

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>PSA 01</u>	<b>Description:</b>	<u>Piping Survey Area Bld 230 W (STM-6)</u>
<b>Survey Unit:</b>	<u>06</u>	<b>Description:</b>	<u>Storm Water piping W of Bld 230</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	Feet West from MH-02	Feet East	Remarks / Notes
P01-06-01-S-O-S-00	O	S	NA	NA	2	N/A	STM-6 Int. Bottom
P01-06-02-S-O-S-00	O	S	NA	NA	9	N/A	STM-6 Int. Bottom
P01-06-03-S-O-S-00	O	S	NA	NA	16	N/A	STM-6 Int. Bottom
P01-06-04-S-O-S-00	O	S	NA	NA	23	N/A	STM-6 Int. Bottom
P01-06-05-S-O-S-00	O	S	NA	NA	30	N/A	STM-6 Int. Bottom
P01-06-06-S-O-S-00	O	S	NA	NA	37	N/A	STM-6 Int. Bottom
P01-06-07-S-O-S-00	O	S	NA	NA	44	N/A	STM-6 Int. Bottom
P01-06-08-S-O-S-00	O	S	NA	NA	51	N/A	STM-6 Int. Bottom
P01-06-09-S-O-S-00	O	S	NA	NA	58	N/A	STM-6 Int. Bottom
P01-06-10-S-O-S-00	O	S	NA	NA	65	N/A	STM-6 Int. Bottom
P01-06-11-S-O-S-00	O	S	NA	NA	72	N/A	STM-6 Int. Bottom
P01-06-12-S-O-S-00	O	S	NA	NA	79	N/A	STM-6 Int. Bottom
P01-06-13-S-O-S-00	O	S	NA	NA	86	N/A	STM-6 Int. Bottom
P01-06-14-S-O-S-00	O	S	NA	NA	93	N/A	STM-6 Int. Bottom
P01-06-15-S-O-S-00	O	S	NA	NA	100	N/A	STM-6 Int. Bottom
P01-06-16-S-O-B-00	O	S	NA	NA	66	N/A	Biased at pipe seam
P01-06-17-S-O-B-00	O	B	NA	NA	74	N/A	Biased at pipe seam
P01-06-18-S-O-B-00	O	B	NA	NA	82	N/A	Biased at pipe seam
P01-06-19-S-O-B-00	O	B	NA	NA	91	N/A	Biased at pipe seam
P01-06-20-S-O-B-00	O	B	NA	NA	99	N/A	Biased at pipe seam
P01-06-21-S-O-B-00	O	B	NA	NA	105	N/A	Biased at pipe seam

\*X and Y coordinates originate from lower left or southwest corner of structural surface. Each structural surface has it's own origin (0,0) point.

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 248144	Ludlum 43-68 216857	Active Probe Area 125 cm <sup>2</sup>	$\alpha$ HDP Efficiency 29.2%	$\alpha$ Cal. Efficiency N/A	$\beta$ HDP Efficiency 19.9%	$\beta$ 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	0.2920	0.25	1.00	2.682E-03	1.96E-04
Np-237	Alpha	5.0	0.2920	0.25	1.00	5.573E-05	4.07E-06
Pu-239	Alpha	5.2	0.2920	0.25	1.00	2.027E-06	1.48E-07
Tc-99	Beta	0.294	0.1990	0.25	1.00	2.829E-03	1.41E-04
Th-232	Alpha	4.1	0.2920	0.25	1.00	3.214E-03	2.35E-04
Ra-228	Beta	0.046	0.1990	0.00	1.00	3.214E-03	0.00E+00
Ac-228	Beta	2.13	0.1990	0.50	1.00	3.214E-03	3.20E-04
Th-228	Alpha	5.5	0.2920	0.25	1.00	3.214E-03	2.35E-04
Ra-224	Alpha	5.8	0.2920	0.25	1.00	3.214E-03	2.35E-04
U-234	Alpha	4.9	0.2920	0.25	1.00	8.270E-01	6.04E-02
U-235	Alpha	4.7	0.2920	0.25	1.00	3.720E-02	2.72E-03
Th-231	Beta	0.390	0.1990	0.25	1.00	3.720E-02	1.85E-03
U-238	Alpha	4.3	0.2920	0.25	1.00	1.270E-01	9.27E-03
Th-234	Beta	0.270	0.1990	0.25	1.00	1.270E-01	6.32E-03
Pa-234m	Beta	2.20	0.1990	0.50	1.00	1.270E-01	1.26E-02

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

$\Sigma =$  9.45%

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>43-68</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> ( $\alpha+\beta$ )		
P01-06-01-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	110	135	-25	-212	0	0%
P01-06-02-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	111	135	-24	-203	0	0%
P01-06-03-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	116	135	-19	-161	0	0%
P01-06-04-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	132	135	-3	-25	0	0%
P01-06-05-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	121	135	-14	-119	0	0%
P01-06-06-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	106	135	-29	-246	0	0%
P01-06-07-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	110	135	-25	-212	0	0%
P01-06-08-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	89	135	-46	-389	0	0%
P01-06-09-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	230	135	95	804	804	4%
P01-06-10-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	232	135	97	821	821	4%
P01-06-11-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	220	135	85	720	720	4%
P01-06-12-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	209	135	74	626	626	3%
P01-06-13-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	210	135	75	635	635	3%
P01-06-14-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	208	135	73	618	618	3%
P01-06-15-S-O-S-00	STM-6 Int. Bottom	06/08/2016	alpha + beta TSC	266	135	131	1,109	1,109	6%
P01-06-16-S-O-B-00	Biased at pipe seam	06/08/2016	alpha + beta TSC	237	135	102	863	863	5%
P01-06-17-S-O-B-00	Biased at pipe seam	06/08/2016	alpha + beta TSC	199	135	64	542	542	3%
P01-06-18-S-O-B-00	Biased at pipe seam	06/08/2016	alpha + beta TSC	182	135	47	398	398	2%
P01-06-19-S-O-B-00	Biased at pipe seam	06/08/2016	alpha + beta TSC	222	135	87	737	737	4%
P01-06-20-S-O-B-00	Biased at pipe seam	06/08/2016	alpha + beta TSC	240	135	105	889	889	5%
P01-06-21-S-O-B-00	Biased at pipe seam	06/08/2016	alpha + beta TSC	310	135	175	1,481	1,481	8%
							Min	0	
							Max	1109	<b>2%</b> Average Fraction Step 8.4.5.g
							Mean	356	<b>DCGL<sub>so</sub></b>
							Median	0	<b>0.5</b> mrem SU Dose Contribution Step 8.4.6
							Stdev	409.7	<b>mrem</b>

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

**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 2360/43-68	S/N 248144	10/02/2016	Survey # 7657 C 160608		
Detector Area (A) =	125 cm <sup>2</sup>	ave. ambient bkg =	135 cpm	weighted eff (ε <sub>w</sub> )=	0.09450
		(α + β)			
TSC (dpm/100cm <sup>2</sup> ) = (qcpm-bkg) / (ε <sub>w</sub> * (A <sub>ref</sub> /100 cm <sup>2</sup> ))					
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	MH02 - B1	12/09/2015	2	1	3	3	31	-3	-16
2	MH02 - B2	12/09/2015	1	0	0	0	30	-4	-21
3	MH02 - B3	12/09/2015	0	-1	-2	0	34	0	-1
4	MH02 - B4	12/09/2015	3	2	6	6	32	-2	-11
5	MH02 - S1	12/09/2015	4	3	8	8	35	1	4
6	MH02 - S2	12/09/2015	2	1	3	3	22	-12	-61
7	MH02 - S3	12/09/2015	1	0	0	0	44	10	49
8	MH02 - S4	12/09/2015	2	1	3	3	31	-3	-16

**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> (α+β)	Exceed 10% of Min. Sys. TSC Result?	Exceed MDA?	Exceed 10% of DCGL?
0	3	Y	N	N
0	0	Y	N	N
0	0	N	N	N
0	6	Y	N	N
4	12	Y	N	N
0	3	Y	N	N
49	49	Y	N	N
0	3	Y	N	N

Min 0  
Max 49  
Mean 10  
Median 3  
StDev 16.5

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 3030/43-10-1 S/N 247399 Cal Due 3/12/16 Survey # 6602 C 151209

alpha bkg = 0.9 cpm      alpha efficiency = 36.60%      alpha MDA = 17.1  
beta bkg = 34.2 cpm      beta efficiency = 20.00%      beta MDA = 116

**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
P01-06-01-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-02-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-03-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-04-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-05-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-06-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-07-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-08-S-O-S-00	STM-6 Int. Bottom	0	0.000	1.000	1.000
P01-06-09-S-O-S-00	STM-6 Int. Bottom	804	0.042	0.958	0.958
P01-06-10-S-O-S-00	STM-6 Int. Bottom	821	0.043	0.957	0.957
P01-06-11-S-O-S-00	STM-6 Int. Bottom	720	0.038	0.962	0.962
P01-06-12-S-O-S-00	STM-6 Int. Bottom	626	0.033	0.967	0.967
P01-06-13-S-O-S-00	STM-6 Int. Bottom	635	0.034	0.966	0.966
P01-06-14-S-O-S-00	STM-6 Int. Bottom	618	0.033	0.967	0.967
P01-06-15-S-O-S-00	STM-6 Int. Bottom	1109	0.059	0.941	0.941
<b>Number of Positive Differences (S+)</b>					<b>15</b>
<b>Sign Test Critical Value (MARSSIM Table I-3)</b>					<b>11</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		

TEST: **PASS**

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