APPENDIX S RADIOLOGICAL SURVEY

RVAAP Load Line 4 Phase II RI Final
THIS PAGE INTENTIONALLY LEFT BLANK.
THIS TRUE IN TENTION MEET EET I BEMAIK.

Rad Survey No. USACELRB-TD-EH-R1-04-03, RVAAP, OH, 11 SEP 01

EXECUTIVE SUMMARY

RADIATION SURVEY REPORT NO. LRB-TD-EH-R1-04-03
LOADLINES 2,3 & 4 REPORT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
11 SEP 01

1. PURPOSE. Radiological surveys of load lines 2,3&4 were conducted to demonstrate that no residual radioactive contamination attributable to Ravenna Army Ammunition Plant (RVAAP) activities is detectable using accepted survey methods for decommissioning. These surveys also demonstrate that the radiological parameters from residual radioactive contamination are below the release criteria for each area surveyed. In addition, records were reviewed to determine if documentation existed to support the proper disposal of the radioactive sources (i.e.Cobalt-60 sealed sources) used in the load lines at the RVAAP.

2. CONCLUSIONS.

- 2.1 A review of the survey results indicates that there is no detectable cobalt 60 contamination in the load lines.
- 2.2 Records exist that indicate that the three, sealed cobalt 60 sources were shipped off site in 1971 and 1972.

TABLE OF CONTENTS

1.	REFERENCES	
2.	PURPOSE	1
3.	GENERAL	1
4.	BACKGROUND	2
	4.1 SITE BACKGROUND	2
	4.2 CHRONOLOGY	3
	4.3 SITE CONDITION AT TIME OF SURVEY	3
	4.4 POTENTIAL CONTAMINANTS AND RELEASE GUIDELINES	
5.	RADIATION SURVEYS AND RESULTS	4
٠.	5.1 INSTRUMENTATION/EQUIPMENT	4
	5.2 INSTRUMENTATION SURVEY	4
	5.3 SAMPLING AND RESULTS	5
	5.4 SURVEY DATA REVIEW	7
6.	HISTORICAL RECORDS REVIEW	8
7.	CONCLUSIONS	9
<i>,</i> .	CONCHOD 2011B	
7 10 1	PENDICES	
API	SENDICES	
А	References and Abbreviations	A - 1
В	Load Line 2 Survey Reports	B-1
C	Load Line 3 Survey Reports	C-1
D	Load Line 4 Survey Reports	D-1
	Historical Records	E-1

RADIATION SURVEY REPORT NO. LRB-TD-EH-R1-04-03 LOADLINES 2,3 & 4 REPORT RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO 11 SEP 01

- 1. REFERENCES. See Appendix A for a list of references.
- 2. **PURPOSE.** The objectives of the Final Status Survey for load lines 2, 3 & 4 were to:
- 2.1 Certify that no residual radioactive contamination attributable to RVAAP activities is detectable using accepted survey methods for decommissioning.
- 2.2 Demonstrate that the radiological parameters from residual radioactive contamination are below the release criteria for each area surveyed.
- 2.1 Document the disposal of the radioactive sources i.e.Co-60 sealed sources) used in the load lines and result of the FSS.

3. GENERAL.

- 3.1 Project management for the survey was conducted by the U.S. Army Corps of Engineers, Buffalo District (USACELRB).
- 3.2 The survey was managed by Mr. Craig Rieman, Chief, Environmental Health, USACELRB. A team of consisting of Mr. Clint Verelle, USACELRB Health Physicist and Mr. Mat Masset, USACELRB, Chemist performed the field surveys.
- 3.3 The USACE personnel mentioned above have varied expertise in radiological health issues and are qualified to perform the survey. Each individual was provided occupational health and safety training by USACELRB to administer a safe working environment.
- 3.4 Quality Assurance oversight and independent verification of the project was provided by the USACE Baltimore District (USACENAB) rather than the U.S. Army Center for Health Promotion and Preventive Medicine, Industrial Health Physics Program (USACHPPM-IHPP) as planned because of schedule conflicts. Mr. Karl Ford, Health Physicist reviewed the work

plan and to insure a comprehensive survey. He also observed surveys in progress to insure the plan was followed.

3.5 A list of abbreviations used in this report can be found in Appendix A.

4. Site and Project Background.

4.1 Site Background.

- 4.1.1 DOD activities at Ravenna Army Ammunition Plant(RVAAP) date back to 1940 and include the storage, handling, and packing of military ammunition and explosives. The site is located in northeastern Ohio in Portage and Trumbell Counties, see Appendix B. The installation includes 21,419 acres in a tract approximately 3.5 miles wide by 11 miles long. RVAAP is a government owned contractor operated facility under the control of the US Army Industrial Operations Command.
- 4.1.2 A site assessment was conducted and documented in: Preliminary Assessment for Ravenna Army Ammunition Plant, February 1996, by Science Applications International Corporation (SAIC). This site assessment did not adequately address the radiological concerns at RVAAP.
- 4.1.3 A historical assessment of radiological use at RVAAP was conducted in July of 1990, by Olin Ordnance. The report generated from that assessment identified the Monazite Sand Storage and Projectile Radiography operations. These operations were licensed by the Atomic Energy Commission [now the US Nuclear Regulatory Commission (NRC)]. Both licenses were terminated.
- 4.1.4 Radioactive materials (RAM) were known to be used or stored at four locations on RVAAP.
 - Monazite Sand Storage Area
 - Projectile Radiography on Load Line 3
 - Building 2F4
 - Building 130
- 4.1.4.1 The radiography sources were two 1,000 Ci and one 500 Ci Co-60 sealed sources. The sources were located on load line 3 in building 10A and were properly disposed. Records of surveys were not available for review so this area will be surveyed according to this plan. Other load lines reportedly

utilized industrial x-ray machines, however, this information has not been verified. Consequently a Final Status Survey for load lines 2&4 as well as load line 3 will be conducted.

4.1.4.2 The Monazite sand location and Buildings 2F4 and 130 are not addressed in this plan as directed by Mr. John Jent.

4.2 Chronology.

- 4.2.1 The USACELRB began preparations for the survey in August 2001.
- 4.2.2 USACELRB finalized the survey work plan on 8 August 2001; RADIATION FINAL STATUS SURVEY PLAN FOR LOADLINES 2,3&4, RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO, September 2001
- 4.2.3 On 11 September 2001 the USACELRB conducted the radiological surveys. USACENAB was unable to complete all QA surveys due to RVAAP site security procedures activated in response to the terrorists attacks on that day.
- 4.2.4 On 19-21 September 2001, USACENAB conducted additional QA survey activities to support the close-out of ammunition load lines 2,3 & 4.
- 4.2.5 The USACELRB received the QA results from USACENAB on 30 October 2001.

4.3 Site Conditions at time of Survey.

- 4.3.1 The load lines 2,3 & 4 AOC are abandoned facilities which have deteriorated due to a lack of maintenance over time. Temporary lighting was established so that appropriate work conditions existed.
- 4.3.2 Various building materials had crumbled from the walls and ceiling in the load lines.
- 4.3.3 Onsite support was available to the USACE team during the survey; excellent support was provided by Mr. Mark Patterson and the RVAAP security personnel.
- 4.3.4 An appropriate reference area in Building 1055 was selected (IAW MARSSIM and sampled prior to beginning surveys of the survey units.

- 4.4 Potential Contaminant. The potential radiological contaminant of concern at RVAAP Loadlines 2,3&4 is Cobalt 60 (Co-60). Co-60 has a 5.2 year half-life and decays by beta emission with a 1.173 MeV gamma.
- 4.4.1 Co-60 has a 5.2 year half-life and decays by beta emission with a 1.173 MeV gamma.

5. RADIATION SURVEYS and RESULTS.

- 5.1 Instruments/Equipment.
- 5.1.1 A list of instruments is provided in table 5-1.

Table 5-1. Instrumentation used during the RVAAP Survey.

Instrument (scalar)	Probe Model	Probe Type	Display (units)
Ludlum 2221	Ludlum 44-10	NaI 2x2 crystal	cpm
Ludlum 2221	Ludlum 44-9	Geiger-Mueller pancake	cpm
Ludlum 2929	Ludlum 43-10-1	NaI 2x2 crystal	cpm

- 5.1.2 All instruments met QA requirements of the FSSP.
- 5.1.3 The gamma probe used was a 2 inch x 2 inch sodium iodide crystal.
- 5.1.4 The sensitivity of the gamma survey meter is less than 1 uR/hr and correlates well with NUREG 1575, Table 6.7.
- 5.1.5 Operational instrument checks were performed with a NIST traceable Cesium-137 source. Checks were made at approximately 1 mm from the source. The same procedures were used for each check to assure reproducibility.
- 5.1.6 The beta instrument (Ludlum 2221, with 44-9 GM probe) was used to check personnel for contamination and to scan personnel out of the survey areas. This instrument response to a check source was checked daily prior to use.
- 5.2 <u>INSTRUMENTATION SURVEYS</u>. A suitable reference area for the environmental survey was located and instrument readings

were collected using the same methods used in the AOC. Reference areas were located outside the load lines on like materials being surveyed.

- 5.2.1 A gamma walkover scan was performed in each load line to identify potential elevated areas. The gamma rate survey was conducted using the NaI gamma instrument walkover scan of 100% of the area with the probe held within six inches of the surface.
- 5.2.2 Various elevated measurement locations were marked or consideration as sample points.
- 5.2.3 One minute integrated counts were also done at each sample location and randomly in each grid square. The 1-minute count was conducted in contact with the ground utilizing the gamma instrument and recorded in counts per minute (cpm).
- 5.2.4 Direct measurements were taken in areas of elevated activity relative to the survey area as determined by scan data.
- 5.2.5 Direct measurements were made at contact by one minute counts utilizing a Geiger-Mueller pancake probe.
- 5.2.6 Wipe samples were not collected since the total activity measurements were less than the removable DCGL (1000dpm/100cm²) during all direct measurement surveys.
- 5.3 <u>Sampling and Results</u> Samples were collected in accordance with the sampling plan, result are as follows.
 - 5.3.1 Load Line 2 survey results may be found in Appendix B
- 5.3.1.1 Both the basement and first floor floors of load line 2 NaI scan results indicated background levels of gamma measurements. Background for the survey was determined outside of the load line on similar building materials. NaI scan results ranged from 2,000 to 6,500 cpm for the load line 2 basement with background being 6,000 cpm. NaI scan results ranged from 4,800 to 12,000 cpm for the load line 2 first floor with background being 9,000 cpm.
- 5.3.1.2 The results of 10 static, one-minute NaI measurements on the basement floor and 23 measurements on the first floor, floor were consistent with the scan data.
- 5.3.1.3 A total of 33 direct beta measurements were collected in load line 2. Both the basement and first floor

floors of load line 2 direct beta measurement results indicated background levels of beta activity. Background for the survey was determined outside of the load line on similar building materials. Direct beta measurement results ranged from 18 cpm to 50 cpm for the load line 2 basement with background being 40 cpm. Direct beta measurement results ranged from 19 to 55 cpm for the load line 2 first floor with background being 40 cpm. Wipe samples were not collected since the total activity measurements were less than the removable DCGL (1000dpm/100cm²).

- 5.3.2 Load Line 3 survey results may be found in Appendix C
- 5.3.2.1 The floor survey of load line 3 NaI scan results indicated background levels of gamma measurements. Background for the survey was determined outside of the load line on similar building materials. NaI scan results ranged from 3,400 to 16,000 cpm for load line 3 with background being 13,000 cpm.
- 5.3.2.2 The results of 32 static, one-minute NaI measurements on the floor were consistent with the scan data.
- 5.3.2.3 A total of 40 direct beta measurements were collected in load line 3. The floor surveys of load line 3 direct beta measurement results were comparable with background levels of beta activity. Background for the survey was determined outside of the load line on similar building materials. Direct beta measurement results ranged from 25 cpm to 60 cpm for the load line 3 with background being 50 cpm. Wipe samples were not collected since the total activity measurements were less than the removable DCGL (1000dpm/100cm²).
 - 5.3.3 Load Line 4 survey result may be found in Appendix D
- 5.3.3.1 The floor survey of load line 4 NaI scan results indicated background levels of gamma measurements. Background for the survey was determined outside of the load line on similar building materials. NaI scan results ranged from 3,000 to 9,300 cpm for load line 4 with background being 8,000 cpm.
- 5.3.3.2 The results of 41 static, one-minute NaI measurements on the floor were consistent with the scan data.
- 5.3.3.3 A total of 37 direct beta measurements were collected in load line 4. The floor surveys of load line 4 direct beta measurement results were comparable with background levels of beta activity. Background for the survey was determined outside of the load line on similar building

materials. Direct beta measurement results ranged from 25 cpm to 50 cpm for the load line 3 with background being 40 cpm. Wipe samples were not collected since the total activity measurements were less than the removable DCGL (1000dpm/100cm²).

5.4 Survey Data Results.

- 5.4.1 Instrument Background Results. Background measurements from the reference area were taken for each monitoring instrument and method. The background values were consistent with expected values for the instruments and building materials. These background data are reported on each survey report.
- 5.4.2 All survey results were within expected background ranges for radioactivity and did not identify elevated contamination in load line 2.
- 5.4.2.1 The NaI scan and static survey results were within expected background ranges for gamma activity.
- 5.4.2.2 For the purpose of survey design very conservative Derived Concentration Guideline Levels (DCGL) were selected for Co-60. Actual site-specific, DCGLs were not established. USNRC Regulatory Guide 1.86 release values for Co-60 were utilized. The DCGL used for structures and equipment was $5000 \, \text{dpm}/100 \, \text{cm}^2$ for total activity (DCGLw) and $1000 \, \text{dpm}/100 \, \text{cm}^2$ for removable contamination. The total direct beta measurements reported beta activity less than $1000 \, \text{dpm}/100 \, \text{cm}^2$. This activity is well below the DCGL of $5000 \, \text{dpm}/100 \, \text{cm}^2$.
- 5.4.3 All survey results were within expected background ranges for radioactivity and did not identify elevated contamination in load line 3.
- 5.4.3.1 The NaI scan and static survey results were within expected background ranges for gamma activity and did not identify elevated contamination.
- 5.4.3.2 The total direct beta measurements reported beta activity less than 1000 dpm/100cm². This activity is well below the DCGL of 5000 dpm/100cm².
- 5.4.4 All survey results were within expected background ranges for radioactivity and did not identify elevated contamination in load line 4.

- 5.4.1 The NaI scan and static survey results were within expected background ranges for gamma activity and did not identify elevated contamination.
- 5.4.2 The total direct beta measurements reported beta activity less than $1000~\rm{dpm/100cm^2}$. This activity is well below the DCGL of $5000~\rm{dpm/100cm^2}$.

6. Historical Records Review.

- 6.1 The historical records available for review in regards to the final disposition of the three Co-60 sealed sources are provided in Appendix E.
- 6.1.1 A 29 November 1971 Radioactive Materials Movement (Shipment) record reports that on that date RVAAP shipped one 500 curie Co-60 source to Technical Operations, Inc. in Burlington, Massachusetts. Radiological surveys to meet Department of Transportation requirements were noted on the record.
- 6.1.2 A 9 March 1972 shipping document reports the request of shipment of two 1000 curie Co-60 sources. It appears that one Co-60 source was actually shipped to Technical Operations, Inc. in Burlington, Massachusetts. The shipping record notes that this shipment to be a "First Partial Shipment" which would indicate that a following shipment would be made for the second 1000 curie Co-60 source. No other documentation was available for review to determine the fate of the second 1000 curie Co-60 source.
- 6.1.3 A 25 July 1990 letter from Mr. H.R. Cooper of the Olin Ordinance, Ravenna Arsenal, Inc. to the US Environmental Protection Agency, Region 5 states that all three Co-60 sources were returned to the "licensed owner".
- 6.1.4 No documentation of receipt of the shipments or Atomic Energy Commission license actions that would acknowledge the decommissioning of the Co-60 sources was available for review.
- 6.1.5 Based on the review of these documents it appears that the three Co-60 sources were returned to Technical Operations, Inc. in Burlington, Massachusetts. However, efforts are being taken to locate any additional pertinent information regarding the fate of the second 1,000-curie Co-60 source.

7. CONCLUSIONS.

- 7.1 A review of the survey results indicates that there is no detectable cobalt 60 contamination in the load lines.
- 7.2 Records exist that indicate that the three, sealed cobalt 60 sources were shipped off site in 1971 and 1972.

Craig R. Rieman Chief, Environmental Health Section Buffalo District Corps of Engineers

Appendix A

REFERENCES and ABBREVIATIONS

1. REFERENCES.

- 1.1 4 AR 385-11, 1 May 1980, Ionizing Radiation protection (Licensing, Control, Transportation, Disposal, and Radiation Safety).
- 1.2 ER and EM 385-1-80, 30 May 1997, Ionizing Radiation Protection, and Radiation Protection, USACE.
- 1.3 EM-385-1-1, 3 Sep 1996, Safety and Health Requirements Manual, USACE.
- 1.4 NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), August 2000.
- 1.5 TG 155, February 1993, Environmental Sampling Guide, US Army Environmental Hygiene Agency (USACHPPM).
- 1.6 Title 10, CFR, 1996 rev, Chapter I, Nuclear Regulatory Commission (USNRC).
- 1.7 USACESWT, Radiation Survey Plan, Radiation Final Status Survey Plan for Load Lines 2,3&4, Ravenna Army Ammunition Plant, Ravenna, OH, September 2001.
- 1.8 Preliminary Assessment for Ravenna Army Ammunition Plant, February 1996, by Science Applications International Corporation (SAIC).
- 1.9 Letter dated July 25, 1990, from Olin Ordnance, RVAAP, to USEPA, Subject: Request for information pursuant to section 104 (e) of CERCLA as amended for industrial landfill INC.
- 1.10 Regulation Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974.

2. ABBREVIATIONS.

AOC Areas of concern

bkg background

BEC Base Realignment and Closure Environmental

Coordinator

BRAC Base Realignment and Closure

cal calibration cm centimeter

cm² square centimeter cpm counts per minute

Cs-137 Cesium-137 Co-60 Cobalt-60

DAC Department of the Army Civilian

dpm disintegrations per minute

dpm/100cm² disintegrations per minute per 100 square

centimeters

eff efficiency

g gram

H-3 hydrogen-3 (tritium)

inst instrument

IAW In Accordance with

LLD Lower Level of Detection

MACOM major Army command

MDA Minimum Detectable Activity

mCi millicurie

NIST National Institute of Standards and Technology

NRC Nuclear Regulatory Commission

NUREG Nuclear Regulatory Guide

pCi picocurie

RVAAP Ravenna Army Ammunition Plant

RCCCD Radiologic, Classic and Clinical Chemistry Division

RPO Radiation Protection Officer

SN serial number

SOP standing operating procedure

U-238 Uranium-238

USACE United States Army Corps of Engineers

USACELRB USACE, Buffalo District USACENAB USACE, Baltimore District

USAEHA United States Army Environmental Hygiene Agency USACHPPM USA Center for Health Promotion & Preventive

Medicine

uR/hr microroentgen per hour

uCi microcurie

Appendix B

Load Line 2 Survey Reports

FUSRAP Survey Cover Sheet JA-RO-051-F1 1. General Information 7. Survey Drawing/ Description/ Comments Survey No LL2 first floor 2x2 Page 1 of Date ## Electronic File No. LL2 first floor 2x2 Site: Ravenna Load Line #2 Tech(s): C. verelle СРМ (First Floor) 2. Item Surveyed Counts by Nal 11.5K 12.0K Ravenna Army Ammunition Plant Load Line #2 first floor 3 11.0K 4 6.0K 5 6.7K 6 5.0K 7 5.0K 8 6.0K 3. Release Limits 9 4.8K Radiological Contaminants: Co-60 10 5.0K 21 Floor 22 Floor Action Limits:Removable: NA Total: NA 20 Floor 11 5.0K Other: 18K cpm 12 6.0K Ref: twice background 13 7.0K 4. Survey BKG and Methods of Determination 14 8.0K 15 8.0K 9K cpm background determined by taking a 1 minute count on similar 16 6.0K 13 Floor material outside of Load Line area 17 8.0K 18 7.0K 19 8.0K 20 7.0K 21 6.5K 5. Survey Type/ Data Codes 22 6.8K Floor Hole Routine Surveys (HS-MISC) CH-SURV 23 6.0K Uncontrolled Area RA-SURV Controlled Area X Other - Specify: Final Status Survey Equipment/Materials (HS-EQIP) Release to: 6 INSTRUMENTATION # Scaler W/ Detector SN w/ SN CAL DUE w/ CAL DUE 1 Ludium 2221 / SPA-3 8498 / 8492 5/6/02 / 5/6/02 Range: 4.8K to 12.0K SSHR Review: Clint Verelle 9/11/2001 Date: RSSS Review: Craig Rieman Date: 9/13/2001

FUSRAP Survey Cover Sheet		JA-RO-051-F1
1. General Information	Loa (Fir	Door Share IS
Release Limits Radiological Contaminants: Co-60 Action Limits Removable: 1000 dpm/100 cm² Total: 5000 dpm/100 dpm/100 cm² Total: 5000 dpm/100 dpm	1	9 40 10 40 11 19 12 43 13 19 14 36 15 50 16 45 17 45 18 30 19 55
Controlled Area X Other - Specify Final Status Survey Equipment/Materials (HS-EQIP) Release to:	3 de carri	
6 INSTRUMENTATION # Scaler W/ Detector SN w/ SN CAL DUE w/ C.	L DUE	
1 Ludlum 2221 / 44-9 8490 / 8351 9/19/01	9/19/01	Range: 19 - 55 cpm
3 4	SSHR Review: Clint Verelle	Date: 9/11/2001
5	RSSS Review: Craig Rieman	Date: 9/13/2001

FUSRAP Survey Data Sheet

Survey N	-	LL2 first floor	Page	2	of	. 2		Comments	S .:	Load Line	2, first flooi	Г						
Date	9/11/2	2001	Site			R	avenna											
Surveyor(s): <u>(</u>	C. Verelle	Count Rm			NA												
Notes:	·	dose rt (urem) = Direct Reading Instr.									Total				Removabl	e	
Instr łostrume	nt	Gamma	(cptm) = Direct Reading Instr.				Parameters	dose rate	Gamma	Corr uR	Alpha		Beta-Gami	ma	Alpha		Beta-Gan	ıma
x = Corr Coeffic			m (u nem):				Instr.					· · · · · · · · · · · · · · · · · · ·	L2221 / 44-9				ļ	
Yint = Y Interce		Direct					×			111 1 11K 11 11F	Taraner arabi			باند لطست تأويد		M		
E = eff = cpm/dp ACF = Area Co			dpm) = (cpm - Bopml/(eff * ACF) om) = (cpm - Bopml/(eff * ACF)			 	Yint E					-i	0.407	and a substitution				
t _B = Backgrour		Remo				вка	Всрт		•			0.107 40					_	
t _S = Sample Ca			tpm) = (com - Bcpm)/ eff			BRG	ACF				1		0.155			,00, 10101 ; kfg		
R _b = Bkgd cox			om) = (cpm - Bcpm)/ eff				t _e						1					gie-egitte del
**Bopm = Backo	round cpm = R _b	* dpm re	adings are per 100cm ²				ts			1141	1		1					
							Lc	dil in i					887.15					
							MDC				<u> </u>		1955.18					
No.		Descriptions			×	У	z	urem/uR	срт	υR	срт	*dpm	cpm	*dpm	срт	*dpm	срт	*dpm
	See map												45	301.48				
- :	See map												45	301.48				
;	See map												50	602.95				
4	See map												30	-602.95				
ţ	See map					["			45	301.48				1
•	See map												40	0.00				
	See map										i — —		50	602.95				
	See map				-								50	602.95		İ.		+
(See map												401	0.00		1		+
10	See map						İ						40	0.00				+
	See map		-				1	-					19	-1266 20				+
	See map					t — —							43	180.89				+
	See map					!							19			1		+
	See map											<u> </u>	, , , , , , , , , , , , , , , , , , ,	-1266.20			-	+
	See map						1						36	-241.18		 		+
	See map						+						50	502 95		 		+
	See map						+				 	 	45	301.48		1		+
													45	301.48		-		+
	See map See map						+				-		30	-502.95		ļ		
						!	1 1				I	ı	55	904.43		1		1

$L_{c} = \frac{1.645\sqrt{R\nu \cdot ts(1 + ts/tB)}}{E * ts * ACF}$	MDC =	$\frac{3+3.29\sqrt{R_b\cdot t_s(1+t_S/t_B)}}{E*t_S*ACF}$	PROJECT HP:	RSO:	
				(INI)	(INI)

FUSRAP Survey Cover Sheet JA-RO-051-F1 1. General Information 7. Survey Drawing/ Description/ Comments Survey No LL2 basement 2x2 Page 1 of Date ## Electronic File No. LL2 basement 2x2 Site: Ravenna C. verelle # CPM Tech(s): 1 6.3K 2. Item Surveyed 2 6.5K 3 6.0K Ravenna Army Ammunition Plant Load Line #2 basement 4 2.5K Load Line #2 5 2.0K **BASEMENT** 6 2.0K Counts by Nal 7 2.5K 8 5K 3. Release Limits 9 6K Radiological Contaminants: Co-60 10 6K Action Limits:Removable: Total: NA NA 6 Floor 5 Floor Other: 12K cpm Ref: twice background 4. Survey BKG and Methods of Determination 6K cpm background determined by taking a 1 minute count on similar material outside of Load Line area 5. Survey Type/ Data Codes CH-SURV Routine Surveys (HS-MISC) P8...\$1 Uncontrolled Area RA-SURV Controlled Area X Other - Specify: Final status Survey Equipment/Materials (HS-EQIP) Release to: 3 Floor 6 K 6 INSTRUMENTATION CAL DUE w/ CAL DUE 2 Floor 6.5 K Scaler W/ Detector SN w/ SN Ludlum 2221 / SPA-3 8498 / 8492 5/6/02 / 5/6/02 10 Floor 1 Floor 6.3 K

SSHR Review: Clint Verelle

RSSS Review: Craig Rieman

Range: 2.0K to 6.5K

9/11/2001

9/13/2001

Date:

Date:

FUSRAP Survey Cover Sheet JA-RO-051-F1 7. Survey Drawing/ Description/ Comments 1. General Information Survey No LL2 basement Page 1 of Electronic File No. LL2 basement ## Date Site: Ravenna CPM Tech(s): C. Verelle 30 2. Item Surveyed Load Line #2 2 40 3 **BASEMENT** 50 Ravenna Army Ammunition Plant 4 25 **CPM** 5 38 Load Line #2 basement **Direct Reading** 6 28 7 35 8 30 9 3. Release Limits 25 Floor 628 cpm 10 Radiological Contaminants: 30 Co-60 Action Limits:Removable: 1000 dpm/100 cm² Total: 5000 dpm/100 cm2 11 20 12 Other: 18 Ref: Reg Guide 1.86 13 20 30 4. Survey BKG and Methods of Determination 14 40 cpm background determined by taking a 1 minute count on similar material outside Load Line area. Floor 12^{16 cpm} 5. Survey Type/ Data Codes CH-SURV Routine Surveys (HS-MISC) 10 Floor 1 120 cpm Uncontrolled Area RA-SURV Controlled Area Floor 3 ^{50 cpm} X Other - Specify: Final Status Survey 1 30 cpm Equipment/Materials (HS-EQIP) Release to: 6 INSTRUMENTATION Scaler W/ Detector SN w/ SN CAL DUE w/ CAL DUE Ludlum 2221 / 44-9 8490 / 8351 9/19/01 / 9/19/01 9/11/2001 Clint Verelle Date: SSHR Review:

Craig Rieman

RSSS Review:

9/13/2001

Date:

Surveyor(s):	11/2001 Site				ll										
			Ra	venna											
	C. Vereile Count Rm		NA												
Notes:	dose r: (σrem) = Direct Reading matr								Total				Removabl	e	
instr Instrument	Gamma (cptm) = Direct Reading instr.			Parameters	dose rate	Gamma	Corr uR	Alpha		Beta-Gamr	na	Alpha		Beta-Gam	ıma
x = Corr. Coefficient	con urem (urem)			instr.						L2221/44-9	salara nasharing				
Yint = Y Intercept	Direct			X	147460 - 1170000 100										i i kuliyati.
E = eff = cpm/dpm	Alpha (dpm) = (cpm - Bcom)/(eff * ACF)			Yint							ang ng balawa 1 Hillian dalamatan 1		5 That 488 (4		Literature superite
ACF = Area Correction Factor	Beta (dpm) = (cpm - Bcpm)/(eff * ACF)			E					100 100 11	0.107			***************************************		1 11
t _B = Background Count Time	Removable		BKG	Bcpm				1		40 0.155		opite sylvalino		54 - 900 - 90	
(_S = Sample Count Time	Alpha (dpm) = (cpm - Bcpm)/ eff		-	ACF	1,7804. 11.417.11		The state of	1		0.155	Water to the second			11.1.1.11111111111111111111111111111111	
R _b = Bkgd count rate **Bopm = Background opm ≈ R _b	Seta (dpm) = (cpm - Bcpm)/ eff * dpm readings are per 100cm²			t _s	-	1		1	1						
Bopin - Background opin - Pe	opin recallings are par 1000m			L.						887.15	سير حميد بالمجهد		1000		1,003 (F 15 WH) (F
				MDC					in early all all all	1955.18	****************			1	
No.	Descriptions	х	у	z	urem/uR	срт	uR	срт	*dpm	срт	*dpm	срт	*dpm	срт	*dpm
1 See map										30	-602.95				
2 See map					<u> </u>					40	0.00				
3 See map										50	602.95				
4 See map										25	-904,43				
5 See map										38	-120.59				
6 See map										28	-723.55				
7 See map										35	-301.48				T
8 See map						1				30	-602.95				
9 See map						<u> </u>				25	-904.43			Ì	
10 See map										30					
11 See map		i	·							20	-1205.91			1	
12 See map		<u> </u>			-	 				18	-1326.50				
13 See map						 		1		20	-1205.91		 		+
13 See map								 		20	-602.95		†		
15				<u> </u>				 			1002.90				
										1			+		+
16			-	1		<u> </u>		 					 		+
17			+	1		 	<u> </u>		_	 			+		+
18			1	1			-	+					 	+	+
19			_1	1	l	<u> </u>	L	Ļ		<u> </u>			<u> </u>	1	

Appendix C

Load Line 3 Survey Reports

S-23

FUSRAP Survey Cover Sheet JA-RO-051-F1 1. General Information 7. Survey Drawing/ Description/ Comments Survey No LL3 2x2 Page 1 of Electronic File No. LI 3 2x2 Date 9/11/2001

Date 9/11/2001 Electronic File	No. <u>LL3 2x2</u>					
Site: Ravenna						
Tech(s): C. Verelle					#	CPM
2. Item Surveyed		Load	Line#	3	1	14K
					2	14.5K
Ravenna Army Ammunition Plant Load Line #3		Counts	s by N	aı	3	13K
			•		4	12.4K
					5	12K
		1			6	11K
					7	13K
					8	14K
3. Release Limits		- "			9	7K
Radiological Contaminants: Co-60		***			10	7K
Action Limits:Removable: NA	Total: NA	31 Floor 30 Floor 31 floor 30 floor 30 floor 31 floor 30 floor 30 floor 31	loor 3 K		11	6.6K
Other: 26K cpm	10.0			3 ·	12	6K
Ref: twice background		1			13	12.3K
4. Survey BKG and Methods of Determination	n	Floor			14	
	••	13 K	n Down		15	16.3K
13K cpm background determined by taking a 1 minute	count on	24 Floor	7.513			14.6K
similar material outside of Load Line area	Court on				16	12.8K
similar material outside of Load Line area		Shield Citter Shield Inner 242 81	k I	Shield inner	17	17.6K
		Shield toner 25	_	20	18	14.5K
					19	7.5K
		26 Floor 23		Shield Outer 7.5 K	20	4.2K
5. Survey Type/ Data Codes		- 1. 20 _{12 K}		19	21	7.6K
				A B I	22	12.6K
Routine Surveys (HS-MISC)	CH-SURV	27 - Shield Inner		A	_23	3.4K
			Floor I	4 a Floor	24	14K
Uncontrolled Area	RA-SURV	28 Floor 13.2 K	12 8 K	18 ^{Floor}	25	7.2K
1 —		Wall Wall 12.3 K 13	- Elect	17 Wall 17.6 K	26	12K
Controlled Area		14	3 _{14.6 K}	8 Floor 7 Flo	27	3.3K
L —		1 2 3 13K	16.3 K	14 K / 13		13.2K
X Other - Specify:		1 2 3			29	13K
		Carousel 6 K 12			30	15K
Equipment/Materials (HS-EQIP) Release to:	<u> </u>	4 Floor 12.4 K		9 - Carousel	31	16K
		Carouse) 6.6 K			32	13K
		11	Carousel 7 K			
6 INSTRUMENTATION			10			
# Scaler W/ Detector SN w/ SN	CAL DUE w/ CAL DUE	F Floor				
1 Ludium 2221 /SPA-3 8498 / 8492	5/6/02 / 5/6/02	5 Floor 12 K		6 Floor		
2						
3		7		Range: 3.4K to 16k		
4		SSHR Review: Clint Verelle	Date:	9/11/2001		
5		RSSS Review: Craig Rieman	Date:	9/13/2001		
<u> </u>		TOGO Review. Orally Melitari	Date.	9/13/2001		

5

FUSRAP Survey Cover Sheet JA-RO-051-F1 CPM 7. Survey Drawing/ Description/ Comments 1. General Information 25 Survey No LL3 Page 1 of 30 Electronic File No. LL3 ## Date 3 25 Load Line #3 Site: Ravenna 4 45 Tech(s): C. Verelle **CPM** 5 60 2. Item Surveyed 6 45 **Direct Reading** 7 45 Ravenna Army Ammunition Plant Load Line #3 8 30 9 40 10 35 11 40 12 25 13 35 3. Release Limits 14 55 Radiological Contaminants: Co-60 15 60 Action LimitsRemovable: 1000 dpm/100 cm² Total: 5000 dpm/100 cm2 24 Floor 26 cor Floor 40 cpm Floor 90 cpm Floor 27 23 55 cpm 25 80 cpm 80 cpm 80 cpm 16 50 Other: 19 Floor 17 50 Reg Guide 1.86 Ref: 18 55 Floor 1855 cpm 4. Survey BKG and Methods of Determination 22 Floor 19 65 20 40 1560 cpm 50 cpm background determined by taking a 1 minute count on 21 50 similar material outside load line area 22 50 23 50 24 40 25 60 34 Floor 40 cpm CatWalk 26 60 33 Floor 5. Survey Type/ Data Codes 35 55 cpm 27 60 Routine Surveys (HS-MISC) CH-SURV 31 Wall 28 60 29 25 RA-SURV Uncontrolled Area 30 35 31 45 Controlled Area 32 50 33 50 X Other - Specify Final Status Survey 34 40 35 55 Equipment/Materials (HS-EQIP) Release to: 36 35 37 25 38 35 6 INSTRUMENTATION 39 40 CAL DUE w/ CAL DUE Scaler W/ Detector SN w/ SN 40 45 Ludlum 2221 / 44-9 8490 / 8351 9/19/01 / 9/19/01 20D 42 Date: 9/11/2001 SSHR Review: Clint Verelle 4 9/13/2001 RSSS Review: Craig Rieman Date:

Survey No.	LL3	Page2	_ of	4	_	Comments	: Load Lim	e #3								
Date _	9/11/2001	Site		Ra	venna											
Surveyor(s):	C. Verelle	Count Rm		NA												
otes:		dose it (urem) = Direct Reading Instr.								Total				Removable)	
str Instrument		Gemma (cptm) ≈ Direct Reading Instr		ļ	Parameters	dose rate	Gamma	Con uR	Alpha		Beta-Gamn	na	Alpha		Beta-Gamm	а
= Corr. Coefficient		corr arem (arem):			instr.		ļ	- FFE	<u> </u>		L2221 / 44-9		. 84886		<u> </u>	8
nt = Y intercept		Direct		<u> </u>		Table 1 and				. The c	 		1 1 111			
≖ eff = cpm/dpm	_	Alpha (dpm) = (cpm - Bcpm)/(eff * ACF)		ļ	Yint E					13 PM	0.107			<u> </u>	1	
CF = Area Correction		Beta (dpm) = (cpm · Bopm)/(eff * ACF) Removable		вко	Ворт		•				50					
: = Beckground Cou : = Sample Count Ti		Alpha (dpm) = (cpm - Bcpm)/ aff		BKG	ACF						0.155		4.1.1			
= Blagd count rate		Bets (dpm) = (cpm · Bcpm)/ eff			10			- C 11			1					
Bopor = Background		* dpm readings are per 100cm²			t _s					farm:	1	•				
•	•				L,						991.86					ji.
					MDC					Hillian II	2164.61					
No.	Dos	riptions	ĸ	у	z	urem/uR	срт	υR	срт	*dpm	срт	*dpm	срт	*dpm	срт	*dpm
1 Se	e map										25	-1507.39				
2											30	-1205.91				
3											25	-1507.39				
4											45	-301.48				
5											60	602.95				
6							1				45	-301.48				
7							1				45	-301.48				
8				+			1				30	-1205.91				
9			 	 				 				-602.95				
10		***	 				 	 			35	"				
			+	+				-								
			1					-		-	40					
11			1	1			1				25	-1507.39				
11 12					ļ		 									
11 12 13										<u> </u>	35	-904 43			ļ	
11 12											36 55					
11 12 13																
11 12 13 14											55	301.48				
11 12 13 14 15											55	301.48 602.95 0.00				
11 12 13 14 15											55 60 50	301.48 602.95 0.00				

19			 	65 904.43	3
$= \frac{1.645\sqrt{Rh \cdot ts(1 + ts/tR)}}{E * ts * ACF}$	MDC =	$\frac{3+3.29\sqrt{R_b\cdot t_s(1+t_s/t_B)}}{E*t_s*ACF}$	PROJECT HP:	RSO:	
		E 'IS 'ACF		(INI)	(INI)

urvey No.	LL3	Page	3	of	4	_	Comments	: Load Line	÷#3								
ate _	9/11/2001	Site			Ra	venna											
urveyor(s):	C. Verelle	Count Rm			NA												
otes:		dose rt (urem) ≈ Direct Reading Instr.									Total				Removable	•	
tr - Instrument		Germma (optim) = Direct Reading thatir				Parameters	dose rate	Gamma	Corr uR	Alpha		Beta-Gamn	na .	Alpha		Beta-Gamm	na
Corr. Coefficient		cort u tem (u rem)				Instr.			1.22	ļ		L2221 / 44-9				<u> </u>	
nt = Y Intercept		Direct				x		-			111	1.1.397.3		48 40 10 1			<u> </u>
eff = cpm/dpm		Alpha (dpm) = (cpm - Bcpm)/(eff * ACF)				Yint	<u> </u>		- 11.712		7.53 - 1.1	0.107					######################################
F = Area Correctio		Beta (dpm) = (cpm - Bcpm)/(eff * ACF)			 	- E	 	<u> </u>				50			To the	├	
= Background Co		Removable			вко	Всри ACF		-	 			0.155	1 30			 	
= Sample Count n = Bkgd count/e		Alpha (dpm) = (cpm - Bopm)/ eff Bata (dpm) = (cpm - Bopm)/ eff			-	t _a	 	 				1	1.0		1.0		
_b = tikga count/e Bopm = Backgroun		"dpm reedings are per 100cm"				t _s					5. 8.	1					
Depin - Dackgroun	- ap					L,	21, 4					991.86					
						MDC		Harles e.			21-5-95	2164.61			· ·	<u> </u>	
No.	Das	criptions		r	у	,	urem/uR	срт	υR	срт	*dpm	срт	dom	cpm	*dipm	cpm	*dpm
20 S	ee map								<u> </u>			40	-602.95			<u> </u>	
21												50	0.00			ļ	
22												50	0.00				1
23					1							50	0.00				1
24												40	-602.95				·
25								1				60	602.95				
26									1			60	602.95				Ī
27						†		 				60	602.95				
		- 			 	 		<u> </u>	† · · · · ·	<u> </u>		60	602.95				1
28						 	 	 	 -	<u> </u>		25					1
29						 	 	 		 		35					+
30					+	+	 	·	 	 	 	45	-301.45		-	 	+
31					+	+	 	┼──		_	ļ	45			 	 	
32								ļ		 	 	50	0.00	***	 		
33					_	 	<u> </u>	ļ <u> </u>	-			50	0.00			 	+
34		<u> </u>	_					 -	 			40	-602.95	-		 	+
35					-	1	<u> </u>	 	 		-	55	-	_	-	+	+
36					ļ		ļ <u>.</u>		ļ	ļ	<u> </u>	35			\vdash	+	+
37					<u> </u>				ļ	ļ		25	-1507.39		\vdash		+
					1	1	1	1	t	1	1	35	-904.43	ı	1	1	1

$3 + 3.29 \sqrt{R_b \cdot t_t(1 + ts / ts)}$ 3+3.29 $\sqrt{R_b \cdot t_t(1 + ts / ts)}$ 200 (507 UP)	30		 	<u> </u>			
E*ts*ACF	$1.645\sqrt{R_b \cdot t_s(1+ts/t_R)}$	MDC =	 		PROJECT HP:	RSO:	(INI)

Survey No	LL3	Page 4	of	4		Comments	s: Load Line	#3								
Date	9/11/2001	_ Site		Ravenna	1											
Surveyor(s): C. Varelle	Count Rm		NA												
Notes:		dose it (urem) = Direct Reading Instr.							<u> </u>	Total				Removable		
netr Instrument		Gamma (optm) = Direct Reading Instr.			Parameters	dose rate	Gamma	Con uR	Alpha		Beta-Gamr	na	Alpha		Beta-Gamr	ma
= Corr. Coeffice	nt	cost usern (usern):			Instr.			٠.		· ·	L2221 / 44-9					
rint = Y Intercept		Direct			x		I			e transcription						With the little
= eff = cpm/dpr	1	Alphe (dpm) = (cpm - Bcpm)/(eff * ACF)			Yint										E11 - 1 N (L	
ACF = Area Corre	ction Factor	Bets (dpm) = (cpm - Bopm)/(eff * ACF)			Ε		1				0.107					_ 4751.1
ਜ਼ੂ = Beckground	Count Time	Removable		вка	Всрм		•				50					3 7 7
S = Sample Cou	nt Time	Alphe (dpm) = (cpm - Bcpm)/ eff			ACF						0.155			3 35 5		
R _b = 8kgd cour	t rete	Beta (dpm) = (cpm · Bcpm) eff			t a		<u> </u>			aptermiss	1				↓	
*Bopm = Backgr	ound cpm = R _e	* dpm readings are per 100cm ²			f s					197711-19	1			<u>aah le</u>		
				ļ	L.			37		ale e pro-	991.86			1 252	<u> </u>	
					MDC		 		<u> </u>	· · · ·	2164.61			T		don
No.	T	cnptions	*	<u> </u>		urem/uR	срт	υR	cpm	*dpm	срт	*dlpm	срт	*dpm	cpm	1 30
9	See map	-	+		+	ļ	-				40	4602.95			\vdash	+-
0			+	-		<u> </u>	<u> </u>				45			ļ	 	+
0D							<u> </u>				42	-482.36				┼
						ļ										—
			1	l]								
•							· ·									1
				1			<u> </u>									1
			+										-			
			+			 										+-
			+	+		 					 				 	+-
				+		ļ	ļ				 				├	+-
	,			 											 	+-
																+-
															L	
							Ī	l								
			1	1	1 -		i								T	1
		-		1					l	ł						
																-

Appendix D

Load Line 4 Survey Reports

S-29 14

JA-RO-051-F1 **FUSRAP Survey Cover Sheet** CPM 7. Survey Drawing/ Description/ Comments 1. General Information 9.1K Page 1 of Survey No LL 4 2x2 2 9.3K Electronic File No. LL 2 2x2 Date ## Load Line #4 3 9.1K Ravenna Site: 4 7.7K C. Verelle Tech(s): Counts by Nal 7.0K 5 2. Item Surveyed 6 7.8K 7 7.4K Ravenna Army Amminution Plant Load Line #4 8 4.0K 9 3.8K 10 8.3K 11 4.1K 12 3.2K 2 Floor 13 3.3K 3. Release Limits 14 4.1K Radiological Contaminants: Co-60 15 3.0K Total: NA Action Limits:Removable: NA 16 3.5K 6 Floor 7.8 K 16K cpm Other: 3 Floor 9.1 K 3.5K 17 twice background 18 3.7K 4. Survey BKG and Methods of Determination 7 Floor 19 3.8K 20 4.0K 8K cpm background determined by taking a 1 minute count on 21 3.7K similar material outside Load Line area 22 3.6K 23 6.1K 24 6.2K 25 6.6K 26 6.7K 5. Survey Type/ Data Codes 27 8.5K CH-SURV Routine Surveys (HS-MISC) 28 8.4K 29 5.0K RA-SURV Uncontrolled Area 25 Floor 6.6 K 24 Floor 6.2 K 30 7.8K 31 8.1K Controlled Area 32 4.5K 33 8.6K X Other - Specify: Final status Survey 34 4.3K 35 4.3K Equipment/Materials (HS-EQIP) Release to: 36 4.5K 27 Floor 8.5 K 37 4.5K 38 6.0K 6 INSTRUMENTATION 39 6.5K CAL DUE w/ CAL DUE Scaler W/ Detector SN w/ SN 40 6.9K 5/6/02 / 5/6/02 Ludlum 2221 / SPA-3 8498 / 8492 28 Floor 8.4 K 7.8K Range: 3.0K to 9.3K 29 Floor 5.0 K 9/11/2001 Clint Verelle Date: SSHR Review:

Craig Rieman

RSSS Review.

9/13/2001

Date:

FUSRAP Survey Cover Sheet

JA-RO-051-F1

1. General Information	7. Survey Drawing/ Description/ Comments		#	CPM
Survey No LL4 Page 1 of 3	Courtey Drawings Descriptions Comments	<u> </u>	1	40
Date ## Electronic File No. LL4		<u> </u>	2	40
Site: Ravenna		<u> </u>	3	35
Tech(s): C. Verelle	1 1 1 :		4	50
2. Item Surveyed	Load Li	ne #4	5	28
a. nom darroyed	CPI	M	6	45
Ravenna Army Ammunition Plant Load Line #4			7	40
Travella Printy Printy Printy Bird 2004 2000	Direct Re	eading ⊢	8	27
		•	9	29
		<u> </u>	10	30
		Г	11	45
			12	43
3. Release Limits			13	40
Radiological Contaminants: Co-60		· · ·	14	35
Action Limits:Removable: 1000 dpm/100 cm ² Total: 5000 dpm/100 cm ²		: :	15	35
Other: NA		· [16	35
Ref: Reg Guide 1.86			17	30
4. Survey BKG and Methods of Determination			18	30
	Floor	Floor 45 opn	19	25
40 cpm background based on 1 minute count on similar material	40 cpm	Shield	20	35
outside Load Line area	Floor 25 gps - 25 gps - 25 gps - Carcusel Carcusel	25 open	21	30
	40 cpm 35 cpm	30 spen	22	25
	Shinte Outst 30 900	45 cpm ;	23	40
	30 opm Carousel 38 opm		24	38
			25	40
5. Survey Type/ Data Codes			26 27	35 30
Routine Surveys (HS-MISC)		Sheld	28	50
Uncontrolled Area RA-SURV	Carousel 40 opm	Cuter 20. 30 cpm	29	50
	Figur Flox		30	45
Controlled Area	50 cpm 56 cp		31	45
		Carousel 30 cpm	32	45
X Other - Specify. Final Status Survey	Wall 25 cpm	Wati 25 oprn	33	40
<u> </u>	2 A 1000	Wall 35 ppm	34	40
Equipment/Materials (HS-EQIP) Release to:	30 cpn1	45 cpm	35	30
	Floor Floor Wall Wall Wall 40 cpm 48 cpm 40 cpm 35 cpm 35 cpm	Wall 40 cpm	36	25
	35 cpr Cárousel 43 cpri	Carous of	37	25
6 INSTRUMENTATION	43 epri	Carcusol	20D	37
# Scaler W/ Detector SN w/ SN CAL DUE w/ CAL DUE	Floor 45 cpm Carouse	Floor 28 cpm		
1 L2221 / 44-9 8490 / 8357 9/19/01 / 9/19/01	35 spm Floor	200,000		
	90 opn	n		
2				
3				
4	SSHR Review: Clint Verelle	Date: 9/11/2001		
5	RSSS Review: Craig Rieman	Date: 9/13/2001		

Survey No.	LL4		Page _	2	of	3	_	Comments	: Load Line	e 4								
Date _	9/11/2001	:	Site			Ravenna												
Surveyor(s)	C. Verelle		Count Rm			NA												
Notes:		dose nt (u rem) ≠ Dir	ect Reading Instr.			7						Total		· · · · · · · · · · · · · · · · · · ·		Removabl	e	
Instr instrument		Gamma (optm) = Di	rect Reading Instr.				Parameters	dose rate	Gamma	Corr uR	Alpha	l	Beta-Gamr	na	Alpha		Beta-Gami	ma
x = Conr. Coefficien	ı	corr u rem (u rem)					instr.						L2221 / 44-9			SUFFERENCE SCHOOL ACT		4. 8 888 a
Yint = Y Intercept		Direct								3 44 44 4					1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
E = eff = cpm/dpm			- Bcpmy(eff * ACF)			ļ	Yint						0.407		na ekabik		Consider and the property	
ACF = Area Correc		Beta (dpm) = (cpm	- Bcpm)/(eff * ACF)				E	5 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7					0.107	111	.	100 C. (100 C.)	 	5902. 6
t _e = Background 0		Removable				BKG	Верт	:	<u> </u>	Transaction			0.155		27 5.			
t _s = Sample Coun		Alpha (dpm) ≃ (cpm					ACF	ratification to the first	E-8-7-9000 05 01 19				0.133		13 <u>1.1</u>		1	
R _b = Bkgd count		Beta (dpm) ≈ (cpm * dpm readings are p				ļ	t _s				 		1				 	Taka taba
1*Bcpm = Backgrou	ind cpm = R _b	opm readings are i	per 100cm			-	L.	1111 11149 7	28 2 3 3 2 2 2 2		1	11. 11. 11. 11. 11.	887.15	****		The balance		1100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
							MDC				-		1955.18	******				
No.	De	escriptions			x	у	ı	urem/uR	срт	uR	срт	*dpm	срт	*dpm	срт	*dpm	срт	*dpm
1	See map												40	0.00			ļ	
2													40	0.00				<u> </u>
3							1					1	35	-301.48				<u> </u>
4													50	602.95				
													28	-723.65				
		-											45	301.46				
7							 				 		40				1	
	1 111						+						27			1	<u> </u>	
8		•					+		 		 	-	28			· · · · · ·	1	
9					-						 	 	30					
10				.		+					 	 						†
11							+						45	<u> </u>		·	 	+
12											 	-	43				├──	+
13									<u> </u>				40	0.00				+
14		10.							_				35	-301.48			 	
15							<u> </u>						35	-301,48		<u> </u>	ļ	ļ
16										<u> </u>			35	-301.48			<u> </u>	
17									1		İ		30	-602.95				
18													30	-602.95				
19					1		1						25	-904.43				
	$\frac{R_b \cdot t_s(1 + t_S / t_B)}{* t_S * ACF}$		٨	NDC =	3-	$+3.29\sqrt{R_b}$ $E * ts$	$t_s(1+t_S/t_E)$ * ACF	<u>,)</u>			PROJECT	ΓHP:	(INI)	RSO:	(INI)			

FUSRAP Survey Data Sheet

Survey No.	LL4		Page	3	of	3	-	Comments	: Load Line	e 4		-						
Date	9/11/2001	_	Site	_		Ravenna												
Surveyor(s): <u>C. Verelle</u>	(Count Rm			NA												
Notes:		cose ri (u rem) = Dire	ct Reading Instr.			1						Total				Removabl	9	
Instr Instrument		Gamma (cptm) = Dire	act Reading Instr.				Parameters	dose rate	Gamma	Corr uR	Alpha		Beta-Gami	na	Alpha		Beta-Gami	ma
х = Corr. Coefficie	nı	corr u rem (u rem) :					instr.					-,	L2221 / 44-9					
Yint ≃ Y Intercept		Direct					x											
E = eff = cpm/dpm	•	Alpha (dpm) = (cpm	- Bcpml/(eff * ACF)				Yint			l likumi				4 Martin 1990 (1990)			100 4 - 100 00 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
ACF = Area Corre	ction Factor	Beta (dpm) = (cpm -	Bcpml/(eff * ACF)				E	1 25 1 1 1 1 1 1 1 1	40.000				0.107			ledit to a late to		
t _B = Background		Removable				BKG	Верт		•		4		40					
t _S = Sample Cou		Aipha (dpm) = (cpm					ACF					marenda a a Mili	0.155				File Tile III	
R _b = Bkgd coun		Beta (dpm) ≃ (cpm -					t _B			10 - 11 - 12 - 12 - 12 - 13 - 13 - 13 - 13			1				ļ <u>.</u>	
"*Bopm = Backgro	und cpm = R _b	* dpm readings are pe	er 100cm"				18		Angelog Military	1			1 207.45					
					<u> </u>	L , MDC				- 41		887.15 1955.18			5 (A) (A) (A) (A)	-		
No.		scriptions		1		<u> </u>	,	urem/uR	cpm	uR	cpm	*dpm	cpm	*dpm	срт	*dpm	cpm	*dpm
	See map	эсприона			х	<u>, , , , , , , , , , , , , , , , , , , </u>	 	brenzak	Брт	ur.	I quii	Ориг	35		opin	- арт	Орт	- Opin
21	oce map																-	
				+		-					1	 	30				1	<u> </u>
22 23					<u> </u>		ļ				 		26	-904.43				
											 		40	0.00				
24						ļ					 		38	-120.59		 	ļ	1
25			······			1	+				 -		40				<u> </u>	
26							1				 		35	-301.48		<u> </u>		
27													30	-602 .95				
28												ļ	50	602.95				
29						<u> </u>							50	602.95				
30				-							1		45	301.48			ļ	
31													45	301.48				1
32				i		1							45	301.48				ĺ
33							1						40	0.00				† · · · · ·
34				-		 	<u> </u>	-			 		40	0.00				
35							1						30					
				+		 						-	 			 		
36				1			1				 -		26			+		
37							+						25	-904.43		 		
20D						<u> </u>							37	-180.89		1	<u> </u>	<u> </u>
$L_c = \frac{1.645}{E}$	$R_b \cdot t_s(1 + t_S / t_B)$ $* t_S * ACF$		М	DC =	3+	$\frac{3.29\sqrt{R_b}}{E * ts}$	$t_s(1+t_S/t_B)$ * ACF	<u>)</u>			PROJECT	HP:	(INI)	RSO:	(INI)	-		

Appendix E

Historical Records



13: 12 E

RAVENNA ARSENAL, INC. 8451 STATE ROUTE 5, RAVENNA. OHIO 44266-9297 TELEPHONE: (216) 358-7111 • FAX: (216) 297-3216

July 25, 1990

THRU: Contracting Officer's Representative

Ravenna Army Ammunition Plant

8451 State Route 5

Ravenna, Ohio 44266-9297

TO:

U. S. Environmental Protection Agency

Region 5

ATTN: 5HS - 11 (Mr. David Meyer)

230 S. Dearborn Street Chicago, IL 60604

Subject: Request For Information Pursuant to Section 104 (e) of

CERCLA As Amended For Industrial Landfill, Inc.

(Ref. USEPA's 21 June 1990 Letter to Ravenna Army

Ammunition Plant, Same Subject as Above)

Dear Mr. Meyer,

As requested by the reference USEPA letter, the Ravenna Army Ammunition Plant (RVAAP) has researched its historical use of radiological materials. There's record of two periods in which radiological materials have been stored and/or used at RVAAP.

The utilized material were two (ea.) units of 1,000 Curies, Cobalt 60, solid radiographic source and one (ea.) unit of 500 Curies, Cobalt 60, solid radiographic source. These three radiographic sources were used from 1969 to 1972 for quality assurance processes to determine uniformity of solidified explosive following melt pour into military projectiles. These cobalt sources were returned to the licensed lender/owner following their discontinued use at RVAAP. All actions that transpired regarding this lend-use agreement were oversighted by the then known Atomic Energy Commission (AEC). Attachment #1 delineates return of these active sources to the licensed owner.

The other radiological material that existed at RVAAP was monazite ore. The ore was a low-specific-activity material that generated a radiological characteristic by naturally contained thorium. The thorium constituent was identified as being less that 10% of the monazite ore compound. The ore was under ownership by Federal Supply Service, Property Management Division of the General Services Administration (GSA) that had leased above ground tank (fully enclosed) space at RVAAP. The exact time of the ore's

OLIN DEFENSE SYSTEMS GROUP O L I N C O R P O R A T I O N

S - 35

emplacement within the RVAAP confines is uncertain due to installation records being destroyed; it can only be approximated. that the ore had arrived at RVAAP sometime in the late 1950's or early 1960's. In June 1974 the monazite ore was removed from RVAAP and exported to Rotterdam, Holland under an AEC licensed Following the ore's removal, processes were transaction. undertaken to decontaminate the storage tanks and affected ground surface area probably contaminated with the ore's fines during the loading operation. All collected contaminants were identified as being transported to an AEC approved burial location in Kentucky. RVAAP made a diligent effort to make personal contact with respective personnel of GSA and the service organization involved with the decontamination process; with the objective to confirm the subject activity and pinpoint the exact location of the disposal No personal contacts were able to be completed due to disbandment of the specified agency within GSA; GSA records were lost due to the agency's policy to destroy documents of completed transactions that are seven years or older; and the vendor performing the decontamination has since gone out of business without any traceability to the whereabouts of employees and company records. RVAAP terminated any further efforts in obtaining additional information on the subject. Attachment #2 provides all available historical records associated to the monazite ore.

RVAAP's point of contact for further discussion or request regarding any of the above subject matter will be Mr. Thomas M. Chanda, Environmental Engineer, at phone 216-297-3221.

Sincerely,

RAVENNA ARSENAL, INC.

H. R. Cooper Plant Engineer

TMC/wt/tc90056.

Attachment

cf: AMCCOM

ATTN: AMSMC-ISE-M (Capt. Michael Leggieri)

cc: N. Wulff

G. Wolfgang

T. Chanda

File

Fee	use of this l	RADIOACTIVE MATI SHIPMENT DWM, 600 AR 3553; the probenom 574	REC	EIPT	Lagisties,						
		. (See instructions	un reverse.)	· · · · · · · · · · · · · · · · · · ·							
			FSHIPHENT		21, '7:	3013-9					
		tions, Inc.	Ravenna	Arsenal, Inc							
Radiation	ı Produ	cts Division	Ravenna	Army Ammunit	ion Pla	nt					
Northwest Burlingto	, Indus n. Mas	trial Park sachusetts	Ravenna,	Ohio 141266	,						
ÀPSA-7-350		4. SECURITY CLASSIFICATION	Commercial Truck								
k 60	MHODITY O	ESCRIPTION	7. RADIOACTIVITY								
	HUMBER				A LEVEL						
CONTAINERS	OF ITEMS 8	HOMENGLATURE a	QUANTITY,	130 TOPE 2NG FORM	SURFACE	AT ONE METER					
l Wooden Transport Package Nodel No. SK-1351	1	Cobalt 60 Radio- graphic Source T.O. Model #520	500 Çuri 60, Soli	es, Cobalt d	2 MR/H	RIMR					

THE ABOVE DESCRIBED ARTICLES ARE PROPERLY CLASSIFIED, PACKAGED, NARKED, AND LABELED. THE ARTICLES ARE IN PROPER CONDITION FOR TRANSPORTATION AND THE SPREAGABLE ACTIVITY AND DOSE RATES ARE WITHIN THE SPECIFIED LINITS, AS PRESCRIBED BY APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION. AND DEPARTMENT OF THE ARMY.

Shipped in compliance with Special Permit (SP) No. 5800 Reference 6th Ind. LOG-TR-TEB-5882, July 11, 1971

Shipment Number AFSA-7-3507-71

S. SPECIAL PRECAUTIONS

- 2 DA 119 Labels on Package Exterior
- 1 DA 110 Label on Package Exterior
- 2 DA 110 Labels on Truck Exterior
- 1 DA 135 Label in Truck Cab
- 1 Leak Test Form
- I Cobalt 60 Source Decay Chart
- D.O.T. Specification Plywood Container D.C.T. (SP) No. 5800

TO, SIGNATURE OF RAPIATION PHOT	ECTION OFFICER (Shipping Diganisetton)	DATE
O. D. Freeton	Ravenna Arsenal, Inc.	Nov. 29, 1971
	NOFFICER (Shipping Organization) GRADE AND TITLE THE FOR TU (S) 47	Nov. 27, 1971
12-OPCANIZATION OF	CHA. Ch. 0 4426.	
DA FORM 2791-R, 1 Oct 70	REPLACES DA FORM 2"1), 1 JUN 64, WHICH IS OB- (Paper size, 8" a 10½"; image size, 7-4/1	

S-37

	REQUISITION AND INVOICE/SHIPPING DOCUMENT		NO. SHEET	1 <u>9 M</u>	IR.	72	APSA-7-	1729-72
, JROKI	AHMO PROC & SUPPLY AGENCY, USAR, JOLIET, ILL.	60436	7. DATE HAT	CRIEL REQUIRE			=, FRIUNIII	
1. 704	APINO PROC & SOTTET Addition,		4. AUTHORIY	F OA PURPOIE				
121	RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO 44266		10. SIGHATU	n C			T-5107-	72 2073
	. MARK FOR		13, DATE SH	(3/15	/72\	·		
. \$817 10	TECHNICAL OPERATIONS, INC.		13. HODE OF		141		14. BILL OF LADING	NUMBER
	BURLINGTON, MASSACHUSETTS 01803		ASSO	CIATED				03060
	,		15. AIR MOY	EMENY DESIGN	ATOR OR F	ORT MEFE	REMER NO.	
. 4778074	2122034 265-8251 p4180(.16.999) OBJECT EXPENDITURE	ACCOUNT To)	CHARGE		ACTIVITY	ONTROL 1 NO.	BUREAU CONTROL NO.	THUOHA
	A1-2-A0001)-2200 S11-173				7775	COH-		
T EN NO.	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND/OR SERVICES	UNIT OF 1850 E (c)	(d)	SUPPLY ACTION (c)		TATHEN NOS. (9)	THIS PRICE	TOTAL COST
<u> </u>	1000 CURIE COBALT 60 RADIOGRAPHIC UNITS, SER. #1299. "RADIO ACTIVE MATERIAL"	EA.	2	1	·			\$17,750.0
	FIRST PARTIAL SOURCE SER. #1299 GAMMA PROJECT #39.		GA	Control of the second	P		33	1 1 1 1 1
	PHEC - 2122030 265-8251 P4880 11 173 AMCMS: 4880.16.9985 PRON: A1-2-80087-01-FOG2	0	- 1	ATURI			3-15-7. DATE	2.
	FIRST PARTIAL			·	<u> </u>	.L	<u> </u>	
OR NS	PORTATION VIA MATS TO CHANGEABLE TO 1 TOTAL TYPE COR. DESCRIPTION	WEIGHT		19. CONTAINS	ns PAT	<u> </u>		SHEET TOTAL
in. 153	TOTAL TYPE CON DESCRIPTION CONTAINERS TAIMER PAL 1000 CURIE COBALT	3,00		BACEPT	^3		· .	BASHO TOTAL
CHC CHC	CCRED OF			QUANTITO QUESTIVA QUESTI	23	•	37	
and a		-			DATI		DY T	ZO. RECEIVER'S VOUCHER
2 PAC	1 PAI ~ TOTAL ->	3.00	$\frac{1}{1}$	POSTER	'			