

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development		
	Westinghouse Non-Proprietary Class 3	Revision: 4	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>	01	<b>Description:</b>	North West Corner Survey Unit (North Burial Pit)
<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
L10-01-01-B-S-S-00	Uniform	S	437.0	436.8	865360.0	827277.0	Surface 2-inch grab
L10-01-02-B-R-S-00	Uniform	S	436.8	432.3	865360.0	827277.0	Root 4.4-foot composite
L10-01-04-B-S-S-00	Uniform	S	436.9	436.5	865317.0	827252.2	Surface 6-inch grab
L10-01-05-B-R-S-00	Uniform	S	436.5	432.0	865317.0	827252.2	Root 4.4-foot composite
L10-01-07-B-R-S-00	Uniform	S	433.2	430.1	865317.0	827301.8	Root 3.1-foot composite
L10-01-08-B-E-S-00	Uniform	S	430.1	429.7	865317.0	827301.8	Excavation 6-inch grab
L10-01-09-B-R-S-00	Uniform	S	427.6	426.6	865317.0	827351.3	Root 1-foot composite
L10-01-10-B-E-S-00	Uniform	S	426.6	426.2	865317.0	827351.3	Excavation 6-inch grab
L10-01-11-B-R-S-00	Uniform	S	436.3	433.1	865274.0	827227.5	Root 3.3-foot composite
L10-01-12-B-E-S-00	Uniform	S	433.1	432.6	865274.0	827227.5	Excavation 6-inch grab
L10-01-13-B-E-S-00	Uniform	S	429.1	428.6	865274.0	827277.0	Excavation 6-inch grab
L10-01-14-B-E-S-00	Uniform	S	425.1	424.7	865274.0	827326.5	Excavation 6-inch grab
L10-01-15-B-S-S-00	Uniform	S	436.9	436.5	865231.1	827252.2	Surface 6-inch grab
L10-01-16-B-R-S-00	Uniform	S	436.5	432.0	865231.1	827252.2	Root 4.4-foot composite
L10-01-13-B-E-Q-00	Uniform	Q	429.1	428.6	865274.0	827277.0	Excavation 6-inch grab
L10-01-18-B-E-B-00	Uniform	B	435.5	422.2	865276.8	827272.7	Excavation 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) with conservative use of Uniform DCGLs.

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  
Data Review and Calculation of the Sum-of-Fractions (SOF)

Use corrected net results for all DE calcs.

MDC SOF
0.17
0.14
0.12
0.14
0.15
0.13
0.13
0.17
0.13
0.16
0.16
0.15
0.15
0.16
0.19

DCLG<sub>W</sub>, Measure To-99, All SEAs

U-234	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

weighted SOF<sub>MEAN</sub> 0.19

SS	RS	ES
0.214285714	0.428571429	0.35714

SOF<sub>MEAN</sub> Re-use Backfill Material

0 Off-Site Backfill

SOF<sub>MEAN</sub> Groundwater

0.16

SOF<sub>TOT</sub> <= 1

SOF<sub>MEAN, BU</sub> 0.35 PASS

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

8.6 mrem

Infer U234

U-238/U235	U-234/U235	U-234	%
7.6	19.5	3.5	2.0
6.2	18.3	3.2	2.5
7.1	18.4	4.3	2.2
7.3	18.5	2.6	2.1
9.8	18.8	2.9	1.6
5.5	18.2	3.0	2.8
6.7	18.4	3.8	2.3
14.8	19.6	1.6	1.1
10.0	18.8	2.1	1.6
3.4	18.1	3.6	4.4
52.0	26.6	0.7	0.3
8.0	18.5	2.9	2.0
30.9	21.8	1.1	0.6
19.3	20.2	1.6	0.9
5.4	18.2	3.4	2.9
5.7	18.3	2.9	2.7
Average Enrichment (%)			1.89

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

3.9659
4.4873
4.6442
5.8944
4.7663
3.4284
4.2658
6.5464
4.5590
3.2225
7.0863
5.0408
6.2236
5.4448
3.4646
6.0804

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

WRS TEST					
SAMPLE ID	AREA (Reference, Survey Unit)	Gross SOF ( $X_{i,ref}$ , $Y_{i,SU,gross}$ )	ADJUSTED SOF ( $Z_i$ )	RANKS	REFERENCE AREA RANKS
9574-SS-140910-01-01	Reference	1.19	2.188	38	38
9574-SS-140910-01-02	Reference	0.76	1.757	16	16
9574-SS-140910-01-03	Reference	1.02	2.023	25	25
9574-SS-140910-01-04	Reference	1.02	2.018	24	24
9574-SS-140910-01-05	Reference	1.00	2.002	21	21
9574-SS-140910-01-07	Reference	0.87	1.873	18	18
9574-SS-140910-01-08	Reference	1.04	2.040	28	28
9574-SS-140910-01-09	Reference	0.96	1.959	20	20
9574-SS-140910-01-10	Reference	1.20	2.204	39	39
9574-SS-140910-01-11	Reference	1.01	2.007	23	23
9574-SS-140910-01-12	Reference	1.22	2.223	40	40
9574-SS-140910-01-13	Reference	1.03	2.035	27	27
9574-SS-140910-01-14	Reference	1.00	2.005	22	22
9574-SS-140910-01-15	Reference	0.86	1.865	17	17
9574-SS-140910-01-16	Reference	1.24	2.238	42	42
9574-SS-140910-01-17	Reference	1.19	2.185	37	37
9574-SS-140910-01-18	Reference	1.31	2.310	44	44
9574-SS-140910-01-20	Reference	1.18	2.179	35	35
9574-SS-140910-01-21	Reference	1.06	2.064	30	30
9574-SS-140910-01-22	Reference	1.10	2.101	31	31
9574-SS-140910-01-23	Reference	1.29	2.293	43	43
9574-SS-140910-01-24	Reference	1.34	2.339	45	45
9574-SS-140910-01-25	Reference	1.15	2.154	34	34
9574-SS-140910-01-26	Reference	1.18	2.182	36	36
9574-SS-140910-01-27	Reference	1.23	2.227	41	41
9574-SS-140910-01-28	Reference	1.38	2.380	46	46
9574-SS-140910-01-29	Reference	1.05	2.055	29	29
9574-SS-140910-01-30	Reference	0.94	1.941	19	19
9574-SS-140910-01-31	Reference	1.12	2.119	32	32
9574-SS-140910-01-32	Reference	1.15	2.152	33	33
9574-SS-140910-01-33	Reference	1.03	2.028	26	26
9574-SS-140910-01-34	Reference	0.44	1.443	13	13
L10-01-01-B-S-S-00	Survey Unit	0.91	0.913	1	0
L10-01-02-B-R-S-00	Survey Unit	1.29	1.295	11	0
L10-01-04-B-S-S-00	Survey Unit	1.29	1.293	10	0
L10-01-05-B-R-S-00	Survey Unit	1.14	1.136	4	0
L10-01-07-B-R-S-00	Survey Unit	1.18	1.179	5	0
L10-01-08-B-E-S-00	Survey Unit	1.20	1.204	6	0
L10-01-09-B-R-S-00	Survey Unit	1.22	1.216	7	0
L10-01-10-B-E-S-00	Survey Unit	1.25	1.250	8	0
L10-01-11-B-R-S-00	Survey Unit	1.07	1.067	3	0
L10-01-12-B-E-S-00	Survey Unit	1.06	1.063	2	0
L10-01-13-B-E-S-00	Survey Unit	1.46	1.457	15	0
L10-01-14-B-E-S-00	Survey Unit	1.45	1.448	14	0
L10-01-15-B-S-S-00	Survey Unit	1.27	1.273	9	0
L10-01-16-B-R-S-00	Survey Unit	1.31	1.313	12	0
<b>Rank Sums</b>				1081	974
<b># Reference Area Measurements</b>				m	32
<b># Survey Unit Measurements</b>				n	14
<b>Total Number of Measurements</b>				N	46
<b>(1-<math>\alpha</math>) percentile of a standard normal distribution (MARSSIM Pg. I-10)</b>				z	1.645
<b>WRS Critical Value (MARSSIM Pg. I-10, Eq. I.1)</b>				CV	821

Min adjusted bkg SOF:  
1.44

No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
No WRS Test Necessary  
Perform WRS Test  
Perform WRS Test  
No WRS Test Necessary  
No WRS Test Necessary

$W_r$

$\alpha = 0.05$

TEST: **PASS**

**HDP-PR-FSS-721 Final Status Survey Data Evaluation  
Retrospective Sample Size Verification**

<b>Uniform DCGL Criteria Evaluation</b>	
<b>N/2 Value Verification</b>	
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 ( $\Delta\sigma$ )	7.36
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 10-01				Survey Unit Description:	North West Corner Survey Unit (North Burial Pit Area)						
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 <sub>i</sub> )	MDC	Activity (x <sub>i</sub> )	MDC						
L10-01-13-B-E-S-00	L10-01-13-B-E-Q-00	Ra-226	1.47	0.0692	1.4	0.121	1.435	1.9	0.07	0.269	0.403	N
L10-01-13-B-E-S-00	L10-01-13-B-E-Q-00	Tc-99	-0.00436	0.23	-0.0103	0.235	-0.00733	25.1	NA	3.552	5.321	NA
L10-01-13-B-E-S-00	L10-01-13-B-E-Q-00	Th-232	1.34	0.132	1.4	0.13	1.370	2.0	0.060	0.283	0.424	N
L10-01-13-B-E-S-00	L10-01-13-B-E-Q-00	U-234 <sup>1</sup>	0.738	NA	3.370	NA	2.054	195.4	2.632	27.649	41.425	N
L10-01-13-B-E-S-00	L10-01-13-B-E-Q-00	U-235	0.0277	0.266	0.185	0.3	0.106	51.6	NA	7.301	10.939	NA
L10-01-13-B-E-S-00	L10-01-13-B-E-Q-00	U-238	1.44	0.926	0.997	1.02	1.2185	168.8	NA	23.885	35.786	NA

Comments:

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

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Date: 02/27/2015

Date: 03/16/2015

Quality Record