23	-	-	0.03	0.03
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.88±0.08	-	-	-	-	0.20	-	-	-	-
Total					<u>0.89</u>	<u>22.08</u>				<u>2.06</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C 5

Sample Identification: A-086-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	< 0.10	-	-	-	-	-	-	-	-	
Strontium-90	0.39±0.11	-	-	-	-	-	-	-	-	
Uranium-234	0.28±0.12	0.01	-	-	0.01	0.60	0.01	0.11	0.12	
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	
Uranium-238	0.16±0.03	-	-	-	-	0.31	-	0.04	0.04	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	
Total					<u>0.01</u>	<u>4.32</u>			<u>0.16</u>	

Sample Identification: A-087-S-6

Radium-226	1.0±0.3	0.37	0.03	0.02	0.42	8.9	-	0.04	0.73	0.77
Radium-228	0.65±0.20	0.10	0.05	0.04	0.19	2.90	-	0.01	0.52	0.53
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>0.61</u>	<u>11.80</u>				<u>1.30</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-003-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.44±0.14	0.07	0.04	0.14	-	0.35	0.36
Strontium-90	0.07±0.03	-	-	-	-	-	-
Uranium-234	13:1	0.36	0.09	0.49	-	-	-
Uranium-235	0.46±0.09	0.01	-	0.01	0.01	4.94	5.38
Uranium-238	2.4±0.6	0.06	0.02	0.09	-	0.14	0.15
Thorium-230	0.15±0.09	(a)	0.06	0.07	-	0.68	0.75
Thorium-232	0.10±0.07	(a)	0.16	0.22	(a)	0.14	0.16
Cesium-137	< 0.05	(a)	-	-	(a)	0.03	0.03
Total	4.5±0.2	-	-	1.02	-	0.01	0.01
				37.38			6.84

Sample Identification: A-004-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.67±0.16	0.10	0.05	0.19	-	0.54	0.55
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.68±0.28	0.02	-	0.02	-	0.26	0.28
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.36±0.20	0.01	-	0.01	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	0.10	0.11
Thorium-232	0.13±0.06	(a)	0.21	0.29	(a)	0.04	0.04
Cesium-137	0.07±0.05	(a)	0.13	0.18	(a)	0.03	0.03
Total	0.11±0.02	-	-	0.69	-	-	-
				5.57			1.01

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-012-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)						
		D	Clearance Rate M	Y	Total	ingestion	D	M	Y	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-	-
Strontium-90	0.19±0.09	-	-	-	-	-	-	-	-	-	-
Uranium-234	0.92±0.33	-	-	-	-	-	-	-	-	-	-
Uranium-235	0.32±0.25	0.02	0.01	-	0.03	0.03	-	0.03	0.35	0.46	
Uranium-238	0.70±0.32	0.01	-	-	0.01	0.62	-	0.01	0.10	0.41	
Thorium-228	< 0.05	0.02	-	-	0.02	1.36	-	0.02	0.20	0.22	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-	
Cesium-137	0.32±0.05	(a)	-	-	-	-	(a)	-	-	-	
Total		-	-	-	0.06	5.62	-	0.07	-	0.71	

Sample Identification: A-021-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)						
		D	Clearance Rate M	Y	Total	ingestion	D	M	Y	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-	-
Radium-228	0.24±0.13	0.04	0.02	0.01	0.07	1.07	-	-	0.19	0.19	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-	
Uranium-234	0.77±0.35	0.02	-	-	0.02	1.66	-	0.02	0.29	0.31	
Uranium-235	0.06±0.03	-	-	-	-	0.12	-	-	0.02	0.02	
Uranium-238	0.36±0.25	-	-	-	-	0.70	-	0.01	0.10	0.11	
Thorium-228	0.05±0.04	(a)	0.02	-	0.01	0.02	(a)	0.01	0.05	0.06	
Thorium-230	0.08±0.05	(a)	0.13	0.05	0.02	0.16	(a)	-	0.02	0.02	
Thorium-232	0.08±0.05	(a)	0.15	0.05	0.20	0.16	(a)	-	0.03	0.03	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-	
Total		-	-	-	0.50	3.89	-	-	-	0.74	

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-050-S-6

Type of Analysis	Activity ($\mu\text{Ci}/\text{g dry}$)	Exposure to Bone ($\mu\text{rem}/\text{yr}$)			Exposure to Lung ($\mu\text{rem}/\text{yr}$)					
		D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate
Radium-226	0.9±0.2	0.34	0.02*	0.02	0.36	8.01	-	0.03	0.66	0.69
Radium-228	0.76±0.16	0.12	0.06	0.04	0.22	3.40	-	0.01	0.61	0.62
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.6±0.5	0.04	0.01	-	0.35	3.44	-	0.05	0.61	0.66
Uranium-235	0.86±0.38	0.02	0.01	-	0.03	1.67	-	0.03	0.26	0.29
Uranium-238	1.2±0.4	0.03	0.01	-	0.04	2.33	-	0.04	0.34	0.38
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	0.09±0.07	(a)	0.16	0.06	0.22	0.19	(a)	-	0.03	0.03
Cesium-137	0.18±0.63	-	-	-	-	0.04	(a)	-	-	-
Total					0.94	19.08				2.67

Sample Identification: A-062-S-6

Radium-226	0.70±0.14	0.26	0.02	0.02	0.30	6.23	-	0.02	0.51	0.53
Radium-228	0.47±0.09	0.07	0.04	0.03	0.14	2.10	-	0.01	0.33	0.39
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.54±0.10	0.01	-	-	0.01	1.16	-	0.02	0.20	0.22
Uranium-235	0.03±0.04	-	-	-	-	0.16	-	0.02	0.02	0.02
Uranium-238	0.63±0.11	0.02	-	-	0.02	1.22	-	0.02	0.18	0.20
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.16±0.02	-	-	-	-	0.04	(a)	-	-	-
Total					0.47	10.91				1.36

(a) ICRP-30 classified thorium compounds as Y and M type.

Table C-5

Sample Identification: A-063-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	2.9±0.4	1.08	0.08	1.23	-	2.12	2.22
Radium-228	1.19±0.22	0.18	0.10	0.35	-	0.96	0.98
Strontium-90	<0.03	-	-	-	-	-	-
Uranium-234	0.32±0.10	0.01	-	0.01	-	0.12	0.13
Uranium-235	0.06±0.04	-	-	-	-	0.02	0.02
Uranium-238	0.20±0.07	-	-	-	-	0.06	0.06
Thorium-228	0.09±0.04	(a)	0.04	0.04	(a)	0.09	0.10
Thorium-230	0.11±0.02	(a)	0.18	0.25	(a)	0.04	0.04
Thorium-232	0.06±0.04	(a)	0.11	0.15	(a)	0.02	0.02
Cesium-137	<0.08	-	-	-	-	-	-
Total				2.03			3.57

Sample Identification: A-078-S-6

Radium-226	2.7±0.3	1.01	0.08	1.16	-	1.98	1.08
Radium-228	0.78±0.15	0.12	0.06	0.23	-	0.63	0.64
Strontium-90	0.10±0.05	-	-	-	-	-	-
Uranium-234	1.2±0.4	0.03	0.01	0.04	-	0.46	0.50
Uranium-235	0.76±0.30	0.02	-	0.02	-	0.22	0.24
Uranium-238	0.92±0.33	0.02	0.01	0.03	-	0.26	0.29
Thorium-228	0.08±0.05	(a)	0.03	0.03	(a)	0.08	0.09
Thorium-230	0.29±0.10	(a)	0.47	0.65	(a)	0.09	0.10
Thorium-232	0.15±0.08	(a)	0.27	0.37	(a)	0.06	0.10
Cesium-137	0.38±0.04	-	-	-	-	-	-
Total				2.53			3.00

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-117-S-6

Type of Analytes	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)					
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Clearance Rate
Radium-226	1.7±0.3	0.64	0.05	0.04	0.73	15.13	-	0.06	1.24	1.30
Radium-228	1.3±0.2	0.20	0.10	0.08	0.38	5.81	-	0.02	1.05	1.07
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-230	0.23±0.14	(a)	0.09	0.01	0.10	0.09	(a)	0.03	0.22	0.25
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	(a)	-	-	-	-	(a)	-	-	-
Total		-	-	-	1.21	21.03	-	-	-	2.62

Sample Identification: A-118-S-6

Radium-226	1.2±0.3	0.45	0.03	0.03	0.51	10.68	-	0.04	0.88	0.92
Radium-228	1.20±0.20	0.18	0.10	0.07	0.35	5.36	-	0.02	0.97	0.99
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.11±0.03	(a)	-	-	-	0.02	(a)	-	-	-
Total		-	-	-	0.86	16.06	-	-	-	1.91

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-128-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Rate Y	Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	-	-
Total		-	-	-	-	-	-	-	-	-

Sample Identification: A-130-S-6

Radium-226	2.2±0.3	0.82	0.06	0.05	0.93	19.58	-	0.08	1.61	1.69
Radium-228	0.80±0.17	0.12	0.06	0.05	0.23	3.53	-	0.01	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.77±0.06	-	-	-	-	0.18	(a)	-	-	-
Total					<u>1.16</u>	<u>23.34</u>				<u>2.34</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-136-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	2.8±0.4	1.05	0.08	0.07	0.10	2.05	2.15
Radium-228	1.3±0.2	0.20	0.10	0.08	0.02	1.05	1.07
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.91±0.35	0.02	0.01	-	0.03	0.34	0.37
Uranium-235	0.73±0.32	0.02	-	-	0.02	0.22	0.24
Uranium-238	0.86±0.37	0.02	-	-	0.02	0.24	0.26
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	-	-	-	<u>4.09</u>

Sample Identification: A-140-5-6

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.74±0.20	0.11	-	-	0.01	0.60	0.64
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	-	-	-	<u>0.64</u>

(a) ²³²Th classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-142-S-5

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	1.2±0.4	0.45	0.03	0.03	0.52	10.68	-	0.04	0.68	0.92
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.05±0.04	(a)	0.02	-	0.02	0.02	(a)	0.01	0.05	0.06
Thorium-230	0.07±0.06	(a)	0.11	0.04	0.15	0.14	(a)	-	0.02	0.02
Thorium-232	0.08±0.06	(a)	0.15	0.05	0.20	0.16	(a)	-	0.03	0.03
Cesium-137	0.16±0.05	-	-	-	-	0.04	(a)	-	-	-
Total					0.89	11.04				1.03

Sample Identification: A-143-S-6

Radium-226	2.6±0.5	0.97	0.07	0.06	1.10	23.14	-	0.09	1.90	1.99
Radium-228	0.84±0.23	0.13	0.07	0.05	0.25	3.75	-	0.01	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.37±0.06	-	-	-	-	0.08	(a)	-	-	-
Total					1.35	26.97				2.68

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-146-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	0.33±0.16	0.05	0.03	0.02	0.10	1.48	-	-	0.26	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	
Uranium-234	0.90±0.47	0.02	0.01	-	0.03	1.94	-	0.03	0.34	
Uranium-235	0.88±0.54	0.02	0.01	-	0.03	1.71	-	0.03	0.27	
Uranium-238	0.49±0.53	0.01	-	-	0.01	0.95	-	0.01	0.14	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	0.16±0.04	-	-	-	-	0.04	-	-	-	
Total					0.17	6.12			1.08	

Sample Identification: A-147-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					-	-			-

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-163-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	0.74±0.18	0.28	0.02	0.02	0.02	0.54	0.57
Radium-228	0.38±0.12	0.06	0.03	0.11	-	0.31	0.31
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.31±0.10	0.01	-	0.01	-	-	-
Uranium-235	0.13±0.06	-	-	-	0.01	0.12	0.13
Uranium-238	0.27±0.09	0.01	-	0.01	-	0.04	0.04
Thorium-228	< 0.05	(a)	-	-	0.01	0.08	0.09
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				0.45			1.14

Sample Identification: A-164-5-6

Radium-226	2.2±0.4	0.82	0.06	0.05	0.03	1.61	1.69
Radium-228	1.1±0.2	0.17	0.09	0.06	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.23±0.10	0.01	-	-	0.01	0.09	0.10
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.22±0.09	-	-	-	0.01	0.06	0.07
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	0.11±0.06	(a)	0.18	0.07	-	0.04	0.04
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				1.51			2.81

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-183-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	0.84±0.22	0.31	0.02	0.02	-	0.62	0.65
Radium-228	0.98±0.16	0.15	0.08	0.06	-	0.79	0.83
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		0.64	0.09	0.09	11.86	1.48	1.48

Sample Identification: A-200-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.31±0.15	0.15	0.02	0.02	-	0.25	0.25
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		0.09	0.09	0.09	1.38	0.25	0.25

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-224-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to bone (urem/yr)			Exposure to lung (urem/yr)		
		D	Clearance Rate M	Y	D	Clearance Rate M	Y
Radium-226	1.7±0.4	0.64	0.05	0.04	-	0.06	1.24
Radium-228	0.66±0.20	0.10	0.05	0.04	-	0.01	0.53
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.48±0.12	0.01	-	-	-	0.02	0.13
Uranium-235	0.06±0.04	-	-	-	-	-	0.02
Uranium-233	0.34±0.11	0.01	-	-	-	0.01	0.10
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total							
			0.94	19.89			2.17

Sample Identification: A-232-S-6

Radium-226	2.3±0.4	0.86	0.06	0.06	-	0.08	1.68
Radium-228	1.2±0.2	0.18	0.10	0.07	-	0.02	0.97
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-233	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total							
			1.33	25.83			2.75

(a) IUPAC classifies Thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-247-5-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.30±0.08	0.01	-	-	0.01	0.11	0.12
Uranium-235	0.06±0.03	-	-	-	-	0.02	0.02
Uranium-238	0.19±0.07	-	-	-	-	0.05	0.05
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total		-	0.01	1.13	-	-	0.19

Sample Identification: A-264-5-6

Radium-226	1.0±0.09	0.37	0.03	0.02	0.04	0.73	0.77
Radium-228	0.50±0.05	0.08	0.04	0.03	-	6.40	0.41
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.16±0.08	-	-	-	-	0.06	0.06
Uranium-235	0.05±0.03	-	-	-	-	0.02	0.02
Uranium-238	0.09±0.05	-	-	-	-	0.02	0.02
Thorium-230	< 0.05	(a)	0.35	0.13	-	-	-
Thorium-232	0.22±0.11	(a)	0.31	0.12	0.01	0.07	0.08
Cesium-137	< 0.08	(a)	-	-	-	0.06	0.06
Total		-	1.48	12.54	-	-	1.42

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-277-5-6

Type of Analysis	Activity {pCi/g dry}	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	0.26±0.09	-	-	-	-	-	-	-	-	-
Uranium-234	0.22±0.09	0.01	-	-	0.01	0.47	0.01	0.08	0.09	0.09
Uranium-235	0.05±0.03	-	-	-	-	0.10	-	0.02	0.02	0.02
Uranium-238	0.40±0.11	0.01	-	-	0.01	0.78	-	0.01	0.11	0.12
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>0.02</u>	<u>3.63</u>				<u>0.23</u>

Sample Identification: A-280-5-6

Radium-226	1.1±0.2	0.41	0.03	0.03	0.47	9.79	-	0.04	0.80	0.84
Radium-228	0.85±0.17	0.13	0.07	0.05	0.25	3.80	-	0.01	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.32±0.11	0.01	-	-	0.01	0.69	-	0.01	0.12	0.13
Uranium-235	0.09±0.05	-	-	-	-	0.17	-	-	0.03	0.03
Uranium-238	0.13±0.06	-	-	-	-	0.25	-	-	0.04	0.04
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.15±0.03	-	-	-	-	-	-	-	-	-
Total					<u>0.73</u>	<u>14.73</u>				<u>1.73</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-285-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	0.31±0.05	0.12	0.01	0.01	0.14	2.76	-	0.01	0.23	0.24
Radium-228	0.33±0.04	0.05	0.03	0.02	0.10	1.48	-	-	0.26	0.26
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.19±0.07	(a)	0.08	0.01	0.09	0.07	(a)	0.03	0.18	0.21
Thorium-230	0.18±0.08	(a)	0.29	0.11	0.40	0.36	(a)	0.06	0.06	0.06
Thorium-232	0.16±0.07	(a)	0.29	0.11	0.40	0.33	(a)	-	0.06	0.06
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.13</u>	<u>5.00</u>				<u>0.83</u>

Sample Identification: A-301-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total										

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-303-S-6

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Ingestion Total	D	Clearance Rate Y	Total
Radium-226	1.9±0.3	0.71	0.05	0.81	-	1.39	1.46
Radium-228	1.1±0.2	0.17	0.09	0.32	-	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.36±0.13	0.01	-	0.01	-	0.14	0.15
Uranium-235	0.06±0.02	-	-	0.01	-	0.02	0.02
Uranium-238	0.21±0.10	-	-	0.01	-	0.06	0.07
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.20±0.09	(a)	0.32	0.44	(a)	0.06	0.07
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.41±0.04	-	-	-	-	-	-
Total				<u>1.59</u>			<u>2.68</u>

Sample Identification: A-319-S-6

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Ingestion Total	D	Clearance Rate Y	Total
Radium-226	1.3±0.3	0.48	0.04	0.55	-	0.95	1.00
Radium-228	0.63±0.16	0.10	0.05	0.19	-	0.55	0.56
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.28±0.12	0.01	-	0.01	-	0.11	0.12
Uranium-235	0.05±0.04	-	-	-	-	0.02	0.02
Uranium-238	0.28±0.11	0.01	-	0.01	-	0.08	0.09
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.10±0.02	-	-	-	-	-	-
Total				<u>0.76</u>			<u>1.83</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-329-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	1.4±0.3	0.52	0.04	0.59	0.05	1.02	1.07
Radium-228	1.1±0.2	0.17	0.09	0.32	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-
Branium-235	< 0.05	-	-	-	-	-	-
Branium-238	< 0.05	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.05	(a)	-	-	-	-	-
Total	0.11±0.03	-	-	0.91	-	-	1.98

Sample Identification: A-344-S-6

Radium-226	0.6±0.2	0.22	0.02	0.25	0.02	0.44	0.46
Radium-228	0.50±0.18	0.08	0.04	0.15	0.01	0.40	0.41
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	0.80±0.17	0.02	-	0.02	0.03	0.30	0.33
Branium-235	0.14±0.08	-	-	-	-	0.04	0.04
Branium-238	0.18±0.09	-	-	-	-	0.05	0.05
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	0.28±0.05	(a)	-	-	-	-	-
Total	-	-	-	0.42	-	-	1.29

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-375-S-6

Type of Analysis	Activity (pci/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Total
Radium-226	2.1±0.3	0.78	0.06	0.05	0.89	18.69	-	0.08	1.54	1.62
Radium-228	1.1±0.2	0.17	0.09	0.06	0.32	4.92	-	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.42±0.16	0.01	-	-	0.01	0.90	-	0.01	0.16	0.17
Uranium-235	0.13±0.09	-	-	-	-	0.25	-	-	0.04	0.04
Uranium-238	0.25±0.12	0.01	-	-	0.01	0.48	-	0.01	0.07	0.08
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.18±0.08	(a)	0.29	0.11	0.40	0.36	-	-	0.06	0.06
Thorium-232	0.22±0.08	(a)	0.40	0.15	0.55	0.46	-	0.01	0.08	0.09
Cesium-137	0.46±0.04	-	-	-	-	0.10	-	-	-	-
Total		-	-	-	<u>2.18</u>	<u>26.16</u>	-	-	-	<u>2.97</u>

Sample Identification: A-381-S-6

Radium-226	0.6±0.2	0.22	0.02	0.01	0.25	5.34	-	0.02	0.44	0.46
Radium-228	0.78±0.17	0.12	0.06	0.05	0.23	3.49	-	0.01	0.63	0.64
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.17±0.09	-	-	-	-	0.36	-	-	0.05	0.05
Uranium-235	0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.18±0.09	-	-	-	-	0.35	-	-	0.05	0.05
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.22±0.03	-	-	-	-	0.05	-	-	-	-
Total		-	-	-	<u>0.48</u>	<u>9.59</u>	-	-	-	<u>1.21</u>

(a) ICRP-30 classifies Thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-382-S-6

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.34±0.10	0.01	-	0.73	-	0.13	0.14
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.14±0.08	-	-	0.27	-	0.04	0.04
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total		0.01	1.00				0.18

Sample Identification: A-384-S-6

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.86±0.16	0.13	0.07	0.05	-	0.69	0.70
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.2±0.2	0.03	0.01	-	-	0.46	0.50
Uranium-235	0.10±0.02	-	-	-	-	0.03	0.03
Uranium-238	4.9±0.4	0.12	0.03	0.01	-	0.40	0.54
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total		0.45	16.12				1.77

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-391-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M/Y	Total	D	Clearance Rate M/Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	9.15±0.09	0.02	0.01	0.04	-	0.12	0.12
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	0.11±0.06	(a)	0.04	0.05	0.02	0.10	0.12
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.09	-	-	0.24

Sample Identification: A-304-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M/Y	Total	D	Clearance Rate M/Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.35±0.14	0.01	-	0.01	0.01	0.13	0.14
Uranium-235	0.15±0.10	-	-	-	-	0.05	0.05
Uranium-238	0.23±0.11	-	-	-	-	0.06	0.07
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.01	-	-	0.26

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-5

Sample Identification: A-407-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	0.22±0.10	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-	-
Thorium-230	0.42±0.10	(a)	0.68	0.26	0.94	(a)	0.01	0.14	0.15	0.15
Thorium-232	0.53±0.11	(a)	0.97	0.36	1.33	(a)	0.01	0.20	0.21	0.21
Cesium-137	0.17±0.04	-	-	-	-	-	-	-	-	-
Total					<u>2.27</u>				<u>3.90</u>	<u>0.36</u>

Sample Identification: A-415-S-6

Radium-226	1.7±0.4	0.64	0.05	0.04	0.73	15.12	-	0.06	1.24	1.30
Radium-228	1.9±0.3	0.29	0.15	0.11	0.55	8.49	-	0.03	1.53	1.56
Strontium-90	0.24±0.13	-	-	-	-	2.10	-	-	-	-
Uranium-234	0.83±0.22	0.02	0.01	-	0.03	1.78	-	0.03	0.32	0.35
Uranium-235	0.06±0.02	-	-	-	-	0.12	-	-	0.02	0.02
Uranium-238	0.81±0.22	0.02	-	-	0.02	1.57	-	0.02	0.23	0.35
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	1.1±0.1	-	-	-	-	0.25	-	-	-	-
Total					<u>1.33</u>	<u>29.44</u>				<u>3.48</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-5

Sample Identification: A-421-S-6

Type of Analysis	Activity (pCi/g dry)	D	Exposure to Bone (mrem/yr)				D	W	Exposure to Lung (mrem/yr)	
			Clearance Rate W	Clearance Rate Y	Total	Ingestion			Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	0.87±0.12	0.13	0.07	0.05	0.25	3.89	-	0.01	0.70	
Strontium-90	1.5±0.2	0.01	0.01	-	0.02	13.12	-	-	0.01	
Uranium-234	3.9±0.6	0.11	0.03	0.01	0.15	8.38	-	0.13	1.48	
Uranium-235	0.20±0.12	-	-	-	-	0.39	-	0.01	0.06	
Uranium-238	0.11±0.08	-	-	-	-	0.21	-	-	0.03	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	3.0±0.1	-	-	-	-	0.69	-	-	-	
Total					<u>0.42</u>	<u>26.68</u>			<u>2.43</u>	

Sample Identification: A-427-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.77±0.14	0.12	0.06	0.04	0.22	3.44	-	0.01	0.62
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0.22</u>	<u>3.44</u>			<u>0.63</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-6

Sample Identification: A-086-5-2

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		0	Clearance Rate W	Y	Total	0	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.72±0.18	0.11	0.06	0.04	0.21	-	0.58	-	0.59
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.55±0.20	0.02	-	-	0.02	-	0.21	-	0.22
Uranium-235	0.05±0.03	-	-	-	-	-	0.02	-	0.02
Uranium-238	0.58±0.18	0.01	-	-	0.01	-	0.16	-	0.18
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	(a)	-	-	-	-	-	-	-
Total		-	-	-	0.24	-	-	-	1.01

Sample Identification: A-087-5-2

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		0	Clearance Rate W	Y	Total	0	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	1.2±0.2	0.03	0.01	-	0.04	-	-	-	-
Uranium-235	0.10±0.03	-	-	-	-	-	-	-	-
Uranium-238	2.6±0.3	0.07	0.02	0.01	0.10	-	0.46	-	0.50
Thorium-228	< 0.05	(a)	-	-	-	-	0.03	-	0.03
Thorium-230	< 0.05	(a)	-	-	-	-	0.74	-	0.82
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	(a)	-	-	-	-	-	-	-
Total		-	-	-	0.14	-	-	-	1.35

(a) ICRP-30 classifies thorium compounds as Y and W Type.

TABLE C-6

Sample Identification: A-088-S-2

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	D	Clearance Rate		Total
			W	Y			W	Y	
Radium-226	0.5±0.2	0.19	0.01	0.21	-	0.02	0.37	0.39	
Radium-228	1.5±0.2	0.15	0.06	0.29	-	0.01	0.80	0.81	
Strontium-90	< 0.3	-	-	-	-	-	-	-	
Branium-234	< 0.05	-	-	-	-	-	-	-	
Branium-235	< 0.05	-	-	-	-	-	-	-	
Branium-238	< 0.05	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	(a)	-	-	-	
Thorium-230	< 0.05	(a)	-	-	(a)	-	-	-	
Thorium-232	< 0.05	(a)	-	-	(a)	-	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	
Total				<u>0.50</u>				<u>1.20</u>	

Sample Identification: A-102-S-2

Radium-226	1.7±0.3	0.64	0.05	0.73	-	0.06	1.24	1.30
Radium-228	0.77±0.18	0.12	0.06	0.22	-	0.01	0.52	0.63
Strontium-90	0.13±0.03	-	-	-	-	-	-	-
Branium-234	0.16±0.03	-	-	-	-	-	-	-
Branium-235	0.06±0.02	-	-	-	-	-	-	-
Branium-238	0.15±0.02	-	-	-	-	-	-	-
Thorium-226	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-	-
Cesium-137	0.33±0.04	-	-	-	-	-	-	-
Total				<u>0.95</u>				<u>2.05</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-6

Sample Identification: A-103-S-2

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-	-	-
Strontium-90	0.38±0.08	-	-	-	-	-	-	-	-
Uranium-234	1.6±0.2	0.04	-	3.32	-	-	-	-	
Uranium-235	0.44±0.11	0.01	-	3.44	-	0.05	-	0.61	
Uranium-238	0.75±0.14	-	-	0.85	-	0.01	-	0.14	
Thorium-228	0.07±0.05	0.02	-	1.46	-	0.02	-	0.21	
Thorium-230	0.19±0.08	(a)	-	0.03	(a)	0.01	-	0.07	
Thorium-232	0.10±0.06	(a)	-	0.38	(a)	0.01	-	0.06	
Cesium-137	< 0.08	(a)	-	0.21	(a)	-	-	0.04	
Total		-	-	3.69	-	-	-	1.23	

Sample Identification: A-116-S-2

Radium-226	2.2±0.3	0.82	0.06	0.05	0.93	19.58	1.61	1.69
Radium-228	0.92±0.15	0.14	0.07	0.05	0.26	4.11	0.74	0.75
Strontium-90	0.13±0.03	-	-	-	-	1.14	-	-
Uranium-234	0.17±0.03	-	-	-	-	0.36	-	-
Uranium-235	< 0.05	-	-	-	-	-	0.06	0.06
Uranium-238	0.19±0.10	-	-	-	-	0.37	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	0.05
Thorium-230	0.27±0.10	(a)	0.44	0.16	0.60	0.54	-	-
Thorium-232	0.36±0.12	(a)	0.66	0.24	0.90	0.74	0.09	0.10
Cesium-137	0.23±0.03	-	-	-	-	0.05	0.14	0.15
Total		-	-	-	2.69	26.89	-	2.80

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-6

Sample Identification: A-133-5-2

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)								
		D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate	Total		
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-	-	-	-
Radium-228	0.28±0.17	0.04	0.02	0.02	0.08	1.25	-	-	-	0.22	-	-	0.22
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	0.08	1.25	-	-	-	-	-	-	-
Total					0.08	1.25							0.22

Sample Identification: A-134-5-2

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)								
		D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate	Total		
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-	-	-	-
Radium-228	0.3±0.16	0.05	0.02	0.02	0.09	1.34	-	-	-	0.24	-	-	0.24
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-	-	-	-
Uranium-234	0.23±0.08	0.01	0.17	-	0.18	0.49	-	-	-	0.09	-	-	0.10
Uranium-235	0.11±0.06	-	-	-	-	0.21	-	-	-	0.03	-	-	0.03
Uranium-238	0.21±0.08	-	-	-	-	0.41	-	-	-	0.06	-	-	0.07
Thorium-228	0.21±0.11	(a)	0.08	0.01	0.09	0.08	-	-	-	0.21	-	-	0.23
Thorium-230	0.49±0.16	(a)	0.79	0.30	1.09	0.98	-	-	-	0.16	-	-	0.18
Thorium-232	0.4±0.10	(a)	0.27	0.10	0.37	0.31	-	-	-	0.06	-	-	0.06
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-	-	-	-
Total					1.82	3.82							0.91

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-6

Sample Identification: A-148-S-2

Type of Analysis	Activity ($\mu\text{Ci/g dry}$)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate $\frac{M}{Y}$	Total Ingestion	D	Clearance Rate $\frac{M}{Y}$	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.22 ± 0.14	0.03	0.02	0.06	-	0.18	0.18
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.06	-	-	0.18

TABLE C-7

Sample Identification: A-086-S-4

Type of Analysis	Activity (pci/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	1.5±0.3	0.56	0.04	0.04	0.64	-	0.05	1.10	1.15
Radium-228	0.80±0.20	0.12	0.06	0.05	0.23	-	0.01	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.43±0.10	(a)	0.69	0.26	0.95	(a)	0.01	0.14	0.15
Thorium-232	0.53±0.11	(a)	0.97	0.36	1.33	(a)	0.01	0.20	0.21
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>3.15</u>				<u>2.16</u>

Sample Identification: A-087-S-4

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.45±0.16	0.07	0.04	0.03	0.14	-	0.01	0.36	0.37
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.21±0.10	-	-	-	-	-	0.01	0.08	0.09
Uranium-235	0.15±0.09	-	-	-	-	-	-	0.05	0.05
Uranium-238	0.28±0.11	0.01	-	-	0.01	-	0.01	0.08	0.09
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.16±0.11	(a)	0.26	0.10	0.36	(a)	-	0.05	0.05
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0.51</u>				<u>0.65</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-7

Sample Identification: A-088-5-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate Y	Total	Ingestion	D	W	Y	Total
Radium-226	0.9±0.3	0.34	0.02	0.38	8.01	-	0.03	0.66	0.69
Radium-228	0.88±0.19	0.14	0.07	0.26	3.93	-	0.01	0.71	0.72
Strontium-90	0.36±0.09	-	-	-	3.15	-	-	-	-
Uranium-234	0.24±0.14	0.01	-	0.01	0.52	-	-	0.09	0.09
Uranium-235	0.17±0.12	-	-	-	0.33	-	-	0.05	0.05
Uranium-238	0.31±0.16	0.01	-	0.01	0.60	-	0.01	0.09	0.10
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total				0.66	16.54				1.65

Sample Identification: A-102-5-4

Radium-226	2.2±0.4	0.82	0.06	0.93	19.58	-	0.08	1.61	1.69
Radium-228	0.81±0.2	0.12	0.06	0.23	3.62	-	0.01	0.65	0.66
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total				1.16	23.20				2.35

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-7

Sample Identification: A-103-S-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	0.11±0.02	-	-	-	-	0.96	-	-	-	-
Uranium-234	0.33±0.14	0.01	-	-	0.01	0.71	-	0.01	0.12	0.13
Uranium-235	0.05±0.03	-	-	-	-	0.10	-	-	0.02	0.02
Uranium-238	0.26±0.13	0.01	-	-	0.01	0.50	-	0.01	0.07	0.08
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	-	-
Total					<u>0.02</u>	<u>2.27</u>				<u>0.23</u>

Sample Identification: A-116-S-4

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.25±0.15	0.04	0.02	0.01	0.07	1.12	-	-	0.20	0.20
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	-	-
Total					<u>0.07</u>	<u>1.12</u>				<u>0.20</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-7

Sample Identification: A-133-S-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	0.73±0.14	0.11	0.06	0.04	0.21	3.26	-	0.01	0.59	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	
Total					<u>0.21</u>	<u>3.26</u>			<u>0.60</u>	

Sample Identification: A-134-S-4

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-230	0.21±0.16	(a)	0.34	0.13	0.47	0.42	(a)	0.01	0.07
Thorium-232	0.34±0.20	(a)	0.62	0.23	0.85	0.70	(a)	0.01	0.13
Cesium-137	0.12±0.04	-	-	-	-	0.03	-	-	-
Total					<u>1.32</u>	<u>1.15</u>			<u>0.22</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-7

Sample Identification: A-148-S-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	1.1±0.3	0.41	0.03	0.03	0.47	9.79	-	0.04	0.80	0.84
Radium-228	0.42±0.18	0.06	0.03	0.02	0.11	1.88	-	0.01	0.34	0.35
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.53±0.10	0.01	-	-	0.01	1.14	-	0.02	0.20	0.22
Uranium-235	0.07±0.02	-	-	-	-	0.14	-	-	0.02	0.02
Uranium-238	0.70±0.19	0.02	-	-	0.02	1.36	-	0.02	0.20	0.22
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	0.83±0.123	(a)	1.52	0.56	2.08	1.72	(a)	0.02	0.31	0.33
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>2.69</u>	<u>16.03</u>				<u>1.65</u>

TABLE C-8

Sample Identification: A-088-S-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Rate Y	Total	Ingestion	D	W	Clearance Rate Y
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0</u>	<u>0</u>			<u>0</u>

Sample Identification: A-102-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0</u>	<u>0</u>			<u>0</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-8

Sample Identification: A-103-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Ingestion Y	D	Clearance Rate W	Total
Radium-226	0.6±0.2	0.22	0.02	0.01	-	-	-
Radium-228	0.39±0.18	0.06	0.03	0.02	-	0.02	0.46
Strontium-90	< 0.03	-	-	-	-	-	0.31
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total							<u>0.77</u>

Sample Identification: A-116-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Ingestion Y	D	Clearance Rate W	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	0.11±0.01	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-226	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.19±0.09	(a)	-	-	(a)	0.01	-
Thorium-232	0.16±0.07	(a)	-	-	(a)	-	0.07
Cesium-137	< 0.08	-	-	-	-	-	0.06
Total							<u>0.13</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-8

Sample Identification: A-133-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	Total
			W	Y				Y		
Radium-226	< 5.5	-	-	-	-	-	-	-	-	
Radium-228	0.50±0.19	0.08	0.04	0.03	0.15	2.24	-	0.40	0.40	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	
Total					<u>0.15</u>	<u>2.24</u>			<u>0.40</u>	

Sample Identification: A-134-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.46±0.14	0.07	0.04	0.03	0.14	2.06	-	0.37	0.38
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.29±0.13	0.01	-	-	0.01	0.62	-	0.11	0.12
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.46±0.16	0.01	-	-	0.01	0.89	-	0.39	0.40
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0.16</u>	<u>3.57</u>			<u>0.90</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-8

Sample Identification: A-148-S-6

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.50±0.14	0.08	0.04	0.15	0.01	0.40	0.41
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				0.15			0.41
							2.24

TABLE C-9

Sample Identification: B-001-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	1.0±0.3	0.37	0.03	0.02	0.42	8.90	-	0.04	0.73	0.77
Radium-228	1.3±0.25	0.20	0.10	0.08	0.38	5.81	-	0.02	1.05	1.07
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.04±0.51	0.03	-	-	0.03	2.24	-	0.03	0.39	0.42
Uranium-235	0.08±0.04	-	-	-	-	0.16	-	-	0.02	0.02
Uranium-238	0.59±0.37	0.02	-	-	0.02	1.14	-	0.02	0.17	0.19
Thorium-228	1.3±0.04	(a)	0.05	-	0.05	0.05	(a)	0.02	0.12	0.14
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	0.11±0.05	(a)	0.20	0.07	0.27	0.23	(a)	-	0.04	0.04
Cesium-137	1.89±0.40	-	-	-	-	0.43	-	-	-	-
Total					<u>1.17</u>	<u>18.96</u>				<u>2.65</u>

Sample Identification: B-002-S-0

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.78±0.22	0.12	0.06	0.05	0.23	3.49	-	0.01	0.63	0.64
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.68±0.25	0.05	0.01	-	0.06	3.61	-	0.06	0.64	0.70
Uranium-235	0.11±0.07	-	-	-	-	0.21	-	-	0.03	0.03
Uranium-238	1.19±0.22	0.03	0.01	-	0.04	2.31	-	0.03	0.34	0.37
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>0.33</u>	<u>9.62</u>				<u>1.74</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-003-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		B	Clearance Rate W Y	Total	B	Clearance Rate W Y	Total
Radium-226	3.5±0.4	1.31	0.09	1.50	-	2.56	2.69
Radium-228	0.68±0.16	0.10	0.04	0.19	-	0.55	0.56
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.15±0.47	0.06	-	0.08	-	0.82	0.89
Uranium-235	0.32±0.18	-	-	-	-	0.10	0.10
Uranium-238	0.78±0.28	0.02	-	0.02	-	0.22	0.24
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.06±0.03	(a)	0.04	0.15	(a)	0.02	0.02
Cesium-137	0.33±0.04	-	-	-	-	-	-
Total				<u>1.94</u>			<u>4.50</u>

Sample Identification: B-004-S-0

Radium-226	4.8±0.4	1.79	0.12	2.05	0.01	3.52	3.70
Radium-228	0.80±0.16	0.12	0.06	0.23	-	0.64	0.65
Strontium-90	0.13±0.09	-	-	-	-	-	-
Uranium-234	1.87±0.31	0.05	-	0.06	-	0.71	0.77
Uranium-235	0.00±0.06	-	-	-	-	0.02	0.02
Uranium-238	0.41±0.14	0.01	-	0.01	-	0.12	0.13
Thorium-228	0.09±0.06	(a)	-	0.04	(a)	0.09	0.10
Thorium-230	0.20±0.08	(a)	0.12	0.44	(a)	0.06	0.07
Thorium-232	0.07±0.05	(a)	0.05	0.18	(a)	0.03	0.03
Cesium-137	0.50±0.05	-	-	-	-	-	-
Total				<u>3.17</u>			<u>5.47</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-005-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	0.83±0.28	0.31	0.02	0.35	-	0.03	0.64
Radium-228	1.07±0.19	0.16	0.09	0.31	-	0.01	0.87
Strontium-90	0.19±0.09	-	-	-	-	-	-
Uranium-234	3.96±0.66	0.11	0.03	0.15	-	0.13	1.63
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	1.39±0.48	0.04	0.01	0.05	-	0.04	0.44
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.08±0.05	(a)	0.13	0.18	(a)	0.02	0.02
Thorium-232	0.05±0.03	(a)	0.09	0.12	(a)	0.02	0.02
Cesium-137	0.33±0.06	-	-	-	-	-	-
Total				1.16			3.62

Sample Identification: B-006-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	0.17±0.09	-	-	-	-	-	-
Uranium-234	2.38±0.35	0.07	0.02	0.10	-	0.08	0.98
Uranium-235	0.10±0.04	-	-	-	-	-	0.03
Uranium-238	0.87±0.39	0.02	-	0.02	-	0.25	0.27
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				0.12			1.28

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-007-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	4.9±0.4	1.83	0.14	2.09	0.01	0.18	3.78
Radium-228	0.83±0.17	0.13	0.07	0.25	-	0.01	0.68
Strontium-90	0.21±0.17	-	-	-	-	-	-
Uranium-234	5.32±0.48	0.15	0.04	0.21	-	0.18	2.20
Uranium-235	0.24±0.11	0.01	-	0.01	-	0.01	0.08
Uranium-238	2.14±0.31	0.05	0.01	0.06	-	0.06	0.67
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.10±0.07	(a)	0.16	0.22	(a)	-	0.03
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.79±0.05	-	-	-	-	-	-
Total		-	-	2.84	-	-	7.44

Sample Identification: B-008-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	0.41±0.12	-	-	-	-	-	-
Uranium-234	2.66±0.49	0.07	0.02	0.10	-	0.09	1.10
Uranium-235	0.05±0.02	-	-	-	-	-	0.02
Uranium-238	0.67±0.25	0.02	-	0.02	-	0.02	0.21
Thorium-228	0.07±0.03	(a)	0.03	0.03	(a)	0.01	0.08
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.10±0.05	(a)	0.18	0.25	(a)	-	0.04
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.40	-	-	1.45

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-009-50

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.81±0.27	0.12	0.06	0.23	-	0.65	0.66
Strontium-90	0.16±0.12	-	-	-	-	-	-
Uranium-234	0.90±0.20	0.02	-	0.02	-	0.34	0.37
Uranium-235	0.06±0.05	-	-	-	-	0.02	0.02
Uranium-238	0.53±0.15	0.01	-	0.01	-	0.15	0.17
Thorium-228	0.05±0.03	(a)	0.02	0.02	(a)	0.05	0.06
Thorium-230	0.07±0.03	(a)	0.11	0.15	(a)	0.02	0.02
Thorium-232	0.05±0.03	(a)	0.09	0.12	(a)	0.02	0.02
Cesium-137	0.46±0.08	-	-	-	-	0.02	0.02
Total		-	-	0.55	-	-	1.32

Sample Identification: B-010-5-0

Radium-226	4.7±0.5	1.76	0.13	2.01	-	3.44	3.61
Radium-228	0.87±0.18	0.13	0.07	0.25	-	0.70	0.71
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.91±0.33	0.08	0.02	0.11	-	-	-
Uranium-235	< 0.05	-	-	-	-	1.10	1.20
Uranium-238	0.87±0.22	0.02	-	0.02	-	-	-
Thorium-228	0.83±0.13	(a)	0.33	0.38	(a)	0.25	0.27
Thorium-230	< 0.05	(a)	-	-	(a)	0.80	0.92
Thorium-232	0.05±0.03	(a)	0.09	0.12	(a)	-	-
Cesium-137	0.37±0.05	-	-	-	-	0.02	0.02
Total		-	-	2.89	-	-	6.73

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-011-5-0

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate M	Y	Total	D	W	Y	Total
Radium-226	6.48±0.73	2.42	0.18	0.16	2.76	0.61	0.24	4.75	5.00
Radium-228	0.76±0.26	0.12	0.06	0.04	0.22	-	0.01	0.61	0.62
Strontium-90	9.14±0.10	-	-	-	-	-	-	-	-
Uranium-234	3.05±0.36	0.08	0.02	0.01	0.11	-	0.10	1.16	1.26
Uranium-235	0.49±0.16	0.01	-	-	0.01	-	0.01	0.15	0.16
Uranium-238	0.78±0.19	0.02	-	-	0.02	-	0.02	0.22	0.24
Thorium-228	0.06±0.04	(a)	0.02	-	0.02	(a)	0.01	0.06	0.07
Thorium-230	0.18±0.07	(a)	0.29	0.11	0.40	(a)	-	0.06	0.06
Thorium-232	0.09±0.05	(a)	0.16	0.06	0.22	(a)	-	0.03	0.03
Cesium-137	0.63±0.08	-	-	-	-	-	-	-	-
Total					<u>3.76</u>				<u>7.44</u>

Sample Identification: B-012-5-0

Radium-226	5.1±0.6	1.90	0.14	0.13	2.17	0.01	0.18	3.74	3.93
Radium-228	0.79±0.22	0.12	0.06	0.05	0.23	-	0.01	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	1.88±0.27	0.05	0.01	-	0.06	-	0.06	0.71	0.77
Uranium-235	0.39±0.23	0.01	-	-	0.01	-	0.01	0.12	0.13
Uranium-238	0.84±0.29	0.02	-	-	0.02	-	0.02	0.24	0.26
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.07±0.04	(a)	0.11	0.04	0.15	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.86±0.08	-	-	-	-	-	-	-	-
Total					<u>2.64</u>				<u>5.76</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	0.9±0.5	0.34	0.03	0.02	0.39	-	0.03	0.66	0.69
Radium-228	0.30±0.21	0.05	-	-	0.09	-	-	-	0.24
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Thorium-234	3.01±0.29	0.08	0.02	0.01	0.11	-	0.13	1.14	1.24
Thorium-235	< 0.05	-	-	-	-	-	-	-	-
Thorium-238	0.83±0.17	0.02	-	-	0.02	-	0.02	0.24	0.26
Thorium-228	0.15±0.06	(a)	0.06	0.01	0.07	(a)	0.02	0.14	0.16
Thorium-230	0.13±0.05	(a)	0.21	0.08	0.29	(a)	-	0.04	0.04
Thorium-232	0.14±0.06	(a)	0.26	0.10	0.36	(a)	-	0.05	0.05
Cesium-137	0.16±0.07	-	-	-	-	-	-	-	-
Total					<u>1.33</u>				<u>2.68</u>
Sample Identification: B-015-S-0									
Radium-226	4.8±0.7	1.79	0.14	0.12	2.05	0.01	0.17	3.52	3.70
Radium-228	< 0.1	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Thorium-234	1.04±0.26	0.03	0.01	-	0.04	-	0.03	0.39	0.42
Thorium-235	0.03±0.06	-	-	-	-	-	-	0.02	0.02
Thorium-238	9.39±0.15	-	-	-	0.01	-	0.01	0.11	0.12
Thorium-228	0.05±0.02	(a)	0.02	-	0.02	(a)	0.01	0.05	0.06
Thorium-230	0.13±0.04	(a)	0.21	0.08	0.29	(a)	-	0.04	0.04
Thorium-232	0.10±0.03	(a)	0.18	0.07	0.25	(a)	-	0.04	0.04
Cesium-137	0.63±0.10	-	-	-	-	-	-	0.01	0.01
Total					<u>2.66</u>				<u>4.41</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-016-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	4.7±0.6	1.76	0.13	0.12	-	0.17	3.44
Radium-228	0.87±0.24	0.13	0.07	0.05	-	0.01	0.70
Strontium-90	< 0.03	-	-	-	-	-	-
Thorium-234	1.01±1.6	0.28	0.07	0.03	-	0.33	3.87
Thorium-235	0.13±0.06	-	-	-	-	-	0.04
Thorium-238	2.87±0.83	0.07	0.02	0.01	-	0.08	0.82
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.11±0.04	(a)	0.18	0.07	(a)	-	0.04
Cesium-137	0.71±0.08	(a)	-	-	(a)	-	-
Total		2.99	-	-	-	-	-
		73.64	0.16	0.22	-	-	9.46

Sample Identification: B-017-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	7.2±0.6	2.69	0.20	0.18	0.01	0.26	5.27
Radium-228	0.37±0.12	0.06	0.03	0.02	-	-	0.30
Strontium-90	2.02±0.19	0.02	0.01	0.01	-	-	0.01
Thorium-234	7.22±0.61	0.20	0.05	0.02	-	0.24	2.74
Thorium-235	0.69±0.19	0.02	-	-	-	0.02	0.21
Thorium-238	1.10±0.24	0.03	0.01	-	-	0.03	0.31
Thorium-232	0.71±0.03	(a)	0.03	-	(a)	-	0.07
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.26±0.05	(a)	-	-	(a)	-	-
Total		3.58	-	-	-	-	-
		102.49	0.06	0.03	-	-	9.48

(a) ICRP-30 classifies Thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-018-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	5.3±0.5	1.98	0.15	0.13	2.26	47.17	0.01	0.19	3.88	4.08
Radium-228	2.94±0.11	0.45	0.24	0.17	0.86	13.14	-	0.04	2.37	2.41
Strontium-90	0.12±0.07	-	-	-	-	1.05	-	-	-	-
Uranium-234	5.42±0.65	0.15	0.04	0.02	0.21	11.65	-	0.18	2.06	2.24
Uranium-235	0.68±0.23	0.02	-	-	0.02	1.32	-	0.02	0.21	0.23
Uranium-238	1.39±0.33	0.04	0.01	-	0.05	2.70	-	0.04	0.40	0.44
Thorium-228	0.06±0.03	(a)	0.02	-	0.02	0.02	(a)	0.01	0.06	0.07
Thorium-230	0.22±0.09	(a)	0.35	0.13	0.48	0.44	(a)	0.01	0.07	0.08
Thorium-232	0.20±0.12	(a)	0.37	0.14	0.51	0.41	(a)	-	0.08	0.08
Cesium-137	0.65±0.07	-	-	-	-	0.15	-	-	-	-
Total					<u>4.41</u>	<u>78.05</u>				<u>9.63</u>

Sample Identification: B-019-S-0

Radium-226	4.31±0.6	1.61	0.12	0.11	1.84	38.27	-	0.16	3.15	3.31
Radium-228	0.85±0.24	0.13	0.07	0.05	0.25	3.80	-	0.01	0.68	0.69
Strontium-90	> 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	3.64±0.37	0.10	0.03	0.01	0.14	7.83	-	0.12	1.39	1.51
Uranium-235	0.46±0.13	0.01	-	-	0.01	0.89	-	0.01	0.14	0.15
Uranium-238	0.74±0.17	0.02	-	-	0.02	1.44	-	0.02	0.21	0.23
Thorium-228	> 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	>> 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	> 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.23±0.05	-	-	-	-	0.05	-	-	-	-
Total					<u>2.26</u>	<u>52.28</u>				<u>5.89</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-020-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate
			W	Y				Y	Total
Radium-226	39±4	14.57	1.10	0.97	16.64	347.10	-	-	-
Radium-228	1.63±0.21	0.25	0.13	0.10	0.48	7.29	0.05	1.42	28.57
Strontium-90	< 0.03	-	-	-	-	-	-	0.02	1.31
Uranium-234	0.54±0.15	0.02	-	-	0.02	1.16	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	0.12	0.20
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	0.33±0.08	(a)	0.53	0.20	0.73	0.66	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	0.01	0.11
Cesium-137	0.52±0.06	-	-	-	-	0.12	(a)	-	-
Total					<u>17.82</u>	<u>356.33</u>			<u>31.81</u>

Sample Identification: B-020-A-S-0

Radium-226	6.4±1.2	2.39	0.18	0.16	2.73	56.96	0.01	0.23	4.69
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	7.54±0.94	0.21	0.06	0.02	0.29	16.21	-	-	-
Uranium-235	0.97±0.34	0.02	0.01	-	0.03	1.88	-	0.25	2.86
Uranium-238	1.82±0.47	0.05	0.01	-	0.06	3.53	-	0.03	0.30
Thorium-228	< 0.05	(a)	-	-	-	-	-	0.05	0.52
Thorium-230	0.10±0.04	(a)	0.02	0.01	0.03	0.92	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-
Cesium-137	0.60±0.08	-	-	-	-	0.14	(a)	-	-
Total					<u>3.14</u>	<u>78.74</u>			<u>8.94</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.



TABLE C-9

Sample Identification: B-020-B-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	13.1±0.8	4.89	0.37	0.32	5.58	116.59	0.02	0.48	9.60	10.10
Radium-228	0.91±0.21	0.14	0.07	0.05	0.26	4.07	-	0.01	0.73	0.74
Strontium-90	0.14±0.06	-	-	-	-	1.22	-	-	-	-
Uranium-234	6.74±0.51	0.19	0.05	0.02	0.26	14.49	-	0.22	2.56	2.78
Uranium-235	0.54±0.2-	0.01	-	-	0.01	1.05	-	0.02	0.17	0.19
Uranium-238	1.23±0.21	0.03	0.01	-	0.04	2.39	-	0.04	0.35	0.39
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.12±0.05	(a)	0.19	0.07	0.26	0.24	(a)	-	0.04	0.04
Thorium-232	0.11±0.08	(a)	0.20	0.07	0.27	0.23	(a)	-	0.04	0.04
Cesium-137	0.13±0.04	-	-	-	-	0.03	-	-	-	-
Total					<u>6.68</u>	<u>140.31</u>				<u>14.28</u>

Sample Identification: B-021-S-0

Radium-226	33±5	12.33	0.93	0.82	14.08	293.70	0.04	1.20	24.18	25.42
Radium-228	1.03±0.19	0.16	0.08	0.06	0.30	4.60	-	0.01	0.83	0.84
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	11.3±0.7	0.3±	0.08	0.03	0.42	24.30	-	0.37	4.29	4.66
Uranium-235	0.98±0.22	0.02	0.01	-	0.03	1.90	-	0.03	0.30	0.33
Uranium-238	1.00±0.22	0.02	0.01	-	0.03	1.94	-	0.03	0.28	0.31
Thorium-228	0.08±0.05	(a)	0.03	-	0.03	0.03	(a)	0.01	0.15	0.16
Thorium-230	0.47±0.12	(a)	0.76	0.28	1.04	0.94	(a)	0.01	0.15	0.16
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0-26±0.04	-	-	-	-	0.06	-	-	-	-
Total					<u>15.93</u>	<u>327.47</u>				<u>31.88</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

C-79

TABLE C-9

Sample Identification: B-022-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	24.2±1.3	9.04	0.68	0.60	10.32	215.38	0.03	0.88	17.73	18.64
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	0.01±0.05	-	-	-	-	0.61	-	-	-	-
Uranium-234	28.5 ± 1.6	0.79	0.21	0.08	1.08	61.28	0.01	0.94	10.82	11.77
Uranium-235	0.49±0.04	0.01	-	-	0.01	0.95	-	0.02	0.15	0.17
Uranium-238	1.96±0.52	0.05	0.01	-	0.06	3.80	-	0.06	0.56	0.62
Thorium-228	0.06±0.04	(a)	0.02	-	0.02	0.02	(a)	0.01	0.06	0.07
Thorium-230	0.18±0.06	(a)	0.29	0.11	0.40	0.36	(a)	-	0.06	0.06
Thorium-232	0.05±0.04	(a)	0.09	0.03	0.12	0.10	(a)	-	0.02	0.02
Cesium-137	0.10±0.02	-	-	-	-	0.02	-	-	-	-
Total					<u>12.01</u>	<u>282.52</u>				<u>31.35</u>

Sample Identification: B-023-S-0

Radium-226	5.0±0.5	1.87	0.14	0.12	2.13	44.50	0.01	0.18	3.66	3.85
Radium-228	0.84±0.20	0.13	0.07	0.05	0.25	3.75	-	0.01	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.02±0.28	0.06	0.01	-	0.07	4.34	-	0.07	0.77	0.84
Uranium-235	0.26±0.10	0.01	-	-	0.01	0.50	-	0.01	0.08	0.09
Uranium-238	0.87±0.18	0.02	-	-	0.02	1.69	-	0.02	0.25	0.27
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>2.48</u>	<u>54.78</u>				<u>5.74</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-024-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	2497±11	932.88	70.66	61.92	1065.46	22223.30	3.12	90.64	1829.30	1833.16
Radium-228	5.40±0.43	0.83	0.43	0.32	1.58	24.12	-	0.08	4.35	4.43
Strontium-90	9.19±0.09	-	-	-	-	1.66	-	-	-	-
Uranium-234	600±32	16.68	4.38	1.74	22.80	1290.00	0.31	19.80	227.82	247.93
Uranium-235	70.0±3.5	1.85	0.49	0.20	2.54	135.80	0.04	2.16	21.54	23.74
Uranium-238	11.0±1.4	0.28	0.07	0.03	0.38	21.34	-	0.32	3.13	3.45
Thorium-228	0.24±0.08	(a)	0.10	0.02	0.12	0.09	(a)	0.03	0.23	0.26
Thorium-230	20.6±0.7	(a)	33.20	12.52	45.72	41.41	(a)	0.66	6.64	7.30
Thorium-232	0.44±0.11	(a)	0.80	0.30	1.10	0.91	(a)	0.01	0.17	0.18
Cesium-137	1.83±0.11	-	-	-	-	0.42	-	-	-	-
Total					<u>1139.70</u>	<u>23739.07</u>				<u>2120.45</u>

Sample Identification: B-025-S-0

Radium-226	108.0±2	40.25	3.06	2.68	46.09	961.20	0.14	3.92	79.12	83.18
Radium-228	1.34±0.24	0.21	0.11	0.08	0.40	5.99	-	0.02	1.08	1.10
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	62.6±3.1	1.74	0.46	0.18	2.38	134.59	0.03	2.06	23.77	25.86
Uranium-235	0.23±0.06	0.01	-	-	0.01	0.45	-	0.01	0.07	0.08
Uranium-238	1.76±0.54	0.04	0.01	-	0.05	3.41	-	0.05	0.50	0.55
Thorium-228	0.15±0.06	(a)	0.06	0.01	0.07	0.06	(a)	0.02	0.14	0.16
Thorium-230	0.49±0.10	(a)	0.79	0.30	1.09	0.98	(a)	0.02	0.16	0.18
Thorium-232	0.10±0.05	(a)	0.18	0.07	0.25	0.21	(a)	-	0.04	0.04
Cesium-137	0.27±0.04	-	-	-	-	0.06	-	-	-	-
Total					<u>50.34</u>	<u>1106.95</u>				<u>111.15</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-026-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate			Ingestion	D	W	Clearance Rate	
			W	Y	Total				Y	Total
Radium-226	17.7±1.0	6.61	0.50	0.44	7.55	157.53	0.02	0.64	12.97	13.63
Radium-228	0.66±0.21	0.10	0.05	0.04	0.19	2.95	-	0.01	0.53	0.54
Strontium-90	0.16±0.13	-	-	-	-	1.40	-	-	-	-
Uranium-234	8.17±1.06	0.23	0.06	0.02	0.31	17.56	-	0.27	3.10	3.37
Uranium-235	0.14±0.07	-	-	-	-	0.27	-	-	0.04	0.04
Uranium-238	0.70±0.31	0.02	-	-	0.02	1.36	-	0.02	0.20	0.22
Thorium-228	0.08±0.05	(a)	0.03	-	0.02	0.02	(a)	0.01	0.08	0.09
Thorium-230	0.52±0.13	(a)	0.84	0.32	1.16	1.04	(a)	0.02	0.17	0.19
Thorium-232	0.25±0.09	(a)	0.46	0.17	0.63	0.52	(a)	0.01	0.09	0.10
Cesium-137	0.5±0.06	-	-	-	-	0.12	(a)	-	-	-
Total					<u>9.89</u>	<u>182.77</u>				<u>18.18</u>

Sample Identification: B-027-S-0

Radium-226	442±5	165.13	12.51	10.96	188.60	3933.80	0.55	16.04	323.81	340.40
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	99.4±2.8	2.76	0.72	0.29	3.77	213.71	0.05	3.28	37.74	41.07
Uranium-235	6.13±0.69	0.16	0.04	0.02	0.22	11.89	-	0.19	1.89	2.08
Uranium-238	2.04±0.40	0.05	0.01	-	0.06	3.96	-	0.06	0.58	0.64
Thorium-228	0.11±0.07	(a)	0.04	0.01	0.05	0.04	(a)	0.02	0.10	0.12
Thorium-230	4.03±0.43	(a)	6.49	2.45	8.94	8.10	(a)	0.13	1.30	1.43
Thorium-232	0.37±0.13	(a)	0.68	0.25	0.93	0.76	(a)	0.01	0.14	0.15
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	-	-
Total					<u>202.57</u>	<u>4172.26</u>				<u>385.89</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-028-S-0

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (µrem/yr)				Exposure to Lung (µrem/yr)			
		D	Clearance Rate W	Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	1785±10	666.88	50.52	761.67	15886.50	2.23	64.80	1307.69	1374.72
Radium-228	1.88±0.28	0.29	0.15	0.55	8.40	-	0.03	1.51	1.54
Strontium-90	0.19±0.10	-	-	-	1.66	-	-	-	-
Uranium-234	309±4	8.59	2.26	11.75	664.35	0.16	10.20	117.33	127.69
Uranium-235	9.93±0.76	0.26	0.07	0.36	19.26	-	0.30	3.06	3.36
Uranium-238	4.61±0.53	0.12	0.03	0.06	8.94	-	3.06	3.06	0.36
Thorium-228	0.13±0.05	(a)	0.05	0.06	0.05	(a)	0.01	0.05	0.06
Thorium-230	5.27±0.33	(a)	8.49	11.69	10.59	(a)	0.17	1.70	1.87
Thorium-232	0.08±0.06	(a)	0.15	0.20	0.16	(a)	-	0.03	0.03
Cesium-137	1.22±0.09	-	-	0.20	0.28	-	-	-	-
Total				<u>786.44</u>	<u>16600.19</u>				<u>1510.72</u>

Sample Identification: B-029-S-0

Radium-226	2.3±0.45	0.86	0.07	0.99	20.47	-	0.08	1.68	1.76
Radium-228	0.63±0.23	0.10	0.05	0.19	2.82	-	0.01	0.51	0.52
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	4.30±1.55	0.12	0.03	0.16	9.24	-	0.14	1.63	1.77
Uranium-235	1.48±1.06	0.04	0.01	0.05	2.87	-	0.04	0.46	0.50
Uranium-238	4.69±1.70	0.12	0.03	0.16	9.10	-	0.14	1.34	1.48
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.12±0.05	(a)	0.19	0.26	0.24	(a)	-	0.04	0.04
Thorium-232	0.13±0.05	(a)	0.24	0.33	0.27	(a)	-	0.05	0.05
Cesium-137	0.19±0.05	-	-	-	0.04	-	-	-	-
Total				<u>2.14</u>	<u>45.05</u>				<u>6.12</u>

(a) ICRP-30 classifies thorium compounds as Y and H type.

TABLE C-9

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Ingestion Total	D	Clearance Rate Y	Total
Sample Identification: B-030-5-0							
Radium-226	357±4	133.38	10.10	142.33	0.45	12.96	274.95
Radium-228	1.58±0.27	0.24	0.13	0.46	-	0.02	1.29
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	83.1±3.4	2.31	0.61	3.16	0.04	2.74	34.33
Uranium-235	5.68±0.95	0.15	0.04	0.20	-	0.17	1.92
Uranium-238	1.90±0.54	0.05	0.01	0.06	-	0.06	0.60
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.65±0.14	(a)	1.05	1.45	(a)	0.02	0.23
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.21±0.04	-	-	-	(a)	-	-
Total				<u>147.66</u>			<u>313.32</u>
Sample Identification: B-031-5-0							
Radium-226	429±6	160.27	12.14	183.05	0.54	15.57	330.39
Radium-228	1.13±0.30	0.17	0.09	0.33	-	0.02	0.93
Strontium-90	0.44±0.17	-	-	-	-	-	-
Uranium-234	198±8	5.50	1.44	7.51	0.10	6.53	81.81
Uranium-235	17.4±2.5	0.46	0.12	0.63	0.01	0.54	5.90
Uranium-238	6.82±1.59	0.17	0.04	0.23	-	0.20	2.14
Thorium-228	0.16±0.07	(a)	0.06	0.07	(a)	0.02	0.17
Thorium-230	2.66±0.26	(a)	4.29	5.91	(a)	0.08	0.94
Thorium-232	0.34±0.12	(a)	0.62	0.85	(a)	0.01	0.14
Cesium-137	0.57±0.09	-	-	-	-	-	-
Total				<u>198.58</u>			<u>422.42</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-032-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	1.19±0.36	0.44	0.03	0.03	0.50	-	0.04	0.87	0.91
Radium-228	0.74±0.19	0.11	0.06	0.04	0.21	-	0.01	0.60	0.61
Strontium-90	0.09±0.05	-	-	-	-	-	-	-	-
Uranium-234	17.7±0.5	0.49	0.13	0.05	0.67	0.01	0.58	6.72	7.31
Uranium-235	0.30±0.19	0.01	-	-	0.01	-	0.01	0.09	0.10
Uranium-238	0.36±0.32	0.02	-	-	0.02	-	0.02	0.24	0.26
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.05±0.03	(a)	0.08	0.03	0.11	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.49±0.08	(a)	-	-	-	(a)	-	-	-
Total					1.52				9.21

Sample Identification: B-033-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	130±3	48.57	3.68	3.22	55.47	0.16	4.72	95.24	99.96
Radium-228	0.83±0.23	0.13	0.07	0.05	0.25	-	0.01	0.67	0.68
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	171±7	4.75	1.25	0.50	6.50	0.09	5.64	64.93	70.66
Uranium-235	7.49±1.85	0.20	0.05	0.02	0.27	-	0.23	2.30	2.53
Uranium-238	2.14±1.20	0.05	0.01	-	0.06	-	0.06	0.61	0.67
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.26±0.05	(a)	-	-	-	(a)	-	-	-
Total					62.55				174.50

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-034-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	66±2	24.66	1.87	1.64	28.17	587.40	0.08	2.40	48.35	50.83
Radium-228	1.07±0.16	0.16	0.09	0.06	0.31	4.78	-	0.02	0.86	0.88
Strontium-90	0.24±0.08	-	-	-	-	2.10	-	-	-	-
Uranium-234	157±4	4.36	1.15	0.46	5.97	337.55	0.08	5.18	59.61	64.87
Uranium-235	9.94±1.04	0.26	0.07	0.03	0.36	19.28	-	0.31	3.06	3.37
Uranium-238	41.2±0.7	1.05	0.28	0.11	1.44	79.93	0.02	1.21	11.73	12.96
Thorium-228	1.26±0.78	(a)	0.51	0.08	0.59	0.48	(a)	0.18	1.21	1.39
Thorium-230	29.0±8.3	(a)	46.74	17.63	64.37	58.29	(a)	0.93	9.35	10.28
Thorium-232	1.26±0.74	(a)	2.31	0.86	3.17	2.61	(a)	0.04	0.48	0.52
Cesium-137	1.16±0.06	-	-	-	-	0.27	-	-	-	-
Total					<u>104.38</u>	<u>1092.69</u>				<u>145.10</u>

Sample Identification: B-035-S-0

Radium-226	532±4	198.76	15.06	13.14	227.01	4734.80	0.66	19.31	389.74	409.71
Radium-228	9.71±0.47	1.49	0.78	0.58	2.85	43.40	-	0.14	7.82	1.36
Strontium-90	1.12±0.11	0.01	-	-	0.01	9.80	-	-	-	-
Uranium-234	121±3	3.36	0.88	0.35	4.59	260.15	0.06	3.99	45.94	49.99
Uranium-235	11.9±1.1	0.31	0.08	0.03	0.42	23.09	0.01	0.37	3.66	4.04
Uranium-238	2.75±0.55	0.07	0.02	0.01	0.10	5.34	-	0.08	0.78	0.86
Thorium-228	0.89±0.15	(a)	0.36	0.06	0.42	0.34	(a)	0.12	0.85	0.97
Thorium-230	1.41±0.19	(a)	2.27	0.86	3.13	2.83	(a)	0.04	0.45	0.49
Thorium-232	0.65±0.19	(a)	1.19	0.44	1.63	1.34	(a)	0.02	0.25	0.27
Cesium-137	6.14±0.17	-	-	-	-	1.41	-	-	0.01	0.01
Total					<u>240.16</u>	<u>5082.50</u>				<u>467.70</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-036-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	623±7	232.75	17.63	265.83	0.78	22.61	479.80
Radium-228	0.93±0.23	0.14	0.07	0.27	-	0.01	0.76
Strontium-90	0.10±0.07	-	-	-	-	-	-
Uranium-234	535±6	14.87	3.90	20.32	0.27	17.66	221.07
Uranium-235	51.2±1.8	1.35	0.36	1.85	0.03	1.58	17.36
Uranium-238	21.0±1.1	0.54	0.14	0.73	0.01	0.62	6.61
Thorium-228	0.17±0.05	(a)	0.07	0.08	(a)	0.02	0.18
Thorium-230	4.17±0.25	(a)	6.72	9.26	(a)	0.13	1.47
Thorium-232	0.11±0.06	(a)	0.20	0.27	(a)	-	0.04
Cesium-137	1.86±0.17	(a)	-	-	(a)	-	-
Total		298.61		6849.16			727.29

Sample Identification: B-037-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	666±6	248.82	18.85	284.19	0.83	24.18	512.92
Radium-228	6.34±0.49	0.98	0.51	1.87	-	0.09	5.20
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	267±9	7.42	1.95	10.14	0.14	8.81	110.33
Uranium-235	19.9±2.5	0.52	0.14	0.72	0.01	0.61	6.74
Uranium-238	3.88±1.16	0.10	0.02	0.13	-	0.11	1.21
Thorium-228	0.36±0.09	(a)	0.14	0.16	(a)	0.05	0.39
Thorium-230	3.72±0.30	(a)	6.00	8.26	(a)	0.12	1.32
Thorium-232	1.23±0.17	(a)	2.25	3.09	(a)	0.03	0.49
Cesium-137	3.80±0.17	-	-	-	-	-	-
Total		308.56		6586.97			638.60

(a) ICRP-9 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-038-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Ingestion	D	Clearance Rate Y	Total
Radium-226	411.52	153.74	11.65	175.59	0.51	14.94	301.48
Radium-228	0.94±0.25	0.14	0.08	0.28	-	0.01	0.77
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	74.2±1.6	2.06	0.54	2.82	0.04	2.45	28.17
Uranium-235	5.32±0.46	0.14	0.04	0.19	-	0.16	1.80
Uranium-238	1.69±0.30	0.04	0.01	0.05	-	0.05	0.53
Thorium-230	0.07±0.04	(a)	0.03	0.03	(a)	0.01	0.08
Thorium-232	5.79±0.38	(a)	9.33	12.85	(a)	0.19	2.06
Cesium-137	0.11±0.06	(a)	0.20	0.27	(a)	-	0.04
Total	0.97±0.11	-	-	192.08	-	-	-
				3851.98			352.87

Sample Identification: B-039-S-0

Radium-226	12±4	4.48	0.34	5.12	0.02	0.44	8.79
Radium-228	1.27±0.21	0.20	0.10	0.38	-	0.02	1.02
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	18.1±0.8	0.50	0.13	0.63	0.01	0.60	6.87
Uranium-235	3.4±0.4	0.09	0.02	0.12	-	0.10	1.15
Uranium-238	1.6±0.2	0.04	0.01	0.04	-	0.05	0.46
Thorium-230	0.06±0.03	(a)	0.02	0.02	(a)	0.01	0.06
Thorium-232	2.41±0.20	(a)	3.88	-	(a)	0.08	0.78
Cesium-137	0.14±0.06	(a)	0.26	0.36	(a)	-	0.05
Total	2.48±0.11	-	-	6.73	-	-	-
				166.82			20.41

(a) ICRP-49 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-040-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate Y	Total	D	Clearance Rate Y	Total
Radium-226	18±3	6.72	0.51	7.68	0.02	0.65	13.86
Radium-228	0.57±0.19	0.09	0.04	0.16	-	0.01	0.47
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	7.62±0.47	0.21	0.06	0.29	-	0.25	3.14
Uranium-235	0.52±0.13	0.01	-	0.01	-	0.02	0.18
Uranium-238	0.31±0.09	0.01	-	0.01	-	0.01	0.10
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.63±0.10	(a)	1.02	1.40	(a)	0.02	0.22
Thorium-232	0.06±0.03	(a)	0.11	0.15	(a)	-	0.02
Cesium-137	0.32±0.06	-	-	-	-	-	-
Total				<u>9.70</u>			<u>17.99</u>

Sample Identification: B-041-S-0

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.6±0.20	0.09	0.05	0.18	-	0.01	0.50
Strontium-90	0.03	-	-	-	-	-	-
Uranium-234	0.29±0.20	0.01	-	0.01	-	0.01	0.12
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.19±0.07	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	0.05
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.40±0.06	-	-	-	-	-	-
Total				<u>0.19</u>			<u>0.67</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-042-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	0.58±0.27	0.22	0.01	0.25	-	0.02	0.42
Radium-228	<0.10	-	-	-	-	-	-
Strontium-90	<0.03	-	-	-	-	-	-
Uranium-234	3.27±0.19	0.09	0.01	0.12	-	0.11	1.24
Uranium-235	0.39±0.10	0.01	-	0.01	-	0.01	0.12
Uranium-238	0.13±0.08	-	-	-	-	-	0.04
Thorium-228	0.05±0.04	(a)	-	0.02	(a)	0.01	0.05
Thorium-230	0.05±0.04	(a)	0.03	0.11	(a)	-	0.02
Thorium-232	0.06±0.04	(a)	0.04	0.15	(a)	-	0.02
Cesium-137	0.42±0.08	-	-	-	-	-	-
Total				0.66			2.06

Sample Identification: B-043-S-0

Radium-226	13±2	4.86	0.37	5.55	0.02	0.47	9.52
Radium-228	2.44±0.35	0.37	0.20	0.71	-	0.04	1.97
Strontium-90	<0.03	-	-	-	-	-	-
Uranium-234	103±15	2.89	0.76	3.95	0.05	3.43	39.49
Uranium-235	1.04±0.15	0.03	0.01	0.04	-	0.02	0.32
Uranium-238	1.61±0.65	0.04	0.01	0.05	-	0.05	0.46
Thorium-228	0.19±0.07	(a)	0.08	0.09	(a)	0.03	0.18
Thorium-230	3.42±0.29	(a)	5.22	7.19	(a)	0.10	1.04
Thorium-232	0.42±0.10	(a)	0.77	1.06	(a)	0.01	0.16
Cesium-137	1.03±0.10	-	-	-	(a)	-	-
Total				18.64			57.37

(a) ICRP-30 classifies thorium compounds as Y and H type.

TABLE C-9

Sample Identification: B-044-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	16±3	5.98	0.45	0.40	6.83	142.40	0.02	0.58	11.72	12.32
Radium-228	1.44±0.35	0.22	0.12	0.08	0.42	6.44	-	0.02	1.16	1.18
Strontium-90	0.08±0.03	-	-	-	-	0.70	-	-	-	-
Uranium-234	34.8±1.3	0.97	0.25	0.10	1.32	74.82	0.02	1.15	13.21	14.38
Uranium-235	1.56±0.43	0.04	0.01	-	0.05	3.03	-	0.05	0.48	0.53
Uranium-238	3.32±0.34	0.08	0.02	0.01	0.11	6.44	-	0.10	0.94	1.04
Thorium-228	0.18±0.08	(a)	0.07	0.01	0.08	0.07	(a)	0.03	0.17	0.20
Thorium-230	4.52±0.40	(a)	7.28	2.75	10.03	9.08	(a)	0.14	1.46	1.60
Thorium-232	0.16±0.08	(a)	0.29	0.11	0.40	0.33	(a)	-	0.06	0.06
Cesium-137	0.87±0.12	-	-	-	-	0.20	-	-	-	-
Total					<u>19.24</u>	<u>243.51</u>				<u>31.31</u>

Sample Identification: B-045-S-0

Radium-226	57±6	21.30	1.61	1.41	24.32	507.30	0.07	2.07	41.76	43.90
Radium-228	1.44±0.28	0.22	0.12	0.08	0.42	6.44	-	0.02	1.16	1.18
Strontium-90	0.25±0.08	-	-	-	-	2.19	-	-	-	-
Uranium-234	18.7±4.6	0.52	0.14	0.05	0.71	40.20	0.01	0.62	7.10	7.73
Uranium-235	1.78±0.14	0.05	0.01	-	0.06	3.45	-	0.05	0.55	0.60
Uranium-238	0.55±0.08	0.01	-	-	0.01	1.07	-	0.02	0.16	0.18
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	7.13±0.39	(a)	12.30	4.64	16.94	15.34	(a)	0.24	2.46	2.70
Thorium-232	0.13±0.06	(a)	0.24	0.09	0.33	0.27	(a)	-	0.05	0.05
Cesium-137	0.73±0.08	-	-	-	-	0.17	-	-	-	-
Total					<u>42.79</u>	<u>576.43</u>				<u>56.34</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	H	Y	Total
Radium-226	12±2	4.48	0.34	0.30	5.12	106.80	0.02	0.44	8.79	9.25
Radium-228	1.20±0.22	0.18	0.10	0.07	0.35	5.36	-	0.02	0.97	0.99
Strontium-90	0.08±0.03	-	-	-	-	0.70	-	-	-	-
Uranium-234	1.67±0.14	0.05	0.01	-	0.06	3.59	-	0.06	0.51	0.57
Uranium-235	0.85±0.31	0.02	-	-	0.02	1.65	-	0.03	0.26	0.29
Uranium-238	0.72±0.29	0.02	-	-	0.02	1.40	-	0.02	0.20	0.22
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.29±0.09	(a)	0.47	0.18	0.65	0.58	0.01	0.09	0.09	0.10
Thorium-232	0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.33±0.05	(a)	-	-	-	0.08	-	-	-	-
Total					6.22	120.16				11.42
Sample Identification: B-046-5-0										
Radium-226	8.4±0.2	3.14	0.24	0.21	3.59	74.76	0.01	0.10	6.15	6.46
Radium-228	0.31±0.18	0.05	0.02	0.02	0.09	1.38	-	-	0.25	-
Strontium-90	0.06±0.03	-	-	-	-	0.52	-	-	-	-
Uranium-234	6.90±0.29	0.19	0.05	0.02	0.26	14.84	-	0.23	2.62	2.85
Uranium-235	0.41±0.08	0.01	-	-	0.01	0.80	-	0.01	0.13	0.14
Uranium-238	0.95±0.45	0.02	0.01	-	0.03	1.84	-	0.03	0.27	0.30
Thorium-228	0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	2.43±0.22	(a)	3.52	1.48	5.40	4.88	0.03	0.78	0.86	0.86
Thorium-232	0.18±0.06	(a)	0.33	0.12	0.45	0.37	(a)	0.07	0.07	0.07
Cesium-137	0.32±0.06	-	-	-	-	0.07	-	-	-	-
Total					9.81	99.46				10.93

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-048-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Clearance Rate Y	Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	0.6±0.2	0.22241	0.169	0.0148	0.25	5.34	-	0.02	0.44	0.46
Radium-228	0.82±0.26	0.13	0.07	0.05	0.25	3.66	-	0.01	0.66	0.67
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.06±0.91	0.03	0.01	-	0.04	2.28	-	0.03	0.40	0.43
Uranium-235	0.28±0.14	0.01	-	-	0.01	0.54	-	0.01	0.09	0.10
Uranium-238	0.21±0.15	-	-	-	-	0.41	-	0.01	0.06	0.07
Thorium-228	0.07±0.03	(a)	0.03	-	0.03	0.03	(a)	0.01	0.07	0.08
Thorium-230	0.06±0.03	(a)	0.10	0.04	0.14	0.12	(a)	0.02	0.02	0.04
Thorium-232	0.10±0.04	(a)	0.18	0.07	0.25	0.21	(a)	-	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>0.97</u>	<u>12.59</u>				<u>1.89</u>

Sample Identification: B-049-S-0

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.61±0.23	0.09	0.05	0.04	0.18	2.73	-	0.01	0.49	0.50
Strontium-90	0.02±0.03	-	-	-	-	0.35	-	-	-	-
Uranium-234	0.71±0.11	0.02	-	-	0.02	1.53	-	0.02	0.27	0.29
Uranium-235	0.19±0.06	-	-	-	-	0.37	-	-	0.06	0.06
Uranium-238	0.23±0.06	-	-	-	-	0.45	-	0.01	0.06	0.07
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.41±0.07	-	-	-	0.09	-	-	-	-	-
Total					<u>0.20</u>	<u>5.52</u>				<u>9.92</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-050-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.58±0.14	0.09	0.05	0.17	-	2.59	0.01
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.18±0.15	0.03	0.01	0.04	-	2.54	0.04
Uranium-235	0.20±0.06	-	-	-	-	0.39	0.01
Uranium-238	0.51±0.110	-	-	0.01	-	0.99	0.01
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	1.52±0.09	-	-	-	-	0.35	-
Total		-	-	0.22	-	6.86	-

Sample Identification: B-051-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	1.18±0.21	0.18	0.09	0.34	-	5.27	0.02
Strontium-90	0.14±0.06	-	-	-	-	1.22	-
Uranium-234	4.21±2.63	0.12	0.03	0.16	-	9.05	0.14
Uranium-235	0.74±0.17	0.02	-	0.02	-	1.44	0.02
Uranium-238	3.13±0.83	0.08	0.02	0.11	-	6.07	0.09
Thorium-228	0.13±0.06	(a)	0.05	0.06	(a)	0.05	0.02
Thorium-230	0.28±0.08	(a)	0.45	0.62	(a)	0.56	0.01
Thorium-232	0.16±0.06	(a)	0.29	0.40	(a)	0.33	-
Cesium-137	2.14±0.11	-	-	-	-	0.49	-
Total		-	-	1.71	-	24.48	-

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-052-S-0

Type of Analysis	Activity (pci/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	1.20±0.22	0.20	0.10	0.08	0.38	-	0.02	1.03	1.05
Strontium-90	0.09±0.04	-	-	-	-	-	-	-	-
Uranium-234	0.37±0.24	0.01	-	-	0.01	-	0.01	0.14	0.15
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.06±0.04	(a)	0.10	0.04	0.14	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	1.91±0.11	(a)	-	-	-	(a)	-	-	-
Total					0.53				1.22

Sample Identification: B-053-S-0

Type of Analysis	Activity (pci/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.72±0.20	0.11	0.06	0.04	0.21	-	0.01	0.58	0.59
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.46±0.10	0.01	-	-	0.01	-	0.02	0.17	0.19
Uranium-235	0.05±0.03	-	-	-	-	-	-	0.02	0.02
Uranium-238	0.26±0.08	0.01	-	-	0.01	-	0.01	0.07	0.08
Thorium-228	0.09±0.05	(a)	0.04	-	0.04	(a)	0.01	0.09	0.10
Thorium-230	0.07±0.04	(a)	0.11	0.04	0.15	(a)	-	0.02	0.02
Thorium-232	0.05±0.03	(a)	0.09	0.03	0.12	(a)	-	0.02	0.02
Cesium-137	4.00±0.17	-	-	-	-	-	-	0.01	0.01
Total					0.54				1.03

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-054-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	Total
			W	Y				Y		
Radium-226	7.6±2.4	3.11	0.24	0.21	3.56	74.14	0.01	0.30	6.10	6.41
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	0.35±0.10	-	-	-	-	-	-	-	-	-
Uranium-234	0.33±0.19	0.01	-	-	0.01	3.06	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	0.71	-	0.01	0.12	0.13
Uranium-238	0.18±0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	0.35	-	-	0.05	0.05
Thorium-230	0.53±0.13	(a)	0.85	0.32	1.17	1.06	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	0.02	0.17	0.19
Cesium-137	0.65±0.10	-	-	-	-	0.15	(a)	-	-	-
Total					<u>4.74</u>	<u>79.47</u>				<u>6.78</u>

Sample Identification: B-055-S-0

Radium-226	31±5	11.58	0.88	0.77	13.23	275.90	0.04	1.12	22.71	23.87
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	45±4	1.25	0.33	0.13	1.71	96.75	-	-	-	-
Uranium-235	7.4±1.0	0.20	0.05	0.02	0.27	14.36	0.02	1.48	17.09	18.59
Uranium-238	2.4±0.6	0.06	0.02	0.01	0.09	4.66	-	0.23	2.28	2.51
Thorium-228	< 0.05	(a)	-	-	-	-	-	0.07	0.68	0.75
Thorium-230	0.54±0.12	(a)	0.87	0.33	1.20	1.08	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	0.02	0.17	0.19
Cesium-137	0.63±0.09	-	-	-	-	0.14	(a)	-	-	-
Total					<u>16.50</u>	<u>392.89</u>				<u>45.91</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-056-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	2.3±1.6	0.86	0.06	0.06	0.98	20.47	-	0.08	1.68	1.76
Radium-228	1.25±0.40	0.19	0.10	0.07	0.36	5.59	-	0.02	1.01	1.03
Strontium-90	0.11±0.08	-	-	-	-	0.96	-	-	-	-
Uranium-234	0.83±0.10	0.02	0.01	-	0.03	1.78	-	0.03	0.32	0.35
Uranium-235	0.13±0.04	-	-	-	-	0.25	-	-	0.04	0.04
Uranium-238	0.09±0.03	-	-	-	-	0.17	-	-	0.02	0.02
Thorium-228	0.12±0.04	(a)	0.05	0.01	0.06	0.04	(a)	0.02	0.12	0.14
Thorium-230	0.17±0.06	(a)	0.27	0.10	0.37	0.34	(a)	-	0.05	0.05
Thorium-232	0.17±0.05	(a)	0.31	0.12	0.43	0.35	(a)	-	0.06	0.06
Cesium-137	0.44±0.10	-	-	-	-	0.10	-	-	-	-
Total					<u>2.23</u>	<u>30.05</u>				<u>3.4</u>

Sample Identification: B-057-S-0

Radium-226	3.9±0.5	1.46	0.11	0.10	1.67	34.71	-	0.11	2.86	3.00
Radium-228	0.84±0.22	0.13	0.07	0.05	0.25	3.75	-	0.01	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.32±0.09	0.01	-	-	0.01	0.69	-	0.01	0.12	0.13
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.09±0.05	-	-	-	-	0.17	-	-	0.02	0.02
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.05±0.03	(a)	0.08	0.03	0.11	0.10	(a)	-	0.02	0.02
Thorium-232	0.07±0.04	(a)	0.13	0.05	0.18	0.14	(a)	-	0.03	0.03
Cesium-137	0.13±0.04	-	-	-	-	0.03	-	-	-	-
Total					<u>2.22</u>	<u>39.59</u>				<u>3.89</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-058-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	2.9±0.2	1.08	0.08	0.07	1.23	25.81	-	0.10	2.12	2.22
Radium	2.14±0.28	0.33	0.17	0.13	0.63	9.56	-	0.03	1.72	1.75
Strontium-90	0.08±0.04	-	-	-	-	0.70	-	-	-	-
Uranium-234	1.4±1.0	0.04	0.01	-	0.05	3.01	-	0.05	0.53	0.58
Uranium-235	0.56±0.31	0.01	-	-	0.01	1.09	-	0.02	0.17	0.19
Uranium-238	1.3±0.4	0.03	0.01	-	0.04	2.52	-	0.04	0.37	0.41
Thorium-228	0.22±0.07	(a)	0.09	0.01	0.10	0.08	(a)	0.03	0.21	0.24
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	0.08±0.04	(a)	0.15	0.05	0.20	0.16	(a)	-	0.03	0.03
Cesium-137	0.68±0.07	-	-	-	-	0.15	(a)	-	-	-
Total					<u>2.26</u>	<u>43.08</u>				<u>5.42</u>

Sample Identification: B-059-S-0

Radium-226	13±8	4.89	0.37	0.32	5.55	115.70	0.02	0.47	9.52	10.01
Radium-228	0.59±0.18	0.09	0.05	0.03	0.17	2.64	-	0.01	0.48	0.49
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	11.8±1.5	0.33	0.09	0.03	0.45	25.37	0.01	0.39	4.48	4.48
Uranium-235	0.53±0.24	0.01	-	-	0.01	1.03	-	0.02	0.16	0.18
Uranium-238	1.5±0.4	0.04	0.01	-	0.05	2.91	-	0.04	0.43	0.47
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.07±0.03	(a)	0.11	0.04	0.15	0.14	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.31±0.05	-	-	-	-	0.07	(a)	-	-	-
Total					<u>6.38</u>	<u>147.86</u>				<u>16.05</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-060-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	0.40±0.16	0.06	0.03	0.02	0.11	1.79	-	-	-	
Strontium-90	< 0.03	-	-	-	-	-	-	0.32	0.32	
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	0.32±0.05	-	-	-	-	0.07	(a)	-	-	
Total					<u>0.11</u>	<u>1.86</u>			<u>0.32</u>	

Sample Identification: B-061-S-6

Radium-226	3.3±0.5	1.23	0.09	0.08	1.40	29.37	-	0.12	2.42	2.54
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	7.5±1.2	0.21	0.05	0.02	0.28	16.12	-	0.25	2.85	3.10
Uranium-235	2.2±0.7	0.06	0.02	0.01	0.09	4.27	-	0.07	0.68	0.75
Uranium-238	4.4±0.9	0.11	0.03	0.01	0.15	8.54	-	0.13	1.25	1.38
Thorium-228	0.53±0.06	(a)	0.21	0.03	0.24	0.20	(a)	0.07	0.51	0.58
Thorium-230	0.10±0.05	(a)	0.16	0.06	0.22	0.20	(a)	-	0.03	0.03
Thorium-232	0.48±0.10	(a)	0.88	0.33	1.21	0.99	(a)	0.01	0.18	0.19
Cesium-137	0.53±0.08	-	-	-	-	0.12	-	-	-	-
Total					<u>3.59</u>	<u>59.81</u>				<u>8.57</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-064-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	2.3±0.4	0.86	0.06	0.06	0.98	20.47	-	0.08	1.68	1.76
Radium-228	1.00±0.21	0.15	0.08	0.06	0.29	4.47	-	0.01	0.80	0.81
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.14±0.19	0.06	0.02	0.01	0.09	4.60	-	0.07	0.81	0.88
Uranium-235	0.16±0.06	-	-	-	-	0.31	-	-	0.05	0.05
Uranium-238	2.75±0.07	0.07	0.02	0.01	0.10	5.34	-	0.08	0.78	0.86
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.06±0.04	(a)	0.10	0.04	0.14	0.12	(a)	-	-	-
Thorium-232	0.12±0.07	(a)	0.22	0.08	0.30	0.25	(a)	-	0.02	0.02
Cesium-137	0.09±0.03	-	-	-	-	0.02	(a)	-	0.04	0.04
Total					<u>1.90</u>	<u>35.58</u>				<u>4.42</u>

Sample Identification: B-065-S-0

Radium-226	1.5±0.4	0.56	0.04	0.04	0.64	13.35	-	0.05	1.10	1.15
Radium-228	0.25±0.16	0.04	0.02	0.01	0.07	1.12	-	-	0.20	0.20
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	11.4±1.16	0.32	0.08	0.03	0.43	24.51	-	-	-	-
Uranium-235	1.46±0.59	0.04	0.01	-	0.05	2.83	-	0.38	4.33	4.71
Uranium-238	3.18±0.88	0.08	0.02	0.01	0.11	6.17	-	0.04	0.45	0.49
Thorium-228	0.05±0.02	(a)	0.02	-	0.02	0.02	-	0.09	0.90	0.99
Thorium-230	0.14±0.05	(a)	0.22	0.08	0.30	0.28	(a)	0.01	0.05	0.06
Thorium-232	0.20±0.06	(a)	0.37	0.14	0.51	0.41	(a)	-	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	0.08	0.08
Total					<u>2.13</u>	<u>48.69</u>				<u>7.72</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-062-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	1.7±0.4	0.64	0.05	0.04	0.73	15.13	-	0.06	1.24	1.30
Radium-228	0.56±0.21	0.09	0.04	0.03	0.16	2.50	-	0.01	0.45	0.46
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.5±0.6	0.17	0.04	0.02	0.23	5.38	-	0.08	0.95	1.03
Uranium-235	0.55±0.26	0.01	-	-	0.01	1.07	-	0.02	0.17	0.19
Uranium-238	1.3±0.4	0.03	0.01	-	0.04	2.52	-	0.04	0.27	0.41
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.67±0.09	-	-	-	-	0.15	(a)	-	-	-
Total					<u>1.17</u>	<u>26.75</u>				<u>3.39</u>

Sample Identification: B-063-S-0

Radium-226	12±1	4.48	0.34	0.30	5.12	106.80	0.02	0.14	8.79	9.25
Radium-228	0.84±0.25	0.13	0.07	0.05	0.25	3.75	-	0.01	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	20.1±2.7	0.56	0.15	0.06	0.77	43.22	0.01	0.66	7.63	8.30
Uranium-235	0.34±0.10	0.01	-	-	0.01	0.46	-	0.01	0.07	0.08
Uranium-238	1.9±0.9	0.05	0.01	-	0.06	3.69	-	0.06	0.54	0.60
Thorium-228	5.2±0.5	(a)	2.10	0.34	2.44	1.98	(a)	0.73	4.99	5.72
Thorium-230	0.76±0.18	(a)	1.22	0.46	1.68	1.53	(a)	0.02	0.24	0.26
Thorium-232	7.2±0.6	(a)	13.19	4.90	18.90	14.90	(a)	0.20	2.73	2.93
Cesium-137	0.27±0.05	-	-	-	-	0.06	-	-	-	-
Total					<u>29.23</u>	<u>176.39</u>				<u>27.83</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-064-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	Total
			W	Y				Y		
Radium-226	2.3±0.4	0.86	0.06	0.06	0.98	20.47	-	-	-	-
Radium-228	1.00±0.21	0.15	0.08	0.06	0.29	4.47	-	0.08	1.68	1.76
Strontium-90	< 0.03	-	-	-	-	-	-	0.01	0.80	0.81
Uranium-234	2.14±0.19	0.06	0.02	0.01	0.09	4.60	-	-	-	-
Uranium-235	0.16±0.06	-	-	-	-	0.31	-	0.07	0.81	0.88
Uranium-238	2.75±0.07	0.07	0.02	0.01	0.10	5.34	-	-	0.05	0.05
Thorium-228	< 0.05	(a)	-	-	-	-	-	0.08	0.72	0.86
Thorium-230	0.06±0.04	(a)	0.10	0.04	0.14	0.12	(a)	-	-	-
Thorium-232	0.12±0.07	(a)	0.22	0.08	0.30	0.25	(a)	-	0.02	0.02
Cesium-137	0.09±0.03	-	-	-	-	0.02	(a)	-	0.04	0.04
Total					<u>1.90</u>	<u>35.58</u>				<u>4.42</u>

Sample Identification: B-065-S-0

Radium-226	1.5±0.4	0.56	0.04	0.04	0.64	13.35	-	-	-	-
Radium-228	0.25±0.16	0.04	0.02	0.01	0.07	1.12	-	0.05	1.10	1.15
Strontium-90	< 0.03	-	-	-	-	-	-	-	0.20	0.20
Uranium-234	11.4±1.16	0.32	0.08	0.03	0.43	24.51	-	-	-	-
Uranium-235	1.46±0.59	0.04	0.01	-	0.05	2.83	-	0.38	4.33	4.71
Uranium-238	3.18±0.88	0.08	0.02	0.01	0.11	6.17	-	0.04	0.45	0.49
Thorium-228	0.05±0.02	(a)	0.02	-	0.02	0.02	-	0.09	0.90	0.99
Thorium-230	0.14±0.05	(a)	0.22	0.08	0.30	0.28	(a)	0.01	0.05	0.06
Thorium-232	0.20±0.06	(a)	0.37	0.14	0.51	0.41	(a)	-	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	0.08	0.08
Total					<u>2.13</u>	<u>48.69</u>				<u>7.72</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-066-S-0

Type of Analysis	Activity ($\mu\text{Ci/g dry}$)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	W	Clearance Rate Y
Radium-226	1.4 \pm 0.04	0.52	0.04	0.59	-	0.05	1.02
Radium-228	1.27 \pm 0.29	0.20	0.10	0.38	-	0.02	1.04
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	4.7 \pm 1.0	0.13	0.03	0.17	-	0.16	1.94
Uranium-235	0.98 \pm 0.50	0.02	0.01	0.03	-	0.03	0.33
Uranium-238	1.7 \pm 0.6	0.04	0.01	0.05	-	0.05	0.53
Thorium-228	0.06 \pm 0.03	(a)	0.02	0.02	(a)	0.01	0.07
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.14 \pm 0.05	-	-	-	-	-	-
Total				1.24			4.98
				33.49			

Sample Identification: B-0.67-S-0	
Radium-226	11.1
Radium-228	0.96 \pm 0.29
Strontium-90	< 0.03
Uranium-234	29 \pm 3
Uranium-235	0.61 \pm 0.18
Uranium-238	2.00 \pm 0.72
Thorium-228	0.13 \pm 0.06
Thorium-230	0.47 \pm 0.10
Thorium-232	0.09 \pm 0.05
Cesium-137	0.25 \pm 0.07
Total	7.48

Sample Identification: B-0.67-S-0	
Radium-226	11.1
Radium-228	0.96 \pm 0.29
Strontium-90	< 0.03
Uranium-234	29 \pm 3
Uranium-235	0.61 \pm 0.18
Uranium-238	2.00 \pm 0.72
Thorium-228	0.13 \pm 0.06
Thorium-230	0.47 \pm 0.10
Thorium-232	0.09 \pm 0.05
Cesium-137	0.25 \pm 0.07
Total	22.41

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-068-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Investigation Y	D	Clearance Rate M	Investigation Y
Radium-226	142±10	53.05	4.02	1263.80	0.18	5.15	104.03
Radium-228	1.25±0.26	0.19	0.10	5.59	-	0.02	1.01
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	73±3	2.03	0.53	156.95	0.04	2.41	27.72
Branium-235	12±1	0.32	0.08	23.28	0.01	0.37	3.69
Branium-238	4.7±0.7	0.12	0.03	9.12	-	0.14	1.34
Thorium-228	0.15±0.08	(a)	0.06	0.07	(a)	0.02	0.14
Thorium-230	0.67±0.17	(a)	1.08	1.35	(a)	0.02	0.22
Thorium-232	0.08±0.05	(a)	0.15	0.16	(a)	-	0.03
Cesium-137	3.96±0.18	-	-	0.91	-	-	-
Total				1461.22			146.54

Sample Identification: B-069-S-0

Radium-226	< 0.5	0.05	0.03	1.52	-	-	0.27
Radium-228	0.34±0.16	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	4.27±1.08	0.12	0.03	9.18	-	0.14	1.62
Branium-235	0.22±0.08	-	-	0.43	-	0.01	0.07
Branium-238	3.64±0.97	0.09	0.02	7.06	-	0.11	1.34
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				18.19			3.26

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-070-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	
Radium-228	0.63±0.18	0.10	0.05	0.19	-	-	
Strontium-90	< 0.03	-	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	
Thorium-228	< 0.05	-	-	-	-	-	
Thorium-230	0.06±0.04	(a)	0.10	0.14	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	
Cesium-137	5.75±0.18	(a)	-	-	-	-	
Total		-	-	0.33	-	-	

Sample Identification: B-071-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	
Radium-228	0.46±0.20	0.07	0.04	0.14	-	-	
Strontium-90	0.31±0.24	-	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	
Thorium-228	< 0.05	-	-	-	-	-	
Thorium-230	0.17±0.07	(a)	0.27	0.37	-	-	
Thorium-232	0.11±0.06	(a)	0.20	0.27	-	-	
Cesium-137	0.38±0.07	(a)	-	-	-	-	
Total		-	-	0.78	-	-	

(a) ICRP-30 classifies Thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-072-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate M	Y	Total	D	M	Y	Total
Radium-226	4.1±0.5	1.53	0.12	0.10	1.75	-	3.00	3.15	
Radium-228	0.33±0.17	0.05	0.03	0.02	0.10	-	0.26	0.26	
Strontium-90	< 0.03	-	-	-	-	-	-	-	
Uranium-234	5913	1.64	0.43	0.17	2.24	0.03	22.40	24.38	
Uranium-235	3.8±0.7	0.10	0.03	0.01	0.14	-	1.17	1.29	
Uranium-238	2.4±0.6	0.06	0.02	0.01	0.09	-	0.68	0.75	
Thorium-228	0.07±0.03	(a)	0.03	-	0.03	(a)	0.07	0.08	
Thorium-230	0.50±0.08	(a)	0.80	0.30	1.10	(a)	0.16	0.18	
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	
Total					5.45			30.09	

Sample Identification: B-073-S-0

Radium-226	4.5±0.5	1.68	0.13	0.11	1.92	-	3.30	3.46
Radium-228	0.76±0.19	0.12	0.06	0.04	0.22	-	0.61	0.62
Strontium-90	< 0.03	-	-	-	-	-	-	-
Uranium-234	4.77±0.77	0.13	0.03	0.01	0.17	-	1.81	1.97
Uranium-235	0.94±0.34	0.02	0.01	-	0.03	-	0.29	0.32
Uranium-238	1.40±0.42	0.04	0.01	-	0.05	-	0.40	0.44
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-
Cesium-137	0.63±0.06	-	-	-	-	-	-	-
Total					2.39			6.81

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-074-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W Y	Total	D	Clearance Rate W Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	1.01±0.21	0.16	0.08	0.30	-	0.81	0.82
Strontium-90	< 0.03	-	-	-	-	-	-
Bromine-234	18.5±1.9	0.54	0.14	0.70	-	-	-
Bromine-235	0.70±0.43	0.02	-	0.02	0.01	7.02	7.64
Bromine-238	3.19±0.82	0.08	0.02	0.11	-	0.22	0.24
Thorium-228	< 0.05	(a)	-	-	(a)	0.91	1.00
Thorium-230	0.26±0.08	(a)	0.42	0.58	(a)	-	-
Thorium-232	0.09±0.04	(a)	0.16	0.22	(a)	0.08	0.09
Cesium-137	0.40±0.05	-	-	-	(a)	0.03	0.03
Total		-	-	1.93	-	-	9.82

Sample Identification: B-075-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W Y	Total	D	Clearance Rate W Y	Total
Radium-226	14±1	5.23	0.40	5.98	0.02	6.51	10.79
Radium-228	0.92±0.22	0.14	0.07	0.26	-	0.01	0.75
Strontium-90	< 0.03	-	-	-	-	-	-
Bromine-234	21.6±1.7	0.60	0.16	0.82	0.01	0.71	8.92
Bromine-235	1.18±0.47	0.03	-	0.03	-	0.04	0.40
Bromine-238	2.88±0.63	0.07	0.02	0.09	-	0.08	0.90
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.14±0.04	-	-	-	(a)	-	-
Total		-	-	7.18	-	-	21.76

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-076-S-0	Type of Analysis	Activity (pci/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)					
			D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate
	Radium-226	37±2	11.96	0.90	0.79	13.65	284.80	0.04	1.16	23.44	24.64
	Radium-228	0.27±0.20	0.04	0.02	0.02	0.08	1.21	-	-	0.22	0.22
	Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
	Thorium-234	56±4	1.56	0.41	0.16	2.13	120.40	0.03	1.85	21.26	23.14
	Thorium-235	4.8±1.0	0.13	0.03	0.01	0.17	9.31	-	0.15	1.48	1.63
	Thorium-238	2.3±0.7	0.06	0.02	-	0.08	4.46	-	0.07	0.65	0.72
	Thorium-228	0.08±0.05	(a)	0.03	-	0.03	0.03	(a)	0.01	0.08	0.09
	Thorium-230	0.86±0.17	(a)	1.38	0.52	1.90	1.73	(a)	0.03	0.28	0.31
	Thorium-232	0.15±0.07	(a)	0.27	0.10	0.37	0.31	(a)	-	0.06	0.06
	Cesium-137	0.33±0.07	-	-	-	-	0.08	-	-	-	-
	Total					18.41	422.33				50.81
	Radium-226	1.8±0.3	0.67	0.05	0.04	0.76	16.02	-	0.06	1.32	1.38
	Radium-228	0.99±0.19	0.15	0.08	0.06	0.29	4.42	-	0.01	0.80	0.81
	Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
	Thorium-234	2.4±0.6	0.07	0.02	0.01	0.10	5.16	-	0.08	0.91	0.99
	Thorium-235	1.0±0.4	0.03	0.01	-	0.04	1.94	-	0.03	0.31	0.34
	Thorium-238	2.1±0.6	0.05	0.01	-	0.06	4.07	-	0.06	0.60	0.66
	Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
	Thorium-230	0.06±0.04	(a)	0.10	0.04	0.14	0.12	(a)	-	0.02	0.02
	Thorium-232	0.14±0.07	(a)	0.26	0.10	0.36	0.29	(a)	-	0.05	0.05
	Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
	Total					1.75	32.02				4.25

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-078-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate Y	Total Ingestion	D	Clearance Rate Y	Total
Radium-226	4.1±0.4	1.53	0.12	1.75	-	3.00	3.15
Radium-228	0.87±0.16	0.13	0.07	0.25	-	0.70	0.71
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	6.2±0.9	0.17	0.04	0.23	-	2.35	2.55
Uranium-235	0.47±0.25	0.01	-	0.01	-	0.14	0.15
Uranium-238	1.8±0.5	0.05	0.01	0.06	-	0.51	0.56
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.16±0.07	(a)	0.26	0.36	-	0.05	0.05
Thorium-232	0.17±0.07	(a)	0.31	0.43	-	0.06	0.06
Cesium-137	< 0.08	-	-	-	-	-	-
Total				3.09			7.23

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Sample Identification: B-079-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate Y	Total Ingestion	D	Clearance Rate Y	Total
Radium-226	1.5±0.3	0.56	0.04	0.64	-	1.10	1.15
Radium-228	0.57±0.17	0.09	0.04	0.16	-	0.46	0.47
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.7±0.6	0.08	0.02	0.11	-	1.02	1.11
Uranium-235	0.05	-	-	-	-	-	-
Uranium-238	2.4±0.7	0.06	0.02	0.09	-	0.68	0.75
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				1.00			3.48

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	2.8±0.3	1.05	0.08	0.07	1.20	-	0.10	2.05	2.15
Radium-228	0.76±0.18	0.12	0.06	0.04	0.22	-	0.01	0.61	0.62
Strontium-90	0.14±0.09	-	-	-	-	-	-	-	-
Uranium-234	4.2±1.0	0.12	0.03	0.01	0.16	-	0.19	1.59	1.78
Uranium-235	0.44±0.10	0.04	0.02	-	0.04	-	0.01	0.14	0.15
Uranium-238	3.2±0.9	-	-	-	0.10	-	0.09	0.91	1.00
Thorium-228	0.05±0.03	(a)	0.02	-	0.02	(a)	-	0.05	0.05
Thorium-230	0.09±0.04	(a)	0.14	0.05	0.19	(a)	-	0.03	0.03
Thorium-232	0.05±0.03	(a)	0.09	0.03	0.12	(a)	-	0.02	0.02
Cesium-137	0.11±0.2	(a)	-	-	-	(a)	-	-	-
Total					2.05				5.80
Sample Identification: B-081-S-0									
Radium-226	1.7±0.9	0.64	0.05	0.04	0.73	-	0.06	1.24	1.30
Radium-228	0.57±0.17	0.09	0.04	0.03	0.16	-	0.01	0.46	0.47
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	28±2	0.78	0.20	0.03	1.06	0.01	0.92	10.63	11.56
Uranium-235	1.8±0.5	0.05	0.01	-	0.06	-	0.06	0.55	0.61
Uranium-238	2.6±0.6	0.07	0.02	0.01	0.10	-	0.08	0.74	0.82
Thorium-228	0.10±0.04	(a)	0.04	0.01	0.05	(a)	0.01	0.10	0.11
Thorium-230	0.12±0.06	(a)	0.19	0.07	0.26	(a)	-	0.04	0.04
Thorium-232	0.06±0.04	(a)	0.11	0.04	0.15	(a)	-	0.02	0.02
Cesium-137	0.68±0.08	-	-	-	-	-	-	-	-
Total					2.57				14.93

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-0820-5-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	3.7±0.2	1.38	0.10	0.09	1.57	32.93	-	0.13	2.71	2.84
Radium-228	4.43±0.48	0.68	0.36	0.26	1.30	19.80	-	0.06	3.57	3.63
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	52±2	1.44	0.38	0.15	1.97	111.80	0.03	1.72	19.74	21.49
Uranium-235	4.1±0.7	0.11	0.03	0.01	0.15	7.95	-	0.13	1.26	1.39
Uranium-238	3.1±0.6	0.08	0.02	0.01	0.11	6.01	-	0.09	0.88	0.97
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.18±0.05	-	-	-	-	0.04	-	-	-	-
Total					<u>5.10</u>	<u>178.53</u>				<u>30.32</u>

Sample Identification: B-083-5-0

Radium-226	15±7	5.60	0.42	0.37	6.39	133.50	0.02	0.54	10.99	11.55
Radium-228	1.78±0.22	0.27	0.14	0.10	0.51	7.96	-	0.03	1.43	1.46
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	5.52±0.33	0.15	0.04	0.02	0.21	11.87	-	0.18	2.10	2.28
Uranium-235	0.25±0.08	0.01	-	-	0.01	0.48	-	0.01	0.08	0.09
Uranium-238	0.35±0.09	0.01	-	-	0.01	0.68	-	0.01	0.10	0.11
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	1.41±0.08	-	-	-	-	0.32	-	-	-	-
Total					<u>7.13</u>	<u>154.81</u>				<u>15.49</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-084-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)		
		D	Clearance Rate W	Y	Total	D	W	Y
Radium-226	5.5±0.5	2.05	0.16	0.14	2.35	0.01	4.03	4.24
Radium-228	1.77±0.25	0.27	0.14	0.10	0.51	-	1.43	1.46
Strontium-90	< 0.03	-	-	-	-	-	-	-
Uranium-234	8.2±1.2	0.23	0.06	0.02	0.31	-	3.11	3.38
Uranium-235	0.73±0.36	0.02	-	-	0.02	-	0.22	0.24
Uranium-238	1.4±0.5	0.04	0.01	-	0.05	-	0.40	0.44
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-
Cesium-137	20±4	-	-	-	-	-	0.03	0.03
Total					3.24			9.79

Sample Identification: B-085-S-0

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)		
		D	Clearance Rate W	Y	Total	D	W	Y
Radium-226	25±2	9.34	0.71	0.62	10.67	0.03	18.32	19.26
Radium-228	0.76±0.24	0.12	0.06	0.04	0.22	-	0.61	0.62
Strontium-90	< 0.03	-	-	-	-	-	-	-
Uranium-234	5.3±3	1.47	0.39	0.15	2.01	0.03	20.12	21.90
Uranium-235	3.4±1.1	0.09	0.02	0.01	0.12	-	1.05	1.15
Uranium-238	3.2±0.7	0.08	0.02	0.01	0.11	-	0.91	1.00
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-
Thorium-230	0.14±0.08	(a)	0.22	0.08	0.30	(a)	0.04	0.04
Thorium-232	0.10±0.07	(a)	0.18	0.07	0.25	(a)	0.04	0.04
Cesium-137	17±4	-	-	-	-	(a)	0.02	0.02
Total					13.68			44.03

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate		Total	Ingestion	D	Clearance Rate		Total
			Y	W				Y	W	
Sample Identification: B-086-S-0										
Radium-226	14.8±0.8	5.53	0.42	0.37	6.32	131.72	0.02	0.54	10.84	11.40
Radium-228	1.47±0.24	0.23	0.12	0.09	0.44	6.57	-	0.02	1.18	1.20
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	28±3	0.78	0.20	0.08	1.06	60.20	0.01	0.92	10.63	11.56
Uranium-235	2.9±0.8	0.08	0.02	0.01	0.11	5.63	-	0.09	0.89	0.98
Uranium-238	3.1±0.9	0.08	0.02	0.01	0.11	6.01	-	0.09	0.88	0.97
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.87±0.07	-	-	-	-	0.20	-	-	-	-
Total					8.04	210.33				26.11
Sample Identification: B-087-S-0										
Radium-226	11±1	4.11	0.31	0.27	4.69	97.90	0.01	0.40	8.06	8.47
Radium-228	1.26±0.25	0.19	0.10	0.07	0.36	5.63	-	0.02	1.02	1.04
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	17±1	0.47	0.12	0.05	0.64	36.55	0.01	0.56	6.45	7.02
Uranium-235	2.5±0.5	0.07	0.02	0.01	0.10	4.85	-	0.08	0.77	0.85
Uranium-238	2.4±0.5	0.06	0.02	0.01	0.09	4.66	-	0.07	0.68	0.75
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.08±0.04	(a)	0.13	0.05	0.18	0.16	(a)	-	0.02	0.02
Thorium-232	0.06±0.04	(a)	0.01	-	0.01	0.01	(a)	-	-	-
Cesium-137	0.56±0.07	-	-	-	-	0.13	-	-	-	-
Total					6.07	149.89				18.15

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-088-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W Y	Total	D	Clearance Rate W Y	Total
Radium-226	3.1±0.4	1.16	0.09	1.33	-	2.27	2.38
Radium-228	1.09±0.22	0.17	0.09	0.32	-	0.88	0.90
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.45±0.15	0.04	0.01	0.05	0.05	0.55	0.60
Uranium-235	0.26±0.07	0.01	-	0.01	0.01	0.08	0.09
Uranium-238	0.46±0.09	0.01	-	0.01	0.01	0.13	0.14
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	0.50±0.06	-	-	-	-	-	-
Total				<u>1.72</u>			<u>4.11</u>

Radium-226	3.4±0.5	1.27	0.10	1.45	0.12	2.49	0.61
Radium-228	1.21±0.23	0.19	0.10	0.36	0.02	0.98	1.00
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.62±0.13	0.02	-	0.02	0.02	0.23	0.25
Uranium-235	0.05±0.03	-	-	-	-	0.02	0.02
Uranium-238	0.14±0.06	-	-	-	-	0.04	0.04
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	0.48±0.06	-	-	-	-	-	-
Total				<u>1.83</u>			<u>1.92</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-090-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	0.8±0.3	0.30	0.02	0.34	7.12	-	0.03	0.59	0.62
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.76±0.10	0.02	-	0.02	1.63	-	0.02	0.29	0.31
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.27±0.07	0.01	-	0.01	0.52	-	0.01	0.08	0.09
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.06	-	-	-	-	-	-	-	-
Total				0.37	9.27				1.02

Sample Identification: B-091-S-0

Radium-226	3.1±0.3	1.16	0.09	1.33	27.59	-	0.11	2.27	2.38
Radium-228	0.84±0.16	0.13	0.07	0.25	3.75	-	-	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.17±0.07	-	-	-	0.36	-	-	0.06	0.06
Uranium-235	0.05±0.03	-	-	-	0.10	-	-	0.02	0.02
Uranium-238	0.09±0.04	-	-	-	0.17	-	-	0.02	0.02
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.30±0.04	-	-	-	0.07	-	-	-	-
Total				1.58	32.04				3.17

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-092-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	2.9±0.4	1.08	0.08	0.07	1.23	25.81	-	-	-	-
Radium-228	0.76±0.18	0.12	0.06	0.04	0.22	3.40	-	0.10	2.12	2.22
Strontium-90	0.15±0.06	-	-	-	-	1.31	-	0.01	0.61	0.62
Uranium-234	0.79±0.08	0.02	-	-	0.02	1.70	-	-	-	-
Uranium-235	0.06±0.02	-	-	-	-	0.12	-	0.03	0.30	0.33
Uranium-238	0.29±0.05	0.01	-	-	0.01	0.56	-	-	0.02	0.02
Thorium-228	0.25±0.03	(a)	0.10	0.02	0.12	0.10	-	0.01	0.08	0.09
Thorium-230	0.22±0.08	(a)	0.35	0.13	0.48	0.44	(a)	0.03	0.24	0.27
Thorium-232	0.20±0.02	(a)	0.37	0.14	0.51	0.41	(a)	0.01	0.07	0.08
Cesium-137	0.24±0.04	-	-	-	-	0.06	(a)	-	0.08	0.08
Total					<u>2.59</u>	<u>33.91</u>				<u>3.71</u>

Sample Identification: B-0930-S-0

Radium-226	1.5±0.4	0.56	0.04	0.04	0.64	13.35	-	0.05	1.10	1.15
Radium-228	0.79±0.21	0.12	0.06	0.05	0.23	3.53	-	0.01	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	29±2	0.81	0.21	0.08	1.19	62.35	-	-	-	-
Uranium-235	0.56±0.09	0.01	-	-	0.01	1.09	0.01	0.96	11.01	11.98
Uranium-238	5.48±1.11	0.14	0.04	0.01	0.19	10.63	-	0.02	0.17	0.19
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	-	-
Total					<u>2.17</u>	<u>90.95</u>				<u>13.97</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-094-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Total
Radium-226	1.1±0.3	0.41	0.03	0.03	0.47	9.79	-	0.04	0.80	0.84
Radium-228	0.89±0.16	0.14	0.07	0.05	0.26	3.98	-	0.01	0.72	0.73
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.9±0.7	0.08	0.02	-	0.10	6.24	0.10	0.10	1.10	1.20
Uranium-235	1.1±0.4	0.03	-	-	0.03	2.13	0.03	0.03	0.34	0.37
Uranium-238	1.9±0.6	0.05	0.01	-	0.06	3.69	0.06	0.06	0.54	0.60
Thorium-230	0.11±0.07	(a)	0.04	-	0.04	0.04	0.02	-	0.18	0.12
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-
Cesium-137	0.17±0.12	(a)	0.31	0.12	0.43	0.35	-	0.06	0.06	0.06
Total	< 0.08	-	-	-	1.39	26.22	-	-	-	3.92

Sample Identification: B-095-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.31±0.16	0.05	0.02	0.02	0.09	1.38	-	0.25	0.25	0.25
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	3.4±0.9	0.09	0.02	0.01	0.12	7.31	0.11	0.11	1.29	1.40
Uranium-235	0.27±0.13	0.01	-	-	0.01	0.52	0.01	0.01	0.08	0.09
Uranium-238	1.7±0.6	0.04	0.01	-	0.05	8.30	0.05	0.48	0.48	0.53
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-
Cesium-137	< 0.08	(a)	-	-	-	-	-	-	-	-
Total	-	-	-	-	0.27	12.51	-	-	-	2.27

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-096-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	0.41±0.19	0.06	0.03	0.02	0.11	1.83	-	-	-	
Strontium-90	< 0.03	-	-	-	-	-	0.01	0.33	0.34	
Uranium-234	2.3±0.5	0.06	0.02	0.01	0.09	4.94	-	0.08	0.95	
Uranium-235	0.05±0.03	-	-	-	-	0.10	-	0.02	0.02	
Uranium-238	0.9±0.4	0.02	0.01	-	0.03	1.75	-	0.03	0.29	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	
Total					<u>0.23</u>	<u>8.62</u>			<u>1.60</u>	

Sample Identification: B-097-S-0

Radium-226	2.4±0.3	0.90	0.07	0.06	1.03	21.36	-	0.09	1.76	1.85
Radium-228	1.0±0.2	0.15	0.08	0.06	0.29	4.47	-	0.01	0.81	0.81
Strontium-90	0.22±0.08	-	-	-	-	1.92	-	-	-	-
Uranium-234	0.16±0.07	-	-	-	-	0.34	-	-	0.06	0.06
Uranium-235	0.05±0.04	-	-	-	-	0.10	-	-	0.02	0.02
Uranium-238	0.17±0.09	-	-	-	-	0.33	-	-	0.05	0.05
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.17±0.03	-	-	-	-	0.04	-	-	-	-
Total					<u>1.32</u>	<u>28.56</u>				<u>2.79</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-098-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to bone (mrem/yr)			Exposure to lung (mrem/yr)		
		B	Clearance Rate W Y	Total Ingestion	D	W Y	Total Clearance Rate
Radium-226	2.2±0.4	0.82	0.06	0.93	-	0.08	1.61
Radium-228	1.21±0.22	0.19	0.10	0.36	-	0.02	0.98
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	4.6±0.7	0.13	0.03	0.17	-	0.15	1.75
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	1.6±0.8	0.04	0.01	0.05	-	0.05	0.46
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.17±0.04	-	-	-	-	-	-
Total				1.51			5.10

Sample Identification: B-099-S-0

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.53±0.122	0.08	0.04	0.15	-	0.01	0.43
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	5.3±0.8	0.15	0.04	0.21	-	0.17	2.01
Uranium-235	0.13±0.04	-	-	-	-	-	-
Uranium-238	1.3±0.4	0.03	0.01	0.04	-	0.04	0.04
Thorium-228	0.16±0.09	(a)	0.06	0.07	-	0.02	0.37
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	1.6±0.2	-	-	-	-	-	-
Total				0.47			3.24

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-100-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	Clearance Rate M	Y	Total	D	W	Y	Total
Radium-226	0.20±0.07	0.07	-	-	0.07	-	-	0.15	0.16
Radium-228	0.50±0.17	0.08	0.04	0.03	0.15	-	0.40	0.41	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	61±4	1.70	0.44	0.18	2.32	0.03	-	23.16	25.20
Uranium-235	4.9±0.9	0.13	0.03	0.01	0.17	-	0.15	1.51	1.66
Uranium-238	2.7±0.7	0.07	0.02	0.01	0.10	-	0.08	0.77	0.85
Thorium-228	0.12±0.04	(a)	0.05	0.01	0.06	(a)	0.02	0.12	0.14
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	1.0±0.1	-	-	-	-	-	-	-	-
Total					<u>2.87</u>				<u>28.42</u>

Sample Identification: B-101-S-0

Radium-226	2.4±0.4	0.90	0.07	0.06	1.03	-	0.09	1.76	1.85
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	8.6±0.9	0.24	0.06	0.02	0.32	-	0.28	3.26	3.54
Uranium-235	0.07±0.04	-	-	-	-	-	-	0.02	0.02
Uranium-238	0.48±0.06	0.01	-	-	0.01	-	0.01	0.14	0.15
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	0.10±0.04	(a)	0.16	0.06	0.22	(a)	-	0.03	0.03
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.16±0.04	-	-	-	-	(a)	-	-	-
Total					<u>1.58</u>				<u>5.59</u>

(a) ICRP-30 classifies Thorium compounds as Y and W type.

Sample Identification: B-102-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	4.9±0.5	1.83	0.14	0.12	2.09	0.01	0.18	3.59	3.78
Radium-228	1.16±0.23	0.18	0.09	0.07	0.34	-	0.02	0.93	0.95
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.90±0.12	0.02	0.01	-	0.03	-	0.03	0.34	0.37
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.18±0.07	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	0.05	0.05
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	1.8±0.1	-	-	-	-	-	-	-	-
Total		-	-	-	2.46	-	-	-	5.15

Sample Identification: B-103-S-0

Radium-226	5.1±0.5	1.90	0.14	0.13	2.17	0.01	0.18	3.74	3.93
Radium-228	0.56±0.19	0.09	0.04	0.03	0.16	-	0.01	0.45	0.46
Strontium-90	0.21±0.06	-	-	-	-	-	-	-	-
Uranium-234	12±1	0.33	0.09	0.03	0.45	-	0.40	4.56	4.96
Uranium-235	0.29±0.08	0.01	-	-	0.01	-	0.01	0.09	0.10
Uranium-238	0.84±0.71	0.02	-	-	0.02	-	0.62	0.24	0.26
Thorium-228	0.05±0.04	(a)	0.02	-	0.02	(a)	0.01	0.05	0.06
Thorium-230	0.09±0.05	(a)	0.14	0.05	0.19	(a)	-	0.03	0.03
Thorium-232	0.10±0.06	(a)	0.18	0.07	0.25	(a)	-	0.04	0.04
Cesium-137	0.83±0.08	-	-	-	-	-	-	-	-
Total		-	-	-	3.27	-	-	-	9.84

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-104-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.90±0.17	0.14	0.07	0.26	-	0.72	0.73
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.89±0.10	0.02	0.01	0.03	0.03	0.34	0.37
Uranium-235	0.06±0.02	-	-	-	-	0.02	0.02
Uranium-238	0.32±0.06	0.01	-	0.01	0.01	0.09	0.10
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	1.1±0.1	-	-	-	-	-	-
Total		0.30	-	0.30	0.01	-	1.22

Sample Identification: B-105-S-0

Radium-226	5.9±0.7	2.20	0.17	2.52	0.01	4.32	4.54
Radium-228	0.93±0.23	0.14	0.07	0.27	-	6.75	0.76
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.0±1.0	0.06	0.01	0.07	-	0.76	0.83
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	1.2±0.8	-	-	-	-	0.34	0.38
Thorium-226	< 0.05	0.03	0.01	0.04	-	-	-
Thorium-230	0.17±0.07	(a)	0.27	0.37	(a)	0.05	0.05
Thorium-232	0.12±0.06	(a)	0.22	0.30	(a)	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	-
Total		3.57	-	3.57	-	-	6.60

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-106-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	0.9±0.2	0.34	0.02	0.38	-	0.66	0.69
Radium-228	0.85±0.16	0.13	0.07	0.25	-	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	4.8±0.7	0.13	0.04	0.18	-	1.82	1.98
Uranium-235	0.24±0.17	0.01	-	0.01	-	0.07	0.08
Uranium-238	1.9±0.5	0.05	0.01	0.06	-	0.54	0.60
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>0.88</u>			<u>4.04</u>

Sample Identification: B-107-S-0

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	0.17±0.07	-	-	-	-	-	-
Uranium-234	14.1	0.39	0.10	0.53	0.01	5.32	5.79
Uranium-235	0.14±0.04	-	-	-	-	0.04	0.04
Uranium-238	2.0±0.4	0.05	0.01	0.06	-	0.57	0.63
Thorium-228	< 0.05	(a)	0.35	0.48	(a)	0.07	0.08
Thorium-230	0.22±0.07	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.18±0.06	-	-	-	-	-	-
Total				<u>1.07</u>			<u>6.54</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-108-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	2.7±0.4	1.01	0.08	0.07	1.16	24.03	-	0.10	1.98	2.08
Radium-228	1.26±0.24	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.0±0.5	0.56	0.01	-	0.57	4.30	-	0.07	0.76	0.83
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.79±0.43	0.02	-	-	0.02	1.53	-	0.02	0.22	0.24
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.10±0.05	(a)	0.16	0.06	0.22	0.20	(a)	-	0.03	0.03
Thorium-232	0.10±0.05	(a)	0.18	0.07	0.25	0.21	(a)	-	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>2.22</u>	<u>30.27</u>				<u>3.22</u>

Sample Identification: B-109-S-0

Radium-226	1.8±0.3	0.67	0.05	0.04	0.76	16.02	-	0.06	1.32	1.38
Radium-228	0.84±0.18	0.13	0.07	0.05	0.25	3.75	-	0.01	0.68	0.69
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.1±0.6	0.03	0.01	-	0.04	2.36	-	0.04	0.42	0.46
Uranium-235	0.24±0.08	0.00	-	-	0.01	0.46	-	0.01	0.07	0.08
Uranium-238	0.96±0.40	0.02	0.01	-	0.03	1.86	-	0.03	0.27	0.30
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.09</u>	<u>24.45</u>				<u>2.91</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-110-S-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	1.11±0.20	0.17	-	0.06	-	0.02	0.89
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.73±0.13	0.02	-	-	-	0.02	0.28
Uranium-235	0.10±0.05	-	-	-	-	-	-
Uranium-238	0.31±0.09	0.01	-	-	-	0.01	0.09
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total			0.35	7.15			1.31

Sample Identification: B-111-S-0

Radium-226	1.81±0.4	0.67	0.05	0.05	0.06	1.32	1.38
Radium-228	0.91±0.22	0.14	0.07	0.05	0.01	0.73	0.74
Strontium-90	0.19±0.08	-	-	-	-	-	-
Uranium-234	4.7±0.7	0.13	0.03	0.01	0.16	1.78	1.94
Uranium-235	0.51±0.22	0.01	-	-	0.02	0.16	0.18
Uranium-238	2.5±0.5	0.06	0.02	0.01	0.07	0.71	0.78
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.38±0.06	-	-	-	-	-	-
Total			1.29	37.78			5.02

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification:	Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (urem/yr)			Exposure to Lung (mrem/yr)		
			D	Clearance Rate W	Total	D	M	Clearance Rate Y
Sample Identification: B-112-S-0								
	Radium-226	< 0.5	-	-	-	-	-	-
	Radium-228	0.63±0.16	0.10	0.05	0.19	-	0.51	0.52
	Strontium-90	< 0.03	-	-	-	-	-	-
	Uranium-234	3.2±0.6	0.09	0.02	0.12	6.88	1.22	1.32
	Uranium-235	0.38±0.22	0.01	-	0.01	0.74	0.12	0.13
	Uranium-238	1.2±0.4	0.03	0.01	0.04	2.33	0.34	0.38
	Thorium-228	< 0.05	(a)	-	-	-	-	-
	Thorium-230	< 0.05	(a)	-	-	-	-	-
	Thorium-232	< 0.05	(a)	-	-	-	-	-
	Cesium-137	0.53±0.06	-	-	-	0.12	-	-
	Total				0.36	12.89		2.35
Sample Identification: B-113-S-0								
	Radium-226	< 0.5	-	-	-	-	-	-
	Radium-228	0.72±0.16	0.11	0.06	0.21	3.22	0.58	0.59
	Strontium-90	< 0.03	-	-	-	-	-	-
	Uranium-234	0.61±0.08	0.02	-	0.02	1.31	0.23	0.25
	Uranium-235	< 0.05	-	-	-	-	-	-
	Uranium-238	0.29±0.06	0.01	-	0.01	0.56	0.08	0.09
	Thorium-226	< 0.05	(a)	-	-	-	-	-
	Thorium-230	< 0.05	(a)	-	-	-	-	-
	Thorium-232	< 0.05	(a)	-	-	-	-	-
	Cesium-137	0.36±0.05	-	-	-	0.08	-	-
	Total				0.24	5.17		0.93

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-114-5-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.47±0.11	0.07	0.04	0.03	-	0.38	-
Strontium-90	< 0.03	-	-	-	-	-	0.39
Uranium-234	0.30±0.04	0.01	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	0.11	-
Uranium-238	0.11±0.06	-	-	-	-	-	0.12
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	0.03	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total							0.54

Sample Identification: B-115-5-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	1.3±0.2	0.48	0.04	0.03	-	0.95	1.00
Radium-228	0.66±0.13	0.10	0.05	0.04	-	0.53	0.54
Strontium-90	0.12±0.05	-	-	-	-	-	-
Uranium-234	0.85±0.34	0.02	0.01	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	0.32	0.35
Uranium-238	0.80±0.35	0.02	-	-	-	-	-
Thorium-228	0.06±0.03	(a)	0.02	-	-	0.23	0.25
Thorium-230	0.06±0.04	(a)	0.10	-	(a)	0.06	0.07
Thorium-232	0.10±0.06	(a)	0.18	0.07	(a)	0.02	0.02
Cesium-137	0.18±0.03	(a)	-	-	(a)	0.04	0.04
Total							2.27

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-116-5-0

Type of Analytes	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.55±0.15	0.08	0.04	0.03	0.15	-	0.01	0.44	0.45
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	4.9±0.8	0.14	0.04	0.01	0.19	-	0.16	1.86	2.02
Uranium-235	0.14±0.07	-	-	-	-	-	-	0.04	0.04
Uranium-238	1.2±1.0	0.03	0.01	-	0.04	-	0.04	0.34	0.38
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	0.16±0.07	(a)	0.26	0.10	0.36	-	-	0.05	0.05
Thorium-232	0.18±0.07	(a)	0.33	0.12	0.45	-	-	0.07	0.07
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total		-	-	-	1.19	-	-	-	3.01

Sample Identification: B-117-5-0

Radium-226	4.0±0.4	1.45	0.11	0.10	1.70	-	0.14	2.93	3.07
Radium-228	0.76±0.16	0.12	0.06	0.04	0.22	-	0.01	0.61	0.62
Strontium-90	0.28±0.10	-	-	-	-	-	-	-	-
Uranium-234	0.89±0.32	0.02	0.01	-	0.03	-	0.03	0.34	0.37
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.31±0.20	0.01	-	-	0.01	-	0.01	0.09	0.10
Thorium-228	0.20±0.10	(a)	0.08	0.01	0.09	-	0.03	0.10	0.22
Thorium-230	0.17±0.10	(a)	0.27	0.10	0.37	-	-	0.05	0.05
Thorium-232	0.16±0.10	(a)	0.29	0.11	0.40	-	-	0.06	0.06
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total		-	-	-	2.82	-	-	-	4.49

(a) ICRP 30 classifies thorium compounds as Y and W type.

TABLE C-9

Sample Identification: B-118-5-0

Type of Analysis	Activity (pci/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate Y	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	28±2	0.78	0.08	1.06	0.01	10.63	11.56
Uranium-235	0.17±0.09	-	-	0.33	-	0.05	0.05
Uranium-238	2.0±0.9	0.05	-	0.06	-	0.57	0.63
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>1.12</u>		<u>12.24</u>	

Sample Identification: B-119-5-0

Type of Analysis	Activity (pci/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate Y	Total	D	Clearance Rate Y	Total
Radium-226	0.5±0.1	0.19	0.01	0.21	-	0.37	0.39
Radium-228	0.80±0.19	0.12	0.05	0.23	-	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	30±2	0.83	0.09	1.14	0.01	11.39	12.39
Uranium-235	0.19±0.09	-	-	0.37	-	0.06	0.06
Uranium-238	2.8±1.1	0.07	0.01	0.10	-	0.80	0.83
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.18±0.08	(a)	0.11	0.40	-	0.06	0.06
Thorium-232	0.06±0.04	(a)	0.04	0.15	(a)	0.02	0.02
Cesium-137	< 0.08	-	-	-	(a)	-	-
Total				<u>2.23</u>		<u>14.45</u>	

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-9

Sample Identification: B-120-5-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	W	Total	D	W	Total
Radium-226	0.7±0.1	0.26	0.02	0.30	-	0.02	0.51
Radium-228	0.70±0.19	0.11	0.06	0.21	-	0.01	0.56
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	26±2	0.72	0.19	0.99	0.01	0.86	9.87
Uranium-235	1.2±0.4	0.03	0.01	0.04	-	0.04	0.37
Uranium-238	2.7±0.6	0.07	0.02	0.10	-	0.08	0.77
Thorium-228	0.05±0.03	(a)	0.02	0.02	(a)	0.01	0.05
Thorium-230	0.08±0.04	(a)	0.13	0.18	(a)	-	0.02
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total				<u>1.84</u>			<u>13.18</u>

Sample Identification: B-121-5-0

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	W	Total	D	W	Total
Radium-226	23.6±1.2	8.82	0.67	10.07	0.03	0.86	17.29
Radium-228	0.63±0.19	0.10	0.05	0.19	-	0.01	0.51
Strontium-90	0.07±0.05	-	-	-	-	-	-
Uranium-234	44±2	1.22	0.32	1.67	0.02	1.45	16.71
Uranium-235	1.4±1.0	0.04	0.01	0.05	-	0.04	0.43
Uranium-238	0.87±0.79	0.02	-	0.02	-	0.02	0.25
Thorium-228	0.07±0.04	(a)	0.03	0.03	(a)	0.01	0.07
Thorium-230	0.48±0.09	(a)	0.77	1.06	(a)	0.02	0.15
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	(a)	-	-
Total				<u>13.09</u>			<u>37.87</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-001-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate W	Clearance Rate Y	Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	2.7±0.4	1.01	0.08	0.07	1.16	24.03	-	0.10	1.98	2.08
Radium-228	1.13±0.20	0.17	0.09	0.08	0.34	5.05	-	0.02	0.91	0.93
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.46±0.24	0.04	0.01	-	0.05	3.14	-	9.95	0.55	0.60
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.95±0.32	0.02	0.01	-	0.03	1.84	-	9.03	0.27	0.30
Thorium-228	0.09±0.04	(a)	0.04	0.01	0.05	0.03	(a)	0.01	0.09	0.10
Thorium-230	0.19±0.06	(a)	0.31	0.12	0.43	0.38	(a)	0.01	0.06	0.07
Thorium-232	0.13±0.05	(a)	0.24	0.09	0.33	0.27	(a)	-	0.05	0.05
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>2.39</u>	<u>34.74</u>				<u>5.13</u>

Sample Identification: B-002-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	1.18±0.21	0.18	0.10	0.07	0.35	5.27	-	0.02	0.95	0.97
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.66±0.15	0.02	-	-	0.02	1.42	-	0.02	0.25	0.27
Uranium-235	0.22±0.09	-	-	-	-	0.43	-	0.01	0.07	0.08
Uranium-238	0.69±0.16	0.02	-	-	0.02	1.34	-	0.02	0.20	0.22
Thorium-228	0.10±0.05	(a)	0.04	0.01	0.05	0.04	(a)	0.01	0.10	0.11
Thorium-230	0.06±0.04	(a)	0.10	0.04	0.14	0.12	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.09±0.02	-	-	-	-	0.02	-	-	-	-
Total					<u>0.58</u>	<u>8.64</u>				<u>1.67</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-003-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	Clearance Rate M	Y	Total	D	W	Y	Total
Radium-226	0.9±0.3	0.34	0.02	0.02	0.38	-	0.03	0.67	0.70
Radium-228	< 0.1	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	7.60±1.73	0.21	0.06	0.02	0.29	-	0.25	2.88	3.13
Uranium-235	0.77±0.53	0.02	-	-	0.02	-	0.02	0.24	0.26
Uranium-238	5.13±1.38	0.13	0.03	0.01	0.17	-	0.15	1.46	1.61
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	0.06±0.03	(a)	0.11	0.04	0.15	(a)	-	0.02	0.02
Cesium-137	0.32±0.06	-	-	-	-	(a)	-	-	-
Total					1.01				5.72

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	Clearance Rate M	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.46±0.18	0.07	0.04	0.03	0.14	-	0.01	0.04	0.05
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.28±0.06	0.01	-	-	0.01	-	0.01	0.11	0.12
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.08±0.03	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	0.02	0.02
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.17±0.04	-	-	-	-	-	-	-	-
Total					0.15				0.19

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10
 ERATA SHEET
 P. C-132
 B-006-S-6

SAMPLE IDENTIFICATION: B-006-S-6

TYPE OF ANALYSIS	ACTIVITY (pCi/g dry)	EXPOSURE TO BONE (mrem/yr)					EXPOSURE TO LUNG (mrem/yr)			
		CLEARANCE RATE					CLEARANCE RATE			
		D	W	Y	TOTAL	INGESTION	D	W	Y	TOTAL
Radium-226	1.7+0.2	0.63	0.05	0.04	0.72	15.13	-	0.06	1.24	1.30
Radium-228	0.89+0.21	0.14	0.07	0.05	0.26	3.98	-	0.01	0.72	0.73
Strontium-90	0.04+0.01	-	-	-	-	0.35	-	-	-	-
Uranium-234	0.34+0.09	-	-	-	-	0.73	-	-	0.13	0.13
Uranium-235	< 0.5	-	-	-	-	-	-	-	-	-
Uranium-238	0.18+0.07	-	-	-	-	0.35	-	-	0.05	0.05
Thorium-228	0.05+0.03	(a)	0.02	-	0.02	0.02	(a)	-	0.05	0.05
Thorium-230	0.24+0.08	(a)	0.39	0.14	0.53	0.48	(a)	-	0.08	0.08
Thorium-232	0.12+0.06	(a)	0.22	0.08	0.30	0.25	(a)	-	0.04	0.04
Cesium-137	0.40+0.01	-	-	-	-	-	-	-	-	-
Total					1.83	21.29				2.43

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-007-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.52±0.16	0.08	0.04	0.03	0.15	-	-	0.42	0.42
Strontium-90	0.17±0.13	-	-	-	-	-	-	-	-
Uranium-234	1.72±0.36	0.05	0.01	-	0.06	-	0.06	0.65	0.71
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.25±0.05	-	-	-	-	-	-	0.07	0.07
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	0.05±0.04	(a)	0.08	0.03	0.11	-	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	0.37±0.05	(a)	-	-	-	-	-	-	-
Total					0.32				1.22

Sample Identification: B-008-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	1.40±0.63	0.04	0.01	-	0.05	-	0.05	0.53	0.58
Uranium-235	0.59±0.41	0.02	-	-	0.02	-	0.02	0.18	0.20
Uranium-238	1.40±0.63	0.04	0.01	-	0.05	-	0.04	0.40	0.44
Thorium-228	0.06±0.03	(a)	0.02	-	0.02	-	0.01	0.06	0.07
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	0.24±0.04	(a)	-	-	-	-	-	-	-
Total					0.14				1.29

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-009-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.57±0.17	0.09	0.04	0.03	0.16	-	0.01	0.46	0.47
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.96±0.28	0.03	0.01	-	0.04	-	0.03	0.36	0.39
Uranium-235	0.13±0.10	-	-	-	-	-	-	0.04	0.04
Uranium-238	0.84±0.26	0.02	0.01	-	0.03	-	0.02	0.24	0.26
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.24±0.04	-	-	-	-	-	-	-	-
Total					0.23				1.16

Sample Identification: B-010-S-6

Radium-226	1.8±0.40	0.67	0.05	0.04	0.76	-	0.06	1.32	1.38
Radium-228	0.68±0.21	0.10	0.05	0.04	0.19	-	0.01	0.55	0.56
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	1.01±0.26	0.03	-	-	0.03	-	0.03	0.38	0.41
Uranium-235	0.20±0.11	-	-	-	-	-	-	0.06	0.06
Uranium-238	0.55±0.26	0.01	-	-	0.01	-	0.02	0.16	0.18
Thorium-228	0.05±0.04	(a)	0.02	-	0.02	-	-	0.05	0.05
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.21±0.04	-	-	-	-	-	-	-	-
Total					1.01				2.64

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-011-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.90±0.51	0.05	0.01	-	0.06	0.72	0.78
Uranium-235	0.32±0.21	-	-	-	0.01	0.10	0.11
Uranium-238	0.56±0.04	-	-	-	0.02	0.16	0.18
Thorium-228	0.06±0.04	0.01	0.02	-	0.01	0.06	0.07
Thorium-230	0.18±0.12	(a)	0.29	0.11	-	0.06	0.06
Thorium-232	0.27±0.15	(a)	0.49	0.13	(a)	0.06	0.10
Cesium-137	0.21±0.05	(a)	-	-	-	0.10	-
Total				<u>1.16</u>			<u>1.30</u>

Sample Identification: B-012-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.48±0.18	0.07	0.04	0.03	0.01	0.39	0.40
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.72±0.36	0.05	0.01	-	0.06	0.65	0.71
Uranium-235	0.12±0.09	-	-	-	-	0.04	0.04
Uranium-238	0.36±0.17	-	-	-	-	0.10	0.11
Thorium-226	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.26±0.05	(a)	-	-	(a)	-	-
Cesium-137		-	-	-	-	-	-
Total				<u>0.20</u>			<u>1.26</u>

(a) ICRP-30 classifies thorium compounds as Y and H type.

TABLE C-10

Sample Identification: B-013-5-6

Type of Analysis	Activity (pci/q dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Total
Radium-226	14.1±0.9	5.27	0.40	0.35	6.02	125.49	0.02	0.51	10.33	10.86
Radium-228	< 0.1	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.51±0.14	0.01	-	-	0.01	1.10	-	0.02	0.19	0.21
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.21±0.09	-	-	-	-	0.41	-	0.01	0.06	0.07
Thorium-228	0.10±0.03	(a)	0.04	0.01	0.05	0.04	(a)	0.01	0.10	0.11
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.43±0.07	-	-	-	-	0.10	-	-	-	-
Total					6.08	127.14				11.25

Sample Identification: B-015-5-6

Radium-226	1.1±0.3	0.41	0.03	0.03	0.47	9.79	-	0.04	0.80	0.84
Radium-228	0.79±0.21	0.12	0.06	0.05	0.23	3.53	-	0.01	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.79±0.22	0.02	-	-	0.02	1.70	-	0.03	0.30	0.33
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	0.16±0.03	-	-	-	-	0.31	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.07±0.03	(a)	0.11	0.04	0.15	0.14	(a)	-	0.02	0.02
Thorium-232	0.13±0.07	(a)	0.24	0.09	0.33	0.27	(a)	-	0.05	0.05
Cesium-137	0.38±0.05	(a)	-	-	-	0.09	(a)	-	-	-
Total					1.20	15.83				1.89

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-016-S-5

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	2.6±0.5	0.97	0.07	0.06	1.10	23.14	-	0.09	1.90	1.99
Radium-228	0.54±0.24	0.08	0.04	0.03	0.15	2.41	-	0.01	0.44	0.45
Strontium-90	0.29±0.11	-	-	-	-	2.54	-	-	-	-
Uranium-234	4.41±0.94	0.12	0.03	0.01	0.16	9.48	-	0.14	1.67	1.81
Uranium-235	0.62±0.35	0.02	-	-	0.02	1.20	-	0.02	0.19	0.21
Uranium-238	1.19±0.49	0.03	0.01	-	0.04	2.31	-	0.03	0.34	0.37
Thorium-228	0.07±0.03	(a)	0.03	-	0.03	0.03	(a)	0.01	0.07	0.08
Thorium-230	0.10±0.03	(a)	0.16	0.06	0.22	0.20	(a)	-	0.03	0.03
Thorium-232	0.05±0.02	(a)	0.09	0.03	0.12	0.10	(a)	-	0.02	0.02
Cesium-137	0.29±0.07	-	-	-	-	0.07	-	-	-	-
Total					<u>1.84</u>	<u>41.48</u>				<u>4.96</u>

Sample Identification: B-017-S-6

Radium-226	< 0.05	-	-	-	-	-	-	-	-	-
Radium-228	0.80±0.25	0.12	0.06	0.05	0.23	3.58	-	0.01	0.64	0.65
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	2.01±0.29	0.05	0.01	-	0.06	4.32	-	0.07	0.76	0.83
Uranium-235	0.24±0.10	-	-	-	-	0.46	-	0.01	0.07	0.08
Uranium-238	1.10±0.21	0.03	-	-	0.03	2.13	-	0.03	0.31	0.34
Thorium-228	0.05±0.03	(a)	0.02	-	0.02	0.02	(a)	-	0.05	0.05
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>0.34</u>	<u>10.51</u>				<u>1.95</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-018-S-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	W	Y	Clearance Rate Y
Radium-226	0.94±0.29	0.35	0.03	0.02	0.40	6.37	-	0.03	0.69	0.72
Radium-228	1.00±0.22	0.15	0.08	0.06	0.29	4.47	-	0.01	0.80	0.81
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.79±0.29	0.05	0.01	-	0.06	3.85	-	0.06	0.68	0.74
Uranium-235	0.18±0.11	-	-	-	-	0.35	-	-	0.06	0.06
Uranium-238	0.95±0.29	0.02	-	-	0.02	1.84	-	0.03	0.27	0.30
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-232	0.05±0.03	(a)	0.09	0.03	0.12	-	-	-	0.02	0.02
Cesium-137	0.13±0.03	(a)	-	-	-	-	-	-	-	-
Total					0.89	19.01				2.65

Sample Identification: B-019-S-6

Radium-226	1.71±0.38	0.64	0.05	0.04	0.73	15.22	-	0.06	1.25	1.31
Radium-228	0.62±0.23	0.10	0.05	0.04	0.19	2.77	-	0.01	0.50	0.51
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.96±0.40	0.05	0.01	0.01	0.07	4.21	-	0.06	0.74	0.80
Uranium-235	0.28±0.16	0.01	-	-	0.01	0.54	-	-	0.09	0.09
Uranium-238	1.26±0.32	0.03	0.01	-	0.04	2.44	-	0.04	0.36	0.40
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-
Cesium-137	0.31±0.05	-	-	-	-	0.07	-	-	-	-
Total					1.04	25.25				3.11

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-020-5-6

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	8.3±0.6	3.10	0.23	0.20	3.53	0.01	0.30	6.03	6.39
Radium-228	0.67±0.17	0.10	0.05	0.04	0.19	-	0.01	0.54	0.55
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Branium-234	0.46±0.05	0.01	-	-	0.01	-	0.02	0.17	0.19
Branium-235	0.06±0.02	0.02	-	-	0.02	-	-	0.02	0.02
Branium-238	0.14±0.03	-	-	-	-	-	-	0.04	0.04
Thorium-228	0.06±0.03	(a)	0.02	-	0.02	(a)	0.01	0.06	0.07
Thorium-230	0.14±0.05	(a)	0.22	0.03	0.30	(a)	-	0.04	0.04
Thorium-232	0.07±0.03	(a)	0.13	0.05	0.18	(a)	-	0.03	0.03
Cesium-137	0.33±0.04	-	-	-	-	-	-	-	-
Total					4.25				7.33

Sample Identification: B-020-A-5-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Branium-234	3.33±0.44	0.09	0.02	0.01	0.12	-	0.11	1.26	1.37
Branium-235	0.32±0.13	0.01	-	-	0.01	-	0.01	0.10	0.11
Branium-238	0.68±0.20	0.02	-	-	0.02	-	0.02	0.19	0.21
Thorium-228	0.05±0.03	(a)	0.02	-	0.02	(a)	0.01	0.05	0.06
Thorium-230	0.25±0.08	(a)	0.40	0.15	0.55	(a)	0.01	0.08	0.09
Thorium-232	0.13±0.06	(a)	0.24	0.09	0.33	(a)	-	0.05	0.05
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					1.05				1.89

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-020-B-5-6

Type of Analysis	Activity ($\mu\text{Ci/g dry}$)	Exposure to Bone ($\mu\text{rem/yr}$)			Exposure to Lung ($\mu\text{rem/yr}$)		
		D	Clearance Rate $\frac{M}{V}$	Total	D	Clearance Rate $\frac{Y}{V}$	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.37±0.19	0.06	0.03	0.11	-	0.30	0.30
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	1.76±0.30	0.05	0.01	0.06	-	0.67	0.73
Branium-235	0.10±0.07	-	-	-	-	0.03	0.03
Branium-238	0.82±0.20	-	-	0.02	-	0.23	0.25
Thorium-228	0.09±0.05	0.02	-	0.02	-	0.09	0.10
Thorium-230	0.07±0.05	(a)	0.04	0.15	(a)	0.02	0.02
Thorium-232	0.03±0.05	(a)	0.15	0.20	(a)	0.03	0.03
Cesium-137	0.10±0.03	-	-	-	-	-	-
Total				0.61		1.46	1.46

Sample Identification: B-021-5-6

Radium-226	5.7±0.8	2.13	0.16	2.43	-	4.18	4.39
Radium-228	0.45±0.23	0.07	0.04	0.14	-	0.36	0.36
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	7.51±0.70	0.21	0.05	0.28	-	2.85	3.10
Branium-235	0.89±0.24	0.02	-	0.02	-	0.27	0.30
Branium-238	1.18±0.28	0.03	0.01	0.04	-	0.34	0.37
Thorium-228	0.05±0.03	(a)	0.02	0.02	(a)	0.05	0.05
Thorium-230	0.12±0.05	(a)	0.19	0.26	(a)	0.04	0.04
Thorium-232	0.05±0.04	(a)	0.09	0.12	(a)	0.02	0.02
Cesium-137	< 0.08	-	-	-	-	-	-
Total				3.31		8.63	8.63

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-022-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M Y	Total	D	M	Clearance Rate Y Total
Radium-226	1.2±0.3	0.45	0.03	0.51	-	0.04	0.88
Radium-228	0.20±0.13	0.03	0.01	0.05	-	-	0.16
Strontium-90	0.16±0.16	-	-	-	-	-	-
Uranium-234	2.98±0.99	0.08	0.02	0.10	-	0.10	1.13
Uranium-235	0.47±0.22	0.01	-	0.01	-	0.01	0.15
Uranium-238	0.91±0.23	0.02	-	0.02	-	0.03	0.29
Thorium-228	0.05±0.04	(a)	0.02	0.02	(a)	-	0.05
Thorium-230	0.11±0.08	(a)	0.18	0.25	(a)	-	0.04
Thorium-232	0.28±0.15	(a)	0.51	0.70	(a)	-	0.11
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	1.66	-	-	2.95

Sample Identification: B-023-5-6

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.00±0.29	0.03	0.01	0.04	-	0.03	0.41
Uranium-235	0.12±0.03	-	-	-	-	-	0.04
Uranium-238	0.22±0.10	-	-	-	-	-	0.06
Thorium-228	0.05±0.03	(a)	0.02	0.02	(a)	0.01	0.05
Thorium-230	0.09±0.04	(a)	0.14	0.19	(a)	0.01	0.06
Thorium-232	< 0.05	(a)	-	-	(a)	-	0.03
Cesium-137	< 0.03	-	-	-	-	-	-
Total		-	-	0.25	-	-	0.61

(a) ICRP-30 classifies thorium compounds as Y and M type.

Sample Identification: B-024-S-6

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrcu/yr)			Exposure to Lung (µrem/yr)		
		D	Clearance Rate M Y	Total	D	Clearance Rate M Y	Total
Radium-226	170±3	63.51	4.31	72.54	0.21	124.54	130.92
Radium-228	0.98±0.25	0.15	0.03	0.29	-	0.79	0.80
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	119±4	3.31	0.37	4.52	0.06	45.18	49.17
Uranium-235	52.6±1.2	1.39	0.37	1.91	0.03	16.18	17.83
Uranium-238	5.05±1.05	-	0.03	0.17	-	1.44	1.59
Thorium-228	0.17±0.07	(a)	0.07	0.08	(a)	0.16	0.18
Thorium-230	1.79±0.23	(a)	2.88	3.97	(a)	0.58	0.64
Thorium-232	0.10±0.06	(a)	0.18	0.25	(a)	0.04	0.06
Cesium-137	< 0.08	-	-	-	-	-	-
Total				83.73			201.19

Sample Identification: B-025-S-6

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrcu/yr)			Exposure to Lung (µrem/yr)		
		D	Clearance Rate M Y	Total	D	Clearance Rate M Y	Total
Radium-226	4.6±0.6	1.72	0.13	1.96	-	3.37	3.54
Radium-228	1.0±0.2	0.15	0.08	0.29	-	0.81	0.82
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.86±0.18	0.02	-	0.02	-	0.33	0.36
Uranium-235	0.07±0.05	-	-	-	-	0.02	0.02
Uranium-238	0.17±0.08	-	-	-	-	0.05	0.05
Thorium-228	0.05±0.05	(a)	0.02	0.02	(a)	0.05	0.05
Thorium-230	0.09±0.04	(a)	0.13	0.18	(a)	0.03	0.03
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				2.47			4.87

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-026-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	D	Clearance Rate		Total
			W	Y			W	Y	
Radium-226	< 0.5	0.09	0.05	0.04	0.18	-	0.01	0.49	0.50
Radium-228	0.61±0.24	-	-	0.04	0.18	-	-	-	-
Strontium-90	0.03	-	-	-	0.02	-	0.02	0.23	0.25
Uranium-234	0.61±0.15	0.02	-	-	0.02	-	-	-	-
Uranium-235	0.05	-	-	-	-	-	-	-	-
Uranium-238	0.23±0.09	-	-	-	0.02	-	0.01	0.06	0.07
Thorium-228	0.05±0.03	(a)	0.02	-	0.02	-	0.01	0.05	0.06
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total		-	-	-	0.22	-	-	-	0.88

Sample Identification: B-027-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	D	Clearance Rate		Total
			W	Y			W	Y	
Radium-226	58.3±1.8	21.78	1.65	1.45	23.88	0.07	2.12	42.71	44.9
Radium-228	0.81±0.21	0.12	0.06	0.05	0.23	-	0.01	0.65	0.66
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	25.5±1.7	0.71	0.19	0.07	0.97	0.01	0.84	9.68	10.53
Uranium-235	0.83±0.44	0.02	-	-	0.02	-	0.02	0.25	0.27
Uranium-238	1.13±0.36	0.03	0.01	-	0.04	-	0.03	0.32	0.35
Thorium-228	0.06±0.04	(a)	0.02	-	0.02	(a)	0.01	0.06	0.07
Thorium-230	0.86±0.16	(a)	1.38	0.58	1.96	(a)	0.03	0.31	0.34
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total		-	-	-	28.12	-	-	-	57.12

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-028-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	1088±9	406.48	30.79	464.25	1.36	797.07	837.87
Radium-228	1.03±0.30	0.17	0.09	0.32	-	0.87	0.89
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	3409±116	91.99	24.16	125.17	1.69	1255.43	1367.32
Uranium-235	15.9±9.2	0.42	0.11	0.57	-	4.89	5.38
Uranium-238	3.83±0.46	0.10	0.02	0.13	-	1.09	1.20
Thorium-228	0.12±0.06	(a)	0.05	0.05	(a)	0.12	0.14
Thorium-230	8.29±0.46	(a)	13.34	18.37	(a)	2.69	2.96
Thorium-232	0.29±0.09	(a)	0.53	0.73	(a)	0.11	0.11
Cesium-137	0.58±0.09	-	-	-	-	-	-
Total	-	-	-	609.59	-	-	2215.97

Sample Identification: B-029-5-6

Radium-226	4.4±0.6	1.64	0.12	1.87	-	3.22	3.38
Radium-228	1.83±0.29	0.29	0.15	0.55	-	1.51	1.54
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	3.44±0.45	0.10	0.02	0.13	-	1.31	1.42
Uranium-235	0.42±0.37	0.01	-	0.01	-	0.13	0.14
Uranium-238	3.59±0.45	0.09	0.02	0.12	-	1.02	1.12
Thorium-228	0.12±0.06	(a)	0.05	0.06	(a)	0.12	0.14
Thorium-230	0.10±0.06	(a)	0.16	0.22	(a)	0.03	0.03
Thorium-232	0.16±0.07	(a)	0.29	0.40	(a)	0.06	0.06
Cesium-137	0.19±0.04	-	-	-	-	-	-
Total	-	-	-	3.36	-	-	7.83

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-030-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	18±1	6.72	0.51	0.45	0.02	0.65	13.19
Radium-228	1.38±0.21	0.21	0.11	0.08	-	0.02	1.11
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	8.41±1.25	0.23	0.06	0.02	-	0.28	3.19
Uranium-235	2.98±0.76	0.08	0.02	0.01	-	0.09	0.92
Uranium-238	1.36±0.79	0.03	0.01	-	-	0.04	0.39
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		8.54			192.87		19.9

Sample Identification: B-031-5-6

Radium-226	34±1	12.70	0.96	0.84	0.04	1.23	24.91
Radium-228	1.37±0.24	0.21	0.11	0.08	-	0.02	1.10
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	26.3±2.9	0.73	0.19	0.08	0.01	0.87	9.99
Uranium-235	3.50±0.73	0.09	0.02	-	-	0.11	1.03
Uranium-238	1.43±0.87	0.04	-	-	-	0.04	0.41
Thorium-228	0.08±0.04	(a)	0.03	-	(a)	0.01	0.08
Thorium-230	0.36±0.09	(a)	0.58	0.22	(a)	0.01	0.12
Thorium-232	0.20±0.07	(a)	1.83	0.14	(a)	0.01	0.08
Cesium-137	0.45±0.06	-	-	-	-	-	-
Total		18.85			376.08		40.11

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-032-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	0.9±0.3	0.34	0.02	0.02	0.38	8.01	-	0.03	0.67	0.70
Radium-228	0.35±0.20	0.05	0.03	0.02	0.10	1.56	-	-	0.28	0.28
Strontium-90	0.21±0.10	-	-	-	-	1.84	-	-	-	-
Uranium-234	3.49±0.50	0.10	0.02	0.01	0.13	7.50	-	0.12	1.32	1.44
Uranium-235	0.24±0.14	0.01	-	-	0.01	0.46	-	0.01	0.07	0.08
Uranium-238	0.94±0.26	0.02	0.01	-	0.03	1.82	-	0.03	0.23	0.26
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.11±0.06	(a)	0.18	0.07	0.25	0.22	(a)	-	0.04	0.04
Thorium-232	0.14±0.08	(a)	0.26	0.10	0.36	0.29	(a)	-	0.05	0.05
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.26</u>	<u>21.70</u>				<u>2.85</u>

Sample Identification: B-033-S-6

Radium-226	13.8±0.8	5.16	0.39	0.34	5.89	122.82	0.02	0.50	10.11	10.63
Radium-228	1.38±0.2	0.21	0.11	0.08	0.40	6.17	-	0.02	1.11	1.13
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	12.4±7.8	0.34	0.09	0.04	0.47	26.66	-	0.41	4.71	5.12
Uranium-235	115±0.24	-	0.01	-	0.01	2.23	-	0.03	0.35	0.38
Uranium-238	2.16±0.33	0.06	0.01	-	0.07	4.19	-	0.06	0.62	0.68
Thorium-228	> 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	> 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>6.84</u>	<u>162.07</u>				<u>17.94</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-034-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	2.41±0.41	0.90	0.07	1.03	-	1.76	1.85
Radium-228	0.79±0.17	0.12	0.06	0.23	-	0.04	0.65
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	4.89±0.69	0.14	0.04	0.19	-	1.86	2.02
Uranium-235	0.77±0.28	0.02	-	0.02	-	0.24	0.26
Uranium-238	1.16±0.33	0.03	-	0.03	-	0.33	0.36
Thorium-228	0.22±0.07	(a)	0.09	0.10	(a)	0.21	0.24
Thorium-230	0.36±0.09	(a)	0.58	0.80	(a)	0.12	0.14
Thorium-232	0.19±0.06	(a)	0.35	0.48	(a)	0.07	0.07
Cesium-137	< 0.08	-	-	-	-	-	-
Total				2.98		5.59	5.59

Sample Identification: B-035-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	271±2	101.24	7.67	115.63	0.34	198.53	208.71
Radium-228	5.44±0.37	0.84	0.44	1.6	-	4.38	4.46
Strontium-90	0.58±0.08	-	-	-	-	-	-
Uranium-234	132±5	3.98	1.04	5.43	0.07	54.30	59.09
Uranium-235	13.8±1.5	0.36	0.10	0.50	0.01	4.25	4.68
Uranium-238	7.04±1.05	0.18	0.05	0.25	-	2.00	2.21
Thorium-228	0.15±0.07	(a)	0.06	0.07	(a)	0.14	0.16
Thorium-230	0.76±0.16	(a)	1.22	1.68	(a)	0.24	0.26
Thorium-232	0.15±0.07	(a)	0.27	0.37	(a)	0.06	0.06
Cesium-137	3.25±0.13	-	-	-	-	-	-
Total				125.53		279.63	279.63

(a) ICIP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-036-S-6

Type of Analysis	Activity (pci/q dry)	Exposure to Bone (urem/yr)				Exposure to Lung (urem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	31.4±1.0	11.73	0.89	0.78	13.40	0.04	1.14	23.00	24.18
Radium-228	1.03±0.19	0.17	0.09	0.06	0.32	-	0.02	0.87	0.89
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	17.9±1.3	0.50	0.13	0.05	0.68	0.01	0.59	6.80	7.40
Uranium-235	1.60±0.38	0.04	0.01	-	0.05	-	0.05	0.49	0.54
Uranium-238	0.72±0.26	0.02	-	-	0.02	-	0.02	0.20	0.22
Thorium-228	0.10±0.04	(a)	0.04	0.01	0.05	(a)	0.01	0.10	0.11
Thorium-230	0.36±0.08	(a)	0.58	0.22	0.70	(a)	0.01	0.12	0.13
Thorium-232	0.07±0.04	(a)	0.13	0.05	0.18	(a)	-	0.03	0.03
Cesium-137	0.22±0.03	-	-	-	-	-	-	-	-
Total		15.40			15.40	0.01			33.67

Sample Identification: B-037-S-6

Radium-226	9.1±0.7	3.40	0.26	0.22	3.88	0.01	0.33	6.67	7.01
Radium-228	1.09±0.21	0.17	0.09	0.06	0.32	-	0.02	0.87	0.89
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	4.56±0.62	0.13	0.03	0.01	0.17	-	0.15	1.73	1.88
Uranium-235	0.72±0.25	0.02	-	-	0.02	-	0.02	0.22	0.24
Uranium-238	0.90±0.28	0.02	0.01	-	0.03	-	0.03	0.26	0.29
Thorium-228	0.10±0.04	(a)	0.04	0.01	0.05	(a)	0.01	0.10	0.11
Thorium-230	0.10±0.08	(a)	0.16	0.06	0.22	(a)	-	0.03	0.03
Thorium-232	< 0.05	-	-	-	-	(a)	-	-	-
Cesium-137	0.23±0.04	-	-	-	-	-	-	-	-
Total		4.69			4.69	0.01			10.45

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-038-5-6

Type of Analyte	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	H	Y	Clearance Rate Y
Radium-226	5.9±0.4	2.20	0.17	0.15	2.52	52.51	-	0.21	4.32	4.53
Radium-228	0.24±0.10	0.04	0.02	0.01	0.07	1.07	-	-	0.19	0.19
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	5.80±0.61	0.16	0.04	0.01	0.21	12.47	-	0.19	2.20	2.39
Uranium-235	2.79±0.61	0.07	0.01	-	0.08	5.41	-	0.08	0.86	0.94
Uranium-238	1.46±0.49	0.04	-	-	0.04	2.83	-	0.04	0.41	0.45
Thorium-228	0.06±0.03	(a)	0.02	-	0.02	0.02	-	-	-	-
Thorium-230	0.19±0.08	(a)	0.30	0.12	0.42	0.38	-	-	0.06	0.06
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-
Cesium-137	0.47±0.05	(a)	-	-	-	0.11	-	-	-	-
Total					3.36	74.80				8.56

Sample Identification: B-039-5-6

Radium-226	1.3±1.0	0.48	0.04	0.03	0.55	11.57	-	0.05	0.95	1.00
Radium-228	1.17±0.23	0.18	0.09	0.07	0.34	5.23	-	0.02	0.94	0.96
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.47±0.14	0.01	-	-	0.01	1.01	-	0.01	0.18	0.19
Uranium-235	0.08±0.05	-	-	-	-	0.16	-	-	0.02	0.02
Uranium-238	0.09±0.01	-	-	-	-	0.17	-	-	0.02	0.02
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-	-
Thorium-232	0.13±0.10	(a)	0.24	0.09	0.33	0.27	-	-	0.05	0.05
Cesium-137	< 0.08	(a)	-	-	-	-	-	-	-	-
Total					1.23	18.41				2.24

(a) B RP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-042-S-6

Type of Analysis	Activity (pCi/g dry)	D	Exposure to Bone (mrem/yr)		D	W	Total	Exposure to Lung (mrem/yr)		Total
			Clearance Rate	Ingestion				Clearance Rate	Inhalation	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.74±0.17	0.11	0.06	0.04	-	0.01	0.21	0.60	0.61	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.05±0.03	(a)	0.08	0.03	(a)	-	0.11	0.02	0.02	-
Thorium-230	0.05±0.04	(a)	0.09	0.03	(a)	-	0.12	0.02	0.02	-
Thorium-232	1.15±0.07	(a)	-	-	(a)	-	0.26	-	-	-
Cesium-137	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	<u>0.44</u>	-	-	<u>0.65</u>

Sample Identification: B-043-S-6

Type of Analysis	Activity (pCi/g dry)	D	Exposure to Bone (mrem/yr)		D	W	Total	Exposure to Lung (mrem/yr)		Total
			Clearance Rate	Ingestion				Clearance Rate	Inhalation	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.79±0.23	0.12	0.06	0.05	-	0.01	0.23	0.64	0.65	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.20±0.07	(a)	0.32	0.12	(a)	0.01	0.44	0.06	0.07	-
Thorium-230	0.06±0.04	(a)	0.11	0.04	(a)	-	0.15	0.02	0.02	-
Thorium-232	0.41±0.06	(a)	-	-	(a)	-	0.09	-	-	-
Cesium-137	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	<u>0.82</u>	-	-	<u>0.74</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-044-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Clearance Rate Y	Total	Ingestion	D	W	Clearance Rate Y	Total
Radium-226	2.5±0.8	0.93	0.07	0.06	1.06	22.25	-	0.09	1.83	1.92
Radium-228	0.52±0.21	0.08	0.04	0.03	0.15	2.32	-	0.01	0.42	0.43
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.35±0.03	0.01	-	-	0.01	0.75	-	0.01	0.13	0.14
Uranium-235	0.10±0.06	-	-	-	-	0.19	-	-	0.03	0.03
Uranium-238	0.38±0.10	0.01	-	-	0.01	0.74	-	0.01	0.11	0.12
Thorium-228	0.09±0.05	(a)	0.04	-	0.04	0.03	(a)	0.01	0.07	0.10
Thorium-230	0.30±0.09	(a)	0.48	0.18	0.66	0.06	(a)	0.01	0.10	0.11
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.18±0.05	-	-	-	-	0.04	-	-	-	-
Total					<u>1.93</u>	<u>26.38</u>				<u>2.92</u>

Sample Identification: B-045-S-6

Radium-226	9.7±2.7	3.62	0.27	0.24	4.13	86.33	0.01	0.35	7.11	7.47
Radium-228	0.67±0.23	0.10	0.05	0.04	0.19	2.99	-	-	0.01	0.01
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	3.73±0.21	0.10	0.03	0.01	0.14	8.02	-	0.12	1.42	1.54
Uranium-235	0.67±0.09	0.02	-	-	0.02	1.30	-	0.02	0.21	0.23
Uranium-238	0.21±0.05	-	-	-	-	0.41	-	-	0.06	0.06
Thorium-228	0.05±0.03	(a)	0.02	-	0.02	0.02	(a)	-	0.05	0.05
Thorium-230	2.39±0.21	(a)	3.85	1.45	5.30	4.80	(a)	0.08	0.77	0.85
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	0.26±0.06	-	-	-	-	0.06	-	-	-	-
Total					<u>9.80</u>	<u>103.93</u>				<u>10.21</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-046-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	1.2±0.6	0.45	0.03	0.03	0.51	10.68	-	0.04	0.88	0.92
Radium-228	1.43±0.26	0.22	0.11	0.08	0.41	6.39	-	0.02	1.15	1.17
Strontium-90	0.05±0.03	-	-	-	-	0.44	-	-	-	-
Uranium-234	1.5±0.4	0.04	0.01	-	0.05	3.22	0.01	0.05	0.57	0.63
Uranium-235	0.30±0.19	0.01	-	-	0.01	0.58	-	0.02	0.09	0.11
Uranium-238	0.73±0.29	0.02	0.05	-	0.07	3.42	-	0.02	0.21	0.23
Thorium-228	0.12±0.05	(a)	0.05	0.01	0.06	0.04	(a)	0.02	0.11	0.13
Thorium-230	0.08±0.04	(a)	0.13	0.05	0.18	0.16	(a)	-	0.02	0.02
Thorium-232	0.15±0.06	(a)	0.27	0.10	0.37	0.31	(a)	-	0.06	0.06
Cesium-137	< 0.08	-	-	-	-	-	(a)	-	-	-
Total					<u>1.66</u>	<u>23.24</u>				<u>3.27</u>

Sample Identification: B-047-S-6

Radium-226	1.4±0.1	0.52	0.04	0.03	0.69	12.46	-	0.05	1.02	1.07
Radium-228	0.92±0.29	0.14	0.07	0.05	0.26	4.11	-	0.01	0.74	0.75
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.17±0.12	0.03	0.01	-	0.04	2.52	-	0.04	0.44	0.48
Uranium-235	0.21±0.05	-	-	-	-	0.41	-	0.01	0.06	0.07
Uranium-238	0.21±0.05	-	-	-	-	0.41	-	0.01	0.06	0.07
Thorium-228	0.05±0.04	(a)	0.02	-	0.02	0.02	(a)	0.01	0.05	0.06
Thorium-230	0.16±0.06	(a)	0.26	0.10	0.36	0.32	(a)	-	0.05	0.05
Thorium-232	0.19±0.07	(a)	0.35	0.13	0.48	0.39	(a)	-	0.07	0.07
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.85</u>	<u>20.64</u>				<u>2.62</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

Sample Identification: B-048-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.85±0.18	0.13	0.07	0.05	-	0.01	0.68
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.49±0.10	0.01	-	-	-	0.02	0.18
Uranium-235	0.06±0.04	-	-	-	-	-	0.02
Uranium-238	0.15±0.06	-	-	-	-	-	0.04
Thorium-228	0.06±0.03	(a)	0.02	-	(a)	0.01	0.06
Thorium-230	0.07±0.04	(a)	0.11	0.04	(a)	-	0.02
Thorium-232	0.14±0.05	(a)	0.26	0.10	(a)	-	0.02
Cesium-137	0.16±0.03	-	-	-	(a)	-	0.05
Total							
			0.79				
							1.09

Sample Identification: B-049-S-6

Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.8±0.15	0.12	0.06	0.05	0.01	0.01	0.65
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.30±0.12	0.04	0.01	-	0.04	0.04	0.49
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.10±0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	0.03
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.60±0.04	-	-	-	-	-	-
Total							
			0.28				
							1.22

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-050-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	11.2±0.2	4.18	0.32	0.28	4.78	99.68	0.01	0.41	8.20	8.62
Radium-228	6.97±0.49	1.07	0.56	0.41	2.04	31.16	-	0.10	5.62	5.72
Strontium-90	0.98±0.12	0.01	-	-	0.01	8.58	-	-	-	-
Uranium-234	0.91±0.05	0.02	0.01	-	0.03	1.96	-	0.03	0.35	0.38
Uranium-235	0.08±0.02	-	-	-	-	0.16	-	-	0.02	0.02
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	0.46±0.08	(a)	0.18	0.03	0.21	0.17	(a)	0.06	0.44	0.50
Thorium-230	0.64±0.08	(a)	1.03	0.39	1.42	1.29	(a)	0.02	0.21	0.23
Thorium-232	0.17±0.05	(a)	0.31	0.12	0.43	0.35	(a)	-	0.06	0.06
Cesium-137	14.9±0.3	-	-	-	-	3.43	-	-	0.02	0.02
Total					<u>8.92</u>	<u>146.78</u>				<u>15.55</u>

Sample Identification: B-051-S-6

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	5.92±0.25	-	-	-	-	1.36	-	-	0.01	0.01
Total					-	<u>1.36</u>				<u>0.01</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-052-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Y	D	Clearance Rate M	Y
Radium-226	1.2±0.4	0.45	0.03	0.03	-	0.04	0.88
Radium-228	0.47±0.19	0.07	0.04	0.03	-	0.01	0.38
Strontium-90	0.05±0.03	-	-	-	-	-	-
Uranium-234	0.15±0.04	-	-	-	-	-	-
Uranium-235	0.05±0.02	-	-	-	-	-	0.06
Uranium-238	0.09±0.03	-	-	-	-	-	0.02
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.05±0.04	(a)	0.09	0.03	(a)	-	0.02
Cesium-137	1.88±0.14	-	-	-	(a)	-	-
Total							
				0.77			1.43

Sample Identification: B-053-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Y	D	Clearance Rate M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.62±0.17	0.10	0.05	0.04	-	0.01	0.50
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.10±0.02	-	-	-	-	-	0.04
Uranium-235	0.05±0.03	-	-	-	-	-	0.02
Uranium-238	0.05±0.03	-	-	-	-	-	0.01
Thorium-228	0.07±0.05	(a)	0.03	-	(a)	0.01	0.07
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.05±0.04	(a)	0.09	0.03	(a)	-	0.02
Cesium-137	7.20±0.22	-	-	-	(a)	-	0.01
Total							
				0.22			0.69

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-054-S-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (μrem/yr)			Exposure to Lung (μrem/yr)		
		B	Clearance Rate M Y	Total	D	W	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.68±0.24	0.10	0.05	0.19	-	0.01	0.56
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.47±0.06	-	-	-	-	-	-
Total		-	-	0.19	-	-	0.56

Sample Identification: B-055-S-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (μrem/yr)			Exposure to Lung (μrem/yr)		
		B	Clearance Rate M Y	Total	D	W	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	1.38±0.24	0.21	0.11	0.40	-	0.02	1.13
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	0.08±0.03	(a)	0.03	0.03	(a)	0.01	0.09
Thorium-230	0.06±0.04	(a)	-	-	(a)	-	-
Thorium-232	0.14±0.30	(a)	0.11	0.15	(a)	-	0.02
Cesium-137	-	-	-	-	-	-	-
Total		-	-	0.58	-	-	1.24

(a) ICRP-39 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-056-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.61±0.24	0.09	0.05	0.04	-	0.01	0.49
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	0.06±0.03	(a)	0.02	-	(a)	0.01	0.06
Thorium-230	< 0.05	(a)	0.11	0.03	(a)	-	0.02
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	0.31	-	-	-	0.59

Sample Identification: B-057-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	0.11±0.04	(a)	0.04	0.01	(a)	0.02	0.10
Thorium-230	0.08±0.04	(a)	0.18	0.05	(a)	-	0.02
Thorium-232	0.14±0.05	(a)	0.36	0.10	(a)	-	0.05
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	0.59	-	-	-	0.19

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		B	Clearance Rate		Total	D	Clearance Rate		Total
			W	Y			W	Y	
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	1.25±0.20	0.19	0.10	0.36	-	0.02	1.01	1.03	
Strontium-90	0.19±0.10	-	-	-	-	-	-	-	
Uranium-234	0.71±0.09	0.02	-	0.02	-	0.02	0.27	0.29	
Uranium-235	0.16±0.04	-	-	-	-	-	0.05	0.05	
Uranium-238	0.96±0.03	0.02	0.01	0.03	-	0.03	0.27	0.30	
Thorium-228	0.06±0.03	(a)	0.02	0.02	(a)	0.01	0.06	0.07	
Thorium-230	< 0.05	(a)	-	-	(a)	-	-	-	
Thorium-232	< 0.05	(a)	-	-	(a)	-	-	-	
Cesium-137	0.33±0.04	-	-	-	(a)	-	-	-	
Total		-	-	0.43	-	-	-	1.74	
Sample Identification: B-059-S-6									
Radium-226	4.2±0.6	1.57	0.12	1.79	-	0.15	3.08	3.23	
Radium-228	< 0.1	-	-	-	-	-	-	-	
Strontium-90	< 0.03	-	-	-	-	-	-	-	
Uranium-234	7.5±1.6	0.21	0.05	0.28	-	0.25	2.65	3.10	
Uranium-235	0.79±0.38	0.02	-	0.02	-	0.02	0.24	0.26	
Uranium-238	1.1±0.6	0.03	0.01	0.04	-	0.03	0.32	0.33	
Thorium-226	< 0.05	(a)	-	-	(a)	-	-	-	
Thorium-230	0.15±0.09	(a)	0.24	0.33	(a)	-	0.05	0.05	
Thorium-232	0.27±0.12	(a)	0.49	0.67	(a)	0.01	0.10	0.11	
Cesium-137	0.14±0.05	(a)	-	-	(a)	-	-	-	
Total		-	-	3.13	-	-	-	7.08	

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-060-5-6

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.37±0.17	0.06	0.03	0.11	0.02	0.30	0.30
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	2.5±0.7	0.07	0.02	0.10	0.01	0.95	1.03
Branium-235	0.31±0.06	0.01	-	0.01	-	0.10	0.11
Branium-238	1.3±0.7	0.03	0.01	0.04	-	0.37	0.41
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>0.26</u>			<u>0.52</u>

Sample Identification: B-061-5-6

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-
Branium-235	< 0.05	-	-	-	-	-	-
Branium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.54±0.08	-	-	-	-	-	-
Total				<u>0.12</u>			<u>0.12</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-062-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Ingestion Total	D	Clearance Rate Y	Total
Radium-226	0.4±0.2	0.15	0.01	0.17	-	0.29	0.30
Radium-228	0.78±0.20	0.12	0.06	0.23	-	0.63	0.64
Strontium-90	0.28±0.08	-	-	-	-	-	-
Uranium-234	3.1±0.9	0.09	0.02	0.12	-	-	-
Uranium-235	0.46±0.29	0.01	-	0.01	-	1.18	1.23
Uranium-238	1.5±0.7	0.04	0.01	0.05	-	0.14	0.15
Thorium-228	0.07±0.03	(a)	0.03	0.03	(a)	0.43	0.47
Thorium-230	< 0.05	(a)	-	-	(a)	0.07	0.08
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total	-	-	-	0.61	-	-	2.92

Sample Identification: B-63-S-6

Radium-226	10±1	3.74	0.28	4.27	0.01	7.33	7.70
Radium-228	0.50±0.20	0.08	0.04	0.15	-	0.40	0.40
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.7±0.2	0.05	0.01	0.06	-	-	-
Uranium-235	0.18±0.07	-	-	-	-	0.64	0.69
Uranium-238	1.3±0.9	0.03	0.01	0.04	-	0.06	0.06
Thorium-228	0.05±0.03	(a)	0.02	0.02	(a)	0.37	0.41
Thorium-230	0.07±0.05	(a)	0.11	0.15	(a)	0.05	0.05
Thorium-232	< 0.05	(a)	-	-	(a)	0.02	0.02
Cesium-137	0.11±0.03	-	-	-	-	-	-
Total	-	-	-	4.63	-	-	9.33

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-064-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	22±1	8.22	0.62	0.02	8.86	0.03	0.80	16.12	16.95
Radium-228	0.56±0.18	0.09	0.04	0.03	0.16	-	0.01	0.45	0.46
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Branium-234	4.4±0.3	0.12	0.03	0.01	0.16	-	0.14	1.67	1.81
Branium-235	0.42±0.08	0.01	-	-	0.01	-	0.01	0.13	0.14
Branium-238	4.0±0.8	0.10	0.03	0.01	0.14	-	0.12	1.14	1.26
Thorium-228	0.09±0.05	(a)	0.04	-	0.04	(a)	0.01	0.09	0.10
Thorium-230	0.29±0.08	(a)	0.47	0.13	0.65	(a)	0.01	0.09	0.10
Thorium-232	0.09±0.07	(a)	0.16	0.06	0.22	(a)	-	0.03	0.10
Cesium-137	0.28±0.04	-	-	-	-	-	-	-	0.03
Total					10.24				20.85

Sample Identification: B-065-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Y	Total	D	W	Y	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Branium-234	< 0.05	-	-	-	-	-	-	-	-
Branium-235	< 0.05	-	-	-	-	-	-	-	-
Branium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	9.10±0.08	(a)	0.16	0.06	0.22	(a)	-	0.03	0.03
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	(a)	-	-	-	(a)	-	-	-
Total					0.22				0.03

(a) ICRP 30 classifies thorium compounds as Y and W type.

Sample Identification: B-066-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.02	-	-	-	-	-	-
Uranium-234	1.3±0.5	0.04	0.01	0.05	-	-	-
Uranium-235	0.43±0.27	0.01	-	0.01	0.26	-	-
Uranium-238	1.9±0.5	0.05	0.01	0.06	0.83	0.04	0.53
Thorium-228	0.06±0.03	(a)	0.02	0.02	3.69	0.01	0.14
Thorium-230	0.06±0.04	(a)	0.10	0.14	0.02	0.01	0.60
Thorium-232	0.07±0.04	(a)	0.13	0.18	0.12	0.02	0.07
Cesium-137	< 0.08	-	-	0.05	0.14	-	0.02
Total		-	-	0.46	-	-	0.03
				7.86			1.39

Sample Identification: B-067-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	3.9±1.2	1.46	0.11	1.67	-	-	-
Radium-228	1.81±0.22	0.28	0.14	0.53	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	17±2	0.47	0.12	0.64	0.01	-	-
Uranium-235	0.75±0.33	0.02	-	0.02	-	-	-
Uranium-238	2.1±0.5	0.05	0.01	0.06	-	-	-
Thorium-228	0.05±0.03	(a)	0.02	0.02	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	1.02±0.07	-	-	-	-	-	-
Total		-	-	2.94	-	-	-
				85.13			12.35

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-068-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	0.88±0.20	0.14	0.07	0.05	0.26	3.93	-	-	-	
Strontium-90	< 0.03	-	-	-	-	-	-	0.01	0.71	
Uranium-234	1.47±0.17	0.04	0.01	-	0.05	3.16	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	0.05	0.56	
Uranium-238	0.30±0.09	0.01	-	-	0.01	0.58	-	-	0.61	
Thorium-228	0.05±0.04	(a)	0.02	-	0.02	0.02	(a)	0.01	0.08	
Thorium-230	0.10±0.05	(a)	0.16	0.06	0.22	0.20	(a)	0.01	0.05	
Thorium-232	0.11±0.06	(a)	0.20	0.07	0.27	0.23	(a)	-	0.03	
Cesium-137	2.53±0.13	-	-	-	-	0.58	(a)	-	0.04	
Total					<u>0.83</u>	<u>8.70</u>			<u>1.55</u>	

Sample Identification: B-069-S-6

Radium-226	> 0.5	-	-	-	-	-	-	-	-
Radium-228	> 0.1	-	-	-	-	-	-	-	-
Strontium-90	> 0.03	-	-	-	-	-	-	-	-
Uranium-234	> 0.05	-	-	-	-	-	-	-	-
Uranium-235	> 0.05	-	-	-	-	-	-	-	-
Uranium-238	> 0.05	-	-	-	-	-	-	-	-
Thorium-228	0.78±0.53	(a)	0.31	0.05	0.36	0.30	(a)	0.11	0.75
Thorium-230	0.28±0.32	(a)	0.45	0.17	0.62	0.56	(a)	0.01	0.10
Thorium-232	0.78±0.48	(a)	1.43	0.53	1.96	1.61	(a)	0.02	0.32
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>2.94</u>	<u>2.47</u>			<u>1.28</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-070-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	0.6±0.3	0.22	0.02	0.25	-	0.44	0.46
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.09±0.01	-	-	0.02	-	-	-
Total		-	-	0.25	-	-	0.46

Sample Identification: B-071-S-6

Radium-226	1.3±0.3	0.48	0.04	0.55	-	0.95	1.00
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.9±0.6	0.08	0.02	0.11	-	1.10	1.20
Uranium-235	0.39±0.23	0.01	-	0.01	-	0.12	0.13
Uranium-238	2.1±0.5	0.05	0.01	0.06	-	0.60	0.66
Thorium-226	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	(a)	-	-
Total		-	-	0.73	-	-	2.99

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-072-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate W	Rate Y	Total	Ingestion	D	H	Clearance Rate Y	Total
Radium-226	1.0±0.4	0.27	0.03	0.02	0.42	8.9	-	-	-	-
Radium-228	0.72±0.26	0.11	0.06	0.04	0.21	3.22	-	0.04	0.73	0.77
Strontium-90	< 0.03	-	-	-	-	-	-	0.01	0.58	0.59
Uranium-234	3.8±0.8	0.10	0.03	0.01	0.14	8.17	-	-	-	-
Uranium-235	0.46±0.29	0.01	-	-	0.01	0.89	-	0.12	1.44	1.56
Uranium-238	3.5±0.8	0.09	0.02	0.01	0.12	6.79	-	0.01	0.14	0.15
Thorium-228	< 0.05	(a)	-	-	-	-	-	0.01	1.00	1.01
Thorium-230	0.14±0.06	(a)	0.22	0.08	0.30	0.28	(a)	-	-	-
Thorium-232	0.13±0.06	(a)	0.24	0.09	0.33	0.27	(a)	-	0.04	0.04
Cesium-137	0.12±0.05	-	-	-	-	0.03	(a)	-	0.05	0.05
Total					<u>1.53</u>	<u>28.55</u>				<u>4.17</u>

Sample Identification: B-073-S-6

Radium-226	2.5±0.5	0.93	0.07	0.06	1.06	22.25	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-	0.09	1.83	1.92
Strontium-90	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-234	12.5±1.1	0.35	0.09	0.04	0.48	26.88	-	-	-	-
Uranium-235	0.79±0.29	0.02	-	-	0.02	1.53	0.01	0.41	4.75	5.17
Uranium-238	3.44±0.58	0.09	0.02	0.01	0.12	6.67	-	0.02	0.24	0.26
Thorium-228	0.05±0.03	(a)	0.02	-	0.02	0.02	-	0.10	0.98	1.08
Thorium-230	0.06±0.03	(a)	0.10	0.04	0.14	0.12	(a)	0.01	0.05	0.06
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	0.02	0.02
Cesium-137	0.57±0.08	-	-	-	-	0.13	(a)	-	-	-
Total					<u>1.84</u>	<u>57.60</u>				<u>8.51</u>

(a) ICRP-30 classifies thorium compounds as Y and H type.

TABLE C-10

Sample Identification: B-074-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		B	Clearance Rate M	Y	D	Clearance Rate M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	-	-	-	-	-	-
Thorium-230	0.12±0.06	(a)	0.19	0.07	(a)	0.04	0.04
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	(a)	-	-	(a)	-	-
Total							<u>0.04</u>

Sample Identification: B-075-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		B	Clearance Rate M	Y	D	Clearance Rate M	Y
Radium-226	7.6±0.6	2.84	0.22	0.19	0.01	0.28	5.57
Radium-228	0.23±0.10	0.03	0.02	0.01	-	-	0.18
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	8.9±1.4	0.25	0.06	0.02	-	-	-
Uranium-235	1.2±0.5	0.03	0.01	-	-	0.29	3.38
Uranium-238	2.6±0.7	0.07	0.02	0.01	-	0.04	0.37
Thorium-228	0.14±0.07	(a)	0.06	0.01	-	0.08	0.74
Thorium-230	0.23±0.10	(a)	0.37	0.14	(a)	0.02	0.13
Thorium-232	0.12±0.07	(a)	0.22	0.08	(a)	0.01	0.07
Cesium-137	0.15±0.04	(a)	-	-	(a)	-	0.04
Total							<u>11.21</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-076-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total Ingestion	D	W	Clearance Rate Y
Radium-226	8.9±0.7	3.32	0.25	3.79	0.01	0.32	6.52
Radium-228	0.26±0.15	0.04	0.02	0.03	-	-	0.21
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.05±0.03	(a)	0.09	0.12	(a)	-	0.02
Cesium-137	0.14±0.04	-	-	-	-	-	-
Total				3.93			7.08

Sample Identification: B-077-S-6

Radium-226	0.7±0.3	0.26	0.02	0.30	-	0.02	0.51
Radium-228	0.83±0.26	0.13	0.07	0.25	-	0.01	0.67
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.8±0.5	0.05	0.01	0.06	-	0.06	0.68
Uranium-235	0.41±0.23	0.01	-	0.01	-	0.01	0.13
Uranium-238	1.8±0.5	0.05	0.01	0.06	-	0.05	0.51
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				0.68			2.65

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-078-5-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	< 0.5	0.06	0.03	0.02	-	-	-
Radium-228	0.36±0.28	-	-	-	-	-	0.29
Sr-90	0.03	-	-	-	-	-	-
Uranium-234	2.3±0.6	0.06	0.02	0.01	-	-	0.87
Uranium-235	0.45±0.25	0.01	-	-	-	0.08	0.15
Uranium-238	1.8±0.5	0.05	0.01	-	-	0.01	0.56
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		0.27	-	-	10.91	-	1.95

Sample Identification: B-079-5-6

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	3.9±0.6	1.46	0.11	0.10	-	-	2.86
Radium-228	< 0.1	-	-	-	-	0.14	-
Sr-90	0.03	-	-	-	-	-	-
Uranium-234	1.13±0.16	0.03	0.01	-	-	0.04	0.43
Uranium-235	0.25±0.08	0.01	-	-	-	0.01	0.08
Uranium-238	0.39±0.10	0.01	-	-	-	0.01	0.12
Thorium-228	0.08±0.04	(a)	0.03	-	(a)	0.01	0.08
Thorium-230	0.13±0.07	(a)	0.21	0.08	(a)	-	0.04
Thorium-232	0.20±0.08	(a)	0.37	0.14	(a)	-	0.08
Cesium-137	< 0.08	-	-	-	-	-	-
Total		2.56	-	-	39.08	-	3.89

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-080-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate W	Y	D	W	Y
Radium-226	< 0.05	-	-	-	-	-	-
Radium-228	0.45±0.21	0.07	0.04	0.03	-	0.36	0.37
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.4±0.7	0.04	0.01	-	-	-	-
Uranium-235	0.38±0.11	0.01	-	-	-	0.53	0.58
Uranium-238	0.51±0.09	0.01	-	-	-	0.12	0.13
Thorium-228	0.16±0.07	(a)	0.06	0.01	-	0.14	0.15
Thorium-230	< 0.05	(a)	-	-	(a)	0.15	0.17
Thorium-232	0.20±0.13	(a)	0.37	0.14	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	0.08	0.08
Total		-	-	-	-	-	-
			0.79				1.38

Sample Identification: B-081-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate W	Y	D	W	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	5.4±1.2	0.15	0.04	0.02	-	-	-
Uranium-235	0.55±0.12	0.01	-	-	-	2.05	2.23
Uranium-238	2.0±0.8	0.05	0.01	-	-	0.17	0.19
Thorium-228	< 0.05	(a)	-	-	-	0.57	0.63
Thorium-230	0.05±0.03	(a)	0.08	0.03	(a)	-	-
Thorium-232	0.11±0.05	(a)	0.20	0.07	(a)	0.02	0.02
Cesium-137	< 0.08	-	-	-	-	0.04	0.04
Total		-	-	-	-	-	-
			0.66				3.11

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-082-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Total	D	W	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	14±2	0.39	0.10	0.53	0.46	5.78	
Uranium-235	1.48±0.50	0.04	0.01	0.05	0.04	0.50	
Uranium-238	2.71±0.19	0.07	0.02	0.10	0.08	0.85	
Thorium-228	< 0.05	(a)	-	-	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	
Thorium-232	< 0.06±0.04	(a)	-	-	-	-	
Cesium-137	< 0.08	(a)	-	-	-	-	
Total				0.83		7.15	

Sample Identification: B-083-5-6

Radium-226	9.3±0.6	3.47	0.26	3.96	0.34	6.81	7.15
Radium-228	2.09±0.25	0.32	0.17	0.61	0.03	1.68	1.71
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.05±0.12	0.03	0.01	0.04	0.03	0.40	0.43
Uranium-235	0.10±0.04	-	-	-	-	0.03	0.03
Uranium-238	0.30±0.07	0.01	-	0.01	0.01	0.08	0.09
Thorium-228	0.21±0.09	(a)	0.08	0.09	0.03	0.20	0.23
Thorium-230	0.25±0.11	(a)	0.40	0.55	0.01	0.08	0.09
Thorium-232	0.21±0.10	(a)	0.38	0.52	0.01	0.08	0.09
Cesium-137	39.9±0.5	-	-	-	0.01	0.06	0.07
Total				5.78		9.90	9.90

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-084-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	3.6±0.4	1.34	0.10	0.09	1.53	32.04	-	0.13	2.64	2.77
Radium-228	2.40±0.27	0.37	0.19	0.14	0.70	10.73	-	0.04	1.93	1.97
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	4.8±0.9	0.13	0.04	0.01	0.18	10.32	-	0.16	1.82	1.98
Uranium-235	0.26±0.21	0.01	-	-	0.01	0.50	-	0.01	0.08	0.09
Uranium-238	2.2±0.6	0.06	0.01	-	0.07	4.27	-	0.06	0.63	0.69
Thorium-228	0.06±0.04	(a)	0.02	-	0.02	0.02	(a)	0.01	0.06	0.07
Thorium-230	0.07±0.04	(a)	0.11	0.04	0.15	0.14	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	17±3	-	-	-	-	3.91	-	-	0.02	-
Total					<u>2.66</u>	<u>61.93</u>				<u>7.59</u>

Sample Identification: B-085-S-6

Radium-226	11.6±0.8	4.33	0.33	0.29	4.95	103.24	0.01	0.42	8.50	8.93
Radium-228	7.09±0.55	1.09	0.57	0.42	2.08	31.69	-	0.10	5.71	5.81
Strontium-90	0.17±0.06	-	-	-	-	1.49	-	-	-	-
Uranium-234	11±1	0.30	0.08	0.03	-	23.65	-	0.36	4.18	-
Uranium-235	1.0±0.5	0.05	0.01	-	0.06	3.49	-	0.06	0.55	0.61
Uranium-238	2.8±0.6	0.07	0.02	0.01	0.10	5.43	-	0.08	0.80	0.88
Thorium-228	1.1±0.2	(a)	0.44	0.07	0.51	0.42	(a)	0.15	1.06	1.21
Thorium-230	0.13±0.07	(a)	0.21	0.08	0.29	0.26	(a)	-	0.04	0.04
Thorium-232	0.15±0.08	(a)	0.27	0.10	0.37	0.31	(a)	-	0.06	0.06
Cesium-137	11.3±1.0	-	-	-	-	2.60	-	-	-	-
Total					<u>8.36</u>	<u>172.58</u>				<u>17.54</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-006-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	1.5±0.3	0.56	0.04	0.04	-	0.05	-
Radium-228	0.65±0.23	0.13	0.07	0.05	-	0.01	-
Strontium-90	< 0.03	-	-	-	-	-	-
Bromine-234	6.4±1.3	0.18	0.05	0.02	-	0.21	-
Bromine-235	0.57±0.37	0.02	-	-	-	0.02	-
Bromine-238	2.3±0.7	0.06	0.02	0.01	-	0.18	-
Thorium-228	< 0.05	(a)	-	-	(a)	0.07	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.43±0.07	-	-	-	-	-	-
Total		1.25	0.10	0.10	-	0.10	5.40

Sample Identification: B-087-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	1.0±0.3	0.37	0.03	0.02	-	0.04	-
Radium-228	1.57±0.34	0.40	0.21	0.15	-	0.04	-
Strontium-90	< 0.03	-	-	-	-	-	-
Bromine-234	7.4±0.8	0.20	0.05	0.02	-	0.24	-
Bromine-235	0.63±0.33	0.02	-	-	-	0.02	-
Bromine-238	3.0±0.6	0.08	0.02	0.01	-	0.19	-
Thorium-228	< 0.05	(a)	-	-	(a)	0.09	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.44±0.08	-	-	-	-	-	-
Total		1.58	0.10	0.10	-	0.10	7.08

(a) ICRP-30 classifies Thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-088 S-6

Type of Analytes	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	D	Clearance Rate		Total
			W	Y			W	Y	
Radium-226	0.6±0.3	0.22	0.02	0.04	0.28	-	0.02	0.44	0.46
Radium-228	0.46±0.22	0.07	0.04	0.03	0.14	-	0.01	0.37	0.38
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	2.76±0.69	0.08	0.02	0.01	0.11	-	0.09	1.05	1.14
Uranium-235	0.38±0.08	0.01	-	-	0.01	-	0.01	0.12	0.13
Uranium-238	0.52±0.06	0.01	-	-	0.01	-	0.02	0.15	0.17
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0.55</u>				<u>2.28</u>

Sample Identification: B-089 S-6

Radium-226	2.8±0.4	1.05	0.08	0.07	1.20	-	0.10	2.05	2.15
Radium-228	1.13±0.23	0.17	0.09	0.07	0.33	-	0.02	0.91	0.93
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.57±0.07	0.02	-	-	0.02	-	0.02	0.22	0.24
Uranium-235	0.06±0.02	-	-	-	-	-	-	0.02	0.02
Uranium-238	0.39±0.06	0.01	-	-	0.01	-	0.01	0.11	0.12
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>1.56</u>				<u>3.36</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-090-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M	Total	D	Clearance Rate Y	Total
Radium-226	0.5±0.3	0.19	0.01	0.21	-	0.37	0.39
Radium-228	0.32±0.18	0.05	0.02	0.09	-	0.26	0.26
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.0±0.5	0.06	0.01	0.07	-	0.76	0.83
Uranium-235	0.18±0.05	-	-	-	-	0.05	0.05
Uranium-238	2.9±0.6	0.07	0.02	0.09	-	0.82	0.90
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.16±0.08	(a)	0.26	0.36	(a)	0.05	0.05
Thorium-232	0.17±0.08	(a)	0.31	0.43	(a)	0.06	0.09
Cesium-137	< 0.02	-	-	-	-	-	-
Total				<u>1.25</u>			<u>2.57</u>

Sample Identification: B-091-S-6

Radium-226	0.5±0.03	0.19	0.01	0.21	-	0.37	0.39
Radium-228	1.0±0.3	0.15	0.08	0.29	-	0.80	0.81
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.8±0.6	0.05	0.01	0.06	-	0.68	0.74
Uranium-235	0.35±0.26	-	-	-	-	0.11	0.12
Uranium-238	1.2±0.5	0.03	-	0.03	-	0.34	0.37
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>0.59</u>			<u>2.43</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-092-S-6

Type of Analysis	Activity (pci/q dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate M	Y	D	W	Y
Radium-226	2.8±0.4	1.05	0.08	0.07	-	0.10	2.05
Radium-228	1.0±0.2	0.15	0.08	0.06	-	0.01	0.80
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.59±0.08	0.02	-	-	-	-	-
Uranium-235	0.05±0.03	-	-	-	-	0.02	0.24
Uranium-238	0.19±0.05	-	-	-	-	-	0.02
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.37±0.04	-	-	-	-	-	-
Total		<u>1.51</u>					<u>3.27</u>

Sample Identification: B-093-S-6

Type of Analysis	Activity (pci/q dry)	Exposure to Bone (urem/yr)			Exposure to Lung (urem/yr)		
		D	Clearance Rate M	Y	D	W	Y
Radium-226	0.8±0.3	0.30	0.02	0.02	-	0.03	0.59
Radium-228	0.76±0.19	0.12	0.06	0.04	-	0.01	0.61
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	12±2	0.33	0.09	0.03	-	-	-
Uranium-235	1.1±0.6	0.03	0.01	-	-	0.40	4.56
Uranium-238	4.2±1.1	0.11	0.03	0.01	-	0.03	0.34
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.79±0.04	-	-	-	-	-	-
Total		<u>1.20</u>					<u>7.89</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-094-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to bone (mrem/yr)			Exposure to lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	1.4±0.4	0.52	0.04	0.03	-	0.05	1.02
Radium-228	0.29±0.18	0.04	0.02	0.02	-	-	0.23
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.0±0.3	0.03	0.01	-	-	0.03	0.38
Uranium-235	0.3±0.18	0.01	-	-	-	0.01	0.09
Uranium-238	0.80±0.30	0.02	-	-	-	0.02	0.23
Thorium-228	0.13±0.06	(a)	0.05	0.01	(a)	0.02	0.12
Thorium-230	0.20±0.08	(a)	0.32	0.12	(a)	0.01	0.06
Thorium-232	0.15±0.06	(a)	0.27	0.10	(a)	-	0.06
Cesium-137	< 0.08	-	-	-	-	-	-
Total		1.61	1.61	18.80	2.33	2.33	2.33

Sample Identification: B-095-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to bone (mrem/yr)			Exposure to lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	0.5	-	-	-	-	-	-
Radium-228	0.20±0.12	0.03	0.02	0.01	-	-	0.16
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.23±0.06	0.01	-	-	-	0.01	0.09
Uranium-235	0.05±0.02	-	-	-	-	-	0.02
Uranium-238	0.24±0.06	0.01	-	-	-	0.01	0.07
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		0.06	0.06	1.94	0.36	0.36	0.36

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Sample Identification: B-096-S-6									
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.51±0.18	0.08	0.04	0.03	0.15	-	0.01	-	0.42
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>0.15</u>				<u>0.42</u>
Sample Identification: B-097-S-6									
Radium-226	1.8±0.3	0.67	0.05	0.04	0.76	-	0.06	1.32	1.38
Radium-228	1.11±0.21	0.17	0.09	0.06	0.32	-	9.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.18±0.06	-	-	-	-	-	-	-	-
Uranium-235	0.06±0.03	-	-	-	-	-	-	-	-
Uranium-238	0.12±0.06	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>1.08</u>				<u>2.41</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-098-S-6

Type of Analysis	Activity (µCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W Y	Total	D	W	Clearance Rate Y Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	1.5±0.2	0.23	0.12	0.44	-	0.02	1.23
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.56±0.09	0.02	-	0.02	-	0.02	0.23
Uranium-235	0.05±0.04	-	-	-	-	-	0.02
Uranium-238	0.34±0.07	0.01	-	0.01	-	0.10	0.11
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.16±0.03	(a)	-	-	(a)	-	-
Total		-	-	0.47	-	-	1.59
				8.70			

Sample Identification: B-099-S-6

Radium-226	2.2±0.4	0.82	0.06	0.93	-	0.08	1.61
Radium-228	0.80±0.24	0.12	0.06	0.23	-	0.01	0.65
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	4.0±0.7	0.11	0.03	0.15	-	0.13	1.65
Uranium-235	0.64±0.30	0.02	-	0.02	-	0.02	0.22
Uranium-238	1.8±0.5	0.05	0.01	0.06	-	0.05	0.56
Thorium-228	0.18±0.08	(a)	0.07	0.08	-	0.02	0.19
Thorium-230	0.24±0.11	(a)	0.39	0.53	(a)	0.01	0.09
Thorium-232	0.21±0.10	(a)	0.38	0.52	(a)	0.08	0.08
Cesium-137	1.3±0.1	-	-	-	-	-	-
Total		-	-	2.52	-	-	5.13
				37.77			

(a) ICRP 30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-104-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	< 0.1	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.44±0.07	0.01	-	-	0.01	-	-
Uranium-235	0.05±0.03	-	-	-	-	0.17	0.18
Uranium-238	0.25±0.05	-	-	-	-	0.02	0.02
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	0.42±0.06	-	-	-	-	-	-
Total		0.01	0.16	1.62	0.27	-	-

Sample Identification: B-105-S-6

Radium-226	1.9±0.3	0.71	0.05	0.05	0.07	0.07	1.39	1.46
Radium-228	1.18±0.19	0.18	0.09	0.07	-	0.02	0.95	0.97
Strontium-90	< 0.03	-	-	-	-	-	-	-
Uranium-234	2.7±0.5	0.07	0.02	0.01	-	0.09	1.02	1.11
Uranium-235	0.39±0.23	0.01	-	-	-	0.01	0.12	0.13
Uranium-238	2.0±0.4	0.05	0.01	-	-	0.06	0.57	0.63
Thorium-228	< 0.05	(a)	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-
Total		1.32	0.16	32.62	4.30	-	-	-

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-106-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	D	Clearance Rate		Total
			Y	W			Y	W	
Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.54±0.17	0.08	0.04	0.15	-	0.01	0.44	0.45	
Strontium-90	0.38±0.06	-	-	-	-	-	-	-	
Uranium-234	1.9±0.5	0.05	0.01	0.06	-	0.06	0.72	0.78	
Uranium-235	0.33±0.19	0.01	-	0.01	-	0.01	0.10	0.11	
Uranium-238	1.6±0.4	0.04	0.01	0.05	-	0.05	0.46	0.51	
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	
Total				0.27				1.85	

Sample Identification: B-107-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	D	Clearance Rate		Total
			Y	W			Y	W	
Radium-226	< 0.5	-	-	-	-	-	-	-	
Radium-228	0.60±0.18	0.09	0.05	0.18	-	0.01	0.48	0.49	
Strontium-90	0.25±0.06	-	-	-	-	-	-	-	
Uranium-234	1.3±1	0.36	0.09	0.49	-	0.43	4.94	5.38	
Uranium-235	< 0.05	-	-	-	-	-	-	-	
Uranium-238	1.3±0.6	0.03	0.01	0.04	-	0.04	0.37	0.41	
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	
Total				0.71				6.24	

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-108-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y					Y	Total
Radium-226	2.0±0.3	0.75	0.06	0.05	0.86	17.80	-	0.07	1.46	1.53
Radium-228	1.44±0.21	0.22	0.12	0.09	0.43	6.44	-	0.02	1.16	1.18
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.39±0.07	0.01	-	-	0.01	0.84	-	0.01	0.15	0.16
Uranium-235	0.14±0.04	-	-	-	-	0.27	-	-	0.04	0.04
Uranium-238	0.43±0.07	0.01	-	-	0.01	0.83	-	0.01	0.12	0.13
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.31</u>	<u>26.18</u>				<u>3.04</u>

Sample Identification: B-109-S-6

Radium-226	1.1±0.3	0.41	0.03	0.03	0.47	9.79	-	0.04	0.30	0.84
Radium-228	1.6±0.2	0.25	0.13	0.09	0.47	7.15	-	0.02	1.29	1.31
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	1.8±0.5	0.05	0.01	-	0.06	3.67	-	0.06	0.68	0.74
Uranium-235	0.26±0.20	0.01	-	-	0.01	0.50	-	0.01	0.08	0.09
Uranium-238	1.4±0.4	0.04	0.01	-	0.05	2.72	-	0.04	0.40	0.44
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>1.06</u>	<u>24.03</u>				<u>3.42</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-110-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to bone (mrem/yr)				Exposure to lung (mrem/yr)			
		D	M	Y	Total	D	M	Y	Total
Radium-226	1.8±0.4	0.67	0.05	0.04	0.76	-	0.06	1.32	1.38
Radium-228	1.10±0.20	0.17	0.09	0.06	0.32	-	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-	-	-
Uranium-234	0.57±0.07	0.02	-	-	0.02	-	0.02	0.22	0.24
Uranium-235	< 0.05	-	-	-	-	-	-	-	-
Uranium-238	0.25±0.05	0.01	-	-	0.01	-	0.01	0.07	0.08
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-
Total					<u>1.11</u>				<u>2.61</u>

Sample Identification: B-111-5-6

Radium-226	0.46±0.09	0.17	0.01	0.01	0.19	-	0.02	0.03	0.05
Radium-228	1.1±0.2	0.17	0.09	0.06	0.32	-	0.02	0.89	0.91
Strontium-90	0.10±	-	-	-	-	-	-	-	-
Uranium-234	4.7±0.7	0.13	0.03	0.01	0.17	-	0.16	1.78	1.94
Uranium-235	0.45±0.23	0.01	-	-	0.01	-	0.01	0.14	0.15
Uranium-238	1.3±0.4	0.03	-	-	0.03	-	0.04	0.37	0.41
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.61±0.06	-	-	-	-	-	-	-	-
Total					<u>0.72</u>				<u>3.46</u>

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-10

Sample Identification: B-112-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	Clearance Rate W Y	Total	Ingestion	D	W	Y	Total
Radium-226	4.2±0.3	1.57	0.12	1.79	37.38	-	0.15	3.08	3.23
Radium-228	0.85±0.12	0.13	0.07	0.25	3.80	-	0.01	0.68	0.69
Strontium-90	0.17±0.05	-	-	-	1.49	-	-	-	-
Uranium-234	0.86±0.10	0.02	0.01	0.03	1.85	-	0.03	0.33	0.36
Uranium-235	0.09±0.03	-	-	-	0.17	-	-	0.03	0.03
Uranium-238	0.15±0.04	-	-	-	0.29	-	-	0.04	0.04
Thorium-228	0.15±0.08	(a)	0.06	0.07	0.06	(a)	0.02	0.14	0.16
Thorium-230	0.13±0.77	(a)	0.21	0.29	0.26	(a)	-	0.04	0.04
Thorium-232	0.18±0.09	(a)	0.33	0.45	0.37	(a)	-	0.07	0.07
Cesium-137	0.48±0.04	-	-	-	0.11	-	-	-	-
Total				2.88	45.78				4.62

Sample Identification: B-113-S-6

Radium-226	1.7±0.3	0.64	0.05	0.73	15.13	-	0.06	1.24	1.30
Radium-228	1.2±0.2	0.18	0.10	0.35	5.36	-	0.02	0.97	0.99
Strontium-90	0.15±0.05	-	-	-	1.31	-	-	-	-
Uranium-234	4.7±0.7	0.13	0.03	0.17	10.10	-	0.16	1.78	1.94
Uranium-235	1.5±0.5	0.04	0.01	0.05	2.91	-	0.05	0.46	0.51
Uranium-238	4.4±0.7	0.11	0.03	0.15	8.54	-	0.13	1.25	1.38
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	-
Cesium-137	0.42±0.05	-	-	-	0.10	-	-	-	-
Total				1.45	43.45				6.12

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-114-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	W	Y	D	W	Y
Radium-226	0.7±0.2	0.26	0.02	0.02	0.02	0.51	0.53
Radium-228	1.1±0.2	0.17	0.09	0.06	0.02	0.88	0.90
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.48±0.23	0.01	-	-	0.02	0.18	0.20
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.42±0.22	0.01	-	-	0.01	0.12	0.13
Thorium-228	0.09±0.05	(a)	0.04	-	0.01	0.09	0.10
Thorium-230	0.31±0.10	(a)	0.50	0.19	0.01	0.10	0.11
Thorium-232	0.11±0.06	(a)	0.20	0.07	-	0.04	0.04
Cesium-137	0.27±0.04	-	-	-	-	-	-
Total		1.64	1.64	13.93	-	2.01	2.01

Sample Identification: B-115-S-6

Radium-226	< 0.5	0.08	0.04	0.03	0.01	0.41	0.42
Radium-228	0.51±0.17	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	2.6±0.7	0.07	0.02	0.01	0.08	0.99	1.07
Uranium-235	0.94±0.46	0.02	0.01	-	0.03	0.29	0.32
Uranium-238	2.4±0.7	0.06	0.02	0.01	0.07	0.68	0.75
Thorium-228	< 0.05	(a)	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		0.37	0.37	14.35	-	2.56	2.56

(a) ICRP-30 classifies Thorium compounds as Y and W type.

TABLE C 10

Sample Identification: B-116-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate M/Y	Ingestion Total	D	Clearance Rate Y	Total
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.26±0.14	0.04	0.02	0.03	-	0.21	0.21
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.97±0.10	0.03	0.01	0.04	-	0.37	0.40
Uranium-235	0.06±0.04	-	-	-	-	0.02	0.02
Uranium-238	0.17±0.05	-	-	-	-	0.05	0.05
Thorium-228	0.05±0.04	(a)	0.02	0.02	(a)	0.05	0.06
Thorium-230	0.06±0.05	(a)	0.10	0.14	(a)	0.02	0.02
Thorium-232	0.10±0.06	(a)	0.18	0.25	(a)	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	-
Total				0.53		0.80	0.80

Sample Identification: B-117-S-6

Radium-226	1.9±0.3	0.71	0.05	0.81	-	1.39	1.46
Radium-228	0.60±0.13	0.09	0.04	0.18	-	0.48	0.49
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	1.0±0.3	0.03	0.01	0.04	-	0.38	0.41
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	0.75±0.29	0.02	-	0.02	-	0.21	0.23
Thorium-228	0.07±0.04	(a)	0.03	0.03	(a)	0.07	0.08
Thorium-230	0.09±0.05	(a)	0.14	0.19	(a)	0.03	0.03
Thorium-232	0.08±0.04	(a)	0.13	0.20	(a)	0.03	0.03
Cesium-137	< 0.08	-	-	-	-	-	-
Total				1.47		2.73	2.73

(a) ICRP-30 classifies thorium compounds as Y and H type.

TABLE C-10

Sample Identification: B-118-5-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate W	Total	D	Clearance Rate Y	Total
Radium-226	0.6±0.1	0.22	0.02	0.25	-	0.02	0.47
Radium-228	0.72±0.17	0.11	0.06	0.21	-	0.01	0.59
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	33±2	0.92	0.24	1.26	0.02	1.09	13.64
Uranium-235	0.26±0.07	-	-	-	-	-	-
Uranium-238	2.9±0.7	0.07	0.02	0.09	-	0.08	0.90
Thorium-228	0.15±0.08	(a)	0.06	0.06	(a)	0.02	0.16
Thorium-230	0.19±0.08	(a)	0.31	0.42	(a)	-	0.06
Thorium-232	0.15±0.08	(a)	0.27	0.37	(a)	-	0.06
Cesium-137	< 0.08	-	-	-	-	-	-
Total				2.66			15.88

Sample Identification: B-119-5-6

Radium-226	1.8±0.2	0.67	0.05	0.76	-	0.06	1.32
Radium-228	0.93±0.23	0.15	0.08	0.29	-	0.01	0.80
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	27±2	0.75	0.20	1.03	0.01	0.89	10.25
Uranium-235	0.43±0.08	0.01	-	0.03	-	0.01	0.13
Uranium-238	2.4±0.6	0.06	0.02	0.08	-	0.07	0.68
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	0.08±0.05	(a)	0.13	0.18	(a)	-	0.02
Thorium-232	0.07±0.05	(a)	0.13	0.18	(a)	-	0.03
Cesium-137	< 0.08	-	-	-	-	-	-
Total				2.52			14.27

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-10

Sample Identification: B-120-S-6

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to Lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	17.9±0.9	6.69	0.51	0.44	7.64	159.31	0.02	0.65	13.11	13.78
Radium-228	0.38±0.15	0.05	0.03	0.02	0.11 (a)	1.70	-	0.01	0.31	0.32
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	28±2	0.78	0.20	0.08	1.06	60.20	0.01	0.92	10.63	11.56
Uranium-235	27±0.6	0.07	0.02	0.01	0.10	5.24	-	0.08	0.83	0.91
Uranium-238	2.8±0.6	0.07	0.02	0.01	0.10	5.43	-	0.08	0.80	0.88
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.08±0.05	(a)	0.13	0.05	0.18	0.16	(a)	-	0.02	0.02
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>9.19</u>	<u>232.04</u>				<u>27.47</u>

Sample Identification: B-121-S-6

Radium-226	2.3±0.3	0.86	0.06	0.06	0.98	20.47	-	0.08	1.68	1.76
Radium-228	< 0.1	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	15±1	0.42	0.11	0.04	0.57	32.25	-	0.50	5.70	6.20
Uranium-235	0.61±0.29	0.02	-	-	0.02	1.18	-	0.02	0.19	0.21
Uranium-238	1.8±0.5	0.05	0.01	-	0.06	3.49	-	0.05	0.51	0.56
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.21±0.07	(a)	0.34	0.13	0.47	0.42	(a)	0.01	0.07	0.08
Thorium-232	0.11±0.06	(a)	0.20	0.07	0.27	0.23	(a)	-	0.04	0.04
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					<u>2.37</u>	<u>58.04</u>				<u>8.85</u>

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-11

Sample Identification: B-058-S-4

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		D	W	Y	Total	D	W	Y	Total
Radium-226	<0.5	-	-	-	-	-	-	-	-
Radium-228	0.93±0.23	0.14	0.07	0.06	0.27	-	0.01	0.75	0.76
Strontium-90	<0.03	-	-	-	-	-	-	-	-
Branium-234	<0.05	-	-	-	-	-	-	-	-
Branium-235	<0.05	-	-	-	-	-	-	-	-
Branium-238	<0.05	-	-	-	-	-	-	-	-
Thorium-228	0.19±0.09	(a)	0.08	0.01	0.09	-	0.03	0.18	0.21
Thorium-230	0.22±0.09	(a)	0.35	0.13	0.48	-	0.01	0.07	0.08
Thorium-232	0.21±0.09	(a)	0.38	0.14	0.52	-	-	0.08	0.08
Cesium-137	<0.08	-	-	-	-	-	-	-	-
Total					1.36				1.13

Sample Identification: B-060-S-4

Radium-226	0.8±0.3	0.30	0.02	0.02	0.34	-	0.03	0.59	0.62
Radium-228	0.54±0.25	0.08	0.04	0.03	0.15	-	0.01	0.44	0.45
Strontium-90	<0.03	-	-	-	-	-	-	-	-
Branium-234	0.66±0.18	0.02	-	-	0.02	-	0.02	0.25	0.27
Branium-235	0.18±0.09	-	-	-	-	-	-	0.06	0.06
Branium-238	0.26±0.12	-	-	-	-	-	-	0.07	0.07
Thorium-228	0.25±0.10	(a)	0.10	0.02	0.12	-	0.04	0.24	0.28
Thorium-230	0.22±0.10	(a)	0.35	0.13	0.48	-	0.01	0.07	0.08
Thorium-232	0.22±0.09	(a)	0.40	0.15	0.55	-	0.01	0.08	0.09
Cesium-137	<0.08	-	-	-	-	-	-	-	-
Total					1.66				1.92

(a) ICRP-30 classifies Thorium compounds as Y and W type.

TABLE C-11

Sample Identification: B-062-S-4

Type of Analysis	Activity (pCi/g dry)	Exposure			to Bone (mrem/yr)			Exposure to Lung (mrem/yr)			
		D	Clearance Rate M	Y	Total	Ingestion	D	M	Y	Clearance Rate	Total
Radium-226	< 0.5	-	-	-	-	-	-	-	-	-	-
Radium-228	< 0.10	-	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-	-
Uranium-234	0.20±0.12	-	-	-	-	-	-	-	-	-	-
Uranium-235	0.16±0.12	-	-	-	-	-	-	-	-	-	-
Uranium-238	0.25±0.14	-	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	0.01	-	-	-	-	-	-	-	-	-
Thorium-230	0.46±0.20	(a)	-	-	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-	-
Cesium-137	< 0.08	(a)	-	-	-	-	-	-	-	-	-
Total					1.03	2.14					0.38

Sample Identification: B-067-S-4

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-	-	-
Radium-228	0.30±0.13	0.05	-	-	-	-	-	-	-	-	-	-
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-	-	-
Uranium-234	0.40±0.12	-	-	-	-	-	-	-	-	-	-	-
Uranium-235	0.05±0.04	0.01	-	-	-	-	-	-	-	-	-	-
Uranium-238	0.16±0.07	-	-	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	-	-	-	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	-	-	-	-	-	-
Cesium-137	0.30±0.05	-	-	-	-	-	-	-	-	-	-	-
Total					0.10	2.68						0.46

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-11

Sample Identification: B-069-S-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)			Exposure to Lung (mrem/yr)		
		D	M	Y	D	M	Y
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	0.26±0.09	0.04	0.02	0.08	-	0.21	0.21
Strontium-90	< 6.3	-	-	-	-	-	-
Uranium-234	0.48±0.25	0.01	-	0.01	-	0.18	0.20
Uranium-235	0.07±0.03	-	-	-	-	0.02	0.02
Uranium-238	0.60±0.27	0.02	-	0.02	-	0.17	0.19
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	0.15±0.10	(a)	0.27	0.37	(a)	0.06	0.06
Cesium-137	< 0.08	-	-	-	-	-	-
Total				<u>6.48</u>			<u>9.68</u>

Sample Identification: B-071-S-4

Radium-226	1.0±0.2	0.37	0.03	0.42	-	0.73	0.77
Radium-228	0.91±0.18	0.14	0.07	0.26	-	0.73	0.74
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	0.34±0.12	0.01	-	0.01	-	-	-
Uranium-235	0.10±0.07	-	-	-	-	0.13	0.14
Uranium-238	0.22±0.10	-	-	-	-	0.03	0.03
Thorium-228	< 0.05	(a)	-	-	(a)	0.06	0.07
Thorium-230	0.20±0.10	(a)	0.32	0.44	(a)	-	-
Thorium-232	0.23±0.11	(a)	0.19	0.35	(a)	0.06	0.07
Cesium-137	< 0.08	-	-	-	(a)	0.09	0.10
Total				<u>1.48</u>			<u>1.92</u>

(a) ICRP 30 classifies thorium compounds as Y and M type.

TABLE C-11

Sample Identification: B-083-S-4

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)			
		0	Clearance Rate M	Y	Total	0	M	Y	Total
Radium-226	0.5±0.2	0.19	0.01	0.01	0.21	-	0.02	0.37	0.39
Radium-228	< 0.10	-	-	-	-	-	-	-	-
Strontium-90	0.10±0.03	-	-	-	-	-	-	-	-
Uranium-234	0.55±0.17	0.02	-	0.02	0.02	0.02	0.21	0.23	
Uranium-235	0.06±0.05	-	-	-	-	-	0.02	0.02	
Uranium-238	0.28±0.12	0.01	-	0.01	0.01	0.01	0.08	0.09	
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	
Thorium-230	0.14±0.08	(a)	0.22	0.08	0.30	(a)	0.04	0.04	
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	
Total				0.54	7.45				0.77

Sample Identification: B-084-S-4

Radium-226	< 0.5	-	-	-	-	-	-	-	-
Radium-228	0.24±0.11	0.04	0.02	0.01	0.07	-	0.19	0.19	
Strontium-90	< 0.03	-	-	-	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	
Total				0.07	1.07				0.19

(a) ICRP-30 classifies thorium compounds as Y and W type.

TABLE C-12

Sample Identification: B-058-S-6*

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)				Exposure to Lung (mrem/yr)				
		D	Clearance Rate W	Y	Total	Ingestion	D	M	Y	Total
Radium-226	1.3±0.3	0.48	0.04	0.03	0.55	11.57	-	0.05	0.95	1.00
Radium-228	0.92±0.19	0.14	0.07	0.05	0.26	4.11	-	0.01	0.74	0.75
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	0.68±0.18	0.02	-	-	0.02	1.46	-	0.02	0.26	0.28
Uranium-235	0.14±0.10	-	-	-	-	0.27	-	-	0.04	0.04
Uranium-238	0.27±0.12	0.01	-	-	0.01	0.52	-	0.01	0.08	0.09
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					0.84	17.93				2.16

Sample Identification: B-060-S-6*

Radium-226	< 0.5	-	-	-	-	-	-	-	-	-
Radium-228	0.52±0.22	0.08	0.04	0.03	0.15	2.32	-	0.01	0.42	0.43
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	-
Total					0.15	2.40				0.43

(a) ICRP-80 classifies Thorium compounds as Y and M type.

TABLE C-12

Sample Identification: B-062-S-6'

Type of Analysis	Activity (pCi/g dry)	Exposure to Bone (mrem/yr)					Exposure to lung (mrem/yr)			
		D	Clearance Rate		Total	Ingestion	D	W	Clearance Rate	
			W	Y				Y	Total	
Radium-226	< 0.5	-	-	-	-	-	-	-	-	
Radium-228	< 0.10	-	-	-	-	-	-	-	-	
Strontium-90	< 0.03	-	-	-	-	-	-	-	-	
Uranium-234	< 0.05	-	-	-	-	-	-	-	-	
Uranium-235	< 0.05	-	-	-	-	-	-	-	-	
Uranium-238	< 0.05	-	-	-	-	-	-	-	-	
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-230	< 0.05	(a)	-	-	-	-	(a)	-	-	
Thorium-232	< 0.05	(a)	-	-	-	-	(a)	-	-	
Cesium-137	< 0.08	-	-	-	-	-	-	-	-	
Total										

Sample Identification: B-067-S-6'

Radium-226	2.5±0.2	0.93	0.07	0.06	1.06	22.25	-	0.09	1.83	1.92
Radium-228	1.5±0.1	0.23	0.12	0.09	0.44	6.70	-	0.02	1.21	1.23
Strontium-90	0.29±0.06	-	-	-	-	2.54	-	-	-	-
Uranium-234	0.23±0.11	0.01	-	-	0.01	0.49	-	0.01	0.09	0.10
Uranium-235	0.18±0.10	-	-	-	-	0.35	-	-	0.06	0.06
Uranium-238	0.21±0.11	-	-	-	-	0.41	-	0.01	0.06	0.07
Thorium-228	< 0.05	(a)	-	-	-	-	(a)	-	-	-
Thorium-230	0.30±0.12	(a)	0.48	0.18	0.66	0.60	(a)	0.01	0.10	0.11
Thorium-232	0.30±0.11	(a)	0.55	0.20	0.75	0.62	(a)	0.01	0.11	0.12
Cesium-137										
Total					<u>2.92</u>	<u>33.99</u>				<u>3.61</u>

(a) ICRP 30 classifies thorium compounds as Y and W type.

TABLE C-12

Sample Identification: B-069-S-6**

Type of Analysis	Activity (pCi/g dry)	D	Exposure to Bone (mrem/yr)		D	M	Exposure to Lung (mrem/yr)	
			Clearance Rate Y	Total			Ingestion	Clearance Rate Y
Radium-226	1.0±0.3	0.37	0.03	0.42	-	0.04	0.73	0.77
Radium-228	1.1±0.2	0.17	0.09	0.22	-	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-	-
Cesium-137	< 0.05	(a)	-	-	(a)	-	-	-
Total				0.64				1.68

Sample Identification: B-071-S-6*

Type of Analysis	Activity (pCi/g dry)	D	Exposure to Bone (mrem/yr)		D	M	Exposure to Lung (mrem/yr)	
			Clearance Rate Y	Total			Ingestion	Clearance Rate Y
Radium-226	0.9±0.2	0.34	0.02	0.38	-	0.03	0.66	0.69
Radium-228	1.1±0.1	0.17	0.09	0.22	-	0.02	0.89	0.91
Strontium-90	< 0.03	-	-	-	-	-	-	-
Uranium-234	0.48±0.17	0.01	-	0.01	-	0.02	0.18	0.20
Uranium-235	0.07±0.05	-	-	-	-	-	0.02	0.02
Uranium-238	0.16±0.09	-	-	-	-	-	0.04	0.04
Thorium-230	< 0.05	(a)	-	-	(a)	-	-	-
Thorium-232	0.50±0.15	(a)	0.80	1.10	(a)	0.02	0.16	0.18
Thorium-232	0.68±0.17	(a)	1.24	1.70	(a)	0.02	0.26	0.28
Cesium-137	0.20±0.02	-	-	-	-	-	-	-
Total				3.41				2.32

(a) ICRP-30 classifies thorium compounds as Y and M type.

TABLE C-12

Type of Analysis	Activity (pCi/q dry)	Exposure to Bone (μCi/yr)			Exposure to Lung (mrem/yr)		
		D	Clearance Rate $\frac{W}{Y}$	Total	D	W	Clearance Rate $\frac{Y}{Y}$
Radium-226	0.5±0.1	0.19	0.01	0.21	-	0.02	0.37
Radium-228	0.15±0.06	0.02	0.01	0.04	-	-	0.12
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	0.12±0.07	(a)	0.01	0.06	(a)	0.02	0.12
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.31	-	-	-
				5.16			0.65
Sample Identification: B-084-S-6 *							
Radium-226	< 0.5	-	-	-	-	-	-
Radium-228	±0.1	0.08	0.03	0.15	-	0.01	0.41
Strontium-90	< 0.03	-	-	-	-	-	-
Uranium-234	< 0.05	-	-	-	-	-	-
Uranium-235	< 0.05	-	-	-	-	-	-
Uranium-238	< 0.05	-	-	-	-	-	-
Thorium-228	< 0.05	(a)	-	-	(a)	-	-
Thorium-230	< 0.05	(a)	-	-	(a)	-	-
Thorium-232	< 0.05	(a)	-	-	(a)	-	-
Cesium-137	< 0.08	-	-	-	-	-	-
Total		-	-	0.15	-	-	-
				2.28			0.42

(a) ICRP-30 classifies thorium compounds as Y and W type.

APPENDIX D

Background Data

1981 BACKGROUND DATA

E-S SERIES

SURFACE

Type of Analysis	E-1-S-0 pCi/gm(dry)	E-2-S-0 pCi/gm(dry)	E-3-S-0 pCi/gm(dry)	E-4-S-0 pCi/gm(dry)	E-5-S-0 pCi/gm(dry)
Gross Alpha	5.9 ± 3.2	4.2 ± 2.9	5.1 ± 2.8	6.8 ± 3.2	5.2 ± 3.0
Gross Beta	4.7 ± 2.1	4.3 ± 2.1	4.6 ± 2.1	5.8 ± 2.2	6.4 ± 2.4
Radium-226	< 0.5	< 0.5	< 0.5	< 0.5	2.0 ± 0.5
Radium-228	< 0.10	0.43 ± 0.21	1.11 ± 0.31	0.87 ± 0.19	0.69 ± 0.26
Strontium-90	< 0.03	< 0.03	0.04 ± 0.03	0.12 ± 0.08	0.03
Uranium-234	1.24 ± 0.29	1.47 ± 0.32	0.95 ± 0.81	1.56 ± 0.23	1.35 ± 0.21
Uranium-235	0.42 ± 0.17	0.34 ± 0.15	0.36 ± 0.40	0.16 ± 0.08	0.28 ± 0.16
Uranium-238	1.03 ± 0.26	0.97 ± 0.26	0.79 ± 0.63	0.92 ± 0.19	0.63 ± 0.31
Thorium-228	0.10 ± 0.05	< 0.05	0.09 ± 0.04	< 0.05	< 0.05
Thorium-230	< 0.05	< 0.05	0.15 ± 0.07	0.10 ± 0.04	< 0.05
Thorium-232	< 0.05	< 0.05	0.35 ± 0.08	< 0.05	< 0.05
Cesium-137	< 0.08	< 0.08	< 0.08	0.66 ± 0.06	1.73 ± 0.13

1981 BACKGROUND DATA
 E-S SERIES - WATER SOLUBILITY TEST
 SURFACE

Type of Analysis	E-01-S-0 pCi/gm(dry)	E-02-S-0 pCi/gm(dry)	E-03-S-0 pCi/gm(dry)	E-04-S-0 pCi/gm(dry)	D-05-S-0 pCi/gm(dry)
Gross Alpha	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Gross Beta	< 0.1	< 0.1	0.4 ± 0.3	< 0.1	< 0.1
Radium-226	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Radium-228	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Strontium-90	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Uranium-234	1.9 ± 0.2	< 0.05	0.23 ± 0.10	< 0.05	< 0.05
Uranium-235	0.24 ± 0.09	< 0.05	0.07 ± 0.05	< 0.05	< 0.05
Uranium-238	0.13 ± 0.07	< 0.05	0.15 ± 0.08	< 0.05	< 0.05
Thorium-228	< 0.05	0.10 ± 0.04	< 0.05	< 0.05	< 0.05
Thorium-230	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Thorium-232	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cesium-137	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08

D-2

1981 BACKGROUND DATA

E-S SERIES

SURFACE

<u>Type of Analysis</u>	<u>E-6-S-0 pCi/gm(dry)</u>	<u>E-7-S-0 pCi/gm(dry)</u>	<u>E-8-S-0 pCi/gm(dry)</u>	<u>E-9-S-0 pCi/gm(dry)</u>
Gross Alpha	4.0 ± 2.4	3.2 ± 2.0	9.2 ± 3.3	8.8 ± 3.1
Gross Beta	12 ± 3	3.4 ± 2.0	8.2 ± 2.3	20 ± 3
Radium-226	0.7 ± 0.4	< 0.05	< 0.5	< 0.5
Radium-228	< 0.10	< 0.10	0.36 ± 0.19	< 0.10
Strontium-90	0.91 ± 0.19	< 0.03	0.33 ± 0.08	< 0.03
Uranium-234	< 0.05	2.09 ± 0.97	1.31 ± 0.44	0.94 ± 0.20
Uranium-235	< 0.05	0.90 ± 0.62	0.39 ± 0.24	< 0.05
Uranium-238	< 0.05	2.70 ± 1.08	0.97 ± 0.38	0.53 ± 0.18
Thorium-228	0.05 ± 0.03	< 0.05	0.05 ± 0.04	< 0.05
Thorium-230	0.21 ± 0.06	< 0.05	< 0.05	0.06 ± 0.04
Thorium-232	0.13 ± 0.05	< 0.05	< 0.05	0.13 ± 0.06
Cesium-137	4.76 ± 0.20	3.39 ± 0.21	1.92 ± 0.13	0.23 ± 0.04

1981 BACKGROUND DATA

E-S SERIES

SUB-SURFACE

Type of Analysis	E-1-S-6 pCi/gm(dry)	E-2-S-6 pCi/gm(dry)	E-3-S-6 pCi/gm(dry)	E-4-S-6 pCi/gm(dry)	E-5-S-6 pCi/gm(dry)
Gross Alpha	4.5 ± 3.0	4.0 ± 3.0	3.7 ± 2.4	4.4 ± 2.5	4.4 ± 3.2
Gross Beta	3.6 ± 2.1	2.8 ± 2.0	1.5 ± 1.0	3.0 ± 2.3	3.7 ± 2.1
Radium-226	< 0.5	1.6 ± 0.4	< 0.5	0.0 ± 0.3	1.8 ± 0.5
Radium-228	< 0.10	0.06 ± 0.22	0.38 ± 0.19	1.36 ± 0.25	< 0.1
Strontium-90	< 0.03	< 0.03	0.23 ± 0.11	< 0.03	< 0.03
Uranium-234	< 0.05	0.99 ± 0.19	0.98 ± 0.23	1.91 ± 0.31	0.49 ± 0.13
Uranium-235	< 0.05	0.11 ± 0.09	0.10 ± 0.03	0.23 ± 0.12	0.08 ± 0.06
Uranium-238	< 0.05	0.91 ± 0.18	0.74 ± 0.21	0.59 ± 0.28	0.38 ± 0.12
Thorium-228	0.06 ± 0.04	0.13 ± 0.07	0.06 ± 0.05	< 0.05	0.11 ± 0.05
Thorium-230	0.21 ± 0.08	0.08 ± 0.02	0.14 ± 0.08	< 0.05	0.09 ± 0.05
Thorium-232	0.19 ± 0.07	0.29 ± 0.03	0.12 ± 0.08	< 0.05	0.10 ± 0.05
Cesium-137	< 0.08	0.29 ± 0.05	0.28 ± 0.06	0.20 ± 0.04	< 0.08

P-0

1981 BACKGROUND DATA
 E-S SERIES - WATER SOLUBILITY TEST
 SURFACE

Type of Analysis	E-06-S-0 pCi/gm(dry)	E-07-S-0 pCi/gm(dry)	E-08-S-0 pCi/gm(dry)	E-09-S-0 pCi/gm(dry)
Gross Alpha	< 0.3	< 0.3	< 0.3	< 0.3
Gross Beta	0.7 ± 0.3	< 0.1	2.0 ± 0.4	< 0.1
Radium-226	< 0.5	< 0.5	< 0.5	< 0.5
Radium-228	< 0.10	< 0.10	1.1 ± 0.4	< 0.10
Strontium-90	< 0.03	< 0.03	< 0.03	< 0.03
Uranium-234	< 0.05	< 0.05	< 0.05	0.35 ± 0.11
Uranium-235	< 0.05	< 0.05	< 0.05	0.05 ± 0.04
Uranium-238	< 0.05	< 0.05	< 0.05	0.21 ± 0.10
Thorium-228	< 0.05	< 0.05	< 0.05	< 0.05
Thorium-230	< 0.05	< 0.05	< 0.05	< 0.05
Thorium-232	< 0.05	< 0.05	< 0.05	< 0.05
Cesium-137	< 0.08	< 0.08	< 0.08	< 0.08

D-5

1981 BACKGROUND DATA

E-S SERIES

SUB-SURFACE

Type of Analysis	E-6-S-6 pCi/gm(dry)	E-7-S-6 pCi/gm(dry)	E-8-S-6 pCi/gm(dry)	E-9-S-6 pCi/gm(dry)
Gross Alpha	3.1 ± 2.2	3.2 ± 2.2	3.6 ± 2.3	1.9 ± 0.9
Gross Beta	< 0.1	< 0.1	1.5 ± 1.1	< 0.1
Radium-226	< 0.5	< 0.5	0.67 ± 0.16	1.12 ± 0.26
Radium-228	< 0.10	< 0.10	0.90 ± 0.13	0.40 ± 0.14
Strontium-90	< 0.03	< 0.03	< 0.03	< 0.03
Uranium-234	< 0.05	3.79 ± 1.28	0.48 ± 0.13	0.40 ± 0.10
Uranium-235	< 0.05	1.42 ± 0.77	< 0.05	0.09 ± 0.05
Uranium-238	< 0.05	3.94 ± 1.29	0.26 ± 0.09	0.37 ± 0.09
Thorium-228	< 0.05	0.16 ± 0.06	0.09 ± 0.04	0.05 ± 0.03
Thorium-230	0.28 ± 0.10	0.32 ± 0.17	< 0.05	0.11 ± 0.05
Thorium-232	0.15 ± 0.10	0.21 ± 0.08	0.13 ± 0.08	0.14 ± 0.06
Cesium-137	0.29 ± 0.05	0.36 ± 0.07	< 0.08	0.55 ± 0.05