

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:	LSA 05	Description:	Technetium-99 Soils Open Land Area
Survey Unit:	04	Description:	Survey Unit in "Barns Area - Area 16"
Survey Type:	FSS	Classification:	Class 1

Measurement or Sample ID	Surface or CSM	Type	Start Elevation*	End Elevation*	Northing** (Y Axis)	Easting** (X Axis)	Remarks / Notes
L05-04-01-T-S-S-00	Uniform	S	425.95	425.5	864605.0	826597.0	Surface 6-inch grab
L05-04-02-T-R-S-00	Uniform	S	425.46	421.0	864605.0	826597.0	Root 4.4-ft composite
L05-04-04-T-E-S-00	Uniform	S	422.973	422.5	864605.0	826653.0	Excavation 6-inch grab
L05-04-05-T-S-S-00	Uniform	S	429.846	429.4	864605.0	826709.0	Surface 6-inch grab
L05-04-06-T-R-S-00	Uniform	S	429.356	424.9	864605.0	826709.0	Root 4.4-ft composite
L05-04-08-T-S-S-00	Uniform	S	426.104	425.6	864557.0	826569.0	Surface 6-inch grab
L05-04-09-T-R-S-00	Uniform	S	425.614	421.2	864557.0	826569.0	Root 4.4-ft composite
L05-04-11-T-S-S-00	Uniform	S	425.355	424.9	864557.0	826625.0	Surface 6-inch grab
L05-04-12-T-R-S-00	Uniform	S	424.865	420.4	864557.0	826625.0	Root 4.4-ft composite
L05-04-14-T-S-S-00	Uniform	S	424.2	423.7	864557.0	826681.0	Surface 6-inch grab
L05-04-15-T-R-S-00	Uniform	S	423.7	419.3	864557.0	826681.0	Root 4.4-ft composite
L05-04-17-T-S-S-00	Uniform	S	430.0	429.5	864557.0	826737.0	Surface 6-inch grab
L05-04-18-T-R-S-00	Uniform	S	429.5	425.1	864557.0	826737.0	Root 4.4-ft composite
L05-04-20-T-S-S-00	Uniform	S	428.0	427.5	864508.0	826597.0	Surface 6-inch grab
L05-04-21-T-R-S-00	Uniform	S	427.5	423.1	864508.0	826597.0	Root 4.4-ft composite
L05-04-22-T-E-S-00	Uniform	S	423.1	422.6	864508.0	826597.0	Excavation 6-inch grab
L05-04-02-T-R-Q-00	Uniform	Q	425.5	421.0	864605.0	826597.0	QA Duplicate Sample
L05-04-22-T-E-Q-00	Uniform	Q	423.1	422.6	864508.0	826597.0	QA Duplicate Sample
L05-04-23-T-R-B-00	Uniform	B	426.6	426.6	864590.0	826700.0	Sidewall 6-in Grab
L05-04-24-T-S-B-00	Uniform	B	422.6	422.1	864617.0	826638.0	Biased 6-in Grab
L05-04-25-T-S-B-00	Uniform	B	426.3	425.8	864625.0	826642.0	Biased 6-in Grab
L05-04-26-T-S-B-00	Uniform	B	422.2	421.7	864592.0	826704.0	Biased 6-in Grab

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

*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

HDP-PR-FSS-721 Final Status Survey Data Evaluation
 Steps 8.3 Preliminary Data Review and 8.4 Calculation of the Sum-of-Fractions (SOF)

Use corrected net results for all DE calcs 721 Sec. 8.4.2

MDC of Step 8.1.0
0.12
0.11
0.13
0.09
0.17
0.11
0.10
0.07
0.13
0.10
0.14
0.05
0.14
0.08
0.11
0.11
0.16
0.12
0.12
0.11
0.11
0.14

Step 8.4.1 DCLG_w 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

Step 8.4.5b
 Wigner's SOF_{SEAs}

U-11		
SS	RS	ES
0.3125	0.5625	0.125

fractions

Step 8.4.5c SOF_{SEAs} Re-use Backfill Material
 0.17 Stockpile 8b

Step 8.4.5e SOF_{SEAs} Groundwater
 0.18

Step 8.4.5g (<=1)
 SOF_{SEAs} SU U-41 PASS

Infer U234 Step 8.3.4

U-238/U235	U-234/U235	U-234	%
3.4	18.1	5.6	4.4
6.0	18.3	2.7	2.6
8.2	18.6	1.7	1.9
7.4	18.5	2.7	2.1
9.2	18.7	2.0	1.7
2.6	18.2	9.3	5.7
3.8	18.1	3.2	4.0
3.3	18.1	8.8	4.8
9.3	18.7	2.2	1.7
2.5	18.2	5.3	5.8
11.4	19.1	1.4	1.4
2.9	18.1	6.1	5.1
0.0	0.0	1.3	0.7
3.8	18.1	5.9	4.0
12.9	19.4	1.3	1.2
14.5	19.6	1.0	1.1
16.0	19.9	2.2	1.0
8.6	18.7	1.3	1.8
5.0	18.2	3.2	3.1
6.6	18.3	1.6	2.4
6.0	18.3	2.4	2.6
6.3	18.3	2.6	2.5

Average Enrichment (%) 2.79

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

3.49405
4.169155
4.313926
2.882538
5.417514
4.284828
2.879193
7.462238
4.180374
3.196511
4.977953
2.319592
0
3.22348
4.305002
4.762624
5.340481
4.274332
3.19687
5.101036
4.425159
5.384764

Step 8.4.6 Calculate the dose contribution for the SU by multiplying SOF_{SEAs}SU (including contribution from Re-use backfill and Groundwater) by 25 mrem.

11.0 mrem

HDP-PR-FSS-701 Final Status Survey Plan Development
Appendix P-1 Step 8. Calculate the Number of Samples in the Statistical Population

Uniform DCGL Criteria Evaluation	
N/2 Value Verification	
Isotope(s)	SOF (Ra/Tc/Th/Iso U)
St. Dev.	0.11
DCGL _{SOF}	1
LBGR (Mean)	0.11
Shift	0.89
Relative Shift (Δ/σ)	7.93
MARSSIM Table 5.1 (P_r)	1.000000
N	12
N + 20%	14.4
N/2	8
FSS N/2	8
Verification Check	SUFFICIENT MEASUREMENTS
"N/2" Corresponds to the number of survey unit measurement locations required for the WRS Test	

MARSSIM Table 5.1

Δ/σ	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, $\alpha = 0.05$, $\beta = 0.10$

α (or β)	$Z_{1-\alpha}$ (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

α
 β

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control										
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**FORM HDP-PR-FSS-703-1
FIELD DUPLICATE SAMPLE ASSESSMENT**

Survey Unit No.:	LSA 05-04				Survey Unit Description:	Survey Unit in "Barns Area - Area 16"						
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 ²	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity (x_i)	MDC	Activity (x_i)	MDC						
L05-04-02-T-R-S-00	L05-04-02-T-R-Q-00	Ra-226	0.909	0.0596	0.909	0.0905	0.909	1.9	0	0.269	0.403	N
L05-04-02-T-R-S-00	L05-04-02-T-R-Q-00	Tc-99	0.0725	0.234	0.0878	0.0905	0.080	25.1	NA	3.552	5.321	NA
L05-04-02-T-R-S-00	L05-04-02-T-R-Q-00	Th-232	1.03	0.0922	0.574	0.225	0.802	2.0	0.456	0.283	0.424	Y
L05-04-02-T-R-S-00	L05-04-02-T-R-Q-00	U-234 ¹	2.743	N/A	2.243	N/A	2.493	195.4	0.499	27.649	41.425	N
L05-04-02-T-R-S-00	L05-04-02-T-R-Q-00	U-235	0.15	0.228	0.113	0.269	0.132	51.6	NA	7.301	10.939	NA
L05-04-02-T-R-S-00	L05-04-02-T-R-Q-00	U-238	0.894	0.775	1.81	1.05	1.352	168.8	0.916	23.885	35.786	N

Comments:

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

Performed by: Thomas Yardy _____

Reviewed by: Clark Evers _____

Date: _____

Date: _____

Quality Record

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control										
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**FORM HDP-PR-FSS-703-1
FIELD DUPLICATE SAMPLE ASSESSMENT**

Survey Unit No.:	LSA 05-04				Survey Unit Description:	Survey Unit in "Barns Area - Area 16"						
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 ²	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity (x_i)	MDC	Activity (x_i)	MDC						
L05-04-22-T-E-S-00	L05-04-22-T-E-Q-00	Ra-226	0.846	0.073	0.912	0.0834	0.879	1.9	0.066	0.269	0.403	N
L05-04-22-T-E-S-00	L05-04-22-T-E-Q-00	Tc-99	0.159	0.227	0.134	0.223	0.147	25.1	NA	3.552	5.321	NA
L05-04-22-T-E-S-00	L05-04-22-T-E-Q-00	Th-232	0.882	0.106	0.972	0.113	0.927	2.0	0.090	0.283	0.424	N
L05-04-22-T-E-S-00	L05-04-22-T-E-Q-00	U-234 ¹	0.955	N/A	1.338	N/A	1.146	195.4	0.384	27.649	41.425	N
L05-04-22-T-E-S-00	L05-04-22-T-E-Q-00	U-235	0.0487	0.243	0.0717	0.229	0.060	51.6	NA	7.301	10.939	NA
L05-04-22-T-E-S-00	L05-04-22-T-E-Q-00	U-238	0.705	0.799	0.619	0.794	0.662	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.

Performed by: Thomas Yardy _____

Reviewed by: Clark Evers _____

Date: _____

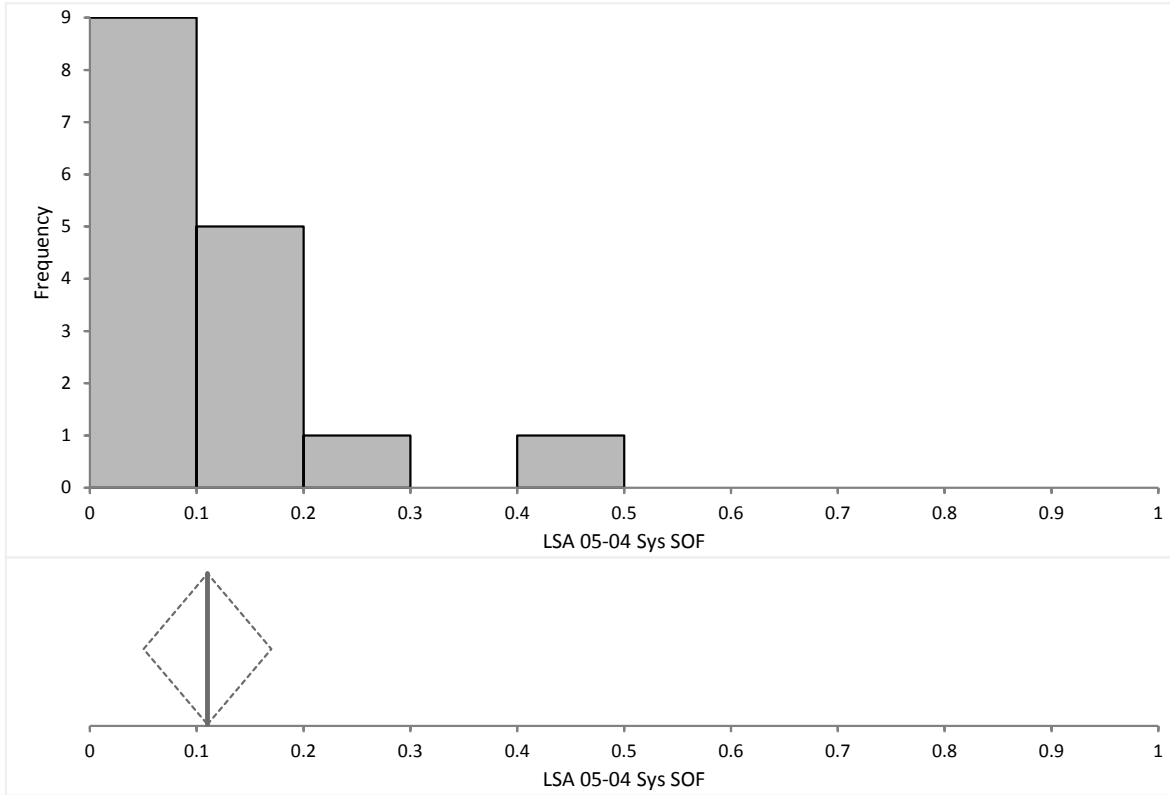
Date: _____

Quality Record

LSA 05-04 Sys SOF

0.2
0.0
0.1
0.0
0.1
0.2
0.1
0.4
0.0
0.0
0.1
0.0
0.0
0.2
0.0
0.0

Descriptives



N | 16

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 05-04 Sys SOF	0.11	0.05 to 0.17	0.028	0.11	0.01	2.0	4.81
	Minimum	1st quartile	Median	97.87% CI	3rd quartile	Maximum	IQR
LSA 05-04 Sys SOF	0.02	0.04	0.05	0.04 to 0.16	0.16	0.4	0.12