

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development					
			Revision: 10		Appendix P-4, Page 1 of 1	

APPENDIX P-4 FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES							
Survey Area:	BSA 02		Description:	Building Survey Area (Building 230)			
Survey Unit:	14		Description:	U-Shaped Area (Southeast) – Lower Walls, Floor and Stairs			
Survey Type:	FSS		Classification:	Class 2			

Measurement or Sample ID	Surface or CSM	Type	Start Elevation	End Elevation	Northing (feet) (Y Axis) *	Easting (feet) (X Axis) *	Remarks / Notes
B02-21-01-S-F-S-00	F	S	NA	NA	62.0	12.0	Floor
B02-21-02-S-F-S-00	F	S	NA	NA	62.0	35.6	Floor
B02-21-03-S-F-S-00	F	S	NA	NA	62.0	59.2	Floor
B02-21-04-S-F-S-00	F	S	NA	NA	46.6	0.2	Floor
B02-21-05-S-F-S-00	F	S	NA	NA	41.7	23.8	Floor
B02-21-06-S-F-S-00	F	S	NA	NA	21.3	12.0	Floor
B02-21-07-S-F-S-00	F	S	NA	NA	21.3	35.6	Floor
B02-21-08-S-F-S-00	F	S	NA	NA	1.0	0.2	Floor
B02-21-09-S-F-S-00	F	S	NA	NA	1.0	23.8	Floor
B02-21-10-S-W-S-00	W	S	NA	NA	5.2	2.1	South Wall
B02-21-11-S-W-S-00	W	S	NA	NA	5.2	25.8	South Wall
B02-21-12-S-F-B-00	F	B	NA	NA	42.0	24.0	Floor
B02-21-13-S-F-B-00	F	B	NA	NA	22.0	38.0	Floor
B02-21-14-S-F-B-00	F	B	NA	NA	1.0	4.0	Floor
B02-21-15-S-F-B-00	F	B	NA	NA	62.0	15.0	Floor
B02-21-16-S-F-B-00	F	B	NA	NA	60.0	58.0	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 ²	α HDP Efficiency 26.6%	α Cal. Efficiency N/A	β HDP Efficiency 27.8%	β Cal. Efficiency N/A
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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	0.2660	0.25	1.00	2.682E-03	1.78E-04
Np-237	Alpha	5.0	0.2660	0.25	1.00	5.573E-05	3.71E-06
Pu-239	Alpha	5.2	0.2660	0.25	1.00	2.027E-06	1.35E-07
Tc-99	Beta	0.294	0.2780	0.25	1.00	2.829E-03	1.97E-04
Th-232	Alpha	4.1	0.2660	0.25	1.00	3.214E-03	2.14E-04
Ra-228	Beta	0.046	0.2780	0.00	1.00	3.214E-03	0.00E+00
Ac-228	Beta	2.13	0.2780	0.50	1.00	3.214E-03	4.47E-04
Th-228	Alpha	5.5	0.2660	0.25	1.00	3.214E-03	2.14E-04
Ra-224	Alpha	5.8	0.2660	0.25	1.00	3.214E-03	2.14E-04
U-234	Alpha	4.9	0.2660	0.25	1.00	8.270E-01	5.50E-02
U-235	Alpha	4.7	0.2660	0.25	1.00	3.720E-02	2.47E-03
Th-231	Beta	0.390	0.2780	0.25	1.00	3.720E-02	2.59E-03
U-238	Alpha	4.3	0.2660	0.25	1.00	1.270E-01	8.45E-03
Th-234	Beta	0.270	0.2780	0.25	1.00	1.270E-01	8.83E-03
Pa-234m	Beta	2.20	0.2780	0.50	1.00	1.270E-01	1.77E-02

Total Weighted Instrument Efficiency = Σ Weighted Instrument Efficiency for all Nuclides of Concern

$\Sigma =$

9.64%

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

ϵ_i = 2 Pi Instrument Efficiency for Nuclide of Concern

ϵ_s = Surface Efficiency for Nuclide of Concern

Meter
43-93

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 ²	Fraction of DCGL Step 8.4.3
				GROSS cpm (α+β)	BKG cpm (a+b)	Net cpm (α + β)	Combined Net dpm/100 cm ² (α+β)		
B02-21-01-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	246	161	85	881	881	5%
B02-21-02-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	295	161	134	1389	1389	7%
B02-21-03-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	254	161	93	964	964	5%
B02-21-04-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	248	161	87	902	902	5%
B02-21-05-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	236	161	75	778	778	4%
B02-21-06-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	221	161	60	622	622	3%
B02-21-07-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	249	161	88	912	912	5%
B02-21-08-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	294	161	133	1379	1379	7%
B02-21-09-S-F-S-00	Floor	11/04/2015	alpha + beta TSC	237	161	76	788	788	4%
B02-21-10-S-W-S-00	South Wall	11/04/2015	alpha + beta TSC	150	161	-11	-114	0	0%
B02-21-11-S-W-S-00	South Wall	11/04/2015	alpha + beta TSC	133	161	-28	-290	0	0%
B02-21-12-S-F-B-00	Floor	11/04/2015	alpha + beta TSC	237	161	76	788	788	4%
B02-21-13-S-F-B-00	Floor	11/04/2015	alpha + beta TSC	285	161	124	1286	1286	7%
B02-21-14-S-F-B-00	Floor	11/04/2015	alpha + beta TSC	212	161	51	529	529	3%
B02-21-15-S-F-B-00	Floor	11/04/2015	alpha + beta TSC	258	161	97	1006	1006	5%
B02-21-16-S-F-B-00	Floor	11/04/2015	alpha + beta TSC	230	161	69	715	715	4%

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

Min	0
Max	1389
Mean	783
Median	881
Stdev	452.6

Average Fraction
Step 8.4.5.g

DCGLso

1.00 mrem SU Dose Contribution
Step 8.4.6

mrem

Instrument used for FSS Static Measurements:

Ludlum 2360/43-93	S/N 227415	11/04/2015	Survey # HDP-PF-110415-072
Detector Area (A) =	100 cm ²	ave. ambient bkg =	161 cpm weighted eff (ε _w)= 0.09645 (α + β)
TSC (dpm/100cm ²) =	(acpm-bkg) / (ε _w * (A _{std} /100 cm ²))		
DCGL (structures) =	18,925 dpm/100 cm ²		

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 ²	Corrected Alpha Net dpm/100cm ²	Beta Gross cpm	Beta Net cpm	Beta Net dpm/100cm ²	Corrected Beta Net dpm/100cm ²	Combined Net dpm/100 cm ² ($\alpha + \beta$)	Exceed 10% of Min. Sys. TSC Result?	Exceed MDA?	Exceed 10% of DCGL?
1	Floor	11/04/2015	1	1	4	4	36	-6	-28	0	4	Y	N	N
2	Floor	11/04/2015	0	0	0	0	41	-1	-5	0	0	N	N	N
3	Floor	11/04/2015	0	0	0	0	40	-2	-9	0	0	N	N	N
4	Floor	11/04/2015	0	0	0	0	44	2	9	9	9	Y	N	N
5	Floor	11/04/2015	0	0	0	0	35	-7	-33	0	0	N	N	N
6	Floor	11/04/2015	1	1	4	4	42	0	0	0	4	Y	N	N
7	Floor	11/04/2015	0	0	0	0	37	-5	-24	0	0	N	N	N
8	Floor	11/04/2015	0	0	0	0	34	-8	-38	0	0	N	N	N
9	Floor	11/04/2015	2	2	8	8	36	-6	-28	0	8	Y	N	N
10	South Wall	11/04/2015	0	0	0	0	25	-17	-80	0	0	N	N	N
11	South Wall	11/04/2015	1	1	4	4	33	-9	-42	0	4	Y	N	N
12	Floor	11/04/2015	0	0	0	0	32	-10	-47	0	0	N	N	N
13	Floor	11/04/2015	0	0	0	0	30	-12	-57	0	0	N	N	N
14	Floor	11/04/2015	1	1	4	4	43	1	5	5	9	Y	N	N
15	Floor	11/04/2015	1	1	4	4	44	2	9	9	14	Y	N	N
16	Floor	11/04/2015	2	2	8	8	38	-4	-19	0	8	Y	N	N

Min
Max
Mean
Median
StDev

0
14
4
2
4.5

DCGL = 18,925 dpm/100cm²

Removable Activity (dpm/100cm²) = (scpm-bkg) / ϵ

Area "swiped" = 100 cm²

Instrument used for Removable Measurements:

Ludlum 2929/43-10-1 S/N 160023 Cal Due 10/28/16 Survey # HDP-PF-110415-072

alpha bkg = 0.3 cpm alpha efficiency = 24.50% alpha MDA = 22.6
beta bkg = 42.1 cpm beta efficiency = 21.20% beta MDA = 157

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
B02-21-01-S-F-S-00	Floor	881	0.047	0.953	0.953
B02-21-02-S-F-S-00	Floor	1389	0.073	0.927	0.927
B02-21-03-S-F-S-00	Floor	964	0.051	0.949	0.949
B02-21-04-S-F-S-00	Floor	902	0.048	0.952	0.952
B02-21-05-S-F-S-00	Floor	778	0.041	0.959	0.959
B02-21-06-S-F-S-00	Floor	622	0.033	0.967	0.967
B02-21-07-S-F-S-00	Floor	912	0.048	0.952	0.952
B02-21-08-S-F-S-00	Floor	1379	0.073	0.927	0.927
B02-21-09-S-F-S-00	Floor	788	0.042	0.958	0.958
B02-21-10-S-W-S-00	South Wall	0	0.000	1.000	1.000
B02-21-11-S-W-S-00	South Wall	0	0.000	1.000	1.000
Number of Positive Differences (S^+)					11
Sign Test Critical Value (MARSSIM Table I-3)					8

$\alpha = 0.05$

If every measurement in the systematic sample population is $\leq$ 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	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		