Westinghouse Non-Proprietary Class 3



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 Our ref:
 HEM-14-31

 Date:
 March 13, 2014

Subject: Hematite Decommissioning Project: Radiological Testing of Backfill Soil from an Off-site Borrow Location (License No. SNM-00033, Docket No. 070-00036)

The purpose of this letter is to inform the U.S. Nuclear Regulatory Commission (NRC) of the measures that Westinghouse Electric Company LLC (Westinghouse) is using for radiological testing of backfill soil brought to the Hematite Decommissioning Project (HDP) from off-site borrow locations. This letter identifies the current NRC regulatory requirements, the current practices and analysis of sample results to date, and the commitments relative to soil from off-site borrow locations.

<u>Current NRC Regulatory Requirements</u>: The current NRC regulatory requirements for soil from off-site borrow locations are found in the Decommissioning Plan (DP) (ML092330136), as follows:

- Section 8.8: "Excavated soil determined to be below the appropriate DCGLs [derived concentration guideline levels], and meeting other regulatory requirements for re-use, will be used as backfill material. Additional off-site backfill material will be imported from an approved off-site source(s), as needed, and tested to ensure it meets site cover requirements for radiological and chemical constituents."
- Section 14.4.4.1.6.2: "Upon completion of backfill, no further FSS samples or measurements are necessary. This is because 1) soil obtained from an approved off-site borrow location was previously tested and determined to be non-impacted, or 2) soil originating from the Site...."
- The term 'non-impacted' is defined in MARSSIM Section 3.6.2: "Non-impacted areas identified through knowledge of site history or previous survey information are those areas where there is no reasonable possibility for residual radioactive contamination. The criteria used for this segregation need not be as strict as those used to demonstrate final compliance with the regulations."

<u>Current Practices and Analysis</u>: Westinghouse has met these commitments by incorporating into its work activities a sample and analysis process for soil from off-site backfill locations. The process meets the data quality objectives discussed in the DP. The process starts with taking samples at the off-site borrow location ahead of the need for the backfill soil. The timing of the sampling is sufficiently ahead of backfilling to allow for sample test results to be received and evaluated prior to authorizing use of the soil from the area sampled. The frequency of sampling the off-site borrow to date has been one sample per  $3000 \text{ yd}^3$ . This sampling frequency was developed during the drafting of the Remedial Design Work Plan for Operable Unit 1 (RDWP), which was approved by the Missouri Department of Natural Resources pursuant to the Consent Decree. The sampling frequency in the RDWP is:

- Commercial Supplier: 1 per source per 5,000 yd<sup>3</sup>.
- Borrow pit on agricultural land (approved by Westinghouse): 1 per source per 3,000 yd<sup>3</sup>.
- All other sources (approved by Westinghouse): 1 per source per  $1,000 \text{ yd}^3$ .

The amount of soil from off-site borrow locations is expected to exceed 70,000 cubic yards, resulting in a sample population of at least 14 samples based on the least conservative sampling frequency listed above. A sample population of 14 is considered sufficient to characterize the soil as non-impacted, the sampling frequency required by the RDWP is considered appropriate for characterizing the soil as non-impacted. The off-site borrow locations used to date are agricultural lands, so the sampling frequency has been 1 sample per 3,000 yd<sup>3</sup>. Sampling methods are consistent with Final Status Survey (FSS) sampling methods.

Table 1 identifies the samples that have been taken to date at the off-site borrow location. At the time of sampling, the area was staked such that a 1 yd layer of soil yields  $3,000 \text{ yd}^3$ . A sample was taken from each 1 yd layer in the staked area.

Sample Date	Number of Sampling Events	Total Volume Sampled (yds <sup>3</sup> )	Approved Volume of Soil (yds <sup>3</sup> )
1/23/2013 (topsoil)	1	3000	3000
1/23/2013	1	3000	3000
9/5/2013	3*	9000*	3000*
11/5/2013	3	9000	9000
12/9/2013	3	9000	9000
12/10/2013	5	15000	15000

Table 1. Samples Taken to Date at Off-site Borrow Location

\*Two of the sample results exceeded the remediation goal for arsenic that is specified by the Record of Decision for Operable Unit 1. The 6,000 yd<sup>3</sup> of soil represented by those two samples was not approved for transport to HDP. Since the sample results for this soil were acceptable from a radiological perspective, they are included in this letter as part of radiological characterization of the current off-site borrow locations.

The samples are sent for analysis at an off-site laboratory, such as Test America, St. Louis. The samples are analyzed by gamma spectroscopy and for Tc-99. The sample results are then evaluated by health physics professionals. This evaluation consists of several factors, including statistical comparisons, box plots, and the methods used in HEM-10-80 (ML102140158) for determining areas of the Westinghouse Hematite property that were non-impacted areas. In

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addition, the gamma spectroscopy results are reviewed for the detection of licensable radioactive material (e.g., Cs-137) that is not part of the DP DCGLs.

Attachment 1 contains the background reference area sample results for isotopes with DP DCGLs. Attachment 2 contains the sample results for soil from off-site borrow locations – there were no detections of non-DCGL licensable radioactive material so such isotopes are not in the table. Once sampling results have been determined to be satisfactory by both the Radiation Safety Officer and the Environmental Manager, approval is granted to obtain soil from the designated area(s).

The sample results for the off-site borrow locations taken to date are evaluated here as an example of this process. The summary results of this comparison are shown in Table 2, along with regional data obtained from ORNL/TM-7343 (State Background Radiation Levels: Results Taken During 1975 – 1979).

	Ra-226 (J	oCi/g)	Th-232 (pCi/g)		U-235 (p	Ci/g)	U-238 (pCi/g)		
	(Regional Background: $1.1 \pm 0.06$ )*		(Regional Background: 1.1 ± 0.06)*		No Regional Background		(Regional Background: 1.1)*		
	HRCR Background	Off-site Soil	HRCR Background	Off-site Soil	HRCR Background	Off-site Soil	HRCR Background	Off-site Soil	
Number Observations	32	16	32	16	32	16	32	16	
Minimum	0.98	0.57	0.53	0.85	-0.52	0.03	-1.00	0.62	
Maximum	2.00	1.23	1.80	1.36	0.41	0.21	4.00	1.90	
Mean	1.47	0.78	1.06	1.18	0.01	0.11	1.12	1.15	
Median	1.50	0.76	1.00	1.21	0.03	0.10	1.00	1.15	
Standard Deviation	0.23	0.16	0.32	0.13	0.22	0.05	1.17	0.34	

Table 2. Comparison of Off-site Backfill Soil Sample Radiological Results to Date to HRCR
<b>Background Reference Area Radiological Sample Results</b>

\* Regional Background based on station MO-9 (Highways I-55 and 141 at Arnold, MO) from ORNL/TM-7343, State Background Radiation Levels: Results Taken During 1975 – 1979. This ORNL report states that standard deviations for Ra-226 and Th-232 are given as the  $\pm 2\sigma$  value, and that error in the U-238 measurements is  $\leq 5\%$  ( $2\sigma$ ).

The sample results in Attachment 2 from the off-site borrow locations compare favorably to the background reference area results in Attachment 1, as shown in the summary statistics contained in Table 2. Graphically, the comparison is presented in box plot format (Figures 1 to 4). The box plots depict the background reference area soil data and off-site borrow location data through five-number summaries: sample minimum (excluding outliers), lower quartile (25th percentile of the data), median (50th percentile of the data), upper quartile (75th percentile of the data), and sample maximum (excluding outliers). The boxes illustrate data that range from the lower quartile to the upper quartile. The box plots display differences between the two data populations without assuming an underlying statistical distribution. These plots illustrate the similarities in the Uranium and Thorium datasets and clearly show that the Radium concentration is well below the background reference area soil concentration. The background reference area data is reflected on the left side of Figures 1 to 4; the offsite borrow location data is on the right side.



Figure 1. Ra-226 Box Plot Comparing Results from Off-site Borrow Locations and Background Reference Area

Figure 2. Th-232 Box Plot Comparing Results from Off-site Borrow Locations and Background Reference Area



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Figure 3. U-235 Box Plot Comparing Results from Off-site Borrow Locations and Background Reference Area

Figure 4. U-238 Box Plot Comparing Results from Off-site Borrow Locations and Background Reference Area



ProUCL v4.00.005 was used to compare the laboratory data for Ra-226, Th-232, U-235, and U-238 from the samples obtained from offsite borrow locations to the data for background reference area soil. ProUCL is a statistical analytical tool to determine if the concentrations of uranium, radium, and thorium were statistically distinguishable from background. This process is consistent with the statistical process described in HEM-10-80, which included two-sample

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hypothesis testing performed using the Quantile and Mann-Whitney U tests (referred to as Wilcoxon-Mann-Whitney in ProUCL).

Both tests concluded that Ra-226, U-235, and U-238 from offsite fill locations were determined to be indistinguishable from the background reference area soil data. For Th-232, the Mann-Whitney U test concluded that the backfill location mean concentration was distinguishable from the background reference area soil data, but the Quantile test concluded that the data from offsite backfill areas was indistinguishable. A review of the data showed that the offsite backfill data for Th-232 all fell within the 25<sup>th</sup> to 75<sup>th</sup> percentile range of the background reference area soil data with a negligible difference in population means and medians. The mean of the background reference area was 1.06 pCi/g versus 1.18 pCi/g for the offsite borrow location. The median was 1.0 pCi/g for the background reference area versus 1.21 pCi/g for the offsite borrow location. The Mann-Whitney U test result is not considered to be disqualifying based on agreement from the Quantile test, the means and medians, and the percentile range comparison.

The Tc-99 results were less than the minimum detectable concentrations (MDCs) for 14 of 16 samples. Trace detections in 2 samples were at a concentration that was only slightly above their respective MDCs. The results were 0.89 pCi/g (standard deviation of 0.11 pCi/g and MDC of 0.35 pCi/g), and 0.88 pCi/g (standard deviation of 0.28 and MDC of 0.33 pCi/g). These results are acceptable considering that they are less than 4 percent of the most restrictive DCGL for Tc-99 of 25.1 pCi/g (Uniform scenario). No non-DCGL licensable radionuclides were detected as present by the analytical laboratory.

Consistent with the guidance in Section 3.6.2 of MARSSIM and the preceding analysis, the soil from the offsite backfill locations is non-impacted material.

<u>Commitments to NRC</u>: Westinghouse will conduct sampling, analysis, and reporting of backfill soil from off-site borrow locations as follows:

- Prior to transporting the soil on-site, the soil will be sampled, analyzed, and the results evaluated.
- Sampling frequency will be at least as frequent as one sample per  $5,000 \text{ yd}^3$ .
- Sampling methods will be consistent with FSS sampling methods.
- Sample results will be compared to the background reference area data set using Quantile and Mann-Whitney U tests, mean, median, quartile, and box plot statistical tools, and checks for non-DCGL licensable radioactivity (e.g., Cs-137).
- The complete data set and evaluation for non-impacted soil from off-site borrow locations will be reported in the FSS Final Report. The complete data set will not be available for the individual FSS Release Records, so these report will only contain the off-site borrow location data and evaluation that available at the time of the FSS.

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Please contact me at the number above or Dennis Richardson at 314-810-3376 should you have questions or need additional information.

Sincerely,

Dennis Richardson For

Gay M. Fussell Deputy Director Hematite Decommissioning Project

Attachments

- 1) Background Reference Area Analytical Gamma Spectroscopy Results
- 2) Radiological Sample Results to Date from Off-site Borrow Location
- 3) ProUCL Statistical Assessment Input Data Set
- 4) Ra-226 Mann-Whitney U Test ProUCL Results
- 5) Ra-226 Quantile Test ProUCL Results
- 6) Th-232 Mann-Whitney U Test ProUCL Results
- 7) Th-232 Quantile Test ProUCL Results
- 8) U-235 Mann-Whitney U Test ProUCL Results
- 9) U-235 Quantile Test ProUCL Results
- 10) U-238 Mann-Whitney U Test ProUCL Results
- 11) U-238 Quantile Test ProUCL Results

cc: J. J. Hayes, NRC/FSME/DWMEP/DURLD

M. M. LaFranzo, NRC Region III/DNMS/MCID

E. A. Bonano, NRC Region III/DNMS/MCID

J. W. Smetanka, Managing Director HDP

	Background Refer	Attachment 1 ence Area – Analytical Gam	ma Spectroscopy Results	
Sample ID	Ra-226 in-growth	Th-232	U-235	U-238
		Activity ± Error	(MDA) (pCi/g)	
		Surface		
BG-01-00-SL	$1.34 \pm 0.28 (0.37)$	0.72 ± 0.18 (0.04)	$0.03 \pm 0.02 \ (0.03)$	0.55 ± 0.12 (0.02)
BG-02-00-SL	$1.32 \pm 0.32 \ (0.53)$	0.75 ± 0.18 (0.03)	$0.02 \pm 0.02 \ (0.01)$	$0.77 \pm 0.16 \ (0.01)$
BG-03-00-SL	$1.28 \pm 0.30 \ (0.41)$	$0.79 \pm 0.18 (0.03)$	$0.03 \pm 0.02 \ (0.02)$	$0.88 \pm 0.17 \ (0.02)$
BG-04-00-SL	$1.42 \pm 0.35 \ (0.57)$	$0.89 \pm 0.21 \ (0.03)$	$0.04 \pm 0.03 \ (0.03)$	$0.60 \pm 0.13 \ (0.03)$
BG-05-00-SL	$1.52 \pm 0.32 \ (0.42)$	$0.80 \pm 0.19 \ (0.05)$	$0.02 \pm 0.02 \ (0.01)$	$0.75 \pm 0.15 \ (0.02)$
BG-06-00-SL	$1.34 \pm 0.34 \ (0.51)$	0.80 ± 0.19 (0.02)	$0.07 \pm 0.03 \ (0.02)$	$0.67 \pm 0.14 \ (0.01)$
BG-07-00-SL	$1.16 \pm 0.28 \ (0.39)$	$0.73 \pm 0.17 (0.03)$	$0.02 \pm 0.02 \ (0.02)$	0.63 ± 0.13 (0.02)
BG-08-00-SL	$1.62 \pm 0.37 \ (0.59)$	$1.30 \pm 0.28 \ (0.04)$	$0.07 \pm 0.04 \ (0.03)$	$0.99 \pm 0.19 \ (0.03)$
BG-09-00-SL	$1.63 \pm 0.28 \ (0.35)$	$1.30 \pm 0.28 \ (0.02)$	$0.07 \pm 0.03 \ (0.03)$	$0.98 \pm 0.19 \ (0.03)$
BG-10-00-SL	$1.74 \pm 0.40 \ (0.57)$	$1.00 \pm 0.22 \ (0.03)$	$0.07 \pm 0.03 \ (0.02)$	$1.00 \pm 0.19 \ (0.02)$
BG-11-00-SL	$1.67 \pm 0.39 \ (0.56)$	$1.20 \pm 0.24 \ (0.03)$	$0.06 \pm 0.03 \ (0.02)$	$0.96 \pm 0.19 \ (0.02)$
BG-12-00-SL	$1.62 \pm 0.31 \ (0.47)$	$1.20 \pm 0.25 \ (0.01)$	$0.06 \pm 0.03 \ (0.01)$	$0.86 \pm 0.17 \ (0.03)$
BG-13-00-SL	$1.55 \pm 0.36 \ (0.53)$	$0.86 \pm 0.19 \ (0.03)$	$0.04 \pm 0.03 \ (0.03)$	$0.86 \pm 0.17 \ (0.03)$
BG-14-00-SL	$1.34 \pm 0.35 \ (0.55)$	$1.10 \pm 0.24 \ (0.04)$	$0.03 \pm 0.02 \ (0.03)$	0.92 ± 0.18 (0.03)
BG-15-00-SL	$1.00 \pm 0.30 \ (0.53)$	0.67 ± 0.15 (0.03)	$0.03 \pm 0.02 \ (0.03)$	0.59 ± 0.13 (0.02)
BG-16-00-SL	$1.26 \pm 0.30 \ (0.42)$	0.81 ± 0.18 (0.02)	$0.05 \pm 0.02 \ (0.01)$	0.72 ± 0.15 (0.02)
		Subsurface (3 feet)		
BG-01-03-SL	$0.98 \pm 0.27 \ (0.45)$	0.83 ± 0.19 (0.03)	$0.06 \pm 0.03 \ (0.03)$	$0.65 \pm 0.13 \ (0.03)$
BG-02-03-SL	$1.53 \pm 0.35 \ (0.56)$	$0.90 \pm 0.21 \ (0.03)$	$0.03 \pm 0.02 \ (0.02)$	$0.74 \pm 0.15 \ (0.02)$
BG-03-03-SL	$1.27 \pm 0.34 \ (0.61)$	$0.84 \pm 0.19 \ (0.04)$	$0.05 \pm 0.03 \ (0.03)$	0.81 ± 0.16 (0.01)
BG-04-03-SL	$1.42 \pm 0.30 \ (0.35)$	0.95 ± 0.21 (0.02)	$0.08 \pm 0.04 \ (0.01)$	$0.76 \pm 0.15 \ (0.02)$
BG-05-03-SL	$1.59 \pm 0.36 \ (0.53)$	0.99 ± 0.23 (0.01)	$0.05 \pm 0.03 \ (0.02)$	0.80 ± 0.16 (0.02)
BG-06-03-SL	$1.64 \pm 0.35 \ (0.50)$	0.90 ± 0.21 (0.03)	0.07 ± 0.03 (0.02)	0.82 ± 0.16 (0.02)
BG-07-03-SL	$1.41 \pm 0.27 (0.42)$	$0.92 \pm 0.21 \ (0.03)$	$0.05 \pm 0.03 \; (0.02)$	0.74 ± 0.15 (0.02)
BG-08-03-SL	$1.61 \pm 0.30 \ (0.47)$	$1.20 \pm 0.27 \ (0.04)$	$0.06 \pm 0.03 \ (0.03)$	0.96 ± 0.18 (0.02)
BG-09-03-SL	$1.97 \pm 0.38 \ (0.52)$	$1.30 \pm 0.29 \ (0.01)$	$0.04 \pm 0.02 \ (0.01)$	$0.96 \pm 0.18 \ (0.02)$
BG-10-03-SL	$1.60 \pm 0.33 \ (0.57)$	$1.20 \pm 0.26 \ (0.03)$	$0.05 \pm 0.03 \ (0.03)$	$0.94 \pm 0.19 \ (0.01)$
BG-11-03-SL	1.58 ± 0.39 (0.50)	$1.20 \pm 0.25 \ (0.02)$	$0.08 \pm 0.04 \ (0.02)$	0.87 ± 0.18 (0.01)
BG-12-03-SL	$1.69 \pm 0.39 \ (0.51)$	$1.10 \pm 0.23 \ (0.03)$	$0.03 \pm 0.02 \ (0.03)$	$0.98 \pm 0.20 \ (0.02)$
BG-13-03-SL	$1.86 \pm 0.40 \ (0.53)$	$1.10 \pm 0.23 \ (0.04)$	0.06 ± 0.03 (0.03)	$0.99 \pm 0.20 \ (0.03)$
BG-14-03-SL	1.56 ± 0.38 (0.57)	$1.30 \pm 0.27 \ (0.03)$	$0.03 \pm 0.02 \ (0.02)$	0.96 ± 0.19 (0.02)
BG-15-03-SL	$1.37 \pm 0.34 \ (0.59)$	$1.20 \pm 0.26 \ (0.03)$	0.06 ± 0.03 (0.02)	$0.80 \pm 0.17 \ (0.02)$
BG-16-03-SL	$1.32 \pm 0.31 \ (0.46)$	$0.92 \pm 0.21 \ (0.05)$	$0.03 \pm 0.02 \ (0.02)$	0.63 ± 0.13 (0.02)

Attachment 2 Radiological Sample Results to Date from Off-site Borrow Location																	
Sample ID	Soil Type Sample	Technetium 99 (pCi/g)		Radiu	Radium (226) (pCi/g) in-growth		Thorium 232 (pCi/g)		Uranium 235 (pCi/g)		pCi/g)	Uranium 238 (pCi/g)		(pCi/g)			
	200 - JP	Date	Result	MDC	Error	Result	MDC	Error	Result	MDC	Error	Result	MDC	Error	Result	MDC	Error
4196-WM-130123-00-01	Deep Soil	1/23/2013	0.9	0.4	0.1	1.2	0.1	0.2	1.3	0.2	0.2	0.1	0.3	0.2	1.9	1.6	1.1
4196-WM-130123-00-02	Topsoil	1/23/2013	0.9	0.3	0.3	0.9	0.1	0.1	0.9	0.1	0.1	0.2	0.2	0.1	0.6	0.7	0.3
6444-WM-130905-00-05	Deep Soil	9/5/2013	0.1	0.2	0.1	0.8	0.1	0.1	1.2	0.1	0.2	0.1	0.2	0.1	1.5	0.9	0.7
6444-WM-130905-00-10	Deep Soil	9/5/2013	0.1	0.2	0.0	0.6	0.1	0.1	1.1	0.1	0.2	0.1	0.2	0.1	1.0	0.9	0.4
6444-WM-130905-00-15	Deep Soil	9/5/2013	0.1	0.2	0.1	0.7	0.1	0.1	1.1	0.1	0.2	0.1	0.3	0.2	0.7	0.9	0.4
7056-WM-131101-00-05	Deep Soil	11/5/2013	0.0	0.2	0.0	0.8	0.1	0.1	1.3	0.1	0.2	0.0	0.2	0.1	0.8	0.8	0.3
7056-WM-131101-00-10	Deep Soil	11/5/2013	0.0	0.2	0.1	0.8	0.1	0.1	1.2	0.1	0.2	0.1	0.2	0.1	1.1	0.8	0.6
7056-WM-131101-00-15	Deep Soil	11/5/2013	0.0	0.2	0.0	0.9	0.1	0.2	1.1	0.1	0.2	0.1	0.2	0.1	1.3	0.9	0.7
7392-WM-131205-00-03	Deep Soil	12/9/2013	-0.1	0.3	0.0	0.8	0.1	0.1	1.3	0.1	0.2	0.1	0.2	0.2	0.9	0.9	0.4
7392-WM-131205-00-06	Deep Soil	12/9/2013	0.0	0.2	0.0	0.9	0.1	0.1	1.4	0.1	0.2	0.1	0.3	0.1	1.5	0.8	0.7
7392-WM-131205-00-10	Deep Soil	12/9/2013	0.0	0.2	0.1	0.8	0.1	0.1	1.3	0.1	0.2	0.1	0.2	0.1	1.4	1.0	0.8
7438-WM-131210-00-03	Deep Soil	12/10/2013	-0.1	0.2	0.0	0.6	0.1	0.1	1.2	0.1	0.2	0.1	0.2	0.1	0.9	0.9	0.4
7438-WM-131210-00-07	Deep Soil	12/10/2013	-0.1	0.2	0.0	0.6	0.1	0.1	1.3	0.1	0.2	0.1	0.2	0.1	0.9	0.7	0.5
7438-WM-131210-00-10	Deep Soil	12/10/2013	-0.1	0.2	0.0	0.7	0.1	0.1	1.1	0.1	0.1	0.1	0.1	0.1	1.2	0.6	0.5
7438-WM-131210-00-13	Deep Soil	12/10/2013	-0.1	0.2	0.1	0.8	0.1	0.1	1.2	0.1	0.2	0.2	0.2	0.2	1.2	0.9	0.6
7438-WM-131210-00-16	Deep Soil	12/10/2013	-0.1	0.2	0.1	0.6	0.1	0.1	1.1	0.1	0.2	0.1	0.2	0.1	1.3	0.9	0.8

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1.3

0.8

0.0

-0.1

1.0

Background Concentration (pCi/g)			Offsite Borrow Concentration (pCi/g)				
Ra-226	Th-232	U-235	U-238	Ra-226	Th-232	U-235	<b>U-238</b>
1.3	1.0	-0.3	1.8	1.2	1.3	0.1	1.9
1.0	0.8	-0.3	-1.0	0.9	0.9	0.2	0.6
1.3	1.0	0.0	-0.8	0.8	1.2	0.1	1.5
1.5	0.7	-0.5	1.0	0.6	1.1	0.1	1.0
1.3	0.5	0.2	0.6	0.7	1.1	0.1	0.7
1.3	0.9	0.3	4.0	0.8	1.3	0.0	0.8
1.4	0.5	0.1	1.0	0.8	1.2	0.1	1.1
1.4	0.8	0.1	1.3	0.9	1.1	0.1	1.3
1.5	0.8	-0.3	-0.1	0.8	1.3	0.1	0.9
1.6	1.0	0.3	-0.5	0.9	1.4	0.1	1.5
1.3	0.8	0.2	1.1	0.8	1.3	0.1	1.4
1.6	0.8	0.4	0.9	0.6	1.2	0.1	0.9
1.2	0.8	-0.3	0.2	0.6	1.3	0.1	0.9
1.4	0.9	-0.1	0.8	0.7	1.1	0.1	1.2
1.6	1.4	0.0	2.0	0.8	1.2	0.2	1.2
1.6	1.8	0.1	1.9	0.6	1.1	0.1	1.3
1.6	1.4	0.1	-0.4				
2.0	1.2	-0.2	0.7				
1.7	1.1	0.3	2.2				
1.6	1.2	0.2	3.4				
1.7	1.4	-0.1	2.2				
1.6	1.2	0.0	-0.2				
1.6	1.4	0.3	2.4				
1.7	1.5	-0.1	1.6				
1.6	1.2	0.1	2.6				
1.9	1.2	0.1	0.9				
1.3	1.0	0.4	1.7				
1.6	1.6	-0.2	1.5				
1.0	0.8	0.0	0.6				
1.4	1.5	0.0	1.7				
1.3	1.0	-0.2	0.7				

# Attachment 3 ProUCL Statistical Assessment Input Data Set

# Attachment 4 Ra-226 Mann-Whitney U Test ProUCL Results

# Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options	
From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Ra226\_Fill Background Data: Ra226\_BKGD

		Raw Statistics	
	Site		Background
Number of Valid Observations	16		32
Number of Distinct Observations	15		10
Minimum	0.568		0.98
Maximum	1.23		2
Mean	0.778		1.474
Median	0.763		1.5
SD	0.159		0.226
SE of Mean	0.0398		0.0399

Wilcoxon-Mann-Whitney (WMW) Test

# H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat 139 WMW Test U-Stat -5.544 WMW Critical Value (0.050) 1.645 P-Value 1

Conclusion with Alpha = 0.05 Do Not Reject H0, Conclude Site <= Background P-Value >= alpha (0.05)

# Attachment 5 Ra-226 Quantile Test ProUCL Results

# Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

# User Selected Options

From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Ra226\_Fill Background Data: Ra226\_BKGD

		Raw Statistics	
	Site		Background
Number of Valid Observations	16		32
Number of Distinct Observations	15		10
Minimum	0.568		0.98
Maximum	1.23		2
Mean	0.778		1.474
Median	0.763		1.5
SD	0.159		0.226
SE of Mean	0.0398		0.0399

### Quantile Test

# H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.052)	10
Approximate K Value (0.052)	6
R Value Adjusted for Ties in Data	15
K Value Adjusted for Ties in Data	11
Number of Site Observations in 'R' Largest	0
Calculated Alpha	0.0537

### Conclusion with Alpha = 0.052

# Attachment 6 Th-232 Mann-Whitney U Test ProUCL Results

# Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options	
From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Th232\_Fill Background Data: Th232\_BKGD

Raw Statistic	cs
Site	Background
16	32
14	18
0.85	0.53
1.36	1.8
1.184	1.063
1.205	1
0.126	0.318
0.0316	0.0561
	Raw Statistic Site 16 14 0.85 1.36 1.184 1.205 0.126 0.0316

# Wilcoxon-Mann-Whitney (WMW) Test

# H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat 470 WMW Test U-Stat 1.695 WMW Critical Value (0.050) 1.645 P-Value 0.045

Conclusion with Alpha = 0.05 Reject H0, Conclude Site > Background P-Value < alpha (0.05)

# Attachment 7 Th-232 Quantile Test ProUCL Results

# Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

# User Selected Options

From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst	
Full Precision	OFF	
Confidence Coefficient	95%	
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)	
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration	

Area of Concern Data: Th232\_Fill Background Data: Th232\_BKGD

Raw Statistics		
	Site	Background
Number of Valid Observations	16	32
Number of Distinct Observations	14	18
Minimum	0.85	0.53
Maximum	1.36	1.8
Mean	1.184	1.063
Median	1.205	1
SD	0.126	0.318
SE of Mean	0.0316	0.0561

### Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.052) 10 Approximate K Value (0.052) 6 Number of Site Observations in 'R' 2 Largest Calculated Alpha 0.0537

# Conclusion with Alpha = 0.052

# Attachment 8 U-235 Mann-Whitney U Test ProUCL Results

# Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without<br/>NDsUser Selected OptionsFrom FileC:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wstFull PrecisionOFFConfidence Coefficient<br/>Substantial Difference95%OSelected Null HypothesisAlternative HypothesisSite or AOC Mean/Median Greater Than Background Mean/Median

# Area of Concern Data: U235\_Fill Background Data: U235\_BKGD

		Raw Statistics	
	Site		Background
Number of Valid Observations	16		32
Number of Distinct Observations	16		30
Minimum	0.0316		-0.52
Maximum	0.21		0.41
Mean	0.109		0.0143
Median	0.104		0.0345
SD	0.0462		0.224
SE of Mean	0.0115		0.0397

#### Wilcoxon-Mann-Whitney (WMW) Test

### H0: Mean/Median of Site or AOC <= Mean/Median of Background

 Site Rank Sum W-Stat
 462.5

 WMW Test U-Stat
 1.531

 WMW Critical Value (0.050)
 1.645

 P-Value
 0.0629

Conclusion with Alpha = 0.05 Do Not Reject H0, Conclude Site <= Background P-Value >= alpha (0.05)

# Attachment 9 U-235 Quantile Test ProUCL Results

### Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options	
From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: U235\_Fill Background Data: U235\_BKGD

		Raw Statistics	
	Site		Background
Number of Valid Observations	16		32
Number of Distinct Observations	16		30
Minimum	0.0316		-0.52
Maximum	0.21		0.41
Mean	0.109		0.0143
Median	0.104		0.0345
SD	0.0462		0.224
SE of Mean	0.0115		0.0397

# Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.052) 10 Approximate K Value (0.052) 6 Number of Site Observations in 'R' 2 Largest Calculated Alpha 0.0537

### Conclusion with Alpha = 0.052

# Attachment 10 U-238 Mann-Whitney U Test ProUCL Results

# Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

	User Selected Options	
	From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst
	Full Precision	OFF
	Confidence Coefficient	95%
	Substantial Difference	0
S	elected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
	Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

# Area of Concern Data: U238\_Fill Background Data: U238\_BKGD

	Raw Statistics	
	Site	Background
Number of Valid Observations	16	32
Number of Distinct Observations	16	29
Minimum	0.62	-1
Maximum	1.9	4
Mean	1.149	1.116
Median	1.145	1
SD	0.335	1.17
SE of Mean	0.0838	0.207

### Wilcoxon-Mann-Whitney (WMW) Test

### H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat 403.5 WMW Test U-Stat 0.241 WMW Critical Value (0.050) 1.645 P-Value 0.405

Conclusion with Alpha = 0.05 Do Not Reject H0, Conclude Site <= Background P-Value >= alpha (0.05)

# Attachment 11 U-238 Quantile Test ProUCL Results

# Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options	
From File	C:\Documents and Settings\guidojs\Desktop\scratch\1403xx\backfill\backfill.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration
Null Hypothesis Alternative Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: U238\_Fill Background Data: U238\_BKGD

	Raw Statistics	
	Site	Background
Number of Valid Observations	16	32
Number of Distinct Observations	16	29
Minimum	0.62	-1
Maximum	1.9	4
Mean	1.149	1.116
Median	1.145	1
SD	0.335	1.17
SE of Mean	0.0838	0.207

### Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.052) 10 Approximate K Value (0.052) 6 Number of Site Observations in 'R' 1 Largest Calculated Alpha 0.0537

### Conclusion with Alpha = 0.052