

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**

<b>Survey Area:</b>	<u>PSA 01</u>	<b>Description:</b>	<u>Piping Survey Area Bld 230 S (STM-9)</u>
<b>Survey Unit:</b>	<u>09</u>	<b>Description:</b>	<u>Storm Water piping S 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 NE from MH-01	Feet East	Remarks / Notes
P01-09-01-S-O-S-00	O	S	NA	NA	12	N/A	STM-9 Int. Bottom
P01-09-02-S-O-S-00	O	S	NA	NA	26	N/A	STM-9 Int. Bottom
P01-09-03-S-O-S-00	O	S	NA	NA	39	N/A	STM-9 Int. Bottom
P01-09-04-S-O-S-00	O	S	NA	NA	53	N/A	STM-9 Int. Bottom
P01-09-05-S-O-S-00	O	S	NA	NA	67	N/A	STM-9 Int. Bottom
P01-09-06-S-O-S-00	O	S	NA	NA	81	N/A	STM-9 Int. Bottom
P01-09-07-S-O-S-00	O	S	NA	NA	94	N/A	STM-9 Int. Bottom
P01-09-08-S-O-S-00	O	S	NA	NA	108	N/A	STM-9 Int. Bottom
P01-09-09-S-O-S-00	O	S	NA	NA	122	N/A	STM-9 Int. Bottom
P01-09-10-S-O-S-00	O	S	NA	NA	136	N/A	STM-9 Int. Bottom
P01-09-11-S-O-S-00	O	S	NA	NA	149	N/A	STM-9 Int. Bottom
P01-09-12-S-O-S-00	O	S	NA	NA	163	N/A	STM-9 Int. Bottom
P01-09-13-S-O-S-00	O	S	NA	NA	177	N/A	STM-9 Int. Bottom
P01-09-14-S-O-S-00	O	S	NA	NA	191	N/A	STM-9 Int. Bottom
P01-09-15-S-O-S-00	O	S	NA	NA	204	N/A	STM-9 Int. Bottom
P01-09-16-S-O-B-00	O	B	NA	NA	25	N/A	Biased at downspout
P01-09-17-S-O-B-00	O	B	NA	NA	67	N/A	Biased at pipe seam
P01-09-18-S-O-B-00	O	B	NA	NA	88	N/A	Biased building floor drain
P01-09-19-S-O-B-00	O	B	NA	NA	106	N/A	Biased at downspout
P01-09-20-S-O-B-00	O	B	NA	NA	145	N/A	Biased at downspout
P01-09-21-S-O-B-00	O	B	NA	NA	187	N/A	Biased at downspout
P01-09-22-S-O-B-00	O	B	NA	NA	190	N/A	Biased at pipe bend

\*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
-----------------------	------------------------	--	----------------------------------	---------------------------------	---------------------------------	--------------------------------

**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>
-------------------------------

**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> ( $\alpha+\beta$ )		
P01-09-01-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	95	118	-23	-195	0	0%
P01-09-02-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	98	118	-20	-169	0	0%
P01-09-03-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	96	118	-22	-186	0	0%
P01-09-04-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	109	118	-9	-76	0	0%
P01-09-05-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	79	118	-39	-330	0	0%
P01-09-06-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	78	118	-40	-339	0	0%
P01-09-07-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	81	118	-37	-313	0	0%
P01-09-08-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	69	118	-49	-415	0	0%
P01-09-09-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	109	118	-9	-76	0	0%
P01-09-10-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	103	118	-15	-127	0	0%
P01-09-11-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	64	118	-54	-457	0	0%
P01-09-12-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	68	118	-50	-423	0	0%
P01-09-13-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	87	118	-31	-262	0	0%
P01-09-14-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	78	118	-40	-339	0	0%
P01-09-15-S-O-S-00	STM-9 Int. Bottom	12/03/2015	alpha + beta TSC	86	118	-32	-271	0	0%
P01-09-16-S-O-B-00	Biased at downspout	12/03/2015	alpha + beta TSC	121	109	12	102	102	1%
P01-09-17-S-O-B-00	Biased at pipe seam	12/03/2015	alpha + beta TSC	114	109	5	42	42	0%
P01-09-18-S-O-B-00	Biased building floor drain	12/03/2015	alpha + beta TSC	97	109	-12	-102	0	0%
P01-09-19-S-O-B-00	Biased at downspout	12/03/2015	alpha + beta TSC	93	109	-16	-135	0	0%
P01-09-20-S-O-B-00	Biased at downspout	12/03/2015	alpha + beta TSC	88	109	-21	-178	0	0%
P01-09-21-S-O-B-00	Biased at downspout	12/03/2015	alpha + beta TSC	113	109	4	34	34	0%
P01-09-22-S-O-B-00	Biased at pipe bend	12/03/2015	alpha + beta TSC	130	109	21	178	178	1%

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

Min	0	Average Fraction
Max	0	Step 8.4.5.g
Mean	0	DCGL <sub>so</sub>
Median	0	0.0
Stdev	0.0	mrem SU Dose Contribution
		Step 8.4.6
		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 2360/43-68	S/N 248144	10/02/2016	Survey # 6937 C 160203		
Detector Area (A) =	125 cm <sup>2</sup>	ave. ambient bkg =	118 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	MH01 - S1	01/07/2016	2	0	0	0	31	-3	-16
2	MH01 - S2	01/07/2016	1	-1	-3	0	30	-4	-21
3	MH01 - S3	01/07/2016	0	-2	-5	0	34	0	-1
4	MH01 - S4	01/07/2016	3	1	3	3	32	-2	-11
5	MH01 - B1	01/07/2016	4	2	5	5	35	1	4
6	MH01 - B2	01/07/2016	2	0	0	0	22	-12	-61
7	MH01 - B3	01/07/2016	1	-1	-3	0	44	10	50
8	MH01 - B4	01/07/2016	2	0	0	0	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	0	N	N	N
0	0	N	N	N
0	0	N	N	N
0	3	Y	N	N
4	10	Y	N	N
0	0	N	N	N
50	50	Y	N	N
0	0	N	N	N

Min 0  
Max 50  
Mean 8  
Median 0  
StDev 17.2

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

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

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

Instrument used for Removable Measurements:

Ludlum 3030/43-10-1 S/N 247399 Cal Due 3/12/16 Survey # 6776 C 160107

alpha bkg = 2 cpm      alpha efficiency = 36.60%      alpha MDA = 21.5  
beta bkg = 34.1 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
P01-09-01-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-02-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-03-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-04-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-05-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-06-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-07-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-08-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-09-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-10-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-11-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-12-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-15-S-O-S-00	STM-9 Int. Bottom	0	0.000	1.000	1.000
P01-09-16-S-O-B-00	Biased at downspout	102	0.005	0.995	0.995
P01-09-17-S-O-B-00	Biased at pipe seam	42	0.002	0.998	0.998
<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.