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Subject: Response to Request for Additional Information Concerning Hematite Decommissioning Plan: Chapter 14, Characterization Report and Surrogates Report (License No. SNM-00033, Docket No. 070-00036)

References:
1) NRC (J. J. Hayes) letter to Westinghouse (E. K. Hackmann), dated July 1, 2010 , "Westinghouse Hematite Decommission Plan Review Requests for Additional Information"
2) Westinghouse (E. K. Hackmann) letter to Document Control Desk (NRC), HEM-09-94, dated August 12, 2009, "Decommissioning Plan and Revision to License Application"

This letter provides the Westinghouse Electric Company LLC response to the NRC's Reference 1 request for additional information concerning Chapter 14 of the Decommissioning Plan and associated documents of Reference 2.

Attachment 1 provides responses to the request for additional information, and provides an explanation of associated changes resulting from those responses to the Decommissioning Plan, the Hematite Radiological Characterization Report and/or the report Derivation of Surrogates and Scaling Factors for Hard-to-Detect Radionuclides. The actual changes to those documents will be provided under separate cover. Attachments 2 though 8 provide information referred to in Attachment 1.

Please contact Gerard Couture, Licensing Manager of my staff at 803-647-2045 should you have questions or need any additional information.

Sincerely,

E. Kurt Hackmann
Director, Hematite Decommissioning Project

Attachment:
1) Response to Request for Additional Information Hematite Decommissioning Plan: Chapter 14, Characterization Report and Surrogates Report
2) ProUCL Statistical Assessment Input Data Set (pCi/g)
3) Th-232 Quantile Test ProUCL Results
4) Th-232 Mann-Whitney U Test ProUCL Results
5) Total Uranium Quantile Test ProUCL Results
6) Total Uranium Mann-Whitney U Test ProUCL Results
7) Total Uranium ProUCL Graphical Review
8) Detailed Description of RCR Discrepancies Identified

cc:
J. J. Hayes, NRC/FSME/DWMEP/DURLD
J. W. Smetanka, Westinghouse, w/o attachments
J. E. Tapp, NRC Region III/DNMS/DB, w/o attachments

ATTACHMENT 1

Response to Request for Additional Information
Hematite Decommissioning Plan:
Chapter 14, Characterization Report and Surrogates Report

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

Response to Request for Additional Information
Hematite Decommissioning Plan:
Chapter 14, Characterization Report and Surrogates Report

The following reiterates the NRC requests for additional information (RAI) of letter dated July 1, 2010, followed by the Westinghouse response for each RAI concerning the Hematite Decommissioning Project (HDP). Some of the responses will result in changes, as noted, to the Decommissioning Plan (DP), the Characterization Report and/or the Surrogates Report. The changes to the documents will be provided under separate cover, denoted by vertical lines in the right margin of each document.

These RAI responses are organized in the same manner as the RAIs; i.e., first those pertaining the Chapter 14 of the DP (Hematite Decommissioning Plan, DO-08-004, Revision 0.0), followed by those pertaining to the Characterization Report (Hematite Radiological Characterization Report, DO-08-003, Revision 0), and the Surrogates Report (Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides, DO-08-008, Revision 0). For each RAI, the NRC's Comment, Basis and Path Forward is reiterated, and followed by the Westinghouse Response.

Decommissioning Plan Chapter 14

1. (HDPC-14-Q1) Comment: Section 14.1.3.1 of the Hematite Decommissioning Plan (HDP) and Section 2.2 of the "Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides" indicate that Np-237, Pu-239/240, and Am-241 are considered to be insignificant radionuclides of concern. This conclusion was based on the aggregate dose of these radionuclides being less than 10% of the Total Effective Dose Equivalent (TEDE) for each Conceptual Site Model. Population activity concentration results are given for these radionuclides in the Surrogate Report (DO-08-008), but it is not clear how the average concentration and associated statistics were determined.

   Basis: Per guidance in NUREG-1757, Vol. 2, Rev. 1, Section 3.3, "It is important that the licensee documents the radionuclides and pathways that have been considered insignificant and eliminated from further consideration and that the licensee justifies the decision to consider them insignificant."

   Path Forward: Provide details on how the average concentration, variance, and range of the results were determined for insignificant radionuclides of concern.

   Westinghouse Response:

   Section 2.2, paragraph 3 of DO-08-008, "*Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides*", states the following:

   > "The aggregate dose contribution from Am-241, Np-237 and Pu-239/240 for each CSM was less then 10 percent of the TEDE; and thus, these radionuclides are considered to be insignificant radionuclides of concern. The summary statistics

and characterization sample population data are provided in Appendix A."

Appendix A of report DO-08-008 presents the characterization survey population in its entirety that was used to reach the above conclusion. The specific locations of where each sample was taken are presented in Figures 4-3 through 4-23 of DO-08-003, *Hematite Radiological Characterization Report*. The soil sample results are segregated into categories representing each of the three Conceptual Site Model (CSM) strata, surface soil, root soil and deep soil. The results of laboratory analysis for each of the three radionuclides in question, Am-241, Np-237 and Pu-239/240, are presented in each represented column. As noted in the table notes, if an analysis result was less than the Minimum Detectable Concentration (MDC), then the actual reported value was used and the fact that the result was less than MDC was denoted by bold font. The average concentration for each radionuclide in question that is presented in Table A-1 of Appendix A is the mean of the data as presented in Table A-2. This average concentration was then divided by the applicable Derived Concentration Guideline Level (DCGL) to derive a Sum-of-Fractions (SOF) representative of the average concentration of each radionuclide.

Additional statistical characteristics of the characterization sample population that is presented in Appendix A is as follows:

Am-241	Surface Soils CSM	Root Soil CSM	Deep Soil CSM
# of Sample Analyzed	390	434	456
Sample Results >MDC	3	5	3
Mean	0.0567	-0.0355	-0.0005
Median	0.0040	0.0040	0.0010
Minimum Result	-1.7700	-11.5000	-0.7160
Maximum Result	3.8000	0.7470	1.0300
Standard Deviation	0.3772	0.5817	0.1509

Np-237	Surface Soils CSM	Root Soil CSM	Deep Soil CSM
# of Sample Analyzed	74	57	19
Sample Results >MDC	12	6	4
Mean	0.0216	0.0132	0.0364
Median	0.0061	0.0022	0.0160
Minimum Result	-0.0140	-0.0170	-0.0170
Maximum Result	0.5840	0.4200	0.2190
Standard Deviation	0.0713	0.0603	0.0617

Pu-239/240	Surface Soils CSM	Root Soil CSM	Deep Soil CSM
# of Sample Analyzed	74	57	19
Sample Results >MDC	5	2	2
Mean	0.0030	0.0003	0.0001
Median	0.0031	0.0006	-0.0012
Minimum Result	-0.0800	-0.0380	-0.0100
Maximum Result	0.0440	0.0290	0.0170
Standard Deviation	0.0155	0.0105	0.0075

There is an error in Table 2-2 of DO-08-008. In the table, a value is reported for "CSM Insignificant Dose" for each of the three CSMs, surface root and deep. These values are labeled incorrectly. The values actually represent the average SOF for each of the three CSMs. It is also incorrect that the Deep Soil DCGL for Np-237 was used to derive the average SOF for the Deep CSM. The correct DCGLs are the Excavation scenario DCGLs. Therefore, Table 2-2 of DO-08-008 will be revised as follows:

Insignificant Radionuclide	**Average Activity Concentration (ρCi/g)**	**Proposed DCGL (ρCi/g)**	**Average SOF**
Surface Soil CSM			
Am-241	0.0567	220.7	0.0003
Np-237 + D	0.0216	17.3	0.0012
Pu-239/240	0.0030	237.0	0.0000
Total Surface Soil CSM Insignificant Dose (mrem per yr):			**0.0379**
Root Soil CSM			
Am-241	0.0000	118.5	0.0000
Np-237 + D	0.0132	5.0	0.0026
Pu-239/240	0.0003	84.8	0.0000
Total Root Soil CSM Insignificant Dose (mrem per yr):			**0.0659**
Deep Soil CSM			
Am-241	0.0000	114.6	0.0000
Np-237 + D	0.0364	5.6	0.0065
Pu-239/240	0.0001	123.3	0.0000
Total Deep Soil CSM Insignificant Dose (mrem per yr):			**0.1624**

The SOF composed of the average concentrations of Am-241, Np-237 and Pu-239/240 in each CSM is still less than 10% of the dose criteria in 10 CFR Part 20.1402. The same conclusion was also reached using the upper confidence limit of the mean concentration at the 95% confidence level. Using this scenario, the maximum dose contribution was found in the Deep CSM at 1.08% of the dose criteria in 10 CFR Part 20.1402.

2. (HDPC-14-Q2) Comment: HDP Section 14.2.7 Adequacy of the Characterization states that "Samples have been taken in each area, along with historical information, provide a clear picture of the residual radioactive materials and its vertical and lateral extent at the site." Section 14.1.4.2 Buildings and Structural Surfaces derives gross activity structural Derived Concentration Guideline Levels (DCGLs) from the fractional abundances from sample residues from floor drains and not from samples from the structures. It is not clear (with some of the very low fractional abundances and large DCGLs) if the nuclides should be eliminated and what effect this has on the derived gross activity DCGL. For example, it is not clear why Tc-99 is included in the calculation when it is the only pure beta emitter, a low fractional abundance, and a high DCGL.

   Path Forward: Provide an evaluation of the Radionuclides of Concern (ROCs), justify the dose contribution, and ensure the derived gross DCGL is conservative.

   Westinghouse Response:

   The basis for the selection of the Radionuclides of Concern (ROC) for Hematite are addressed in section 6.1 of report DO-08-005, *"Historical Site Assessment"*. The basis for the development of the structural surface Derived Concentration Guideline Levels (DCGL) for the Hematite Decommissioning Project (HDP) is provided in section 5.4 of DO-08-004, *"Hematite Decommissioning Plan"* (DP). Isotopic DCGLs for all Radionuclides of Concern (ROC) at HDP, including DCGLs for Transuranic Radionuclides (TRU) and hard-to-detect radionuclides were derived based upon dose modeling to the critical group and exposure pathways. The parameters and sensitivity analysis of the parameters used to develop the structural surface DCGLs are provided in section 5.4.3 of the DP. The structural surface DCGLs for all ROCs that were derived by this process are provided in Table 5-19.

   In accordance with the guidance provided by section 3.3 of NUREG-1757, *"Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria, Volume 2, Revision 1"*, several of the ROC were deemed as insignificant contributors to dose in soil at Hematite and were eliminated from further consideration. The basis for this determination was documented in section 2.2 and Appendix A of DO-08-008, *"Derivation of Surrogates and Scaling Factors for Hard-to-Detect Radionuclides."*

   The distribution of Radionuclides of Concern (ROC) in structures that is presented in Table 4-1 of the Decommissioning Plan is based upon two material samples taken in

Building 230 during characterization, and additional samples obtained from the drain systems in Buildings 230 and 110. The small population of samples obtained from surfaces outside of the drain system was caused by the absence of any significant amount of contamination on surfaces. Given this limitation on the number of samples, and the fact that assuming the trace amount of transuranic radionuclides found in the additional samples taken from the drain systems in Building 110 and Building 230 would result in a conservative estimate of the potential dose, the two groups of samples were combined. These fractions are presented in Table 14-6 of the DP and are summarized as follows:

Nuclide	Activity Fraction
U-234	0.827
U-235	0.037
U-238	0.127
Tc-99	0.00283
Th-232	0.00321
Np-237	0.00006
Pu-239/240	0.000002
Am-241	0.00268

As these fractions show, the majority of the activity can be attributed to Uranium, with the other five radionuclides contributing less than 0.9% of the total activity. HDP believes that the use of this mixture is appropriate for two reasons. The first reason is the simple fact that all other residual radioactivity outside of the drain systems in Buildings 110, 230 and 231 have been remediated and removed. The second reason pertains to the fact that based upon an assessment of all the structural characterization data, there is no credible evidence that the abundance of Tc-99, Th-232, Np-237, Pu-239/240 and Am-241 will contribute a significant fraction to the overall structural surface activity. In all cases, the majority of the activity is due to Uranium.

Two volumetric material samples (dust) were obtained (BD1-230-1-DUST and BD3-230-1-DUST) from surfaces in Building 230 during the characterization following the identification of localized areas of elevated activity. Sample BD1-230-1-DUST was obtained from an anchor bolt hole in the floor near the KARDEX Room in the Rod Loading Room (crack and seam survey location). Sample BD3-230-1-DUST was from a floor seam in the southwest portion of the Class 2 “U” shaped area. Additional samples were not available for analysis simply because a sufficient level of contamination was not present. Both samples were assessed for isotopic content and the analytical results for these samples are presented in Table 4-52 of DO-08-003 and are summarized as follows:

Sample BD1-230-1-DUST		**Sample BD3-230-1-DUST**	
Radionuclide	**Concentration**	**Radionuclide**	**Concentration**
U-234	54,100 ρCi/g	U-234	40,900 ρCi/g
U-235	2,800 ρCi/g	U-235	1,880 ρCi/g
U-238	8,000 ρCi/g	U-238	6,090 ρCi/g
Tc-99	<MDC	Tc-99	0.75 ρCi/g
Th-232	<MDC	Th-232	<MDC
Np-237	Not Analyzed	Np-237	<MDC
Pu-239/240	Not Analyzed	Pu-239/240	<MDC
Am-241	<MDC	Am-241	<MDC

Substituting the Minimum Detectable Concentration (MDC) value for the radionuclides reported as less than MDC, the following radionuclide fractions can be derived:

Sample BD1-230-1-DUST		**Sample BD3-230-1-DUST**	
Radionuclide	**Fraction**	**Radionuclide**	**Fraction**
U-234	0.832	U-234	0.619
U-235	0.043	U-235	0.286
U-238	0.123	U-238	0.092
Tc-99	0.000123	Tc-99	0.000011
Th-232	0.001046	Th-232	0.001817

Sample BD1-230-1-DUST		**Sample BD3-230-1-DUST**	
Radionuclide	**Fraction**	**Radionuclide**	**Fraction**
Np-237	Not Analyzed	Np-237	0.000013
Pu-239/240	Not Analyzed	Pu-239/240	0.000696
Am-241	0.000615	Am-241	0.000147

In both samples, the majority of the activity is due to the presence of Uranium, and in both cases, the remaining five radionuclides represent less than 0.2% of the overall activity.

Subsequently, the drain system data were combined with the isotopic analysis of the two dust samples from Building 230 and used to establish a radionuclide mixture for the buildings based upon the average ROC concentrations. This average mixture was then used to derive the Adjusted Gross DCGL.

In conclusion, HDP contends that there is no credible evidence or survey data that would lead to the conclusion that Tc-99, Th-232, Np-237, Pu-239/240 and Am-241 are present on structural surfaces in Buildings 110, 230 and 231 in anything but trace concentrations.

Based upon the data presented, an argument can be made that the dose contribution from Tc-99, Th-232, Np-237, Pu-239/240 and Am-241 can also be classified as insignificant for structures. However NUREG-1757 does not dictate the licensee to take this action. The calculation of the Adjusted Gross DCGL sufficiently adjusts the dose impact of these radionuclides such that the process of classifying them as insignificant becomes irrelevant. In this case, the most limiting radionuclide for demonstrating compliance becomes U-235. The DCGL for U-235 in accordance with Table 5-19 is 19,000 dpm/100cm^2. Using the radionuclide mixture from the drain system samples, the Adjusted Gross DCGL is calculated as 18,925 dpm/100cm^2. HDP concludes that this value is conservative and appropriate for using gross activity measurements to demonstrate compliance with the dose-based unrestricted release criteria for structures at Hematite.

3. (HDPC-14-Q3) Comment: Section 14.1.4.3.1 Surrogate Radionuclides appears to provide an acceptable method for in inferring ROCs when U-235 is present but it is not clear how Surrogate will be determined when U-235 is not present.

   Path Forward: Please describe the criteria and process for determining the nuclides when U-235 is not present of very low specific activity, or low detect ability; and the quality assurance procedures to ensure surrogate ratios are maintained during the survey process.

Westinghouse Response:

The surrogate relationship between U-235 and Tc-99 that is presented in DO-08-008, "*Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides*" is the result of an assessment of all available surface and sub-surface soil characterization data for the Hematite facility. The analytical data was sorted and segregated into three populations, each representing one of the Surrogate Evaluation Areas (SEA), and then further segregated into three additional data sets representing the three strata of depth defined by the Conceptual Site Model (CSM). The resultant nine populations of data were used in the statistical evaluations to determine the relationship between Tc-99 and U-235. The resulting distribution ratios are based on the mean Tc-99 : U-235 ratio observed in each of the designated SEAs and CSMs adjusted for 95 percent confidence. The distribution ratios are location specific, conservative and consistent with the guidance provided in section 4.3.2 of NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM).

In section 4.6 of DO-08-008, HDP examined the possibility that Tc-99 could be present in soils subjected to Final Status Survey with only limited amounts of U-235. An assessment was performed of the characterization data in each SEA and soil stratum. An assumption was made that all soil containing total uranium in excess of the $DCGL_w$ was remediated. In the Plant Soil Area (PSA) and Burial Pit Area (BPA) SEAs, in all cases where remediation for total uranium was complete, the associated Tc-99 concentration was predicted to be less than the $DCGL_w$. As indicated in section 4.6 of DO-08-008, within the Tc-99 Soil Area (TSA) SEA, there were six instances where Tc-99 could remain at concentrations exceeding the $DCGL_w$:

> *"Of the six samples specified above, all reported significant Tc-99 activity with minimal U-235 activity. Based on the characterization data, this type of situation is bounded to the TSA SEA only. To address this, the approach for decommissioning these areas calls for the complete excavation and removal of surface stratum and root stratum soil in this SEA, and the direct analysis of Tc-99 concentrations in soil samples taken during FSS to demonstrate compliance."*

For the Hematite Decommissioning Project (HDP), the primary reason for establishing a surrogate relationship for Tc-99 is to assess the capability to perform scan surveys during Final Status Survey using conventional radiological instrumentation rather than to rely solely on this relationship to demonstrate compliance. HDP acknowledges, particularly in the TSA SEA, the possibility that Tc-99 may be present in soils with low concentrations of U-235.

Also, note that since the time DO-08-008 was published, HDP has reconsidered the initial plan to excavate to the depth of the root stratum. Given that the soil in excess of the DCGL within this area extends to a depth of only approximately two feet, this initial approach would double the amount of soil disposed, and include a large fraction of soil containing little, or no radioactivity from licensed activities.

HDP will use the excavation contours based on quantitative results of characterization sampling to guide excavation, coupled with field surveys that apply the conservative surrogate ratios from DO-08-008 which should provide adequate overlap to reduce the possibility of leaving residual Tc-99 in concentrations exceeding the $DCGL_w$. To confirm that the amount of Tc-99 as residual radioactivity is accurately quantified, HDP intends to analyze for Tc-99 in all samples taken for demonstrating compliance with the dose-based unrestricted release criteria during FSS.

4. (HDPC-14-Q4) Comment: Section 14.2.6 of the HDP (Justification for Non-Impacted Areas) states that "Sufficient survey coverage and an adequate number of samples were obtained in the areas subsequently designated as non-impacted to serve as the basis for this classification. The survey measurements and laboratory data from the samples showed radioactivity levels in all cases to be only a small fraction of the DCGLs, and in most instances, within the range of background." Per MARSSIM guidance, non-impacted areas should not contain residual radioactivity above background. However, the justification given in Section 14.2.6 indicates that some residual radioactivity above background may be located in areas that have been classified as non-impacted.

   There are also inconsistencies between what is stated in Section 14.2.6 of the HDP and the Radiological Characterization Report (DO-08-003) (RCR). It is indicated in the Executive Summary of the RCR that "The conclusion that areas were non-impacted was based on a review of the Historical Site Assessment (HSA), gamma scan measurements, and analytical results obtained from soil sampling. Non-impacted areas do not show detectable Tc-99 activity or concentrations of licensed radioactivity statistically distinguishable from background."

   The justification for non-impacted areas needs to be revised and re-evaluated to ensure that non-impacted areas, and associated background reference areas, are consistent with MARSSIM guidance and do not contain residual radioactivity above background.

   Basis: The following discussions from MARSSIM should be considered when designating impacted vs. non-impacted areas:

   MARSSIM Section 3.6 - *Evaluation of Historical Site Assessment Data*
   If process knowledge suggests that no residual contamination should be present and the historical analytical data also suggests that no residual contamination is present, the process knowledge provides an additional level of confidence and supports classifying the area as non-impacted. However, if process knowledge suggests no residual contamination should be present but the historical analytical data indicate the presence of residual contamination, the area will probably be considered impacted.

   MARSSIM Section 4.4 - *Classify Areas by Contamination Potential*
   Class 3 areas: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGLw, based on site operating history and previous radiological surveys. Examples of areas that might be classified as Class 3 include buffer

zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Path Forward: Provide a revised justification of non-impacted areas that is consistent with MARSSIM. Re-evaluate (and re-classify if necessary) any currently designated non-impacted areas that may contain residual radioactivity above background levels.

Westinghouse Response:

The last sentence of the second paragraph of DP Section 14.2.6 will be replaced with the following text, consistent with the Executive Summary of the Radiological Characterization Report (RCR).

The survey measurements and laboratory data from the samples obtained from areas designated as non-impacted did not show detectable Tc-99 activity or concentrations of licensed radioactivity as statistically distinguishable from background. The "statistically distinguishable from background" determination used ProUCL v4.00.005 for Th-232 and total Uranium consistent with the statistical process described in Appendix A of the HRCR, which included two-sample hypothesis testing performed using the Quantile and Mann-Whitney U tests (referred to as Wilcoxon-Mann-Whitney in ProUCL) in parallel.

Both tests concluded that Th-232 data from non-impacted areas were indistinguishable from the background data. For total Uranium, the Mann-Whitney U test concluded that the data from non-impacted were indistinguishable from the background data, but the Quantile test concluded that the data from non-impacted areas were distinguishable from the background data. A review of the summary statistics and a graphical review of the data were performed and showed that the non-impacted data and background data had very similar means and medians (as demonstrated by the Mann-Whitney U test), but the non-impacted data had greater variability. The non-impacted data, while having greater variability, was not skewed compared to the background data. The Quantile test specifically looks at the upper tails of the two distributions and does not consider the lower tails and therefore it is expected that the Quantile test would fail in this situation. It is also an acceptable result that the non-impacted data had greater variability since the data was collected over a larger geographically-sized area than the background data.

Lastly, the highest four total Uranium activity concentrations from the non-impacted area are from sub-surface samples at depths ranging from 4.5 to 9 feet. Based on the information provided in the HSA (e.g., historical use and aerial photographs), the most likely mode of *contaminant transport would be air deposition on surface soil rather than placement below the ground surface. Therefore it is doubtful that the Uranium activity observed in these samples can be attributed to licensed activities.*

The following Attachments to the accompanying letter provide supporting documentation. The supporting information will be incorporated into a revision of the RCR as an additional appendix as well as being incorporated as appropriate into DP Chapters 4 and 14:

2) ProUCL Statistical Assessment Input Data Set (pCi/g)
3) Th-232 Quantile Test ProUCL Results
4) Th-232 Mann-Whitney U Test ProUCL Results
5) Total Uranium Quantile Test ProUCL Results
6) Total Uranium Mann-Whitney U Test ProUCL Results
7) Total Uranium ProUCL Graphical Review

5. (HDPC-14-Q5): Comment: Section 14.2.8 of the HDP (Inaccessible or Not Readily Accessible Areas) indicates that some areas, such as drain systems and the Sanitary Wastewater Treatment Plant, were not fully characterized due to inaccessibility.

   Path Forward: Provide clarification that while drains and certain areas may not be currently accessible, they will be surveyed as Class 1 areas during decommissioning to demonstrate compliance with the DCGLs or for removal.

   Westinghouse Response:

   Buried piping and equipment that will remain in place after site closure that have had a potential for radioactive contamination above the $DCGL_W$ (based on site operating history) or known contamination above the $DCGL_W$ (based on previous radiation surveys or surveys performed during decommissioning) will be designated as Class 1 for the purpose of Final Status Survey. The DP will be revised to reflect such a condition.

   Piping sections that are currently Inaccessible or Not Readily Accessible and are slated for removal during decommissioning will be surveyed in accordance with HDP Radiation Protection Plan and Nuclear Criticality Safety Assessment requirements to support Radiation Work Permit generation, proper waste classification, and the establishment of radiological and nuclear criticality safety controls.

6. (HDPC-14-Q6): Comment: It is stated in Section 14.4 of the HDP (Final Status Survey Design) that "Guidance for conducting an FSS on piping internals is outside the scope of MARSSIM. These special situations will be evaluated by judgment sampling and measurements. Pipe crawlers or other specialty conveyance devices will be deployed using conventional instrumentation. If advanced technology instrumentation, such as insitu gamma-spectroscopy, is selected for use, a technical support document will be

developed which describes the technology to be used and how the technology meets the objectives of the survey." NRC expects to review and approve methodology used for embedded pipe characterization. Technical support documentation for embedded piping should be consistent with MARSSIM and NUREG-1757 guidance.

Basis: Guidance in NUREG-1757, Vol. 2, Rev. 1, Appendix 0 states that acceptable methodology for characterizing embedded pipes should address the following issues:

- radionuclides of interest and chosen surrogate,
- levels and distribution of contamination,
- internal surface condition of the piping,
- internal residues and sediments and their radiation attenuation properties,
- removable and fixed surface contamination,
- instrument sensitivity and related scan and fixed minimum detectable concentrations,
- piping geometry and presence of internally inaccessible areas/sections,
- instrument calibration, and
- data quality objectives (DQOs).

Appendix O additionally notes that "Regardless of the source of the information, it is incumbent on the licensee to develop and document a comprehensive approach to embedded pipe and buried piping characterization that accounts for limitations and uncertainties, taking into account MARSSIM guidance in developing the related DQOs. It should also specifically address each of the critical issues in the bulleted list above."

Path Forward: Provide for NRC approval a comprehensive approach to embedded pipe and buried piping characterization that accounts for limitations and uncertainties, taking into account MARSSIM guidance in developing the related DQOs.

Westinghouse Response:

Buried piping that is slated for removal during decommissioning will be surveyed in accordance with HDP Radiation Protection Plan and Nuclear Criticality Safety Assessment requirements to support Radiation Work Permit generation, proper waste classification, and the establishment of radiological and nuclear criticality safety controls.

Buried piping and equipment that will remain in place after site closure that have had a potential for radioactive contamination above the $DCGL_W$ (based on site operating history) or known contamination above the $DCGL_W$ (based on previous radiation surveys or surveys performed during decommissioning) will be designated as Class 1 for the purpose of Final Status Survey. HDP will provide buried piping survey methodology and technical support documentation for buried piping that is consistent with MARSSIM and NUREG-1757 guidance for NRC review and approval prior to Final Status Survey of buried piping. The methodology and technical support documentation will address the following NUREG-1757, Vol. 2, Rev. 1, Appendix O guidance:

- radionuclides of interest and chosen surrogate,
- levels and distribution of contamination,
- internal surface condition of the piping,
- internal residues and sediments and their radiation attenuation properties,
- removable and fixed surface contamination,
- instrument sensitivity and related scan and fixed minimum detectable concentrations,
- piping geometry and presence of internally inaccessible areas/sections,
- instrument calibration, and
- data quality objectives (DQOs).

The methodology will account for limitations and uncertainties, and take into account MARSSIM guidance for developing the related DQOs. It will also specifically address each of the critical issues in the bulleted list above.

HDP will provide the buried piping FSS survey methodology described above later during the decommissioning project. HDP is aware of NRC precedent that allowed similar information to be provided during the course of active decommissioning work at other projects, including Connecticut Yankee and NASA Plum Brook.

7. (HDPC-14-Q7): Comment: It is stated in Section 14.4.1 of the HDP (Final Status Survey Design) that "Although expected to occur infrequently, a situation could arise where it can be determined that, the origin of a location of localized elevated concentration (>DCGLw) within a Class 2 or 3 survey unit is understood, and it is highly unlikely that a similar condition exists elsewhere within the survey unit. In this instance, it may be determined that reclassification and re-survey are not required. This determination will be thoroughly documented in the release record, and will be based on further research into operational history, the results of additional scan surveys and sampling, or a combination of these sources of information." This statement is inconsistent with MARSSIM, and needs to be revised. A similar statement is given in Section 14.4.3.1.11 of the HDP (Small Areas of Elevated Radioactivity) as "Instances where a measurement obtained in a Class 2 or 3 survey unit exceeds the DCGLw may not require reclassification and re-survey provided that the investigation demonstrates that the area of elevated radioactivity is localized in nature, and there is sufficient evidence to support that a similar condition is not likely elsewhere in the survey unit." This statement is also not consistent with MARSSIM, and needs to be revised. Similar statements in Section 14.4.3.6 (Remediation and Reclassification) that deal with isolated elevated areas should also be revised.

   Basis: The following excerpts from MARSSIM describe NRC expectations for reclassification of Class 2 or 3 areas:

MARSSIM Section 4.4 - *Classify Areas by Contamination Potential*
As a survey progresses, reevaluation of this classification may be necessary based on newly acquired survey data. For example, if contamination is identified in a Class 3 area, an investigation and reevaluation of that area should be performed to determine if the Class 3 area classification is appropriate. Typically, the investigation will result in part or all of the area being reclassified as Class 1 or Class 2. If survey results identify residual contamination in a Class 2 area exceeding the DCGL or suggest that there may be a reasonable potential that contamination is present in excess of the DCGL, an investigation should be initiated to determine if all or part of the area should be reclassified to Class 1.

MARSSIM Section 5.5.3 - *Developing an Integrated Survey Strategy*
Identification of contamination suggests that the area may be incorrectly classified. If so, a re-evaluation of the Class 3 area classification should be performed and, if appropriate, all or part of the survey unit should be resurveyed as a Class 1 or Class 2 area.

Westinghouse Electric Company (WEC) correctly notes in Section 14.4.3.1.11 of the HDP that "the consideration of small areas of elevated radioactivity typically applies only to Class I survey units since Class 2 and Class 3 survey units should not have contamination in excess of the DCGLw," but seems to contradict this principle in other parts of the DP.

Path Forward: Revise statements on classification so that they are consistent with MARSSIM guidance for reclassification of survey areas. For areas being reclassified, the results of the investigation of measurements exceeding the investigation level and the basis for reclassification from a higher to lower designation (i.e. Class 3 or 2 areas reclassified to either Class 2 or 1 areas) should be appropriately documented in the final status survey report.

Westinghouse Response:

HDP agrees that presence of concentrations that exceed the $DCGL_W$ within a Class 2 or 3 survey unit should be an infrequent occurrence. However, HDP does not concur that the wording in DP Chapter 14, Section 4.1 and 4.3.1.11 is inconsistent with MARSSIM guidance. The following example in Section 8.5.3 of MARSSIM illustrates a situation in which a Class 2 survey unit passed the statistical test but had individual measurements that exceed the $DCGL_W$ and reclassification was not necessary. The example states the following (from *MARSSIM Section 8.5.3 – If the Survey Unit Fails)*:

"For example, a Class 2 survey unit passes the nonparametric statistical test, but has several measurements on the sampling grid that exceed the $DCGL_W$. This is unexpected in a Class 2 area, and so these measurements are flagged for further investigation. Additional sampling confirms that there are several areas where the concentration exceeds the $DCGL_W$. This indicates the survey unit was misclassified. However, the scanning technique that was used was sufficient to detect residual radioactivity at the $DCGL_{EMC}$ calculated for the sample grid. No areas exceeding the $DCGL_{EMC}$ where found. Thus, the only difference between the final status survey actually done, and that which would be required for a Class 1 area, is that scanning may not have covered 100% of the survey unit area. In this case, one might simply increase scan coverage to 100%. Reasons why the survey unit was misclassified should be noted. In no areas exceeding the $DCGL_{EMC}$ are found, the survey unit essentially demonstrates compliance with the release criterion as a Class 1 survey unit.

If, in the example above, the scanning technique was not sufficiently sensitive, it may be possible to reclassify as Class 1 only that portion of the survey unit containing the higher measurements. This portion would be re-sampled at the higher measurement density required for a Class 1 survey unit, with the rest of the survey unit remaining Class 2."

The presence of concentrations that exceed the $DCGL_W$ in a Class 2 survey unit; or concentrations between the investigation level and the DCGLw in a Class 3 survey unit will result in an investigation. If verified to be present, this would likely lead to re-classification of a portion, or an entire survey unit (i.e., re-classification from Class 3 to Class 2, or Class 2 to Class 1). However, as indicated in the above example, the DQO process can also be utilized to determine whether the survey unit should be reclassified, or whether the additional investigation samples or gamma scan surveys would suffice to ensure the release criterion is met. All HDP investigation results will be documented in the release record. The wording in DP Section 14.4.1 will be modified as follows:

"Although expected to occur infrequently, a situation could arise where a location of localized elevated concentration (>$DCGL_W$) within a Class 2 survey unit; or a location in excess of the investigation level in a Class 3 survey unit but less than the $DCGL_W$ is identified. If the extent of the elevated activity is understood, and it is highly unlikely that a similar condition exists elsewhere within the survey unit, it may be determined that reclassification and re-survey are not required. This determination will be based on further research into operational history, the results of additional scan surveys and sampling, or a combination of these sources of information. Instances where a result is verified to exceed the $DCGL_W$ in a Class 3 survey unit will require reclassification of the survey unit, or a portion of the Class 3 survey unit. The investigation and the evaluation of the additional information will be thoroughly documented in the release record."

Also, the wording in DP 14.4.3.1.11 will be modified as follows:

"Instances where a measurement obtained in a Class 2 survey unit exceeds the $DCGL_W$; or a measurement exceeds the investigation level in a Class 3 survey unit but does not exceed the $DCGL_W$ may not require reclassification and re-survey provided that the investigation demonstrates that the area of elevated radioactivity is localized in nature, and there is sufficient evidence to support that a similar condition is not likely elsewhere in the survey unit. Instances where a result is verified to exceed the $DCGL_W$ in a Class 3 survey unit will require reclassification of the survey unit, or a portion of the Class 3 survey unit. The investigation and the evaluation of the additional information will be thoroughly documented in the release record."

8. (HDPC- 14- Q8) Comment: Under Section 14.4.2.1.5 (Develop a Decision Rule) of the HDP it is stated that "If the SOF is greater than or equal to unity (1), then the Radiation Safety Officer will be consulted to determine further action. Potential actions included are remediation, reclassification, additional data collection, or dose assessment." It is not clear what is meant by "dose assessment" or how the stated potential actions, other than remediation, would affect a SOF level that is greater than 1.

   Path Forward: Please clarify what is meant by "dose assessment" and how the stated potential actions, other-than remediation would affect an SOF level that is great than 1.

   Westinghouse Response:

   The term dose assessment was intended to represent the very unusual circumstance where HDP would propose an area-specific dose assessment based on actual site data and conditions if they differed significantly from the assumptions and parameters used to develop DCGLs. HDP does not anticipate that this will occur and will remove the term “dose assessment” from DP Section 14.4.2.1.5.

   The stated actions other than remediation (i.e., reclassification and additional data collection) would not affect the results of a SOF level greater than 1. Survey unit reclassification would be considered if, for example, a survey unit was Class 2 and reclassification to Class 1 was appropriate due to the presence of a sample with a SOF greater than 1. Additional data collection could be used to bound the area of interest and better understand the extent of contamination and would be used in an area factor calculation if applied.

9. (HDPC 14-Q9) Comment: In the "Th-232 Soil Concentration Comparison With Background Th-232 Soil Concentration (RCR, Appendix A)" WEC provides an analysis based on two background reference areas. Nuclear Regulatory Commission (NRC) Guidance recommends using at least four reference areas. A detailed analysis on the determination of the number of reference areas, and the number of samples per area, was not provided.

   Basis: NRC guidance in NUREG-1757, Appendix A, A.3.4 states the following:

   > When there may be a significant difference in backgrounds between different areas, a Kruskal-Wallis test, as described in Chapter 13 of NUREG-1505, can be conducted to determine whether there are, in fact, significant differences in mean background concentrations among potential reference areas.
   >
   > While NUREG-1505 does not recommend specific values for the Kruskal-Wallis test, NRC staff recommends at least 15 samples in each of at least 4 reference areas and a Type I error rate of KW = 0.2 to provide an adequate number of measurements for the determination of whether there is a significant difference in the background concentrations. However, different values may be appropriate on a site-specific basis.

   The HDP refers to this guidance in Section 14.4.2.5, and notes that "the site may consider this and other statistical guidance options in the evaluation of apparent significant variations in background reference area." The discussion in the "Th-232 Soil Concentration Comparison With Background Th-232 Soil Concentration (HRCR, Appendix A)" indicates that two background reference areas (consisting of 16 samples each) were used, but there is no statistical analysis of how WEC arrived at this scenario. It is also not clear what background values were used in this analysis, and NRC staff has assumed that the data provided in Table 4-50 of the RCR were used. However, Appendix A of the RCR gives an example Th-232 background value of 1.83 pCi/g that does not exist in Table 4-50.

   Path Forward: Provide a detailed analysis of how the number and sample size of background areas was determined. This analysis should be consistent with guidance provided in NUREG-1505, Section 13.5, "Determining the Number of Reference Areas and the Number of Samples."

   Provide the actual data used for the background reference areas.

   Westinghouse Response:

   The characterization report has combined the survey results from several characterization survey campaigns. The samples to establish background radioactivity in soil were collected in January 2005 from two reference areas and the data were reported in the Remedial Investigation (SAIC 2007). The background reference area sample data were not collected in accordance with the NUREG-1505, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, Section 13.5 guidance. NUREG-1505 methodology was not used in the determination of samples or the areas containing Th-232 activity in concentrations greater than background; however, the Pro UCL statistical tests used were the same or similar to those in NUREG-1505. Appendix A used the available data and acceptable statistical tests to determine areas where the site concentrations of Th-232 are different from the Th-232 concentrations in background (as determined using the Wilcoxon-Mann-Whitney test, the Quantile test, and a Background Threshold Value for identifying outliers).

These tests were not performed as a Final Status Survey of the areas using Scenario B – Indistinguishable from Background, but rather to determine what areas are impacted by Th-232 from licensed activities. The reference area data in the RCR will be used during Final Status Survey (using Scenario A) to correct gross results and determine the net concentration above background.

The data used were the gamma spectroscopy results for Ac-228 for all samples. Table 4-50 and other tables in the RCR show the result that is determined to be the best data based on detection sensitivity. Therefore, for Th-232 where thorium isotopic analysis was performed, the alpha spectroscopy value is shown. When thorium analysis was not performed the value shown is the Ac-228 gamma spectroscopy result. This is described in footnote 1 of RCR Table 4-50. Appendix A describes that the samples from two (or more) populations should all be obtained using similar methods. It was therefore determined that only gamma spectroscopy data analysis for Ac-228 would be used.

The gamma spectroscopy data used in the evaluation are contained in RCR Reference A-4, Westinghouse Electric Company, LLC, "Pro UCL Output Files and QQ Plots for the Th-232 Background Evaluation in Appendix A of the Hematite Radiological Characterization Report." Reference A-4 will be provided under separate cover.

Some of the RCR tables referenced in Table A-1 were noted to be off by one and will be corrected in the RCR revision.

Westinghouse believes that the method used for determining areas impacted by Th-232 is acceptable and in accordance with the guidance contained in MARSSIM Section 3.6.2 which states:

> *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*** *[emphasis added]…*

10. (HDPC-14-Q10) Comment: Under the discussion of HPGe Spectrometer Analysis in Section 14.4.4.2.6 of the HDP it is stated that "The MDCs as provided by the [Gamma Spectrometer] operational software will be similar to the following equation: [Equation 14-31]." The actual equation to be used should be provided.

    Path Forward: Provide the actual equation(s) to be used for MDC calculations.

    Westinghouse Response:

    The Canberra software used to operate the onsite HDP gamma spectroscopy system employees the Currie MDA formulation at the 95% confidence interval in the MDC calculation routine. The actual equation expressed in terms of sample mass is more accurately represented as:

$$\mathrm{MDC(pCi/g)} = \frac{2.71 + 4.65\sqrt{\mathrm{B}}}{(\mathrm{K})(\mathrm{W})(\mathrm{t})}$$

    Where,

    B = Number of background counts during the count interval t;

    K = Proportionality constant that relates the detector response to the radioactivity level in a sample for a given set of measurement conditions;

    W = Sample weight (dry grams); and,

    t = Count time (minutes)

    The laboratory currently used by HDP for offsite gamma spectroscopy analysis (Test America) uses the same MDC equation. Current and future laboratories are audited by quality assurance to ensure that they operate in accordance with a written quality assurance program and maintain suitable accreditation.

11. (HDPC-14-Q11) Comment: Section 14.4.4.2.6 of the HDP states that "Thorium-232 radioactivity concentration (inferred from the Ac-228 TAP) will be reported for use in areas distinguishable from background or for sample results greater than the BTV of 1.7 pCi/g (see Section 14.2). There does not appear to be a discussion of this topic in Section 14.2.

    Path Forward: Provide the reference to the discussion on thorium-232 indistinguishability from background. Also, consider the separate RAI on RCR, Appendix A dealing with the appropriateness of the proposed analysis of thorium-232 in background.

    Westinghouse Response:

    The aforementioned text in DP section 14.4.4.2.6 “(see Section 14.2)” will be revised to "(see Appendix A of Reference 14-3)".

12. (HDPC-14-Q12) Comment: In Section 14.4.3.1.8 of the HDP there is a reference to Equation 5-1 of NUREG-1507 that may be used to calculate the number of sampling and measurement locations. Equation 5-1 in NUREG-1507 deals with total efficiency of a distributed source. This is likely a misprint that was intended to refer to Equation 5.1 of NUREG-1575.

    Path Forward: Correct this statement to refer to the intended reference.

    Westinghouse Response:

    NRC is correct. The reference in Section 14.4.3.1.8 of the DP will be changed to indicate Equation 5.1 of NUREG-1575.

13. (HDPC-14-Q13) (relates to HDP-4Q14) Comment: Section 14.4.4.1.5.5, Building Foundations and Sub-grade Soil, does not provide a specific reference in the HAS and RCR for drawing conclusions that there is no contamination in excess on structures surfaces and beneath the slabs and foundations of the buildings. It is also stated that, "it does not appear that residual radioactivity is present on the exterior surfaces that exceed the remedial goal." It is not clear why building exteriors would be discussed in this section and there is no discussion on volumetric contamination.

    Path Forward: Please clarify this section.

    Westinghouse Response:

    The following sentence of the first paragraph of Section 14.4.4.1.5.5 of the DP will be removed because it does not pertain to building foundations and sub-grade soil:

    > "Based on this compilation of information, it does not appear that residual radioactivity is present on the exterior surfaces that exceed the remedial goal."

    Table 5-2 of the Historical Site Assessment (HSA) provides a summary of building usage and modification. For example, Table 5-2 notes for Building 230 that "Prior to construction of Building 230, soil under this building was sampled and determined to be less than an average of 13 pCi/g (Reference 6-2)."

    Section 2.3.13.2 of the RCR notes that prior to the construction of Building 230, Health Physics sampling was performed to confirm that the building site was less than a 30 pCi/g gross alpha soil concentration guideline. From the RCR: "Pre-construction survey results, documented in ABB Interoffice Correspondence (Reference 2-8), document that the maximum activity soil concentration was 11.6 pCi/g with an average concentration of 6.2 +/- 2.8 pCi/g gross alpha." The discrepancy between these results and those noted in Table 5-2 of the HSA are not significant and therefore does not affect the conclusion that there is no significant contamination in soil beneath Building 230. Given the low concentrations, there is no need to revise the HSA.

Table 5-1 of the RCR notes that the classification for soil under buildings to be demolished is Class 1, based on the analytical results provided in Table 4-25 of the RCR. Table 4-25 shows predominantly low sum-of-fractions (SOF) values with isolated SOF values exceeding unity. Table 5-1 also notes that soils under the buildings to remain are Class 3, consistent with the HSA and RCR references provided in the above discussion.

To incorporate the above discussion, the first paragraph of DP Section 14.4.4.1.5.5 will be replaced with the following text:

> *Building 110, Building 230 and Building 231 are expected to remain at the time of license termination. The HSA and HRCR include a description of the historical use and the analytical data associated with samples and measurements obtained from the structure surfaces and beneath the slabs and foundations of these buildings. Some floor drains in Building 110 and Building 230 indicate the presence of residual radioactivity that may require remediation or removal. A decision will be made whether to remediate or dispose of the drains as waste based upon the approved release criteria and the level of effort necessary to remediate or remove and dispose as waste.*
>
> *It does not appear that the concentrations in soil beneath Building 110, Building 230 and Building 231 exceed the remedial goal. Section 2.3.13.2 of the HRCR notes that prior to the construction of Building 230, Health Physics sampling was performed to confirm that the building site was less than a 30 pCi/g gross alpha soil concentration guideline. Pre-construction survey results documented that the maximum activity soil concentration was 11.6 pCi/g with an average concentration of 6.2 +/- 2.8 pCi/g gross alpha. Table 5-1 of the HRCR notes that the classification for soil under buildings to be demolished is Class 1, based on the analytical results provided in Table 4-25 of the HRCR. That table shows predominantly low sum-of-fractions (SOF) values with isolated SOF values exceeding unity. Table 5-1 of the HRCR also notes that the soil under the buildings to remain is Class 3. However, it will be necessary to ascertain the radiological conditions of these foundations and sub-soil to demonstrate suitability for unrestricted release.*

14. (HDPC-14-Q14)) Comment: Section 14.4.4.1.5.5, Building Foundations and Sub-grade Soil, it states that floor drains in Building 110 and 230 have determined to have residual contamination and may require remediation or removal. It also states that WEC may have to core through slabs and foundations to facilitate collection of soil samples. The technical basis for determining if the floor drains will need to be removed, how they will be surveyed, and the criteria WEC will apply to ensure floor drains have not leaked

material under the slabs is not clearly stated. Also, it is not clear what survey criteria will be employed to detect the accumulation and migration to subsurface soils from cracks, floor and wall interfaces, etc ...

Path Forward: Please clarify this section.

Westinghouse Response:

Regarding buried piping to remain after site closure in Buildings 110, 230 and 231 (and potentially Building 115 and the Sanitary Water Treatment Plant), HDP is currently aware of two options:

Option 1: Buried pipe that HDP has decided will be removed during decommissioning will be surveyed in accordance with HDP Radiation Protection Plan and Nuclear Criticality Safety Assessment requirements to support Radiation Work Permit generation, proper waste classification, and the establishment of radiological and nuclear criticality safety controls. During removal, adjacent soils will be surveyed and excavated as needed in accordance with HDP Radiation Protection Plan and Nuclear Criticality Safety Assessment requirements, and to ensure the area has been properly prepared for Final Status Survey.

Option 2: Buried piping that HDP has decided will remain in place after site closure will be surveyed in accordance with the NRC approved FSS buried piping survey methodology referenced in the response to HDPC-14-06 above. If buried piping surveys determine that remediation is required to meet the appropriate DCGLs, remediation activities will be conducted in accordance with HDP Radiation Protection Plan and Nuclear Criticality Safety Assessment requirements. Following remediation, FSS surveys will be performed to verify DCGLs have been met.

To verify that buried piping leaks have not contaminated surrounding soil, HDP will utilize biased core bore samples through building slabs to evaluate soils adjacent to buried piping against appropriate DCGLs. Factors for determining biased location decisions will include location of pipe joints, low points, and any survey or video evidence available from the buried piping.

The HDP decision regarding which of these two options to utilize will be based on several factors including:

- the probability that remediation and/or survey would adequately demonstrate that the piping and adjacent soils meet the appropriate DLGLs,
- the cost for removing and disposing of the piping versus the cost of remediation and/or survey of the buried piping and adjacent soils,
- the impact of buried piping removal on the building's structural integrity based on the extent of removal required. For example extra effort to

decontaminate and FSS survey may be warranted for a section of piping that travels under a load bearing wall.

Ultimately HDP will choose the option that most safely and effectively facilitates achievement of the site release criteria.

Regarding cracks and floor and wall interfaces within buildings to remain that contain embedded piping, it should be noted that historical contamination levels on surfaces within Buildings 110, 115, 230, and 231 are very low. The radiological conditions of the buildings are summarized in response to NRC RCR-Q6, and as detailed in DO-08-003, Hematite Radiological Characterization Report. The operational history for these buildings did not include the use of process liquids beyond laboratory quantity, therefore the accumulation and migration to subsurface soils from cracks, and floor and wall interfaces is considered very unlikely. Although the characterization data obtained to date support this understanding of the radiological conditions, this understanding will be confirmed during the Final Status Survey through the inclusion of measurements of cracks and interfaces between floors and walls. Also, the location of the decommissioning water treatment system within Building 230 will be included in the Final Status Survey, and the survey design will consider the potential for migration to sub-grade soil in the event that a leak should occur and the secondary containment does not effectively contain the spill.

15. (HDPC-14-Q15) Comment: Section 14.4.4.6.4 of the HDP was supposed to deal with groundwater as it relates to "Final Status Survey Implementation." However, it only briefly mentions that assessments of residual radioactivity in groundwater will be performed via monitoring wells and refers to Section 14.3 for additional information. The referenced section was reviewed, and there is no discussion of groundwater. Rather, Section 14.3 deals with "Remedial Action Support (In-Process) Surveys."

    Path Forward: Provide a detailed discussion of how groundwater will be assessed during "Final Status Survey Implementation."

    Westinghouse Response:

    The reference in DP Section 14.4.4.6.4 to Section 14.3 is incorrect and will be corrected in the next revision to the DP. The discussion of groundwater monitoring is provided in Section 14.5 which describes the groundwater monitoring to be performed after soil remediation is complete. This groundwater monitoring program represents the Final Status survey for groundwater. If there are positive results, above background, from samples collected in the sand/gravel or bedrock aquifers, then the corresponding dose will be calculated using the Dose to Source Ratios (DSRs) listed in DP Chapter 5, Table 5-14. Initially, the contribution to dose from the groundwater sample showing the highest individual aquifer sample result will be added to the dose attributable to the survey unit with the highest dose (calculated in accordance with Section 14.4.5.6.1) to ensure that the total dose remains below 25 mrem/yr. This contribution to dose is expected to be insignificant when compared to soil, however if this initial approach is determined to be unduly conservative, then Westinghouse may choose to perform additional hydrogeological investigations. The investigations will be used to determine the extent of the groundwater contamination and a more realistic estimate of the groundwater source term for the purpose of performing the dose estimate as opposed to applying an individual maximum value. NRC will be provided a report describing the method used to assess the groundwater source term if the maximum individual result is not deemed appropriate.

Groundwater dose was not considered in the DP because the groundwater sample results (from the sand/gravel and bedrock aquifers) reported at the time of DP submittal represented an insignificant dose. The maximum positive result in the aquifers was 49 pCi/l Tc-99 which corresponds to 0.05 mrem/yr.

The commitment to add groundwater dose to demonstrate compliance with the 25 mrem/yr limit will be added in a new section to DP Chapter 14, i.e., Section14.4.5.6.3. The method for calculating the dose will also be included in the new Section 14.4.5.6.3. Equation 14-47 will be revised to add a term for groundwater dose in the summation of doses.

16. (HDPC-14-Q16) Comment: HDP Table 14-19, Total Weighted Efficiency Example Calculation identifies Instrument Efficiency as "nominally" 0.40 for Tc-99, Th-234 and other beta emitters for 126 cm^2 gas flow proportional detector with a 0.8 mg/cm^2 window in the a + 13 mode. Based on manufacturer technical literature for this type of detector, the nominal efficiencies are 32 % for Tc-99 and 35 % Pu-239 for α + β 13 counting. Based on the Hematite radionuclides of concern, a mixture of a + 13 emitters are expected and therefore the lower, more conservative efficiencies should be employed.

Path Forward: Revise Table 14-19 to be consistent with the manufacturer's technical information, evaluate HDP instrument calibration and health physics procedures to ensure instrument efficiencies are properly applied and the health physics technician training program is consistent with the procedures. Evaluate efficiencies used in operational and characterization surveys to determine if lower efficiencies would result in higher radioactivity measurements and the effect on information provided in the DP.

Westinghouse Response:

DP Table 14-19 was provided as an illustration of the methodology that will be used to calculate the weighted efficiency for the instrumentation that will be used, and does not necessarily represent the actual efficiency values that will be used during final status surveys of building surfaces.

However, HDP will update the example table as suggested using efficiency values cited in the vendor manual for the Ludlum 43-68 detector (http://www.deqtech.com/Ludlum/Manuals/m43-6843-68-143-68-2dec00.pdf). Note that the more appropriate 2 π efficiency value cited in the Ludlum documentation for the 2.20 MeV Pa-234m and 2.13 MeV Ac-228 emissions is 40% and as such this value was used in the example along with the 32% value for Tc-99 and 35% value for Pu-239.

For the purpose of implementing the HDP operational health physics program, the instrument efficiencies are based on a 4π geometry. The instrument efficiency values are determined using NIST traceable sources having energies that are comparable, or conservative, with respect to the energies of the radionuclides that are present. These methods are consistent with ANSI N323A-1997, *American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*. For operational surveys, the gross results of alpha and/or beta surface contamination measurements are converted to standard units of activity, and compared to limits specified in the HDP Materials License and health physics operational implementation procedures. Radiological surveys conducted to support the operational health physics program are implemented through written procedures which are followed by health physics technicians who have been trained in accordance with this program.

For the measurements to be conducted during final status survey, HDP will implement the recommendations of ISO 7503-1. Final status survey procedures and associated training lesson plans specific to the performance of final status surveys will include calculation of a weighted efficiency as detailed in Chapter 14 of the DP. Training to these procedures will be administered to technicians prior to the implementation of final status survey, and subsequent changes to these procedures will be reviewed with technicians prior to implementation.

The previous characterization surveys of building structures (Buildings 110, 230, and 231) implemented ISO 7503-1 recommendations, but did not apply the weighted efficiency. Net alpha and beta surface contamination measurements were converted to standard units of activity using an efficiency based on Th-230 and Tc-99 for alpha and beta efficiency determination, respectively. A surface efficiency of 0.25 was assumed for both alpha and beta measurements which is conservative with respective to the recommendations of ISO 7503-1. The results of these surveys have been reviewed and assuming that the weighted efficiency had been applied, this could have resulted in an increase in the reported activity. This review also indicated the use of the weighted efficiency would not have resulted in any change to the decisions regarding the classification that will be implemented for final status survey.

Radiological Characterization Report

1. (RCR-09-Q1) Comment: In RCR-09 Table 4-25, it appears that Westinghouse Electronic Corporation (WEC) obtained additional soil samples in 2007 from beneath buildings to be demolished. However, based on the information provided it is not clear where the location of the UBC soil samples were taken. The GPS coordinates provide a means to locate the 2007 in the field, but the 2007 sample locations are not correlated to the 2003 sample locations and results presented in the 2005 Decommissioning Plan (DP) and reviewed with WEC in 2006.

   Basis: Hematite Decommissioning Plan (HDP) Section 14.2.7. "Adequacy of the Characterization" states that "Samples taken in each area, along with historical information, provide a clear picture of the residual radioactive materials and its vertical and lateral extent at the site." In the U.S. Nuclear Regulatory (NRC) Summary Letter (ML060900323) for the January 25, 2006, meeting, to Mr. Henry Sepp, WEC Hematite Project Director, NRC identified the need for additional characterization of under building contamination (UBC) for the buildings expected to be demolished as part of the decommissioning. The NRC basis for this comment was based on the limited number of UBC soil samples that were taken and the need for WEC to obtain additional samples and investigate areas having significant contamination, especially in rooms and areas having a history of high levels of radiological contamination where floor cracks, crevices and joints could provide access to under building substrate. At the January 25, 2006, meeting and a site visit in April 2006, NRC specifically identified two areas, the Red and Erbia Rooms, warranting additional subsurface characterization. One of the specific areas identified by the NRC was Building 240 Red Room, which has a history of spills and contamination in excess of 1 Million dpm/100 cm^2 beta and 0.25 Million dpm/100 cm^2 alpha loose surface activity. WEC confirms these radiological conditions on Page 4-47 of RCR-09.

   Path Forward: Please provide building maps identifying both the 2003 and 2007 sample locations. Please revise Table 4-25 to provide a clear description of the 2007 sample locations and results.

   Westinghouse Response:

   Westinghouse obtained additional core samples in 2010 which are expected to be specifically germane to this RAI. Those samples are currently being analyzed. Those analytical results, along with a complete response to this RAI, will be provided under separate cover.

2. (RCR-09-Q2) Comment: Having performed subsurface soil core borings in 2007, it is not clear to the NRC staff why additional soil samples were not obtained of the Red and Erbia Room under slab soils at that time to complete the subsurface soils characterization. Shallow ground water samples, e.g. Well BD-04 has had detectable

activity as high as 6080 pCi/l Tc-99 and 60 pCi/1 total uranium that is originating from contamination from the under building sub surface soil contamination. Basis: HDP Section 14.2.7 Adequacy of the Characterization states that "Samples taken in each area, along with historical information, provide a clear picture of the residual radioactive materials and its vertical and lateral extent at the site." In the August 12, 2009, letter from Mr. E. Kurt Hackmann to NRC with the subject, Decommissioning Plan and Revision to License Application, WEC provided a response to NRC January 25, 2006 Meeting Comments. In the original response to Comment 6 concerning the subsurface sampling to characterize the soil beneath the process building slab, WEC responded that it would not be efficient to core through the cement foundations to obtain soil samples and that the samples will be taken after the buildings have been demolished.

In the 2009 WEC response, WEC states, "soils under site buildings are provided in Sections 4.8 and 4.20 of the Hematite Radiological Characterization Report (HRCR) and summarized in HDP Chapter 4, section 4.3". HDP Chapter 4, section 4.1.3 and 4.1.4 discuss which buildings will be demolished and which buildings will be subjected to the Final Status Survey (FSS). Building sub-slab soil data is presented in Tables 4-24 and 4-46 of the HRCR and Tables 4-13 and 4-24 of HDP Chapter 4. Additional characterization sampling of sub-slab soil including was conducted in the fall of 2007 by WEC contractor Energy Solutions. Methodology and results are presented in Section 3.2 and 4.1 of the HRCR. Also the Section in Chapter 14.2.8 entitled, "Inaccessible or Not Readily Accessible Areas" includes the following within the buildings that will remain after site closure. Floor drains were evaluated by direct survey of the drain surface and sampling and analysis of residue within the drain traps. The storm drain system and the Sanitary Wastewater Treatment Plant have not been extensively characterized directly by radiological surveys and sampling.

Path Forward: Please provide a safety evaluation that justifies performing additional characterization sampling at the time of decontamination and/or removal to ensure nuclear safety. Please clarify the difference between these two time periods. In the evaluation, please justify how it would significantly reduce the potential for a release of contaminated soil onsite and offsite to sample subsurface soils and floor drains after the buildings serving as containments are removed.

Westinghouse Response:

DP Chapter 10, Section 10.9 contains a detailed description of nuclear safety controls that will be in place for physical work activities. Section 10.9 provides the Nuclear Criticality Safety Basis, as well as characterization surveys required before and during remediation activities. Further nuclear safety details are contained in HDP Nuclear Criticality Safety Assessments (NCSAs) developed for decommissioning work activities. In a letter dated November 30, 2009, HDP submitted those NCSAs to the NRC (E. K. Hackmann letter to NRC Document Control Desk, HEM-09-139, dated November 30, 2009, "Hematite Decommissioning Project Criticality Technical Reports Supporting Decommissioning Plan").

Following the January 25, 2006 meeting with NRC and the subsequent UBC sampling conducted in 2007, Westinghouse determined based on reviews of available data and NRC recommendations that it would be prudent to obtain the additional UBC samples in 2010. Maps identifying the 2003, 2007, and 2010 UBC sampling locations, and revised RCR Tables 4-24 and 4-25 and DP Table 4-13 that provide a clear description of all sampling locations will be included in Westinghouse's response to RCR-09-Q1. The analytical data obtained from the additional UBC samples obtained in 2010, including that obtained from within the Red Room and Erbia Room will be included with that information.

With respect to reducing the potential for a release of radioactivity, HDP considers the presence of the building to serve as a containment during characterization work is a benefit from the perspectives of contamination control and protection from adverse weather conditions. Although the characterization work could be performed safely without the presence of the building through the implementation of other controls (e.g., localized containment, portable ventilation), this would be a less than ideal approach.

3. (RCR-09-Q3 or HDP-14-QX) Comment: Clarification is needed on what appears to be a discrepancy between 2006 and 2009 characterization results.

Basis: HDP Section 14.2.7 Adequacy of the Characterization states that "Samples taken in each area, along with historical information, provide a clear picture of the residual radioactive materials and its vertical and lateral extent at the site." In RCR-09, Table 4-24, Soil Sample BL0255-08-01 results are significantly less than the results previously provided to the NRC. In the Hematite DP (DO-04-004), Rev 3, dated April 2006, Table 14-3, "Soil Samples Underneath Facility Buildings" and in the Hematite Radiological Contamination Report (DO-04-010), results are significantly different:

Soil Sample BLD255-08-01	Np-237	Tc-99	U-234	U-235	U-238
RCR-09	0.02	0	0	13.4	17.3
DO-04-004	2.6	30.2	604	23.1	13.8

The above sample was from Building 255 Erbia Room subsurface soil. The Erbia Room historically had significant radioactive contamination during operations.

Path Forward: Please conduct an audit of sample information provided in RCR-09 and provide corrections to data table(s) as appropriate and any conclusions based on the review of the data.

Westinghouse Response:

HDP has audited the data contained within the 2009 Hematite Radiological Characterization Report (DO-08-003). Discrepancies identified during this review are indicated in Attachment 8 of the accompanying letter. In summary Tc-99 results were excluded for two locations (values between 7.5 and 30 pCi/g); U-234 results were excluded for three locations (values from 172 to 604 pCi/g); U-235 by gamma spectroscopy instead of alpha spectroscopy was reported at six locations; and U-238 by gamma spectroscopy instead of alpha spectroscopy was reported at three locations. Additionally, Np-237 by gamma spectroscopy results for 482 locations and Ra-226 by gamma spectroscopy (with in-growth) for 32 locations were not included within the decommissioning plan even though these results were published in the 2006 Hematite Radiological Characterization Report (DO-04-010), Rev 1.

None of these discrepancies would have impacted any of the conclusions drawn within the decommissioning plan. This conclusion is based on the following analysis:

- The Tc-99: U-235 ratio for the excluded Tc-99 results is less than the surrogate ratio calculated for the areas in which the samples were collected (TSA for BLD255-08-01 and PSA for BLD253-02-04). Inclusion of these samples in the dataset used to calculate the surrogate ratios would not have resulted in a less conservative surrogate ratio.
- The excluded U-234 results were not of similar magnitude to the value calculated using the available U-235 and U-238 data.
- The substituted gamma spectroscopy results were either of similar magnitude or higher than the alpha spectroscopy results,
- All but three of these Np-237 values were less than the MDA. The maximum concentration of these three values was 0.44 pCi/g. The impact of this excluded data on the evaluation of insignificant radionuclides was assessed and it was determined to have no impact on the final conclusions
- The radium samples which were not included will not be used to evaluate existing characterization data. Radium-226 analysis of these characterization samples was performed without ingrowth and as such the dataset that was included (Radium-226 without ingrowth) was the appropriate data to be used for comparison.

4. (RCR, - Q4) Comment: It is indicated in the HRCR (Th-232 Soil Concentration Comparison With Background Th-232 Soil Concentration, Appendix A) that the preliminary site Derived Concentration Guideline Level (DCGL) for Th-232 is only slightly higher than the typical background concentration and that some areas would be considered indistinguishable from background. Additional details are needed on the analysis used to determine that Th-232 concentrations in certain areas are indistinguishable from background.

   Basis: NRC staff considers methodology from NUREG-1505, Rev. 1, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys;' as acceptable to determine a radionuclide's indistinguishability from background. Licensees should provide a sufficiently detailed justification to establish consistency with NUREG-1505.

WEC suggests that a Th-232 activity greater than 1.7 pCi/g (based on the Background Threshold Value generated from a ProUCL V4.0 analysis of surface Th-232 data) is distinguishable from background and that only values above this level will be used in the sum of fractions analysis. Section 13.3 of NUREG-1505 (Establishing the Concentration Level That is Indistinguishable) suggests that a component of variance (ω^2) be calculated for reference areas and that a multiple of w be used to establish the Lower Boundary of the Gray Region (LBGR). NUREG-11505 indicates that a specific multiple of w should be decided during the Data Quality Objectives (DQO) process and that a 'reasonable default' LBGR value is 3ω. The established LBGR value would then be used in Wilcoxon Rank Sum (WRS) and Quantile tests of survey measurements.

Path Forward: Provide a detailed description of the analysis to determine Th-232 is indistinguishable from background, and provide the complete survey and reference area data sets that were used. Provide specific details and calculations used to determine the activity level or threshold value that represents indistinguishable values from background. Demonstrate that background threshold values are consistent with (or comparable to) the LBGR analysis recommended in Chapter 13 of NUREG-1505.

Westinghouse Response:

The gamma spectroscopy data used in the evaluation for both the background and the site samples will be provided under separate cover. The data and the outputs from the statistical tests are contained in RCR Reference A-4, Westinghouse Electric Company, LLC, "Pro UCL Output Files and QQ Plots for the Th-232 Background Evaluation in Appendix A of the Hematite Radiological Characterization Report."

The evaluation did not use the specific method prescribed in (Draft) NUREG-1505, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, for the reasons listed below:

1) The characterization data was not being used for a Scenario B final status survey but rather to support the Historical Site Assessment that certain areas were not impacted by Th-232[1].
2) The characterization data did not contain 4 background data sets as recommended by NUREG-1505.
3) The data (in Appendix A of the RCR) were being used to determine if areas were impacted by Th-232 from licensed activities. The guidance contained in MARSSIM Section 3.6.2 states:

[1] This analysis does not affect the use of the characterization reference area data for use in the Final Status Survey Scenario A. The characterization reference area data provides background concentrations that will be used to correct gross final status results.

> *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*** *[emphasis added]…*

The NRC path forward suggested that Westinghouse demonstrate that background threshold values are consistent with (or comparable to) the LBGR analysis recommended in Chapter 13 of NUREG-1505. The background threshold values (BTV) provided in RCR Appendix A are not comparable to the LBGR analysis in NUREG-1505, but rather the BTV was used to flag outliers. The BTV value was used because there is a possibility that the results of the Wilcoxon Mann Whitney test and the Quantile test could conclude that the site area is less than or equal to background when there is an outlier in the data set.

5. (RCR-Q5) Comment: Additional details are needed on survey methods and contamination levels for Ra-226 during burial pit remediation.

   Basis: RCR-09 Section 4.4.3 Elevated Radium Results discusses Ra-226 activity believed to have been introduced in the burial pits as contaminated equipment or materials from the Mallinckrodt Site Uranium Division. Results reported for samples, SO-BP6C-12 and SS-BP-028-DV-EL-9 were 414 pCi/g and 183 pCi/g, respectively. Regulatory Guide 1.86, 'Termination of Operating Licenses for Nuclear Power Reactors' and NRC Policy and Guidance Directive FC 83-23, "Guidelines For Decontamination of Facility and Equipment Prior to Release of Unrestricted Use or Termination of Licenses for Byproduct, Source and Special Nuclear Materials;' have specific contamination limits for Ra-226. The Ra-226 limits for fixed contamination are 100 dpm/100 cm^2 average and 300 dpm/100 cm^2 maximum and 20 dpm/100 cm^2 removable contamination. The Ra-226 limits are confirmed in HDP Chapter 10, Table 10-3.

   The Hematite Radiation Protection Plan (HRPP) (PO-HP-001, Rev 4) defines the site contamination action levels as 200 dpm/100 cm^2 for Step-off Pad Areas, 5000 dpm/100 cm^2 for contamination Areas and 200 dpm/100 cm^2 for Clear Areas. Path Forward: Please provide the survey methods to be employed during the burial pit remediation (and other areas found to have Ra-226 contamination) to ensure that Ra-226 contaminated materials are identified controlled to ensure personnel safety is maintained. Please provide the methods by which personnel will be surveyed for contamination and the technical basis for the measurements, including instrumentation and minimum detectable count rates and minimum detectable activities.

Westinghouse Response:

The survey methodology for release of equipment and materials from an area where Ra-226 has been identified will be performed using approved survey procedures and will include direct scans for alpha/beta contamination using a Ludlum Model 2360 coupled to a 43-89 detector, or equivalent. If sustained elevated beta counts or additional alpha counts are observed, then a static reading will be obtained to determine the level of total contamination at the location for comparison to the release criterion. In addition, smear samples for removable contamination will be obtained and analyzed using a Ludlum Model 3030 bench top counter, a Tennelec gas-flow proportional counter, or equivalent instrumentation.

The results of surveys of equipment and material used in areas where Ra-226 is known to exist will be compared to the limits identified in, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material". Chapter 10 of the Decommissioning Plan, section 10.7.1, Surveys of Surface Contamination, discusses the details for implementation when multiple nuclides are present, and is reiterated below for convenience:

> *"The basis for the survey of surface contamination and limits as provided through the site contamination control and radiological monitoring procedures for the HDP Site are provided in Table 10-3, which is reproduced from NRC Policy and Guidance Directive FC 83-23,"Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material,"(Reference 10-19). For a mixture of radionuclides with differing limits, the effective contamination limit may be derived by using the most conservative radionuclide present, by weighting the radionuclides, or by an alternate means determined by the RSO. The RSO shall approve any effective contamination limit."*

Based on characterization data, the area designated as containing Ra-226 is located in the northern portion of the burial pit area. The characterization data from this area indicate that the average Ra-226 concentration is 13 pCi/g, and that the average total uranium concentration is 31 pCi/g. Using this characterization data to derive a surface limit in consideration of the relative contributions and applicable surface contamination limits results in a removable contamination limit of approximately 720 dpm/100 cm^2 and a total surface contamination limit of approximately 3,600 dpm/100 cm^2.

Surveys of personnel upon exiting from areas where Ra-226 is known to be present will also be performed using the Ludlum Model 2360 coupled to a 43-89 detector, or equivalent. The detector is passed over the surface at a speed of approximately two inches per second, and is maintained as close as practicable to the surface to be surveyed. If an audible alpha count or elevated beta counts are identified during the scan, the surveyor will stop and pause for a period of approximately 5 seconds to determine if contamination may be present. If the survey confirms the presence of contamination, then the Health Physics department is notified to perform additional surveys and investigate.

This combination of instrumentation and survey method is expected to identify the presence of contamination on equipment and personnel at levels that do not exceed those specified by section 10.7.1 of DO-08-004. For example, assuming a typical alpha background of 3 counts per minute, an alpha detection efficiency of 0.15 counts per disintegration, and a radionuclide composition of 70 percent total uranium and 30 percent Ra-226, a pause time of 0.2 seconds would be sufficient based on the effective total surface contamination limit of 3600 dpm/100cm^2.

Typical minimum detectable activity values for HDP instrumentation are provided in Table 14-14 of the decommissioning plan. As noted in this table, MDC values for alpha and beta static measurements are 100 and 700 dpm/100 cm^2, respectively (with background rates of 10 cpm alpha and 300 cpm beta). This same table lists a scan MDC of 1500 dpm/100cm^2. The minimum detectable count rate for a beta scan survey with a 300 cpm background is 152 cpm.

6. (RCR-Q6) Comment: WEC's approach to radiological characterization of the structures that may remain after decommissioning is incomplete and inconsistent with NRC guidance.

   Basis: In NUREG 1757 V2 Rev1 Appendix O (page O-19), the guidance provides examples of characterization shortcomings. These include, "only limited information is being provided about the presence of Transuranic Radionuclides (TRU) (e.g., plutonium-239, americium-241) and hard-to-detect radionuclides. In other instances, the data failed to provide "sufficient information in determining the fraction of surface contamination that is fixed or removable. Similar shortcomings were noted for removable alpha and beta radioactivity found in embedded pipe, usually contained in residues. It should be noted that characterization surveys provide the most important information (i.e., the basis to design the Final Status Survey Plan (FSSP); define radionuclide distributions and concentrations; identify hard-to-detect radionuclides and develop surrogate ratios; ...)"

   The technical bases for the structural DCGLs are derived from building floor drain sediment samples as given in RCR-09 Section 3.3.5.1 and discussed briefly in HDP Section 14.2.9.1. The sediment samples may be representative of the loose (non-fixed) contamination in the floor drain pipes. However, the characterization data (radionuclides identified and fractional abundances) may not be representative of the radionuclides fixed or loose in structures. It is inappropriate to extend the data floor drain sediment data to building structure surveys (gross $\alpha + \beta$ measurements). These surveys do not identify (or confirm) the nuclides that may be loose or fixed in the building structures. RCR-09 Section 3.3.5.1 states "Alpha plus beta scans were performed of joints and cracks in

Building 230 for elevated radiation levels and locations of elevated radiation levels were identified and samples from these areas were collected, with some of the samples sent off-site for analysis." Since this sample data was not provided the nuclides and fractional abundances are not known, and these measurements may not account for self attenuation and other impacts that may generate technically defensible results with which to design the FSSP.

Path Forward: Perform structural characterization surveys and sampling to identify the radionuclides present and the fractional abundances for determining the DCGLs for structures that will remain after decommissioning. Evaluate the data to determine if new DCGLs are required and the impact of the data on the FSSP design.

Westinghouse Response:

Westinghouse agrees that the optimum approach for the derivation of a defensible radionuclide mixture for structures is to identify the concentrations and relative fractions of any loose and fixed residual radioactivity on walls, floors or ceilings. Of the buildings at Hematite, Building 110 (Security Building), Building 230 (Rod Loading Building) and Building 231 (Warehouse); and potentially Building 115 (Fire Pump House) and the Sanitary Wastewater Treatment Plant Shed will remain and be subject to Final Status Survey (FSS).

Two separate characterization survey efforts were performed in these structures in preparation for decommissioning. A scoping survey of portions of these buildings was performed in 2004, and a MARSSIM based characterization survey was performed in 2007 within Buildings 110, 230 and 231. Surface scans, total surface contamination (TSC) measurements and smear samples were taken throughout these structures. The results of these surveys are summarized in section 4.26 and Tables 4-52 through 4-53 of DO-08-003, *Hematite Radiological Characterization Report*.

In Building 110, one-hundred and sixty two (162) TSC measurements and smear samples were taken on interior and exterior walls, ceilings, floors, roof and systems. With the exception of the floor drain system, the highest direct measurement observed in this building was 1,527 dpm/100cm^2 beta-gamma. The highest removable contamination measurement observed was 72 dpm/100cm^2 beta.

In Building 231, one-hundred and three (103) TSC measurements and smear samples were taken on interior and exterior walls, ceilings, floors and the roof. There are no floor drains or process systems in this building. The highest TSC measurement observed in this building was 892 dpm/100cm^2 beta-gamma. The highest removable contamination measurement observed was 43 dpm/100cm^2 beta.

In Building 230, three-hundred and ninety-seven (397) TSC measurements and smear samples were taken on interior and exterior walls, ceilings, floors, roof and systems. The surveys identified a few areas of elevated activity above the conservative action level of 6,700 dpm/100 cm^2 beta-gamma that was used at that time. A discussion of these identified areas is provided in section 4.26.3 of DO-08-003.

Two volumetric material samples (dust) were obtained (BD1-230-1-DUST and BD3-230-1-DUST) from surfaces in Building 230 during the characterization following the identification of localized areas of elevated activity. Sample BD1-230-1-DUST was obtained from an anchor bolt hole in the floor near the KARDEX Room in the Rod Loading Room (crack and seam survey location). Sample BD3-230-1-DUST was from a floor seam in the southwest portion of the Class 2 "U" shaped area. These samples contained a sufficient amount of activity to define the radionuclide mixture for use in the development of an Adjusted Gross DCGL for the buildings. Additional samples were not available for analysis simply because a sufficient level of contamination was not present. Both samples were assessed for isotopic content and the analytical results for these samples are presented in Table 4-52 of DO-08-003 and are summarized as follows:

Sample BD1-230-1-DUST		**Sample BD3-230-1-DUST**	
Radionuclide	**Concentration**	**Radionuclide**	**Concentration**
U-234	54,100 ρCi/g	U-234	40,900 ρCi/g
U-235	2,800 ρCi/g	U-235	1,880 ρCi/g
U-238	8,000 ρCi/g	U-238	6,090 ρCi/g
Tc-99	<MDC	Tc-99	0.75 ρCi/g
Th-232	<MDC	Th-232	<MDC
Np-237	Not Analyzed	Np-237	<MDC
Pu-239/240	Not Analyzed	Pu-239/240	<MDC
Am-241	<MDC	Am-241	<MDC

Substituting the Minimum Detectable Concentration (MDC) value for the radionuclides reported as less than MDC, the following radionuclide fractions can be derived:

Sample BD1-230-1-DUST		**Sample BD3-230-1-DUST**	
Radionuclide	**Fraction**	**Radionuclide**	**Fraction**
U-234	0.832	U-234	0.619
U-235	0.043	U-235	0.286
U-238	0.123	U-238	0.092
Tc-99	0.000123	Tc-99	0.000011
Th-232	0.001046	Th-232	0.001817
Np-237	Not Analyzed	Np-237	0.000013
Pu-239/240	Not Analyzed	Pu-239/240	0.000696
Am-241	0.000615	Am-241	0.000147

In both samples, the majority of the activity is due to the presence of Uranium, and in both cases, the remaining five radionuclides represent less than 0.2% of the overall activity.

The distribution of Radionuclides of Concern (ROC) in structures that is presented in Table 4-1 of the Decommissioning Plan is based upon these two material samples and additional samples obtained from the drain systems in Buildings 230 and 110. The small population of samples obtained from surfaces outside of the drain system was caused by the absence of any significant amount of contamination on surfaces. Given this limitation on the number of samples, and the fact that assuming the trace amount of transuranic radionuclides found in the additional samples taken from the drain systems in Building 110 and Building 230 would result in a conservative estimate of the potential dose, the two groups of samples were combined. This average mixture was then used to derive the Adjusted Gross DCGL. These fractions are presented in Table 4-1 of the DP and are summarized as follows:

Nuclide	Activity Fraction
U-234	0.827
U-235	0.037
U-238	0.127
Tc-99	0.00283
Th-232	0.00321
Np-237	0.00006
Pu-239/240	0.000002
Am-241	0.00268

As these fractions show, the majority of the activity can be attributed to Uranium, with the other five radionuclides contributing less than 0.9% of the total average activity.

At the present time in Building 110 and Building 230, the only remaining residual radioactivity in any significant amount is within the floor drain piping. Outside of the drain system and a small sump in the Cushman Room, the balance of the building surface in Building 230 that exhibited elevated gross activity were decontaminated shortly after the abovementioned sampling. As with Building 110, the majority of Building 230 meets the site criteria for unrestricted release.

HDP believes that the use of this mixture which is dominated by samples obtained from the drains is appropriate. There is no credible evidence or sampling data to suggest that Tc-99, Th-232, Np-237, Pu-239/240 and Am-241 are present on structural surfaces within these building that exceed trace concentrations. In this case, the most limiting radionuclide for demonstrating compliance therefore becomes U-235. The DCGL for U-235 in accordance with Table 5-19 is 19,000 dpm/100cm^2. Using the radionuclide mixture presented in Table 4-1 of the DP, the Adjusted Gross DCGL is calculated as 18,925 dpm/100cm^2. HDP believes that this value is conservative and appropriate for gross activity measurements to demonstrate compliance with the dose-based unrestricted release criteria for structures.

Surrogates Report

1. (Surrogate Report, DO-08-008 - Q1) Comment: It is stated in Section 4.1 of the "Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides" that Insignificant Radionuclides of Concern are discussed in Section 2.1 of the document. Radionuclides of concern are discussed in Section 2.1, and the Insignificant Radionuclides of Concern are discussed in Section 2.2.

   Path Forward: Reference the correct section of the document.

   Westinghouse Response:

   HDP will revise Section 4.1 of DO-08-008, *"Derivation of Surrogates and Scaling Factors for Hard-to-Detect Radionuclides"* to indicate that Insignificant Radionuclides of Concern are discussed in Section 2.2.

2. (Surrogate Report, DO-08-008) Comment: Section 4.1 of the "Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides" indicates that the scaling factors for U-234 to U-235 are defined in Appendix D. This scaling factor is not identified in Appendix D, but appears to be defined in Appendix C.

   Path Forward: Clearly indicate the location and derivation of scaling factors for U-234 to U-235.

   Westinghouse Response:

   HDP will revise Section 4.1 of DO-08-008, *"Derivation of Surrogates and Scaling Factors for Hard-to-Detect Radionuclides"* to indicate that the scaling factors are defined in Appendix C.

ATTACHMENT 2

ProUCL Statistical Assessment Input Data Set (pCi/g)

(referred to in response to RAI HDPC-14-Q4)

ProUCL Statistical Assessment Input Data Set (pCi/g)

GS = gamma spectroscopy
AS = alpha spectroscopy
BKG = background
NI = non-impacted

Th-232 GS BKG	Th-232 GS NI	TotalU AS BKG	TotalU AS NI
0.53	-0.0859	1.1488	0.422
0.532	-0.0767	1.2636	0.746
0.68	-0.0743	1.289	0.7598
0.758	-0.0536	1.3131	1.0024
0.767	-0.0347	1.326	1.025
0.774	-0.00504	1.3679	1.158
0.802	0.0184	1.4172	1.4696
0.806	0.0204	1.4375	1.5068
0.814	0.024	1.4738	1.509
0.82	0.05	1.487	1.6348
0.834	0.05	1.5101	1.7955
0.877	0.0546	1.52	1.7968
0.931	0.0776	1.5517	1.882
0.978	0.08	1.5812	1.9238
0.997	0.103	1.6062	1.9636
1	0.109	1.6364	2.032
1.01	0.117	1.7519	2.261
1.04	0.12	1.7582	2.472
1.14	0.121	1.7774	2.596
1.17	0.134	1.7904	3.197
1.17	0.14	1.8036	
1.17	0.14	1.8345	
1.18	0.142	1.8603	
1.19	0.185	1.8724	
1.38	0.205	1.8864	
1.38	0.208	1.8919	
1.43	0.216	1.9327	
1.43	0.218	1.9407	
1.46	0.226	1.968	
1.49	0.253	1.9712	
1.55	0.257	1.9908	
1.83	0.258	1.993	
	0.261		
	0.304		
	0.304		
	0.308		
	0.32		
	0.327		

Th-232 GS BKG	Th-232 GS NI	TotalU AS BKG	TotalU AS NI
	0.331		
	0.342		
	0.343		
	0.345		
	0.35		
	0.358		
	0.363		
	0.374		
	0.376		
	0.377		
	0.377		
	0.384		
	0.399		
	0.401		
	0.404		
	0.42		
	0.425		
	0.425		
	0.432		
	0.443		
	0.478		
	0.48		
	0.509		
	0.526		
	0.533		
	0.537		
	0.54		
	0.546		
	0.573		
	0.574		
	0.579		
	0.58		
	0.584		
	0.595		
	0.6		
	0.607		
	0.627		
	0.632		
	0.632		
	0.638		
	0.64		
	0.647		
	0.65		

Th-232 GS BKG	Th-232 GS NI	TotalU AS BKG	TotalU AS NI
	0.651		
	0.66		
	0.682		
	0.682		
	0.69		
	0.692		
	0.694		
	0.708		
	0.711		
	0.719		
	0.726		
	0.735		
	0.74		
	0.742		
	0.743		
	0.75		
	0.771		
	0.774		
	0.784		
	0.791		
	0.793		
	0.807		
	0.816		
	0.818		
	0.82		
	0.824		
	0.828		
	0.83		
	0.846		
	0.846		
	0.852		
	0.854		
	0.854		
	0.859		
	0.86		
	0.862		
	0.865		
	0.865		
	0.875		
	0.878		
	0.883		
	0.89		
	0.906		

Th-232 GS BKG	Th-232 GS NI	TotalU AS BKG	TotalU AS NI
	0.91		
	0.913		
	0.915		
	0.919		
	0.94		
	0.95		
	0.951		
	0.959		
	0.96		
	0.962		
	0.97		
	0.974		
	0.987		
	0.99		
	0.99		
	0.992		
	0.993		
	0.996		
	1		
	1		
	1.01		
	1.02		
	1.03		
	1.04		
	1.06		
	1.06		
	1.07		
	1.07		
	1.07		
	1.07		
	1.09		
	1.1		
	1.12		
	1.12		
	1.13		
	1.16		
	1.16		
	1.17		
	1.18		
	1.2		
	1.21		
	1.23		
	1.23		

Th-232 GS BKG	Th-232 GS NI	TotalU AS BKG	TotalU AS NI
	1.28		
	1.28		
	1.3		
	1.3		
	1.33		
	1.33		
	1.33		
	1.34		
	1.35		
	1.37		
	1.37		
	1.4		
	1.41		
	1.42		
	1.45		
	1.46		
	1.47		
	1.49		
	1.5		
	1.62		

ATTACHMENT 3

Th-232 Quantile Test ProUCL Results

(referred to in response to RAI HDPC-14-Q4)

Th-232 Quantile Test ProUCL Results

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

User Selected Options

From File	ProUCL.wst
Full Precision	OFF
Confidence Coefficient	99%
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: Th-232 GS NI

Background Data: Th-232 GS BKG

Raw Statistics

	Site	Background
Number of Valid Observations	187	32
Number of Distinct Observations	163	28
Minimum	-0.0859	0.53
Maximum	1.62	1.83
Mean	0.709	1.06
Median	0.74	1.005
SD	0.407	0.314
SE of Mean	0.0298	0.0555

Quantile Test

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

Approximate R Value (0.015)	15
Apprcximate K Value (0.015)	15
Number of Site Observations in 'R' Largest	9
Calculated Alpha	N/A

Conclusion with Alpha = 0.015

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

ATTACHMENT 4

Th-232 Mann-Whitney U Test ProUCL Results

(referred to in response to RAI HDPC-14-Q4)

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	ProUCL.wst
Full Precision	OFF
Confidence Coefficient	99%
Substantial Difference	0.000
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: Th-232 GS NI

Background Data: Th-232 GS BKG

Raw Statistics

	Site	Background
Number of Valid Observations	187	32
Number of Distinct Observations	163	28
Minimum	-0.0859	0.53
Maximum	1.62	1.83
Mean	0.709	1.06
Median	0.74	1.005
SD	0.407	0.314
SE of Mean	0.0298	0.0555

Wilcoxon-Mann-Whitney (WMW) Test

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

Site Rank Sum W-Stat	19153
WMW Test U-Stat	-4.28
WMW Critical Value (0.010)	2.326
P-Value	1

Conclusion with Alpha = 0.01

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.01)

ATTACHMENT 5

Total Uranium Quantile Test ProUCL Results

(referred to in response to RAI HDPC-14-Q4)

Total Uranium Quantile Test ProUCL Results

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

User Selected Options

From File	ProUCL.wst
Full Precision	OFF
Confidence Coefficient	99%
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: TotalU AS NI

Background Data: TotalU AS BKG

Raw Statistics

	Site	Background
Number of Valid Observations	20	32
Number of Distinct Observations	20	32
Minimum	0.422	1.149
Maximum	3.197	1.993
Mean	1.658	1.655
Median	1.715	1.694
SD	0.688	0.252
SE of Mean	0.154	0.0445

Quantile Test

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

Approximate R Value (0.007)	5
Approximate K Value (0.007)	5
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.00597

Conclusion with Alpha = 0.007

Reject H0, Conclude Site Concentration > Background Concentration

ATTACHMENT 6

Total Uranium Mann-Whitney U Test ProUCL Results

(referred to in response to RAI HDPC-14-Q4)

Total Uranium 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	ProUCL.wst
Full Precision	OFF
Confidence Coefficient	99%
Substantial Difference	0.000
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: TotalU AS NI

Background Data: TotalU AS BKG

Raw Statistics

	Site	Background
Number of Valid Observations	20	32
Number of Distinct Observations	20	32
Minimum	0.422	1.149
Maximum	3.197	1.993
Mean	1.658	1.655
Median	1.715	1.694
SD	0.688	0.252
SE of Mean	0.154	0.0445

Wilcoxon-Mann-Whitney (WMW) Test

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

Site Rank Sum W-Stat	532
WMW Test U-Stat	0.0282
WMW Critical Value (0.010)	2.326
P-Value	0.489

Conclusion with Alpha = 0.01

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.01)

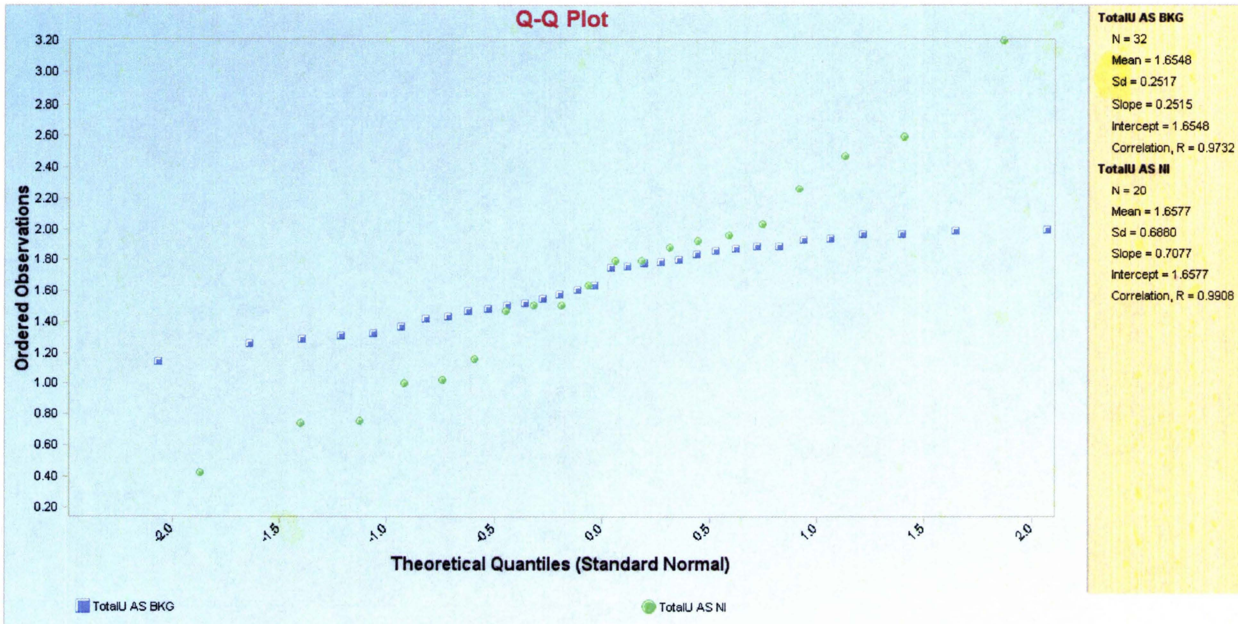
ATTACHMENT 7

Total Uranium ProUCL Graphical Review

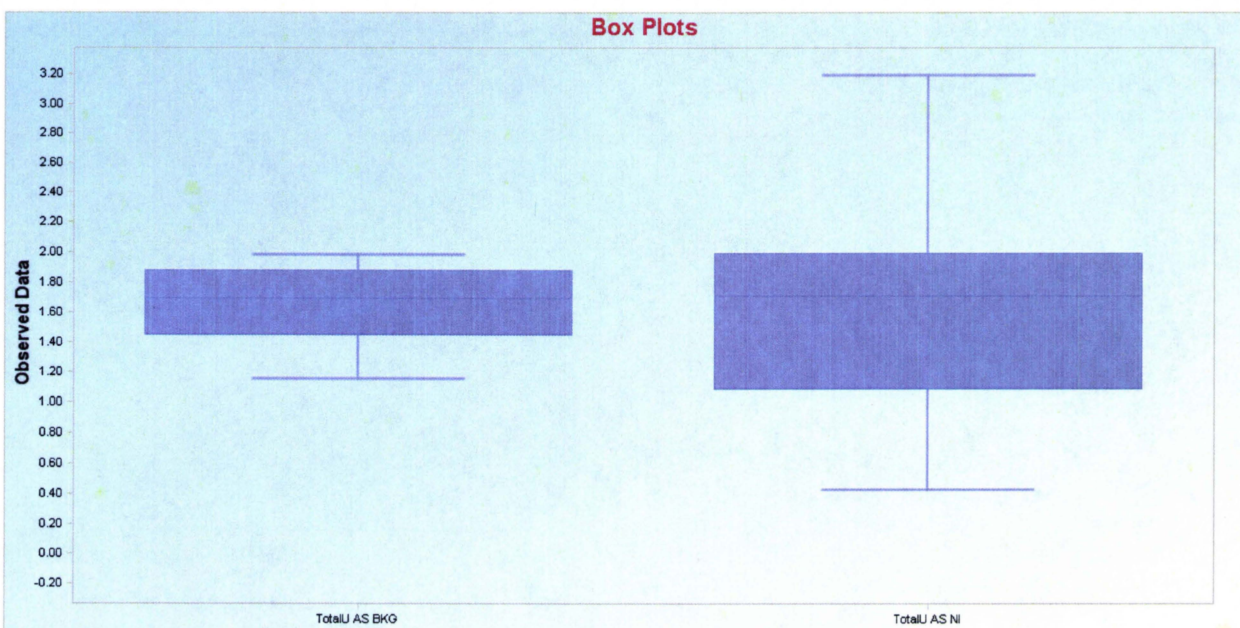
(referred to in response to RAI HDPC-14-Q4)

Total Uranium ProUCL Graphical Review

Quantile Plot – Provides the entire background and non-impacted data distribution, ranging from the lowest to the highest. The vertical axis represents measures concentrations (pCi/g) and the horizontal axis represents percentiles of each distribution. This plot illustrates the similarities in the means.



Box Plot – Depicts the background and non-impacted 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 (non-parametric). This plot illustrates the similarities in the medians.



ATTACHMENT 8

Detailed Description of RCR Discrepancies Identified

(referred to in response to RAI RCR-Q3)

Detailed Description of RCR Discrepancies Identified

Location	Issue	Listed Value (pCi/g)	Corrected Value (pCi/g)
BLD255-08-01	Tc-99 Result not reported in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	30.2
	U-234 Result not reported in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	315 604
	U-235 Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	13.4	23.1 11.8
	U-238 – Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	17.3	13.8 9.5
BLD253-02-04	Tc-99 Result not reported in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	7.5
	U-234 Result not reported in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	172 188
	U-235 Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	5.9	7.7 9.5
	U-238 – Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha	10.9	11.1 11.7

Location	**Issue**	**Listed Value (pCi/g)**	**Corrected Value (pCi/g)**
	spectroscopy result		
BP-13-05-SL	U-234 Result not reported in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	0.943
	U-235 Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	0.319	0.048
	U-238 – Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	0.245	0.853
NB-30-05-SL	U-235 Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	0.123	0.0363
NB-31-15-SL	U-235 Gamma Spectroscopy result reported in 2009 Hematite Radiological Characterization Report (DO-08-003) instead of alpha spectroscopy result	0.237	0.0356
See Table 1, below	Np-237 gamma spectroscopy results not included in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	See Table 1,below
See Table 2, below	Ra-226 gamma spectroscopy results not included in 2009 Hematite Radiological Characterization Report (DO-08-003)	[Blank]	See Table 2,below

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
BD-10-00-SL	0.0541	0.355	0.207	U,G
BD-11-00-SL	-0.0396	0.336	0.188	U,G
BD-13-09-SL	-3.29	20.8	11.8	U,G
BD-13-15-SL	-9.11	22.1	12.3	U,G
BD-13-23-SL	-0.0764	0.312	0.157	U,G
BD-13-30-SL	-0.0254	0.284	0.148	U,G
BD-14-05-SL	-0.201	0.385	0.178	U,G
BD-14-13-SL	0.0943	0.187	0.116	U,G
BD-14-25-SL	-1.87	22.9	12.5	U
BD-14-31-SL	-0.0319	0.318	0.163	U
BD-15-05-SL	-0.0118	0.259	0.136	U,G
BD-15-17-SL	-0.203	0.52	0.258	U,G
BD-15-25-SL	-0.0818	0.218	0.101	U
BD-15-31-SL	0.315	0.295	0.213	G,TI
BD-16-19-SL	-3.04	24.4	13.1	U,G
BD-16-25-SL	0.0299	0.4	0.219	U,G
BD-16-34-SL	-0.0256	0.308	0.162	U,G
BLD240-01-09	-2	21	11	U
BLD240-01-09FD	-3.9	17.6	9.2	U
BLD240-01-Concrete	12	18	11	U
BLD240-01-Fill	-13	68	39	U
BLD240-03-04FD	3	21	12	U
BLD240-03-19	8	27	16	U
BLD240-03-Concrete	9	16	73	U
BLD240-03-Fill	-9	96	57	U
BLD240-04-04	5.3	16.7	9.8	U
BLD240-04-Concrete	2	19	97	U
BLD240-04-Fill	1	22	85	U
BLD240-05-01	2	22	13	U
BLD240-05-02	-13	24	12	U
BLD253-02-01	3	20	82	U
BLD253-02-Concrete	1	18	10	U
BLD253-02-Fill	1	19	86	U
BLD253-02-FillFD	-4	31	18	U

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
BLD255-05-Concrete	-15	35	19	U
BLD255-05-Fill	2.2	15.6	8.8	U
BLD255-07-15	6	22	13	U
BLD255-07-ConcreteFD	10	18	11	U
BLD255-08-Concrete	3.1	16.1	9.2	U
BLD260-06-03	13	21	13	U
BLD260-06-Concrete	10	20	120	U
BLD260-06-Fill	-3	52	30	U
BP-01-00-SL	-0.0423	0.375	0.195	U,G
BP-02-00-SL	-0.0458	0.205	0.106	U,G
BP-05-00-SL	0.0458	0.191	0.11	U,G
BP-06-00-SL	-0.043	0.26	0.14	U,G
BP-08-00-SL	-0.128	0.668	0.385	U,G
BP-09-00-SL	-0.104	0.296	0.153	U,G
BP-10-00-SL	0.0251	0.225	0.126	U,G
BP-11-00-SL	-3.25	22.5	12.4	U,G
BP-12-00-SL	-0.109	0.284	0.146	U,G
BP-13-05-SL	-0.0627	0.332	0.172	U,G
BP-13-11-SL	-0.716	21.5	11.9	U,G
BP-13-15-SL	-0.0373	0.343	0.178	U,G
BP-13-25-SL	0.0425	0.355	0.199	U,G
BP-13-35-SL	-4.33	20.6	11.1	U,G
BP-17-05-SL	-0.829	26	14.4	U,G
BP-17-15-SL	0.022	0.183	0.0983	U
BP-17-23-SL	-9.08	20.2	9.98	U,G
BP-17-31-SL	-7.89	25.9	13.6	U,G
BP-18-05-SL	0.0141	0.402	0.223	U,G
BP-18-15-SL	-0.0425	0.454	0.242	U,G
BP-18-25-SL	-2.38	25.5	13.9	U,G
BP-18-31-SL	-4.27	14.3	7.14	U
BP-19-05-SL	0.0515	0.231	0.132	U
BP-19-13-SL	-4.4	22.3	12.1	U
BP-19-25-SL	-0.0343	0.269	0.139	U,G
BP-19-29-SL	-0.0356	0.327	0.17	U

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
BP-20-03-SL	-4.9	22.5	12	U
BP-20-19-SL	-0.0791	0.366	0.19	U,G
BP-20-27-SL	-0.0726	0.249	0.123	U
BP-21-07-SL	-7.71	21.4	10.7	U,G
BP-21-07-SL-FD	-2.01	24.1	13.3	U
BP-21-13-SL	-3.31	18.2	9.64	U
BP-21-24-SL	0.0359	0.364	0.201	U,G
BP-21-34-SL	-0.0471	0.3	0.156	U
BP-22-05-SL	-7.77	20.4	10.4	U,G
BP-22-13-SL	-3.38	23.1	12.6	U,G
BP-22-23-SL	-0.146	16.6	9.09	U
BP-22-33-SL	-3.15	18.8	10	U
CB-01-00-SL-FD	-0.0466	0.331	0.167	U,G
CB-02-05-SL	0.0264	0.281	0.154	U,G
CB-02-15-SL	-0.0391	0.3	0.154	U,G
DM-01-00-SL	0.0246	0.89	0.513	U,G
DM-02-00-SL	0.0499	0.775	0.46	U,G
DM-02-17-SL	-0.13	0.361	0.181	U,G
DM-02-22-SL	-26.3	70.6	40.9	U
DM-03-05-SL	-0.0239	0.305	0.162	U,G
DM-03-05-SL-FD	-10.5	27.6	14.3	U,G
DM-03-13-SL	0.0342	0.23	0.127	U,G
DM-03-25-SL	-0.0832	0.411	0.211	U,G
DM-03-34-SL	0.0814	0.202	0.121	U,G
EP-01-00-SL	0.44	0.329	0.24	G
EP-04-00-SL	-0.12	0.871	0.489	U,G
EP-04-00-SL-FD	0.137	0.506	0.302	U,G
EP-05-00-SL	-0.0409	0.287	0.158	U,G
EP-06-00-SL	-0.0422	0.388	0.201	U,G
EP-07-00-SL	0.152	0.373	0.224	U,G
EP-08-00-SL	-39.6	74.7	42.9	U,G
EP-13-03-SL	-3.56	36.1	20.5	U,G
EP-13-13-SL	0.109	0.364	0.212	U,G
EP-13-25-SL	-0.244	20.8	11.4	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
EP-13-30-SL	0.0689	0.238	0.138	U,G
EP-14-05-SL	-17.8	30.8	15.5	U,G
EP-14-13-SL	0.0391	0.262	0.145	U,G
EP-14-25-SL	-0.114	0.351	0.172	U,G
EP-14-31-SL	-4.2	17.1	8.68	U,G
EP-15-05-SL	-0.0695	0.327	0.165	U,G
EP-15-13-SL	0.0813	0.346	0.2	U,G
EP-15-25-SL	-3.91	19.2	10.1	U
EP-15-29-SL	-1.81	21.2	11.6	U
EP-16-05-SL	-9.71	22	11.1	U,G
EP-16-15-SL	0.0487	0.273	0.154	U,G
EP-16-27-SL	-3.38	14.7	7.48	U
EP-17-15-SL	-0.0929	0.391	0.204	U,G
EP-17-25-SL	-1.75	26.4	14.4	U,G
EP-17-30-SL	-8.81	18.4	8.99	U
EP-18-09-SL-FD	-0.0754	0.257	0.141	U,G
EP-18-15-SL	0.135	0.255	0.158	U,G
EP-18-29-SL	0.0871	0.386	0.221	U,G
EP-19-05-SL	-7.86	30.7	17.7	U,G
EP-19-25-SL	-2.42	18.9	10.1	U,G
EP-19-31-SL	-1.7	20.3	11.6	U,G
EP-20-05-SL	-0.0794	0.272	0.149	U,G
EP-20-15-SL	-5.95	24.3	12.8	U,G
EP-20-25-SL	0.107	0.237	0.144	U,G
GS-01-00-SL	-9.52	22.3	12.4	U,G
GS-01-00-SL-FD	-0.0164	0.325	0.184	U,G
GS-02-00-SL	-7.58	21.7	11.6	U,G
GS-03-00-SL	-1.3	14.8	7.97	U,G
GS-04-00-SL	-3.01	18	9.79	U,G
GS-05-00-SL	-3.73	18.7	10.1	U,G
LF-01-00-SL	-0.0414	0.488	0.259	U,G
LF-02-00-SL	-0.0121	0.254	0.144	U,G
LF-03-00-SL	-6.69	29.4	15.6	U,G
LF-04-00-SL	0.126	0.326	0.194	U,G

Table 1 Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)				
Sample ID	**Result**	**MDA**	**Error**	**Flag**
LF-05-00-SL	-0.0325	0.404	0.214	U,G
LF-06-13-SL	-4.38	19.9	11.2	U,G
LF-06-27-SL	-2.68	20.5	11.7	U,G
LF-06-32-SL	-4.64	17	9.43	U,G
LF-07-15-SL	0.135	0.231	0.146	U,G
LF-07-25-SL	-0.414	23.9	13.2	U,G
LF-07-34-SL	0.212	0.306	0.199	U,G
LF-08-05-SL	0.0192	0.399	0.218	U,G
LF-08-05-SL-FD	-0.0235	0.288	0.152	U,G
LF-08-15-SL	-0.0774	0.341	0.175	U,G
LF-08-21-SL	-1.24	24.2	13.2	U,G
LF-08-37-SL	-12.9	22.9	11.1	U,G
LF-09-03-SL	0.173	0.3	0.188	U,G
LF-09-17-SL	-4.25	25.4	13.7	U,G
LF-09-25-SL	0.0836	0.32	0.185	U,G
LF-09-31-SL	-0.101	0.309	0.151	U,G
LS-01-00-SL	0.0186	0.203	0.117	U
LS-02-00-SL	-0.019	0.185	0.0929	U
LS-03-00-SL	0.0149	0.262	0.147	U,G
LS-03-00-SL	0.0149	0.262	0.147	U,G
NB-01-00-SL	-0.0655	17.4	9.69	U,G
NB-02-00-SL	-0.0611	0.253	0.128	U,G
NB-04-00-SL	0.0371	0.308	0.175	U,G
NB-05-00-SL	-5.92	22.4	12.5	U,G
NB-07-00-SL	0.122	0.24	0.148	U,G
NB-07-00-SL-FD	-8.93	19.5	10	U,G
NB-08-00-SL	0.0489	0.244	0.14	U,G
NB-09-00-SL	-3.19	20.5	11.2	U,G
NB-10-00-SL	-5.51	21	11.3	U,G
NB-13-00-SL	-0.0696	0.274	0.144	U,G
NB-15-00-SL	0.0542	0.198	0.115	U,G
NB-16-00-SL	-0.221	16.2	9.05	U,G
NB-17-00-SL	0.0188	0.26	0.145	U,G
NB-18-00-SL	0.0375	0.282	0.16	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-19-00-SL	0.032	0.224	0.128	U,G
NB-20-00-SL	-10.6	21.6	11.5	U,G
NB-21-00-SL	0.00911	0.258	0.143	U,G
NB-22-00-SL	-3.17	23.7	13.1	U,G
NB-24-00-SL	-2.56	16.2	8.82	U,G
NB-25-00-SL	-1.02	17.2	9.49	U,G
NB-26-00-SL	0.0539	0.164	0.0963	U,G
NB-27-00-SL	-0.171	0.324	0.173	U,G
NB-27-00-SL-FD	-0.115	0.345	0.168	U,G
NB-28-04-SL	0.0136	0.265	0.141	U,G
NB-28-14-SL	0.0344	0.385	0.213	U,G
NB-28-24-SL	-2.8	18.4	10.4	U,G
NB-28-35-SL	-0.0747	0.224	0.12	U,G
NB-29-05-SL	0.0743	0.379	0.215	U,G
NB-29-14-SL	0.0111	0.23	0.132	U,G
NB-29-22-SL	-1.52	13.4	6.95	U
NB-30-05-SL	0.0294	0.337	0.186	U,G
NB-30-15-SL	-0.476	25.1	14	U,G
NB-30-25-SL	0.108	0.381	0.221	U,G
NB-30-33-SL	-0.038	0.298	0.154	U,G
NB-31-05-SL	-0.164	0.459	0.227	U,G
NB-31-15-SL	0.0374	0.287	0.16	U,G
NB-31-27-SL	-3.38	24.6	13.4	U,G
NB-31-32-SL	-5.82	24.1	12.7	U,G
NB-32-05-SL	-0.052	0.474	0.254	U,G
NB-32-15-SL	0.0106	0.355	0.191	U,G
NB-32-27-SL	-3.18	18.9	9.97	U,G
NB-32-33-SL	-0.429	20.2	11	U,G
NB-33-05-SL	-0.0627	0.301	0.153	U,G
NB-33-15-SL	-0.0348	0.41	0.218	U,G
NB-33-27-SL	0.0641	0.178	0.105	U
NB-34-05-SL	-0.143	0.451	0.228	U,G
NB-34-15-SL	-0.137	0.292	0.135	U,G
NB-34-25-SL	0.0394	0.273	0.152	U

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-35-15-SL	0.353	0.238	0.194	G,TI
NB-35-25-SL	-0.202	0.339	0.157	U,G
NB-36-05-SL	-8.61	20.8	10.5	U,G
NB-36-15-SL	-0.0504	0.395	0.208	U,G
NB-36-27-SL	-17.3	26.3	13.1	U
NB-37-05-SL	-0.452	22.3	12.3	U,G
NB-37-15-SL	-4.21	23.9	12.8	U,G
NB-37-25-SL	0.162	0.234	0.152	U,G
NB-38-09-SL	-0.0492	0.252	0.14	U,G
NB-38-15-SL	-6.16	18.1	10.1	U
NB-38-25-SL	-3	18.7	10.6	U
NB-39-05-SL	-0.509	25.2	14	U,G
NB-39-05-SL	-0.509	25.2	14	U,G
NB-39-15-SL	-4.11	20.2	10.8	U,G
NB-39-15-SL	-4.11	20.2	10.8	U,G
NB-39-25-SL	-0.148	0.365	0.174	U,G
NB-39-25-SL	-0.148	0.365	0.174	U,G
NB-39-30-SL	-12.7	24.4	12.3	U,G
NB-39-30-SL	-12.7	24.4	12.3	U,G
NB-40-05-SL	-0.0278	0.368	0.194	U,G
NB-40-05-SL-FD	-8.69	19.1	10.6	U
NB-40-17-SL	-1.21	23	12.7	U,G
NB-40-25-SL	-0.0201	0.308	0.162	U
NB-40-31-SL	0.0979	0.174	0.108	U
NB-41-05-SL	-0.441	22	12.3	U
NB-41-13-SL	-0.0297	0.273	0.141	U
NB-41-19-SL	-8.81	19.7	10.8	U,G
NB-42-05-SL	-0.0373	0.305	0.159	U,G
NB-42-13-SL	-0.0607	0.307	0.156	U
NB-42-23-SL	-1.24	14.4	8.16	U
NB-43-05-SL	-2.45	18.6	9.87	U,G
NB-43-13-SL	-3.91	17	8.87	U
NB-44-05-SL	0.0938	0.246	0.147	U
NB-44-18-SL	-2.78	16.7	8.83	U

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-45-05-SL	-0.0371	0.494	0.268	U,G
NB-45-05-SL-FD	-6.9	25.9	13.5	U,G
NB-45-13-SL	-1.63	23.6	12.8	U,G
NB-45-25-SL	-2.58	27.3	14.9	U,G
NB-45-33-SL	-3.56	15.8	8.82	U
NB-46-09-SL	-10.7	22.5	11.3	U
NB-46-17-SL	-0.0448	0.22	0.121	U,G
NB-46-25-SL	-2.23	24.6	13.6	U,G
NB-46-29-SL	-0.0223	0.25	0.13	U,G
NB-47-05-SL	0.0799	0.237	0.139	U
NB-47-15-SL	-8.32	21.4	10.9	U,G
NB-47-25-SL	0.0978	0.385	0.222	U,G
NB-47-31-SL	-0.0524	0.301	0.153	U,G
NB-48-05-SL	0.0375	0.358	0.202	U,G
NB-48-11-SL	-2.91	19.6	10.5	U,G
NB-48-15-SL	-0.214	0.423	0.201	U,G
NB-48-25-SL	-3.34	20	10.6	U,G
NB-49-05-SL	0.0852	0.348	0.201	U,G
NB-49-05-SL-FD	-7.04	22.7	11.6	U,G
NB-49-15-SL	-0.743	23.4	12.9	U,G
NB-49-25-SL	-6.31	21	10.8	U,G
NB-49-37-SL	-1.51	18.1	9.54	U,G
NB-50-05-SL	0.0132	0.312	0.17	U,G
NB-50-15-SL	-0.0625	0.352	0.186	U,G
NB-50-25-SL	0.0396	0.364	0.202	U,G
NB-50-37-SL	0.0814	0.261	0.153	U
NB-51-05-SL	-3.81	19.2	10.1	U,G
NB-51-13-SL	-0.109	0.367	0.186	U,G
NB-51-25-SL	0.0131	0.309	0.168	U,G
NB-51-37-SL	-0.076	0.247	0.114	U,G
NB-52-05-SL	0.129	0.356	0.211	U,G
NB-52-13-SL	0.0819	0.328	0.189	U,G
NB-52-35-SL	-0.0874	0.424	0.22	U,G
NB-53-05-SL	0.0857	0.268	0.157	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-53-13-SL	-0.0466	0.274	0.14	U,G
NB-53-23-SL	0.00831	0.444	0.243	U,G
NB-53-33-SL	0.0229	0.257	0.141	U,G
NB-54-05-SL	-7.11	26.1	14	U,G
NB-54-13-SL	-4.65	25.9	14	U,G
NB-54-25-SL	0.112	0.397	0.231	U,G
NB-54-31-SL	-1.6	14.8	7.88	U
NB-55-05-SL	-3.1	24.6	13.3	U,G
NB-55-13-SL	-0.131	0.38	0.193	U,G
NB-55-25-SL	-5.26	20.9	10.7	U,G
NB-55-33-SL	-2.21	15.8	8.37	U
NB-56-05-SL	-5.89	17.6	8.95	U
NB-56-13-SL	-6.51	26.1	14	U,G
NB-56-25-SL	-0.0376	0.302	0.157	U,G
NB-56-33-SL	-0.045	0.258	0.131	U
NB-57-05-SL	-9.54	26.2	13.8	U,G
NB-57-29-SL	0.138	0.231	0.146	U,G
NB-57-34-SL	-1.37	22.9	12.6	U,G
NB-58-05-SL	0.0119	0.286	0.156	U,G
NB-58-15-SL	-3.81	26.3	14.3	U,G
NB-58-29-SL	-1.47	20	10.8	U,G
NB-58-36-SL	-5.41	22.4	11.9	U,G
NB-59-05-SL	-0.0236	0.265	0.138	U,G
NB-59-13-SL	-11.5	26.8	14.1	U,G
NB-59-25-SL	-2.5	18.4	9.81	U,G
NB-59-31-SL	-1.5	20.8	11.2	U,G
NB-60-05-SL	0.0382	0.256	0.142	U,G
NB-60-13-SL	0.0606	0.398	0.223	U,G
NB-60-23-SL	-0.0119	0.246	0.139	U,G
NB-60-31-SL	-10.6	24	11.9	U,G
NB-61-05-SL	-4.25	25.6	14	U,G
NB-61-13-SL	0.144	0.269	0.169	U,G
NB-61-23-SL	-7.5	25	13.4	U,G
NB-61-28-SL	0.0318	0.214	0.118	U

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-62-05-SL	0.0793	0.33	0.189	U,G
NB-62-12-SL	0.0112	0.226	0.121	U,G
NB-62-22-SL	-0.0398	0.352	0.183	U,G
NB-63-05-SL	0.00282	0.34	0.179	U,G
NB-63-13-SL	-2.66	21	11.2	U,G
NB-63-19-SL	-1.31	14.4	7.54	U
NB-64-05-SL	-0.126	0.328	0.156	U,G
NB-64-13-SL	-9.34	22	10.8	U,G
NB-64-17-SL	-0.0337	0.239	0.121	U,G
NB-65-05-SL	-0.0889	0.292	0.142	U,G
NB-65-13-SL	-0.134	0.287	0.132	U,G
NB-65-17-SL	-0.0841	0.351	0.173	U,G
NB-66-05-SL-FD	-1.01	27.1	14.7	U,G
NB-66-15-SL	-2.76	23.5	12.7	U,G
NB-66-19-SL	-1.03E-08	0.217	0.114	U
NB-67-05-SL	-1.7	24.3	13.1	U,G
NB-67-11-SL	-7.79	16.6	9.01	U,G
NB-67-21-SL	-4.51	18.7	9.9	U
NB-68-05-SL	0.0742	0.258	0.153	U,G
NB-68-13-SL	0.0283	0.333	0.182	U,G
NB-68-17-SL	0.0399	0.333	0.186	U,G
NB-68-25-SL	-0.264	19.9	10.8	U,G
NB-68-33-SL	0.0224	0.342	0.187	U,G
NB-69-05-SL	-8.08	17.9	9.83	U,G
NB-69-15-SL	-4.86	16.9	9.38	U,G
NB-69-22-SL	-3.08	21.1	12	U,G
NB-69-34-SL	-8.13	18.4	10.2	U
NB-70-05-SL	-7.77	19.3	10.7	U,G
NB-70-15-SL	-0.0353	0.3	0.158	U,G
NB-70-23-SL	-1.79	20.2	11.5	U,G
NB-70-33-SL	0.0353	0.233	0.135	U,G
NB-71-01-SL	0.0395	0.296	0.165	U,G
NB-71-01-SL-FD	-2.88	27	14.9	U,G
NB-71-11-SL	0.0225	0.345	0.188	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-71-27-SL	-0.158	0.293	0.133	U,G
NB-72-05-SL	-0.0132	0.295	0.156	U,G
NB-72-11-SL	0.0543	0.413	0.229	U,G
NB-72-19-SL	-12.3	16.7	8.84	U
NB-73-05-SL	0.134	0.283	0.174	U,G
NB-74-05-SL	0.00613	0.263	0.151	U,G
NB-74-05-SL	0.00613	0.263	0.151	U,G
NB-74-17-SL	0.0134	0.354	0.195	U,G
NB-74-17-SL	0.0134	0.354	0.195	U,G
NB-74-25-SL	-6.14	23	12.1	U,G
NB-74-25-SL	-6.14	23	12.1	U,G
NB-74-33-SL	-0.0882	0.222	0.0991	U,G
NB-74-33-SL	-0.0882	0.222	0.0991	U,G
NB-75-08-SL	-7.52	19.9	10	U,G
NB-75-15-SL	-13.3	23	11.5	U,G
NB-75-19-SL	-0.0327	0.226	0.113	U
NB-76-06-SL	-0.132	0.348	0.171	U,G
NB-76-10-SL	-0.0212	0.2	0.0996	U
NB-76-24-SL	-0.0594	0.303	0.153	U
NB-77-05-SL	0.0286	0.216	0.125	U,G
NB-77-13-SL	0.0952	0.207	0.126	U
NB-77-24-SL	0.0295	0.178	0.0984	U
NB-78-07-SL	0.052	0.361	0.2	U,G
NB-78-11-SL	-0.0328	0.218	0.121	U,G
NB-78-18-SL	0.0255	0.264	0.144	U,G
NB-79-05-SL	0.0591	0.332	0.187	U,G
NB-79-05-SL-FD	-0.0374	0.28	0.143	U,G
NB-79-11-SL	0.0103	0.344	0.185	U,G
NB-79-24-SL	-0.0214	0.246	0.129	U
NB-80-05-SL	0.015	0.312	0.168	U,G
NB-80-11-SL	0.0622	0.231	0.136	U,G
NB-80-27-SL	0.0779	0.337	0.195	U,G
NB-81-09-SL	0.071	0.245	0.142	U,G
NB-81-11-SL	-0.0124	0.25	0.129	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
NB-81-31-SL	-0.123	0.227	0.118	U,G
NB-82-05-SL	0.15	0.298	0.183	U,G
NB-82-11-SL	-0.0592	0.218	0.119	U
NB-82-20-SL	-0.0759	0.266	0.132	U
NB-83-05-SL	0.083	0.453	0.256	U,G
NB-83-11-SL	-0.0225	0.226	0.126	U,G
NB-83-23-SL	0.0324	0.21	0.116	U
NB-84-05-SL	-0.0528	0.453	0.236	U,G
NB-84-15-SL	-0.0118	0.231	0.129	U,G
NB-84-23-SL	-0.012	0.242	0.125	U,G
NB-84-33-SL	0.0116	0.266	0.144	U
NB-85-05-SL	-0.0147	0.33	0.174	U,G
NB-85-15-SL	0.0137	0.315	0.171	U,G
NB-85-25-SL	-0.028	0.33	0.173	U,G
NB-85-35-SL	0.0406	0.161	0.091	U
NB-86-05-SL	0.00327	0.476	0.258	U,G
NB-86-15-SL	-0.04	0.334	0.175	U,G
NB-86-19-SL	-0.0116	0.226	0.116	U,G
OA-01-00-SL-FD	0.026	0.284	0.156	U,G
OA-03-00-SL	-4.4	23.7	12.6	U,G
OA-04-00-SL	0.0352	0.417	0.242	U,G
OA-05-00-SL	0.0292	0.285	0.16	U,G
OA-06-00-SL	-0.0571	0.256	0.136	U,G
OA-09-00-SL	-2.76	22.1	12.4	U,G
OA-12-00-SL	0.0516	0.376	0.209	U,G
OA-13-00-SL	-12	56.2	31.9	U,G
OA-14-00-SL	-0.137	0.394	0.188	U,G
OA-15-00-SL	0.115	0.342	0.201	U,G
OA-18-17-SL	-0.0579	0.29	0.148	U,G
OA-18-25-SL	-0.0329	0.409	0.217	U,G
OA-18-33-SL	-0.722	15.1	8.13	U
OA-19-05-SL	0.121	0.28	0.169	U
OA-19-15-SL	-1.73	18.3	9.89	U,G
OA-19-25-SL	-2.64	23.1	12.5	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
OA-19-33-SL	-1.99	16	8.45	U
OA-20-00-SL	-0.0139	0.28	0.145	U,G
OA-21-00-SL	-17.8	49.3	28	U,G
OA-23-00-SL	-0.096	0.272	0.134	U
OA-24-00-SL	-0.0415	0.378	0.202	U,G
OA-25-00-SL	-0.185	0.243	0.124	U,G
OA-27-00-SL	0.0233	0.195	0.108	U,G
OA-28-00-SL	0.0764	0.195	0.117	U,G
OA-29-00-SL	-2.53	18.8	10.4	U,G
OA-30-00-SL	-5.14	22.6	12.3	U,G
OA-31-00-SL	-3.79	19	10.4	U,G
OA-32-00-SL	-0.254	17.9	10	U,G
OA-34-00-SL	0.0085	0.213	0.117	U,G
OA-35-00-SL	-0.00575	0.359	0.204	U,G
OA-36-00-SL	-0.0925	0.324	0.169	U,G
OA-38-00-SL	-0.0831	0.29	0.151	U,G
OA-39-00-SL	-1.87	17.8	9.84	U,G
OA-40-00-SL	0.0674	0.213	0.124	U,G
PL-02-00-SL	-0.0362	0.319	0.172	U,G
PL-03-00-SL	-4.08	18.3	9.96	U,G
PL-04-13-SL	0.0357	0.361	0.2	U,G
PL-04-13-SL	0.0357	0.361	0.2	U,G
PL-04-23-SL	-0.0368	0.34	0.182	U
PL-04-23-SL	-0.0368	0.34	0.182	U
PL-04-31-SL	0.0718	0.2	0.118	U,G
PL-04-31-SL	0.0718	0.2	0.118	U,G
PL-05-05-SL	-0.0395	20.1	11.1	U,G
PL-05-15-SL	-4.45	23.3	12.6	U
PL-05-28-SL	-1.68	20.2	10.9	U,G
PL-06-07-SL	-6.85	21.6	11.2	U,G
PL-06-13-SL	0.0862	0.262	0.154	U,G
PL-06-17-SL	-6.53	21.1	10.9	U,G
PL-06-29-SL	-1.61	15.9	9.03	U
PL-06-33-SL	-4.52	19.5	10.3	U

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
RR-02-00-SL	-0.0146	0.303	0.158	U,G
RR-03-00-SL	0.114	0.477	0.274	U,G
RR-04-15-SL	-2.64	20	10.6	U,G
RR-04-25-SL	0.072	0.392	0.222	U,G
RR-05-05-SL	-0.0816	0.377	0.196	U,G
RR-05-05-SL-FD	-0.16	0.441	0.213	U,G
RR-05-15-SL	0.0252	0.268	0.147	U,G
RR-05-25-SL	0.0575	0.399	0.226	U,G
SW-02-00-SL	-0.0335	0.596	0.321	U,G
SW-02-09-SL	-8.18	20.7	10.5	U,G
SW-02-15-SL	-0.0146	0.404	0.22	U,G
SW-02-23-SL	0.107	0.246	0.149	U,G
SW-03-00-SL	0.0722	0.252	0.145	U,G
SW-03-SS	-0.947	27.1	14.8	U,G
SW-04-00-SL	0.0957	0.522	0.296	U,G
SW-04-SS	0.0557	0.257	0.151	U,G
SW-05-08-SL	-5.95	23.6	12.4	U,G
SW-05-12-SL	-0.076	0.298	0.148	U,G
SW-05-SS	0.0903	0.385	0.22	U,G
SW-06-05-SL	-0.0263	0.309	0.162	U,G
SW-06-05-SL-FD	0.0383	0.319	0.179	U,G
SW-06-13-SL	0.0161	0.336	0.181	U,G
SW-06-SS	0.00313	0.631	0.353	U,G
SW-07-05-SL	-9.18	20.4	10.2	U,G
SW-07-15-SL	0.0489	0.372	0.206	U,G
SW-07-23-SL	-5.53	21.9	12.3	U,G
SW-08-03-SL	-6.72	25.1	13.2	U,G
SW-08-05-SL	0.0396	0.303	0.169	U,G
SW-08-15-SL	-1.37	26.2	14.4	U,G
SW-08-25-SL	-0.0358	14.3	7.69	U
SW-08-SS	0.0179	0.113	0.0629	U
SW-08-SS-FD	-0.754	9.05	4.84	U,G
SW-10-SS	0.0545	0.194	0.113	U,G
SW-11-SS	-1.19	14.8	8.23	U,G

Table 1
Np-237 gamma spectroscopy results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
SW-12-SS	-0.103	0.267	0.134	U,G
SW-14-SS	-0.54	9.67	5.26	U,G
SW-15-SS	0.00718	0.18	0.0984	U,G
SW-16-SS	-7.1	11.2	5.36	U,G
US-04-SS	-0.204	14.5	8.08	U,G
US-05-SS	-0.0495	0.176	0.0873	U,G

Table 2
Ra-226 gamma spectroscopy with in-growth results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
BG-01-00-SL	1.34	0.367	0.282	
BG-01-03-SL	0.976	0.453	0.271	LT
BG-02-00-SL	1.32	0.533	0.316	G
BG-02-03-SL	1.53	0.564	0.349	G
BG-03-00-SL	1.28	0.407	0.301	G
BG-03-03-SL	1.27	0.613	0.343	G
BG-04-00-SL	1.42	0.571	0.347	G
BG-04-03-SL	1.42	0.346	0.299	G
BG-05-00-SL	1.52	0.42	0.324	G
BG-05-03-SL	1.59	0.532	0.361	G
BG-06-00-SL	1.34	0.505	0.336	G
BG-06-03-SL	1.64	0.501	0.351	G
BG-07-00-SL	1.16	0.39	0.284	G
BG-07-03-SL	1.41	0.417	0.273	G
BG-08-00-SL	1.62	0.589	0.369	G
BG-08-03-SL	1.61	0.473	0.298	G
BG-09-00-SL	1.63	0.35	0.275	
BG-09-03-SL	1.97	0.518	0.38	G
BG-10-00-SL	1.74	0.572	0.397	G
BG-10-03-SL	1.6	0.565	0.327	G
BG-11-00-SL	1.67	0.564	0.385	G
BG-11-03-SL	1.58	0.501	0.386	G
BG-12-00-SL	1.62	0.47	0.312	G
BG-12-03-SL	1.69	0.514	0.388	G
BG-13-00-SL	1.55	0.534	0.357	G
BG-13-03-SL	1.86	0.528	0.395	G
BG-14-00-SL	1.34	0.553	0.347	G

Table 2
Ra-226 gamma spectroscopy with in-growth results excluded from 2009 Hematite Radiological Characterization Report (DO-08-003)

Sample ID	Result	MDA	Error	Flag
BG-14-03-SL	1.56	0.566	0.376	G
BG-15-00-SL	0.995	0.529	0.303	LT,G
BG-15-03-SL	1.37	0.59	0.338	G
BG-16-00-SL	1.26	0.419	0.302	G
BG-16-03-SL	1.32	0.462	0.305	G