

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development		
	Westinghouse Non-Proprietary Class 3	Revision: 5	Appendix P-4, Page 1 of 1

**APPENDIX P-4**

**FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES**

<b>Survey Area:</b>	LSA 10	<b>Description:</b>	Burial Pits Open Land Area
<b>Survey Unit:</b>	13	<b>Description:</b>	Northern Survey Unit in "Area 2"
<b>Survey Type:</b>	FSS	<b>Classification:</b>	Class 1

Measurement or Sample ID	Surface or CSM	Type	Start Elevation*	End Elevation*	Northing** (Y Axis)	Easting** (X Axis)	Remarks / Notes
L10-13-01-B-E-S-00	Uniform	S	426.4	426.0	865152.8	827426.0	Excavation 6-inch grab
L10-13-02-B-R-S-00	Uniform	S	431.2	429.7	865105.9	827398.9	Root 12-inch composite
L10-13-03-B-E-S-00	Uniform	S	429.7	429.2	865105.9	827398.9	Excavation 6-inch grab
L10-13-04-B-E-S-00	Uniform	S	421.5	421.1	865105.9	827453.1	Excavation 6-inch grab
L10-13-05-B-R-S-00	Uniform	S	429.1	428.0	865105.9	827507.2	Root 7-inch composite
L10-13-06-B-E-S-00	Uniform	S	428.0	427.5	865105.9	827507.2	Excavation 6-inch grab
L10-13-07-B-R-S-00	Uniform	S	431.5	430.6	865059.0	827426.0	Root 5-inch composite
L10-13-08-B-E-S-00	Uniform	S	430.6	430.1	865059.0	827426.0	Excavation 6-inch grab
L10-13-09-B-E-S-00	Uniform	S	415.3	414.8	865059.0	827480.1	Excavation 6-inch grab
L10-13-10-B-R-S-00	Uniform	S	429.7	428.4	865059.0	827534.3	Root 10-inch composite
L10-13-11-B-E-S-00	Uniform	S	428.4	427.9	865059.0	827534.3	Excavation 6-inch grab
L10-13-12-B-E-S-00	Uniform	S	419.1	418.6	865012.1	827507.2	Excavation 6-inch grab
L10-13-07-B-R-Q-00	Uniform	Q	431.5	430.6	865059.0	827426.0	Excavation 6-inch grab
L10-13-13-B-R-B-00	Uniform	B	435.0	431.5	865063.0	827417.0	Biased 6-inch Grab
L10-13-14-B-E-B-00	Uniform	B	419.1	418.6	865069.6	827494.4	Sidewall 6-inch grab
L10-13-15-B-E-B-00	Uniform	B	421.6	421.1	865060.7	827453.1	Sidewall 6-inch grab

\*Elevations are in feet above mean sea level.

\*\* Missouri - East State Plane Coordinates [North American Datum (NAD) 1983]

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

CSM: Three-Layer (Surface-Root-Excavation) or Uniform DCGLs used

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

Green shaded samples are the samples at each sample location, for use in WRS test.

Quality Record



HDP-PR-FSS-721 Final Status Survey Data Evaluation  
Preliminary Data Review and Calculation of the Sum-of-Fractions (SOF)

Use corrected net results for all DE calcs.

DCL Gw, Measure Tc-99, All SEAs

	Uniform
U-234	195.4
U-235	51.6
U-238	168.8
Tc-99	25.1
Th-232	2.0
Ra-226	1.9

Infer U234			
U-238/U235	U-234/U235	U-234	%
4.6	18.2	6.5	3.3
11.5	19.1	1.5	1.4
4.1	18.1	3.8	3.7
6.9	18.4	2.5	2.3
6.8	18.4	3.6	2.3
5.6	18.3	3.6	2.7
9.8	18.8	2.5	1.6
8.7	18.7	2.4	1.9
6.2	18.3	3.8	2.5
16.2	19.9	1.6	1.0
4.2	18.1	4.5	3.6
8.7	18.7	2.0	1.8
3.1	18.3	19.7	4.8
1.4	18.6	33.3	9.6
8.3	18.6	1.6	1.9
10.2	18.8	2.3	1.6
Average Enrichment (%)			2.33

Infer U-234 MDC using U-235 MDC \* ratio of U-234/U-235 @ that sample's enrichment

4.084919778
4.272008805
3.841620459
4.89090527
4.78058703
2.978283468
5.408796223
4.255666561
3.901206726
5.12209701
3.607334615
4.610305441
4.34660266
11.09706886
11.23108194
4.351811594

weighted SOF <sub>MEAN</sub>	0.19		
fractions	SS	RS	ES
	0	0.3333333	0.6666667
SOF <sub>MEAN</sub> Re-use Backfill Material	0.14		
SOF <sub>MEAN</sub> Stockpile 3	0.16		
SOF <sub>MEAN</sub> Groundwater	0.16		
SOF <sub>TOT</sub> <=1	0.40		
SOF <sub>MEAN,SU</sub>	0.40		
	PASS		

Calculate the dose contribution for the SU by multiplying SOF<sub>MEAN,SU</sub> (including contribution from Re-use backfill and Groundwater) by 25 mrem.

12.3 mrem

**HDP-PR-FSS-721 Final Status Survey Data Evaluation**  
**Performance of Statistical Tests**

<b>WRS TEST</b>						
<b>SAMPLE ID</b>	<b>AREA (Reference, Survey Unit)</b>	<b>Gross SOF (<math>X_{i,ref}</math>, <math>Y_{i,SU}</math>)</b>	<b>ADJUSTED SOF (<math>Z_i</math>)</b>	<b>RANKS</b>	<b>REFERENCE AREA RANKS</b>	
9574-SS-140910-01-01	Reference	1.31	2.310	42	42	
9574-SS-140910-01-02	Reference	1.18	2.179	33	33	
9574-SS-140910-01-03	Reference	1.06	2.064	28	28	
9574-SS-140910-01-04	Reference	1.10	2.101	29	29	
9574-SS-140910-01-05	Reference	1.29	2.293	41	41	
9574-SS-140910-01-07	Reference	1.34	2.339	43	43	
9574-SS-140910-01-08	Reference	1.15	2.154	32	32	
9574-SS-140910-01-09	Reference	1.18	2.182	34	34	
9574-SS-140910-01-10	Reference	1.23	2.227	39	39	
9574-SS-140910-01-11	Reference	1.38	2.380	44	44	
9574-SS-140910-01-12	Reference	1.05	2.055	27	27	
9574-SS-140910-01-13	Reference	0.94	1.941	17	17	
9574-SS-140910-01-14	Reference	1.12	2.119	30	30	
9574-SS-140910-01-15	Reference	1.15	2.152	31	31	
9574-SS-140910-01-16	Reference	1.03	2.028	24	24	
9574-SS-140910-01-17	Reference	0.44	1.443	12	12	
9574-SS-140910-01-18	Reference	1.19	2.188	36	36	
9574-SS-140910-01-20	Reference	0.76	1.757	14	14	
9574-SS-140910-01-21	Reference	1.02	2.023	23	23	
9574-SS-140910-01-22	Reference	1.02	2.018	22	22	
9574-SS-140910-01-23	Reference	1.00	2.002	19	19	
9574-SS-140910-01-24	Reference	0.87	1.873	16	16	
9574-SS-140910-01-25	Reference	1.04	2.040	26	26	
9574-SS-140910-01-26	Reference	0.96	1.959	18	18	
9574-SS-140910-01-27	Reference	1.20	2.204	37	37	
9574-SS-140910-01-28	Reference	1.01	2.007	21	21	
9574-SS-140910-01-29	Reference	1.22	2.223	38	38	
9574-SS-140910-01-30	Reference	1.03	2.035	25	25	
9574-SS-140910-01-31	Reference	1.00	2.005	20	20	
9574-SS-140910-01-32	Reference	0.86	1.865	15	15	
9574-SS-140910-01-33	Reference	1.24	2.238	40	40	Min adjusted bkg SOF
9574-SS-140910-01-34	Reference	1.19	2.185	35	35	1.44
L10-13-01-B-E-S-00	Survey Unit	1.09	1.094	1	0	No WRS test necessary
L10-13-02-B-R-S-00	Survey Unit	1.14	1.144	4	0	No WRS test necessary
L10-13-03-B-E-S-00	Survey Unit	1.16	1.162	5	0	No WRS test necessary
L10-13-04-B-E-S-00	Survey Unit	1.37	1.371	10	0	No WRS test necessary
L10-13-05-B-R-S-00	Survey Unit	1.34	1.342	9	0	No WRS test necessary
L10-13-06-B-E-S-00	Survey Unit	1.13	1.132	3	0	No WRS test necessary
L10-13-07-B-R-S-00	Survey Unit	1.46	1.460	13	0	Perform WRS test
L10-13-08-B-E-S-00	Survey Unit	1.21	1.207	6	0	No WRS test necessary
L10-13-09-B-E-S-00	Survey Unit	1.39	1.390	11	0	No WRS test necessary
L10-13-10-B-R-S-00	Survey Unit	1.22	1.223	7	0	No WRS test necessary
L10-13-11-B-E-S-00	Survey Unit	1.10	1.104	2	0	No WRS test necessary
L10-13-12-B-E-S-00	Survey Unit	1.29	1.294	8	0	No WRS test necessary
<b>Rank Sums</b>				990	911	$W_r$
<b># Reference Area Measurements</b>				m	32	
<b># Survey Unit Measurements</b>				n	12	
<b>Total Number of Measurements</b>				N	44	
<b>(1-<math>\alpha</math>) percentile of a standard normal distribution (MARSSIM Pg. I-10)</b>				z	1.645	$\alpha = 0.05$
<b>WRS Critical Value (MARSSIM Pg. I-10, Eq. I.1)</b>				CV	783	

TEST: **PASS**

HDP-PR-FSS-721 Final Status Survey Data Evaluation

Retrospective Sample Size Verification

Uniform DCGL Criteria Evaluation	
N/2 Value Verification	
Isotope(s)	SOF (Ra/Tc/Th/Iso U)
St. Dev.	0.11
DCGL <sub>SOF</sub>	1
LBGR (Mean)	0.19
Shift	0.81
Relative Shift ( $\Delta/\sigma$ )	7.16
MARSSIM Table 5.1 ( $P_r$ )	1.000000
N	12
N + 20%	14.4
N/2	8
FSS N/2	8
Verification Check	<b>SUFFICIENT MEASUREMENTS</b>
"N/2" Corresponds to the number of survey unit measurement locations required for the WRS Test	

MARSSIM Table 5.1

$\Delta/\sigma$	$P_r$
0.1	0.528182
0.2	0.556223
0.3	0.583985
0.4	0.611335
0.5	0.638143
0.6	0.664290
0.7	0.689665
0.8	0.714167
0.9	0.737710
1.0	0.760217
1.1	0.781627
1.2	0.801892
1.3	0.820978
1.4	0.838864
1.5	0.855541
1.6	0.871014
1.7	0.885299
1.8	0.898420
1.9	0.910413
2.0	0.921319
2.25	0.944167
2.5	0.961428
2.75	0.974067
3.0	0.983039
3.5	0.993329
4.0	0.997658
4.01	1.000000

MARSSIM Table 5.2,  $\alpha = 0.05$ ,  $\beta = 0.10$

$\alpha$ (or $\beta$ )	$Z_{1-\alpha}$ (or $Z_{1-\beta}$ )
0.005	2.576
0.01	2.326
0.015	2.241
0.025	1.960
0.05	1.645
0.10	1.282
0.15	1.036
0.2	0.842
0.25	0.674
0.30	0.524

$\alpha$   
 $\beta$

**FORM HDP-PR-FSS-703-1**  
**FIELD DUPLICATE SAMPLE ASSESSMENT**

Survey Unit No.:	LSA 10-13				Survey Unit Description:	Burial Pits Open Land Area Northern Survey Unit in "Area 2"						
Sample ID	Field Duplicate Sample ID	Radionuclide	Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ( $\bar{x}$ ) (pCi/g)	Nuclide DCGL (pCi/g)	Statistic <sup>2</sup>	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity ( $x_i$ )	MDC	Activity ( $x_i$ )	MDC						
L10-13-07-B-R-S-00	L10-13-07-B-R-Q-00	Ra-226	1.42	0.0945	1.31	0.0627	1.365	1.9	0.11	0.269	0.403	N
L10-13-07-B-R-S-00	L10-13-07-B-R-Q-00	Tc-99	0.358	0.202	0.34	0.212	0.349	25.1	0.018	3.552	5.321	N
L10-13-07-B-R-S-00	L10-13-07-B-R-Q-00	Th-232	1.35	0.19	1.15	0.114	1.250	2.0	0.200	0.283	0.424	N
L10-13-07-B-R-S-00	L10-13-07-B-R-Q-00	U-234 <sup>1</sup>	2.524	NA	2.336	NA	2.430	195.4	0.188	27.649	41.425	N
L10-13-07-B-R-S-00	L10-13-07-B-R-Q-00	U-235	0.134	0.287	0.124	0.231	0.129	51.6	NA	7.301	10.939	NA
L10-13-07-B-R-S-00	L10-13-07-B-R-Q-00	U-238	1.31	1.02	1.26	0.807	1.285	168.8	0.050	23.885	35.786	N

Comments:

1. U-234 is inferred, no MDC available.
2. Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: \_\_\_\_\_

Reviewed by: \_\_\_\_\_

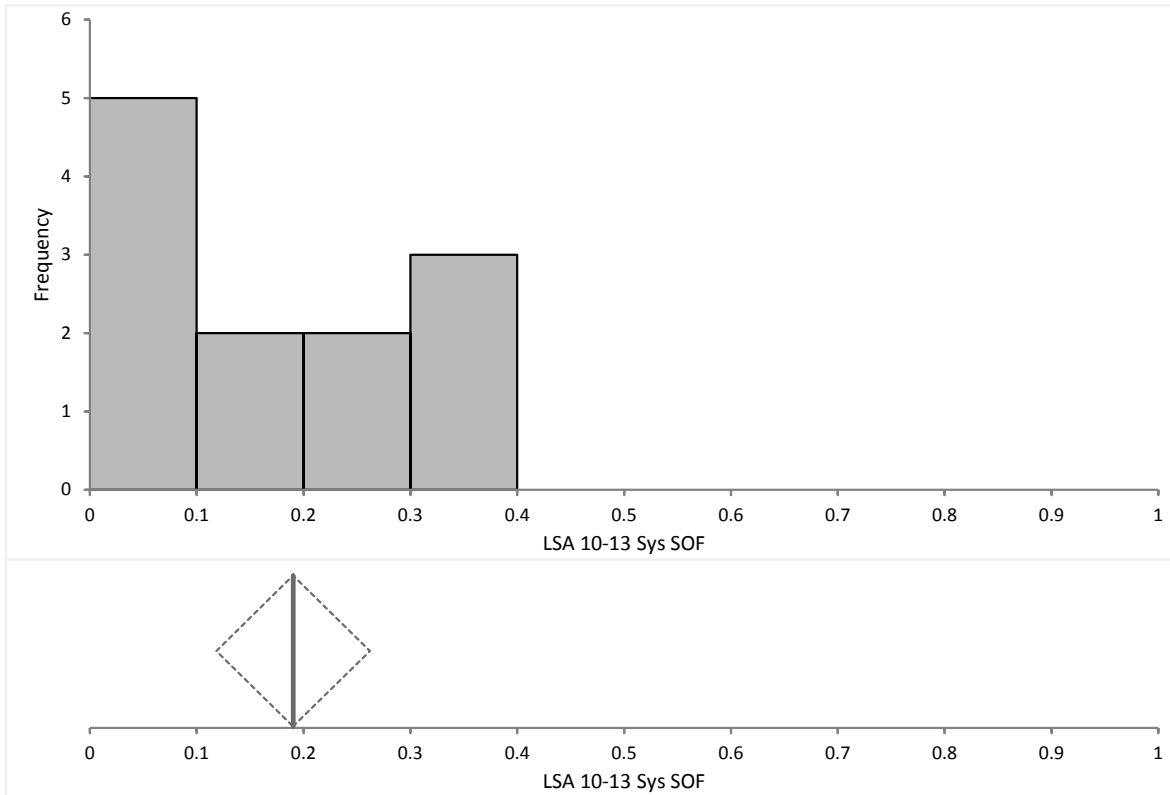
Date: \_\_\_\_\_

Date: \_\_\_\_\_

LSA 10-13 Sys SOF

- 0.1
- 0.1
- 0.1
- 0.3
- 0.3
- 0.1
- 0.4
- 0.1
- 0.3
- 0.2
- 0.1
- 0.2

Descriptives



N | 12

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 10-13 Sys SOF	0.19	0.12 to 0.26	0.033	0.11	0.01	0.6	-1.15
	Minimum	1st quartile	Median	96.14% CI	3rd quartile	Maximum	IQR
LSA 10-13 Sys SOF	0.1	0.09	0.15	0.09 to 0.31	0.30	0.4	0.21