Attachment 2

Final Status Survey Final Report Volume 4, Chapter 13

Survey Area Release Record for Building Survey Area 04, Survey Unit 09

with CD containing Appendices

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

Westinghouse

Final Status Survey Report

Hematite Decommissioning Project

Final Status Survey Final Report Volume 4, Chapter 13

TITLE: **Survey Area Release Record for Building Survey Area 04, Survey Unit 09 (BSA 04-09)**

REVISION: **0**

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Approvals:

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LIST OF ACRONYMS AND SYMBOLS

ALARA	As Low As Reasonably Achievable
bgs	below ground surface
CFR	Code of Federal Regulations
cm	centimeter(s)
cpm	count(s) per minute
CSM	Conceptual Site Model
DCGL	Derived Concentration Guideline Level
$DCGL_{SO}$	Derived Concentration Guideline Level for Small Office
$DCGL_W$	DCGL for average concentrations over a survey unit, used with statistical tests. ("W" suffix denotes "Wilcoxon")
DP	Hematite Decommissioning Plan
dpm	disintegrations per minute
ft	foot (feet)
FSS	Final Status Survey
FSSFR	Final Status Survey Final Report
HDP	Hematite Decommissioning Project
I & C	Isolation and Control
IAL	Investigation Action Level
LSA	Land Survey Area
m	meter(s)
m^2	square meter(s)
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
mrem	milliroentgen equivalent man
NAD	North American Datum
NRC	U.S. Nuclear Regulatory Commission
QC	Quality Control
Ra	Radium
RASS	Remedial Action Support Survey
SOF	Sum of Fractions
SSC	Systems, Structures and Components
SU	Survey Unit
Tc	Technetium
Th	Thorium
U	Uranium

EXECUTIVE SUMMARY

This Survey Area Release Record (SARR) presents the results of the final status radiological surveys of the Hematite Decommissioning Project (HDP) Building Survey Area (BSA) 04, Survey Unit (SU) 09 (BSA 04-09). As provided in Final Status Survey Final Report (FSSFR), Volume 1, Chapter 1, Section 7.0 {ML15257A307}, the final report summary, FSSFR Volume 7, *Final Status Survey Final Report*, will be submitted at the conclusion of the post-remediation groundwater monitoring period. FSSFR Volume 7 will be submitted to demonstrate that the site has met the requirements for unrestricted release consistent with the requirements of the Title 10 Code of Federal Regulations (CFR) 20 Subpart E, "Criteria for License Termination."

As provided in FSSFR Volume 4, Chapter 1, *Building Survey Areas (BSA) Overview*, "*There will be a number of ancillary structures that will remain at the time of license termination. These structures are primarily concrete and/or asphalt and provide an existing function. Examples are the Site Pond Dam, the Rail Scale foundation, parking lots and walkways.*" FSS of ancillary structures is conducted in accordance with HDP-PO-FSS-700, *Final Status Survey Program.* The objective of the FSS for the SU was to obtain and document measurement results, analytical data, and other supporting information in order to demonstrate that the residual radioactivity levels in BSA 04-09 meets the criteria for unrestricted release.

This SARR was prepared as described in FSSFR Volume 4, Chapter 1, Section 8.0, *Survey Area Release Record Organization*, as implemented by FSS procedure HDP-PR-FSS-722.

1.0 REPORT BACKGROUND

As a result of the U. S. Nuclear Regulatory Commission (NRC) feedback regarding the submittal of the FSSFR, Westinghouse and the NRC agreed that Westinghouse would develop an outline presenting the format and content of FSS documents required for NRC review. Westinghouse provided the outline to the NRC for discussion during the August 19, 2015, publicly noticed teleconference and the format was agreed upon {ML15238B032}.

FSSFR Volume 4, Chapter 1, Revision 1, *Building Survey Areas (BSA) Overview* provides the information common to building survey areas. This report, FSSFR Volume 4, Chapter 13, builds upon the general information provided in FSSFR Volume 4, Chapter 1, Revision 1.

2.0 HDP SITE, BSA AND SURVEY UNIT DESCRIPTION

2.1 HDP Site Description

A general description of the HDP site is given in FSSFR Volume 1, Chapter 1.

2.2 BSA Configuration

During the development of the DP the site staff recognized that the demonstration of compliance necessary to release the site for unrestricted release would include the FSS of several structures that would potentially remain on the site after remediation was complete. Therefore discussion related to FSS was included in DP Chapter 14.

As some of the structures that remain onsite were not specifically discussed in the DP a new Survey Area Code designated BSA 04 was established to incorporate these ancillary remaining structures within the FSS program. As such there is not a specific BSA configuration for ancillary remaining structures. Rather each BSA 04 structure is described in the section that contains the SU description and configuration.

For this Survey Area Release Record the BSA SU being addressed is the asphalt/concrete which is located within LSA 04-01.

2.3 BSA 04-09 Survey Unit Description and Configuration

The BSA 04-09 SU consists of the asphalt/concrete in LSA 04-01. SU BSA 04-09 is located adjacent to the northeast wall of Building 230 within LSA SU 04-01 which is a Class 3 SU and as such BSA 04-09 has been designated a Class 3 SU. The total surface area of BSA 04-09 is 749 m^2.

Figure 2-1 below shows the configuration of BSA 04-09 within LSA 04-01.

Figure 2-1
Location of BSA 04-09 within LSA 04-01

3.0 HISTORY OF USE OF BSA 04-09 ASPHALT/CONRETE IN LSA 04-01

BSA 04-09 resides within the former area of the site security system designated as the "Sally Port." The Sally Port served as a controlled access point for vehicles to enter the site's Controlled Access Area during the time a physical security plan was required. The asphalt/concrete served as a stable surface for vehicular traffic.

During site remediation operations after termination of the site's physical security plan the area was utilized for general storage of equipment and materials.

3.1 Radioactive Materials BSA 04-09

As a Class 3 SU there was no expectation of identification of radioactive materials in BSA 04-09. Radioactive materials within LSA 04-09 that would be identified on the surface of BSA 04-09 would have been deposited by environmental effluent. The radioactive materials within BSA 04-09 consist of the radionuclides of concern as provided in the DP Section 14.1.1 and reiterated in FSSFR Volume 1, Chapter 1, Section 5.1.

3.2 Remediation and Remedial Action Support Surveys (RASS) Phase

The sections below provide a discussion of the remediation and the preparation of BSA 04-09 for FSS.

3.2.1 Remedial Actions BSA 04-09

BSA 04-09 contains asphalt/concrete and was located outside of any active remediation area. Therefore, no remedial actions were necessary to prepare BSA 04-09 for FSS.

3.2.2 Remedial Action Support Survey for BSA 04-09

RASS are conducted to determine when an area or SU had been adequately prepared for FSS, and provide updated estimates of the parameters to be used for planning the FSS. No remediation was necessary for BSA 04-09, and final RASS surveys indicated that the area was acceptable to undergo FSS.

3.3 Isolation and Control

Isolation and Control of BSA 04-09 was performed in conjunction with the Isolation and Control of the surrounding LSA 04-01. As the LSA 04-01 SU completely encompassed the BSA 04-09 SU, no additional isolation features were required specific to BSA 04-09.

4.0 BSA RELEASE CRITERIA

As the release criteria for all BSA SUs is common, FSSFR Volume 4, Chapter 1, Section 3.0, *Release Criteria*, provides a detailed discussion on the release criteria that is applicable to BSA 04-09. Table 4-1 provides the applicable DCGLs.

Table 4-1
Building and Structural Surfaces Gross Radioactivity $DCGL_w$ for Small Office

Radionuclide	$DCGL_w$ (dpm/100 cm^2)	Radioactivity Fractions Based on Characterization Data [a]
U-234	20,000	8.27E-01
U-235 + D	19,000	3.72E-02
U-238 + D	21,000	1.27E-01
Tc-99	13,000,000	2.83E-03
Th-232 + C	1,200	3.21E-03
Np-237 + D	2,700	5.57E-05
Pu-239/240	3,500	2.03E-06
Am-241	3,400	2.68E-03
Totals:		**1.0**
Gross Activity $DCGL_{SO}$ (dpm/100 cm^2) [b] :		**18,925**

[a] Values are taken from Table 4-1 of DP Chapter 4.
[b] Calculated using Equation 4-4 of MARSSIM and rounded down (truncated) to two significant figures.

5.0 FINAL STATUS SURVEY DESIGN BSA 04-09

This section of the report describes the method for determining the number of measurements required for the FSS of BSA 04-09 as well as summarizing the applicable requirements of the FSS Plan. These include the $DCGL_{SO,}$ scan survey coverage and Investigation Action level (IAL). The radiological instrumentation used in the FSS of BSA 04-09 and the detection sensitivities are also discussed.

5.1 FSS Plan Design Requirements

FSS Plan requirements for BSA 04-09 were driven by the type (Structure) and Class (Class 1) of the SU and developed in accordance with HDP procedure, HDP-PR-FSS-701, Revision 9, *Final Status Survey Plan Development*, October 2015.

5.1.1 $DCGL_{SO}$

During the FSS design process a review was performed of the RASS radiological survey data for BSA 04-09. The RASS radiological survey data provided an expectation that the structure would meet the release criteria of the $DCGL_{SO}$.

5.1.2 Scan Coverage

As a Class 3 structure SU, the scan survey requirement is a minimum of 1-10% of the exposed surfaces of the structure.

5.1.3 Instrumentation

The chosen instrumentation to perform the FSS was a Ludlum Model 43-89 detector, paired with a Ludlum Model 2360 data logging meter. Note that the FSS Plan prepared for BSA 04-09 referenced a Ludlum 43-93 detector instead of a Ludlum 43-89, however these two probes are considered equivalent. The MDC's provided below are those that were determined during the FSS Planning stage, and therefore reference the Ludlum 43-93 detector.

5.1.4 Scan Minimum Detectable Concentration (MDC)

Instrument detection sensitivities depend upon the measurement geometry, instrument efficiencies, count times and scan speeds. Both scan and static measurement sensitivities for the various detectors are determined using the guidance in Chapter 14 of the DP.

The calculations for detection sensitivity assume a nominal background rate of 200 cpm (based on observed operational instrument background) for the Ludlum Model 43-93 probe. The Scan MDC calculation for SSC SUs given in HDP-PR-FSS-701, *Final Status Survey Plan Development*, Step 8.3.5.b, was applied:

$$\text{Scan MDC} = \frac{1.38 \times \sqrt{\frac{bkgd}{60}} \times \frac{60}{1}}{0.707 \times \text{eff}_{total} \times \left(\frac{\text{Probe Area}}{100}\right)}$$

Equation 5-1

This equation assumes the following parameters:

- An index of sensitivity (1.38) corresponding to the Type I and Type II error rates of 0.05 and 0.10, respectively.
- A background count performed for 60 seconds
- A surveyor efficiency of 0.5.

In order to calculate the Scan MDC using the above equation, the total weighted efficiency (eff_{total}) must be calculated for each probe used during FSS. The method for calculating the weighted and total weighted efficiency from Appendix A of HDP-PR-HP-415 (Equation 1) is:

Weighted Instrument Efficiency = $\varepsilon_i * \varepsilon_s *$ *Yield* * *Activity Fraction*

Total Weighted Instrument Efficiency = $\sum$ Weighted Instrument Efficiency (for all nuclides of concern)

Notes:
ε_i = 2 pi (π) instrument efficiency for nuclide of concern
ε_s = surface efficiency for nuclide of concern
Yield = 100% for all nuclides of concern
Activity Fraction = value listed on Form HDP-PR-HP-415-2 for nuclide of concern

Equation 5-2

The Scan MDC calculation using the inputs of the instrumentation used for FSS are given below. The Static MDC for a detector having an area of 100 cm^2 (e.g., Ludlum Model 43-93), a nominal background rate of 200 cpm (based on observed operational instrument background), and a total weighted efficiency of 9.75% is calculated to be:

$$\text{Scan MDC} = \frac{1.38 \times \sqrt{\frac{200}{60}} \times \frac{60}{1}}{0.707 \times 0.0975 \times \left(\frac{100}{100}\right)} = 2{,}187 \text{ dpm}/100 \text{ cm}^2$$

Equation 5-3

The total weighted efficiency calculation worksheet for the Ludlum Model 43-93 is given in Table 5-1.

Table 5-1
Total Weighted Efficiency Calculation (Ludlum Model 43-93) for BSA 04-09

Ludlum 2360	Ludlum Model 43-93	Active Probe Area	α HDP Efficiency	α Cal. Efficiency	ß HDP Efficiency	ß Cal. Efficiency
287589	PR312650	100 cm2	27.37%	N/A	27.01%	N/A

TOTAL WEIGHTED INSTRUMENT EFFICIENCY CALCULATION

Radionuclide	Radiation	Maximum Energy (MeV)	Instrument Efficiency (ε_i)	Surface Efficiency (ε_s)	Yield 100%	Activity Fraction	Weighted Efficiency
Am-241	Alpha	5.6	0.2737	0.25	1.00	2.682E-03	1.84E-04
Np-237	Alpha	5.0	0.2737	0.25	1.00	5.573E-05	3.81E-06
Pu-239	Alpha	5.2	0.2737	0.25	1.00	2.027E-06	1.39E-07
Tc-99	Beta	0.294	0.2701	0.25	1.00	2.829E-03	1.91E-04
Th-232	Alpha	4.1	0.2737	0.25	1.00	3.214E-03	2.20E-04
Ra-228	Beta	0.046	0.2701	0.00	1.00	3.214E-03	0.00E+00
Ac-228	Beta	2.13	0.2701	0.50	1.00	3.214E-03	4.34E-04
Th-228	Alpha	5.5	0.2737	0.25	1.00	3.214E-03	2.20E-04
Ra-224	Alpha	5.8	0.2737	0.25	1.00	3.214E-03	2.20E-04
U-234	Alpha	4.9	0.2737	0.25	1.00	8.270E-01	5.66E-02
U-235	Alpha	4.7	0.2737	0.25	1.00	3.720E-02	2.55E-03
Th-231	Beta	0.390	0.2701	0.25	1.00	3.720E-02	2.51E-03
U-238	Alpha	4.3	0.2737	0.25	1.00	1.270E-01	8.69E-03
Th-234	Beta	0.270	0.2701	0.25	1.00	1.270E-01	8.58E-03
Pa-234m	Beta	2.20	0.2701	0.50	1.00	1.270E-01	1.72E-02
						Σ=	**9.75%**

Total Weighted Instrument Efficiency = Σ Weighted Instrument Efficiency for all Nuclides of Concern
Weighted Instrument Efficiency = ε_i * ε_s * Yield * Activity Fraction
ε_i = 2 Pi Instrument Efficiency for Nuclide of Concern
ε_s = Surface Efficiency for Nuclide of Concern

Lud 43-93

5.1.5 Static Minimum Detectable Concentration

The Static MDC for Piping and Structural Surfaces is (using Equation 14-29, Section 14.4.4.2.5 of Chapter 14 of the DP) is calculated as follows:

$$\textit{Static MDC (dpm / 100 cm}^2\textit{)} = \frac{3+3.29\sqrt{R_B t_s\left(1+\frac{t_s}{t_b}\right)}}{(\varepsilon_t)(t_s)\left(\frac{A}{100\ cm^2}\right)}$$

Equation 5-4

where:

R_B = Background count rate (cpm);
t_S = Sample or measurement count time (minutes);
t_b = Background count time (minutes);
ε_t = Total weighted efficiency (2π); and;
A = Probe area (cm^2).

The Static MDC calculation using inputs of the instrumentation used for FSS is given below. The Static MDC for a detector having an area of 100 cm^2 (e.g., Ludlum Model 43-93), a nominal background rate of 200 cpm (based on observed operational instrument background), and a total weighted efficiency of 9.75% is calculated to be:

$$\textit{Static MDC (dpm / 100 cm}^2\textit{)} = \frac{3+3.29\sqrt{200 \times 1\left(1+\frac{1}{1}\right)}}{(0.0975)(1)\left(\frac{100}{100}\right)} = 706 \text{ dpm/100 cm}^2$$

Equation 5-5

The average background count rate (in cpm) is subtracted from each gross TSC measurement prior to calculation of a dpm value, which is in turn compared to the IAL or $DCGL_{SO}$. The typical background values for the Ludlum Model 43-89 detectors for FSS in the SU were between 100 and 300 cpm for BSA 04-09. Negative values are treated as zero for calculating the DCGL Fraction.

Note that the instrument sensitives presented above are the prospective values used during the development of the FSS Plan. The actual instrument sensitivities will vary slightly based on the background and efficiency of the scanning instrumentation that was used to perform the FSS survey.

5.1.6 Investigation Action Level

The Investigation Action Level was established at 50% of the $DCGL_{SO}$ (9,463 dpm /100 cm^2).

5.1.7 BSA 04-09 FSS Design Summary

The complete FSS Plan for BSA 04-09 is provided in Appendix B. A summary table of the requirements in the FSS Plan for BSA 04-09 is presented in Table 5-2 below.

Table 5-2
FSS Design Summary for BSA 04-09

Portable Instrument Scanning:	
Scan Coverage	1% - 10% of BSA 04-09 total area (judgmental)
Scan MDC	1,148 dpm / 100 cm^2 (Ludlum 43-37) 2,187 dpm / 100 cm^2 (Ludlum 43-93)
Investigation Action Level (IAL): general area	9,463 dpm / 100 cm^2 (50% of the DCGL)
IAL: (cracks, holes, depressions)	2,187 dpm / 100 cm^2 (Ludlum 43-93)

Total Surface Contamination (TSC) Measurements:		
Surface	Minimum Number of Measurements	Comments
Paved Areas overlying LSA 04-01 (Asphalt Driveway)	11	A total of **11** TSC measurements locations have been randomly determined.
TSC Investigation Action Level	9,463 dpm / 100cm^2 (50% of the Adjusted Gross DCGL)	

Removable Activity Locations:
After each TSC measurement, at the same point as the TSC measurement, using moderate pressure swipe a cloth smear over the surface (e.g. exterior wall, roof, window, etc.) in an S-shaped pattern within an approximately 4" by 4" box.

Biased Measurement Locations:
Perform static biased measurements at points on the pavement such as cracks, holes, or depressions where the Scan MDC was exceeded. Consult FSS supervision for guidance on the amount and specific locations of biased measurements. At locations where biased measurements exceed the instrument static MDA, adjustments to instrument efficiency or volumetric sampling may be necessary – consult FSS supervision for guidance.

Instrumentation	
Ludlum 2360 with 43-37 floor monitor.	Used for general area scanning.
Ludlum 2360 with 43-93 scintillation detector.	Used for investigational scanning and to obtain static (TSC) measurements.
Ludlum 2929 with 43-10-1 scintillation detector.	Used for counting of swipe (smear) samples.

6.0 FINAL STATUS SURVEY IMPLEMENTATION BSA 04-09

FSS was performed in accordance with procedure HDP-PR-FSS-712, *Final Status Surveys of Structures, Systems, and Components*.

6.1 Scan Survey Performance

As a Class 3 SU the FSS plan required that 1-10% of the exposed structural surfaces be subject to scanning. Review of the FSS scans performed confirms that a minimum of 10% of the structural surfaces were scanned as prescribed by the FSS Plans (provided in Appendix C).

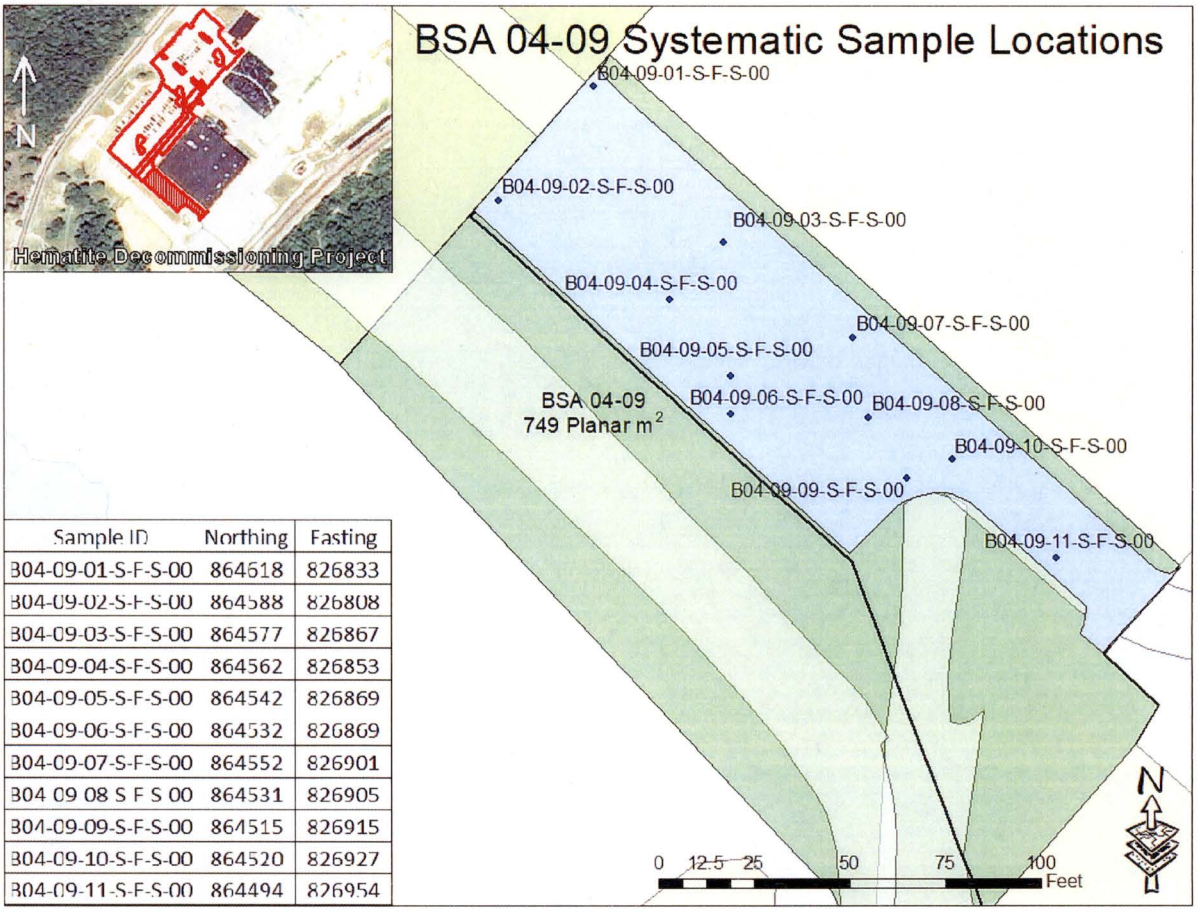
6.2 Systematic Measurements

Based on statistical evaluations of the RASS characterization data set used for FSS planning purposes, a minimum of eleven (11) TSC measurements were calculated for BSA 04-09. These direct, static-count measurement locations were designed in a randomly selected pattern (See Figure 6-1). Determination of the required number of TSC measurements for the SU was performed according to the requirements in Step 8.3.4 of HDP-PR-FSS-701 (and is documented in the FSS Plan in Step 7 of Appendix P-2).

Additionally, a removable smear contamination measurement was collected at each TSC location, after the initial TSC measurement was collected. The smear measurement provides the necessary information to determine how much of the TSC measurement is considered removable contamination.

Table 6-1 provides the listing of systematic measurement locations as specified in the FSS Plan (Appendix B).

Figure 6-1
BSA 04-09 Measurement Locations



Sample ID	Northing	Easting
B04-09-01-S-F-S-00	864618	826833
B04-09-02-S-F-S-00	864588	826808
B04-09-03-S-F-S-00	864577	826867
B04-09-04-S-F-S-00	864562	826853
B04-09-05-S-F-S-00	864542	826869
B04-09-06-S-F-S-00	864532	826869
B04-09-07-S-F-S-00	864552	826901
B04-09-08-S-F-S-00	864531	826905
B04-09-09-S-F-S-00	864515	826915
B04-09-10-S-F-S-00	864520	826927
B04-09-11-S-F-S-00	864494	826954

No systematic location exceeded the $DCGL_{SO}$. The highest observed systematic TSC measurement was 824 dpm/100 cm^2 (4% of the DCGLso). No removable contamination measurement exceeded the Minimum Detectable Activity (MDA). The FSS documentation for BSA 04-09 is provided in Appendix C.

Table 6-1
FSS Measurement Locations for BSA 04-09

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development		
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APPENDIX P-4

FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area: BSA 04 **Description:** Structure Survey Unit in LSA 04-01

Survey Unit: 09 **Description:** Asphalt Pavement

Survey Type: FSS **Classification:** Class 3

Measurement or Sample ID	Surface or CSM	Type	Start Elevation	End Elevation	Northing (feet) (Y Axis) *	Easting (feet) (X Axis) *	Remarks / Notes
B04-09-01-S-F-S-00	F	S	NA	NA	864618	826833	Asphalt
B04-09-02-S-F-S-00	F	S	NA	NA	864588	826808	Asphalt
B04-09-03-S-F-S-00	F	S	NA	NA	864577	826867	Asphalt
B04-09-04-S-F-S-00	F	S	NA	NA	864562	826853	Asphalt
B04-09-05-S-F-S-00	F	S	NA	NA	864542	826869	Asphalt
B04-09-06-S-F-S-00	F	S	NA	NA	864532	826869	Asphalt
B04-09-07-S-F-S-00	F	S	NA	NA	864552	826901	Asphalt
B04-09-08-S-F-S-00	F	S	NA	NA	864531	826905	Asphalt
B04-09-09-S-F-S-00	F	S	NA	NA	864515	826915	Asphalt
B04-09-10-S-F-S-00	F	S	NA	NA	864520	826927	Asphalt
B04-09-11-S-F-S-00	F	S	NA	NA	864494	826954	Asphalt

*X and Y coordinates are provided using Missouri - East State Plane Coordinates [North American Datum (NAD) 1983] (Open Land Area)

Surface: Floor = F; Wall = W; Ceiling = C; Roof = R

CSM: Three-Layer (Surface-Root-Deep) or Uniform

Type: Systematic = S, Biased = B; QC =Q; Investigation = I

Quality Record

6.3 Biased Measurement

No biased measurements were necessary in BSA 04-09 as no areas were identified to exceed the Scan IAL.

6.4 Quality Control Measurements

For the purpose of FSS ancillary structure SUs are treated as "normal" structure SUs, and as such the Quality Control (QC) requirement found in HDP-PR-FSS-703, *Final Status Survey Quality Control* states that at least 5% of the total number of structural SUs undergoes a complete replicate survey by a different Health Physics Technician from that which was used in the original FSS of the selected structural SU. As there are 17 ancillary SUs in total identified for FSS, one QC replicate survey will be performed (5.8%). BSA 04-14 was randomly selected as the BSA to undergo a QC replicate survey, and as such, no QC measurements were necessary for BSA 04-09.

7.0 FINAL STATUS SURVEY RESULTS BSA 04-09

During the performance of FSS in BSA 04-09, no scan measurement exceeded the Scan MDC of 2,458 dpm /100 cm^2. No static measurement exceeded the IAL of 9,463 dpm / 100 cm^2 (50% of the $DCGL_{SO}$). No removable contamination measurement exceeded MDA, therefore no removable measurement exceeded 10% of the $DCGL_{SO}$. The highest observed TSC measurement was 824 dpm /100 cm^2 (4% of the $DCGL_{SO}$), and the average residual radioactivity based on all systematically collected measurements is 508 dpm/100 cm^2 (3% of the $DCGL_{SO}$).

The analytical data sheets used to evaluate the BSA 04-09 FSS data are provided in Appendix A. A summary table of the FSS results is presented below in Table 7-1.

Table 7-1
FSS Data Summary for BSA 04-09

MEASUREMENT ID	MEASUREMENT LOCATION	DATE MEAS	MEASUREMENT	GROSS cpm (α+β)	BKG cpm (a+b)	Net cpm (α + β)	Combined Net dpm/100 cm² (α+β)	Corrected Net dpm/100cm²	Fraction of DCGL
B04-09-01-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	205	137	67.667	778	778	4%
B04-09-02-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	179	137	41.667	479	479	3%
B04-09-03-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	177	137	39.667	456	456	2%
B04-09-04-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	209	137	71.667	824	824	4%
B04-09-05-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	177	137	39.667	456	456	2%
B04-09-06-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	191	137	53.667	617	617	3%
B04-09-07-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	168	137	30.667	352	352	2%
B04-09-08-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	173	137	35.667	410	410	2%
B04-09-09-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	180	137	42.667	490	490	3%
B04-09-10-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	163	137	25.667	295	295	2%
B04-09-11-S-F-S-00	Asphalt	2/26/2016	alpha + beta TSC	175	137	37.667	433	433	2%

*NOTE: Differences from documented survey results are due to rounding in Excel

Min	295	**3%**
Max	824	
Mean	508	**DCGLso**
Median	456	**0.75**
Stdev	166.0	**mrem**

8.0 ALARA EVALUATION BSA 04-09

All measurements collected within BSA 04-09 were evaluated against the $DCGL_{SO}$. For BSA 04-09 no measurement result exceeded the $DCGL_{SO}$. The average result, based on all systematically collected measurements was 3% of $DCGL_{SO}$ for BSA 04-09. The average of all measurements equates to residual activity contribution from the SU area of 0.75 mrem/year for BSA 04-09. As the estimated Total Effective Dose Equivalent for LSA 04-01 including the dose contribution of BSA 04-09 is below the regulatory release criterion of 25 mrem/year, the conclusion of the ALARA evaluation is that the FSS of BSA 04-09 was successful and that there would be no discernable benefit to the health and safety of the public in discounting the results of FSS and performing remediation of BSA 04-09.

9.0 FSS PLAN DEVIATIONS BSA 04-09

There were no deviations from the FSS Plan as written.

9.1 Remedial Actions During FSS

As the measurement results of the FSS indicated the results were below the $DCGL_{SO}$ no remedial actions during FSS were necessary.

10.0 DATA QUALITY ASSESSMENT

The DQO process is thoroughly integrated within the DP and Hematite FSS procedures. The steps of the DQO process specific to FSS of structures are presented in HDP-PO-FSS-700 Section 9.0 and correspond to the DQO steps described in Chapter 14, Section 4.2.1 of the DP. The HDP DQO process reflects the recommendations given in MARSSIM, Chapter 2, Figure 2-2.

10.1 Data Quality Assessment for BSA 04-09

The Data Quality Assessment of the survey methodology, measurement and analysis results to ascertain the validity of the conclusion for BSA 04-09 (see Figure 10-1) provides the following:

- The field and laboratory instruments utilized were capable of detecting activity at an MDC less than the appropriate investigation level, and were verified to be operable prior to and after use in accordance with HDP-PR-HP-415 (*Operation of the Ludlum 2360 for Final Status Survey*), and HDP-PR-HP-411 (*Radiological Instrumentation*).
- The calibration of all instruments that were used to measure or analyze data was current at the time of use and the calibrations of the instruments were performed using a NIST traceable source. The instruments used were successfully source checked prior to and after use.
- The TSC systematic samples that were collected (on a random-start triangular grid) and the scan surveys that were conducted were performed in accordance with procedure HDP-PR-FSS-712, *Final Status Surveys of Structures, Systems and Components*.

- Quality Control sample results were not necessary for BSA 04-09. However a Quality Control Replicate Survey was performed for BSA 04-14, and the results were found to be acceptable, satisfying the requirement that a minimum of 5% of structure surveys undergo a successful QC Replicate Survey.
- BSA 04-09 survey and sample results were independently reviewed and validated in accordance with HDP-PR-FSS-721 *Final Status Survey Data Validation.*
- Eleven (11) systematic measurements were collected in BSA 04-09. None of the 11 measurements exceeded the $DCGL_{SO}$ resulting in a systematic average result of 3% of the $DCGL_{SO}$. As such performance of the Sign Test is not required, but was still performed for illustrative purposes and is provided in Table 10-1. The Sign Test was successful as the total number of systematic measurements (11), exceeded the minimum requirement of 8 measurements.
- Smear samples were collected at each TSC measurement location after the initial TSC measurement was collected. No removable smear sample exceeded MDA, and therefore no removable activity exceeding 10% of the $DCGL_{SO}$ was identified.
- The maximum observed result in BSA 04-09 was 4% of the $DCGL_{SO}$. The average residual radioactivity concentration fraction based on the systematically collected measurements was 3% of the $DCGL_{SO}$, resulting in a residual dose contribution of 0.75 mrem/year.
- No FSS measurement result in BSA 04-09 exceeded the $DCGL_{SO}$, therefore an elevated measurement comparisons or hot spot averaging was not required.
- HDP staff ensured that a visual inspection of the SU configuration and of the Isolation & Control measures for BSA 04-09 (within LSA 08-04) was completed prior to and after the performance of the FSS. BSA 04-09 remained isolated after the completion of FSS field activities ensuring SU isolation, until all Field FSS activities on the site were completed.

Table 10-1
Sign Test for BSA 04-09

Sign Test						
SAMPLE ID	SAMPLE ID	Gross TSC	Gross TSC / Adj. Gross DCGL (W_s)	Difference (1-W_s)	Corrected Difference	
B04-09-01-S-F-S-00	Asphalt	778	0.041	0.959	0.959	$\alpha = 0.05$
B04-09-02-S-F-S-00	Asphalt	479	0.025	0.975	0.975	
B04-09-03-S-F-S-00	Asphalt	456	0.024	0.976	0.976	
B04-09-04-S-F-S-00	Asphalt	824	0.044	0.956	0.956	
B04-09-05-S-F-S-00	Asphalt	456	0.024	0.976	0.976	
B04-09-06-S-F-S-00	Asphalt	617	0.033	0.967	0.967	
B04-09-07-S-F-S-00	Asphalt	352	0.019	0.981	0.981	
B04-09-08-S-F-S-00	Asphalt	410	0.022	0.978	0.978	
B04-09-09-S-F-S-00	Asphalt	490	0.026	0.974	0.974	
B04-09-10-S-F-S-00	Asphalt	295	0.016	0.984	0.984	
B04-09-11-S-F-S-00	Asphalt	433	0.023	0.977	0.977	
				Number of Positive Differences (S+)	11	
				Sign Test Critical Value (MARSSIM Table I-3)	8	

If every measurement in the systematic sample population is <= the DCGL, a statistical test is not required.

TEST: PASS

MARSSIM Table I-3 Critical Values for the Sign Test Statistic S+		MARSSIM Table I-3 Critical Values for the Sign Test Statistic S+	
N	Alpha = 0.05	N	Alpha = 0.05
4	4	28	18
5	4	29	19
6	5	30	19
7	6	31	20
8	6	32	21
9	7	33	21
10	8	34	22
11	8	35	22
12	9	36	23
13	9	37	23
14	10	38	24
15	11	39	25
16	11	40	25
17	12	41	26
18	12	42	26
19	13	43	27
20	14	44	27
21	14	45	28
22	15	46	29
23	15	47	29
24	16	48	30
25	17	49	30
26	17	50	31
27	18		

Figure 10-1
Data Evaluation Checklists prepared for BSA 04-09 (page 1 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-721, Final Status Survey Data Evaluation		
		Revision: 10	Appendix G-1, Page 1 of 2

APPENDIX G-1
FINAL STATUS SURVEY DATA QUALITY OBJECTIVES REVIEW CHECKLIST

Survey Area: BSA 04 **Description:** Structure Survey Unit in LSA 04-01
Survey Unit: 09 **Description:** Asphalt Pavement

1.	Have all measurements and/or analysis results that will be subjected to data analysis for FSS been individually reviewed and validated in accordance with Section 8.1 of this procedure?	Yes ☒	No ☐	
2.	Have all systematic measurements and/or samples been taken or acquired at the locations specified in the FSSP and the FSS Sample Instructions?	Yes ☒	No ☐	
3.	Have all scans surveys been performed of the areas specified as required in the FSSP and the FSS Sample Instructions?	Yes ☒	No ☐	
4.	Have all biased measurements and/or samples been taken or acquired at the locations specified in the FSSP & the FSS Sample Instructions?	Yes ☐	No ☐	NA ☒
5.	Have duplicate and/or split samples or measurements been taken or acquired at each location designated as a QC sample?	Yes ☐	No ☐	NA ☒
6.	Were the instruments used to measure or analyze the survey data capable of detecting the ROCs or gross activity at a MDC less than the appropriate investigation level?	Yes ☒	No ☐	
7.	Was the calibration of all instruments that were used to measure or analyze data, current at the time of use and were those calibrations performed using a NIST traceable source?	Yes ☒	No ☐	
8.	Were the instruments successfully response-checked before use and, where required, after use on the day the data was measured?	Yes ☒	No ☐	
9.	Do the samples match those identified on the chain of custody?	Yes ☐	No ☐	NA ☒
10.	Do the QC Sample Results meet the acceptance criteria as specified in HDP-PR-FSS-703, Final Status Survey Quality Control?	Yes ☐	No ☐	NA ☒
11.	Are all Laboratory QC parameters within acceptable limits?	Yes ☐	No ☐	NA ☒

If "No" was the response to any of the questions above, then document the discrepancy as well as any corrective actions that were taken to resolve the discrepancy.

Comments: N/A

Quality Record

Figure 10-1
Data Evaluation Checklists prepared for BSA 04-09 (page 2 of 2)

APPENDIX G-1
FINAL STATUS SURVEY DATA QUALITY OBJECTIVES REVIEW CHECKLIST

Survey Area: No. BSA 04 **Description:** Structure Survey Unit in LSA 04-01

Survey Unit: No. 09 **Description:** Asphalt Pavement

Discrepancy: None

Corrective Actions Taken: None

11. Have the corrective actions resolved the discrepancy with the data? Yes ☐ No ☐ NA ☒
    a. If "No", then forward this form to the RSO.
12. The following questions will be answered by the RSO.
    a. If the answer to question 11 was "No", then is the affected data still valid? Yes ☐ No ☐ NA ☒
    b. If "No", then are the existing valid measurements or samples sufficient to demonstrate compliance for the survey unit? Yes ☐ No ☐ NA ☒
    c. If "No", then direct the acquisition of additional measurements or samples as necessary to demonstrate compliance for the survey unit.

	(Print Name)	(Signature)	(Date)
Prepared by (HP Staff):	Thomas Yardy		7-10-17
Approved by (RSO):	Clark Evers		7/10/17

Quality Record

11.0 CONCLUSION BSA 04-09

An adequate quantity and quality of radiological surveys and measurements has been performed, evaluated and documented to demonstrate that the dose associated with the structures designated as BSA 04-09 of 0.75 mrem/year does not to exceed the dose criterion for unrestricted release in accordance with 10 CFR 20.1402 of 25 mrem/year.

Table 11-1
BSA 04-09 $DCGL_{SO}$ and Dose Summation

AVE. SU RESIDUAL RADIOACTIVITY	
$DCGL_{SO}$	**3%**
Dose	**0.75 mrem/year**

12.0 DOSE CONTRIBUTION OF BSA 04-09 TO THE LSA SURVEY UNIT

The 0.75 mrem/year dose contribution determined for the structure designated as BSA 04-09 will be added to the total dose determination for SU LSA 04-01.

13.0 REFERENCES

13.1 DO-08-004, Hematite Decommissioning Plan {ML092330123}

14.0 APPENDICES (To Be Provided On A Separate Data Disc)

APPENDIX A: Analytical Data Evaluation Spreadsheets for BSA 04-09

APPENDIX B: FSS Plan Development for BSA 04-09

APPENDIX C: FSS Documentation for BSA 04-09