

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**

<b>Survey Area:</b>	<u>BSA 02</u>	<b>Description:</b>	<u>Building Survey Area (Building 230)</u>
<b>Survey Unit:</b>	<u>06</u>	<b>Description:</b>	<u>Rod Load Area - Section 4 Floor</u>
<b>Survey Type:</b>	<u>FSS</u>	<b>Classification:</b>	<u>Class 1</u>

Measurement or Sample ID	Surface or CSM	Type	Start Elevation	End Elevation	Northing (feet) (Y Axis) *	Easting (feet) (X Axis) *	Remarks / Notes
B02-06-01-S-F-S-00	F	S	NA	NA	35.9	2.0	Floor
B02-06-02-S-F-S-00	F	S	NA	NA	35.9	10.5	Floor
B02-06-03-S-F-S-00	F	S	NA	NA	35.9	19.1	Floor
B02-06-04-S-F-S-00	F	S	NA	NA	35.9	27.6	Floor
B02-06-05-S-F-S-00	F	S	NA	NA	28.7	14.8	Floor
B02-06-06-S-F-S-00	F	S	NA	NA	28.7	23.3	Floor
B02-06-07-S-F-S-00	F	S	NA	NA	21.4	2.0	Floor
B02-06-08-S-F-S-00	F	S	NA	NA	21.4	27.6	Floor
B02-06-09-S-F-S-00	F	S	NA	NA	14.2	14.8	Floor
B02-06-10-S-F-S-00	F	S	NA	NA	14.2	23.3	Floor
B02-06-11-S-F-S-00	F	S	NA	NA	7.0	2.0	Floor
B02-06-12-S-F-S-00	F	S	NA	NA	7.0	27.6	Floor
B02-06-13-S-F-B-00	F	B	NA	NA	35.0	20	Floor
B02-06-14-S-F-B-00	F	B	NA	NA	33.0	20	Floor
B02-06-15-S-F-B-00	F	B	NA	NA	20.0	20	Floor
B02-06-16-S-F-B-00	F	B	NA	NA	30.0	2	Floor

\*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

Ludlum 2360 278647	Ludlum 43-89 311685	Active Probe Area 125 cm <sup>2</sup>	$\alpha$ HDP Efficiency 27.5%	$\alpha$ Cal. Efficiency N/A	$\beta$ HDP Efficiency 28.7%	$\beta$ Cal. Efficiency N/A
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**TOTAL WEIGHTED INSTRUMENT EFFICIENCY CALCULATION**

Radionuclide	Radiation	Maximum Energy (MeV)	Instrument Efficiency ( $\epsilon_i$ )	Surface Efficiency ( $\epsilon_s$ )	Yield 100%	Activity Fraction	Weighted Efficiency
Am-241	Alpha	5.6	0.2750	0.25	1.00	2.682E-03	1.84E-04
Np-237	Alpha	5.0	0.2750	0.25	1.00	5.573E-05	3.83E-06
Pu-239	Alpha	5.2	0.2750	0.25	1.00	2.027E-06	1.39E-07
Tc-99	Beta	0.294	0.2870	0.25	1.00	2.829E-03	2.03E-04
Th-232	Alpha	4.1	0.2750	0.25	1.00	3.214E-03	2.21E-04
Ra-228	Beta	0.046	0.2870	0.00	1.00	3.214E-03	0.00E+00
Ac-228	Beta	2.13	0.2870	0.50	1.00	3.214E-03	4.61E-04
Th-228	Alpha	5.5	0.2750	0.25	1.00	3.214E-03	2.21E-04
Ra-224	Alpha	5.8	0.2750	0.25	1.00	3.214E-03	2.21E-04
U-234	Alpha	4.9	0.2750	0.25	1.00	8.270E-01	5.69E-02
U-235	Alpha	4.7	0.2750	0.25	1.00	3.720E-02	2.56E-03
Th-231	Beta	0.390	0.2870	0.25	1.00	3.720E-02	2.67E-03
U-238	Alpha	4.3	0.2750	0.25	1.00	1.270E-01	8.73E-03
Th-234	Beta	0.270	0.2870	0.25	1.00	1.270E-01	9.11E-03
Pa-234m	Beta	2.20	0.2870	0.50	1.00	1.270E-01	1.82E-02

Total Weighted Instrument Efficiency =  $\Sigma$  Weighted Instrument Efficiency for all Nuclides of Concern

$\Sigma =$  9.97%

Weighted Instrument Efficiency =  $\epsilon_i * \epsilon_s * \text{Yield} * \text{Activity Fraction}$

$\epsilon_i$  = 2 Pi Instrument Efficiency for Nuclide of Concern

$\epsilon_s$  = Surface Efficiency for Nuclide of Concern

<p>Meter <b>43-93</b></p>
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**HDP-PR-FSS-721 Final Status Survey Data Evaluation  
Preliminary Data Review and Determination of Sum-of-Fractions (SOF)**

MEASUREMENT ID	MEASUREMENT LOCATION	DATE MEAS	MEASUREMENT	Step 8.3.2				Corrected Net dpm/100cm <sup>2</sup>	Fraction of DCGL Step 8.4.3
				GROSS cpm ( $\alpha+\beta$ )	BKG cpm (a+b)	Net cpm ( $\alpha$ + $\beta$ )	Combined Net dpm/100 cm <sup>2</sup> ( $\alpha+\beta$ )		
B02-06-01-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	248	165	82.667	829	829	4%
B02-06-02-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	222	165	56.667	568	568	3%
B02-06-03-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	246	165	80.667	809	809	4%
B02-06-04-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	273	165	107.67	1080	1080	6%
B02-06-05-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	212	165	46.667	468	468	2%
B02-06-06-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	229	165	63.667	639	639	3%
B02-06-07-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	249	165	83.667	839	839	4%
B02-06-08-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	251	165	85.667	859	859	5%
B02-06-09-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	247	165	81.667	819	819	4%
B02-06-10-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	249	165	83.667	839	839	4%
B02-06-11-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	246	165	80.667	809	809	4%
B02-06-12-S-F-S-00	Floor	08/07/2015	alpha + beta TSC	211	165	45.667	458	458	2%
B02-06-13-S-F-B-00	Floor	08/07/2015	alpha + beta TSC	257	165	91.667	919	919	5%
B02-06-14-S-F-B-00	Floor	08/07/2015	alpha + beta TSC	250	165	84.667	849	849	4%
B02-06-15-S-F-B-00	Floor	08/07/2015	alpha + beta TSC	333	165	167.67	1682	1682	9%
B02-06-16-S-F-B-00	Floor	08/07/2015	alpha + beta TSC	1284	165	1118.7	11220	11220	59%

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

Min	458	4%	Average Fraction Step 8.4.5.g
Max	1080		
Mean	751	DCGLso	mrem SU Dose Contribution Step 8.4.6
Median	814		
Stdev	182.1		
		1.00	
		mrem	

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

Instrument used for FSS Static Measurements:

Ludlum 2360/43-93	S/N 275001	08/07/2015	Survey # HDP-PF-080715-042
Detector Area (A) =	100 cm <sup>2</sup>	ave. ambient bkg = 165.3 cpm ( $\alpha + \beta$ )	weighted eff ( $\epsilon_w$ )= 0.09970
TSC (dpm/100cm <sup>2</sup> ) = (qcpm-bkg) / ( $\epsilon_w * (A_{ref}/100 \text{ cm}^2)$ )			
DCGL (structures) = 18,925 dpm/100 cm <sup>2</sup>			

**HDP-PR-HP-314 Unrestricted Release of Materials and Equipment  
Removable Data Evaluation**

MEASUREMENT ID	MEASUREMENT LOCATION	DATE MEAS	Alpha Gross cpm	Alpha Net cpm	Alpha Net dpm/100cm <sup>2</sup>	Corrected Alpha Net dpm/100cm <sup>2</sup>	Beta Gross cpm	Beta Net cpm	Beta Net dpm/100cm <sup>2</sup>
1	Floor	08/07/2015	1	0	0	0	40	-9	-38
2	Floor	08/07/2015	0	-1	-4	0	34	-15	-63
3	Floor	08/07/2015	0	-1	-4	0	47	-2	-8
4	Floor	08/07/2015	1	0	0	0	46	-3	-13
5	Floor	08/07/2015	0	-1	-4	0	40	-9	-38
6	Floor	08/07/2015	2	1	4	4	42	-7	-29
7	Floor	08/07/2015	0	-1	-4	0	40	-9	-38
8	Floor	08/07/2015	2	1	4	4	38	-11	-46
9	Floor	08/07/2015	0	-1	-4	0	37	-12	-50
10	Floor	08/07/2015	0	-1	-4	0	41	-8	-34
11	Floor	08/07/2015	0	-1	-4	0	48	-1	-4
12	Floor	08/07/2015	0	-1	-4	0	39	-10	-42
13	Floor	08/07/2015	1	0	0	0	49	0	0
14	Floor	08/07/2015	2	1	4	4	44	-5	-21
15	Floor	08/07/2015	0	-1	-4	0	44	-5	-21
16	Floor	08/07/2015	0	-1	-4	0	33	-16	-67

**HDP-PR-HP-314 Unrestricted Release of Materials and Equipment  
Removable Data Evaluation**

Corrected Beta Net dpm/100cm <sup>2</sup>	Combined Net dpm/100 cm <sup>2</sup> ( $\alpha+\beta$ )	Exceed 10% of Min. Sys. TSC Result?	Exceed MDA?	Exceed 10% of DCGL?
0	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	4	N	N	N
0	0	N	N	N
0	4	N	N	N
0	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	4	N	N	N
0	0	N	N	N
0	0	N	N	N

Min 0  
Max 4  
Mean 1  
Median 0  
StDev 1.6

DCGL = 18,925 dpm/100cm<sup>2</sup>

$$\text{Removable Activity (dpm/100cm}^2\text{)} = (\text{gcpm-bkg}) / \epsilon$$

$$\text{Area "swiped"} = 100 \text{ cm}^2$$

Instrument used for Removable Measurements:

Ludlum 2929/43-10-1  
Meter I

S/N 115578  
PR098469

Cal Due 10/30/15

Survey # HDP-PF-080715-042

alpha bkg = 0.6 cpm  
beta bkg = 49 cpm

alpha efficiency = 24.90%  
beta efficiency = 23.80%

alpha MDA = 26.5  
beta MDA = 149

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

Sign Test					
SAMPLE ID	SAMPLE ID	Gross TSC Step 8.5.4.a	Gross TSC / Adj. Gross DCGL ( $W_s$ ) Step 8.5.4.b	Difference ( $1-W_s$ ) Step 8.5.4.d	Corrected Difference Step 8.5.4.e
B02-06-01-S-F-S-00	Floor	829	0.044	0.956	0.956
B02-06-02-S-F-S-00	Floor	568	0.030	0.970	0.970
B02-06-03-S-F-S-00	Floor	809	0.043	0.957	0.957
B02-06-04-S-F-S-00	Floor	1080	0.057	0.943	0.943
B02-06-05-S-F-S-00	Floor	468	0.025	0.975	0.975
B02-06-06-S-F-S-00	Floor	639	0.034	0.966	0.966
B02-06-07-S-F-S-00	Floor	839	0.044	0.956	0.956
B02-06-08-S-F-S-00	Floor	859	0.045	0.955	0.955
B02-06-09-S-F-S-00	Floor	819	0.043	0.957	0.957
B02-06-10-S-F-S-00	Floor	839	0.044	0.956	0.956
B02-06-11-S-F-S-00	Floor	809	0.043	0.957	0.957
B02-06-12-S-F-S-00	Floor	458	0.024	0.976	0.976
<b>Number of Positive Differences (S+)</b>					<b>12</b>
<b>Sign Test Critical Value (MARSSIM Table I-3)</b>					<b>9</b>

$\alpha = 0.05$

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	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		

If every measurement in the systematic sample population is  $\leq$  the DCGL, a statistical test is not required.

**TEST: PASS**