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Our ref: HEM-13-77
Date: June 3, 2013

Subject: Westinghouse Hematite Decommissioning Project: Request for NRC Review of Report HDP-RPT-FSS-104, *Data Summary Report for Reuse Stockpile 5* (License No. SNM-00033, Docket No. 070-00036)

References: 1) NRC (Camper) letter to Westinghouse (Richardson), dated April 11, 2013, "Issuance of Hematite Amendment No. 60 Approving Westinghouse Hematite Request for Alternative Disposal of Specified Low Activity Radioactive Material and Granting Exemptions to 10 CFR 30.3 and 10 CFR 70.3"

Reference 1 contains the current amendment to materials license SNM-33 issued by the U.S. Nuclear Regulatory Commission (NRC) to the Westinghouse Electric Company LLC (Westinghouse) for the Hematite Decommissioning Project (HDP). Condition 15 of SNM-33 incorporates by reference the HDP Decommissioning Plan (DP) and Westinghouse's responses to the NRC's Requests for Additional Information (RAIs). Section 14.3.2.3 of DP Chapter 14 contains requirements regarding radiological survey methodologies for soil intended to be used as backfill in an excavation.

The purpose of this letter is to provide for NRC review the results of the radiological survey methodologies for Soil Reuse Stockpile 5 at HDP. Enclosure 1 contains the report HDP-RPT-FSS-104, *Data Summary Report for Reuse Stockpile 5*. The objective of the report is to document that the average radioactivity concentration (expressed as the sum contribution from all radionuclides) within this stockpile of reuse soil does not exceed the applicable derived concentration guideline levels approved via Reference 1.

NRC's review is requested at this time as this review is part of the phased approach to documenting final status surveys as discussed DP Chapter 14. Your timely review of this report is important to the ongoing conduct of the remediation work per the schedule provided in DP Chapter 1.

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Please contact Kevin Davis at 314-810-3348, should you have questions or need additional information.

Sincerely,

Dennis Richardson

Dennis C. Richardson
Deputy Director
Hematite Decommissioning Project

Enclosure: 1) Report HDP-RPT-FSS-104, *Data Summary Report for Reuse Stockpile 5*

cc: J. J. Hayes, NRC/FSME/DWMEP/DURLD/MD
J. W. Smetanka, Westinghouse
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# ENCLOSURE 1

# REPORT HDP-RPT-FSS-104
## *DATA SUMMARY REPORT FOR REUSE STOCKPILE 5*

**Westinghouse Electric Company LLC**
**Hematite Decommissioning Project**

**Docket No. 070-00036**

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# Hematite Decommissioning Project

## Technical Report

**NUMBER:** **HDP-RPT-FSS-104**

**TITLE:** **Data Summary Report for Reuse Stockpile 5**

**REVISION:** **0**

**EFFECTIVE DATE:** **May 23, 2013**

**Approvals:**

Author: Michelle E. Bresnahan*

Owner/ Manager Joseph S. Guido*

*Electronically approved records are authenticated in the electronic document management system

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## 1.0 Soil Description

Reuse Soil Stockpile 5 is comprised of 211 tons of soil that originated from the barn area overburden. Specifically, the soil originated from excavation activities within Survey Units LSA 05-02 (Tile Barn Footprint) and LSA 05-03 (Wood Barn Footprint). The soil was segregated from other waste bearing soil during excavation, and transported to the lay-down area in 11 truckloads on 02/04/2013. Prior to the soil comprising Stockpile 5 being transported to the lay-down area, it was identified that all necessary gamma walkover surveys required of soil intended for Reuse were not performed before the soil was excavated. As a result, the method for determining if Stockpile 5 soil is suitable as backfill followed steps b. through e. described in Approach 2 of subsection 14.3.2.3.2 of the HDP decommissioning plan (DO-08-004). The soil was assayed by the box counter prior to placement in the lay-down area that occupies a portion of Land Survey Area 04 (LSA-04) as shown in Figures 1-1 and 1-2, below.

**Figure 1-1, Location of Reuse Stockpile 5.**

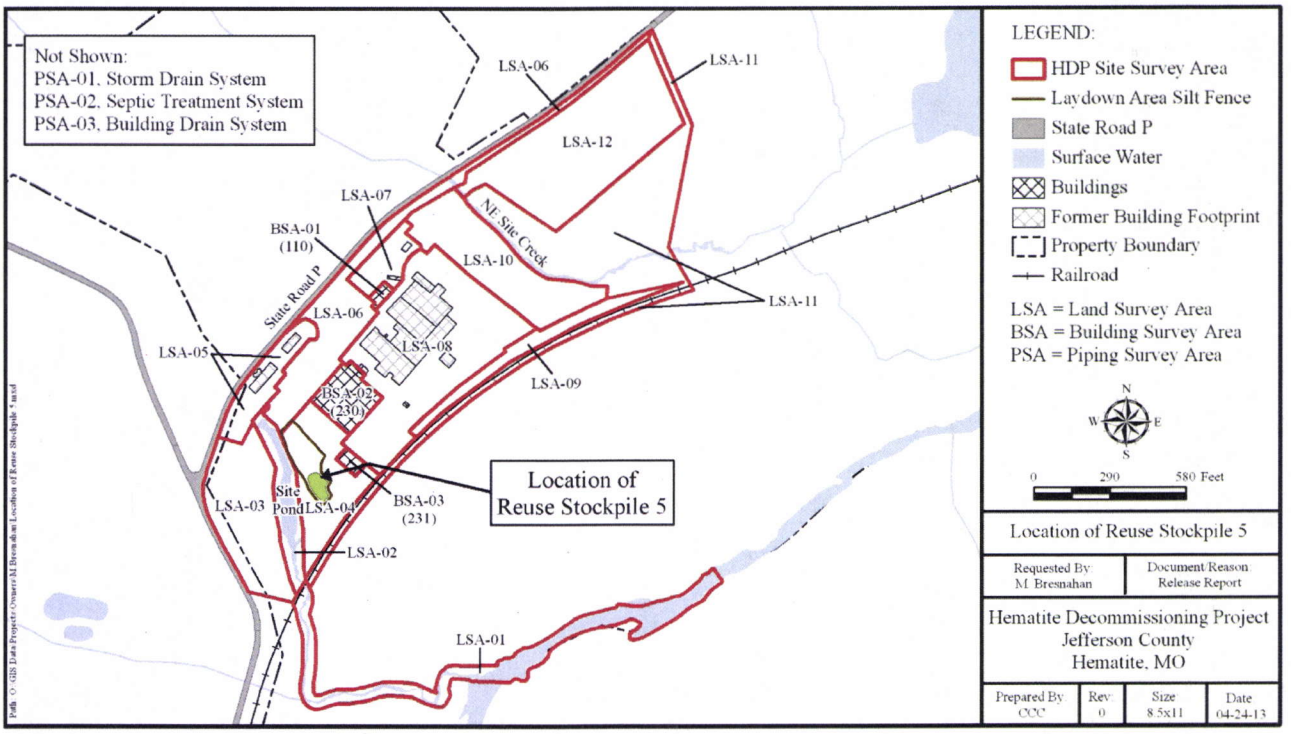

**Figure 1-2, Reuse Stockpile 5, Aerial Photograph 03/07/2013**

## 2.0 Reuse Soil Criteria

The objective of the soil characterization was to demonstrate that the average radioactivity concentration (expressed as the sum contribution from all radionuclides) within a stockpile of soil intended for use as backfill does not exceed the DCGL that is applicable to the depth of backfill placement relative to the final grade. The Uniform $DCGL_w$ was conservatively used as the initial comparator to determine suitability for Reuse soil. Candidate soil was identified through sampling and laboratory analysis. The following summarizes the decision rules applied to backfill soil:

- If sample results indicate that the average concentration in a stockpile is ≤ Uniform stratum DCGL, then the soil may be placed as backfill within any strata;

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- If sample results indicate that the average concentration in a stockpile is > Uniform stratum DCGL, but ≤ Root stratum DCGL, then the soil may be placed as backfill within the Root or Deep strata;
- If sample results indicate that a stockpile is > Root stratum DCGL, but ≤ Excavation DCGL, then the soil may only be placed as backfill within the Deep stratum.

The dose contribution from Reuse soil will be added to dose from residual radioactivity within each survey unit in which the soil is placed to demonstrate that the total contribution will not exceed the site decommissioning criteria (25 mrem/yr).

## 3.0 Survey Design

Three options for scanning, segregating and sampling soil intended for Reuse during excavation and handling are described in subsection 14.3.2.3 of the HDP decommissioning plan (DO-08-004). Since the Stockpile 5 soil did not have an initial gamma scan survey performed over 100% of the exposed surface prior to excavation, the approach used to identify its suitability as backfill followed steps b. through e. of Approach 2 in subsection 14.3.2.3.2 in the HDP decommissioning plan (DO-08-004).

In summary, the method used provided for: (1) bulk analysis of the entire volume of soil intended for Reuse as backfill by gamma spectroscopy; (2) spreading out the excavated soil to approximately a 6 inch depth; and (3) performing a 100% gamma scan survey over the exposed surface of the spread soil and collection of systematic soil samples. These survey elements were implemented in accordance with standard operating procedures: HDP-PR-HP-601 (*Remedial Action Support Surveys)*; CS-IN0PR-016 (*Operation of the Guardian-III for use at the Hematite Decommissioning Project*); HDP-PR-FSS-711 (*Final Status Surveys and Sampling of Soil and Sediment*); and written FSS Plans and Sampling Instructions.

## 4.0 Survey Implementation

The identified Reuse soil was loaded into a dump truck with a capacity of approximately twenty (20) cubic yards, and then assayed using the box counter which is comprised of an array of calibrated high-purity germanium detectors. Soil that exceeded the Reuse criteria based on the gamma spectroscopy result was identified as not suitable for use as Reuse soil and was directed to the waste stream.

The soil not consigned to the waste stream was transported to the lay-down area and dumped from the truck. After all identified Reuse material from the barn area overburden was delivered; it was spread to a depth of approximately 6 inches. Prior to starting the final status survey of material in stockpile 5, FSS instructions were prepared in accordance with HDP-PR-FSS-701 (*Final Status Survey Plan Development*) and are provided in Appendix B. The following bullet list summarizes the information in the FSS instructions:

- A gamma scan survey (using a 2x2 NaI detector) of 100% of the spread pile surface was performed to identify any locations of elevated count rate (above the investigation action level) for biased sampling.
- The investigation action level (IAL) was 1,512 net cpm assuming a 10,000 cpm background

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- 14 systematic sample locations were identified as described in section 5 of the Final Status Survey Sampling Plan for Stockpile 5 (Appendix B.)
- A biased sample was collected in any location that exceeds the IAL found during the gamma scan survey
- Samples were collected on the ground surface to a depth of 6 inches
- 1 quality control sample was collected

## 5.0 Survey and Sampling Results

The results of the gamma walkover survey conducted over 100% of the spread pile show that there were no areas in stockpile 5 that exceeded the investigation action level of 1,512 net cpm. The IAL was based on a background of 10,000 cpm; at the time the survey was performed, the background in the area of stockpile 5 was 7,000 cpm. This would adjust the IAL to 1,256 net cpm. Based on the adjusted IAL there were still no areas in stockpile 5 that would have exceeded 1,256 net cpm. Therefore, no biased sampling was performed. The results of the gamma walkover survey performed are shown on Form HDP-PR-HP-311-3 in Appendix A.

Table 5-1 includes the summary results of the 14 systematic samples obtained from Reuse Soil Stockpile 5, and the associate sum of fractions when compared to the Uniform DCGLw. The arithmetic average concentration resulted in a sum of fractions for Reuse Soil Stockpile 5 of 0.32. The weighted average SOF (considering the contribution of each individual load of soil) is 0.33. Figure 5-1 shows a statistical summary of Reuse Stockpile 5. The top graph in Figure 5-1 is a histogram of the frequency versus the sum of fractions for the data population comprising Stockpile 5. The middle graph of Figure 5-1 shows a box plot of the same data set providing the mean (indicated by the vertical line in the gray box) of the sample. The bottom graph calculates the 95% confidence intervals for the mean the median of the same data set.

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**Figure 5-1, Statistical Summary for Reuse Stockpile 5**

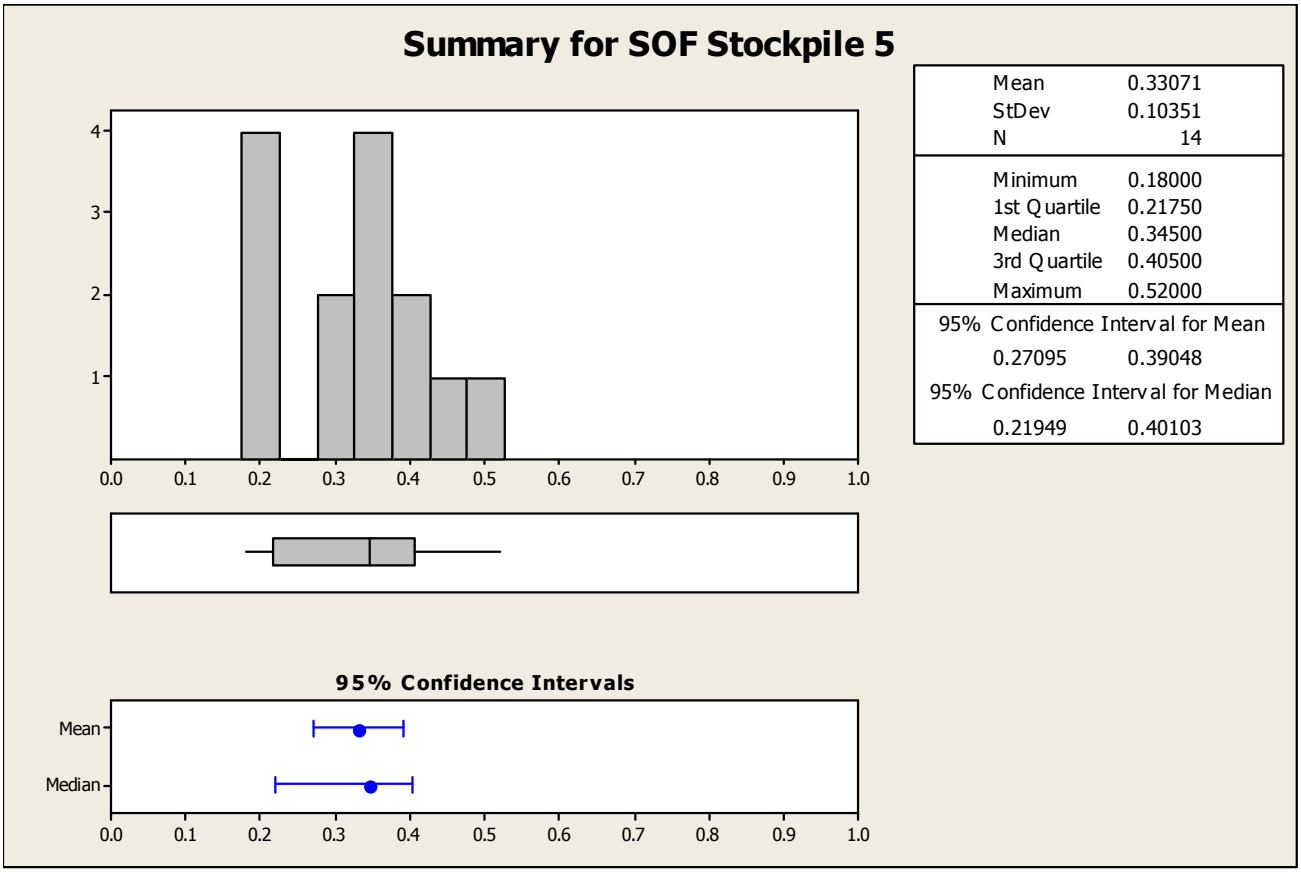
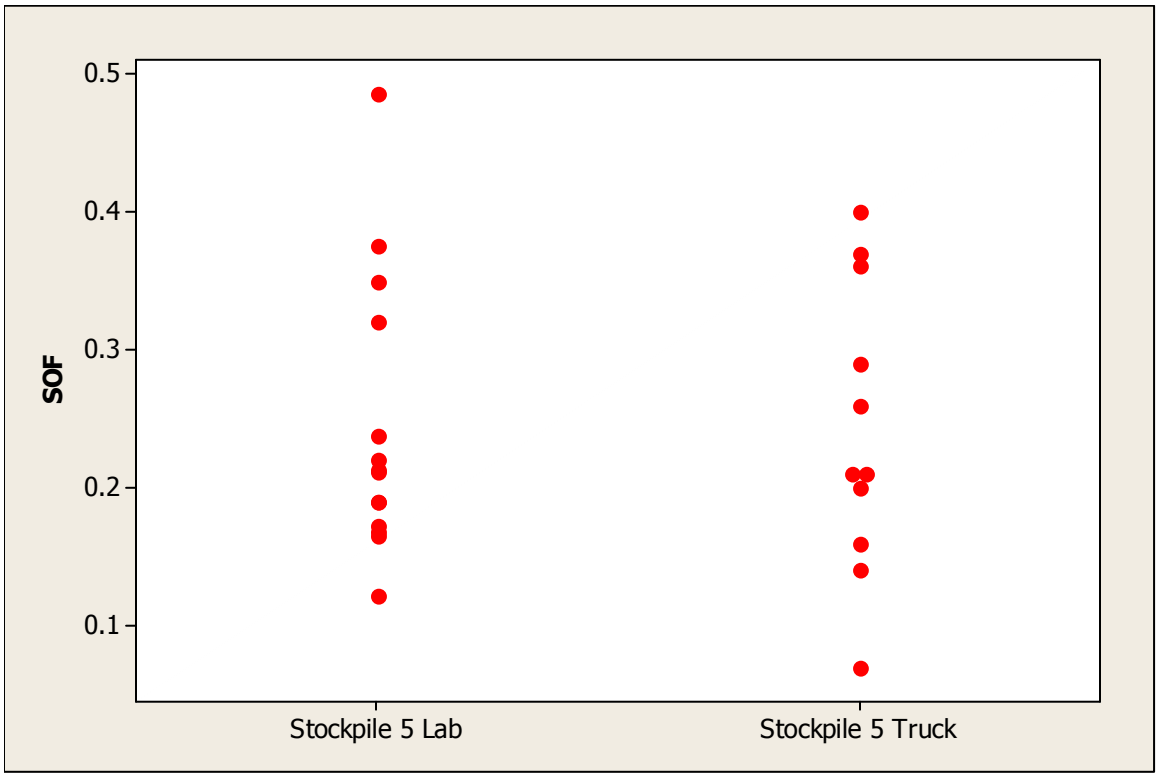



Figure 5-2 below provides an individual value plot of the FSS systematic sample results and the Box Counter results which were used to screen material prior to disposition as reuse material (box counter results are tabulated in Table 5-3). These results are consistent with those of the laboratory as seen in the figure.

**Figure 5-2 Comparison of Box Counter and Laboratory Data**




A retrospective sample analysis was performed in accordance with procedure HDP-PR-FSS-701. This analysis included (1) an initial calculation of the number of systematic samples necessary to take from data evaluated of the samples collected during FSS; and (2) an adjusted systematic sample population based on the scan MDC (provided in Appendix B). The analysis provided assurance that the number of systematic samples taken on Stockpile 5 satisfied both conditions above. The scan MDC (90.5 pCi/g) was greater than the calculated $DCGL_w$ for total Uranium (45.0 pCi.g) therefore, an elevated measurement comparison was performed ($DCGL_{EMC}$ = 148.5 pCi.g). The results (provided in Appendix B) indicated the initial calculated sample density was enough to account for the scan MDC. The retrospective sample analysis indicated only 7 systematic samples would need to be taken based on the Wilcoxon Rank Sum Test. Since 14 systematic samples were taken, it is not necessary to perform further systematic sampling. Appendix B provides the final status survey sampling plan for stockpile 5.

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Table 511, Reuse Stockpile 5, Sample Data and Calculated SOF Values

| Sample | Ra-226 DCGL = 1.9 pCi/g Background = 0.9 pCi/g | Tc-99 DCGL = 25.1 pCi/g | Th-232 DCGL = 2.0 pCi/g Background = 1.0 pCi/g | U-234 DCGL = 195.4 pCi/g | U-235 DCGL = 51.6 pCi/g | U-238 DCGL = 168.8 pCi/g | Enrichment (%) | Sample SOF (Uniform DCGL) |
|---|---|---|---|---|---|---|---|---|
| R010101PSS00 | 1.03 ± 0.15 (0.07) | 0.45 ± 0.18 (0.23) | 1.09 ± 0.18 (0.12) | 8.00 (Inf. U235/U238) | 0.44 ± 0.17 (0.20) | 1.66 ± 0.68 (0.89) | 4.0 | 0.19 |
| R010102PSS00 | 1.03 ± 0.15 (0.07) | 1.10 ± 0.17 (0.22) | 0.90 ± 0.16 (0.09) | 40.10 (Inf. U235/U238) | 2.21 ± 0.34 (0.27) | 9.80 ± 1.57 (1.22) | 3.4 | 0.42 |
| R010103PSS00 | 0.99 ± 0.15 (0.08) | 1.28 ± 0.19 (0.22) | 1.03 ± 0.20 (0.12) | 33.91 (Inf. U235/U238) | 1.87 ± 0.31 (0.25) | 8.07 ± 1.32 (1.11) | 3.5 | 0.37 |
| R010104PSS00 | 1.10 ± 0.17 (0.08) | 0.77 ± 0.18 (0.23) | 0.87 ± 0.16 (0.12) | 11.09 (Inf. U235/U238) | 0.61 ± 0.20 (0.23) | 2.80 ± 0.85 (0.98) | 3.3 | 0.22 |
| R010105PSS00 | 1.10 ± 0.18 (0.09) | 3.13 ± 0.49 (0.23) | 0.93 ± 0.18 (0.11) | 16.43 (Inf. U235/U238) | 0.90 ± 0.35 (0.36) | 2.23 ± 0.77 (1.89) | 6.0 | 0.34 |
| R010106PSS00 | 0.94 ± 0.16 (0.08) | 3.40 ± 0.36 (0.23) | 0.94 ± 0.19 (0.19) | 24.10 (Inf. U235/U238) | 1.32 ± 0.30 (0.29) | 7.64 ± 1.59 (1.44) | 2.7 | 0.35 |
| R010107PSS00 | 1.07 ± 0.17 (0.08) | 4.13 ± 0.58 (0.23) | 0.62 ± 0.18 (0.20) | 20.47 (Inf. U235/U238) | 1.13 ± 0.30 (0.32) | 3.52 ± 0.82 (2.13) | 4.8 | 0.40 |
| R010108PSS00 | 1.06 ± 0.16 (0.07) | 1.19 ± 0.18 (0.24) | 0.96 ± 0.16 (0.10) | 10.70 (Inf. U235/U238) | 0.59 ± 0.21 (0.22) | 2.56 ± 0.55 (1.13) | 3.5 | 0.21 |
| R010109PSS00 | 0.98 ± 0.14 (0.06) | 2.64 ± 0.34 (0.24) | 0.92 ± 0.15 (0.08) | 22.00 (Inf. U235/U238) | 1.21 ± 0.21 (0.20) | 5.97 ± 1.22 (1.14) | 3.1 | 0.32 |
| R010110PSS00 | 1.04 ± 0.15 (0.07) | 4.15 ± 0.43 (0.23) | 0.89 ± 0.14 (0.12) | 14.75 (Inf. U235/U238) | 0.81 ± 0.20 (0.25) | 4.32 ± 0.95 (0.96) | 2.9 | 0.36 |
| R010111PSS00 | 1.03 ± 0.16 (0.08) | 0.76 ± 0.26 (0.23) | 0.92 ± 0.16 (0.14) | 54.10 (Inf. U235/U238) | 2.98 ± 0.42 (0.28) | 13.80 ± 1.99 (1.42) | 3.3 | 0.52 |
| R010112PSS00 | 0.98 ± 0.15 (0.07) | 1.57 ± 0.21 (0.23) | 1.06 ± 0.16 (0.12) | 5.98 (Inf. U235/U238) | 0.33 ± 0.17 (0.21) | 1.83 ± 0.79 (0.94) | 2.8 | 0.18 |
| R010113PSS00 | 1.07 ± 0.16 (0.07) | 3.08 ± 0.40 (0.23) | 0.91 ± 0.16 (0.10) | 10.33 (Inf. U235/U238) | 0.57 ± 0.20 (0.22) | 2.40 ± 0.75 (0.88) | 3.6 | 0.29 |
| R010114PSS00 | 1.08 ± 0.16 (0.07) | 2.68 ± 0.29 (0.22) | 1.02 ± 0.21 (0.11) | 32.62 (Inf. U235/U238) | 1.80 ± 0.30 (0.26) | 7.29 ± 1.30 (1.18) | 3.7 | 0.46 |
| Average | 1.05 | 2.17 | 0.94 | 21.76 | 1.20 | 5.28 | 3.61 | 0.32 |
| Minimum | 0.94 | 0.45 | 0.62 | 5.98 | 0.33 | 1.66 | 2.70 | 0.18 |
| Maximum | 1.26 | 4.15 | 1.09 | 54.10 | 2.98 | 13.80 | 6.00 | 0.52 |

Notes:
1. Data format: Result ± 2 σ ( MDA value). '<' indicates result less than MDA.
2. All units are pCi/g.
3. Ra-226 and Th-232 background subtracted prior to calculating SOF value. Negative SOF components set to zero in SOF calculation.
4. Average SOF for data set calculated using average radionuclide concentrations.

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Table 5-2, Reuse Stockpile 5 QC Sample Data

| Sample | Ra-226 DCGL = 1.9 pCi/g Background = 0.9 pCi/g | Tc-99 DCGL = 25.1 pCi/g | Th-232 DCGL = 2.0 pCi/g Background = 1.0 pCi/g | U-234 DCGL = 195.4 pCi/g | U-235 DCGL = 51.6 pCi/g | U-238 DCGL = 168.8 pCi/g | Sample SOF (Uniform DCGL) |
|---|---|---|---|---|---|---|---|
| R010101PSS00 | 1.03 ± 0.15 (0.07) | 0.45 ± 0.18 (0.23) | 1.09 ± 0.18 (0.12) | 8.00 (Inf. U235/U238) | 0.44 ± 0.17 (0.20) | 1.66 ± 0.68 (0.89) | 0.19 |
| R010101PSQ00 | 1.26 ± 0.20 (0.09) | 0.58 ± 0.14 (0.22) | 1.07 ± 0.22 (0.11) | 5.83 (Inf. U235/U238) | 0.32 ± 0.20 (0.23) | 2.13 ± 0.98 (1.14) | 0.30 |

Table 5-3, Reuse Stockpile 5 Box Counter Results

| Sample | Ra-226 DCGL=1.9 pCi/g Background=0.9 pCi/g | Th-232 DCGL=2.0 pCi/g Background=1.0 pCi/g | U-234 DCGL=195.4 pCi/g | U-235 DCGL=51.6 pCi/g | U-238 DCGL=168.8 pCi/g | Sample SOF (Uniform DCGL) |
|---|---|---|---|---|---|---|
| 0000-TR-130204-02-01 | 0.72 ± 0.10 ( 0.19 ) | ND ( 0.41 ) | 47.73 (Inf. U235/U238) | 2.63 ± 0.35 ( 0.41 ) | 11.81 ± 4.84 ( 6.11 ) | 0.37 |
| 0000-TR-130204-02-02 | 0.78 ± 0.11 ( 0.17 ) | ND ( 0.40 ) | 27.49 (Inf. U235/U238) | 0.85 ± 0.25 ( 0.38 ) | ND ( 8.75 ) | 0.16 |
| 0000-TR-130204-02-03 | 0.86 ± 0.11 ( 0.18 ) | ND ( 0.39 ) | 24.25 (Inf. U235/U238) | 0.75 ± 0.27 ( 0.41 ) | ND ( 8.75 ) | 0.14 |
| 0000-TR-130204-02-04 | 0.79 ± 0.10 ( 0.20 ) | ND ( 0.41 ) | 36.60 (Inf. U235/U238) | 1.13 ± 0.27 ( 0.39 ) | ND ( 9.72 ) | 0.21 |
| 0000-TR-130204-02-05 | 0.73 ± 0.10 ( 0.12 ) | ND ( 0.40 ) | 33.35 (Inf. U235/U238) | 1.83 ± 0.32 ( 0.42 ) | 9.18 ± 4.65 ( 6.55 ) | 0.26 |
| 0000-TR-130204-02-06 | 0.66 ± 0.09 ( 0.17 ) | ND ( 0.39 ) | 63.56 (Inf. U235/U238) | 1.96 ± 0.33 ( 0.42 ) | ND ( 10.26 ) | 0.36 |
| 0000-TR-130204-03-01 | 0.69 ± 0.11 ( 0.19 ) | ND ( 0.35 ) | 35.90 (Inf. U235/U238) | 1.10 ± 0.25 ( 0.35 ) | ND ( 7.87 ) | 0.21 |
| 0000-TR-130204-03-02 | 0.62 ± 0.09 ( 0.15 ) | ND ( 0.36 ) | 12.40 (Inf. U235/U238) | 0.38 ± 0.23 ( 0.38 ) | ND ( 8.10 ) | 0.07 |
| 0000-TR-130204-03-03 | 0.57 ± 0.09 ( 0.15 ) | 0.59 ± 0.13 ( 0.19 ) | 34.62 (Inf. U235/U238) | 1.07 ± 0.25 ( 0.35 ) | ND ( 8.40 ) | 0.20 |
| 0000-TR-130204-03-04 | 0.69 ± 0.11 ( 0.19 ) | 0.78 ± 0.16 ( 0.24 ) | 70.77 (Inf. U235/U238) | 2.18 ± 0.35 ( 0.43 ) | ND ( 9.31 ) | 0.40 |
| 0000-TR-130204-03-05 | 0.70 ± 0.09 ( 0.17 ) | 0.50 ± 0.13 ( 0.20 ) | 39.79 (Inf. U235/U238) | 2.20 ± 0.35 ( 0.41 ) | 7.24 ± 4.05 ( 5.90 ) | 0.29 |

Notes: 1. Data format: Result ± 2 □ MDA value).

2. All units are pCi/g.

3. ND = non-detect.

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## 6.0 Quality Control

### 6.1 Laboratory QC Measurements

Duplicate samples were collected at a 5% frequency in accordance with HDP-PR-FSS-703 (*Final Status Survey Quality Control)*. Duplicate samples were evaluated per subsection 7.4.1.1 of MARLAP (*Multi-Agency Radiological Laboratory Analytical Protocols*) using the following equations:

If $\bar{x} <$ DCGL:

Statistic: $|x_1 - x_2|$

Warning limit: 0.1415(DCGL)
Control limit: 0.2120(DCGL)

If $\bar{x} \geq$ DCGL:

Statistic: $RPD(\%) = \frac{|x_1 - x_2|}{\bar{x}}(100\%)$

Warning limit: 14.15%
Control limit: 21.20%

where:
$x_1$ = activity of sample
$x_2$ = activity of field duplicate sample
$\bar{x}$ = average activity
RPD=Relative Percent Difference

There was one duplicate sample taken during the collection of the 14 systematic samples from Stockpile 5. The results were documented on form HDP-PR-FSS-703-1. Form HDP-PR-FSS-703-1 indicates the duplicate sample collected shows results less than the calculated limits. Table 5.2 shows the field duplicate sample data and Table 6.1 summarizes the results from the analysis of the field duplicate sample.

Table 6-1, Summary of Laboratory QC Results

| Nuclide | Statistic | Warning Limit | Control Limit |
|---|---|---|---|
| Ra-226 | 0.23 | 0.27 | 0.40 |
| Th-232 | 0.02 | 0.28 | 0.42 |
| Tc-99 | 0.13 | 3.55 | 5.32 |
| U-235 | 0.12 | 7.30 | 10.94 |

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### 6.2 Selection of Personnel

The individual assigned to perform FSS on Stockpile 5 soil was a qualified senior health physics technician and was provided specific training on the sampling of FSS Reuse soil.

### 6.3 Instrumentation Operation and Daily QC

The instrument used was operated in accordance with procedure HDP-PR-HP-416 (*Operation of the Ludlum 2221 for Final Status Survey*). Prior to and after use, a daily source check was performed to verify instrument response was within ±20% of the calculated mean based on the initial set-up of the instrument per HDP-PR-HP-411 (*Radiological Instrumentation*). All QC check logs were reviewed for the appropriate dates and verified to have been both pre and post checked in accordance with the procedure with no discrepancies noted. The meter used was verified to be calibrated within the year.

### 6.4 Survey Records and Documentation

Sample results from Stockpile 5 are provided in Table 5.1. All sample results were independently reviewed, recorded and stored in accordance with procedure HDP-PR-FSS-721 (*Final Status Survey Data Evaluation*). All results from samples associated with Reuse Stockpile 5 were loaded into the Hematite FSS database and verified to be in units of pCi/g (picocuries per gram) consistent with the units used for the site DCGL values to which they were compared.

## 7.0 Data Quality Assessment (DQA)

1) Sample results were independently reviewed and validated in accordance with HDP-PR-FSS-721 (*Final Status Survey Data Evaluation*), and are provided in Table 5-1.
2) All samples sent for analysis at the approved offsite laboratory (Test America) were tracked on a chain of custody form in accordance with HDP-PR-QA-006 (*Chain of Custody*).
3) Samples were collected on a systematic grid and gamma scan surveys were performed in accordance with procedure HDP-PR-FSS-711 (*Final Status Surveys and Sampling of Soil and Sediment*).
4) Duplicate samples were collected in accordance with HDP-PR-FSS-703 (*Final Status Survey Quality Control*). QC Sample Results were verified to meet the acceptance criteria as specified in HDP-PR-FSS-703 (*Final Status Survey Quality Control*).
5) Field and laboratory instruments were capable of detecting activity at a minimal detection concentration (MDC) less than the appropriate investigation level, and were verified to be operable prior to and after use in accordance with HDP-PR-HP-416 (*Operation of the Ludlum 2221 for Final Status Survey*).

## 8.0 Conclusions

The calculated average SOF value of Reuse Stockpile 5 when compared to the Uniform Stratum is 0.32. Therefore, the soil comprising Reuse Soil Stockpile 5 is suitable for Reuse as backfill within any stratum.

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# APPENDIX A
## Gamma Walkover Survey of Reuse Stockpile 05

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| Hematite Decommissioning Project | Procedure HDP-PR-HP-311, *Radiological Surveys* | Revision 0 |
|---|---|---|
| | Westinghouse Proprietary Class 2: This document is the property of and contains Proprietary Information owned by Westinghouse Electric Company LLC and/or its subcontractors and suppliers. It is transmitted to you in confidence and trust, and you agree to treat this document in strict accordance with the terms and conditions of the agreement under which it was provided to you. | |

**FORM HDP-PR-HP-311-3**
**RADIOLOGICAL SURVEY REPORT - WALKOVER SURVEYS**

| | | | |
|---|---|---|---|
| SURVEY LOCATION: | Stockpile 5 | | |
| DATE: 3/7/2013 | TIME: 13:30 | RWP: RP-13-G009 | LOG NUMBER: 0921 C 130307 |
| PURPOSE OF SURVEY: | FSS Walkover of soil for potential re-use | | |

| Instrument Types(s) | Serial Number (meter/detector) | Cal Due Date: (meter-detector) | Field Background (CPM α/βγ) | Efficiency (%) (α/βγ) |
|---|---|---|---|---|
| Lud 2221 44-10 X | 290829 / PR 320673 | 11/8/2013 | 7000 | N/A |
| N/A | N/A | N/A | N/A | N/A |
| N/A | N/A | N/A | N/A | N/A |
| N/A | N/A | N/A | N/A | N/A |

REMARKS: 8000 gross cpm = 1000 net cpm walkover RESULTS.


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TECHNICIAN(S): Josh Bushman / Josh Bushman / 3.7.13
Print Name/Sign/Date

N/A
Print Name/Sign/Date

REVIEWER: Aland D. Smith / Aland Smith 3/7/2013
Print Name/Sign/Date

Quality Record

# APPENDIX B
## Final Status Survey Sampling Plan for Stockpile 5

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**HDP-PR-FSS-701, Final Status Survey Plan Development**
**APPENDIX P-7**
**FINAL STATUS SURVEY SAMPLING PLAN FOR RE-USE SOIL UTILIZING APPROACHES 2 AND 3**

**Description:** Potential Re-Use Material – Stockpile 05

**Part I: Number of Samples**

**1. Define Approach Used:**

☐ Approach 2, Survey and Sampling of Soil In-situ

☒ Approach 3, Survey and Sampling of Soil after Excavation

**2. Verify Isolation & Control**

a. Is the area with potential reuse material properly isolated and/or controlled (e.g. indicated by outlining the area with green rope and posting the appropriate signage) as required by HDP-PR-HP-602, *Data Package Development and Isolation and Control Measures to Support Final Status Survey*? Yes☒ No☐
(If "No", discontinue survey design until area turnover requirements have been met.)

**3. Define the Area:**

Survey Unit Area ($m^2$): 497

**4. Define the Type of FSS Samples and Measurements:**

Soil Samples:

Approach 2:
- Collect systematic and biased samples from 0-30 cm below ground surface.

Approach 3:
- Collect systematic and biased samples from 0-30 cm below ground surface

Scan Measurements:

Approach 2:
- In situ (100% accessible surface), prior to excavation.

Approach 3:
- 100% scan of the surface of the spread soil pile

**5. Determine the Number of Samples:**

The number of samples that will be taken for a given area of potential re-use material is 14. The number of samples is based on statistical analysis of a sample population pulled from all potential re-use material samples taken in 2012 (a total of 823 samples in all.) The sample population used consists of 7 samples with the greatest calculated SOF value and the 7 samples with the smallest calculated SOF value. The analysis resulted in a SOF standard deviation ($\sigma_{SOF}$) of 0.45 and a mean SOF ($SOF_{Mean}$) of 0.33. This equates to a Relative Shift of 1.5. Using Table 5.3 found in MARSSIM (Reference 5.3) and a Type I error of 0.05 and a Type II error of 0.1, the number of samples necessary to take is 14

**No. of Samples (N/2) = 14**

**6. Calculate the Grid Spacing**

a. Calculate Grid Spacing (L).

☒ Triangular Grid $L = \sqrt{\frac{Area}{.866(N/2)}}$ ☐ Square Grid $L = \sqrt{\frac{Area}{(N/2)}}$

Grid Spacing (L) for Survey Unit (m) = 6.4

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# APPENDIX B
## Final Status Survey Sampling Plan for Stockpile 5



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**7. Generate a Survey Map**

a. Assign a unique identification number to each sample in the Statistical Sample Population.
b. Generate a graphic representation of the area with dimensions and boundaries corresponding to the established reference coordinate system in accordance with step 8.7.7 of HDP-PR-FSS-701.
c. Using the reference coordinate system, ascertain coordinates for each sample location.
d. Designate sample locations, and location coordinates on Appendix P-4, *FSS Sample & Measurement Locations & Coordinates* and attach a copy of that form to this FSSP.

**8. QC & Biased Samples**

a. Randomly choose 5% of the Statistical Sample Population as QC Samples in accordance with HDP-PR-FSS-703, *Final Status Survey Quality Control* (Reference 5.9).
b. Designate QC sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates*.
c. Designate if any biased samples will be taken at the discretion of the survey designer and the basis for taking them. Necessary biased samples will be explained on Appendix P-3, *FSS Sample Instructions.*
d. Using the reference coordinate system, determine coordinates for each biased sample location.
e. Designate biased sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates*.

**9. Survey Instructions and Sample Measurement Locations and Coordinates FSSP Approval**

Attach a copy of completed forms as appropriate:

☒ Appendix P-3, *FSS Survey Sample Instructions,*
☒ Appendix P-4, *FSS Sample Measurement Locations & Coordinates*
☒ Appendix P-6, *FSS Field Log*
☒ Survey Figure
☐ Other:



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**Part II: Retrospective Sample Analysis**

**1. Evaluate Data from Samples Collected During FSS.**

a. Number of Samples: 14

b. Record analytical results and summary statistics for each sample

| | U-234 (ρCi/g) | U-235 (ρCi/g) | U-238 (ρCi/g) | Tc-99 (ρCi/g) | Th-232 (ρCi/g) | Ra-226 (ρCi/g) |
|---|---|---|---|---|---|---|
| Minimum | 5.98E+00 | 3.28E-01 | 1.66E+00 | 4.49E-01 | -3.78E-01 | 3.60E-02 |
| Maximum | 5.41E+01 | 2.98E+00 | 1.38E+01 | 4.15E+00 | 9.00E-02 | 2.00E-01 |
| Mean | 2.18E+01 | 1.20E+00 | 5.28E+00 | 2.17E+00 | 0.00E+00 | 1.35E-01 |
| Median | 1.84E+01 | 1.02E+00 | 3.92E+00 | 2.11E+00 | -7.40E-02 | 1.35E-01 |
| Standard Deviation | 1.40E+01 | 7.70E-01 | 3.63E+00 | 1.29E+00 | 1.12E-01 | 4.93E-02 |

Note: NR = not reported

**2. Define Derived Concentration Guideline Levels (DCGL)**

- The Uniform DCGL values will be used as the initial comparator for all potential Re-Use Soil. The RSO may approve use of DCGLs from the Surface, Root or Deep strata or Excavation scenario.

| | Uniform (pCi/g) |
|---|---|
| U-234 | 195.4 |
| U-235 | 51.6 |
| U-238 | 168.8 |
| Tc-99 | 25.1 |
| Th-232 + C | 2.0 |
| Ra-226 + C | 1.9 |

**3. Calculate the Number of Samples in the Statistical Survey Population**

NOTE: The Statistical Survey Population is routinely derived based on the Uniform DCGL.

- The values used in the following equations ($SOF_{mean}$ and $\sigma_{SOF}$) can be found in the tables from Section 1b and Section 2.

a. Calculate a mean SOF for the survey data set.

$$SOF_{Mean} = \frac{Conc_{U-234}}{DCGL_{U-234}} + \frac{Conc_{U-235}}{DCGL_{U-235}} + \frac{Conc_{U-238}}{DCGL_{U-238}} + \frac{Conc_{Tc-99}}{DCGL_{Tc-99}} + \frac{Conc_{Th-232}}{DCGL_{Th-232}} + \frac{Conc_{Ra-226}}{DCGL_{Ra-226}}$$

Lower Bound of the Grey Region (LBGR) = $SOF_{Mean}$ = 0.32

b. Calculate the mean and standard deviation in the SOF for the survey data set.

NOTE: For the calculation of $SOF_{Mean}$ and $\sigma_{SOF}$, include the concentration for Tc-99 if it was measured. If Tc-99 was not measured, include the modified U-235 DCGL and omit Tc-99 concentration term.



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$$\sigma_{SOF} = \sqrt{\left(\frac{\sigma_{U-234}}{DCGL_{U-234}}\right)^2 + \left(\frac{\sigma_{U-235}}{DCGL_{U-235}}\right)^2 + \left(\frac{\sigma_{U-238}}{DCGL_{U-238}}\right)^2 + \left(\frac{\sigma_{Tc-99}}{DCGL_{Tc-99}}\right)^2 + \left(\frac{\sigma_{Th-232}}{DCGL_{Th-232}}\right)^2 + \left(\frac{\sigma_{Ra-226}}{DCGL_{Ra-226}}\right)^2}$$

✓ *Used in worksheet survey design*

| | | |
|---|---|---|
| Survey Unit $\sigma_{SOF}$ = | 0.11 | ☐ |
| Background $\sigma_{SOF}$= | 0.16 | ☒ |

c. Define the Decision Errors.
Type I Error = 0.05 Type II Error = 0.10
NOTE: The Type II Error is set at 0.10 initially but it may be adjusted with RSO concurrence.

d. Calculate the Relative Shift.

$$Relative Shift = \frac{1 - LBGR}{\sigma_{SOF}}$$

Relative Shift = 4.25

e. Determine the Number of Samples (N/2 for the WRS test) required corresponding to the Type I error, Type II Error and the Relative Shift.
- The WRS Test has been chosen as the statistical test, use Appendix F of HDP-PR-FSS-701 to determine N/2.

No. of Samples (N/2) = 7

**4. Calculate the Scan MDC for Total Uranium**
- When U-235 is reported as negative or zero and U-238 is reported as positive, set the sample enrichment to 0.71% (natural uranium).
- When U-235 is reported as positive and U-238 is reported as negative or zero, set the sample enrichment to 100% (highly enriched).Note: When both U-235 and U-238 data are reported as positive, calculate the U-238/U-235 ratio for each sample and use Appendix G of HDP-PR-FSS-701, to determine the uranium enrichment that corresponds to the mean U-238:U-235 ratio.

*NOTE: The modified U-235 DCGL value is used to calculate the DCGLw for Total Uranium*
a. Calculate and record the average Uranium enrichment for the survey unit using the enrichment calculated for each individual sample.

Average Enrichment (%): 3.16

NOTE: The Activity Fractions ( $f$ ) for each radionuclide that corresponds to the mean enrichment in the following calculations is obtained from Appendix G of HDP-PR-FSS-701.

**b.** Calculate a $DCGL_w$ for Total Uranium

$$DCGL_{wTotU} = \frac{1}{\frac{f_{U-234}}{DCGL_{U-234}} + \frac{f_{U-235}}{DCGL_{U-235}} + \frac{f_{U-238}}{DCGL_{U-238}}}$$



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$DCGL_{wTotU}$ for Total Uranium = 45.0 ρCi/g

c. Identify the Radiological Instrument that was used for scanning.

☒ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

d. Calculate the Scan MDC for the selected instrument

NOTE: 2x2 Sodium Iodide (with surveyor efficiency factor of 0.5 and a background count rate of 10,000 cpm). If the instrument is not a 2"x 2" NaI detector, or if the background count rate exceeds 10,000 cpm, the $MDC_{scan}$ can be determined in accordance with DP Ch. 14, section 14.4.4.2.9 (Reference 5.1) of HDP-PR-FSS-701.

$$ScanMDC = \frac{1}{\frac{f_{U-234}}{7383\,pCi/g} + \frac{f_{U-235}}{4.9\,pCi/g} + \frac{f_{U-238}}{62.8\,pCi/g}}$$

$MDC_{scan}$ for Total Uranium = 90.5 ρCi/g

**5. Calculate the Scan MDC for Th-232 and Ra-226**

a. Select the appropriate $DCGL_w$ for Th-232 and Ra-226.

Th-232 $DCGL_w$ = 2.0 ρCi/g Ra-226 $DCGL_w$ = 1.9 ρCi/g

b. Identify the Radiological Instrument that was used for scanning.

☒ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

c. Calculate the Scan MDC for the selected instrument

Note: Table 6.4 of NUREG-1507 (Reference 5.8) of HDP-PR-FSS-701 has calculated an $MDC_{scan}$ of 1.8 ρCi/g for Th-232 and 2.8 ρCi/g for Ra-226 when using a 2"x 2" NaI detector.

Note: If the selected instrument is not a 2"x 2" NaI detector, then the $MDC_{scan}$ can be determined in accordance with DP Ch. 14, section 14.4.4.2.9 (Reference 5.1) of HDP-PR-FSS-701.

$MDC_{scan}$ for Th-232 = 1.8 ρCi/g $MDC_{scan}$ for Ra-226 = 2.8 ρCi/g

NOTE: If a value is not applicable, mark as N/A.

**6. Adjust the Statistical Sample Population Size (N/2) for Scan MDC**

a. Divide the total area of the survey unit by the Number of Samples (N/2) in step 5 to calculate the area bounded by the statistical sample population.

Area Bounded by the Statistical Sample Population ($A_{su}$) = 71 $m^2$

**URANIUM**

b. Is the Scan MDC for the selected instrument less than the $DCGL_w$ that was calculated for Total Uranium? (compare values from step 4b and 4d) Yes☐ No☒
(If yes proceed to step 6j)

c. Using the Area Factors in Appendix H of HDP-PR-FSS-701, calculate a Total Uranium AF for each listed area using the Activity Fractions (*f*) for each radionuclide that corresponds to the mean enrichment from Appendix G of HDP-PR-FSS-701.



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$$AF_{TotU} = \frac{1}{DCGL_{w,TotU} \times \left( \frac{f_{U\text{-}234}}{AF_{U\text{-}234} \times DCGL_{w,U\text{-}234}} + \frac{f_{U\text{-}235}}{AF_{U\text{-}235} \times DCGL_{w,U\text{-}235}} + \frac{f_{U\text{-}238}}{AF_{U\text{-}238} \times DCGL_{w,U\text{-}238}} \right)}$$

| Area ($m^2$) | 153,375 | 10,000 | 3,000 | 1,000 | 300 | 100 | 30 | 10 | 3 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| $AF_{TotalU}$ | 1.00 | 1.13 | 1.15 | 1.15 | 2.21 | 3.11 | 4.25 | 3.16 | 12.50 | 26.53 |

NOTE: The AFs for the Uniform strata will generally be used. The RSO may approve use of AFs from the Surface, Root or Deep CSMs, or the Excavation Scenario.

d. Find the Area Factor ($AF_{TotalU}$) calculated in the previous step that corresponds to the area bounded by the Statistical Sample Population ($A_{su}$ ).
$AF_{TotU}$ for the Bounded Area ($A_{su}$ ) = 3.3

e. Multiply the $DCGL_w$ calculated for Total Uranium by the Area Factor ($AF_{TotU}$) to derive a $DCGL_{EMC}$ for Total Uranium.
$DCGL_{EMC}$ for Total Uranium = 148.5 pCi/g

f. Is the $MDC_{scan}$ for the selected instrument less than the $DCGL_{EMC}$ that was calculated for Total Uranium? NA☐ Yes☒ No☐

(If "Yes" then proceed to step 6j.)

g. Calculate a new AF ($AF_{EMC}$) corresponding to the $MDC_{scan}$ for the selected instrument by dividing the $MDC_{scan}$ by the DCGLw.
$AF_{EMC}$ for Utotal = N/A

h. Find the Area (A') that corresponds to the Area Factor ($AF_{EMC}$).
A' for Utotal = N/A

i. Calculate an Adjusted Number of Samples ($N_{EMC}$) for the Statistical Sample Population size that corresponds to the bounded $A_{EMC}$.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

$N_{EMC}$ corresponding to A' for Utotal = N/A

**THORIUM-232**

j. Is the $MDC_{Scan}$ for Th-232 less than the $DCGL_W$ ? Yes☒ No☐
(If "Yes" then proceed to step 6q)

k. Find the Area Factor (AF) in Appendix H that corresponds to the area bounded by the Statistical Sample Population ($A_{su}$).



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$AF_{Th-232}$ for the Bounded Area ($A_{su}$) = N/A

l. Multiply the $DCGL_W$ for Th-232 by the Area Factor (AF) to derive a $DCGL_{EMC}$ for Th-232
$DCGL_{EMC}$ for Th-232 = N/A ρCi/g

m. Is the $MDC_{scan}$ for Th-232 less than the $DCGL_{EMC}$ that was calculated for Th-232? NA☒ Yes☐ No☐

(If "Yes" then proceed to step 6q)

n. Calculate a new AF ($AF_{EMC}$) corresponding to the $MDC_{scan}$ for the selected instrument by dividing the $MDC_{scan}$ by the $DCGL_W$.
$AF_{EMC}$ for Th-232 = N/A

o. Find the Area (A') that corresponds to the Area Factor ($AF_{EMC}$).
A' for Th-232 = N/A

NOTE: The Area Factors for Th-232 can be found in Appendix H of HDP-PR-FSS-701.

p. Calculate an Adjusted Number of Samples ($N_{EMC}$) for the Statistical Sample Population size that corresponds to the bounded $A_{EMC}$.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

$N_{EMC}$ corresponding to A' for Th-232 = N/A

**RADIUM-226**

q. Is the $MDC_{Scan}$ for Ra-226 less than the $DCGL_W$ ? Yes☐ No☒
(If "Yes" then proceed to Part III)

r. Find the Area Factor (AF) in Appendix H that corresponds to the area bounded by the Statistical Sample Population ($A_{su}$).
$AF_{Ra-226}$ for the Bounded Area ($A_{su}$) = 4.8

s. Multiply the $DCGL_W$ for Ra-226 by the Area Factor (AF) to derive a $DCGL_{EMC}$ for Ra-226
$DCGL_{EMC}$ for Ra-226 = 9.12

t. Is the $MDC_{scan}$ for Ra-226 less than the $DCGL_{EMC}$ that was calculated for Ra-226? NA☐ Yes☒ No☐

(If "Yes" then proceed to Part III)

u. Calculate a new AF ($AF_{EMC}$) corresponding to the $MDC_{scan}$ for the selected instrument by dividing the $MDC_{scan}$ by the $DCGL_W$
$AF_{EMC}$ for Ra-226 = N/A

v. Find the Area (A') that corresponds to the Area Factor ($AF_{EMC}$).
A' for Ra-226 = N/A

w. Calculate an Adjusted Number of Samples ($N_{EMC}$) for the Statistical Sample Population size that corresponds to the bounded $A_{EMC}$.



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$$N_{EMC} = \frac{A_{SU}}{A'}$$

$N_{EMC}$ corresponding to A' for Ra-226 = N/A

**Part III: Approval**
**1. FSSP Approval**

| | (Print Name) | (Signature) | (Date) |
|---|---|---|---|
| Prepared by : | Michelle Bresnahan | | 4/23/13 |
| Peer Reviewed by : | Mark Nevcau | | 04-25-2013 |
| Approved by (RSO): | Joseph Guido | | 5/1/2013 |



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