APPENDIX G
FINAL SURVEY REPORT BY ENERGY SOLUTIONS

ENERGYSOLUTIONS

82A9611

FINAL STATUS SURVEY REPORT
WASTE STORAGE PAD
AAR MANUFACTURING, INC. (FORMER BROOKS AND PERKINS) SITE

12633 Inkster Road
Livonia, Michigan

Revision 0

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1.0 INTRODUCTION

The former Brooks and Perkins manufacturing site located in Livonia, Michigan contained radioactive thorium left over from the use of thorium and thorium ores in a manufacturing process. Brooks and Perkins terminated their radioactive materials license on May 17, 1971. A review of the license termination by the Oak Ridge National Laboratory (ORNL) in 1994 discovered remaining amounts of thorium in excess of the U.S. Nuclear Regulatory Commission (NRC) release criteria. The site was purchased in 1981 by AAR Corporation (AAR) for use in assembly of aircraft parts. Since 1996, AAR has been in negotiations with the NRC to remediate the site. Partners Environmental has represented AAR in this process and has come to a resolution with the NRC to complete the site remediation.

2.0 DESCRIPTION OF SITE ACTIVITIES

Energy*Solutions*, LLC was contracted by AAR to perform work at the site related to site remediation and release as described in the project Work Plan (Ref. 1). Part of these activities included the clearing of previously collected waste from a concrete storage pad and performing a final status survey of the pad. The pad is located at the west end of the south extension to the AAR facility.

Upon arrival at the site there were 101 55-gallon drums and 7 96-cubic yard B-25 waste boxes containing demolition and environmental samples on or near the waste storage pad. There were also four coolers, one small storage box, and a 15-gallon paper drum also containing environmental samples on the pad. All the waste was removed early in the project and placed in a temporary storage area at the west end of the rear parking lot to facilitate the survey of the pad. It was noted during the transfer of the drums and boxes that several were significantly degraded. Many containers had obvious holes and many of the wooden pallets were severely rotted. Photographs 2-1 and 2-2 show the condition of some of the drums.

Health Physics personnel performed external contamination surveys using large area smears on the drums and boxes prior to removal. No external contamination was identified. Drums were repackaged into certified IP-1 B-25 waste boxes received from the Energy*Solutions* low-level radioactive waste disposal site in Clive, Utah. Health Physics personnel also monitored container transfers to ensure that no waste spilled from degraded drums and boxes. Photograph 2-3 shows the storage pad area after the removal of the most of the waste containers. The B-25 box shown in the photograph was one of the seven that was filled with demolition debris from an earlier remediation inside the building.

The actual area used for storage exceeded beyond the concrete pad by two feet on the north and west side as depicted in the Photograph 2-4. The tarp used to cover the waste was disposed as radioactive waste as a precaution.

The Energy*Solutions* Health Physics Technician performed a preliminary survey of the area after removal of all the drums and boxes (Photograph 2-5) and found no contamination above background. Based on the results of the preliminary survey, the Energy*Solutions* Project Health

Physicist developed a final status survey based on the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (Ref. 2). Applying the protocols in MARSSIM, it was determined that:

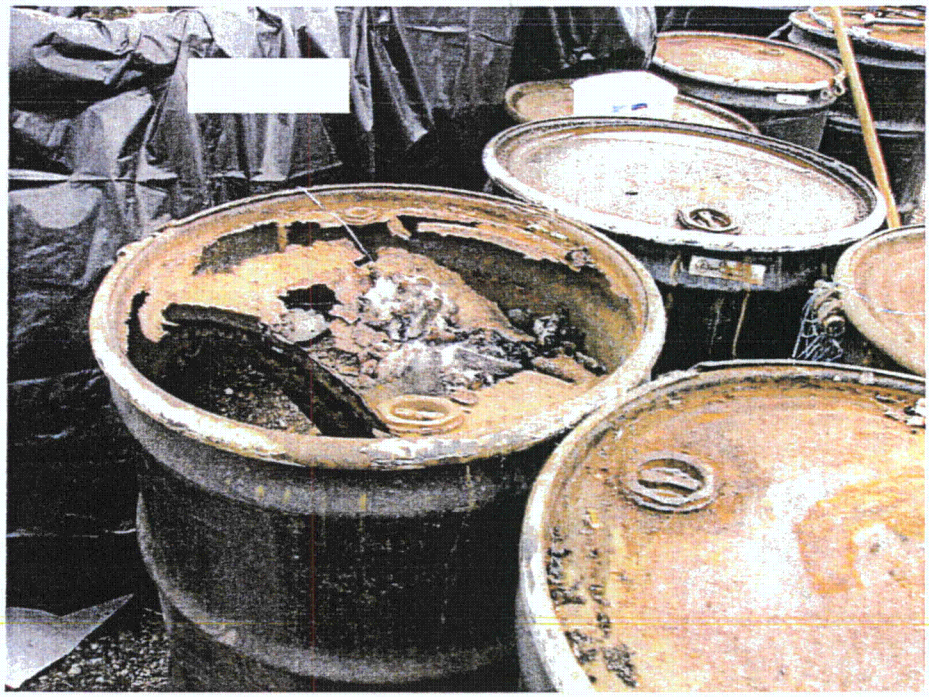
- The storage pad was a Class 1 survey unit;
- The pad would receive a 100% scan for both beta/gamma and alpha activity;
- There would be 15 direct alpha/beta measurements placed on a random start triangular grid;
- There would be a removable contamination smear collected at each direct measurement location and each smear would be counted for alpha and beta activity; and
- A gamma exposure rate measurement would be collected at each direct measurement location at a height of 1 meter from the pad surface.

In addition to the MARSSIM-based final status survey of the pad, it was determined that the soil to the north and west of the pad would receive:

- A 100% gamma walk-over scan; and
- Alpha and beta activity measurements, gamma count rate measurements, and gamma exposure rate measurements at 8 measurement locations.

The Project Health Physicists provided the Health Physics Technicians with survey forms to document the surveys described above. The Health Physics Technicians used calibrated meters and performed the survey according to instructions.

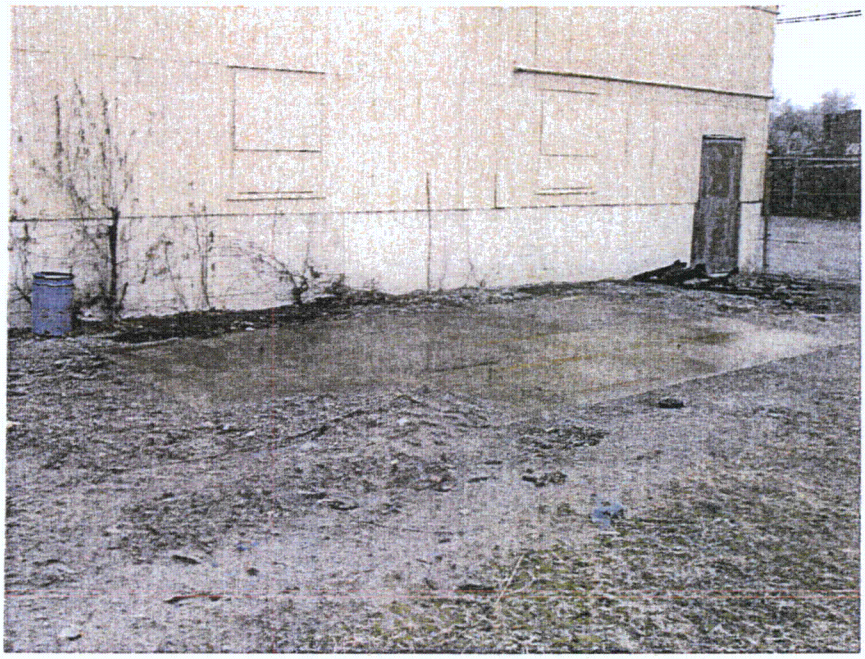
PHOTOGRAPH 2-1
DEGRADED DRUMS FROM WASTE STORAGE PAD



PHOTOGRAPH 2-2
DEGRADED DRUMS FROM WASTE STORAGE PAD

PHOTOGRAPH 2-3
DEBRIS ON WASTE STORAGE PAD

PHOTOGRAPH 2-4
SOIL AREA ADJACENT TO WASTE STORAGE PAD



PHOTOGRAPH 2-5
CLEARED WASTE STORAGE PAD

3.0 RELEASE CRITERIA

Final release surveys were designed to ensure that waste storage pad met the release criteria identified in the project Work Plan (Ref. 1). These criteria, provided in the Table 3-1 below, are consistent with Regulatory Guide 1.86 (Ref. 3).

TABLE 3-1
ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclide	Average[a]	Maximum	Removable
Natural Thorium	1,000 dpm/100cm^2	3,000 dpm/100cm^2	200 dpm/100cm^2

4.0 SURVEY RESULTS

The following attachments provide the results of the waste storage pad surveys:

- Attachment A: Pad beta/gamma contamination survey results
- Attachment B: Pad alpha contamination survey results
- Attachment C: Soil area survey results

The data indicate that the storage pad meets the release criteria established in the Work Plan (Ref. 1). The pad survey data are summarized in Table 4-1 below. All data are within the background levels of the instrument. Contamination values less than the minimum detectable concentration (MDC) are reported as "< MDC."

TABLE 4-1
WASTE STORAGE PAD SURVEY DATA SUMMARY

Survey Type	Average Activity	Maximum Activity	MDC ($dpm/100cm^2$)
Direct Alpha	< MDC	< MDC	91
Removable Alpha	< MDC	< MDC	23
Alpha Scan	< MDC	< MDC	548
Direct Beta	< MDC	< MDC	289
Removable Beta	< MDC	< MDC	132
Beta Scan	< MDC	< MDC	2,624
Gross Exposure Rate	6.5 μR/hr	7 μR/hr	NA

The results of the alpha and beta/gamma surveys of the soil area were all < MDC and the gamma count rate measurements, measured with a 2-inch by 2-inch sodium iodide gamma scintillation detector were all within background levels.

Table 4-2 provides a list of the instruments used during the surveys.

TABLE 4-2
SURVEY INSTRUMENTS

Survey Type	Manufacturer	Detector and Probe Model Numbers	Serial Number
Direct Alpha/Beta	Ludlum	2224-1 w/ 43-93 phoswich scintillation probe	129463 509
Removable Alpha/Beta	Ludlum	3030 w/ internal alpha/beta scintillation detector	217617 229370
Alpha/Beta Scan	Ludlum	2224-1 w/ 43-93 phoswich scintillation probe	129463 509
Gamma Exposure Rate	Ludlum	19	62196
Gamma Count Rate	Ludlum	2221 w/ 44-10 2"x2" NaI scintillation probe	68537 226943

5.0 WASTE MANAGEMENT

To manage the drums staged on the waste storage pad, many of which contained free liquids, Energy*Solutions* provided the project with twenty-five B-25 boxes and several hundred pounds of Stabl-Cob absorbent. Each drum was rigged with a lifting sling and suspended over a B-25 containing 16 cubic feet of Stabl-Cob absorbent. Holes were drilled into the bottom of the drum and the liquid was allowed to drain into the box. The drum was then lowered into the box. Four drums were packaged in this manner into each B-25 box.

Once a box contained four drums, the lid was placed on the box and secured. Health Physics personnel surveyed the box to ensure contamination and radiation levels did not exceed DOT limits and it was loaded onto a flat bed trailer for transport to the rail loading area. At the rail loading area, the B-25 boxes were placed into Sealand containers and braced. Four boxes were placed in each Sealand. The Sealand containers were loaded onto flatbed rail cars and processed in accordance with approved procedures for shipment to Energy*Solutions*, Clive, UT waste disposal site. All shipments were classified as low-specific activity waste, LSA-1.

6.0 REFERENCES

1. *Remedial Work Plan - Waste Excavation and Site Restoration.* AAR Manufacturing, Inc. (Former Brooks and Perkins) Site. Energy*Solutions* Document No. 82A9606. November 2006.

2. U.S. Nuclear Regulatory Commission (NRC) Guide, NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM), Revision 1, August 2000.

3. NRC Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, June 1974.

ATTACHMENT A

PAD BETA/GAMMA CONTAMINATION SURVEY RESULTS

ENERGYSOLUTIONS

Final Status Survey Results
AAR Manufacturing, Inc.

Location:	AAR Cargo Systems	
Surveyor:	Vicky Baldwin (Print)	12/29/2006 (Date)
Reviewer:	Kevin Taylor, CHP (Print)	1/4/2007 (Date)

Survey Meters

Beta-Gamma Scan Instrumentation		Beta-Gamma Smear Instrument		Beta-Gamma Direct Measurement Instrumentation		Dose Rate Instrumentation	
Meter Model #	L2224-1	Meter Model #	L3030	Meter Model #	L2224-1	Meter Model #	L 19
Meter Serial #	129463	Meter Serial #	217617	Meter Serial #	129463	Meter Serial #	62196
Probe Serial #	509	Probe Serial #	229370	Probe Serial #	509	Cal Due	1/10/2007
Cal Due	5/16/2007	Cal Due	5/17/2007	Cal Due	5/16/2007	Type	gamma
2-pi Efficiency (%)	25.20%	2-pi Efficiency (%)	23.37%	2-pi Efficiency (%)	25.20%	BKG (uR/hr)	6
Type	beta/gamma	Type	beta/gamma	Type	beta/gamma	Guideline (mR/hr)	NA
Sample Time (min)	5	Sample Time (min)	2	Sample Time (min)	5	Action Level (mR/hr)	NA
Background Time (min)	5	Background Time (min)	60	Background Time (min)	5		
Background Reading (counts)	1481	Background Reading (counts)	2426	Background Reading (counts)	1481		
BKG (cpm)	296.2	BKG (cpm)	40.4	BKG (cpm)	296.2		
MDC (dpm/100cm2)	2624	MDC (dpm/100cm2)	132	MDC (dpm/100cm2)	289		
Guideline (dpm/100cm^2)	1000	Guideline (dpm/100cm^2)	200	Guideline (dpm/100cm^2)	1000		
Action Level (dpm/100cm^2)	NA	Action Level (dpm/100cm^2)	NA	Action Level (dpm/100cm^2)	NA		

Instrument	L2224-1		Instrument	L3030		Instrument	L2224-1	
S/N	129463		S/N	217617		S/N	129463	
R_B	296.2	cpm	R_B	40.43333333	cpm	R_B	296.2	cpm
t_s	5	minutes	t_s	2	minutes	t_s	5	minutes
t_b	5	minutes	t_b	60	minutes	t_b	5	minutes
ε_s	0.5		ε_s	0.5		ε_s	0.5	
ε_i	25%		ε_i	25%		ε_i	25%	
probe area	100	cm^2	probe area	NA	cm^2	probe area	100	cm^2
Scan MDC	2624	dpm/100cm^2	MDC	132	dpm/100cm^2	MDC	289	dpm/100cm^2

$$MDC = \frac{3 + 3.29\sqrt{R_B t_s (1 + \frac{t_s}{t_b})}}{\varepsilon_s(\varepsilon_i)(t_s)(\frac{probe\ area}{100cm^2})}$$

$$ScanMDC = \frac{1.38 * \frac{60}{t}\sqrt{R_B \frac{t}{60}}}{\sqrt{0.5}\varepsilon_s(\varepsilon_i)(\frac{probe\ area}{100cm^2})}$$

Location	Beta/G - Scan Ave Results (dpm/100cm^2)	Beta/G - Scan Max Results (dpm/100cm^2)	Beta/G - Smear Results (dpm/100cm2)	Beta/G - Direct Results (dpm/100cm^2)	Dose Rate Results (µR/hr)	Material
1	<MDC	<MDC	<MDC	<MDC	6	Concrete
2	<MDC	<MDC	<MDC	<MDC	7	Concrete
3	<MDC	<MDC	<MDC	<MDC	7	Concrete
4	<MDC	<MDC	<MDC	<MDC	7	Concrete
5	<MDC	<MDC	<MDC	<MDC	7	Concrete
6	<MDC	<MDC	<MDC	<MDC	7	Concrete
7	<MDC	<MDC	<MDC	<MDC	6	Concrete
8	<MDC	<MDC	<MDC	<MDC	6	Concrete
9	<MDC	<MDC	<MDC	<MDC	6	Concrete
10	<MDC	<MDC	<MDC	<MDC	6	Concrete
11	<MDC	<MDC	<MDC	<MDC	7	Concrete
12	<MDC	<MDC	<MDC	<MDC	7	Concrete
13	<MDC	<MDC	<MDC	<MDC	7	Concrete
14	<MDC	<MDC	<MDC	<MDC	6	Concrete
15	<MDC	<MDC	<MDC	<MDC	6	Concrete

Data Input

Location	Beta/G - Scan Ave Results		Beta/G - Scan Max Results		Beta/G - Smear Results		Dose Rate	Beta/G - Direct Reading Results	
	Gross CPM	dpm/100cm^2	Gross CPM	dpm/100cm^2	Gross Counts	dpm/100cm^2	µR/hr	Gross CPM	dpm/100cm^2
1	250	-366.67	300	30.16	46	-139.47	6	261	-279.37
2	250	-366.67	300	30.16	46	-139.47	7	261	-279.37
3	250	-366.67	340	347.62	49	-127.47	7	258	-303.17
4	240	-446.03	340	347.62	54	-107.47	7	249	-374.60
5	220	-604.76	300	30.16	45	-143.47	7	280	-128.57
6	240	-446.03	340	347.62	52	-115.47	7	258	-303.17
7	220	-604.76	340	347.62	49	-127.47	6	278	-144.44
8	240	-446.03	300	30.16	53	-111.47	6	258	-303.17
9	250	-366.67	340	347.62	52	-115.47	6	250	-366.67
10	250	-366.67	330	268.25	51	-119.47	6	279	-136.51
11	250	-366.67	340	347.62	43	-151.47	7	275	-168.25
12	220	-604.76	340	347.62	54	-107.47	7	271	-200.00
13	220	-604.76	330	268.25	48	-131.47	7	280	-128.57
14	240	-446.03	340	347.62	51	-119.47	6	270	-207.94
15	240	-446.03	330	268.25	48	-131.47	6	278	-144.44

ATTACHMENT B

PAD ALPHA CONTAMINATION SURVEY RESULTS

ENERGYSOLUTIONS

Final Status Survey Results
AAR Manufacturing, Inc.

Location:	AAR Cargo Systems	
Surveyor:	Vicky Baldwin (Print)	12/29/2006 (Date)
Reviewer:	Kevin Taylor, CHP (Print)	1/4/2007 (Date)

Survey Meters

Alpha Scan Instrumentation		Alpha Smear Instrument		Alpha Direct Measurement Instrumentation	
Meter Model #	L2224-1	Meter Model #	L3030	Meter Model #	L2224-1
Meter Serial #	129463	Meter Serial #	217617	Meter Serial #	129463
Probe Serial #	509	Probe Serial #	229370	Probe Serial #	509
Cal Due	5/16/2007	Cal Due	5/17/2007	Cal Due	5/16/2007
2-pi Efficiency (%)	32.60%	2-pi Efficiency (%)	48.40%	2-pi Efficiency (%)	32.60%
Type	alpha	Type	alpha	Type	alpha
Sample Time (min)	5	Sample Time (min)	2	Sample Time (min)	5
Background Time (min)	5	Background Time (min)	60	Background Time (min)	5
Background Reading (counts)	54	Background Reading (counts)	19	Background Reading (counts)	54
BKG (cpm)	10.8	BKG (cpm)	0.3	BKG (cpm)	10.8
MDC (dpm/100cm2)	548	MDC (dpm/100cm2)	23	MDC (dpm/100cm2)	91
Guideline (dpm/100cm^2)	100	Guideline (dpm/100cm^2)	20	Guideline (dpm/100cm^2)	100
Action Level (dpm/100cm^2)	NA	Action Level (dpm/100cm^2)	NA	Action Level (dpm/100cm^2)	NA

Instrument	L2224-1		Instrument	L3030		Instrument	L2224-1	
S/N	129463		S/N	217617		S/N	129463	
R_B	10.8	cpm	R_B	0.32	cpm	R_B	10.8	cpm
t_s	5	minutes	t_s	2	minutes	t_s	5	minutes
t_b	5	minutes	t_b	60	minutes	t_b	5	minutes
ε_s	0.25		ε_s	0.5		ε_s	0.25	
ε_i	33%		ε_i	25%		ε_i	33%	
probe area	100	cm^2	probe area	NA	cm^2	probe area	100	cm^2
Scan MDC	548	dpm/100cm^2	MDC	23	dpm/100cm^2	MDC	91	dpm/100cm^2

$$MDC = \frac{3 + 3.29\sqrt{R_B t_s (1 + \frac{t_s}{t_b})}}{\varepsilon_s \varepsilon_i (\frac{probe\ area}{100cm^2})}$$

$$Scan\ MDC = \frac{1.38 + \frac{60}{t}\sqrt{R_B \frac{t}{60}}}{\sqrt{0.5}\varepsilon_s \varepsilon_i (\frac{probe\ area}{100cm^2})}$$

Location	Alpha - Scan Ave Results (dpm/100cm^2)	Alpha - Scan Max Results (dpm/100cm^2)	Alpha - Smear Results (dpm/100cm2)	Alpha - Direct Results (dpm/100cm^2)		Material
1	<MDC	<MDC	<MDC	<MDC		Concrete
2	<MDC	<MDC	<MDC	<MDC		Concrete
3	<MDC	<MDC	<MDC	<MDC		Concrete
4	<MDC	<MDC	<MDC	<MDC		Concrete
5	<MDC	<MDC	<MDC	<MDC		Concrete
6	<MDC	<MDC	<MDC	<MDC		Concrete
7	<MDC	<MDC	<MDC	<MDC		Concrete
8	<MDC	<MDC	<MDC	<MDC		Concrete
9	<MDC	<MDC	<MDC	<MDC		Concrete
10	<MDC	<MDC	<MDC	<MDC		Concrete
11	<MDC	<MDC	<MDC	<MDC		Concrete
12	<MDC	<MDC	<MDC	<MDC		Concrete
13	<MDC	<MDC	<MDC	<MDC		Concrete
14	<MDC	<MDC	<MDC	<MDC		Concrete
15	<MDC	<MDC	<MDC	<MDC		Concrete

Data Input

Location	Alpha - Scan Ave Results		Alpha - Scan Max Results		Alpha - Smear Results			Alpha - Direct Reading Results	
	Gross CPM	dpm/100cm^2	Gross CPM	dpm/100cm^2	Gross Counts	dpm/100cm^2		Gross CPM	dpm/100cm^2
1	1	-120.25	2	-107.98	0	-2.53		4	-83.44
2	0	-132.52	1	-120.25	0	-2.53		5	-71.17
3	0	-132.52	0	-132.52	1	1.47		6	-58.90
4	0	-132.52	1	-120.25	0	-2.53		5	-71.17
5	0	-132.52	0	-132.52	0	-2.53		3	-95.71
6	1	-120.25	3	-95.71	2	5.47		13	26.99
7	0	-132.52	0	-132.52	0	-2.53		3	-95.71
8	0	-132.52	0	-132.52	2	5.47		3	-95.71
9	0	-132.52	0	-132.52	0	-2.53		4	-83.44
10	0	-132.52	1	-120.25	0	-2.53		9	-22.09
11	1	-120.25	2	-107.98	0	-2.53		4	-83.44
12	0	-132.52	0	-132.52	1	1.47		7	-46.63
13	0	-132.52	1	-120.25	0	-2.53		5	-71.17
14	0	-132.52	1	-120.25	1	1.47		6	-58.90
15	1	-120.25	2	-107.98	1	1.47		8	-34.36

ATTACHMENT C

SOIL AREA SURVEY RESULTS

ENERGY SOLUTIONS

AAR Storage Pad
Soil Survey

[redacted]eyor: Vicky Baldwin (Print) — 12/29/2006 (Date)

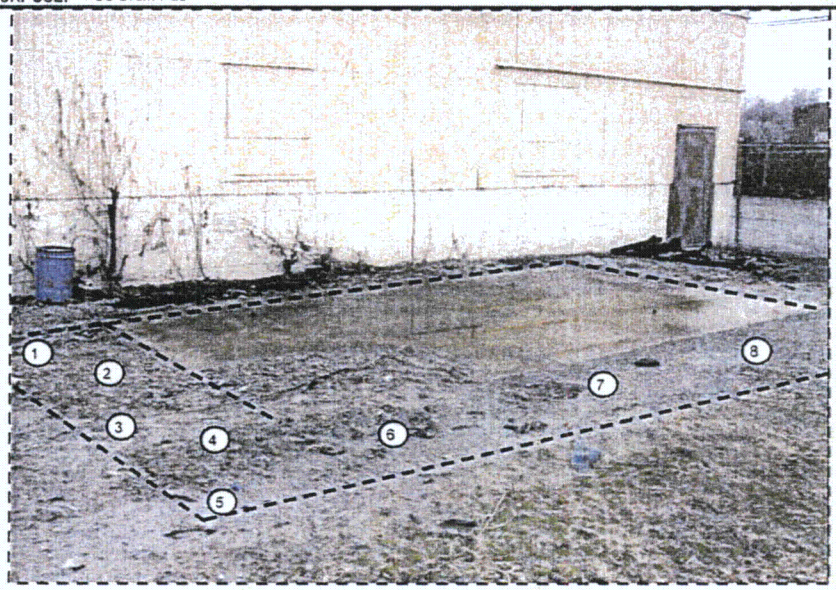
Reviewer: Kevin Taylor, CHP (Print) — 1/4/2007 (Date)

Survey Meters

Direct Beta		Direct Alpha		Direct Gamma (2x2 NaI)		Exposure Rate @ 1 meter	
Meter Model #	L2224-1	Meter Model #	L2360	Meter Model #	L2221	Meter Model #	L19
Meter Serial #	129463	Meter Serial #	129463	Meter Serial #	68537	Meter Serial #	62196
Probe Serial #	509	Probe Serial #	509	Probe Serial #	226943	Cal Due	1/10/2007
Cal Due	5/16/2007	Cal Due	5/16/2007	Cal Due	6/20/2007	Type $\alpha, \beta \gamma$	gamma
2-pi Efficiency (%)	13%	2-pi Efficiency (%)	16%	2-pi Efficiency (%)	NA	BKG (µR/hr)	6
Surface Efficiency	0.50	Surface Efficiency	0.25	Surface Efficiency	NA		
Type $\alpha, \beta \gamma$	beta/gamma	Type $\alpha, \beta \gamma$	alpha	Type $\alpha, \beta \gamma$	gamma	Guideline (µR/hr)	NA
Sample Time (min)	5	Sample Time (min)	5	Sample Time (min)	1	Action Level (µR/hr)	NA
Background Time (min)	5	Background Time (min)	5	Background Time (min)	10		
Background Reading (counts)	1481	Background Reading (counts)	54	Background Reading (counts)	69963		
BKG (cpm)	296.2	BKG (cpm)	10.8	BKG (cpm)	6996.3		
MDC (dpm/100cm2)	578	MDC (dpm/100cm2)	183	MDC (dpm/100cm2)	NA		
Guideline (dpm/100cm^2)	NA	Guideline (dpm/100cm^2)	NA	Guideline (dpm/100cm^2)	NA		
Action Level (dpm/100cm^2)	NA	Action Level (dpm/100cm^2)	NA	Action Level (dpm/100cm^2)	NA		

[redacted]TION: AAR Cargo Systems

PURPOSE: FSS Drum Pad



Location	β/γ - Direct dpm/100cm2	α - Direct dpm/100cm2	γ - Direct cpm	Exp. Rate uR/hr
1	<MDC	<MDC	6613	7
2	<MDC	<MDC	6204	7
3	<MDC	<MDC	7063	7
4	<MDC	<MDC	6307	7
5	<MDC	<MDC	6606	7
6	<MDC	<MDC	6147	6
7	<MDC	<MDC	6063	6
8	<MDC	<MDC	5978	6
	Gamma Walk Over Scans			
	Ave. cpm	Max. cpm		
1	6500	7400		
2	6400	7100		
3	6500	7400		
4	6300	7400		
5	6500	6800		
6	6200	6400		
7	6000	6600		
8	6000	6600		

[redacted]

$$MDC = \frac{3 + 3.29\sqrt{R_B t_S (1 + \frac{t_S}{t_B})}}{\varepsilon_s (\varepsilon_i)(t_S)(\frac{probe\ area}{100cm^2})}$$