

35

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*Radionuclide Concentrations in Honey Bees  
from Area G at TA-54 during 1997*



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NATIONAL LABORATORY

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*Edited by Hector Hinojosa, Group CIC-1*

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*Radionuclide Concentrations in Honey Bees  
from Area G at TA-54 during 1997*

T. K. Haarmann  
P. R. Fresquez

# RADIONUCLIDE CONCENTRATIONS IN HONEY BEES FROM AREA G AT TA-54 DURING 1997

T.K. Haarmann and P.R. Fresquez

## ABSTRACT

Honey bees were collected from two colonies located at Los Alamos National Laboratory's Area G, Technical Area 54, and from one control (background) colony located near Jemez Springs, NM. Samples were analyzed for the following: cesium ( $^{137}\text{Cs}$ ), americium ( $^{241}\text{Am}$ ), plutonium ( $^{238}\text{Pu}$  and  $^{239,240}\text{Pu}$ ), tritium ( $^3\text{H}$ ), total uranium, and gross gamma activity. Area G sample results from both colonies were higher than the upper (95%) level background concentration for  $^{238}\text{Pu}$  and  $^3\text{H}$ .

## INTRODUCTION

As part of the ongoing environmental surveillance program at Area G (Fresquez *et al.* 1997a)—a 25.5-ha (63-ac) low-level radioactive waste management and disposal area located on the east end of Mesa del Buey at Technical Area (TA) 54 at Los Alamos National Laboratory (LANL) (Figure 1)—samples of honey bees were collected from beehives during the summer of 1997. Honey bees can be thought of as mobile samplers that efficiently cover a large sample area

and then return to a central location (Bromenshenk 1992). Honey bees forage in an area with a radius as large as 6 km (3.7 mi) and often cover a total area up to 100 square km (39 square mi) (Leita *et al.* 1996, Visscher and Seeley 1982). Each hive contains literally thousands of bees, most of whom will forage for nectar, water, pollen, and plant resins, which are all brought back into the hive. During these foraging flights, bees inadvertently contact and accumulate a wide array of pollutants,

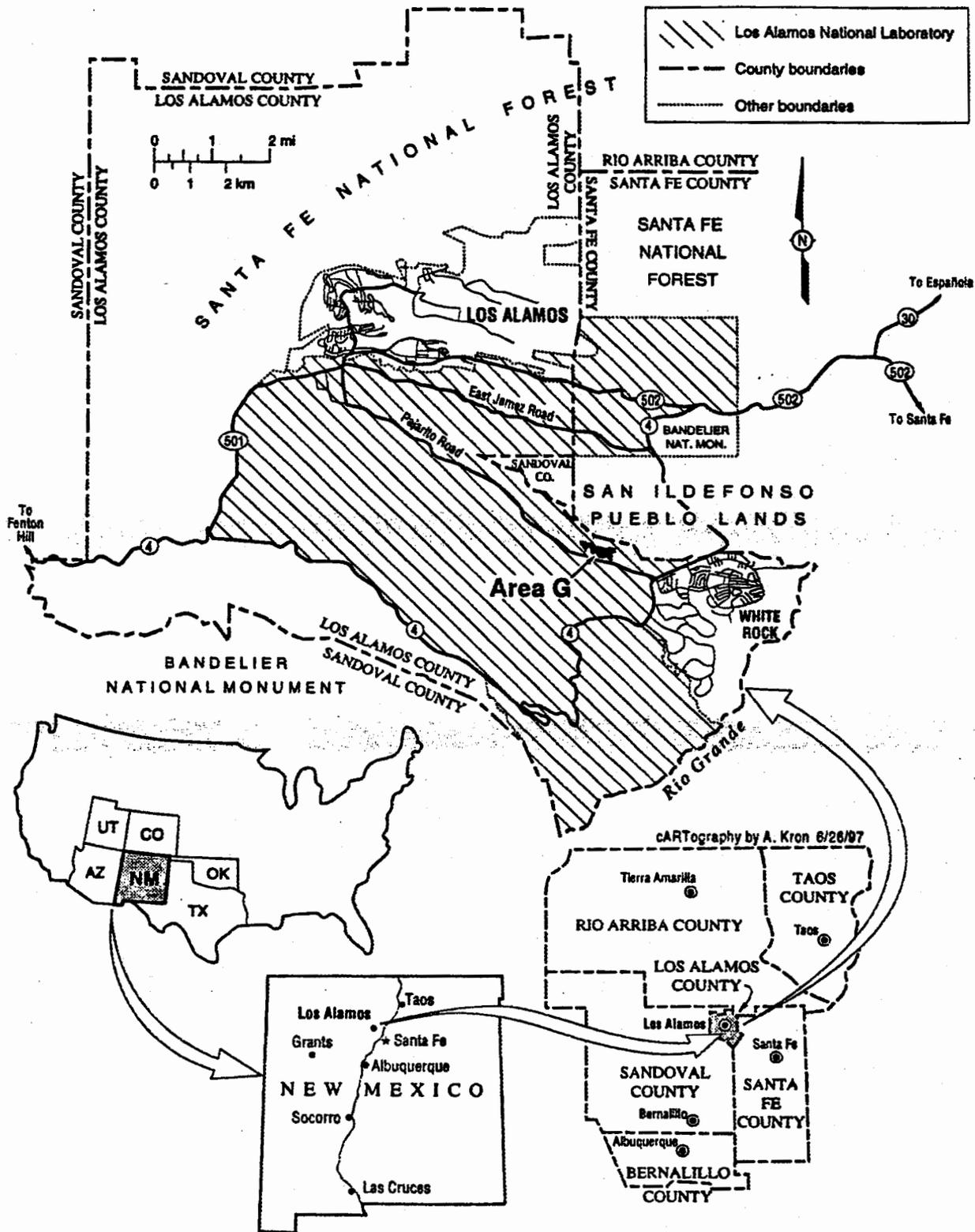


Figure 1. The location of Area G at Los Alamos National Laboratory.

some of which are brought back to the colony (Bromenshenk *et al.* 1985). These contaminants often become incorporated into the bee tissue, the wax, the honey, or the hive itself (Wallwork-Barber *et al.* 1982).

Honey bee studies have been conducted on many different types of pollutants including fluoride (Bromenshenk *et al.* 1988a, Mayer *et al.* 1988), lead (Migula *et al.* 1989), zinc (Bromenshenk *et al.* 1988b), nickel (Balestra *et al.* 1992), potassium (Barbattini *et al.* 1991), cesium (Bettoli *et al.* 1987, Tonelli *et al.* 1990), tritium (White *et al.* 1983, Fresquez *et al.* 1997b), and plutonium (Hakonson and Bostick 1976). It is an inexpensive form of monitoring, especially considering the many different sampling points the foraging bees visit. Collection of bees at one location (the hive) can provide a plethora of information from numerous points concerning the distribution and bioavailability of contaminants. Comparing the amounts of contaminants in honey bees with the known amounts of contaminants in the surrounding area could be useful for modeling the redistribution of contaminants through

ecosystems. The very nature of honey bee ecology makes them an excellent living system from which to monitor the presence of contaminants.

The objective of this study was to compare various radionuclide concentrations in honey bees from Area G with honey bees collected from a background location.

## METHODS

We monitored Area G using beehives consisting of a standard Langstroth hive stocked with Italian honey bees (*Apis mellifera ligustica*). During 1997, two colonies were established on the south end of Area G near the  $^3\text{H}$  shafts (Figure 2). These colonies were brought into the study site from an uncontaminated area. In addition, a control (background) site with one colony was established 10 km (6 mi) south of Jemez Springs, NM.

After three months, bee tissue samples were collected from all of the colonies. Three separate samples (one from each colony), each containing approximately 100 g of bees, were collected. Each individual 100-g sample consisted of approximately 1,000 bees.

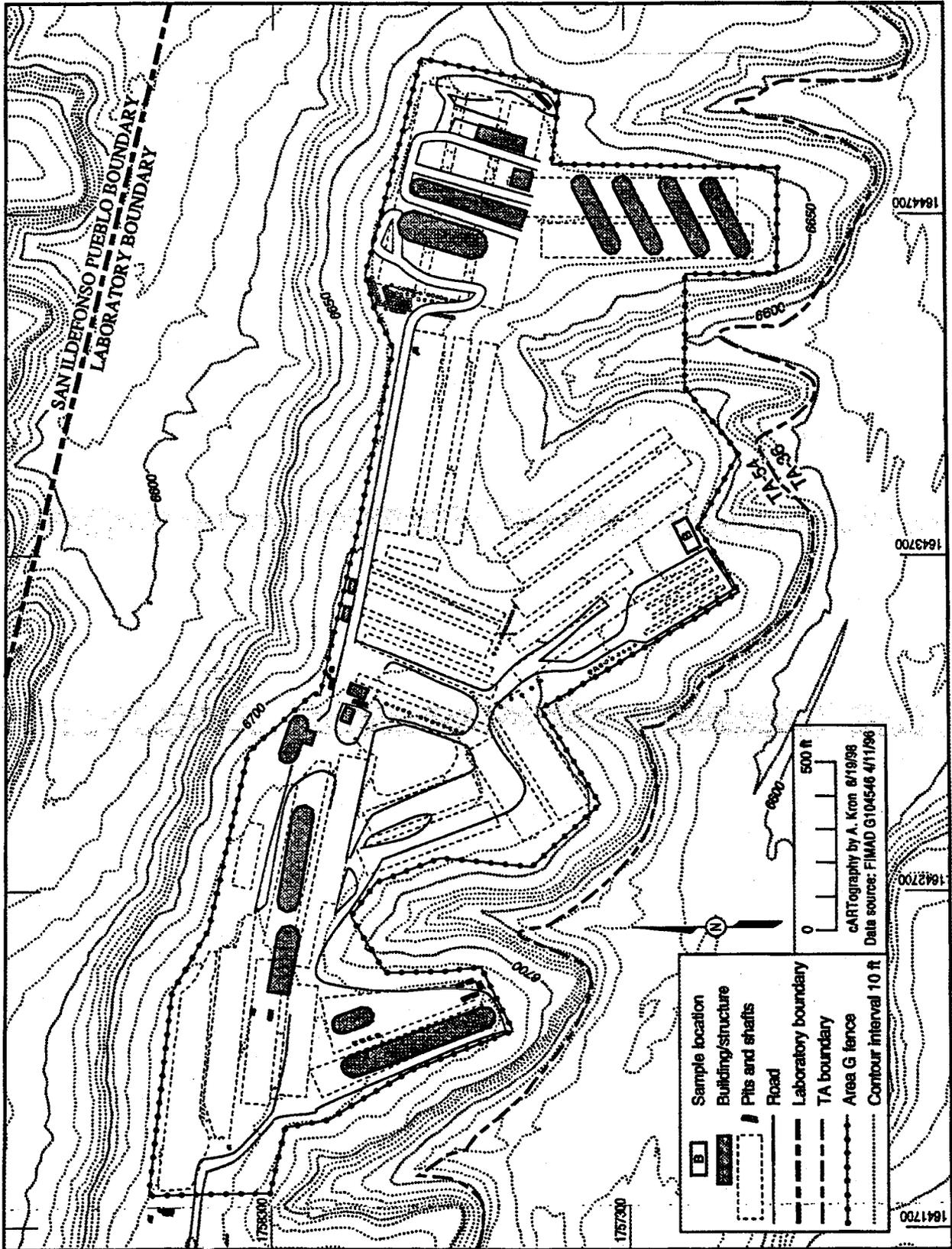


Figure 2. Site/sample location of bee hives at Area G.

Bee samples were collected using a small, rechargeable vacuum. Bees were vacuumed off frames that were removed from the honey supers, transferred to a plastic resealable bag, weighed, and double bagged into plastic resealable bags. All samples were kept in a cooler and frozen upon returning to the laboratory. With each sample collected, the vacuum collection area was thoroughly cleaned to avoid cross-contamination of samples.

All samples were analyzed by LANL's Environmental Chemistry Group for  $^3\text{H}$ ,  $^{137}\text{Cs}$ ,  $^{241}\text{Am}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ , total uranium, and gamma activity. Analytical methods have been previously described in Fresquez *et al.* (1997a). The bee tritium samples were analyzed by liquid scintillation counting in the following manner: 5 ml of moisture were distilled from each sample, mixed with 15 ml of a scintillation solution, and counted on a scintillation counter for 50 minutes. All gamma-emitting radionuclide concentrations were determined using high-resolution germanium detector gamma-ray spectrometry. Pu and Am samples were dissolved in nitric acid, isolated by

anion exchange, electroplated onto stainless steel disks and counted using an alpha spectrometer. Total uranium was determined by kinetic phosphorescence analysis.

## RESULTS

Table 1 contains a summary of the analytical results from samples collected near Area G and the control site. The original analytical reports are included in Appendix A for future reference. In general, most radionuclides, with the exception of  $^{238}\text{Pu}$  and  $^3\text{H}$ , were within or just above the regional statistical reference level (RSRL). The RSRL is the upper (95%) level background concentration (mean + two std dev) from the present data. And, of these two radionuclides ( $^{238}\text{Pu}$  and  $^3\text{H}$ ), only  $^3\text{H}$  concentrations were at detectable levels—where the analytical result was higher than two times the counting uncertainty. Tritium levels in the Area G bees, for example, were at 82.8 and 110.20 pCi mL<sup>-1</sup>; the control colony contained only 1.03 pCi mL<sup>-1</sup>. These data are consistent with other surveillance studies of  $^3\text{H}$  (and other radionuclides) at Area G in bees

(Fresquez *et al.* 1997b), soils (Conrad *et al.* 1996, Fresquez *et al.* 1997c), small mammals (Biggs *et al.* 1997), and vegetation (Fresquez *et al.* 1997c).

#### ACKNOWLEDGMENT

Thanks to Rebecca J. Wechsler, Environmental Coordinator, EM-SWO, for technical assistance at Area G.

**Table 1. Analytical Results from Honey Bee Samples Collected from Colonies at Area G and a Control Site in 1997.**

Element/ Activity	Units	Area G		Area G		Control	AU	RSRL <sup>b</sup>
		C-1	AU <sup>a</sup>	C-2	AU			
<sup>137</sup> Cs	pCi/g <sup>c</sup>	0.52	0.78	0.86	0.29	-0.33	1.81	3.29
U-total	µg/g <sup>c</sup>	0.18	0.02	0.13	0.01	0.13	0.01	0.15
<sup>241</sup> Am	pCi/g <sup>c</sup>	0.0329	0.0075	0.0234	0.0058	0.0165	0.0067	0.0299
<sup>238</sup> Pu	pCi/g <sup>c</sup>	0.0026	0.0039	0.0021	0.0034	-0.0089	0.0024	-0.0041
<sup>239,240</sup> Pu	pCi/g <sup>c</sup>	0.0113	0.0060	0.0020	0.0027	0.0095	0.0050	0.0195
<sup>3</sup> H	pCi/mL <sup>d</sup>	82.80	3.60	110.20	4.40	1.03	0.75	2.53
Gamma	pCi/g <sup>c</sup>	36.0	16.3	28.9	14.1	16.9	9.3	36.0

<sup>a</sup>Analytical uncertainty; values are the uncertainty in the analytical results at the 65% confidence level (one sigma).

<sup>b</sup>Regional Statistical Reference Level; the upper (95%) level background concentration (mean + two sigma) from present control data.

<sup>c</sup>Units are in g per ash.

<sup>d</sup>Units are in mL tissue moisture.

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**APPENDIX A**

**CST ANALYTICAL REPORTS OF RADIONUCLIDES IN BEES**

LOS ALAMOS NATIONAL LABORATORY  
CST Analytical Chemistry  
Analytical Results Report

Method Area: EH-GAMMA

Submission Id : 100023448

Requester Name:	TIM HAARMANN	Customer Cost Code:	7C20WE6A1000	Due Date:	23-DEC-97
Requester Group:	ESH-20	Logged Date:	23-OCT-97	Screening Data:	NO SCREENING DATA REQUIRED
Mail Stop:	M887	Study:	ESH20 BIOLOGICALS	Logged by:	LBRANCH
Requester Phone:	667-5019	Analytical Service Agreement #:			
Requester Fax #:					

## CUSTOMER SAMPLES

<u>Method</u>	<u>Sample Id</u>	<u>Task Id</u>	<u>Customer Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>
GENERIC GAMMA	200043493	300118357	G1-97	CS-137	0.52	0.78	pCi/g	
	200043494	300118366	G2-97	CS-137	0.86	0.29	pCi/g	
	200043497	300118386	C1-97	CS-137	-0.33	1.81	pCi/g	

## DUPLICATE TASKS

None run for this submission

## SAMPLE SPIKES

None run for this submission

\*\*\*\* FINAL REPORT \*\*\*\*

Method Area: EH-GAMMA

Submission Id : 100023448

\*\*\*\*\* CST QUALITY ASSURANCE REPORT \*\*\*\*\*

BLIND QC

None run for this submission

METHOD BLANKS

<u>Customer Id</u>	<u>Task Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>	<u>QC Value</u>	<u>QC Uncertainty</u>	<u>QC units</u>	<u>QC Evaluation</u>
00.22785	300143215	CS-137	-0.00	1.80	pCi/g		0.0	0.0	pCi/g	UNDER CONTROL

OPEN QC

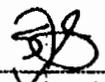
<u>Customer Id</u>	<u>Task Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>	<u>QC Value</u>	<u>QC Uncertainty</u>	<u>QC units</u>	<u>QC Evaluation</u>
00.33987	300143216	CS-137	4.87	0.54	pCi/g		4.8000	0.1600	pCi/g	UNDER CONTROL

A-2

\*\*\*\* FINAL REPORT \*\*\*\*

Method Area: EH-GAMMA

Submission Id : 100023448

 _____ Analyst	 _____ Review	 _____ Team Leader	 _____ QA Officer
<u>3/26/98</u> Date	<u>3/26/98</u> Date	<u>3/27/98</u> Date	<u>3/27/98</u> Date

A-3

No Sample Discrepancies Noted by Sample Management Section

The control status of the preceding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level."

\*\*\*\* FINAL REPORT \*\*\*\*

LOS ALAMOS NATIONAL LABORATORY  
 CST Analytical Chemistry  
 Analytical Results Report

81705

Method Area: EH-ALPHA

Submission Id : 100023448

Requester Name:	TIM HAARMANN	Customer Cost Code:	7C20WE6A1000	Due Date:	23-DEC-97
Requester Group:	ESH-20	Logged Date:	23-OCT-97	Screening Data:	NO SCREENING DATA REQUIRED
Mail Stop:	M887	Study:	ESH20 BIOLOGICALS	Logged by:	LBRANCH
Requester Phone:	667-5019	Analytical Service Agreement #:			
Requester Fax #:					

CUSTOMER SAMPLES

Method	Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
GENERIC KPA	200043493	300118354	G1-97	U	0.18	0.02	ug/g	
	200043494	300118363	G2-97	U	0.13	0.01	ug/g	
	200043497	300118391	C1-97	U	0.13	0.01	ug/g	

A-4

DUPLICATE TASKS

None run for this submission

SAMPLE SPIKES

None run for this submission

Method Area: EH-ALPHA

Submission Id : 100023448

81739

## \*\*\*\*\* CST QUALITY ASSURANCE REPORT \*\*\*\*\*

## BLIND QC

None run for this submission

## METHOD BLANKS

<u>Customer Id</u>	<u>Task Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>	<u>QC Value</u>	<u>QC Uncertainty</u>	<u>QC units</u>	<u>QC Evaluation</u>
00.22784	300143686	U	0.00	0.01	ug/g		0	0	ug/g	UNDER CONTROL

## OPEN QC

<u>Customer Id</u>	<u>Task Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>	<u>QC Value</u>	<u>QC Uncertainty</u>	<u>QC units</u>	<u>QC Evaluation</u>
00.38058	300143685	U	10.78	1.08	ug/L		10.1	1.0	ug/L	UNDER CONTROL

A-5

\*\*\*\* FINAL REPORT \*\*\*\*

Method Area: EH-ALPHA

Submission Id : 100023448

70818

ml  
Analyst

Eng  
Review

LS  
Team Leader

NK  
QA Officer

3/31/98  
Date

4-1-98  
Date

4/1/98  
Date

04/02/98  
Date

A-6

No Sample Discrepancies Noted by Sample Management Section

The control status of the preceding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level."

\*\*\*\* FINAL REPORT \*\*\*\*

LOS ALAMOS NATIONAL LABORATORY  
 CST Analytical Chemistry  
 Analytical Results Report

Method Area: EH-ALPHA

Submission Id : 100023448

Requester Name:	TIM HAARMANN	Customer Cost Code:	7C2QWE6A1000	Due Date:	23 DEC 97
Requester Group:	ESH-20	Logged Date:	23-OCT-97	Screening Data:	NO SCREENING DATA REQUIRED
Mail Stop:	M887	Study:	ESH20 BIOLOGICALS	Logged by:	LBRANCH
Requester Phone:	667-5019	Analytical Service Agreement #:			
Requester Fax #:					

CUSTOMER SAMPLES

A-7

Method	Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier				
AM RAS ENV	200043493	300118359	G1-97	Am-241	0.0329	0.0075	pCi/g					
				Am-243T Spike	1.95		pCi					
				Am-243T Recovery	56.25		%					
				Am-243T Recovered	1.1		pCi					
				Am-241 Gross Counts	31		counts					
				Am-241 Background Counts	6.2		counts					
				Efficiency	19.94		%					
				Count Time	3000.00		min					
				Analysis Date	04/08/98		MM/DD/YY					
				Instrument	ALPHA 80		NONE					
				200043494	300118368		G2-97	Am-241	0.0234	0.0058	pCi/g	
								Am-243T Spike	1.95		pCi	
								Am-243T Recovery	58.33		%	
								Am-243T Recovered	1.14		pCi	
Am-241 Gross Counts	24	counts										
Am-241 Background Counts	3.8	counts										
Efficiency	19.02	%										
Count Time	3000.00	min										
Analysis Date	04/08/98	MM/DD/YY										

\*\*\*\* FINAL REPORT \*\*\*\*

01/12

Method Area: EH-ALPHA

Submission Id : 100023448

A-8

<u>Method</u>	<u>Sample Id</u>	<u>Task Id</u>	<u>Customer Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>
AM RAS ENV	200043494	300118368	G2-97	Instrument	ALPHA 80		NONE	
	200043497	300118388	CI-97	Am-241	0.0165	0.0067	pCi/g	
			CI-97	Am-243T Spike	1.95		pCi	
			CI-97	Am-243T Recovery	43.39		%	
			CI-97	Am-243T Recovered	0.85		pCi	
			CI-97	Am-241 Gross Counts	10		counts	
			CI-97	Am-241 Background Counts	2.2		counts	
			CI-97	Efficiency	20.24		%	
			CI-97	Count Time	3000.00		min	
			CI-97	Analysis Date	04/08/98		MM/DD/YY	
			CI-97	Instrument	ALPHA 80		NONE	

**DUPLICATE TASKS**

None run for this submission

**SAMPLE SPIKES**

None run for this submission

\*\*\*\* FINAL REPORT \*\*\*\*

6 of 12

Method Area: EH-ALPHA

Submission Id : 100023448

\*\*\*\*\* CST QUALITY ASSURANCE REPORT \*\*\*\*\*

BLIND QC

None run for this submission

METHOD BLANKS

None run for this submission

OPEN QC

None run for this submission

A-9

\*\*\*\* FINAL REPORT \*\*\*\*

7/12

Method Area: EH-ALPHA

Submission Id : 100023448

PEA  
Analyst

Eroy  
Review

LB  
Team Leader

NK  
QA Officer

4/13/98  
Date

4-14-98  
Date

4/14/98  
Date

04/14/98  
Date

A-10

No Sample Discrepancies Noted by Sample Management Section

The control status of the preceding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level."

\*\*\*\* FINAL REPORT \*\*\*\*

8 of 12

LOS ALAMOS NATIONAL LABORATORY  
 CST Analytical Chemistry  
 Analytical Results Report

Method Area: EH-ALPHA

Submission Id : 100023448

Requester Name:	TIM HAARMANN	Customer Cost Code:	7C20WE6A1000	Due Date:	23-DEC-97
Requester Group:	ESH-20	Logged Date:	23-OCT-97	Screening Data:	NO SCREENING DATA REQUIRED
Mail Stop:	M887	Study:	ESH20 BIOLOGICALS	Logged by:	LBRANCH
Requester Phone:	667-5019	Analytical Service Agreement #:			
Requester Fax #:					

CUSTOMER SAMPLES

Method	Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
A-11 PU RAS ENV	200043493	300118358	G1-97	Pu-238	0.0026	0.0039	pCi/g	
			G1-97	Pu-239	0.0113	0.0060	pCi/g	
			G1-97	Pu-242T Spike	1.95		pCi	
			G1-97	Pu-242T Recovery	33.47		%	
			G1-97	Pu-242T Recovered	0.65		pCi	
			G1-97	Pu-238 Gross Counts	6		counts	
			G1-97	Pu-238 Background Counts	4.2		counts	
			G1-97	Pu-239 Gross Counts	15		counts	
			G1-97	Pu-239 Background Counts	7.2		counts	
			G1-97	Efficiency	30.54		%	
			G1-97	Count Time	3000.00		min	
			G1-97	Analysis Date	04/2/98		MM/DD/YY	
			G1-97	Instrument	ALPHA 32		NONE	
			200043494	300118367	G2-97	Pu-238	0.0021	0.0034
G2-97	Pu-239	0.0020			0.0027	pCi/g		
G2-97	Pu-242T Spike	1.95				pCi		
G2-97	Pu-242T Recovery	46.78				%		
G2-97	Pu-242T Recovered	0.91				pCi		
G2-97	Pu-238 Gross Counts	10				counts		

\*\*\*\* FINAL REPORT \*\*\*\*

503

Method Area: EH-ALPHA

Submission Id : 100023448

<u>Method</u>	<u>Sample Id</u>	<u>Task Id</u>	<u>Customer Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>		
PURAS ENV	200043494	300118367	G2-97	Pu-238 Background Counts	7.6		counts			
			G2-97	Pu-239 Gross Counts	8		counts			
			G2-97	Pu-239 Background Counts	5.8		counts			
			G2-97	Efficiency	30.81		%			
			G2-97	Count Time	3000.00		min			
			G2-97	Analysis Date	04/2/98		MM/DD/YY			
			G2-97	Instrument	ALPHA 32		NONE			
			200043497	300118387	C1-97	Pu-238	-0.0089	0.0024	pCi/g	
					C1-97	Pu-239	0.0095	0.0050	pCi/g	
					C1-97	Pu-242T Spike	1.95		pCi	
	C1-97	Pu-242T Recovery			40.20		%			
	C1-97	Pu-242T Recovered			0.78		pCi			
	C1-97	Pu-238 Gross Counts			2		counts			
	C1-97	Pu-238 Background Counts			8.0		counts			
	C1-97	Pu-239 Gross Counts			11		counts			
	C1-97	Pu-239 Background Counts			4.6		counts			
	C1-97	Efficiency			31.12		%			
	C1-97	Count Time	3000.00		min					
	C1-97	Analysis Date	04/2/98		MM/DD/YY					
	C1-97	Instrument	ALPHA 32		NONE					

A-12

## DUPLICATE TASKS

None run for this submission

\*\*\*\* FINAL REPORT \*\*\*\*

6 of 13

Method Area: EH-ALPHA

Submission Id : 100023448

SAMPLE SPIKES

None run for this submission

A-13

\*\*\*\* FINAL REPORT \*\*\*\*

7 9 3

Method Area: EH-ALPHA

Submission Id : 100023448

\*\*\*\*\* CST QUALITY ASSURANCE REPORT \*\*\*\*\*

BLIND QC

None run for this submission

METHOD BLANKS

None run for this submission

OPEN QC

None run for this submission

A-14

Method Area: EH-ALPHA

Submission Id : 100023448

CEA  
Analyst

Eroy  
Review

CB  
Team Leader

NK  
QA Officer

4/6/98  
Date

4-7-98  
Date

4/7/98  
Date

04/07/98  
Date

A-15

No Sample Discrepancies Noted by Sample Management Section

The control status of the preceding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol 1, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level."

\*\*\*\* FINAL REPORT \*\*\*\*

943

LOS ALAMOS NATIONAL LABORATORY  
CST Analytical Chemistry  
Analytical Results Report

Method Area: EH-ALPHA

Submission Id : 100023448

Requester Name:	TIM HAARMANN	Customer Cost Code:	7C20WE6A1000	Due Date:	23-DEC-97
Requester Group:	ESH-20	Logged Date:	23-OCT-97	Screening Data:	NO SCREENING DATA REQUIRED
Mail Stop:	M887	Study:	ESH20 BIOLOGICALS	Logged by:	LBRANCH
Requester Phone:	667-5019	Analytical Service Agreement #:			
Requester Fax #:					

CUSTOMER SAMPLES

Method	Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
A-16 H-3 LS ENV	200043493	300118355	G1-97	H-3	82800	3600	pCi/L	
			G1-97	H-3 MDA	450		pCi/L	
	200043494	300118364	G2-97	H-3	110200	4400	pCi/L	
			G2-97	H-3 MDA	450		pCi/L	
	200043497	300118392	C1-97	H-3	1030	750	pCi/L	
			C1-97	H-3 MDA	450		pCi/L	

000000

DUPLICATE TASKS

None run for this submission

SAMPLE SPIKES

None run for this submission

Method Area: EH-ALPHA

Submission Id : 100023448

\*\*\*\*\* CST QUALITY ASSURANCE REPORT \*\*\*\*\*

BLIND QC

None run for this submission

METHOD BLANKS

None run for this submission

OPEN QC

None run for this submission

A-17-

000006

\*\*\*\* FINAL REPORT \*\*\*\*

Method Area: EH-ALPHA

Submission Id : 100023448

Ajp  
Analyst

[Signature]  
Review  
for ERB

[Signature]  
Team Leader

mag  
QA Officer

2/27/98  
Date

2/27/98  
Date

2/27/98  
Date

3/4/98  
Date

A-18

200000

No Sample Discrepancies Noted by Sample Management Section

The control status of the preceding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level."

\*\*\*\* FINAL REPORT \*\*\*\*

Method Area: EH-GAMMA

Submission Id : 100023448

## \*\*\*\*\* CST QUALITY ASSURANCE REPORT \*\*\*\*\*

## BLIND QC

None run for this submission

## METHOD BLANKS

<u>Customer Id</u>	<u>Task Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>	<u>QC Value</u>	<u>QC Uncertainty</u>	<u>QC units</u>	<u>QC Evaluation</u>
00.22776	300140432	Gamma	0.1	0.2	pCi/g		0.0	0.0	pCi/g	UNDER CONTROL

## OPEN QC

<u>Customer Id</u>	<u>Task Id</u>	<u>Component</u>	<u>Result Value</u>	<u>Uncertainty</u>	<u>Units</u>	<u>Qualifier</u>	<u>QC Value</u>	<u>QC Uncertainty</u>	<u>QC units</u>	<u>QC Evaluation</u>
00.31809	300140433	Gamma	31.5	3.1	pCi/g		28.8800	0.9500	pCi/g	UNDER CONTROL

\*\*\*\* FINAL REPORT \*\*\*\*

A-19

Method Area: EH-GAMMA

Submission Id : 100023448

Yg  
Analyst

STG  
Review

GD  
Team Leader

NK  
QA Officer

3/12/98  
Date

3/12/98  
Date

3/12/98  
Date

3/12/98  
Date

A-20

No Sample Discrepancies Noted by Sample Management Section

The control status of the preceding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level."

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