

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:	<u>BSA 04</u>	Description:	<u>Structure Survey Unit in "Area 3"</u>
Survey Unit:	<u>13</u>	Description:	<u>Concrete pavement and Transmformer in LSA 08-04</u>
Survey Type:	<u>FSS</u>	Classification:	<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
B04-13-01-S-F-S-00	F	S	436.9	436.9	865078.7	827148.9	Concrete Pad
B04-13-02-S-F-S-00	F	S	442.6	442.6	865070.9	827144.3	Disconnect Top
B04-13-03-S-F-S-00	F	S	436.9	436.9	865070.9	827153.5	Concrete Pad
B04-13-04-S-F-S-00	F	S	444.7	444.7	865070.9	827162.7	Switch House Top
B04-13-05-S-F-S-00	F	S	439.8	439.8	865063.0	827158.1	Main Transformer NW Side
B04-13-06-S-F-S-00	F	S	440.8	440.8	865063.0	827167.3	Switch House SW Side
B04-13-07-S-F-S-00	F	S	436.9	436.9	865078.7	827185.6	Asphalt
B04-13-08-S-F-S-00	F	S	436.9	436.9	865078.7	827194.8	Asphalt
B04-13-09-S-F-S-00	F	S	436.9	436.9	865087.0	827190.0	Asphalt
B04-13-10-S-F-S-00	F	S	436.9	436.9	865086.6	827199.4	Asphalt
B04-13-11-S-F-S-00	F	S	436.9	436.9	865094.5	827194.8	Asphalt

*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 26.5%	α Cal. Efficiency N/A	β HDP Efficiency 13.6%	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	0.2650	0.25	1.00	2.682E-03	1.78E-04
Np-237	Alpha	5.0	0.2650	0.25	1.00	5.573E-05	3.69E-06
Pu-239	Alpha	5.2	0.2650	0.25	1.00	2.027E-06	1.34E-07
Tc-99	Beta	0.294	0.1360	0.25	1.00	2.829E-03	9.62E-05
Th-232	Alpha	4.1	0.2650	0.25	1.00	3.214E-03	2.13E-04
Ra-228	Beta	0.046	0.1360	0.00	1.00	3.214E-03	0.00E+00
Ac-228	Beta	2.13	0.1360	0.50	1.00	3.214E-03	2.19E-04
Th-228	Alpha	5.5	0.2650	0.25	1.00	3.214E-03	2.13E-04
Ra-224	Alpha	5.8	0.2650	0.25	1.00	3.214E-03	2.13E-04
U-234	Alpha	4.9	0.2650	0.25	1.00	8.270E-01	5.48E-02
U-235	Alpha	4.7	0.2650	0.25	1.00	3.720E-02	2.46E-03
Th-231	Beta	0.390	0.1360	0.25	1.00	3.720E-02	1.26E-03
U-238	Alpha	4.3	0.2650	0.25	1.00	1.270E-01	8.41E-03
Th-234	Beta	0.270	0.1360	0.25	1.00	1.270E-01	4.32E-03
Pa-234m	Beta	2.20	0.1360	0.50	1.00	1.270E-01	8.64E-03

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

$\Sigma =$ 8.10%

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

<p>Meter 43-89</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 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)		
B04-13-01-S-F-S-00	Concrete Pad	04/15/2016	alpha + beta TSC	214	193	20.667	204	204	1%
B04-13-02-S-F-S-00	Disconnect Top	04/15/2016	alpha + beta TSC	180	193	-13.33	-132	0	0%
B04-13-03-S-F-S-00	Concrete Pad	04/15/2016	alpha + beta TSC	235	193	41.667	412	412	2%
B04-13-04-S-F-S-00	Switch House Top	04/15/2016	alpha + beta TSC	145	193	-48.33	-478	0	0%
B04-13-05-S-F-S-00	Main Transformer NW Side	04/15/2016	alpha + beta TSC	222	193	28.667	283	283	1%
B04-13-06-S-F-S-00	Switch House SW Side	04/15/2016	alpha + beta TSC	173	193	-20.33	-201	0	0%
B04-13-07-S-F-S-00	Asphalt	04/15/2016	alpha + beta TSC	229	193	35.667	353	353	2%
B04-13-08-S-F-S-00	Asphalt	04/15/2016	alpha + beta TSC	193	193	-0.333	-3	0	0%
B04-13-09-S-F-S-00	Asphalt	04/15/2016	alpha + beta TSC	234	193	40.667	402	402	2%
B04-13-10-S-F-S-00	Asphalt	04/15/2016	alpha + beta TSC	210	193	16.667	165	165	1%
B04-13-11-S-F-S-00	Asphalt	04/15/2016	alpha + beta TSC	226	193	32.667	323	323	2%

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

Min	0	1%	Average Fraction
Max	412		Step 8.4.5.g
Mean	195	DCGLso	
Median	204	0.26	mrem SU Dose Contribution
Stdev	170.9	mrem	Step 8.4.6

Instrument used for FSS Static Measurements:

Ludlum 2360/43-89	S/N 278647	04/15/2016	Survey # 7342 C 160415
Detector Area (A) =	125 cm ²	ave. ambient bkg =	193.3 cpm weighted eff (ε _w) = 0.08090 (α + β)
TSC (dpm/100cm ²) =	(acpm-bkg) / (ε _w * (A _{cm} /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	Concrete Pad	04/15/2016	3.1	2.5	9.9	9.9	1.2	-1.5	-5.9	0.0	10	Y	N	N
2	Disconnect Top	04/15/2016	1.0	0.4	1.6	1.6	2.9	0.2	0.8	0.8	2	Y	N	N
3	Concrete Pad	04/15/2016	0.0	-0.6	-2.4	0.0	4.2	1.5	5.9	5.9	6	Y	N	N
4	Switch House Top	04/15/2016	2.0	1.4	5.5	5.5	6.6	3.9	15.4	15.4	21	Y	N	N
5	Main Transformer NW Side	04/15/2016	3.0	2.4	9.5	9.5	2.2	-0.5	-2.0	0.0	9	Y	N	N
6	Switch House SW Side	04/15/2016	1.0	0.4	1.6	1.6	2.9	0.2	0.8	0.8	2	Y	N	N
7	Asphalt	04/15/2016	1.0	0.4	1.6	1.6	5.9	3.2	12.6	12.6	14	Y	N	N
8	Asphalt	04/15/2016	1.0	0.4	1.6	1.6	2.9	0.2	0.8	0.8	2	Y	N	N
9	Asphalt	04/15/2016	1.0	0.4	1.6	1.6	5.9	3.2	12.6	12.6	14	Y	N	N
10	Asphalt	04/15/2016	1.0	0.4	1.6	1.6	1.9	-0.8	-3.1	0.0	2	Y	N	N
11	Asphalt	04/15/2016	1.0	0.4	1.6	1.6	3.9	1.2	4.7	4.7	6	Y	N	N

Instrument used for Removable Measurements:

Tennelec Unit #1 Batch # 51807 ##### Survey # 7343 C 160415
 alpha bkg = 0.6 cpm alpha efficiency = 25.30% alpha MDA = 12.9
 beta bkg = 2.7 cpm beta efficiency = 25.40% beta MDA = 24.3

Min 2
 Max 21
 Mean 8
 Median 6
 StDev 6.3

DCGL = 18,925 dpm/100cm²

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

Area "swiped" = 100 cm²

**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
B04-13-01-S-F-S-00	Concrete Pad	204	0.011	0.989	0.989
B04-13-02-S-F-S-00	Disconnect Top	0	0.000	1.000	1.000
B04-13-03-S-F-S-00	Concrete Pad	412	0.022	0.978	0.978
B04-13-04-S-F-S-00	Switch House Top	0	0.000	1.000	1.000
B04-13-05-S-F-S-00	Main Transformer NW Side	283	0.015	0.985	0.985
B04-13-06-S-F-S-00	Switch House SW Side	0	0.000	1.000	1.000
B04-13-07-S-F-S-00	Asphalt	353	0.019	0.981	0.981
B04-13-08-S-F-S-00	Asphalt	0	0.000	1.000	1.000
B04-13-09-S-F-S-00	Asphalt	402	0.021	0.979	0.979
B04-13-10-S-F-S-00	Asphalt	165	0.009	0.991	0.991
B04-13-11-S-F-S-00	Asphalt	323	0.017	0.983	0.983
Number of Positive Differences (S+)					11
Sign Test Critical Value (MARSSIM Table I-3)					8

$\alpha = 0.05$

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**