SRNL-STI-2010-00400

KEY WORDS: Tank Sampling
Tank 19F
Tank Closure

Statistical Analysis of Tank 19F Floor Sample Results

S. P. Harris

SEPTEMBER 2, 2010

Savannah River National Laboratory
Savannah River Nuclear Solutions
Savannah River Site
Aiken, SC 29808

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy

Author:

_____ _____
S. P. Harris, Author Date
Applied Computational Engineering and Statistics

Review/Approval:

_____ _____
E. P. Shine, Technical Reviewer Date
Applied Computational Engineering and Statistics

_____ _____
F. M. Pennebaker, Manager Date
Advanced Characterization & Processing

_____ _____
W. B. Dean, Closure and Disposal Assessment Date
Savannah River Remediation

_____ _____
G. D. Thaxton, Closure Project Engineering Date
Savannah River Remediation

_____ _____
P. L. Lee, Manager Date
Applied Computational Engineering and Statistics

This page intentionally left blank

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Representative sampling has been completed for characterization of the residual material on the floor of Tank 19F as per the statistical sampling plan developed by Harris and Shine [1]. Samples from eight locations have been obtained from the tank floor and two of the samples were archived as a contingency. Six samples, referred to in this report as the current scrape samples, have been submitted to and analyzed by SRNL [2].

This report contains the statistical analysis of the floor sample analytical results to determine if further data are needed to reduce uncertainty. Included are comparisons with the prior Mantis samples results [3] to determine if they can be pooled with the current scrape samples to estimate the upper 95% confidence limits ($UCL_{95\%}$) for concentration.

Statistical analysis revealed that the Mantis and current scrape sample results are not compatible. Therefore, the Mantis sample results were not used to support the quantification of analytes in the residual material. Significant spatial variability among the current scrape sample results was not found. Constituent concentrations were similar between the North and South hemispheres as well as between the inner and outer regions of the tank floor. The current scrape sample results from all six samples fall within their 3-sigma limits. In view of the results from numerous statistical tests, the data were pooled from all six current scrape samples. As such, an adequate sample size was provided for quantification of the residual material on the floor of Tank 19F.

The uncertainty is quantified in this report by an upper 95% confidence limit ($UCL_{95\%}$) on each analyte concentration. The uncertainty in analyte concentration was calculated as a function of the number of samples, the average, and the standard deviation of the analytical results. The $UCL_{95\%}$ was based entirely on the six current scrape sample results (each averaged across three analytical determinations).

This page intentionally left blank

1.0 INTRODUCTION

Representative sampling is required for characterization of the residual material on the floor of Tank 19F. Tank 19F is a Type IV underground waste storage tank located in the F-Tank Farm. It is a cylindrical-shaped, carbon steel tank with a diameter of 85 feet, a height of 34.25 feet, and a working capacity of 1.3 million gallons. Tank 19F was placed in service in 1961 and initially received a small amount of low heat waste from Tank 17. It then served as an evaporator concentrate (saltcake) receiver from February 1962 to September 1976. Tank 19F also received the spent zeolite ion exchange media from a cesium removal column that once operated in the Northeast riser of the tank to remove cesium from the evaporator overheads.

Recent mechanical cleaning of the tank removed all mounds of material resulting in a residual layer requiring characterization to support closure activities. Anticipating a low level of solids in the residual waste, Huff and Thaxton [4] developed a baseline sampling plan to sample the waste during the final clean-up process while it would still be resident in sufficient quantities to support analytical determinations in four quadrants of the tank. Execution of the baseline sampling plan produced fewer solids than expected to support analytical determinations in all quadrants. Huff and Thaxton [4] then restructured the plan to characterize the residual separately in the North and the South hemispheres.

The Huff and Thaxton [4] sampling plan focused on obtaining in-process samples using the Mantis rover. During the mechanical cleaning process, waste from Tank 19F was mobilized and transferred by eduction to a Waste Mix Chamber (WMC) in Tank 7. There the waste was ground by an immersion mill grinder to less than 38 microns. Once sufficiently triturated, the particles floated upward and into a sampler in the WMC.

The original sampling plan called for two in-process vials (samples) of about 125 ml each from each of four tank quadrants: Northwest, Northeast, Southwest, and Southeast. In addition, a third 125 ml vial per quadrant was planned as an archival sample.

The baseline plan was executed (Figure 1), and the samples were sent to the Savannah River National Laboratory (SRNL). The samples did not yield an adequate quantity of solids to support all of the analytical tests in all four quadrants. As a result, Huff and Thaxton [4] report that the sampling plan was revised by partitioning the tank into a North and a South hemisphere. In addition to the Mantis rover samples, a quality assurance (QA) scrape sample was obtained near the center riser slightly within the Southern hemisphere by scraping material from the tank floor (Figure 2). The amount of solids in the scrape sample was sufficient to support the analysis of a subset of key analytes.

The sampling plan was revised several more times for various reasons. First, the justification for using in-process samples for characterization was based upon an assumption that the mechanical cleaning of the tanks would result in a tank that was so clean that it would not be possible to retrieve a sufficient quantity of sample solids to perform a full characterization of the residual waste. This assumption was proven false at the completion of mechanical cleaning. Additional revisions resulted from a statistical review of the preliminary sample analysis results (which indicated that additional data was needed) and due to the addition of more analytes in the sample

analyses (which required a larger mass of sample material at each sample location).

A subsequent sampling plan developed by Harris and Shine [1] was implemented to complete the characterization of the residual material on the floor of the tank. Specifically, the sample size was determined from a modification of the formula previously published in Edwards [4] and the sample characterization data for previous sampling of Tank 19F described by Oji [3]. The Harris and Shine sampling plan [1] was based on partitioning the Tank 19F floor into an inner and an outer ring and six 60° sectors as depicted in Figure 3. The inner and outer regions were selected so that each region contains approximately fifty percent of the residual material. The location of the border between the inner and outer rings is based on dividing the residual material into two approximately equal volumes. Apart from the new samples to be archived, there were three samples taken from each hemisphere. In order to balance the samples between the inner and outer rings, two of the additional samples were taken from the outer ring in each hemisphere. The two samples, one from each hemisphere, slated to be archived were taken from the inner ring, since they are the primary contingency if the Mantis samples were demonstrated to be incompatible with the scrape samples. The scrape samples that were archived were closest to the Mantis sample in each hemisphere.

A scrape sample taken from the floor was obtained from each of the six sectors, three in each hemisphere (North and South), consisting of one within the inner and two within the outer region of each hemisphere. In addition, two samples were taken within the inner region (one in each hemisphere) and archived.

This sampling plan assumed that concentration may differ between the North and South hemispheres so each hemisphere was sampled independently. The sampling plan supported separate quantification of the analyte concentrations in the two hemispheres if the results from the North and the South hemispheres were not demonstrated to be similar.

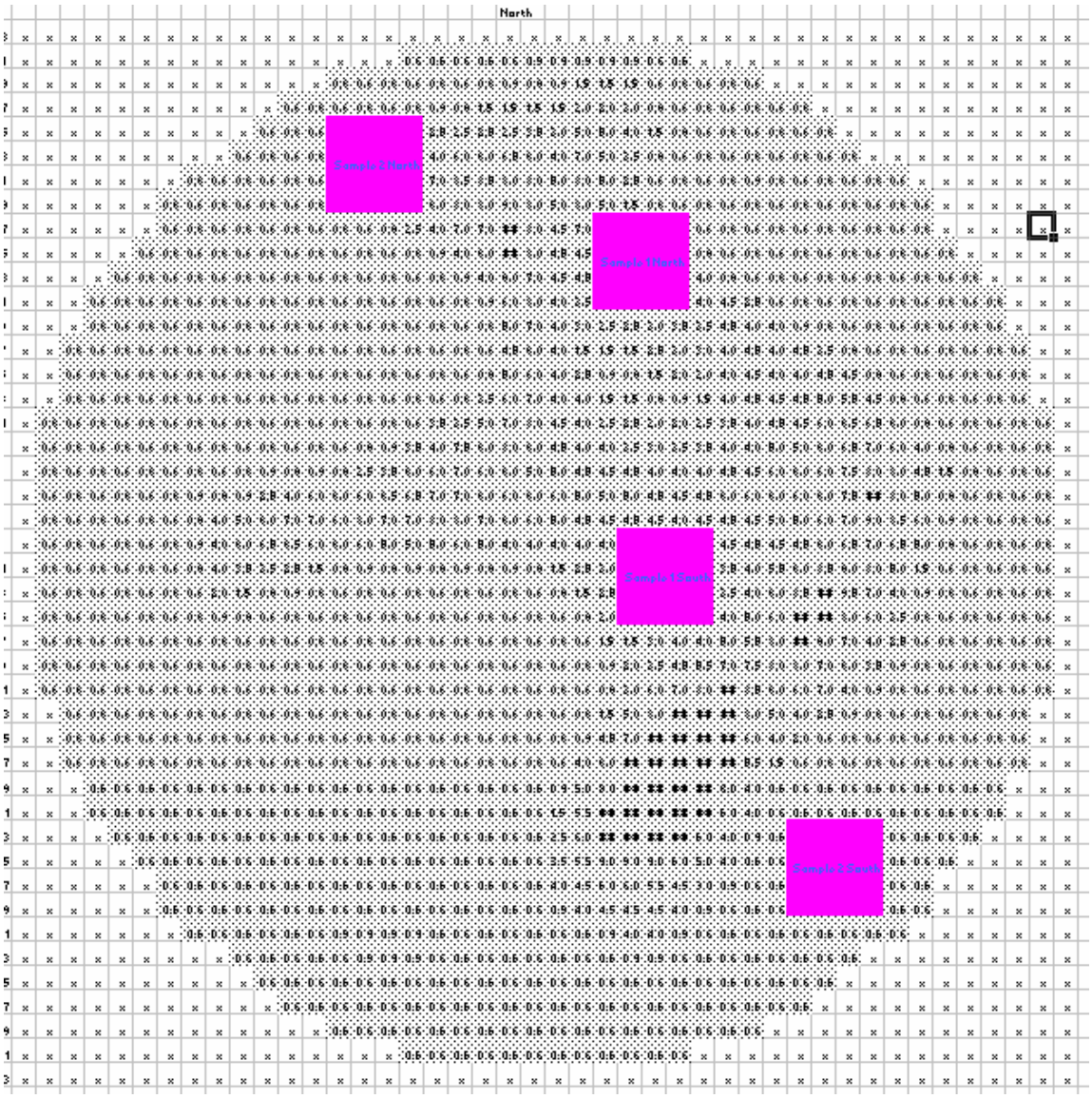
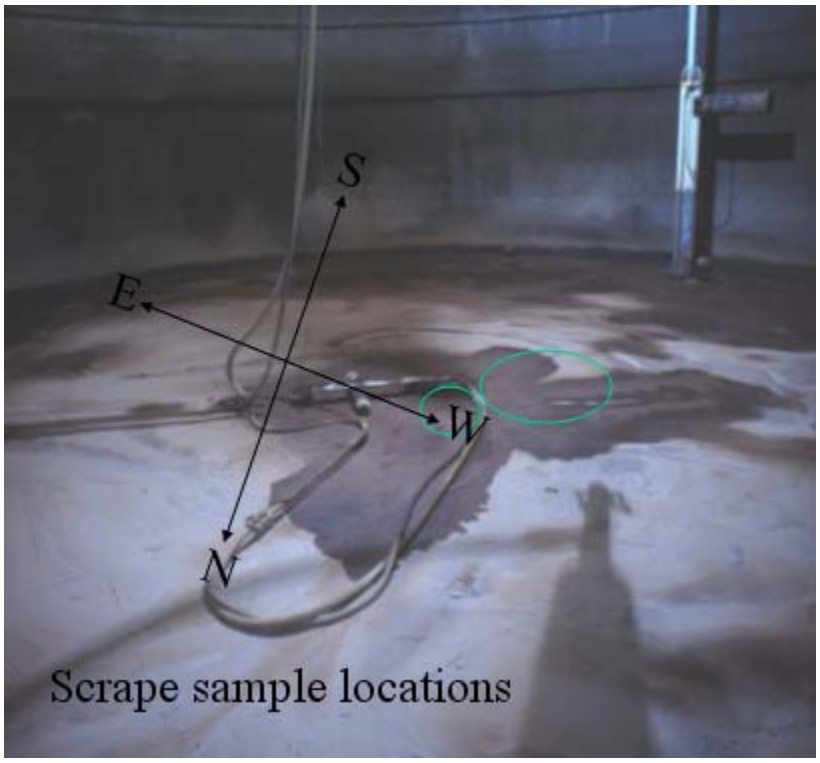


Figure 1. Previous[1] Mantis rover sampling locations in Tank 19[2]

[1]Each of squares forming the grid is 2-by-2 feet square.

[2] Table information from E-mail communication from K. Barbour, Type IV Tank Closure org., August 10, 2009

Figure 2. Tank 19 Scrape Sample Locations (Southern Hemisphere)



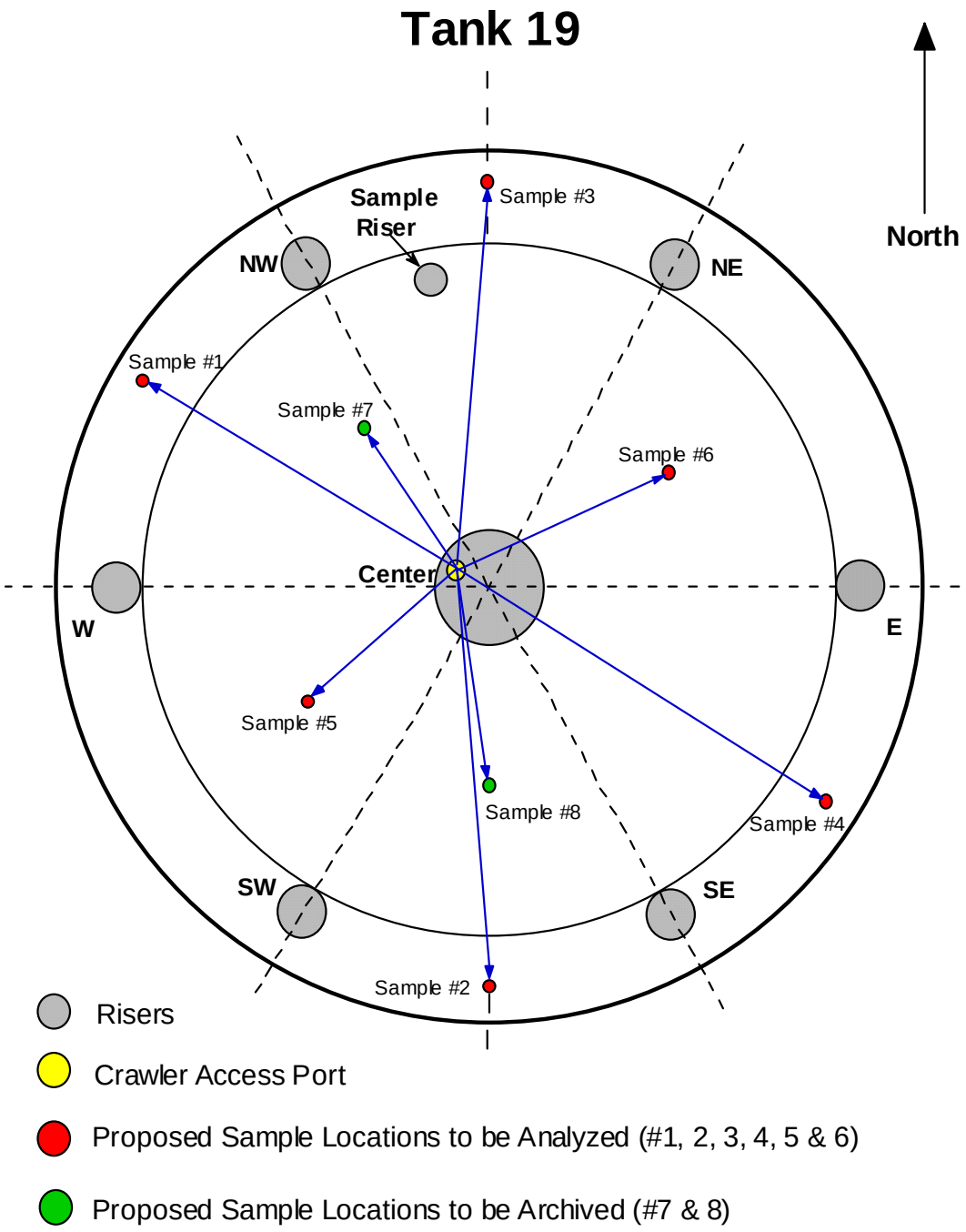


Figure 3. Tank 19 Current Scrape Samples

This page intentionally left blank

2.0 DATA

The current floor scrape samples [FTF-19-1, FTF-19-2, FTF-19-3, FTF-19-4, FTF-19-5, FTF-19-6, FTF-19-7 and FTF-19-8 in Table 1] were taken from Tank 19F floor in February, 2010 and made available to SRNL for analyses in the same month. Sample FTF-19-7 and FTF-19-8 served as archived samples and thus were not analyzed. The suffix on each Sample ID is referred to as the sample number. The corresponding sectors (non-overlapping 60° segment of the tank) where the samples were taken are listed in Table 1. The six Tank 19F samples ("as-received") were digested at SRNL and characterized without further processing such as drying. The conversion to a dried solids basis (original "as received" basis to dry basis) was accomplished through the use of the weight percent solid (wt %) [2, 3]. For example, μCi/g dry solids = [μCi/g of "as received solids" x (100/ wt % solids)].

Table 1. Tank 19F Floor Samples (February 2010)

Sample ID	Sector	Hemisphere	Min Degrees	Max Degrees	Sample ID	Inner/ Outer Code	Analyzed/ Archived
1	3	North	120	180	FTF-19-1	Outer	Analyzed
2	5	South	240	300	FTF-19-2	Outer	Analyzed
3	2	North	60	120	FTF-19-3	Outer	Analyzed
4	6	South	300	360	FTF-19-4	Outer	Analyzed
5	4	South	180	240	FTF-19-5	Inner	Analyzed
6	1	North	0	60	FTF-19-6	Inner	Analyzed
7	3	North	120	180	FTF-19-7	Inner	Archived
8	5	South	240	300	FTF-19-8	Inner	Archived

Three replicate measurements were made for each analyte and sample. Analysis results reported by SRNL [2, 3] with values preceded by "<" (less than sign) indicate that the values were below detection limits (Table 4). Sample results with two or three repeat analyses below detection were not included in the statistical estimation. The censored data estimation procedure in Statgraphics [6] was used to estimate the mean when one value out of three was below the detection limit.

This page intentionally left blank

3.0 STATISTICAL REVIEW

The current floor scrape sample results were compared to the results from the Mantis samples to determine if the Mantis and current scrape sample results can be pooled to estimate the upper 95% confidence limits ($UCL_{95\%}$) for concentration. Statistical analysis of the analytical results revealed that the Mantis and current scrape sample results are not compatible. The Mantis samples, retrieved after grinding from the Waste Mix Chamber, may have been altered based on the residence time in the grinder. Therefore, the Mantis results were not used to quantify the analytes in the residual material. The results from the prior quality assurance scrape sample were not included in calculating $UCL_{95\%}$ because they were only available for approximately 25% of measured analytes. The QA scrape sample results all fall within the 3-sigma limits. Their inclusion with the current scrape sample results would have a negligible impact (within 3%) on the upper 95% confidence limits for most analytes.

After a statistical comparison demonstrated spatial similarity, the results from the entire tank were consolidated into a single unit. As a result, adequate sample size was obtained for quantification of the residual material on the floor of Tank 19F. Analyzing the archive samples was not necessary since essentially no significant difference was found between the North and South hemispheres measurements (except for Hg). Furthermore, no significant differences were found between the inner and outer regions (except for Fe). The uncertainty was quantified by an upper 95% confidence limit ($UCL_{95\%}$) on each analyte concentration. The uncertainty in analyte concentration was calculated as a function of the number of samples, the average, and the standard deviation of the analytical measurements. The $UCL_{95\%}$ was based entirely on the six current scrape sample results each averaged across three determinations.

The statistical tests that were conducted and the data used for evaluating the differences between hemispheres and also between the inner and outer regions are listed in Table 2. No significant differences were found between the inner and outer regions within hemispheres (except for Fe in the North Hemisphere) and in addition no significant differences were found between the hemispheres except for Hg (Table 5). Finally an overall test revealed that only the Fe concentration difference between the inner and outer regions was significant. In comparing the current scrape sample results with the Mantis sample results, significant differences were found within hemispheres for Am-241, Cd, Co-60, Cs-135, Eu-154, Hg, Np-237, Pu238, Sm-151, Ti, U234 and U238 (Table 6 with entries 0.05 or less).

Table 2. Statistical Models and Data Sources for Testing Mantis vs Scrape, North vs. South Hemisphere and Inner vs. Outer Region Differences

Data Used (Y) (Dry Solids)	Terms in Model	Nested Terms	Results Table	Columns in Table	Tests
New Scrape Only	Hemisphere	Inner_Outer[Hemisphere]	Table 5	Cols 2, 3	Inner vs. Outer within Hemisphere
New Scrape Only	Hemisphere	n/a	Table 5	Col 4	North vs. South Overall
New Scrape Only	Hemisphere	Inner_Outer[Hemisphere]	Table 5	Col 5	Overall Inner vs. Outer and North vs. South
New Scrape and Mantis	Hemisphere	Scrape_Mantis[Hemisphere]	Table 6	Cols 2, 3	New Scrape vs Mantis; North within Hemisphere
New Scrape and Mantis	Hemisphere	n/a	Table 6	Col 4	North vs. South Overall
New Scrape and Mantis	Hemisphere	Scrape_Mantis[Hemisphere]	Table 6	Col 5	Overall New Scrape vs Mantis and North vs. South

Sequence plots by sector (Sector definitions are in Table 1) are displayed in Appendix 1 for the current scrape sample results for the analytes above detection. The results for the inner region are displayed using solid black dots while the results for the outer region are displayed using open dots. In addition, the Mantis sample results and the prior scrape sample results are superimposed on the sequence plots. Generally, no discernable patterns were found in the sequence plots for the current scrape samples going counterclockwise around the tank from due east (Zero degrees). The differences noted while conducting significance tests were corroborated through visual inspection of the sequence plots. The Mantis sample results do not overlap the current scrape samples for a number of analytes. In particular, both the North and South Mantis sample results are both either higher or lower than the six current scrape sample results for Cs-135, Nitrate, Np-237 and U-233.

The data (z-score) for constructing 3-sigma charts were standardized by subtracting the average and then dividing by the sample standard deviation calculated from the current floor scrape data. If the data are well behaved and fall into the same range as the current scrape samples, the plotted points should fall between plus and minus three. The 3-sigma charts for the standardized data are displayed in Appendix 2, 3a and 3b. Review of the chart in Appendix 2 suggests that the new scrape sample and Mantis sample results are not similar. The Mantis results and the prior scrape sample results were eliminated from the plot and the remaining results (Current Scrape Sample) are displayed in Appendix 3a. The Sample 1 (Sector 3: 120 to 180 deg) result is at the upper range for a number of analytes (e.g.: Am-241, Am-243, Cs-137). To compare Sample 1 with the remaining scrape samples (Samples 2 through 6), the current scrape sample results were standardized by using the average and standard deviations for samples 2 through 6 (Appendix 3b). The plot shows that Am-241, Am-243, Eu-154, Pu-238 and Tc-99 from Sample 1 are outside the upper control limit (+3). Both Ba-137m and Cs-137 are below the lower control limit (-3). The current scrape sample results from all six samples fall within the 3-sigma control limits (Appendix 3a). Therefore, the results from all six samples were used in calculating the confidence limits.

3.1. Upper Confidence Limits

The upper 95% confidence limits were established for analytes that have supporting data (an adequate number of results above the detection limit). The limit establishes a credible upper bound on the concentration of analyte *a* in the residual material on the floor of the tank. The form of the interval is as follows.

$$UCL_{95\%} = \bar{x}_a + t_{0.95,df} s_a / \sqrt{n}, \quad (1)$$

where $\bar{x}_a$ is the average of the sample means of analyte a, s_a is the corresponding sample standard deviation, and $t_{0.95,df}$ is the upper 95th percentile of the t-distribution with df degrees of freedom. For the current scrape samples, n is usually equal to six and $t_{0.95,5} = 2.02$. The *df* is the degrees of freedom associated with s_a, based on $n-1$ sampling degrees of freedom where n is the number of samples. The standard deviation includes sample preparation variation, measurement error and the sampling variation within Tank 19F.

The $UCL_{95\%}$ depends on the sample design, the number of samples in each stratum, and the number of analytical determinations per sample. An increase in the number of samples or an increase in the number of determinations per sample will generally produce a decrease in the $UCL_{95\%}$. In the current sampling plan, the three repeat analyses on each sample and analyte were determined to be adequate [1]. These results were averaged resulting in six sample results (one for each sector).

Table 3 lists constituents that have sufficient measurements above detection to compute an $UCL_{95\%}$. The table is based on combining the North and South hemisphere, inner and outer measurements. The estimated concentrations are in *uCi/g* or *Wt%* dried solids dependent on the constituent measured. The $UCL_{95\%}$ for an analyte is the upper 95% confidence limit for the average tank concentration for the analyte. The 95% level of confidence refers to the reliability of the method, in that 95% of such upper confidence will correctly bound the actual mean concentration.

Table 3. Constituent Averages, Standard Deviations, and $UCL_{95\%}$ for the Current Scrape Samples on a Dried Solids Basis

Analyte	Units	Average	Standard Deviation	Upper 95% Confidence Limit
Am-241	uCi/g	2.48E-01	7.96E-02	3.14E-01
Am-243	uCi/g	6.03E-04	2.58E-04	8.16E-04
Ba	Wt%	8.70E-02	1.11E-02	9.61E-02
Ba-137m	uCi/g	5.77E+02	6.10E+01	6.27E+02
C-14	uCi/g	2.86E-01	2.49E-01	4.90E-01
Cd	Wt%	1.19E-02	2.62E-03	1.40E-02
CHLORIDE	Wt%	1.87E-02	6.66E-03	2.42E-02
Cm-244	uCi/g	3.81E-02	1.28E-02	4.87E-02
Co-60	uCi/g	4.65E-03	7.85E-04	5.30E-03
Cr	Wt%	3.22E-02	4.42E-03	3.58E-02
Cs-135	uCi/g	2.78E-03	2.24E-04	2.97E-03
Cs-137	uCi/g	6.09E+02	6.45E+01	6.63E+02
Eu-154	uCi/g	8.46E-04	2.19E-04	1.03E-03
Fe	Wt%	3.75E+00	1.31E+00	4.83E+00
FLUORIDE	Wt%	1.51E-01	3.56E-02	1.80E-01
Hg	Wt%	3.26E-02	1.67E-02	4.63E-02
I-129	uCi/g	7.64E-06	4.22E-06	2.65E-05
Mn	Wt%	1.67E-01	2.46E-02	1.88E-01
NITRATE	Wt%	1.55E+00	6.25E-01	2.06E+00
NITRITE	Wt%	8.07E-01	3.14E-01	1.07E+00
Np-237	uCi/g	1.53E-04	1.81E-05	1.68E-04
Pd-107	uCi/g	7.59E-03	9.71E-03	2.40E-02
Pu-238	uCi/g	3.79E-01	5.08E-02	4.21E-01
Pu-239	uCi/g	4.02E-01	8.64E-02	4.74E-01
Pu-240	uCi/g	9.84E-02	2.11E-02	1.16E-01
Pu-241	uCi/g	6.50E-01	1.24E-01	7.53E-01
Ra-226	uCi/g	1.15E-03	3.50E-04	1.44E-03
Sb-126	uCi/g	3.66E-04	5.94E-05	4.15E-04
Sb-126m	uCi/g	3.82E-04	3.39E-05	4.10E-04
Sm-151	uCi/g	1.80E-02	2.50E-03	2.00E-02
Sn-126	uCi/g	3.82E-04	3.39E-05	4.10E-04
Sr-90	uCi/g	7.40E-01	3.26E-01	1.01E+00
Tc-99	uCi/g	3.88E-02	8.23E-03	4.55E-02
Th-229	uCi/g	1.49E-05	5.52E-06	2.42E-05
Th-230	uCi/g	7.64E-06	1.30E-06	1.35E-05
Ti	Wt%	4.97E-02	5.94E-03	5.46E-02
U-232	uCi/g	1.07E-05	2.37E-06	1.26E-05
U-233	uCi/g	4.37E-04	6.60E-05	4.91E-04
U-234	uCi/g	5.09E-04	7.68E-05	5.72E-04
U-235	uCi/g	1.78E-05	2.74E-06	2.01E-05
U-236	uCi/g	2.66E-05	3.74E-06	2.97E-05
U-238	uCi/g	5.84E-04	8.05E-05	6.50E-04
Y-90	uCi/g	7.40E-01	3.26E-01	1.01E+00

Analyte	Units	Average	Standard Deviation	Upper 95% Confidence Limit
Zn	Wt%	7.20E-03	1.40E-03	8.35E-03
Zr-93	uCi/g	1.43E-03	8.62E-04	2.14E-03

Table 4. Current Scrape Sample Constituents with 2 or 3 Repeat Measurements Below Detection Limits

Radiological Constituents		Elemental Constituents	
Analyte	**Number of Samples**	**Analyte**	**Number of Samples**
Ac-227	**6**	**Ag**	**6**
Al-26	**6**	**As**	**6**
Am-242m	**6**	**B**	**6**
Cf-249	**6**	**Be**	**6**
Cm-243	**6**	**Ce**	**6**
Cm-245	**6**	**Cu**	**6**
Cm-247	**6**	**Gd**	**6**
Cm-248	**6**	**La**	**6**
Eu-152	**1**	**Li**	**6**
Eu-152	**5**	**Mo**	**6**
Eu-155	**6**	**Ni**	**6**
H-3	**6**	**P**	**6**
I-129	**4**	**Pb**	**6**
Ni-59	**6**	**S**	**6**
Ni-63	**6**	**Sb**	**6**
Pa-231	**6**	**Se**	**6**
Pm-147	**6**	**U**	**6**
Pu-242	**6**	**V**	**6**
Pu-244	**6**		
Ra-226	**6**		
Se-79	**6**		
Th-229	**3**		
Th-230	**4**		
U-233	**2**		

This page intentionally left blank

4.0 RESULTS AND CONCLUSIONS

The Mantis sample results were significantly different from the current floor samples. Considering that the Mantis samples were taken prior to cleaning and prior to evaporation and in view of the statistical results, the current scrape samples were used to characterize the material remaining in the tank.

The characterization of Tank 19F floor is fully supported by the current scrape samples. Within each hemisphere, inner and outer regions were sampled, resulting in eight samples. Six samples were analyzed and two samples were archived. Statistical models were used for significance testing of the inner and outer region nested within hemispheres, hemisphere differences, and also for scrape versus Mantis sample results.

Determined from over 150 comparisons, the current scrape sample characterization data representing spatial areas on the tank floor showed significant differences for only two constituents: Hg and Fe. The results from the six samples were combined for each constituent. The QA scrape sample data set was not included in estimating the $UCL_{95\%}$s since it would have a negligible impact on the results. If further reduction in the upper confidence limits is needed, the archived samples could be analyzed and included in the statistical computations.

Table 5. Tail Probabilities (p values) and Significance Testing for Regional Differences (Inner vs. Outer, North vs. South Hemispheres) using the Current Scrape Samples

P≤ 0.05 indicates significance at the 5% level (95% Confidence) (red)

Analyte	New Scrape Inner vs. Outer North	New Scrape Inner vs. Outer South	New Scrape North vs. South	New Scrape Overall
Am-241	0.64	0.83	0.43	0.84
Am-243	0.64	0.90	0.38	0.83
Ba	0.17	0.55	0.75	0.40
Ba-137m	0.54	0.98	0.47	0.82
C-14	0.85	0.66	0.78	0.94
Cd	0.92	0.63	0.66	0.92
Cm-244	0.49	0.57	0.83	0.77
Co-60	0.54	0.75	0.69	0.85
Cr	0.62	0.70	0.45	0.81
Cs-135	0.07	0.76	0.39	0.16
Cs-137	0.54	0.98	0.47	0.82
Eu-154	0.50	0.90	0.34	0.72
Fe	(In> Out) 0.00	0.06	0.80	0.01
Hg	0.82	0.76	(N>S) 0.01	0.27
I-129	0.87	0.84	0.88	0.99
Mn	0.97	0.80	0.92	0.99
Nitrate	0.72	0.57	0.11	0.50
Np-237	0.63	0.74	0.34	0.78
Pu-238	0.66	0.61	0.35	0.75
Pu-239	0.91	0.54	0.76	0.88

Analyte	New Scrape Inner vs. Outer North	New Scrape Inner vs. Outer South	New Scrape North vs. South	New Scrape Overall
Pu-240	0.83	0.63	0.81	0.93
Pu-241	0.98	0.57	0.78	0.91
Ra-226	0.98	0.99	0.66	0.99
Sb-126	0.46	0.16	0.10	0.18
Sb-126m	0.18	0.15	0.08	0.11
Sm-151	0.49	0.54	0.52	0.70
Sn-126	0.18	0.15	0.08	0.11
Sr-90	0.84	0.08	0.65	0.20
Tc-99	0.38	0.80	0.90	0.75
Ti	0.27	0.72	0.50	0.53
U-232	0.62	0.70	0.42	0.80
U-233	0.67	0.71	0.36	0.80
U-234	0.52	0.69	0.80	0.84
U-235	0.91	0.75	0.79	0.97
U-236	0.27	0.67	0.67	0.56
U-238	0.60	0.76	0.77	0.90
Y-90	0.84	0.08	0.65	0.20
Zn	0.45	0.25	0.43	0.43

Table 6. Tail Probabilities (p values) and Significance Testing for Mantis, Scrape Sample and Hemisphere Differences

P≤ 0.05 indicates significance at the 5% level (95% Confidence) (red)

Analyte	New Scrape vs Mantis North	New Scrape vs Mantis South	New Scrape vs Mantis N S Combined	New & Old Scrape Combined vs Mantis, S Only
Am-241	(Man> Scr) 0.00	0.62	0.15	N/A
Am-243	0.89	0.61	0.63	N/A
Ba	0.87	0.76	0.69	N/A
Ba-137m	0.24	0.95	0.35	N/A
C-14	0.38	0.50	0.19	N/A
Cd	(Man>Scr) 0.01	0.37	0.30	N/A
Cm-244	0.57	0.35	0.76	N/A
Co-60	(Man>Scr) 0.04	0.46	0.37	N/A
Cr	0.11	0.59	0.15	N/A
Cs-135	(Man>Scr) 0.00	0.01	(Man>Scr) 0.00	N/A
Cs-137	0.29	0.94	0.41	0.71
Eu-154	(Man> Scr) 0.00	0.80	0.11	N/A
Fe	1.00	0.97	0.97	N/A
Hg	(Man>Scr) 0.05	0.28	0.16	N/A
I-129	N/A	N/A	0.01	N/A
Mn	0.31	0.14	(Man<Scr) 0.045	N/A
Nitrate	0.29	0.052	0.06	N/A
Np-237	(Man<Scr) 0.01	(Man<Scr) 0.00	(Man<Scr) 0.00	(Scr>Man) 0.01
Pu-238	0.37	(Man<Scr) 0.02	0.06	(Scr>Man) 0.01
Pu-239	0.53	0.36	0.83	0.24
Pu-240	0.78	0.24	0.49	0.09
Pu-241	0.51	0.58	0.93	0.36
Ra-226	N/A	N/A	0.46	N/A
Sb-126	0.42	0.42	0.99	N/A
Sb-126m	0.17	0.62	0.55	N/A
Sm-151	(Man>Scr) 0.00	0.13	0.22	N/A
Sn-126	0.17	0.62	0.55	N/A
Sr-90	0.11	0.40	0.54	N/A
Tc-99	0.65	0.50	0.85	N/A
Ti	0.06	(Man>Scr) 0.04	(Man>Scr) 0.00	N/A
U-232	0.42	0.08	(Man<Scr) 0.05	N/A
U-233	0.07	0.14	(Man<Scr) 0.02	0.19
U-234	(Man> Scr) 0.01	0.15	0.42	N/A
U-235	0.38	0.10	0.06	0.13
U-236	0.35	0.12	0.06	0.22
U-238	0.18	(Man<Scr) 0.05	(Man<Scr) 0.02	0.15
Y-90	0.11	0.40	0.54	N/A
Zn	0.44	0.48	0.25	N/A

This page intentionally left blank

5.0 REFERENCES

[1] Harris, S.P. and Shine, E.P., Recommendations for Sampling of Tank 19 in F Tank Farm, SRNL-STI-2009-00779, December 2009.

[2] Oji, L.N., Diprete, D.D. and Coleman, C.J., Characterization of Additional Tank 19F Floor Samples, SRNL-STI-2010-00439, August 30, 2010.

[3] Oji, L.N., Diprete, D., and Click, D.R., Characterization Tank 19F Samples, SRNL-STI-2009-00700, Rev. 0, December 17, 2009.

[4] Huff, T. and Thaxton, G.D. Draft of "Tanks 18 and 19 Waste Determination Sample Plan," LWO-LWE-2008-00186, Revision 2, Savannah River Site, Aiken, SC. (June 22)

[5] Edwards, T.B., "A Decision Support Tool for Planning the Sampling of Tank 19 (U)," WSRC-RP-2001-00781, Revision 0, July 2001.

[6] Statgraphics Centurion XV, Ver. 15.1.03, StatPoint, Inc.

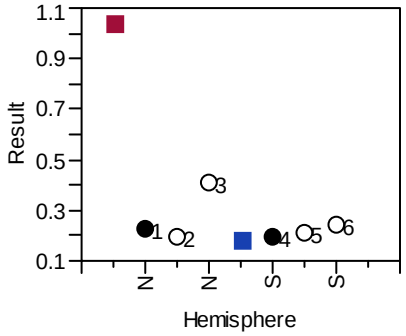
This page intentionally left blank

APPENDIX 1. SEQUENCE PLOTS FOR TANK 19F MANTIS AND SCRAPE SAMPLE RESULTS

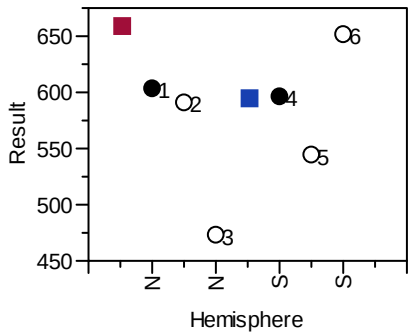
by Analyte , Hemisphere and Sector (Dried Solids)

■	1	Mantis N	
■	2	Mantis S	
●	3	New Scrape	Inner
○	4	New Scrape	Outer
●	5	Prior Scrape	

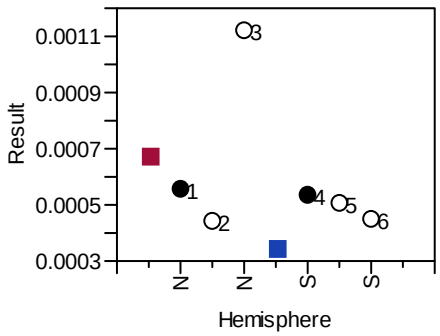
Am-241, uCi/g



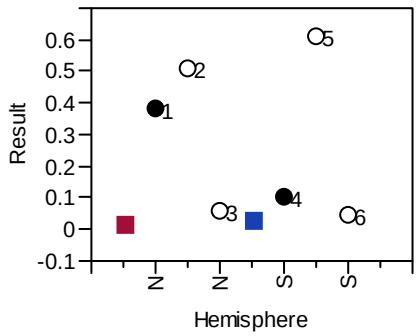
Ba-137m, uCi/g



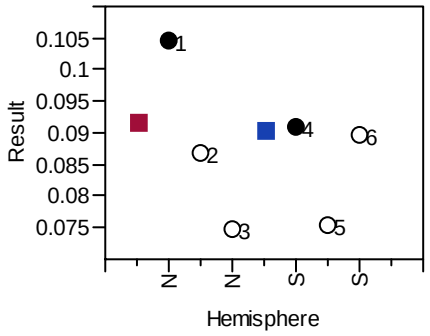
Am-243, uCi/g



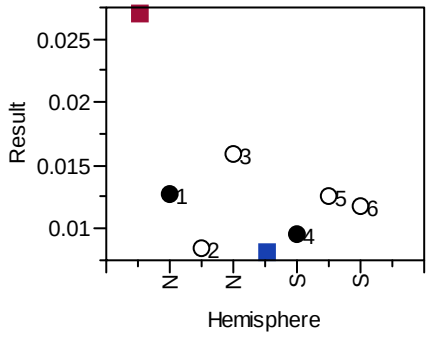
C-14, uCi/g



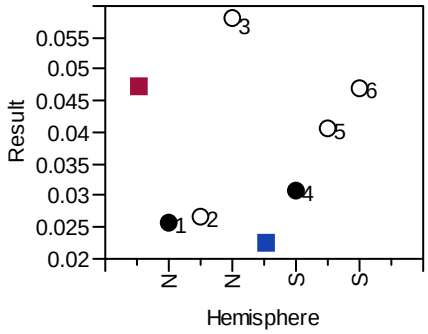
Ba, Wt%



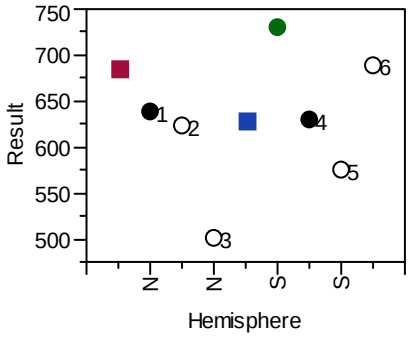
Cd, Wt%



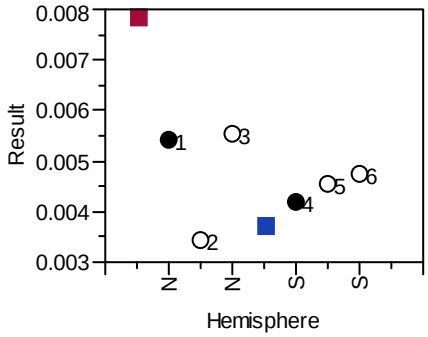
Cm-244, uCi/g



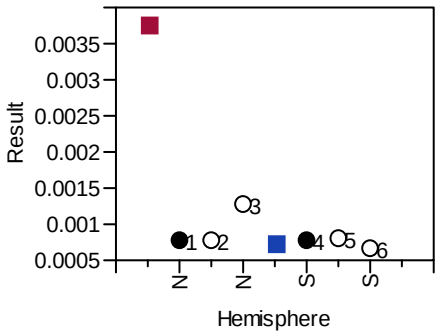
Cs-137, uCi/g



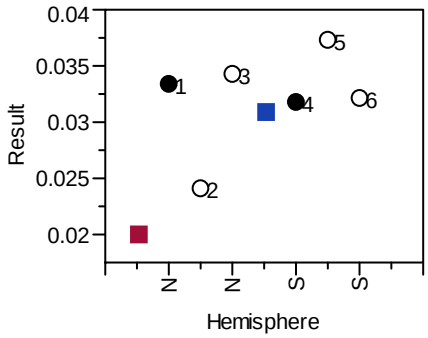
Co-60, uCi/g



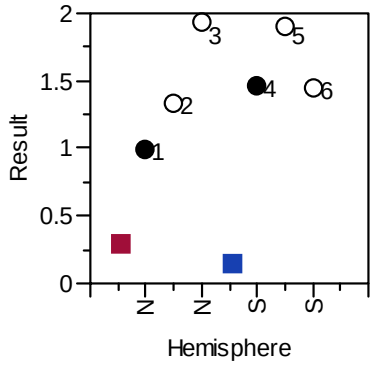
Eu-154, uCi/g



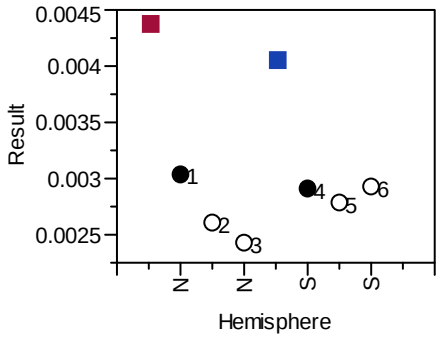
Cr, Wt%



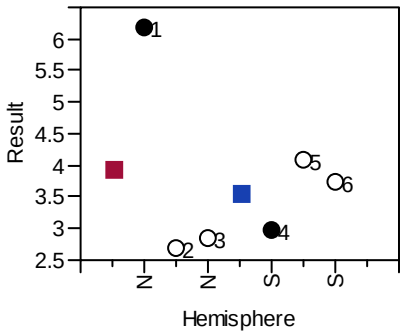
F-1, Units=mg/g solids



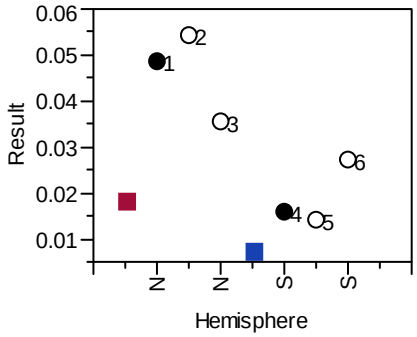
Cs-135, uCi/g



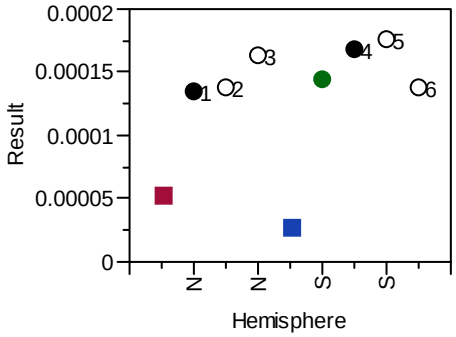
Fe, Wt%



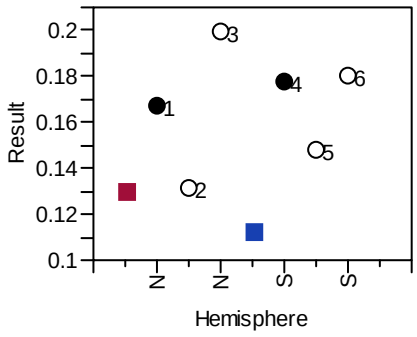
Hg, Wt%



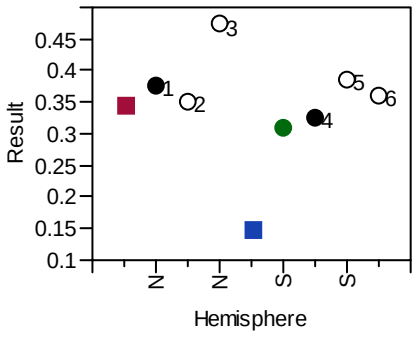
Np-237, uCi/g



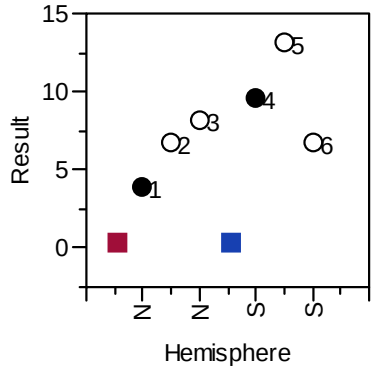
Mn, Wt%



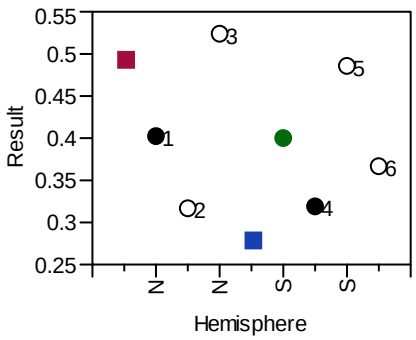
Pu-238, uCi/g



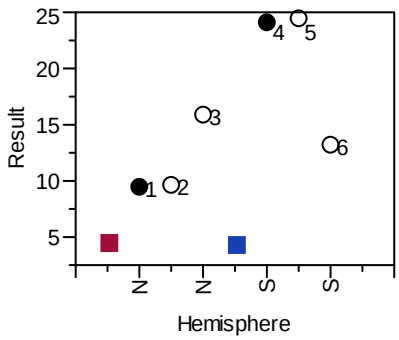
NO2-1, Units=mg/g solids



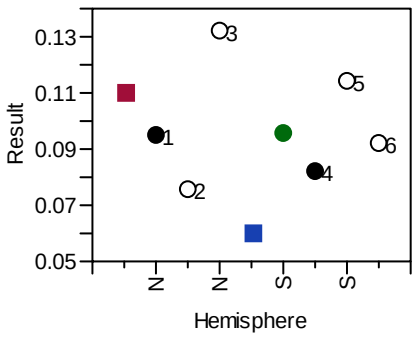
Pu-239, uCi/g



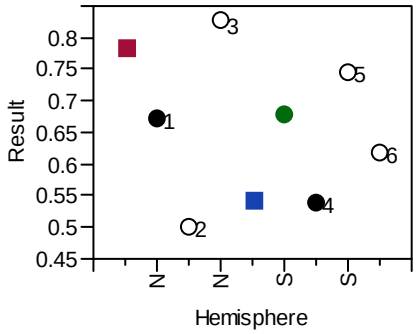
Nitrate, mg/g



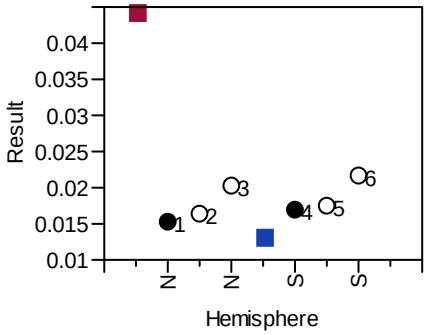
Pu-240, uCi/g



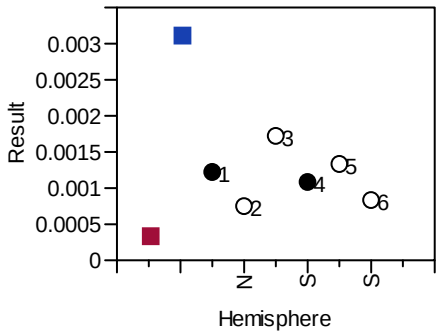
Pu-241, uCi/g



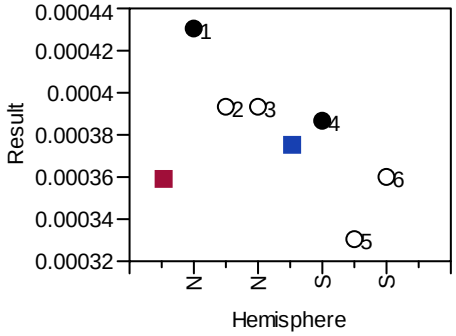
Sm-151, uCi/g



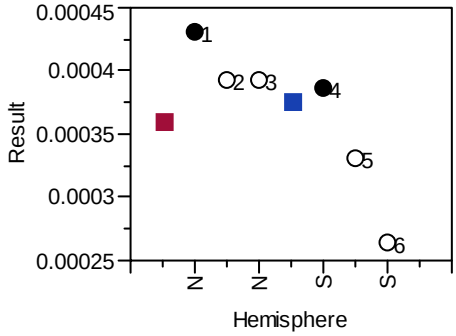
Ra-226, uCi/g



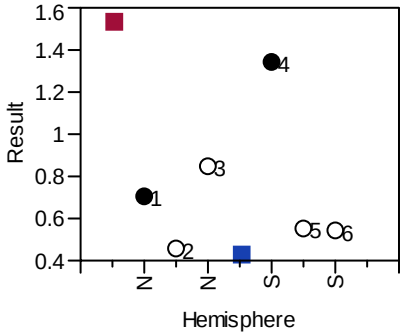
Sn-126, uCi/g



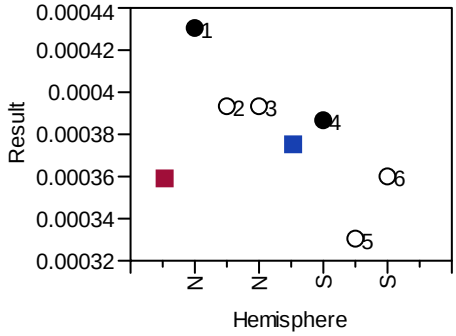
Sb-126, uCi/g



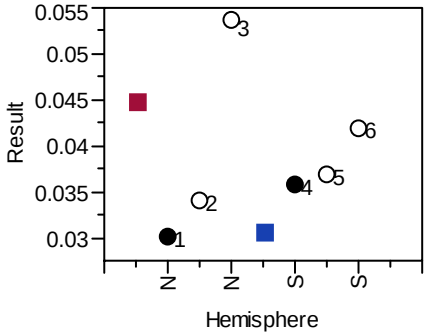
Sr-90, uCi/g



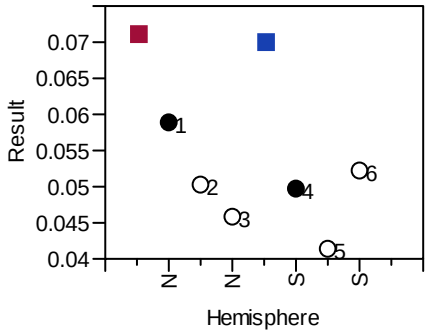
Sb-126m, uCi/g



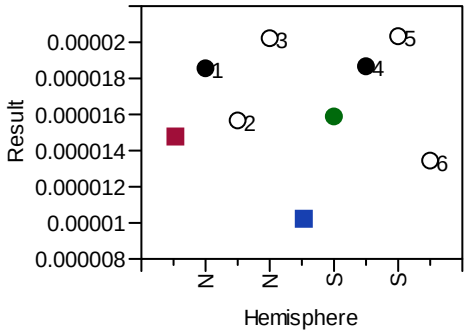
Tc-99, uCi/g



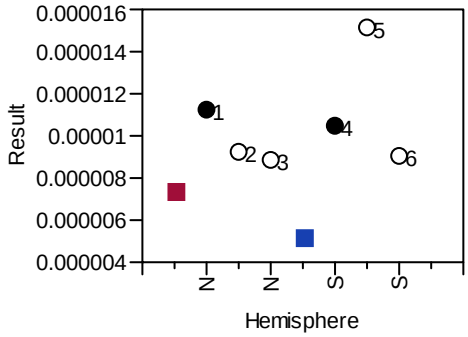
Ti, Wt%



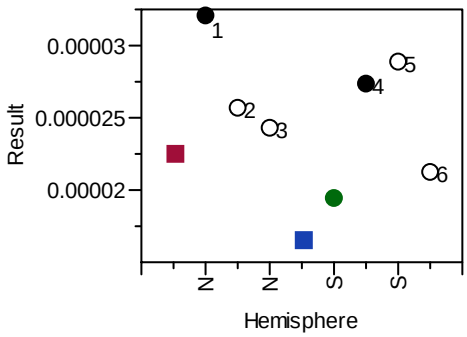
U-235, uCi/g



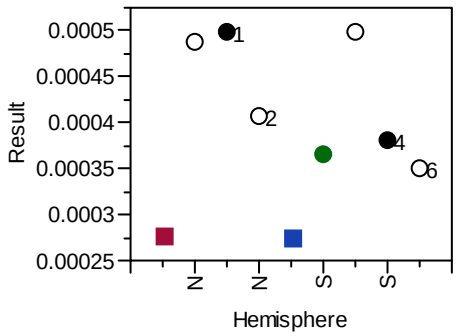
U-232, uCi/g



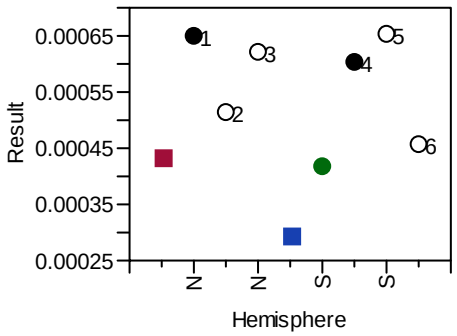
U-236, uCi/g



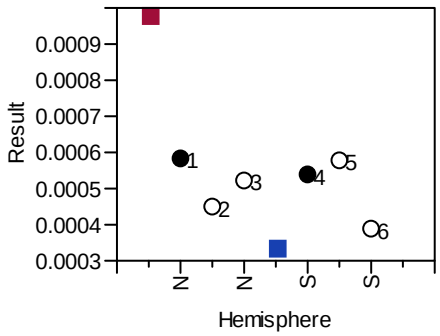
U-233, uCi/g



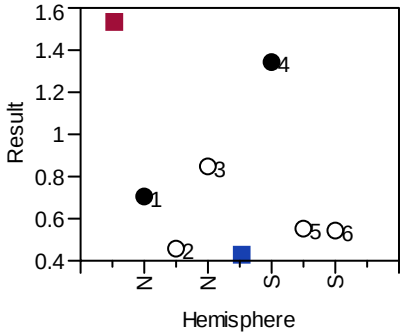
U-238, uCi/g



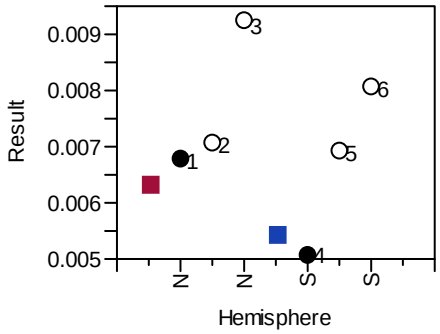
U-234, uCi/g



Y-90, uCi/g



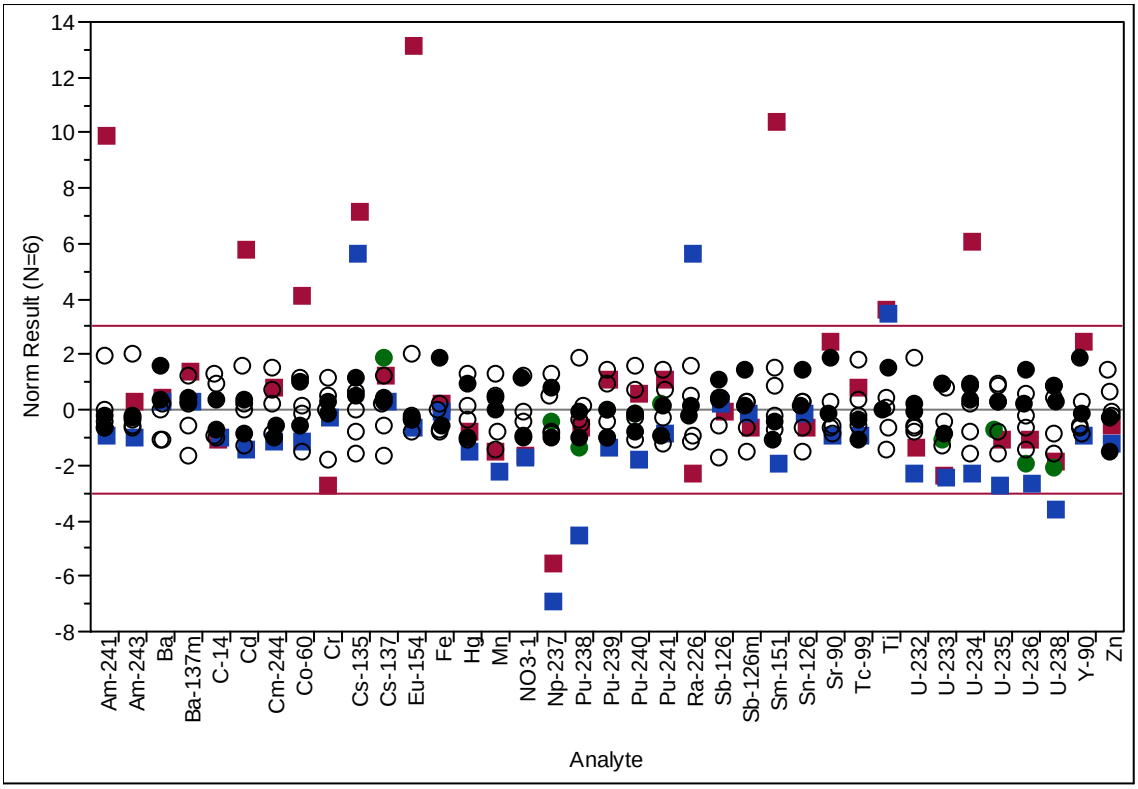
Zn, Wt%



APPENDIX 2. 3-SIGMA PLOTS FOR TANK 19F MANTIS AND SCRAPE SAMPLE RESULTS NORMALIZED

by the Current Scrape Sample Mean and Standard Deviation by Analyte (Dried Solids)

Norm Result (N=6)= (Result-Mean)/(Std Dev) using the Current Scrape Sample Mean and Standard Deviation

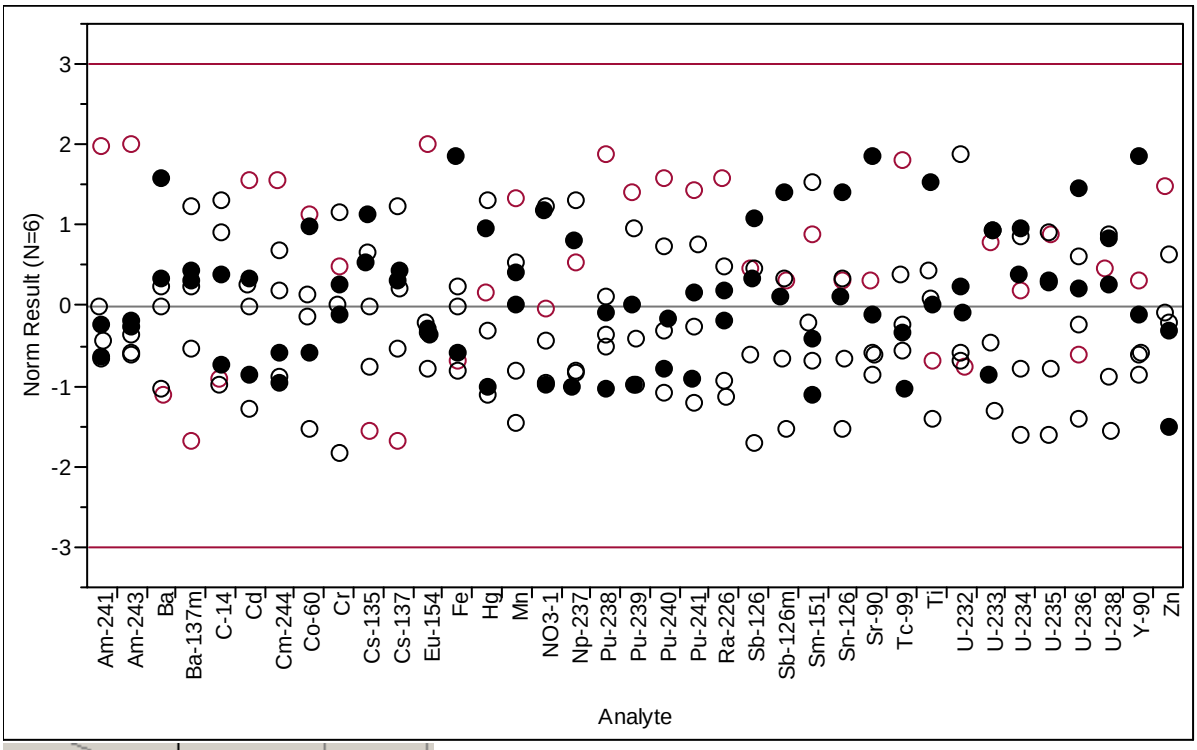


■	1	Mantis N	
■	2	Mantis S	
●	3	New Scrape	Inner
○	4	New Scrape	Outer
●	5	Prior Scrape	

This page intentionally left blank

APPENDIX 3A. 3-SIGMA PLOTS FOR TANK 19F CURRENT SCRAPE SAMPLE RESULTS NORMALIZED by its Mean and Standard Deviation by Analyte (Dried Solids)

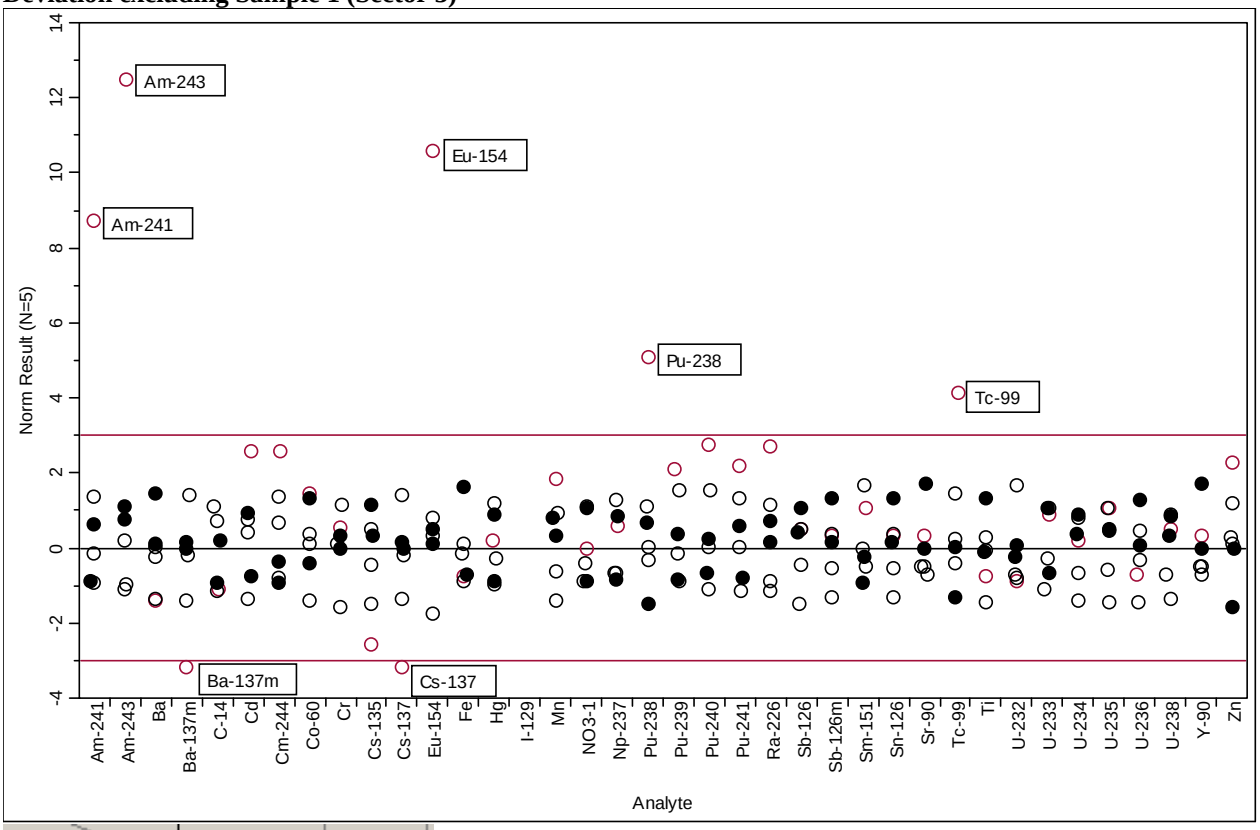
Norm Result (N=6)= (Result-Mean)/(Std Dev) using the Current Scrape Sample Mean and Standard Deviation



	Inner/Outer	Sample
1	Outer	1
2	Outer	2, 3, 4
3	Inner	5, 6

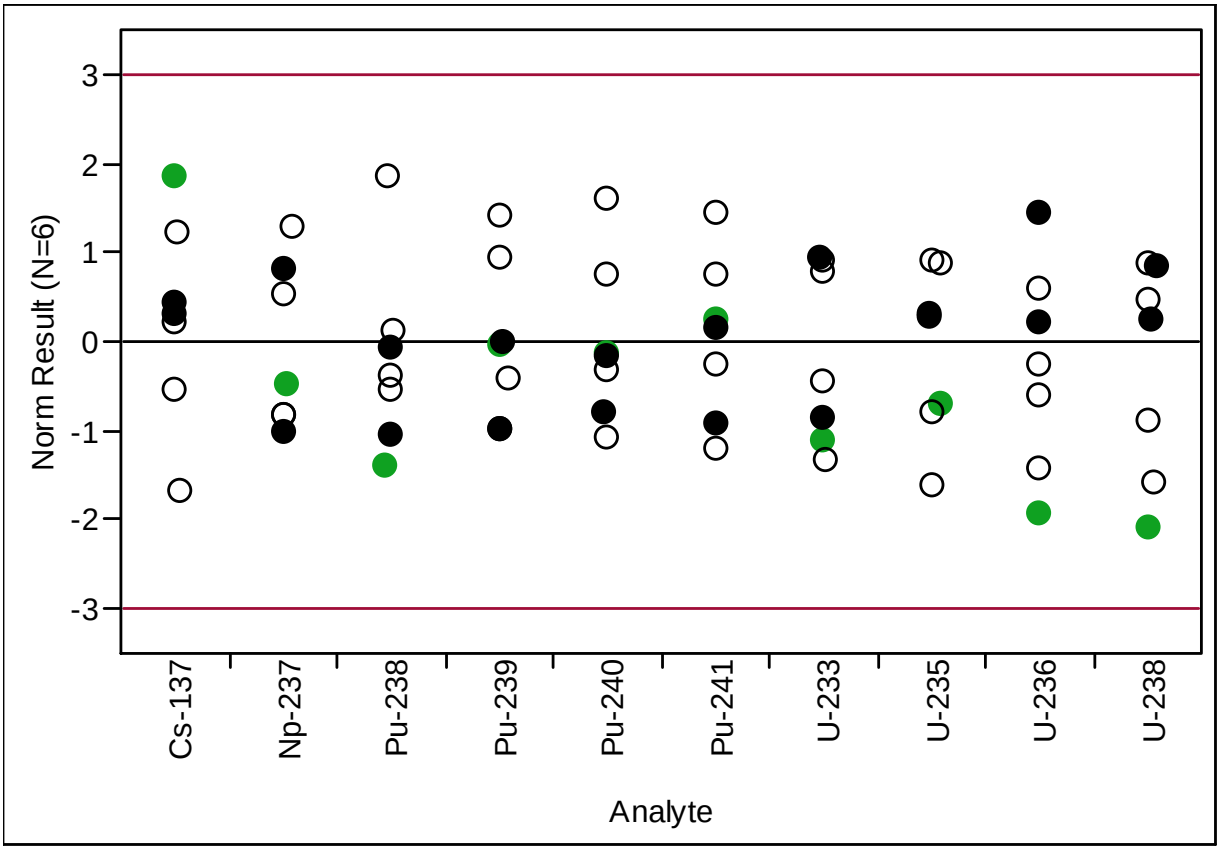
APPENDIX 3B 3-SIGMA PLOTS FOR TANK 19F CURRENT SCRAPE SAMPLE RESULTS NORMALIZED (EXCLUDING SAMPLE 1) by its Mean and Standard Deviation by Analyte (Dried Solids)

Norm Result (N=5)= (Result-Mean)/(Std Dev) using the Current Scrape Sample Mean and Standard Deviation excluding Sample 1 (Sector 3)



	Inner/Outer	Sample
1	Outer	1
2	Outer	2, 3, 4
3	Inner	5, 6

APPENDIX 4. PLOT OF TANK 19F PRIOR SCRAPE (QA SAMPLE) RESULTS VERSUS CURRENT SCRAPE SAMPLES RESULTS

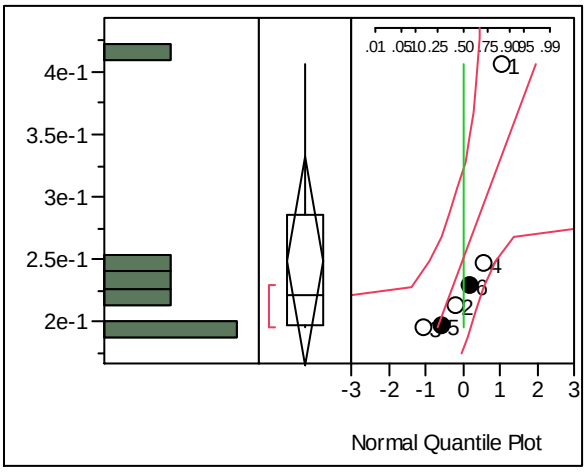


	Scrape/Mantis	Inner/Outer
1	Prior Scrape	
2	Scrape	Inner
3	Scrape	Outer

This page intentionally left blank

APPENDIX 5. TANK 19F SUMMARY STATISTICS AND UPPER 95% CONFIDENCE LIMITS BY ANALYTE

Tank 19F, Am-241, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.40580
75.0%	quartile	0.28630
50.0%	median	0.22152
25.0%	quartile	0.19706
0.0%	minimum	0.19623

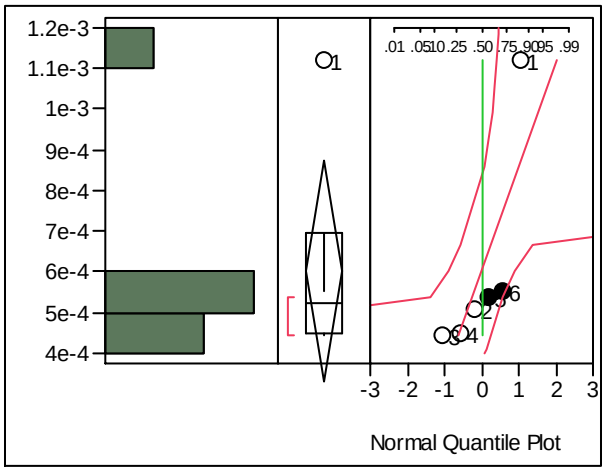
Moments

Mean	0.2481448
Std Dev	0.0796239
Std Err Mean	0.0325063
upper 95% Mean	0.331705
lower 95% Mean	0.1645847
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.248145	0.313647
Std Dev	0.079624	0.166355

Tank 19F, Am-243, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00112
75.0%	quartile	0.00070
50.0%	median	0.00052
25.0%	quartile	0.00045
0.0%	minimum	0.00044

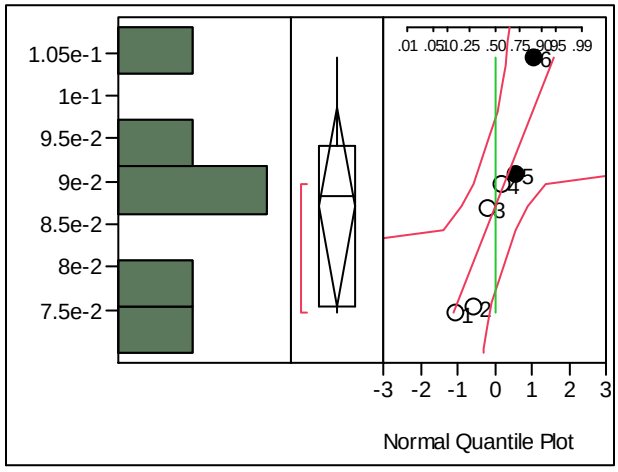
Moments

Mean	0.0006033
Std Dev	0.0002583
Std Err Mean	0.0001055
upper 95% Mean	0.0008744
lower 95% Mean	0.0003322
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000603	0.000816
Std Dev	0.000258	0.00054

Tank 19F, Ba, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.10456
75.0%	quartile	0.09424
50.0%	median	0.08832
25.0%	quartile	0.07529
0.0%	minimum	0.07475

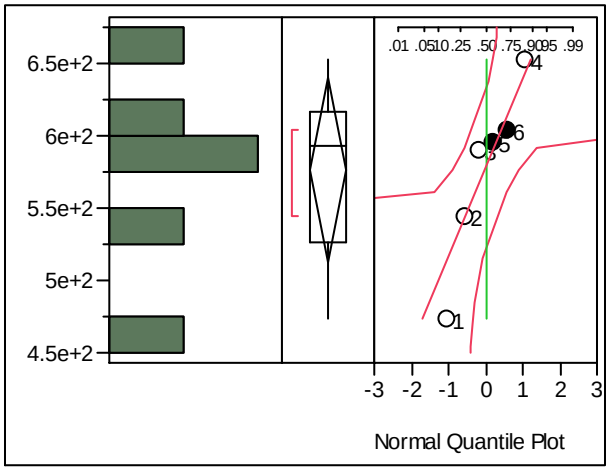
Moments

Mean	0.0870379
Std Dev	0.011074
Std Err Mean	0.004521
upper 95% Mean	0.0986594
lower 95% Mean	0.0754164
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.087038	0.096148
Std Dev	0.011074	0.023137

Tank 19F, Ba-137m, uCi/g, Dried Solids



Quantiles

100.0%	maximum	652.14
75.0%	quartile	615.98
50.0%	median	593.17
25.0%	quartile	526.42
0.0%	minimum	474.08

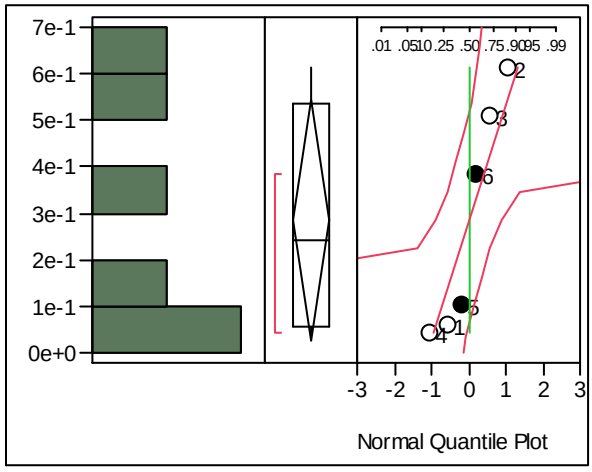
Moments

Mean	576.72644
Std Dev	60.990042
Std Err Mean	24.899081
upper 95% Mean	640.73157
lower 95% Mean	512.72132
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	576.7264	626.8993
Std Dev	60.99004	127.4239

Tank 19F, C-14, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.61154
75.0%	quartile	0.53682
50.0%	median	0.24283
25.0%	quartile	0.05619
0.0%	minimum	0.04349

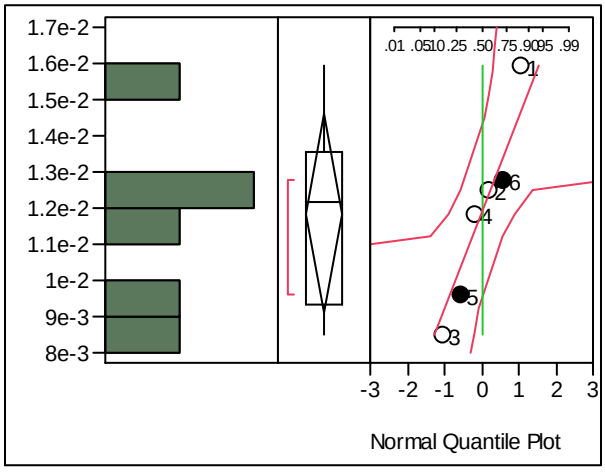
Moments

Mean	0.2855047
Std Dev	0.2487901
Std Err Mean	0.1015681
upper 95% Mean	0.5465939
lower 95% Mean	0.0244155
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.285505	0.490169
Std Dev	0.24879	0.519787

Tank 19F, Cd, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.01594
75.0%	quartile	0.01356
50.0%	median	0.01216
25.0%	quartile	0.00931
0.0%	minimum	0.00850

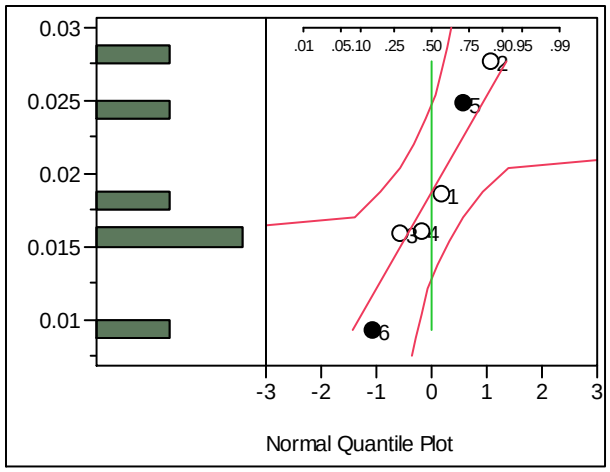
Moments

Mean	0.011853
Std Dev	0.0026223
Std Err Mean	0.0010706
upper 95% Mean	0.014605
lower 95% Mean	0.009101
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.011853	0.01401
Std Dev	0.002622	0.005479

Tank 19F, CHLORIDE, Wt% Dried Solids



Quantiles

100.0%	maximum	0.02770
75.0%	quartile	0.02553
50.0%	median	0.01730
25.0%	quartile	0.01425
0.0%	minimum	0.00928

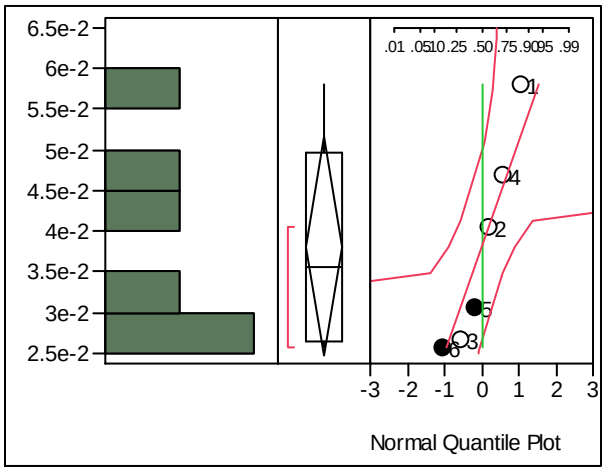
Moments

Mean	0.0187133
Std Dev	0.0066646
Std Err Mean	0.0027208
upper 95% Mean	0.0257074
lower 95% Mean	0.0117193
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.018713	0.024196
Std Dev	0.006665	0.013924

Tank 19F, Cm-244, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.05804
75.0%	quartile	0.04976
50.0%	median	0.03566
25.0%	quartile	0.02645
0.0%	minimum	0.02574

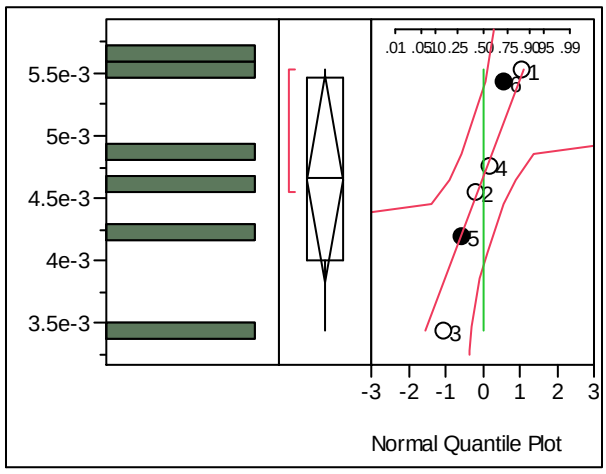
Moments

Mean	0.0381317
Std Dev	0.0128035
Std Err Mean	0.005227
upper 95% Mean	0.0515682
lower 95% Mean	0.0246953
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.038132	0.048664
Std Dev	0.012803	0.02675

Tank 19F, Co-60, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00554
75.0%	quartile	0.00546
50.0%	median	0.00466
25.0%	quartile	0.00400
0.0%	minimum	0.00344

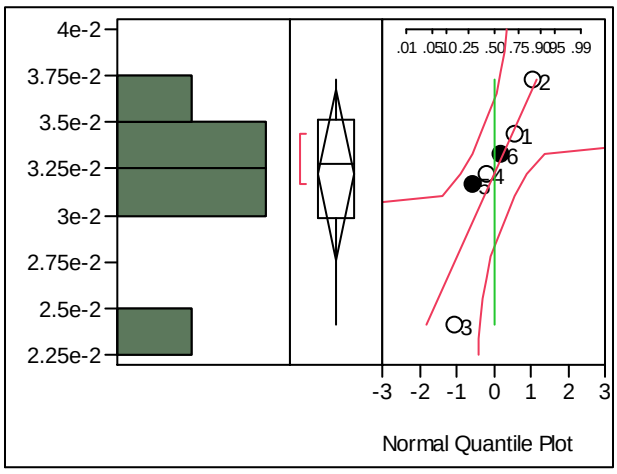
Moments

Mean	0.0046519
Std Dev	0.0007853
Std Err Mean	0.0003206
upper 95% Mean	0.0054761
lower 95% Mean	0.0038278
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.004652	0.005298
Std Dev	0.000785	0.001641

Tank 19F, Cr, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.03734
75.0%	quartile	0.03510
50.0%	median	0.03276
25.0%	quartile	0.02982
0.0%	minimum	0.02414

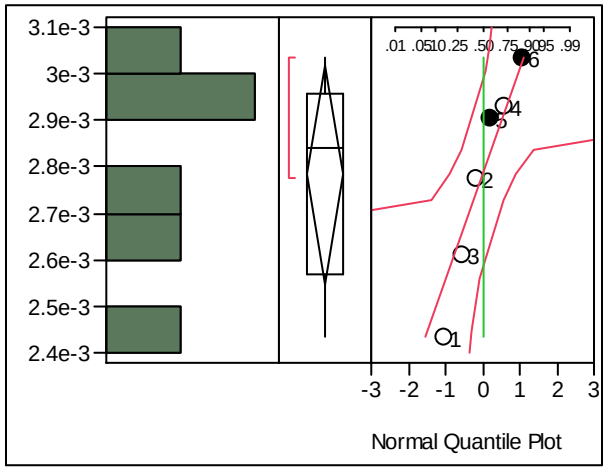
Moments

Mean	0.0321768
Std Dev	0.0044162
Std Err Mean	0.0018029
upper 95% Mean	0.0368113
lower 95% Mean	0.0275422
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.032177	0.03581
Std Dev	0.004416	0.009227

Tank 19F, Cs-135, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00304
75.0%	quartile	0.00296
50.0%	median	0.00284
25.0%	quartile	0.00257
0.0%	minimum	0.00244

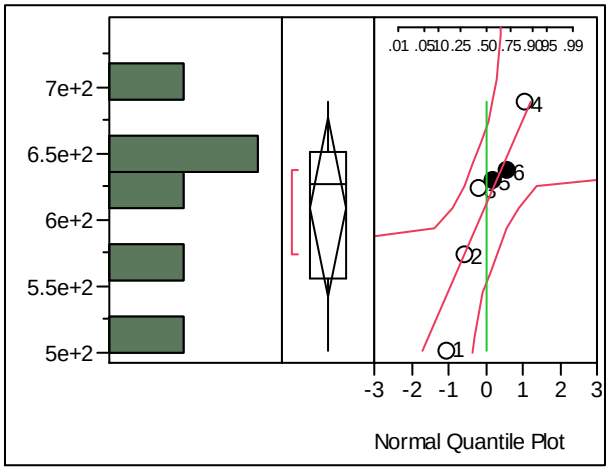
Moments

Mean	0.0027824
Std Dev	0.0002237
Std Err Mean	9.1327e-5
upper 95% Mean	0.0030172
lower 95% Mean	0.0025477
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.002782	0.002966
Std Dev	0.000224	0.000467

Tank 19F, Cs-137, uCi/g, Dried Solids



Quantiles

100.0%	maximum	689.33
75.0%	quartile	650.98
50.0%	median	626.71
25.0%	quartile	556.22
0.0%	minimum	500.83

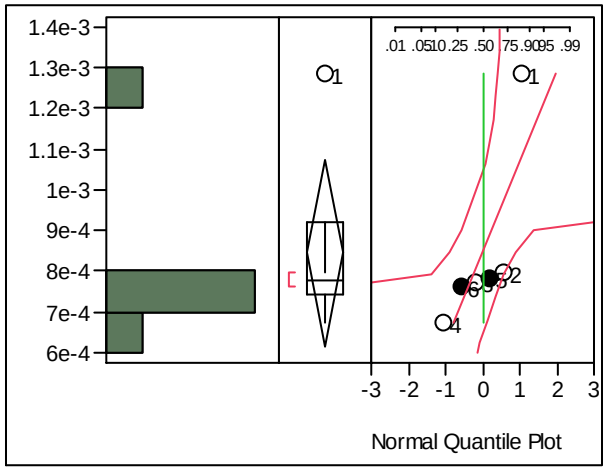
Moments

Mean	609.41147
Std Dev	64.540511
Std Err Mean	26.348553
upper 95% Mean	677.14258
lower 95% Mean	541.68036
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	609.4115	662.5051
Std Dev	64.54051	134.8417

Tank 19F, Eu-154, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00128
75.0%	quartile	0.00092
50.0%	median	0.00078
25.0%	quartile	0.00074
0.0%	minimum	0.00067

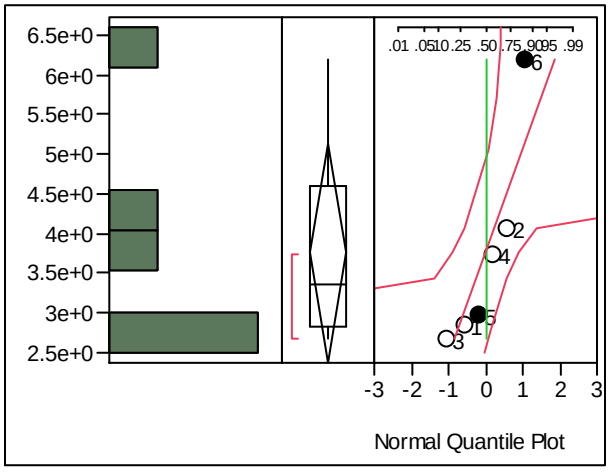
Moments

Mean	0.0008459
Std Dev	0.0002195
Std Err Mean	0.0000896
upper 95% Mean	0.0010762
lower 95% Mean	0.0006156
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000846	0.001026
Std Dev	0.000219	0.000459

Tank 19F, Fe, Wt%, Dried Solids



Quantiles

100.0%	maximum	6.1897
75.0%	quartile	4.6033
50.0%	median	3.3555
25.0%	quartile	2.8204
0.0%	minimum	2.6869

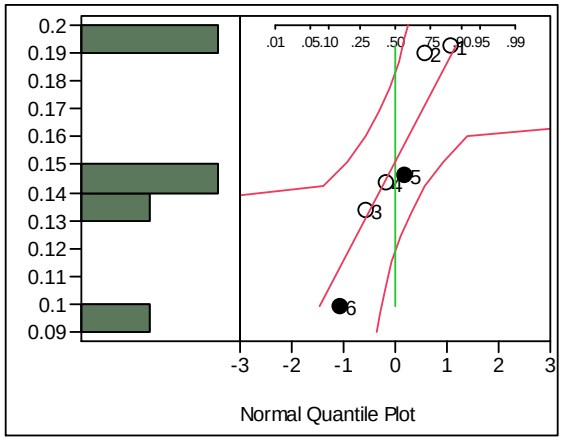
Moments

Mean	3.7545142
Std Dev	1.3090201
Std Err Mean	0.5344052
upper 95% Mean	5.1282465
lower 95% Mean	2.380782
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	3.754514	4.831367
Std Dev	1.30902	2.73488

Tank 19F, FLUORIDE, Wt% Dried Solids



Quantiles

100.0%	maximum	0.19300
75.0%	quartile	0.19075
50.0%	median	0.14500
25.0%	quartile	0.12528
0.0%	minimum	0.09910

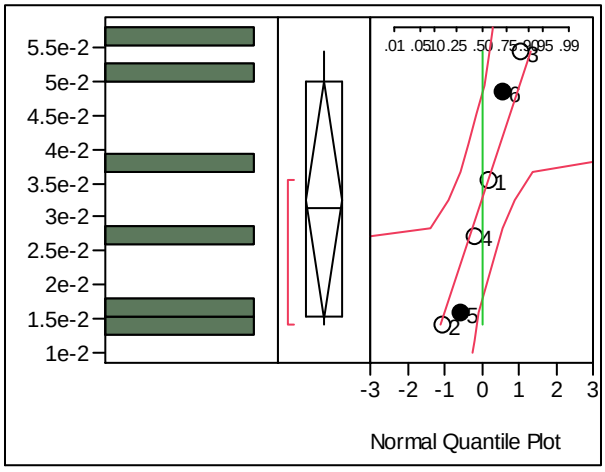
Moments

Mean	0.1510167
Std Dev	0.0356135
Std Err Mean	0.0145392
upper 95% Mean	0.1883907
lower 95% Mean	0.1136426
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.151017	0.180314
Std Dev	0.035614	0.074406

Tank 19F, Hg, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.05442
75.0%	quartile	0.05009
50.0%	median	0.03135
25.0%	quartile	0.01540
0.0%	minimum	0.01410

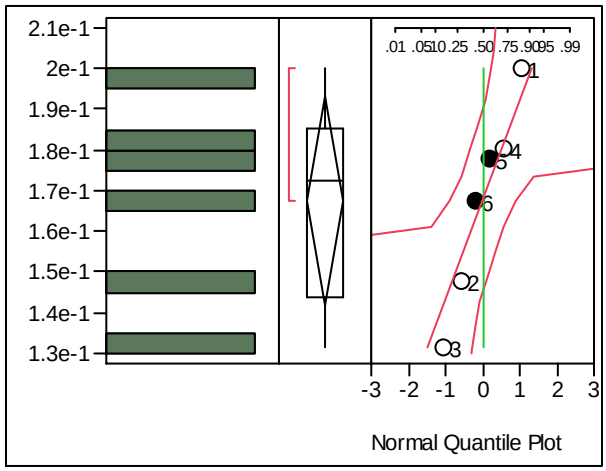
Moments

Mean	0.0326159
Std Dev	0.0166934
Std Err Mean	0.0068151
upper 95% Mean	0.0501346
lower 95% Mean	0.0150972
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.032616	0.046349
Std Dev	0.016693	0.034877

Tank 19F, Mn, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.19991
75.0%	quartile	0.18529
50.0%	median	0.17259
25.0%	quartile	0.14363
0.0%	minimum	0.13130

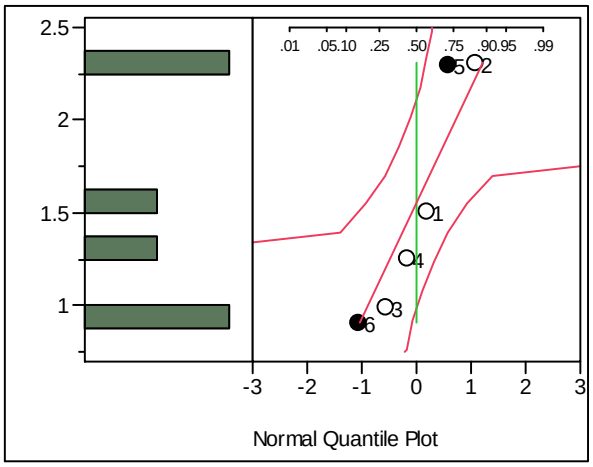
Moments

Mean	0.1674244
Std Dev	0.0245827
Std Err Mean	0.0100358
upper 95% Mean	0.1932224
lower 95% Mean	0.1416265
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.167424	0.187647
Std Dev	0.024583	0.05136

Tank 19F, NITRATE, Wt% Dried Solids



Quantiles

100.0%	maximum	2.3100
75.0%	quartile	2.3025
50.0%	median	1.3850
25.0%	quartile	0.9695
0.0%	minimum	0.9080

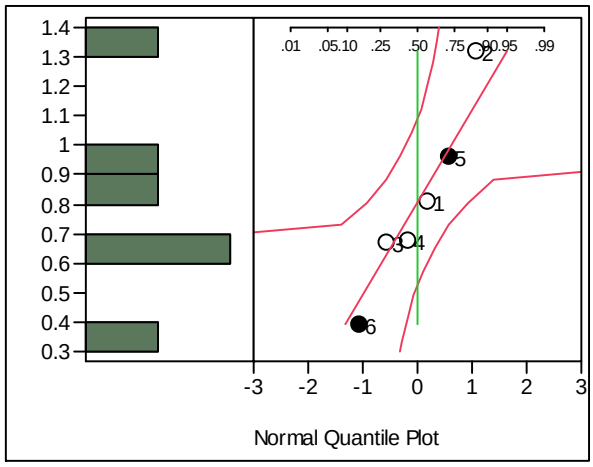
Moments

Mean	1.5463333
Std Dev	0.6247373
Std Err Mean	0.2550479
upper 95% Mean	2.2019549
lower 95% Mean	0.8907118
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	1.546333	2.060267
Std Dev	0.624737	1.305237

Tank 19F, NITRITE, Wt% Dried Solids



Quantiles

100.0%	maximum	1.3200
75.0%	quartile	1.0523
50.0%	median	0.7465
25.0%	quartile	0.6028
0.0%	minimum	0.3920

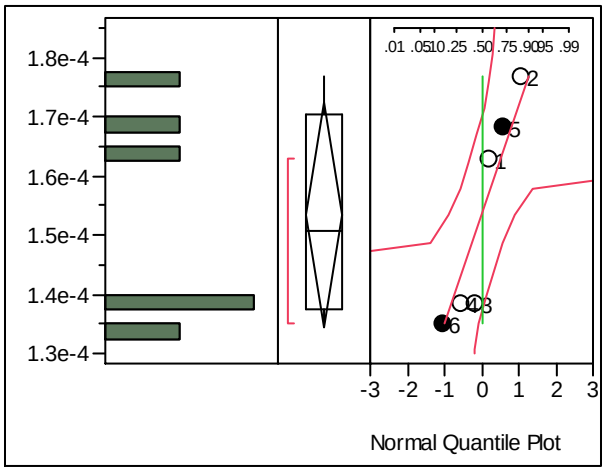
Moments

Mean	0.8068333
Std Dev	0.3141932
Std Err Mean	0.1282688
upper 95% Mean	1.1365589
lower 95% Mean	0.4771078
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.806833	1.065301
Std Dev	0.314193	0.65643

Tank 19F, Np-237, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00018
75.0%	quartile	0.00017
50.0%	median	0.00015
25.0%	quartile	0.00014
0.0%	minimum	0.00013

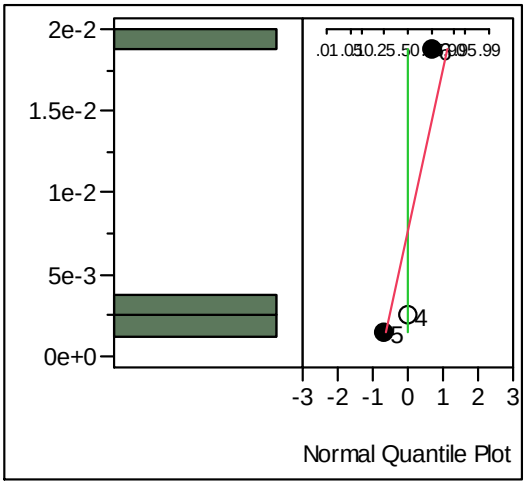
Moments

Mean	0.0001533
Std Dev	1.8136e-5
Std Err Mean	7.4042e-6
upper 95% Mean	0.0001723
lower 95% Mean	0.0001343
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000153	0.000168
Std Dev	1.814e-5	3.789e-5

Tank 19F, Pd-107, uCi/g, Dry Solids



Quantiles

100.0%	maximum	0.01878
75.0%	quartile	0.01878
50.0%	median	0.00256
25.0%	quartile	0.00142
0.0%	minimum	0.00142

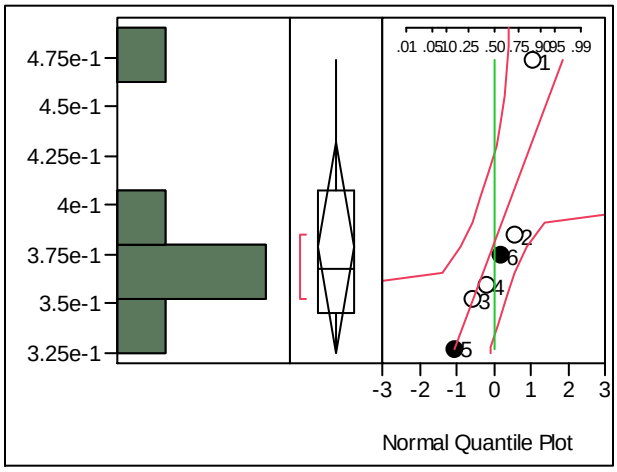
Moments

Mean	0.0075853
Std Dev	0.0097104
Std Err Mean	0.0056063
N	3

Upper 95% Confidence Limit

Parameter	Estimate	95% Upper CI
Mean	0.007585	0.023956

Tank 19F, Pu-238, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.47408
75.0%	quartile	0.40737
50.0%	median	0.36751
25.0%	quartile	0.34584
0.0%	minimum	0.32656

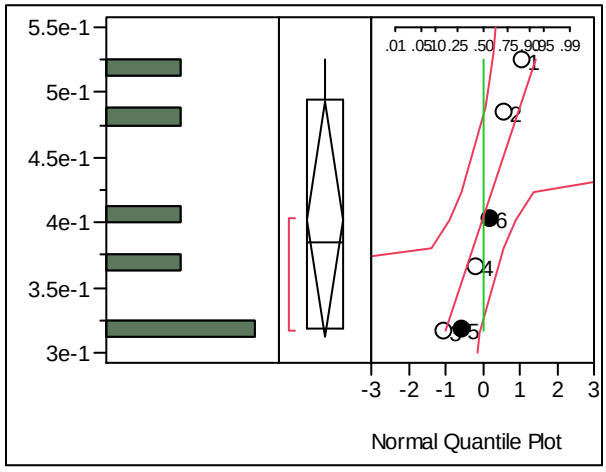
Moments

Mean	0.3788425
Std Dev	0.0508231
Std Err Mean	0.0207484
upper 95% Mean	0.4321781
lower 95% Mean	0.325507
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.378843	0.420652
Std Dev	0.050823	0.106182

Tank 19F, Pu-239, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.52476
75.0%	quartile	0.49471
50.0%	median	0.38480
25.0%	quartile	0.31797
0.0%	minimum	0.31748

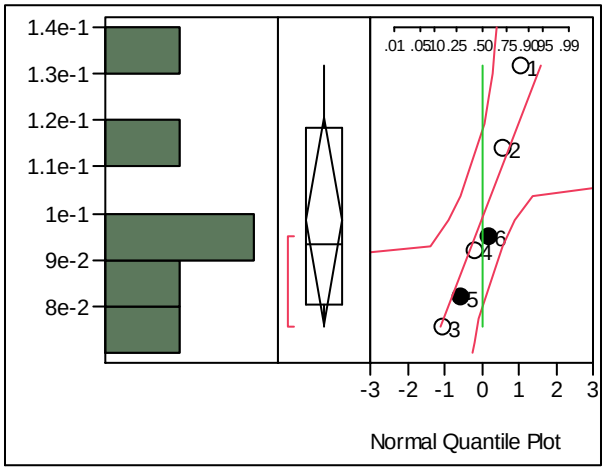
Moments

Mean	0.4024426
Std Dev	0.0864348
Std Err Mean	0.0352868
upper 95% Mean	0.4931503
lower 95% Mean	0.3117349
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.402443	0.473547
Std Dev	0.086435	0.180584

Tank 19F, Pu-240, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.13198
75.0%	quartile	0.11851
50.0%	median	0.09344
25.0%	quartile	0.08030
0.0%	minimum	0.07544

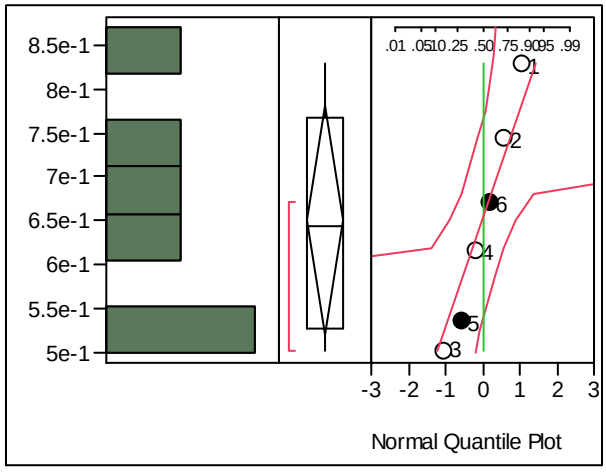
Moments

Mean	0.0983748
Std Dev	0.0210899
Std Err Mean	0.0086099
upper 95% Mean	0.1205072
lower 95% Mean	0.0762423
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.098375	0.115724
Std Dev	0.02109	0.044062

Tank 19F, Pu-241, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.82920
75.0%	quartile	0.76613
50.0%	median	0.64405
25.0%	quartile	0.52848
0.0%	minimum	0.50115

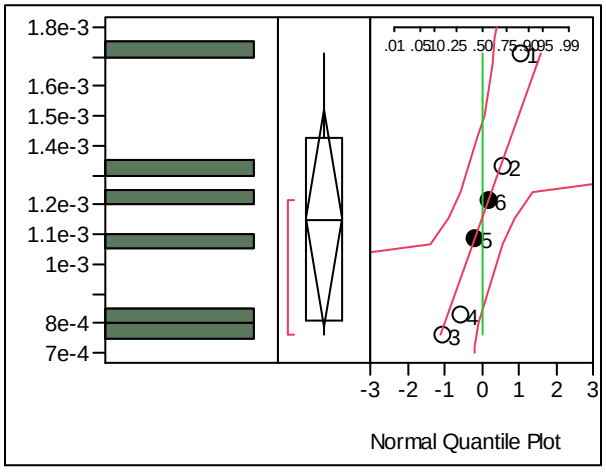
Moments

Mean	0.6501908
Std Dev	0.1244847
Std Err Mean	0.0508206
upper 95% Mean	0.7808294
lower 95% Mean	0.5195522
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.650191	0.752597
Std Dev	0.124485	0.260081

Tank 19F, Ra-226, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00171
75.0%	quartile	0.00142
50.0%	median	0.00115
25.0%	quartile	0.00081
0.0%	minimum	0.00076

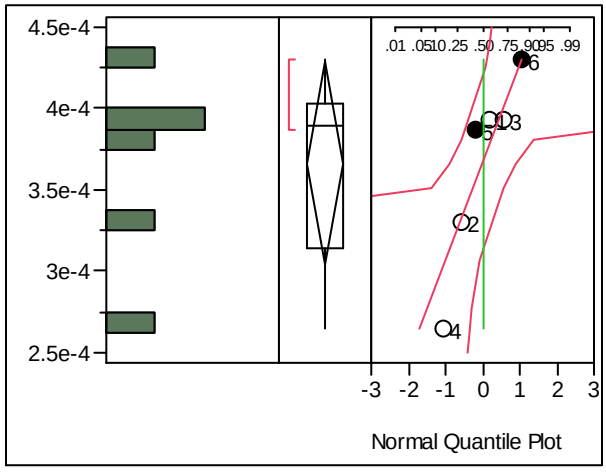
Moments

Mean	0.0011545
Std Dev	0.0003499
Std Err Mean	0.0001428
upper 95% Mean	0.0015216
lower 95% Mean	0.0007873
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.001154	0.001442
Std Dev	0.00035	0.000731

Tank 19F, Sb-126, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00043
75.0%	quartile	0.00040
50.0%	median	0.00039
25.0%	quartile	0.00031
0.0%	minimum	0.00026

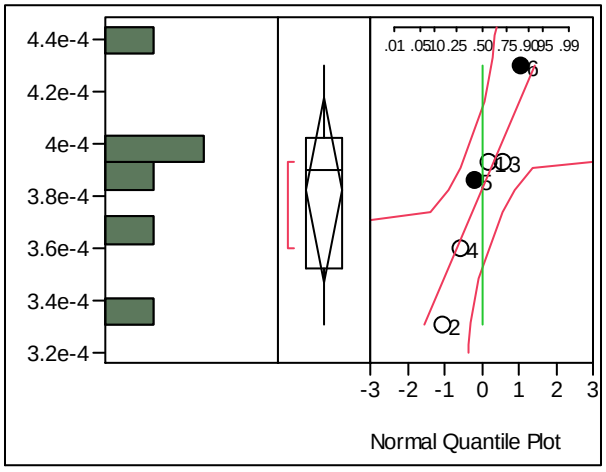
Moments

Mean	0.0003664
Std Dev	5.944e-5
Std Err Mean	2.4266e-5
upper 95% Mean	0.0004288
lower 95% Mean	0.0003041
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000366	0.000415
Std Dev	5.944e-5	0.000124

Tank 19F, Sb-126m, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00043
75.0%	quartile	0.00040
50.0%	median	0.00039
25.0%	quartile	0.00035
0.0%	minimum	0.00033

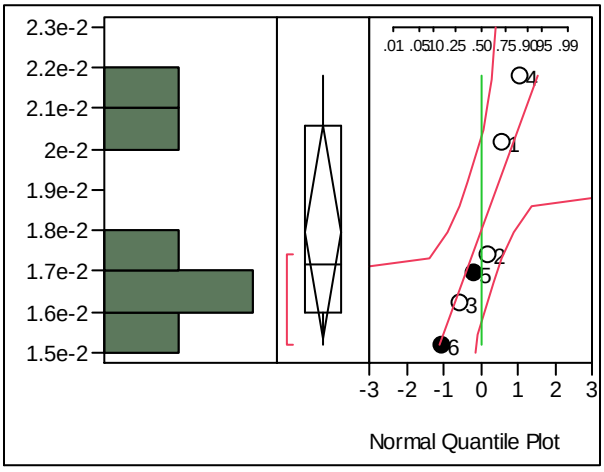
Moments

Mean	0.0003824
Std Dev	3.3912e-5
Std Err Mean	1.3845e-5
upper 95% Mean	0.000418
lower 95% Mean	0.0003468
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000382	0.00041
Std Dev	0.000034	7.085e-5

Tank 19F, Sm-151, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.02180
75.0%	quartile	0.02057
50.0%	median	0.01720
25.0%	quartile	0.01599
0.0%	minimum	0.01521

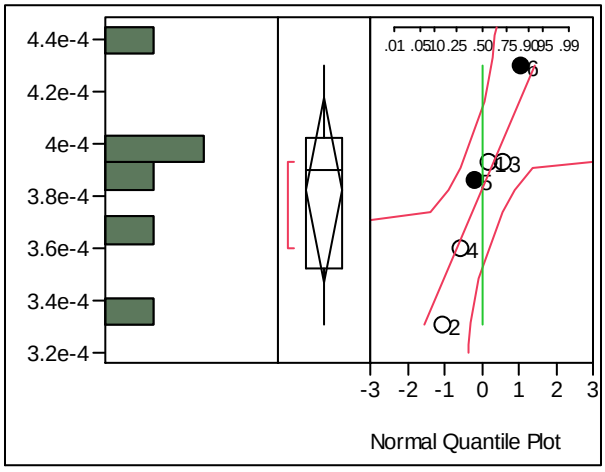
Moments

Mean	0.0179695
Std Dev	0.0025034
Std Err Mean	0.001022
upper 95% Mean	0.0205967
lower 95% Mean	0.0153423
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.017969	0.020029
Std Dev	0.002503	0.00523

Tank 19F, Sn-126, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00043
75.0%	quartile	0.00040
50.0%	median	0.00039
25.0%	quartile	0.00035
0.0%	minimum	0.00033

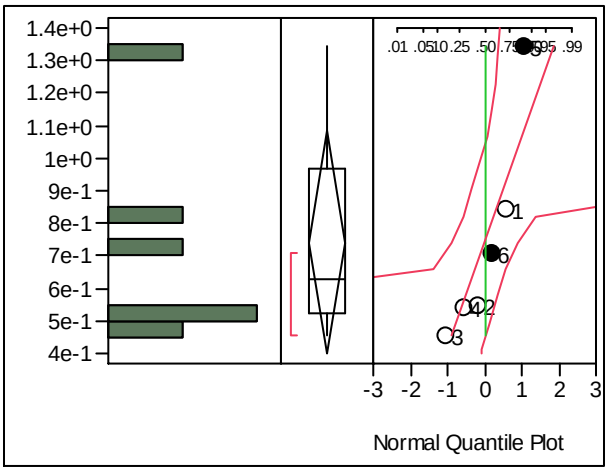
Moments

Mean	0.0003824
Std Dev	3.3912e-5
Std Err Mean	1.3845e-5
upper 95% Mean	0.000418
lower 95% Mean	0.0003468
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000382	0.00041
Std Dev	0.000034	7.085e-5

Tank 19F, Sr-90, uCi/g, Dried Solids



Quantiles

100.0%	maximum	1.3434
75.0%	quartile	0.9694
50.0%	median	0.6271
25.0%	quartile	0.5209
0.0%	minimum	0.4567

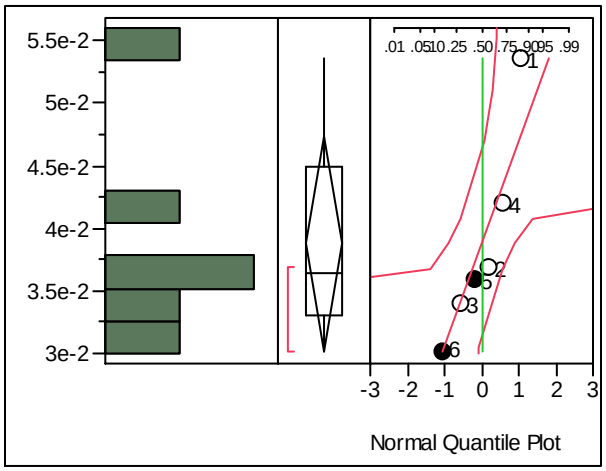
Moments

Mean	0.7402076
Std Dev	0.3262928
Std Err Mean	0.1332085
upper 95% Mean	1.0826309
lower 95% Mean	0.3977843
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.740208	1.008629
Std Dev	0.326293	0.68171

Tank 19F, Tc-99, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.05360
75.0%	quartile	0.04487
50.0%	median	0.03637
25.0%	quartile	0.03310
0.0%	minimum	0.03014

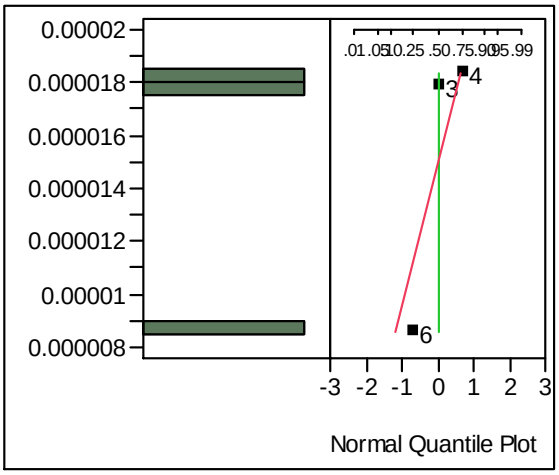
Moments

Mean	0.038753
Std Dev	0.0082289
Std Err Mean	0.0033594
upper 95% Mean	0.0473887
lower 95% Mean	0.0301173
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.038753	0.045522
Std Dev	0.008229	0.017192

Tank 19F, Th-229, uCi/g Dry Solids



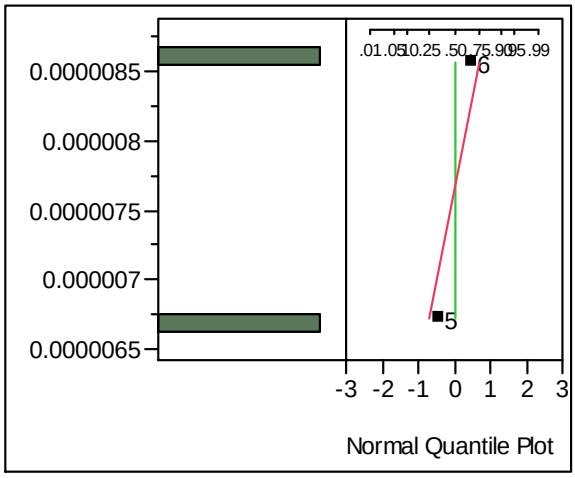
Moments

Mean	1.4928e-5
Std Dev	5.519e-6
N	3

Upper 95% Confidence Limit

Parameter	Estimate	95%Upper CI
Mean	0.000015	2.423e-5

Tank 19F, Th-230, uCi/g Dry Solids



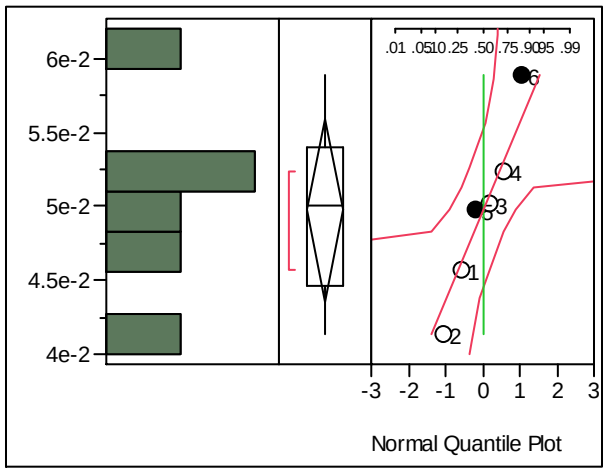
Moments

Mean	7.6403e-6
Std Dev	0.0000013
N	2

Upper 95% Confidence Limit

Parameter	Estimate	95% Upper CI
Mean	7.64e-6	1.345e-5

Tank 19F, Ti, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.05889
75.0%	quartile	0.05396
50.0%	median	0.05001
25.0%	quartile	0.04463
0.0%	minimum	0.04138

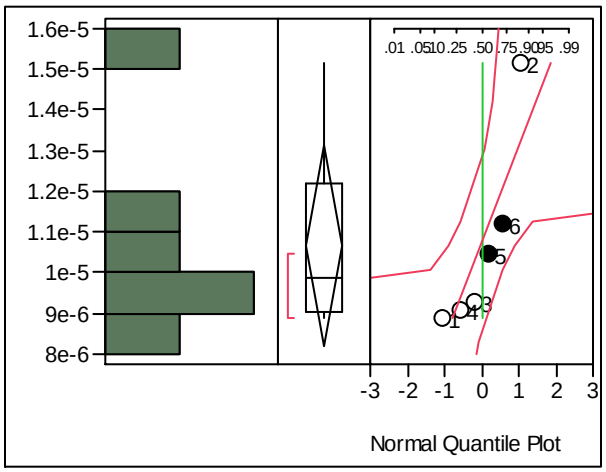
Moments

Mean	0.0497201
Std Dev	0.0059425
Std Err Mean	0.002426
upper 95% Mean	0.0559563
lower 95% Mean	0.0434839
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.04972	0.054609
Std Dev	0.005942	0.012415

Tank 19F, U-232, uCi/g, Dried Solids



Quantiles

100.0%	maximum	1.51e-5
75.0%	quartile	1.22e-5
50.0%	median	0.00001
25.0%	quartile	0.00001
0.0%	minimum	8.87e-6

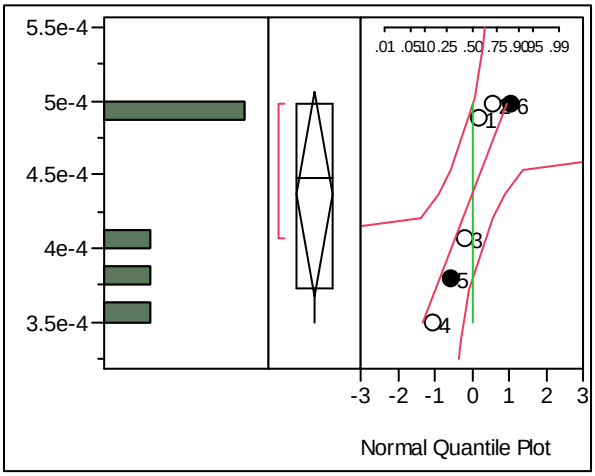
Moments

Mean	1.0669e-5
Std Dev	2.3702e-6
Std Err Mean	9.6761e-7
upper 95% Mean	1.3156e-5
lower 95% Mean	8.1814e-6
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	1.067e-5	1.262e-5
Std Dev	2.37e-6	4.952e-6

Tank 19F, U-233, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00050
75.0%	quartile	0.00050
50.0%	median	0.00045
25.0%	quartile	0.00037
0.0%	minimum	0.00035

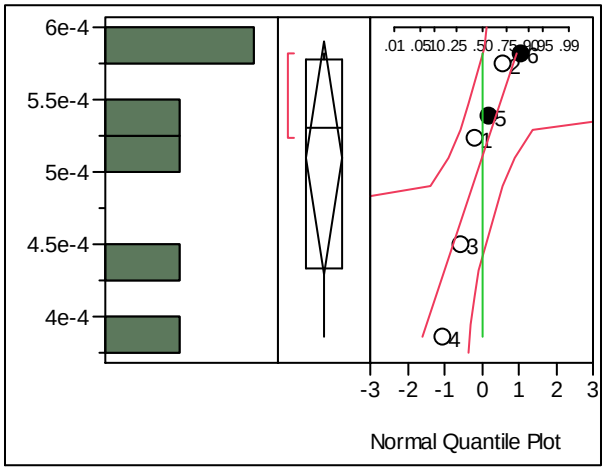
Moments

Mean	0.0004369
Std Dev	6.6045e-5
Std Err Mean	2.6963e-5
upper 95% Mean	0.0005062
lower 95% Mean	0.0003675
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000437	0.000491
Std Dev	0.000066	0.000138

Tank 19F, U-234, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00058
75.0%	quartile	0.00058
50.0%	median	0.00053
25.0%	quartile	0.00043
0.0%	minimum	0.00039

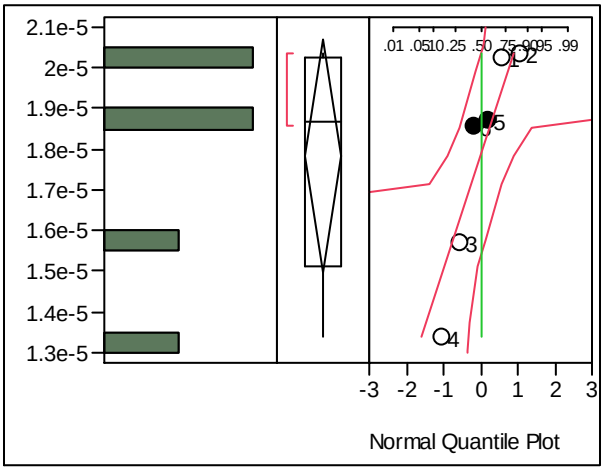
Moments

Mean	0.0005093
Std Dev	0.0000768
Std Err Mean	3.1352e-5
upper 95% Mean	0.0005899
lower 95% Mean	0.0004287
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000509	0.000572
Std Dev	7.68e-5	0.00016

Tank 19F, U-235, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00002
75.0%	quartile	0.00002
50.0%	median	1.87e-5
25.0%	quartile	1.51e-5
0.0%	minimum	1.34e-5

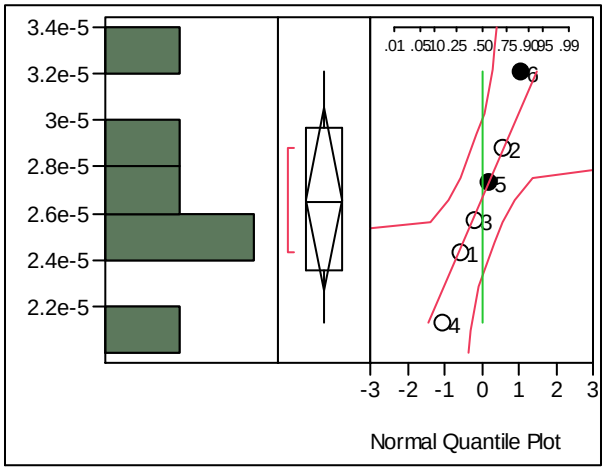
Moments

Mean	1.7837e-5
Std Dev	2.7354e-6
Std Err Mean	1.1167e-6
upper 95% Mean	0.0000207
lower 95% Mean	1.4967e-5
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	1.784e-5	0.00002
Std Dev	2.735e-6	5.715e-6

Tank 19F, U-236, uCi/g, Dried Solids



Quantiles

100.0%	maximum	3.21e-5
75.0%	quartile	0.00003
50.0%	median	2.65e-5
25.0%	quartile	2.35e-5
0.0%	minimum	2.13e-5

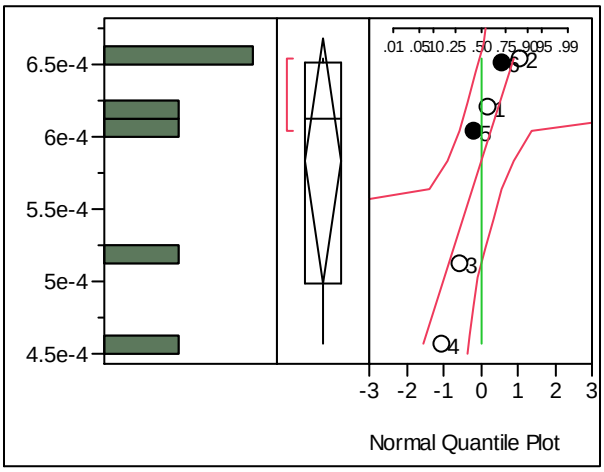
Moments

Mean	2.6584e-5
Std Dev	3.7427e-6
Std Err Mean	1.528e-6
upper 95% Mean	3.0512e-5
lower 95% Mean	2.2657e-5
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	2.658e-5	2.966e-5
Std Dev	3.743e-6	7.82e-6

Tank 19F, U-238, uCi/g, Dried Solids



Quantiles

100.0%	maximum	0.00065
75.0%	quartile	0.00065
50.0%	median	0.00061
25.0%	quartile	0.00050
0.0%	minimum	0.00046

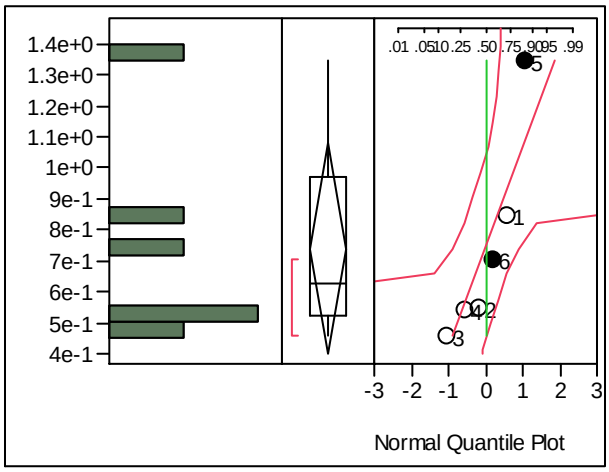
Moments

Mean	0.0005836
Std Dev	8.0534e-5
Std Err Mean	3.2878e-5
upper 95% Mean	0.0006682
lower 95% Mean	0.0004991
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.000584	0.00065
Std Dev	8.053e-5	0.000168

Tank 19F, Y-90, uCi/g, Dried Solids



Quantiles

100.0%	maximum	1.3434
75.0%	quartile	0.9694
50.0%	median	0.6271
25.0%	quartile	0.5209
0.0%	minimum	0.4567

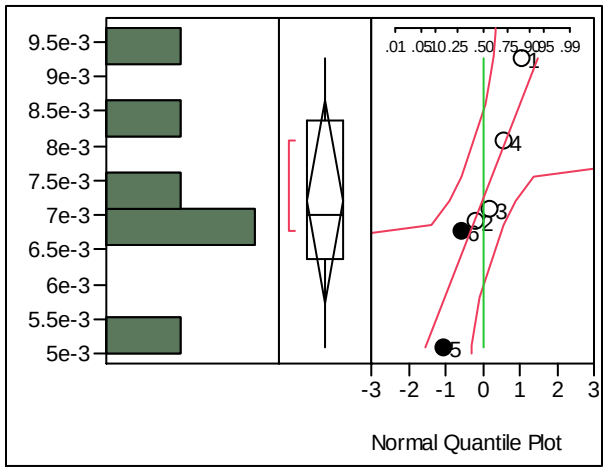
Moments

Mean	0.7402076
Std Dev	0.3262928
Std Err Mean	0.1332085
upper 95% Mean	1.0826309
lower 95% Mean	0.3977843
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.740208	1.008629
Std Dev	0.326293	0.68171

Tank 19F, Zn, Wt%, Dried Solids



Quantiles

100.0%	maximum	0.00926
75.0%	quartile	0.00837
50.0%	median	0.00700
25.0%	quartile	0.00635
0.0%	minimum	0.00508

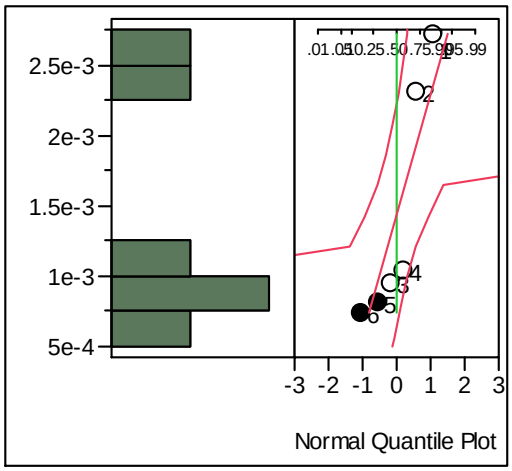
Moments

Mean	0.0071973
Std Dev	0.0013958
Std Err Mean	0.0005698
upper 95% Mean	0.0086621
lower 95% Mean	0.0057325
N	6

Upper 95% Confidence Limit

Parameter	Estimate	Upper CI
Mean	0.007197	0.008346
Std Dev	0.001396	0.002916

Tank 19F, Zr-93, uCi/g, Dry Solids



Quantiles

100.0%	maximum	0.00272
75.0%	quartile	0.00242
50.0%	median	0.00099
25.0%	quartile	0.00079
0.0%	minimum	0.00073

Moments

Mean	0.0014286
Std Dev	0.0008622
Std Err Mean	0.000352
N	6

Upper 95% Confidence Limit

Parameter	Estimate	95% Upper CI
Mean	0.001429	0.002138

This page intentionally left blank

Distribution

W.L. Isom, Jr., 704-26F
R.C. Jolly, 704-70F
B.A. Martin, 705-1C
G.D. Thaxton, IV, 704-70F
F.M. Pennebaker, 773-42A
P.L. Lee, 703-41A
E.P. Shine, 703-41A