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Environmental Protection  
Agency

National Air and Radiation  
Environmental Laboratory  
540 South Morris Avenue  
Montgomery, AL 36115-2601

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Radiation

# Environmental Radiation Data Report 73

January-March 1993

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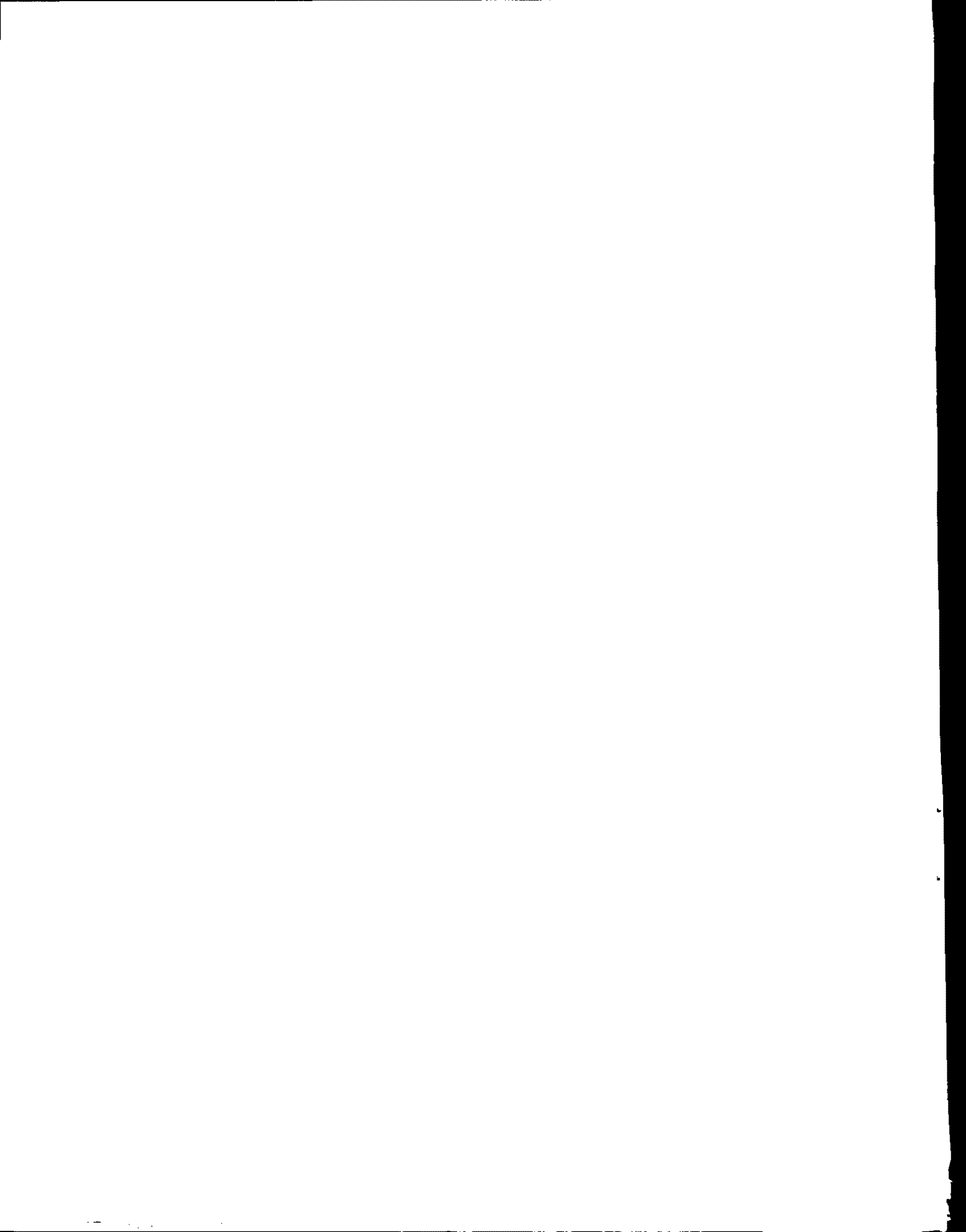
REPORT 73

January-March 1993

United States Environmental Protection Agency

Office of Radiation and Indoor Air

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## Preface

*Environmental Radiation Data* (ERD) is compiled and distributed quarterly by the Office of Radiation and Indoor Air's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama, and contains data from the Environmental Radiation Ambient Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available.

ERAMS was established in 1973 by the United States Environmental Protection Agency. It is comprised of a nationwide network of sampling stations that provide air, surface and drinking water, and milk samples from which environmental radiation levels are derived. The major emphasis for ERAMS is upon identifying trends in the accumulation of long-lived radionuclides in the environment.

Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, strontium, iodine, radium, krypton, and tritium. This monitoring effort also provides ancillary information on natural background levels and on routine and accidental releases into the environment from stationary sources.

The radiochemical procedures used by NAREL to analyze the ERAMS samples are contained in the *Eastern Environmental Radiation Facility Radiochemistry Procedures Manual* (EPA 520/5-84-006). Station operation and sample collection are in accordance with procedures contained in the *ERAMS Manual* (EPA 520/5-84-007, 008, 009).



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## Data Reporting Rationale

Frequently, there is little or no radioactivity in environmental media. Thus, the results of laboratory analyses should show a distribution of negative and positive numbers about zero. A negative value occurs when a previously determined background value is subtracted from a sample value that is less than that of the background. From July 1975 to March 1991, ERAMS data were reported as calculated, whether the results were negative, zero, or positive. Since April 1991, negative results have been denoted as "not detectable," or "ND." For gamma analyses only, results less than the  $2\sigma$  counting error are also denoted as "not detectable."

All data are stored in the NAREL sample database as generated, and these values are available for statistical evaluation. However, caution should be exercised in the use of the data in this report for statistical analysis, since the removal of negative numbers produces a positive bias in the distribution of results.

### Reported Error Terms

Each reported value for specific analyses will be accompanied by a counting error term at the  $2\sigma$  (95%) confidence level. Error terms are therefore reported as counting errors. At the very low levels characteristic of most ERAMS measurements, counting error is the greatest contributor to overall error.

### Significant Figures

No more than three significant figures will be reported. A datum that contains more than three figures will be rounded off to three figures.

### Reporting Levels

The reporting units, smallest increments for reporting, and typical minimum detectable levels (MDL's) for each isotope are shown in Table 1. MDL is defined as the  $3\sigma$  error of the background. Reporting increments are sometimes considerably smaller than MDL's to avoid truncation errors in averaging.

### Averages

Averages will be calculated along with appropriate error terms in an annual summary and analysis of ERAMS data. In calculating these averages, all values of individual data, including negative numbers, will be utilized. Averages will not be included in ERD quarterly reports.

**Table 1**  
**ERAMS Reporting Increments and Minimum Detectable Levels**  
**for Radionuclide Analyses**

Radionuclide	Media	Reporting Units	Reporting Increments	Minimum Detectable Levels
Gross Alpha	Water	pCi/L	1 pCi/L	2 pCi/L
† Gross Beta	Air	pCi/m <sup>3</sup>	0.01 pCi/m <sup>3</sup>	0.01 pCi/m <sup>3</sup>
	Water	pCi/L	1 pCi/L	1 pCi/L
	Precipitation	nCi/m <sup>2</sup>	0.01 nCi/m <sup>2</sup>	0.01 nCi/m <sup>2</sup>
	(specific radiochemical analyses)			
Tritium	Water	nCi/L	0.1 nCi/L	0.2 nCi/L
	Milk	nCi/L	0.1 nCi/L	0.2 nCi/L
Carbon-14	Milk	pCi/L	1 pCi/L	15 pCi/L
Krypton-85	Ambient Air	pCi/m <sup>3</sup>	0.1 pCi/m <sup>3</sup>	2 pCi/m <sup>3</sup>
†† Plutonium-238,239,240	Air	aCi/m <sup>3</sup>	0.1 aCi/m <sup>3</sup>	0.015 pCi
	Milk	pCi/L	0.001 pCi/L	0.015 pCi
	Water	pCi/L	0.001 pCi/L	0.015 pCi
‡ Uranium-234,235,238	Air	aCi/m <sup>3</sup>	0.1 aCi/m <sup>3</sup>	0.015 pCi
	Milk	pCi/L	0.001 pCi/L	0.015 pCi
	Water	pCi/L	0.001 pCi/L	0.015 pCi
Radium-226	Water	pCi/L	0.1 pCi/L	0.1 pCi/L
Strontium-90	Milk	pCi/L	0.1 pCi/L	1 pCi/L
	Water	pCi/L	0.1 pCi/L	1 pCi/L
‡‡ Strontium-89	Milk	pCi/L	1 pCi/L	5 pCi/L
‡‡ Iodine-131	Milk	pCi/L	1 pCi/L	10 pCi/L
	Water	pCi/L	1 pCi/L	10 pCi/L
	Water	pCi/L	0.1 pCi/L	0.4 pCi/L
Iodine-129	Milk	fCi/L	0.1 fCi/L	0.4 fCi/L
Cesium-137	Milk	pCi/L	1 pCi/L	10 pCi/L
	Water	pCi/L	1 pCi/L	10 pCi/L
‡‡ Barium-140	Milk	pCi/L	1 pCi/L	10 pCi/L
	Water	pCi/L	1 pCi/L	10 pCi/L
Potassium	Milk	g/L	0.1 g/L	0.12 g/L
	Water	g/L	0.1 g/L	0.12 g/L
Potassium-40	Water	pCi/L	1 pCi/L	100 pCi/L

† The value of MDL for precipitation in terms of nCi/m<sup>2</sup> would be dependent on precipitation (mm).

†† This value of MDL for air in terms of pCi/m<sup>3</sup> would be dependent on the air volume. Measurement by alpha spectroscopy that includes contributions of plutonium-239 and plutonium-240. MDL for all media given per sample.

‡ This value of MDL for air in terms of pCi/m<sup>3</sup> would be dependent on the air volume. MDL for all media given per sample.

‡‡ Activity as of the day of counting.

# 1. Air Program

## Airborne Particulates and Precipitation

Gross beta radioactivity measurements and certain specific analyses are performed on air particulates and precipitation samples as indicator measurements in assessing the general (national) impact of all contributing sources on environmental levels of radiation.

Airborne particulates are collected continuously at field stations representing wide geographic coverage, including present and potential sources of environmental radioactivity. Sampling sites are located throughout the United States.

Filters (10-cm diameter synthetic fiber) from air samplers are changed twice weekly and field measurements are made with a G-M survey meter† at 5 hours and 29 hours after collection to allow for radon and thoron daughter product decay. Field estimates are reported to appropriate EPA officials by telephone or mail depending on the activity levels found.

The filters are sent to NAREL for more sensitive analyses in a low background beta counter. Gamma scans are performed on all filters showing gross beta counts greater than  $1 \text{ pCi/m}^3$ . The laboratory obtained values are usually lower than the field estimates due to the decay of naturally occurring radionuclides between the times of the two measurements.

Precipitation samples are collected at those field stations collecting air filters. These samples are also sent to NAREL where they are composited monthly for gamma scans, tritium, and gross beta activity measurements. A composite of the March, April, and May precipitation samples is analyzed for plutonium-238, -239, -240, and uranium-234, -235, and -238.

A compilation of individual measurements is available from the National Air and Radiation Environmental Laboratory, 540 South Morris Avenue, Montgomery, AL 36115-2601.

Tables 2-4 contain the data from airborne particulate samples for January-March 1993. Tables 5-7 contain the data from precipitation samples for January-March 1993. Table 8 contains the data from tritium in precipitation samples for January-March 1993 at the selected sites.

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† The counts at five hours for the Montgomery, Alabama, station are performed on a low background beta counter.

**Table 2**  
**Gross Beta in Airborne Particulates**  
**January 1993**

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
		(pCi/m <sup>3</sup> )			(pCi/m <sup>3</sup> )		
AK:Anchorage	4	0.0	0.0	0.0	0.02	0.01	0.01
AK:Juneau	8	0.0	0.0	0.0	0.01	0.00	0.00
AL:Montgomery	6	0.3	0.0	0.1	0.03	0.01	0.01
AR:Little Rock	9	0.2	0.1	0.1	0.02	0.01	0.02
AZ:Phoenix	5	0.3	0.0	0.2	0.01	0.00	0.01
CA:Berkeley	8	0.3	0.0	0.1	0.02	0.00	0.00
CA:Los Angeles	8	0.2	0.0	0.1	0.02	0.00	0.01
CO:Denver	8	0.4	0.0	0.3	0.05	0.01	0.03
CT:Hartford	8	0.1	0.0	0.0	0.01	0.01	0.01
DE:Wilmington	1	0.2	0.2	0.2	0.01	0.01	0.01
FL:Jacksonville	7	0.1	0.0	0.0	0.02	0.00	0.01
FL:Miami	8	0.1	0.0	0.0	0.01	0.00	0.00
HI:Honolulu	1	0.2	0.2	0.2	0.00	0.00	0.00
IA:Iowa City	8	0.1	0.0	0.1	0.04	0.01	0.02
ID:Boise	8	0.2	0.1	0.2	0.02	0.01	0.02
ID:Idaho Falls	8	0.0	0.0	0.0	0.03	0.01	0.01
IL:Chicago	3	0.1	0.0	0.1	0.03	0.01	0.02
IN:Indianapolis	7	0.2	0.0	0.1	0.03	0.01	0.02
KS:Topeka	7	0.3	0.1	0.2	0.02	0.01	0.02
KY:Frankfort	4	0.1	0.1	0.1	0.03	0.01	0.02
LA:New Orleans	7	0.3	0.0	0.1	0.02	0.01	0.01
MA:Lawrence	9	0.1	0.0	0.0	0.01	0.01	0.01
ME:Augusta	8	0.2	0.0	0.1	0.02	0.01	0.01
MI:Lansing	8	0.1	0.0	0.0	0.02	0.01	0.01
MN:Minneapolis	4	0.0	0.0	0.0	0.02	0.01	0.02
MO:Jefferson City	8	1.5	0.1	0.3	0.03	0.01	0.02
MS:Jackson	9	0.4	0.0	0.1	0.03	0.01	0.02
NC:Charlotte	8	0.2	0.0	0.1	0.02	0.00	0.01
NC:Wilmington	2	0.0	0.0	0.0	0.03	0.01	0.02
ND:Bismarck	6	0.3	0.1	0.1	0.03	0.01	0.02
NE:Lincoln	7	0.1	0.0	0.1	0.03	0.01	0.02
NH:Concord	8	0.4	0.0	0.1	0.02	0.01	0.01
NJ:Trenton	8	0.5	0.1	0.2	0.02	0.01	0.01
NM:Santa Fe	7	0.3	0.1	0.2	0.01	0.00	0.01
NV:Las Vegas	8	0.4	0.0	0.1	0.01	0.00	0.00
NY:Albany	4	0.1	0.0	0.1	0.03	0.01	0.02
NY:Niagara Falls	8	0.1	0.0	0.1	0.02	0.01	0.01

**Table 2 (continued)**  
**Gross Beta in Airborne Particulates**  
**January 1993**

Location	Number of Samples	5-Hour Field Estimate (pCi/m <sup>3</sup> )			NAREL Lab Measurement (pCi/m <sup>3</sup> )		
		Max	Min	Avg	Max	Min	Avg
NY:Syracuse	2	0.0	0.0	0.0	0.02	0.01	0.01
NY:Yaphank	7	0.2	0.1	0.1	0.01	0.01	0.01
OH:Columbus	4	0.0	0.0	0.0	0.02	0.02	0.02
OH:Painesville	9	0.1	0.0	0.0	0.02	0.01	0.01
OH:Ross	8	0.0	0.0	0.0	0.04	0.01	0.02
OH:Toledo	8	0.2	0.1	0.2	0.02	0.01	0.01
OR:Portland	8	0.0	0.0	0.0	0.05	0.00	0.02
PA:Harrisburg	8	0.8	0.0	0.2	0.02	0.00	0.01
RI:Providence	6	0.0	0.0	0.0	0.01	0.01	0.01
SC:Barnwell	1	0.0	0.0	0.0	0.01	0.01	0.01
SC:Columbia	8	0.2	0.0	0.1	0.03	0.00	0.01
SD:Pierre	7	0.3	0.1	0.1	0.03	0.01	0.02
TN:Knoxville	5	0.9	0.0	0.4	0.04	0.01	0.02
TN:Nashville	8	0.2	0.1	0.1	0.05	0.01	0.02
TX:Austin	6	0.1	0.0	0.1	0.02	0.01	0.02
TX:El Paso	7	1.5	0.1	0.7	0.02	0.01	0.01
UT:Salt Lake City	7	0.1	0.0	0.0	0.02	0.01	0.02
VA:Lynchburg	8	0.5	0.1	0.2	0.02	0.01	0.01
VA:Virginia Beach	1	0.0	0.0	0.0	0.01	0.01	0.01
WA:Olympia	8	0.1	0.0	0.1	0.03	0.00	0.01
WA:Spokane	8	0.1	0.0	0.1	0.05	0.01	0.03
WI:Madison	8	0.1	0.0	0.0	0.03	0.01	0.02

Minimum Detectable Limit for field estimates - 0.1 pCi/m<sup>3</sup>.

Minimum Detectable Limit for laboratory measurement - 0.01 pCi/m<sup>3</sup>.

**Table 3**  
**Gross Beta in Airborne Particulates**  
**February 1993**

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
		(pCi/m <sup>3</sup> )			(pCi/m <sup>3</sup> )		
AK:Anchorage	8	0.0	0.0	0.0	0.02	0.00	0.01
AK:Juneau	6	0.0	0.0	0.0	0.01	0.00	0.01
AL:Montgomery	8	0.5	0.0	0.2	0.16	0.01	0.03
AR:Little Rock	7	0.3	0.1	0.2	0.02	0.01	0.02
AZ:Phoenix	7	1.3	0.0	0.6	0.02	0.01	0.01
CA:Berkeley	8	0.2	0.0	0.1	0.03	0.00	0.01
CA:Los Angeles	7	0.1	0.0	0.1	0.02	0.00	0.01
CO:Denver	8	0.6	0.1	0.3	0.03	0.01	0.02
CT:Hartford	8	0.0	0.0	0.0	0.01	0.00	0.01
DE:Wilmington	8	0.2	0.0	0.1	0.01	0.01	0.01
FL:Jacksonville	6	0.1	0.0	0.1	0.01	0.00	0.01
FL:Miami	8	0.1	0.0	0.0	0.01	0.00	0.01
HI:Honolulu	4	0.2	0.0	0.2	0.00	0.00	0.00
IA:Iowa City	8	0.1	0.0	0.0	0.02	0.01	0.02
ID:Boise	8	0.3	0.1	0.2	0.05	0.00	0.03
ID:Idaho Falls	8	0.0	0.0	0.0	0.04	0.00	0.02
IL:Chicago	6	0.1	0.0	0.1	0.02	0.01	0.01
IN:Indianapolis	7	0.5	0.1	0.2	0.02	0.01	0.01
KS:Topeka	5	0.2	0.1	0.1	0.02	0.01	0.01
KY:Frankfort	4	0.6	0.0	0.3	0.03	0.01	0.02
LA:New Orleans	5	0.3	0.1	0.2	0.02	0.01	0.01
MA:Lawrence	8	0.1	0.0	0.0	0.02	0.01	0.01
ME:Augusta	7	0.1	0.0	0.0	0.02	0.01	0.01
MI:Lansing	8	0.1	0.0	0.0	0.02	0.01	0.01
MN:Minneapolis	4	0.0	0.0	0.0	0.02	0.01	0.01
MO:Jefferson City	8	1.2	0.1	0.4	0.02	0.01	0.02
MS:Jackson	7	0.5	0.1	0.2	0.02	0.01	0.01
NC:Charlotte	6	0.1	0.0	0.1	0.02	0.01	0.01
NC:Wilmington	6	0.0	0.0	0.0	0.01	0.01	0.01
ND:Bismarck	7	0.5	0.0	0.2	0.02	0.01	0.02
NE:Lincoln	7	0.2	0.0	0.1	0.02	0.01	0.02
NH:Concord	8	0.0	0.0	0.0	0.02	0.01	0.01
NJ:Trenton	8	0.4	0.0	0.1	0.01	0.01	0.01
NM:Santa Fe	5	0.3	0.1	0.2	0.03	0.01	0.01
NV:Las Vegas	8	0.3	0.1	0.2	0.02	0.00	0.01
NY:Albany	4	0.1	0.0	0.1	0.02	0.01	0.02
NY:Niagara Falls	8	0.1	0.0	0.0	0.02	0.01	0.01



**Table 3 (continued)**  
**Gross Beta in Airborne Particulates**  
**February 1993**

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
NY:Syracuse	1	0.0	0.0	0.0	0.01	0.01	0.01
NY:Yaphank	8	0.2	0.0	0.1	0.01	0.01	0.01
OH:Columbus	5	0.1	0.0	0.0	0.01	0.01	0.01
OH:Painesville	8	0.1	0.0	0.0	0.01	0.01	0.01
OH:Ross	7	0.1	0.1	0.1	0.02	0.01	0.01
OH:Toledo	9	0.2	0.1	0.1	0.02	0.01	0.01
OR:Portland	7	0.1	0.0	0.0	0.04	0.01	0.02
PA:Harrisburg	7	0.3	0.0	0.1	0.02	0.01	0.01
RI:Providence	8	0.1	0.0	0.0	0.01	0.01	0.01
SC:Barnwell	2	0.1	0.0	0.1	0.03	0.03	0.03
SC:Columbia	8	0.6	0.1	0.2	0.02	0.01	0.01
SD:Pierre	8	1.2	0.1	0.3	0.03	0.01	0.02
TN:Knoxville	6	1.3	0.1	0.5	0.03	0.01	0.02
TN:Nashville	8	0.3	0.1	0.2	0.11	0.01	0.03
TX:Austin	8	0.1	0.0	0.1	0.02	0.01	0.01
TX:El Paso	8	1.3	0.0	0.7	0.03	0.01	0.01
UT:Salt Lake City	7	0.1	0.0	0.0	0.05	0.00	0.02
VA:Lynchburg	8	1.2	0.1	0.4	0.02	0.01	0.01
VA:Virginia Beach	3	0.1	0.0	0.1	0.01	0.01	0.01
WA:Olympia	8	0.2	0.1	0.1	0.02	0.00	0.01
WA:Spokane	8	0.2	0.0	0.1	0.05	0.01	0.02
WI:Madison	8	0.1	0.0	0.0	0.02	0.01	0.02

Minimum Detectable Limit for field estimates - 0.1 pCi/m<sup>3</sup>.

Minimum Detectable Limit for laboratory measurement - 0.01 pCi/m<sup>3</sup>.

**Table 4**  
**Gross Beta in Airborne Particulates**  
**March 1993**

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
AK:Anchorage	8	0.0	0.0	0.0	0.01	0.00	0.00
AK:Juneau	9	0.0	0.0	0.0	0.01	0.00	0.00
AL:Montgomery	8	0.2	0.1	0.2	0.05	0.01	0.02
AR:Little Rock	9	0.3	0.1	0.2	0.02	0.01	0.01
AZ:Phoenix	9	2.2	0.1	0.8	0.01	0.01	0.01
CA:Berkeley	9	0.1	0.0	0.0	0.01	0.00	0.01
CA:Los Angeles	9	0.3	0.0	0.2	0.01	0.01	0.01
CO:Denver	9	1.4	0.1	0.6	0.03	0.01	0.01
CT:Hartford	9	0.0	0.0	0.0	0.02	0.00	0.01
DE:Wilmington	6	0.1	0.0	0.0	0.02	0.00	0.01
FL:Jacksonville	8	0.1	0.0	0.1	0.01	0.01	0.01
FL:Miami	9	0.1	0.0	0.0	0.01	0.00	0.01
HI:Honolulu	9	0.2	0.1	0.1	0.01	0.00	0.01
IA:Iowa City	9	0.1	0.0	0.0	0.02	0.01	0.01
ID:Boise	9	0.3	0.1	0.2	0.04	0.00	0.02
ID:Idaho Falls	9	0.0	0.0	0.0	0.04	0.00	0.01
IL:Chicago	9	0.1	0.0	0.1	0.02	0.01	0.01
IN:Indianapolis	8	0.2	0.0	0.1	0.02	0.01	0.01
KS:Topeka	8	0.5	0.1	0.3	0.02	0.01	0.01
KY:Frankfort	4	0.1	0.1	0.1	0.01	0.01	0.01
LA:New Orleans	6	0.2	0.1	0.1	0.01	0.01	0.01
MA:Lawrence	9	0.1	0.0	0.0	0.02	0.00	0.01
ME:Augusta	9	0.1	0.0	0.0	0.02	0.01	0.01
MI:Lansing	9	0.1	0.0	0.0	0.02	0.00	0.01
MN:Minneapolis	4	0.0	0.0	0.0	0.02	0.01	0.01
MO:Jefferson City	9	0.5	0.1	0.2	0.02	0.01	0.01
MS:Jackson	9	0.1	0.0	0.1	0.02	0.01	0.01
NC:Charlotte	9	0.1	0.0	0.0	0.02	0.00	0.01
NC:Wilmington	6	0.0	0.0	0.0	0.01	0.00	0.01
ND:Bismarck	7	0.4	0.0	0.2	0.02	0.01	0.02
NE:Lincoln	5	0.3	0.1	0.2	0.02	0.01	0.01
NH:Concord	9	0.2	0.0	0.0	0.02	0.01	0.01
NJ:Trenton	9	0.1	0.0	0.1	0.02	0.00	0.01
NM:Santa Fe	8	0.4	0.0	0.2	0.01	0.01	0.01
NV:Las Vegas	9	0.3	0.1	0.2	0.02	0.01	0.01
NY:Albany	5	0.0	0.0	0.0	0.02	0.01	0.01
NY:Niagara Falls	9	0.1	0.0	0.1	0.02	0.00	0.01

**Table 4 (continued)**  
**Gross Beta in Airborne Particulates**  
**March 1993**

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
NY:Syracuse	2	0.0	0.0	0.0	0.01	0.00	0.00
NY:Yaphank	7	0.1	0.0	0.1	0.03	0.00	0.01
OH:Columbus	5	0.1	0.0	0.0	0.01	0.00	0.01
OH:Painesville	8	0.0	0.0	0.0	0.02	0.00	0.01
OH:Ross	9	0.0	0.0	0.0	0.02	0.01	0.01
OH:Toledo	9	0.1	0.0	0.1	0.02	0.01	0.01
OR:Portland	9	0.0	0.0	0.0	0.03	0.00	0.01
PA:Harrisburg	9	0.1	0.0	0.1	0.02	0.00	0.01
RI:Providence	8	0.0	0.0	0.0	0.02	0.01	0.01
SC:Barnwell	2	0.0	0.0	0.0	0.01	0.01	0.01
SC:Columbia	9	0.2	0.0	0.1	0.02	0.01	0.01
SD:Pierre	8	0.8	0.1	0.3	0.03	0.01	0.02
TN:Knoxville	5	0.4	0.1	0.3	0.03	0.01	0.02
TN:Nashville	9	0.2	0.0	0.1	0.02	0.01	0.01
TX:Austin	8	0.1	0.0	0.1	0.01	0.00	0.01
TX:El Paso	9	1.2	0.4	0.8	0.02	0.01	0.01
UT:Salt Lake City	9	0.2	0.0	0.1	0.02	0.00	0.01
VA:Lynchburg	9	0.3	0.0	0.1	0.01	0.00	0.01
VA:Virginia Beach	3	0.1	0.1	0.1	0.01	0.00	0.00
WA:Olympia	8	0.2	0.0	0.1	0.01	0.00	0.01
WA:Spokane	9	0.3	0.0	0.1	0.03	0.01	0.01
WI:Madison	9	0.1	0.0	0.0	0.02	0.00	0.01

Minimum Detectable Limit for field estimates - 0.1 pCi/m<sup>3</sup>.

Minimum Detectable Limit for laboratory measurement - 0.01 pCi/m<sup>3</sup>.

**Table 5**  
**Gross Beta and Specific Gamma in Precipitation**  
**January 1993**

Location	Depth (mm)	Gross Beta Activity		Specific Gamma
		nCi/m <sup>2</sup>	±2σ	Activity pCi/L ±2σ
AL:Montgomery	108.0	0.09	0.03	ND
AR:Little Rock	102.0	0.25	0.04	<sup>7</sup> Be: 41.2±28.8
AZ:Phoenix	74.8	0.07	0.02	ND
CA:Berkeley	180.8	0.07	0.05	ND
CT:Hartford	53.0	0.10	0.02	<sup>7</sup> Be: 36.8±25.9
FL:Jacksonville	116.8	0.10	0.03	ND
FL:Miami	161.4	0.06	0.04	ND
ID:Boise	32.0	0.09	0.01	ND
ID:Idaho Falls	6.0	0.02	0.00	ND
IL:Chicago	99.6	0.12	0.03	ND
LA:New Orleans	107.0	0.11	0.03	ND
MN:Minneapolis	13.0	0.03	0.01	<sup>7</sup> Be: 41.1±26.8
MO:Jefferson City	73.0	0.37	0.04	<sup>7</sup> Be: 48.9±26.3
NC:Charlotte	121.0	0.06	0.03	<sup>7</sup> Be: 32.3±22.5
NC:Wilmington	104.6	0.10	0.03	<sup>7</sup> Be: 44.2±31.3
ND:Bismarck	15.8	0.14	0.01	ND
NJ:Trenton	52.4	0.19	0.02	<sup>7</sup> Be: 61.2±25.7
NM:Santa Fe	13.0	0.02	0.00	ND
NV:Las Vegas	43.0	0.15	0.02	ND
NY:Albany	51.2	0.11	0.02	ND
NY:Niagara Falls	39.0	0.04	0.01	<sup>7</sup> Be: 45.6±34.8
NY:Yaphank	16.0	0.02	0.01	<sup>7</sup> Be: 28.8±24.3
OH:Painesville	66.8	0.13	0.02	<sup>7</sup> Be: 50.4±29.2
OH:Toledo	76.0	0.13	0.03	<sup>7</sup> Be: 28.1±26.9
				<sup>212</sup> Pb: 11.8±4.9
OR:Portland	79.0	0.14	0.03	<sup>7</sup> Be: 89.2±27.9
PA:Harrisburg	57.6	0.07	0.02	<sup>7</sup> Be: 40.8±23.5
SC:Barnwell	61.8	0.09	0.02	<sup>7</sup> Be: 30.8±27.7
SC:Columbia	203.8	0.15	0.06	ND
TN:Knoxville	81.0	0.06	0.02	ND
TN:Nashville	83.8	0.14	0.03	ND
TX:Austin	80.0	0.11	0.03	<sup>7</sup> Be: 34.8±34.4
TX:El Paso	41.0	0.04	0.01	ND
UT:Salt Lake City	95.0	0.09	0.03	ND
VA:Lynchburg	76.4	0.09	0.02	ND
WA:Olympia	154.0	0.08	0.04	ND
WI:Madison	53.2	0.11	0.02	<sup>7</sup> Be: 42.3±28.9

Note: σ = Counting Error. ND = Not Detectable.

**Table 6**  
**Gross Beta and Specific Gamma in Precipitation**  
**February 1993**

Location	Depth (mm)	Gross Beta Activity		Specific Gamma
		nCi/m <sup>2</sup>	±2σ	Activity pCi/L ±2σ
AL:Montgomery	101.0	0.16	0.04	<sup>7</sup> Be: 64.3±25.0
AR:Little Rock	63.0	0.12	0.02	<sup>7</sup> Be: 33.3±20.5
AZ:Phoenix	49.6	0.05	0.02	<sup>7</sup> Be: 46.1±22.6
CA:Berkeley	58.4	0.04	0.02	ND
CO:Denver	16.6	0.03	0.01	<sup>7</sup> Be: 31.8±26.7
CT:Hartford	16.0	0.02	0.01	<sup>7</sup> Be: 27.2±23.5
DE:Wilmington	15.0	0.03	0.01	ND
FL:Jacksonville	44.4	0.05	0.02	ND
FL:Miami	36.2	0.04	0.01	ND
HI:Honolulu	21.0	0.02	0.01	ND
ID:Boise	34.0	0.02	0.01	<sup>7</sup> Be: 25.1±21.9
ID:Idaho Falls	40.0	0.05	0.01	ND
IL:Chicago	24.6	0.10	0.01	<sup>7</sup> Be: 49.7±35.6
LA:New Orleans	68.0	0.06	0.02	ND
MO:Jefferson City	46.0	0.04	0.01	<sup>7</sup> Be: 27.1±20.3
MS:Jackson	42.0	0.06	0.01	ND
NC:Charlotte	88.0	0.15	0.03	<sup>7</sup> Be: 55.1±22.8
NC:Wilmington	44.0	0.11	0.02	ND
ND:Bismarck	7.8	0.02	0.00	ND
NJ:Trenton	64.4	0.14	0.03	ND
NM:Santa Fe	22.0	0.03	0.01	ND
NV:Las Vegas	14.0	0.05	0.01	<sup>7</sup> Be: 37.8±23.8
NY:Albany	42.2	0.09	0.02	ND
NY:Niagara Falls	30.0	0.06	0.01	ND
NY:Yaphank	42.0	0.05	0.01	ND
OH:Painesville	31.0	0.14	0.02	<sup>7</sup> Be: 68.6±30.9
OH:Toledo	24.0	0.08	0.01	<sup>7</sup> Be: 77.5±26.0
PA:Harrisburg	75.0	0.07	0.02	ND
SC:Barnwell	153.0	0.28	0.06	ND
SC:Columbia	69.0	0.05	0.02	<sup>7</sup> Be: 46.3±23.9
TN:Knoxville	50.0	0.04	0.02	<sup>7</sup> Be: 61.1±25.6
TN:Nashville	73.2	0.10	0.03	<sup>212</sup> Pb: 8.7±8.4 <sup>7</sup> Be: 54.1±36.0
TX:Austin	40.0	0.12	0.02	<sup>7</sup> Be: 58.8±22.0
UT:Salt Lake City	43.0	0.03	0.01	ND
VA:Lynchburg	76.4	0.07	0.02	ND
WA:Olympia	7.6	0.02	0.00	<sup>7</sup> Be: 95.9±24.7
WI:Madison	16.6	0.01	0.00	ND

Note: σ = Counting Error. ND = Not Detectable.

**Table 7**  
**Gross Beta and Specific Gamma in Precipitation**  
**March 1993**

Location	Depth (mm)	Gross Beta Activity		Specific Gamma
		nCi/m <sup>2</sup>	±2σ	Activity pCi/L ±2σ
AK:Juneau	8.0	0.00	0.00	ND
AL:Montgomery	147.0	0.22	0.05	ND
AR:Little Rock	96.0	0.13	0.03	<sup>212</sup> Pb: 7.7±5.7
AZ:Phoenix	40.0	0.02	0.01	<sup>214</sup> Pb: 9.4±6.4
CA:Berkeley	51.4	0.02	0.01	ND
CO:Denver	8.6	0.02	0.00	ND
CT:Hartford	142.0	0.24	0.05	<sup>214</sup> Bi: 13.8±6.1
FL:Jacksonville	69.2	0.03	0.02	ND
FL:Miami	60.8	0.05	0.02	ND
ID:Boise	50.6	0.05	0.02	ND
ID:Idaho Falls	29.6	0.08	0.01	ND
IL:Chicago	63.2	0.10	0.02	<sup>7</sup> Be: 87.6±45.6
LA:New Orleans	93.0	0.07	0.03	ND
MN:Minneapolis	5.0	0.03	0.00	ND
MO:Jefferson City	79.0	0.16	0.03	ND
MS:Jackson	42.0	0.07	0.01	<sup>7</sup> Be: 62.9±45.6
NC:Charlotte	191.0	0.39	0.07	<sup>214</sup> Pb: 9.8±8.4
NC:Wilmington	104.0	0.14	0.03	ND
ND:Bismarck	6.6	0.02	0.00	ND
NJ:Trenton	160.0	0.26	0.06	ND
NV:Las Vegas	46.0	0.12	0.02	ND
NY:Albany	74.0	0.14	0.03	ND
NY:Niagara Falls	31.4	0.12	0.01	<sup>7</sup> Be: 92.1±44.5
				<sup>7</sup> Be: 102±45
OH:Painesville	54.0	0.18	0.03	ND
OH:Toledo	82.0	0.27	0.04	ND
OR:Portland	109.4	0.08	0.03	ND
PA:Harrisburg	182.6	0.33	0.07	ND
SC:Barnwell	56.8	0.13	0.02	ND
SC:Columbia	138.2	0.16	0.04	ND
TN:Knoxville	150.0	0.08	0.04	<sup>7</sup> Be: 68.0±51.9
TN:Nashville	127.8	0.20	0.05	ND
TX:Austin	61.0	0.06	0.02	ND
UT:Salt Lake City	32.6	0.03	0.01	ND
VA:Lynchburg	71.6	0.03	0.02	ND
WA:Olympia	93.6	0.08	0.03	ND
WI:Madison	26.8	0.03	0.01	ND

Note: σ = Counting Error. ND = Not Detectable.

**Table 8**  
**Tritium in Precipitation**  
**January–March 1993**

Location	January 1993		February 1993		March 1993	
	nCi/L	$\pm 2\sigma$	nCi/L	$\pm 2\sigma$	nCi/L	$\pm 2\sigma$
AK:Juneau	NS		NS		0.1	0.2
AL:Montgomery	0.2	0.2	0.1	0.2	0.1	0.2
AR:Little Rock	0.1	0.2	0.1	0.2	0.1	0.2
AZ:Phoenix	0.2	0.2	0.1	0.2	0.1	0.2
CA:Berkeley	0.1	0.2	0.1	0.2	0.1	0.2
CO:Denver	NS		0.1	0.2	0.1	0.2
CT:Hartford	0.1	0.2	0.1	0.2	0.1	0.2
DE:Wilmington	NS		0.1	0.2	NS	
FL:Jacksonville	0.1	0.2	0.1	0.2	0.1	0.2
FL:Miami	0.2	0.2	0.1	0.2	0.1	0.2
HI:Honolulu	NS		0.2	0.2	NS	
ID:Boise	0.1	0.2	0.1	0.2	0.1	0.2
ID:Idaho Falls	0.1	0.2	0.2	0.2	0.2	0.2
IL:Chicago	0.1	0.2	0.1	0.2	0.2	0.2
LA:New Orleans	0.1	0.2	0.1	0.2	0.1	0.2
MN:Minneapolis	0.2	0.2	NS		0.2	0.2
MO:Jefferson City	0.1	0.2	0.1	0.2	0.2	0.2
MS:Jackson	NS		0.1	0.2	0.2	0.2
NC:Charlotte	0.1	0.2	0.1	0.2	0.1	0.2
NC:Wilmington	0.1	0.2	0.1	0.2	0.1	0.2
ND:Bismarck	0.1	0.2	0.1	0.2	0.1	0.2
NJ:Trenton	0.1	0.2	0.1	0.2	0.1	0.2
NM:Santa Fe	0.3	0.2	0.1	0.2	NS	
NV:Las Vegas	0.1	0.2	0.2	0.2	0.1	0.2
NY:Albany	0.1	0.2	0.2	0.2	0.1	0.2
NY:Niagara Falls	0.1	0.2	0.2	0.2	0.1	0.2
NY:Yaphank	0.1	0.2	0.2	0.2	NS	
OH:Painesville	0.1	0.2	0.1	0.2	0.1	0.2
OH:Toledo	0.2	0.2	0.1	0.2	0.1	0.2
OR:Portland	0.1	0.2	NS		0.1	0.2
PA:Harrisburg	0.1	0.2	0.1	0.2	0.1	0.2
SC:Barnwell	0.3	0.2	0.5	0.2	0.2	0.2
SC:Columbia	0.1	0.2	0.1	0.2	0.1	0.2
TN:Knoxville	0.2	0.2	0.1	0.2	0.1	0.2
TN:Nashville	0.2	0.2	0.1	0.2	0.1	0.2
TX:Austin	0.1	0.2	0.1	0.2	0.3	0.2
TX:El Paso	0.1	0.2	NS		NS	
UT:Salt Lake City	0.1	0.2	0.1	0.2	0.1	0.2
VA:Lynchburg	0.1	0.2	0.1	0.2	0.1	0.2
WA:Olympia	0.1	0.2	0.3	0.2	0.2	0.2
WI:Madison	0.2	0.2	0.1	0.2	0.3	0.2

## **Plutonium and Uranium in Airborne Particulates and Precipitation**

Environmental radiation levels of plutonium and uranium are determined by the analysis of semiannually composited samples (air filters) collected from the continuously operating airborne particulate samplers.

Concentrations of the specific isotopes of plutonium-238, -239, and -240 and uranium-234, -235, and -238 are determined by alpha spectroscopy following chemical separation. The volume of air represented by the semiannual composite ranges from 60,000 to 250,000 cubic meters.

Plutonium and uranium results are published when they become available.



## Krypton-85

Krypton-85 is a long-lived noble gas with a half-life of 10.8 years. It is released into the atmosphere by nuclear reactor operations, fuel reprocessing, weapons tests, and research and defense related activities. Krypton-85 also occurs naturally in minor quantities primarily from the neutron capture of stable krypton-84 as well as spontaneous fission and neutron-induced fission of uranium. Krypton-85 in the atmosphere has been monitored to identify and establish baseline levels and long-term trends.

Krypton-85 analysis began in January 1973 with sample collections and analyses being performed for 12 sampling locations. These locations were selected to provide atmospheric coverage of the United States with considerations being given to the proximity to fuel reprocessing plants, nuclear reactors, and wide geographic coverage.

Dry compressed air samples, collected at each location, are purchased from commercial air suppliers and shipped to the NAREL, where the krypton-85 is cryogenically separated and counted in a liquid scintillation system.

The last Kr-85 results were for 1976, 1977, and 1979. They were published in *Environmental Radiation Data: Report 30*.

## 2. Water Program

The ERAMS water program provides data on ambient radiation levels in the nation's rivers, streams, and drinking water supplies.

### Surface Water

Quarterly grab samples are taken downstream from operating or future nuclear facilities at 58 stations. Surface water samples are analyzed for tritium quarterly and specific gamma activity annually. Tritium is a primary radioactive pollutant from nuclear power plants and weapons production activities. Tritium concentrations are determined by liquid scintillation counting of distilled samples. Gamma scans are performed annually to determine levels of gamma emitting radionuclides.

Table 9 contains the tritium concentration data for January-March 1993.

**Table 9**  
**Tritium in Surface Water**  
**January-March 1993**

Location	Source	Date Collected	<sup>3</sup> H	
			nCi/L	±2σ
AL:Decatur	Tennessee River	01/06/93	0.2	0.2
AL:Gordon	Chattahoochee River	01/14/93	0.2	0.2
AL:Scottsboro	Tennessee River	01/06/93	0.3	0.2
AR:Little Rock	Arkansas River	01/04/93	0.2	0.2
CA:Clay Station	Folsom S. Canal	01/05/93	0.1	0.2
CA:Diablo Canyon	Pacific Ocean	01/05/93	0.1	0.2
CA:Eureka	Humboldt Bay	01/14/93	0.1	0.2
CA:San Onofre	Pacific Ocean	03/11/93	0.1	0.2
CO:Platteville	South Platte River	01/08/93	0.1	0.2
CT:East Haddam	Connecticut River	12/21/92	0.2	0.2
CT:Waterford	Long Island Sound	12/21/92	0.2	0.2
FL:Crystal River	Gulf Of Mexico	01/19/93	0.1	0.2
FL:Ft. Pierce	Atlantic Ocean	01/20/93	0.1	0.2
FL:Homestead	Biscayne Bay	01/13/93	0.6	0.2
GA:Baxley	Altamaha River	01/13/93	0.1	0.2
IA:Cedar Rapids	Cedar River	01/05/93	0.1	0.2
IL:E. Moline	Mississippi River	01/11/93	0.1	0.2
IL:Morris	Illinois River	02/01/93	0.1	0.2
IL:Zion	Lake Michigan	03/20/93	0.3	0.2
KS:Leroy	Neosho River	03/30/93	0.1	0.2
LA:New Orleans	Mississippi River	01/22/93	0.1	0.2
MA:Plymouth	Cape Cod Bay	02/03/93	0.1	0.2
MD:Conowingo	Susquehanna River	01/12/93	0.1	0.2
MD:Lusby	Chesapeake Bay	01/05/93	0.1	0.2
ME:Wiscasset	Montseway Bay	01/05/93	0.4	0.2
MI:Bridgman	Lake Michigan	12/27/92	0.2	0.2
MI:Charlevoix	Lake Michigan	12/19/92	0.1	0.2
MI:Monroe	Lake Erie	12/21/92	0.2	0.2
MI:South Haven	Lake Michigan	12/27/92	0.1	0.2
MN:Monticello	Mississippi River	01/14/93	0.1	0.2
MN:Red Wing	Mississippi River	02/03/93	0.1	0.2
MS:Port Gibson	Mississippi River	01/05/93	0.2	0.2
NC:Charlotte	Catawba River	01/21/93	0.3	0.2
NC:Southport	Atlantic Ocean	01/11/93	0.2	0.2
NE:Rulo	Missouri River	01/05/93	0.1	0.2
NJ:Bayside	Delaware River	01/12/93	0.1	0.2
NJ:Oyster Creek	Oyster Creek	01/14/93	0.1	0.2

**Table 9 (continued)**  
**Tritium in Surface Water**  
**January–March 1993**

Location	Source	Date Collected	<sup>3</sup> H	
			nCi/L	±2σ
NV:Boulder City	Colorado River	01/06/93	0.1	0.2
NY:Chelsea	Hudson River	01/06/93	0.1	0.2
NY:Oswego	Lake Ontario	03/24/93	0.2	0.2
OH:Toledo	Lake Erie	01/07/93	0.1	0.2
OR:Bradwood	Columbia River	01/05/93	0.2	0.2
PA:Danville	Susquehanna River	01/13/93	0.1	0.2
PA:Philadelphia	Delaware River	01/25/93	0.1	0.2
PA:Philadelphia	Schuylkill R.-Queen	01/25/93	0.1	0.2
PA:Philadelphia	Schuylkill R.-Belmont	01/25/93	0.1	0.2
SC:Allendale	Savannah River	01/06/93	0.6	0.2
SC:Broad River	Broad River	01/22/93	0.2	0.2
SC:Hartsville	Lake Robinson	01/12/93	0.9	0.2
TN:Kingston	Clinch River	01/05/93	0.6	0.2
TN:Oak Ridge	Clinch River	02/23/93	0.1	0.2
TX:Matagorda	Colorado River	01/05/93	0.1	0.2
VA:Doswell	North Anna River	01/06/93	4.7	0.2
VA:Newport News	James River	01/12/93	0.1	0.2
VT:Vernon	Connecticut River	02/16/93	0.1	0.2
WA:Northport	Columbia River	01/25/93	0.1	0.2
WA:Richland	Columbia River	02/01/93	0.1	0.2
WI:Two Creeks	Lake Michigan	03/31/93	0.1	0.2
WI:Two Creeks	Lake Michigan	01/25/93	0.1	0.2
WI:Victory	Mississippi River	01/12/93	0.1	0.2
WV:Wheeling	Ohio River	01/04/93	0.2	0.2

Note: σ = Counting Error.

## Drinking Water

This program monitors ambient radiation levels in drinking water at 78 sites. These data serve to assess trends and anomalies in concentrations, and to compare with standards set forth in the EPA "National Interim Primary Drinking Water Regulations." These regulations provide for approval of supplies when the combined radium-226 and radium-228 levels do not exceed 5 pCi/L, when the gross alpha (excluding radon and uranium) levels do not exceed 15 pCi/L, when tritium levels do not exceed 20,000 pCi/L, when the strontium-90 levels do not exceed 8 pCi/L, and when the gross beta levels do not exceed 50 pCi/L.

Grab samples are taken at the 78 sites which are either major population centers or selected nuclear facility environs.

The analyses include (a) tritium on a quarterly basis; (b) gross alpha, gross beta, strontium-90, and gamma on annual composites; (c) radium-226 if the gross alpha exceeds 2 pCi/L and radium-228 if the radium-226 falls between 3 and 5 pCi/L; (d) specific iodine-131 on one quarterly sample per year for each station; and (e) an annual composite for plutonium-238, -239, and -240 and uranium-234, -235, and -238 for stations that demonstrate gross alpha levels greater than 2 pCi/L.

Tritium analyses are performed by scintillation counting of the distilled samples. Gross beta and alpha are determined by evaporating an aliquot on a stainless steel planchet for counting. Radium-226 is determined by the standard emanation technique. Strontium-90 is determined by beta counting a strontium carbonate precipitate isolated by ion exchange.

Table 10 contains the data from drinking water samples for January–March 1993.

**Table 10**  
**Tritium in Drinking Water**

January-March 1993

Location	Date Collected	<sup>3</sup> H	
		nCi/L	±2σ
AK:Fairbanks	01/12/93	0.1	0.2
AL:Dothan	01/14/93	0.1	0.2
AL:Montgomery	01/14/93	0.1	0.2
AL:Muscle Shoals	01/06/93	0.1	0.2
AL:Scottsboro	01/06/93	0.1	0.2
AR:Little Rock	01/04/93	0.2	0.2
CA:Berkeley	03/25/93	0.1	0.2
CA:Los Angeles	01/04/93	0.1	0.2
CO:Denver	01/07/93	0.2	0.2
CO:Platteville	01/07/93	0.1	0.2
CT:Hartford	12/29/92	0.2	0.2
DE:Dover	01/21/93	0.1	0.2
FL:Miami	01/07/93	0.1	0.2
FL:Tampa	01/22/93	0.1	0.2
GA:Baxley	01/13/93	0.1	0.2
HI:Honolulu	01/04/93	0.1	0.2
IA:Cedar Rapids	01/05/93	0.1	0.2
ID:Boise	03/25/93	0.1	0.2
ID:Idaho Falls	01/07/93	0.1	0.2
IL:Morris	02/26/93	0.1	0.2
IL:W. Chicago	01/04/93	0.1	0.2
KS:Topeka	01/06/93	0.1	0.2
LA:New Orleans	12/21/92	0.2	0.2
MA:Lawrence	01/11/93	0.1	0.2
MD:Baltimore	01/04/93	0.2	0.2
MD:Conowingo	01/12/93	0.1	0.2
ME:Augusta	01/28/93	0.1	0.2
MI:Detroit	12/31/92	0.3	0.2
MI:Grand Rapids	12/30/92	0.2	0.2
MN:Minneapolis	01/04/93	0.2	0.2
MN:Red Wing	01/05/93	0.1	0.2
MO:Jefferson City	03/22/93	0.1	0.2
MS:Jackson	01/05/93	0.1	0.2
MS:Port Gibson	01/05/93	0.2	0.2
MT:Helena	03/22/93	0.1	0.2
NC:Charlotte	01/21/93	0.3	0.2
NC:Wilmington	01/13/93	0.1	0.2
ND:Bismarck	01/04/93	0.3	0.2
NE:Lincoln	12/22/92	0.3	0.2
NH:Concord	03/22/93	0.1	0.2
NJ:Trenton	01/13/93	0.1	0.2

**Table 10 (continued)**  
**Tritium in Drinking Water**  
**January-March 1993**

Location	Date Collected	<sup>3</sup> H	
		nCi/L	±2σ
NJ:Waretown	01/14/93	0.1	0.2
NM:Santa Fe	01/05/93	0.1	0.2
NV:Las Vegas	01/04/93	0.1	0.2
NY:Albany	01/05/93	0.1	0.2
NY:New York City	01/12/93	0.1	0.2
NY:Niagara Falls	01/05/93	0.3	0.2
NY:Syracuse	02/01/93	0.1	0.2
OH:Cincinnati	03/01/93	0.2	0.2
OH:Columbus	02/08/93	0.1	0.2
OH:East Liverpool	03/03/93	0.1	0.2
OH:Painesville	12/14/92	0.4	0.2
OH:Toledo	01/07/93	0.2	0.2
OK:Oklahoma City	03/04/93	0.1	0.2
OR:Portland	01/14/93	0.1	0.2
PA:Columbia	01/14/93	0.1	0.2
PA:Harrisburg	01/14/93	0.1	0.2
PA:Philadelphia-Baxter	01/25/93	0.1	0.2
PA:Philadelphia-Queen	01/25/93	0.1	0.2
PA:Philadelphia	01/25/93	0.1	0.2
PA:Pittsburgh	03/03/93	0.3	0.2
PC:Ancon	01/08/93	0.1	0.2
PC:Corozal	03/26/93	0.1	0.2
RI:Providence	02/18/93	0.2	0.2
SC:Barnwell	01/14/93	0.1	0.2
SC:Columbia	01/05/93	0.2	0.2
SC:Hartsville	01/12/93	0.1	0.2
SC:Jenkinsville	01/08/93	0.1	0.2
SC:Seneca	01/19/93	0.1	0.2
TN:Chattanooga	01/11/93	0.3	0.2
TN:Knoxville	12/31/92	0.1	0.2
TX:Austin	01/08/93	0.1	0.2
VA:Doswell	01/04/93	0.1	0.2
VA:Lynchburg	01/07/93	0.1	0.2
WA:Richland	02/01/93	0.1	0.2
WA:Seattle	12/22/92	0.2	0.2
WI:Genoa City	01/12/93	0.2	0.2
WI:Madison	01/04/93	0.1	0.2

Note:  $\sigma$  = Counting Error.

### 3. External Gamma Ambient Monitoring Program

The External Gamma Monitoring Program (EGAMP), which began in October 1978, provides a continuous measurement of ambient gamma exposure rates, including cosmic, at selected sites throughout the continental United States. Data from this program are used to evaluate fluctuations in natural background due to variations in environmental conditions and to provide a means of monitoring any significant increases in ambient gamma levels. The program consists of approximately 22 sites representing wide geographic coverage throughout the country.† Although exposure measurements at these few sites are not totally representative of nationwide exposures, they do indicate national trends.

The EGAMP program utilizes  $\text{CaF}_2:\text{Mn}$  thermoluminescent dosimeters (TLD's). These dosimeters are commercially available glass-bulb type dosimeters with energy compensating shields. A group of three TLD's is located at each station or site. Dosimeters are annealed by the station operator prior to positioning in the field. The dosimeters are returned to NAREL for readout approximately every three months. Several dosimeters are annealed by the station operator as controls and returned with the exposed field dosimeters to correct for any exposures accumulated during shipment.

Publication of EGAMP data has been suspended until problems with the data are resolved.

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† Since some of these sites may not return dosimeters each period, the number of sites listed may vary slightly.



## 4. Milk Program

### Pasteurized Milk

This is a cooperative program with the Dairy and Lipid Products Branch, Milk Sanitation Section, Food and Drug Administration. Milk is a reliable indicator of the general population's intake of radionuclides since it is consumed fresh by a large segment of the population and can contain several of the biologically important radionuclides that result from environmental releases from nuclear activities. A primary function of this program is to obtain reliable monitoring data relative to current radionuclide concentrations and determine any long-term trends.

Monthly samples are collected at 65 sampling sites with at least one located in each state, Puerto Rico, and the Panama Canal Zone. The samples are composited, according to production, from the major milk suppliers representing more than 80 percent of the milk consumed in a given population center.

The samples are analyzed for gamma emitting nuclides, including iodine-131, barium-140, cesium-137, and potassium. All samples collected in July are analyzed for strontium-90. Also, for the first month of the three quarters beginning January, April, and October, 10 regional composite samples of milk made up from the states within each of EPA's 10 regions are analyzed for strontium-90.

Iodine-131, barium-140, cesium-137, and potassium are determined by gamma spectral analysis. Strontium-90 is determined by beta counting a total strontium precipitate that has been chemically separated by ion exchange.

Tables 11-13 contain the concentrations of radionuclides in pasteurized milk for January-March 1993. Table 14 contains the concentrations of strontium-90 in pasteurized milk EPA Regional Composites for January 1993.

**Table 11**  
**Radionuclides in Pasteurized Milk**  
**January 1993**

Location	Date Collected	K g/L $\pm 2\sigma$	<sup>137</sup> Cs pCi/L $\pm 2\sigma$	<sup>140</sup> Ba pCi/L $\pm 2\sigma$	<sup>131</sup> I pCi/L $\pm 2\sigma$
AL:Montgomery	01/07/93	1.55 0.08	ND	ND	ND
AR:Little Rock	01/11/93	1.54 0.10	ND	ND	ND
AZ:Phoenix	01/12/93	1.61 0.06	ND	ND	ND
CA:Los Angeles	01/04/93	1.73 0.07	ND	ND	ND
CA:Sacramento	01/05/93	1.43 0.12	ND	ND	ND
CA:San Francisco	01/07/93	1.56 0.08	ND	ND	ND
DE:Wilmington	01/27/93	1.67 0.06	ND	ND	ND
GA:Atlanta	01/05/93	1.44 0.08	ND	ND	ND
HI:Honolulu	01/07/93	1.60 0.12	ND	ND	ND
IA:Des Moines	01/04/93	1.64 0.08	ND	ND	ND
IL:Chicago	01/07/93	1.60 0.06	ND	ND	ND
IN:Indianapolis	01/04/93	1.45 0.14	ND	ND	ND
KS:Wichita	01/25/93	1.56 0.08	ND	ND	ND
KY:Louisville	01/05/93	1.62 0.08	ND	ND	ND
LA:New Orleans	01/12/93	1.75 0.07	ND	ND	ND
MA:Boston	01/04/93	1.61 0.08	ND	ND	ND
MD:Baltimore	01/07/93	1.51 0.12	ND	ND	ND
MI:Detroit	01/26/93	1.55 0.14	ND	ND	ND
MI:Grand Rapids	01/04/93	1.66 0.08	ND	ND	ND
MN:St. Paul	01/06/93	1.56 0.09	ND	ND	ND
MO:Kansas City	01/20/93	1.63 0.05	ND	ND	ND
MO:St. Louis	01/05/93	1.72 0.07	ND	ND	ND
MS:Jackson	01/04/93	1.60 0.08	ND	ND	ND
MT:Helena	01/26/93	1.33 0.11	ND	ND	ND
NC:Charlotte	01/28/93	1.64 0.09	ND	ND	ND
ND:Minot	01/27/93	1.61 0.09	ND	ND	ND
NJ:Trenton	01/07/93	1.59 0.08	ND	ND	ND
NM:Albuquerque	01/05/93	1.53 0.06	ND	ND	ND
NY:Buffalo	01/04/93	1.58 0.08	ND	ND	ND
OH:Cincinnati	01/29/93	1.67 0.09	ND	ND	ND
OH:Cleveland	01/22/93	1.63 0.08	ND	ND	ND
OK:Oklahoma City	01/13/93	1.60 0.08	ND	ND	ND
PA:Philadelphia	01/04/93	1.57 0.11	ND	ND	ND
PA:Pittsburgh	01/05/93	1.53 0.12	ND	ND	ND
PC:Cristobal	01/07/93	1.55 0.06	5	2	ND
PR:San Juan	01/08/93	1.54 0.09	ND	ND	ND
SC:Charleston	01/19/93	1.57 0.12	ND	ND	ND

**Table 11 (continued)**  
**Radionuclides in Pasteurized Milk**  
**January 1993**

Location	Date Collected	K		<sup>137</sup> Cs		<sup>140</sup> Ba		<sup>131</sup> I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
SD:Rapid City	01/04/93	1.63	0.08	ND		ND		ND	
TN:Knoxville	01/06/93	1.62	0.10	ND		ND		ND	
TN:Memphis	01/12/93	1.63	0.08	ND		ND		ND	
TX:Austin	01/05/93	1.61	0.08	ND		ND		ND	
TX:Ft. Worth	01/26/93	1.63	0.06	ND		ND		ND	
VA:Norfolk	01/29/93	1.63	0.08	ND		ND		ND	
VT:Burlington	01/18/93	1.49	0.13	ND		ND		ND	
WA:Seattle	01/06/93	1.58	0.14	ND		ND		ND	
WA:Spokane	01/04/93	1.55	0.09	ND		ND		ND	
WV:Charleston	01/20/93	1.58	0.08	ND		ND		ND	

Note: σ = Counting Error. ND = Not Detectable.

**Table 12**  
**Radionuclides in Pasteurized Milk**  
**February 1993**

Location	Date Collected	K		<sup>137</sup> Cs		<sup>140</sup> Ba		<sup>131</sup> I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
AL:Montgomery	02/04/93	1.62	0.06	ND		ND		ND	
AR:Little Rock	02/03/93	1.60	0.08	ND		ND		ND	
AZ:Phoenix	02/24/93	1.54	0.08	ND		ND		ND	
CA:Los Angeles	02/02/93	1.61	0.07	ND		ND		ND	
CA:Sacramento	02/02/93	1.64	0.06	ND		ND		ND	
CA:San Francisco	02/04/93	1.54	0.08	ND		ND		ND	
CO:Denver	02/16/93	1.45	0.11	ND		ND		ND	
DE:Wilmington	02/09/93	1.57	0.06	ND		ND		ND	
GA:Atlanta	02/09/93	1.61	0.07	ND		ND		ND	
IA:Des Moines	02/02/93	1.60	0.06	ND		ND		ND	
IL:Chicago	02/04/93	1.66	0.06	ND		ND		ND	
IN:Indianapolis	02/08/93	1.60	0.06	ND		ND		ND	
KS:Wichita	02/22/93	1.59	0.06	ND		ND		ND	
KY:Louisville	02/02/93	1.67	0.06	ND		ND		ND	
MA:Boston	02/08/93	1.55	0.14	ND		ND		ND	
MD:Baltimore	02/05/93	1.69	0.08	ND		ND		ND	
ME:Portland	02/05/93	1.66	0.08	ND		ND		ND	
MI:Detroit	02/02/93	1.67	0.05	ND		ND		ND	
MI:Grand Rapids	02/08/93	1.57	0.06	ND		ND		ND	
MN:St. Paul	02/03/93	1.48	0.06	ND		ND		ND	
MO:Kansas City	02/16/93	1.60	0.06	ND		ND		ND	
MO:St. Louis	02/03/93	1.68	0.07	ND		ND		ND	
MS:Jackson	02/03/93	1.51	0.08	ND		ND		ND	
MT:Helena	02/22/93	1.63	0.06	ND		ND		ND	
NC:Charlotte	02/26/93	1.56	0.08	ND		ND		ND	
ND:Minot	02/25/93	1.57	0.06	ND		ND		ND	
NJ:Trenton	02/03/93	1.67	0.07	ND		ND		ND	
NM:Albuquerque	02/04/93	1.56	0.06	ND		ND		ND	
NV:Las Vegas	02/02/93	1.56	0.10	ND		ND		ND	
NY:Buffalo	02/02/93	1.20	0.06	ND		ND		ND	
NY:Syracuse	02/02/93	1.57	0.08	ND		ND		ND	
OH:Cincinnati	02/26/93	1.63	0.08	ND		ND		ND	
OH:Cleveland	02/12/93	1.64	0.09	ND		ND		ND	
PA:Philadelphia	02/08/93	1.55	0.08	ND		ND		ND	
PA:Pittsburgh	02/08/93	1.72	0.07	ND		ND		ND	
PC:Cristobal	02/11/93	1.57	0.06	6	2	ND		ND	
PR:San Juan	02/12/93	1.55	0.14	ND		ND		ND	

**Table 12 (continued)**  
**Radionuclides in Pasteurized Milk**  
**February 1993**

Location	Date Collected	K		<sup>137</sup> Cs		<sup>140</sup> Ba		<sup>131</sup> I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
SC:Charleston	02/11/93	1.49	0.09	ND		ND		ND	
SD:Rapid City	02/01/93	1.60	0.06	ND		ND		ND	
TN:Chattanooga	02/09/93	1.61	0.08	ND		ND		ND	
TN:Knoxville	02/03/93	1.41	0.08	ND		ND		ND	
VA:Norfolk	02/26/93	1.61	0.08	ND		ND		ND	
VT:Burlington	02/10/93	1.56	0.08	ND		ND		ND	
WA:Seattle	02/02/93	1.61	0.06	ND		ND		ND	
WA:Spokane	02/10/93	1.63	0.12	ND		ND		ND	
WV:Charleston	02/22/93	1.57	0.08	ND		ND		ND	

Note: σ = Counting Error. ND = Not Detectable.

**Table 13**  
**Radionuclides in Pasteurized Milk**  
**March 1993**

Location	Date Collected	K		<sup>137</sup> Cs		<sup>140</sup> Ba		<sup>131</sup> I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
AL:Montgomery	03/11/93	1.58	0.07	ND		ND		ND	
AR:Little Rock	03/15/93	1.54	0.08	ND		ND		ND	
AZ:Phoenix	03/22/93	1.56	0.08	ND		ND		ND	
CA:Los Angeles	03/10/93	1.56	0.08	ND		ND		ND	
CA:Sacramento	03/03/93	1.62	0.08	ND		ND		ND	
CA:San Francisco	03/03/93	1.63	0.05	ND		ND		ND	
CO:Denver	03/11/93	1.50	0.14	ND		ND		ND	
CT:Hartford	03/04/93	1.50	0.11	ND		ND		ND	
DE:Wilmington	03/09/93	1.56	0.08	ND		ND		ND	
FL:Tampa	03/03/93	1.67	0.06	4	1	ND		ND	
GA:Atlanta	03/10/93	1.38	0.13	ND		ND		ND	
HI:Honolulu	03/22/93	1.60	0.10	ND		ND		ND	
IA:Des Moines	03/08/93	1.56	0.12	ND		ND		ND	
IL:Chicago	03/04/93	1.56	0.08	ND		ND		ND	
IN:Indianapolis	03/15/93	1.61	0.12	ND		ND		ND	
KS:Wichita	03/29/93	1.43	0.10	ND		ND		ND	
KY:Louisville	03/02/93	1.51	0.08	ND		ND		ND	
LA>New Orleans	03/05/93	1.60	0.06	ND		ND		ND	
MA:Boston	03/12/93	1.57	0.08	ND		ND		ND	
MD:Baltimore	03/05/93	1.59	0.06	ND		ND		ND	
MI:Detroit	03/04/93	1.61	0.09	ND		ND		ND	
MI:Grand Rapids	03/08/93	1.53	0.12	ND		ND		ND	
MN:St. Paul	03/03/93	1.56	0.08	ND		ND		ND	
MO:Springfield	03/24/93	1.57	0.08	ND		ND		ND	
MO:St. Louis	03/03/93	1.54	0.08	ND		ND		ND	
MS:Jackson	03/09/93	1.62	0.08	ND		ND		ND	
MT:Helena	03/18/93	1.66	0.09	ND		ND		ND	
NC:Charlotte	03/25/93	1.57	0.10	ND		ND		ND	
ND:Minot	03/30/93	1.61	0.12	ND		ND		ND	
NJ:Trenton	03/03/93	1.62	0.09	ND		ND		ND	
NM:Albuquerque	03/22/93	1.54	0.08	ND		ND		ND	
NV:Las Vegas	03/09/93	1.50	0.08	ND		ND		ND	
NY:Buffalo	03/09/93	1.67	0.09	ND		ND		ND	
NY:Syracuse	03/03/93	1.56	0.08	ND		ND		ND	
OH:Cincinnati	03/24/93	1.56	0.08	ND		ND		ND	
OK:Oklahoma City	03/15/93	1.38	0.10	ND		ND		ND	
OR:Portland	03/03/93	1.53	0.14	ND		ND		ND	

**Table 13 (continued)**  
**Radionuclides in Pasteurized Milk**  
**March 1993**

Location	Date Collected	K		<sup>137</sup> Cs		<sup>140</sup> Ba		<sup>131</sup> I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
PA:Philadelphia	03/08/93	1.50	0.08	ND		ND		ND	
PA:Pittsburgh	03/12/93	1.58	0.09	ND		ND		ND	
PC:Cristobal	03/18/93	1.56	0.08	6	2	ND		ND	
PR:San Juan	03/12/93	1.58	0.08	ND		ND		ND	
SC:Charleston	03/23/93	1.49	0.11	ND		ND		ND	
SD:Rapid City	03/04/93	1.62	0.08	ND		ND		ND	
TN:Knoxville	03/09/93	1.50	0.10	ND		ND		ND	
TX:Austin	03/01/93	1.61	0.08	ND		ND		ND	
TX:Ft. Worth	03/22/93	1.58	0.08	ND		ND		ND	
VT:Burlington	03/10/93	1.54	0.09	ND		ND		ND	
WA:Seattle	03/02/93	1.56	0.10	ND		ND		ND	
WA:Spokane	03/08/93	1.64	0.06	ND		ND		ND	
WV:Charleston	03/24/93	1.58	0.07	ND		ND		ND	

Note: σ = Counting Error. ND = Not Detectable.

**Table 14**  
**Strontium-90 in Pasteurized Milk**  
**EPA Regional Composites**  
**January 1993**

EPA Region	Collection Date	<sup>90</sup> Sr	
		pCi/L	±2σ
I	01/15/93	0.9	0.1
II	01/15/93	1.2	0.6
III	01/15/93	1.2	0.6
IV	01/15/93	1.4	0.3
V	01/15/93	1.6	0.5
VI	01/15/93	1.4	0.2
VII	01/15/93	1.9	0.3
VIII	01/15/93	2.2	0.2
IX	01/15/93	0.6	0.1
X	01/15/93	1.0	0.5

Note: σ = Counting Error.



## Carbon-14 in Milk

Nine stations, chosen for wide geographical distribution, contribute milk samples for annual analysis of carbon-14. These samples are monitored for carbon-14 levels in the food chain resulting from nuclear testing. The pasteurized milk is freeze-dried and the resulting powder is pelletized for ease of combustion. Analysis consists of combusting the samples and converting the released carbon dioxide through a series of chemical conversions to benzene, which is then assayed for carbon-14 by liquid scintillation.

The samples undergo three main steps in the chemical conversions to benzene prior to liquid scintillation counting. They include (1) combustion of the sample to carbon dioxide, (2) conversion of the carbon dioxide to acetylene, and (3) trimerizations of the acetylene to benzene. The last carbon-14 results were for samples collected during April-May 1982, 1983-1986, and March-May 1987. They were published in *Environmental Radiation Data: Report 54* and *Environmental Radiation Data: Report 59*.



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