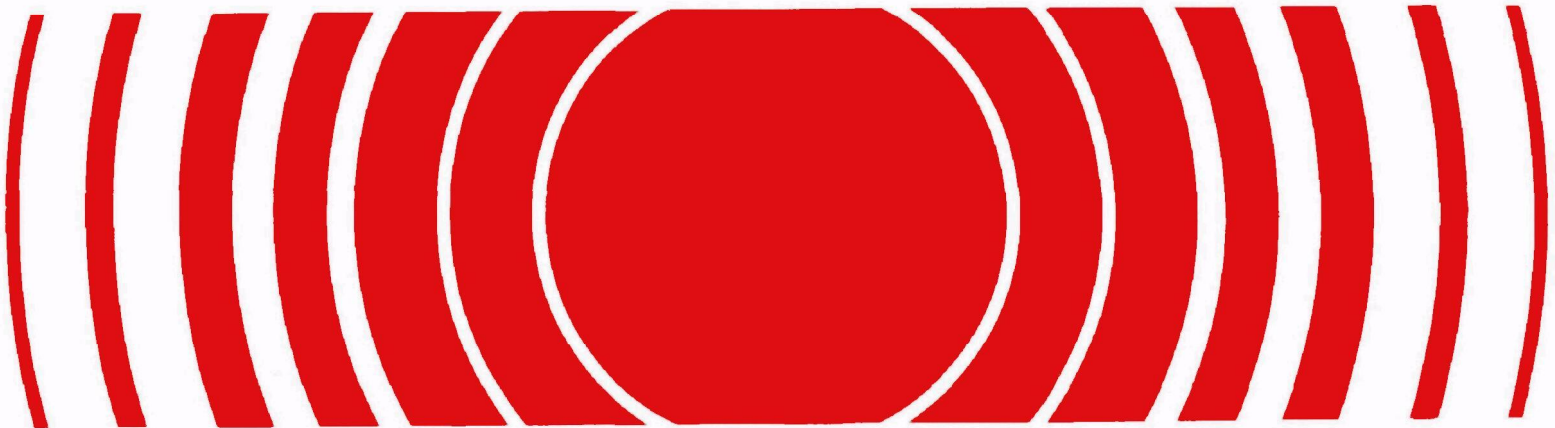


Office of Radiation and Indoor Air



Environmental Radiation Data Report 76

October - December 1993



ENVIRONMENTAL

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DATA

REPORT 76

October–December 1993

United States Environmental Protection Agency

Office of Radiation and Indoor Air

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 2σ 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 2σ (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 3σ 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 ³	0.01 pCi/m ³	0.01 pCi/m ³
	Water	pCi/L	1 pCi/L	1 pCi/L
	Precipitation	nCi/m ²	0.01 nCi/m ²	0.01 nCi/m ²
	(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 ³	0.1 pCi/m ³	2 pCi/m ³
‡‡ Plutonium-238,239,240	Air	aCi/m ³	0.1 aCi/m ³	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 ³	0.1 aCi/m ³	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/m² would be dependent on precipitation (mm).

‡‡ This value of MDL for air in terms of pCi/m³ 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/m³ 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 pCi/m³. 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 October-December 1993. Tables 5-7 contain the data from precipitation samples for October-December 1993. Table 8 contains the data from tritium in precipitation samples for October-December 1993 at the selected sites.

† 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
October 1993

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
		(pCi/m ³)			(pCi/m ³)		
AK:Juneau	7	0.0	0.0	0.0	0.00	0.00	0.00
AL:Montgomery	8	0.5	0.2	0.3	0.02	0.01	0.01
AR:Little Rock	7	0.4	0.1	0.3	0.02	0.01	0.01
AZ:Phoenix	4	1.5	0.4	0.8	0.02	0.01	0.01
CA:Berkeley	9	0.3	0.0	0.1	0.02	0.00	0.01
CA:Los Angeles	9	0.6	0.0	0.3	0.03	0.01	0.02
CO:Denver	7	1.4	0.2	0.7	0.02	0.01	0.01
CT:Hartford	8	0.1	0.0	0.1	0.01	0.00	0.01
DE:Wilmington	7	0.2	0.1	0.1	0.02	0.01	0.01
FL:Jacksonville	8	0.1	0.0	0.0	0.02	0.00	0.01
FL:Miami	9	0.1	0.0	0.0	0.01	0.00	0.00
HI:Honolulu	5	0.2	0.1	0.1	0.01	0.00	0.00
IA:Iowa City	8	0.1	0.0	0.1	0.02	0.01	0.01
ID:Boise	9	1.1	0.3	0.7	0.02	0.01	0.01
ID:Idaho Falls	9	0.0	0.0	0.0	0.02	0.01	0.01
IL:Chicago	8	0.5	0.2	0.3	0.02	0.01	0.02
IN:Indianapolis	9	0.9	0.1	0.3	0.03	0.01	0.02
KS:Topeka	7	0.9	0.1	0.5	0.02	0.01	0.01
KY:Frankfort	1	0.0	0.0	0.0	0.01	0.01	0.01
LA:New Orleans	5	0.2	0.1	0.2	0.02	0.01	0.01
MA:Lawrence	3	0.1	0.0	0.1	0.01	0.01	0.01
ME:Augusta	9	0.2	0.1	0.2	0.01	0.00	0.01
MI:Lansing	8	0.2	0.0	0.1	0.01	0.01	0.01
MN:Minneapolis	4	0.2	0.1	0.2	0.02	0.01	0.02
MO:Jefferson City	9	0.6	0.2	0.3	0.02	0.00	0.01
MS:Jackson	9	0.8	0.1	0.3	0.03	0.01	0.02
NC:Charlotte	8	0.4	0.0	0.2	0.02	0.01	0.02
NC:Wilmington	4	0.0	0.0	0.0	0.01	0.01	0.01
ND:Bismarck	3	0.0	0.0	0.0	0.02	0.01	0.01
NH:Concord	9	0.2	0.0	0.1	0.01	0.00	0.01
NJ:Trenton	8	0.4	0.2	0.3	0.01	0.01	0.01
NM:Santa Fe	6	0.5	0.2	0.3	0.02	0.01	0.01
NV:Las Vegas	8	0.3	0.1	0.2	0.03	0.01	0.01
NY:Albany	4	0.1	0.0	0.0	0.02	0.01	0.01
NY:Niagara Falls	9	0.3	0.1	0.2	0.02	0.00	0.01
NY:Syracuse	4	0.1	0.0	0.1	0.01	0.01	0.01
NY:Yaphank	9	0.0	0.0	0.0	0.01	0.01	0.01

Table 2 (continued)
Gross Beta in Airborne Particulates
October 1993

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
OH:Columbus	7	0.1	0.0	0.0	0.02	0.01	0.01
OH:Painesville	9	0.2	0.0	0.1	0.02	0.00	0.01
OH:Ross	9	0.0	0.0	0.0	0.03	0.01	0.02
OH:Toledo	8	0.3	0.1	0.2	0.02	0.01	0.01
OR:Portland	8	0.0	0.0	0.0	0.01	0.01	0.01
PA:Harrisburg	8	0.5	0.0	0.2	0.02	0.01	0.01
SC:Barnwell	2	0.1	0.0	0.1	0.01	0.01	0.01
SC:Columbia	9	0.5	0.1	0.3	0.05	0.01	0.02
SD:Pierre	7	0.8	0.2	0.4	0.02	0.01	0.01
TN:Knoxville	3	0.6	0.1	0.4	0.02	0.01	0.02
TN:Nashville	9	1.0	0.1	0.5	0.03	0.01	0.02
TX:Austin	9	0.4	0.1	0.2	0.02	0.01	0.01
TX:El Paso	8	1.3	0.5	0.9	0.02	0.01	0.01
UT:Salt Lake City	8	0.5	0.0	0.2	0.03	0.01	0.02
VA:Lynchburg	8	1.0	0.1	0.7	0.02	0.01	0.01
VA:Virginia Beach	3	0.1	0.1	0.1	0.01	0.01	0.01
WA:Olympia	9	0.3	0.1	0.2	0.01	0.00	0.01
WA:Spokane	8	0.7	0.2	0.5	0.02	0.01	0.01
WI:Madison	9	0.4	0.1	0.2	0.02	0.01	0.01

Minimum Detectable Limit for field estimates – 0.1 pCi/m³.

Minimum Detectable Limit for laboratory measurement – 0.01 pCi/m³.

Table 3
Gross Beta in Airborne Particulates
November 1993

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
		(pCi/m ³)			(pCi/m ³)		
AK:Juneau	8	0.0	0.0	0.0	0.01	0.00	0.00
AL:Montgomery	8	0.3	0.1	0.2	0.14	0.01	0.03
AR:Little Rock	7	0.4	0.1	0.2	0.02	0.01	0.01
AZ:Phoenix	5	1.1	0.1	0.8	0.03	0.01	0.02
CA:Berkeley	9	0.5	0.1	0.2	0.02	0.01	0.02
CA:Los Angeles	8	0.6	0.0	0.2	0.03	0.01	0.02
CO:Denver	8	0.9	0.2	0.5	0.02	0.01	0.01
CT:Hartford	9	0.1	0.0	0.0	0.02	0.01	0.01
DE:Wilmington	9	0.8	0.0	0.2	0.03	0.01	0.02
FL:Jacksonville	6	0.1	0.0	0.0	0.01	0.01	0.01
FL:Miami	9	0.1	0.0	0.0	0.01	0.00	0.01
HI:Honolulu	4	0.2	0.1	0.1	0.01	0.00	0.00
IA:Iowa City	8	0.3	0.1	0.2	0.02	0.00	0.01
ID:Boise	9	3.6	0.3	1.3	0.05	0.01	0.02
ID:Idaho Falls	9	0.0	0.0	0.0	0.03	0.01	0.02
IL:Chicago	6	0.5	0.1	0.2	0.03	0.01	0.02
IN:Indianapolis	8	0.5	0.0	0.3	0.03	0.01	0.02
KS:Topeka	8	1.1	0.4	0.7	0.02	0.01	0.01
LA:New Orleans	6	0.2	0.1	0.2	0.02	0.01	0.01
MA:Lawrence	3	0.1	0.0	0.0	0.01	0.01	0.01
ME:Augusta	7	0.2	0.0	0.1	0.02	0.01	0.01
MI:Lansing	9	0.5	0.1	0.2	0.02	0.01	0.01
MN:Minneapolis	4	0.6	0.2	0.4	0.04	0.01	0.02
MO:Jefferson City	6	0.6	0.1	0.3	0.02	0.01	0.01
MS:Jackson	8	0.3	0.1	0.2	0.02	0.00	0.01
NC:Charlotte	9	0.2	0.0	0.1	0.03	0.01	0.02
NC:Wilmington	4	0.0	0.0	0.0	0.01	0.01	0.01
ND:Bismarck	5	0.0	0.0	0.0	0.02	0.01	0.01
NH:Concord	9	0.2	0.0	0.1	0.02	0.01	0.01
NJ:Trenton	6	0.4	0.1	0.2	0.02	0.01	0.01
NM:Santa Fe	5	0.6	0.2	0.4	0.02	0.01	0.01
NV:Las Vegas	9	0.5	0.1	0.3	0.04	0.02	0.02
NY:Albany	5	0.1	0.0	0.0	0.02	0.01	0.02
NY:Niagara Falls	7	0.2	0.0	0.1	0.02	0.01	0.01
NY:Syracuse	2	0.0	0.0	0.0	0.02	0.01	0.01
NY:Yaphank	8	0.0	0.0	0.0	0.02	0.01	0.01
OH:Columbus	5	0.1	0.0	0.1	0.02	0.01	0.01

Table 3 (continued)

Gross Beta in Airborne Particulates

November 1993

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
OH:Painesville	9	0.3	0.1	0.1	0.02	0.00	0.01
OH:Ross	9	0.0	0.0	0.0	0.03	0.01	0.01
OH:Toledo	9	0.6	0.1	0.2	0.02	0.01	0.01
OR:Portland	9	0.0	0.0	0.0	0.04	0.01	0.02
PA:Harrisburg	9	0.6	0.0	0.2	0.02	0.01	0.01
SC:Barnwell	2	0.1	0.0	0.1	0.01	0.01	0.01
SC:Columbia	7	0.5	0.1	0.3	0.02	0.01	0.01
SD:Pierre	6	0.4	0.2	0.3	0.02	0.01	0.01
TN:Knoxville	4	0.3	0.2	0.3	0.03	0.01	0.02
TN:Nashville	8	0.8	0.1	0.4	0.04	0.01	0.02
TX:Austin	8	0.2	0.0	0.1	0.02	0.00	0.01
TX:El Paso	7	1.9	0.3	1.2	0.06	0.01	0.03
UT:Salt Lake City	7	0.9	0.0	0.3	0.03	0.01	0.02
VA:Lynchburg	8	0.9	0.1	0.5	0.02	0.01	0.01
VA:Virginia Beach	2	0.1	0.1	0.1	0.01	0.01	0.01
WA:Olympia	8	0.3	0.0	0.1	0.02	0.00	0.01
WA:Spokane	7	1.0	0.0	0.5	0.04	0.01	0.03
WI:Madison	9	1.1	0.1	0.5	0.02	0.00	0.02

Minimum Detectable Limit for field estimates - 0.1 pCi/m³.

Minimum Detectable Limit for laboratory measurement - 0.01 pCi/m³.

Table 4
Gross Beta in Airborne Particulates
December 1993

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
AK:Anchorage	1	0.0	0.0	0.0	0.00	0.00	0.00
AK:Juneau	6	0.0	0.0	0.0	0.00	0.00	0.00
AL:Montgomery	8	0.4	0.1	0.2	0.02	0.01	0.01
AR:Little Rock	6	0.3	0.1	0.2	0.02	0.01	0.02
AZ:Phoenix	4	0.9	0.6	0.7	0.02	0.02	0.02
CA:Berkeley	9	0.3	0.0	0.2	0.04	0.00	0.01
CA:Los Angeles	8	0.5	0.1	0.2	0.03	0.01	0.02
CO:Denver	7	1.2	0.3	0.6	0.01	0.01	0.01
CT:Hartford	9	0.1	0.0	0.1	0.01	0.00	0.01
DE:Wilmington	9	0.2	0.0	0.1	0.02	0.00	0.01
FL:Jacksonville	6	0.2	0.0	0.1	0.02	0.01	0.01
FL:Miami	8	0.1	0.0	0.0	0.01	0.01	0.01
HI:Honolulu	6	0.2	0.1	0.1	0.01	0.00	0.00
IA:Iowa City	9	0.2	0.0	0.1	0.03	0.01	0.02
ID:Boise	9	0.3	0.1	0.2	0.07	0.00	0.03
ID:Idaho Falls	9	0.0	0.0	0.0	0.05	0.01	0.02
IL:Chicago	7	0.5	0.0	0.2	0.03	0.01	0.02
IN:Indianapolis	7	0.3	0.0	0.2	0.02	0.01	0.02
KS:Topeka	7	2.5	0.3	0.9	0.03	0.01	0.02
LA:New Orleans	6	0.5	0.0	0.2	0.03	0.01	0.01
MA:Lawrence	4	0.0	0.0	0.0	0.01	0.01	0.01
ME:Augusta	7	0.1	0.0	0.1	0.01	0.01	0.01
MI:Lansing	9	0.2	0.0	0.1	0.02	0.01	0.01
MN:Minneapolis	4	0.2	0.0	0.1	0.04	0.03	0.03
MO:Jefferson City	9	0.5	0.1	0.3	0.03	0.01	0.02
MS:Jackson	8	0.2	0.0	0.1	0.02	0.01	0.01
NC:Charlotte	8	0.2	0.0	0.1	0.02	0.01	0.02
NC:Wilmington	3	0.0	0.0	0.0	0.01	0.01	0.01
ND:Bismarck	7	0.0	0.0	0.0	0.02	0.01	0.02
NE:Lincoln	3	0.6	0.1	0.3	0.02	0.02	0.02
NH:Concord	9	0.1	0.0	0.1	0.01	0.01	0.01
NJ:Trenton	9	0.5	0.1	0.2	0.02	0.01	0.01
NM:Santa Fe	7	0.5	0.2	0.3	0.01	0.01	0.01
NV:Las Vegas	9	0.4	0.1	0.2	0.03	0.01	0.02
NY:Albany	5	0.1	0.0	0.0	0.02	0.01	0.01
NY:Niagara Falls	7	0.1	0.0	0.1	0.02	0.01	0.01
NY:Syracuse	5	0.0	0.0	0.0	0.02	0.01	0.01

Table 4 (continued)

Gross Beta in Airborne Particulates

December 1993

Location	Number of Samples	5-Hour Field Estimate			NAREL Lab Measurement		
		Max	Min	Avg	Max	Min	Avg
NY:Yaphank	9	0.0	0.0	0.0	0.02	0.01	0.01
OH:Columbus	5	0.1	0.1	0.1	0.02	0.01	0.01
OH:Painesville	9	0.1	0.0	0.1	0.02	0.01	0.01
OH:Ross	9	0.0	0.0	0.0	0.02	0.01	0.01
OH:Toledo	9	0.4	0.0	0.2	0.02	0.01	0.02
OR:Portland	5	0.0	0.0	0.0	0.01	0.00	0.00
PA:Harrisburg	9	0.3	0.1	0.2	0.02	0.01	0.01
PA:Pittsburgh	9	0.1	0.1	0.1	0.02	0.01	0.01
SC:Barnwell	2	0.1	0.0	0.1	0.01	0.01	0.01
SC:Columbia	8	0.3	0.0	0.1	0.02	0.01	0.01
SD:Pierre	4	1.2	0.0	0.4	0.03	0.01	0.02
TN:Knoxville	6	1.2	0.0	0.3	0.03	0.01	0.02
TN:Nashville	9	0.4	0.0	0.2	0.03	0.01	0.02
TX:Austin	8	0.2	0.0	0.1	0.02	0.01	0.01
TX:El Paso	9	2.0	0.5	1.0	0.04	0.01	0.02
UT:Salt Lake City	7	0.3	0.0	0.1	0.04	0.01	0.02
VA:Lynchburg	8	0.6	0.1	0.3	0.02	0.01	0.01
VA:Virginia Beach	3	0.1	0.1	0.1	0.02	0.01	0.01
WA:Olympia	7	0.3	0.0	0.1	0.01	0.00	0.00
WA:Spokane	9	0.1	0.1	0.1	0.07	0.00	0.02
WI:Madison	9	0.4	0.1	0.2	0.03	0.01	0.02

Minimum Detectable Limit for field estimates - 0.1 pCi/m³

Minimum Detectable Limit for laboratory measurement - 0.01 pCi/m³.

Table 5
Gross Beta and Specific Gamma in Precipitation
October 1993

Location	Depth (mm)	Gross Beta Activity		Specific Gamma Activity
		nCi/m ²	±2σ	pCi/L ±2σ
AK:Juneau	48.0	0.06	0.02	⁷ Be: 41.9±24.4
AL:Montgomery	31.0	0.05	0.01	⁷ Be: 37.8±33.3
AR:Little Rock	93.0	0.13	0.03	ND
AZ:Phoenix	20.0	0.01	0.01	ND
CA:Berkeley	11.8	0.02	0.00	ND
CO:Denver	40.0	0.03	0.01	⁷ Be: 30.8±22.5
CT:Hartford	80.0	0.08	0.03	ND
DE:Wilmington	49.0	0.07	0.02	⁷ Be: 72.3±26.8
FL:Jacksonville	164.2	0.11	0.05	⁷ Be: 47.5±27.3
FL:Miami	170.6	0.11	0.05	ND
HI:Honolulu	40.0	0.03	0.01	ND
ID:Boise	9.0	0.02	0.00	ND
ID:Idaho Falls	33.6	0.04	0.01	ND
IL:Chicago	55.4	0.04	0.02	ND
LA:New Orleans	42.0	0.06	0.01	ND
ME:Augusta	69.0	0.16	0.03	⁷ Be: 70.1±36.5 ²¹² Pb: 6.0±5.7
MI:Lansing	66.6	0.05	0.02	ND
MN:Minneapolis	30.0	0.05	0.01	ND
MO:Jefferson City	32.0	0.04	0.01	⁷ Be: 34.2±20.4
MS:Jackson	124.0	0.14	0.04	²¹⁴ Pb: 7.6±7.2
NC:Wilmington	68.0	0.04	0.02	ND
NH:Concord	17.4	0.03	0.01	⁷ Be: 38.6±32.3
NJ:Trenton	81.4	0.22	0.04	⁷ Be: 43.7±22.3
NM:Santa Fe	7.0	0.01	0.00	⁷ Be: 46.5±36.6 ⁷ Be: 74.9±42.4
NY:Albany	60.8	0.15	0.03	⁷ Be: 46.6±23.2
NY:Niagara Falls	83.0	0.15	0.03	ND
NY:Syracuse	39.0	0.04	0.01	ND
NY:Yaphank	32.0	0.08	0.01	ND
OH:Painesville	82.8	0.16	0.03	⁷ Be: 72.5±36.0
OH:Toledo	32.0	0.05	0.01	ND
OR:Portland	18.2	0.02	0.01	ND
PA:Harrisburg	67.4	0.13	0.03	⁷ Be: 54.5±32.1
SC:Barnwell	101.2	0.33	0.04	ND
SC:Columbia	33.4	0.04	0.01	ND
TN:Knoxville	13.6	0.02	0.00	⁷ Be: 44.9±37.2
TN:Nashville	69.6	0.06	0.02	ND
TX:Austin	40.0	0.01	0.01	ND
UT:Salt Lake City	60.8	0.04	0.02	ND

Table 5 (continued)

Gross Beta and Specific Gamma in Precipitation

October 1993

Location	Depth (mm)	Gross Beta Activity		Specific Gamma
		nCi/m ²	$\pm 2\sigma$	Activity pCi/L $\pm 2\sigma$
VA:Lynchburg	23.8	0.26	0.02	ND
WA:Olympia	49.2	0.02	0.01	ND
WI:Madison	12.8	0.02	0.00	ND

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

Table 6
Gross Beta and Specific Gamma in Precipitation
November 1993

Location	Depth (mm)	Gross Beta Activity		Specific Gamma
		nCi/m ²	±2σ	Activity pCi/L ±2σ
AK:Juneau	24.0	0.02	0.01	ND
AL:Montgomery	81.6	0.07	0.02	²¹⁴ Bi: 12.8±5.5 ⁷ Be: 42.1±22.4
AR:Little Rock	74.0	0.07	0.02	⁷ Be: 34.7±23.6
AZ:Phoenix	41.0	0.02	0.01	ND
CA:Berkeley	51.4	0.03	0.01	ND
CO:Denver	28.6	0.08	0.01	ND
CT:Hartford	106.0	0.21	0.04	⁷ Be: 43.0±20.7
DE:Wilmington	92.0	0.09	0.03	⁷ Be: 38.9±24.1
FL:Jacksonville	84.2	0.03	0.02	ND
FL:Miami	64.4	0.03	0.02	ND
HI:Honolulu	19.0	0.06	0.01	ND
ID:Boise	9.0	0.02	0.00	⁷ Be: 36.0±22.9
ID:Idaho Falls	4.6	0.06	0.00	⁷ Be: 113±31
IL:Chicago	56.4	0.03	0.02	ND
LA:New Orleans	128.0	0.10	0.04	ND
ME:Augusta	66.0	0.09	0.02	⁷ Be: 25.3±22.7
MI:Lansing	35.4	0.07	0.02	⁷ Be: 49.4±35.8
MN:Minneapolis	30.0	0.04	0.01	ND
MO:Jefferson City	41.0	0.01	0.01	ND
MS:Jackson	6.0	0.00	0.00	ND
NC:Charlotte	100.0	0.17	0.04	ND
NC:Wilmington	46.0	0.02	0.01	ND
ND:Bismarck	6.6	0.08	0.01	⁷ Be: 58.6±29.5
NJ:Trenton	76.2	0.12	0.03	ND
NM:Santa Fe	9.0	0.01	0.00	ND
NY:Albany	76.4	0.09	0.03	⁷ Be: 40.0±23.4
NY:Niagara Falls	40.8	0.17	0.02	⁷ Be: 66.6±21.7
NY:Syracuse	32.0	0.02	0.01	ND
NY:Yaphank	24.0	0.03	0.01	ND
OH:Painesville	130.4	0.16	0.05	⁷ Be: 58.5±36.8
OH:Toledo	88.0	0.35	0.05	ND
OR:Portland	8.6	0.01	0.00	⁷ Be: 62.9±28.5
PA:Harrisburg	70.4	0.06	0.02	⁷ Be: 67.7±28.2
SC:Barnwell	96.4	0.09	0.04	²¹⁴ Bi: 8.4±5.7
SC:Columbia	90.2	0.04	0.03	ND
TN:Knoxville	42.0	0.05	0.01	²¹⁴ Bi: 12.6±6.7
TN:Nashville	57.4	0.07	0.02	ND
TX:Austin	20.0	0.01	0.01	ND
TX:El Paso	12.0	0.01	0.00	ND

Table 6 (continued)

Gross Beta and Specific Gamma in Precipitation

November 1993

Location	Depth (mm)	Gross Beta Activity		Specific Gamma
		nCi/m ²	±2σ	Activity pCi/L ±2σ
UT:Salt Lake City	16.0	0.03	0.01	⁷ Be: 58.1±29.4
VA:Lynchburg	33.4	0.26	0.02	ND
WA:Olympia	55.4	0.03	0.01	⁷ Be: 45.0±27.4
WI:Madison	32.4	0.02	0.01	ND

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

Table 7
Gross Beta and Specific Gamma in Precipitation
December 1993

Location	Depth (mm)	Gross Beta Activity		Specific Gamma Activity	
		nCi/m ²	±2σ	pCi/L	±2σ
AK:Juneau	8.0	0.01	0.00	ND	
AL:Montgomery	90.0	0.12	0.03	⁷ Be: 63.8±34.8	
AR:Little Rock	105.0	0.06	0.03	⁷ Be: 39.1±35.3	
CA:Berkeley	79.4	0.04	0.02	ND	
CT:Hartford	56.0	0.09	0.02	⁷ Be: 72.6±29.6	
DE:Wilmington	67.0	0.23	0.03	⁷ Be: 141±26	
FL:Miami	9.8	0.02	0.00	ND	
ID:Idaho Falls	3.8	0.02	0.00	⁴⁰ K: 88.5±69.1	
				⁷ Be: 59.4±49.3	
				²⁰⁸ Tl: 5.3±4.6	
IL:Chicago	20.8	0.03	0.01	⁷ Be: 70.2±28.8	
LA:New Orleans	86.0	0.06	0.02	ND	
MN:Minneapolis	8.0	0.03	0.00	⁷ Be: 68.4±30.3	
MO:Jefferson City	31.0	0.05	0.01	⁷ Be: 46.8±25.6	
MS:Jackson	119.4	0.08	0.03	ND	
NC:Charlotte	98.0	0.09	0.03	⁷ Be: 70.6±36.4	
NC:Wilmington	60.0	0.03	0.02	ND	
ND:Bismarck	12.4	0.01	0.00	ND	
NJ:Trenton	70.6	0.14	0.03	ND	
NY:Albany	195.4	0.22	0.06	⁷ Be: 33.7±27.8	
NY:Niagara Falls	50.0	0.14	0.02	²¹² Pb: 4.8±4.2	
				⁷ Be: 40.3±24.2	
NY:Syracuse	8.0	0.00	0.00	ND	
NY:Yaphank	16.0	0.02	0.00	⁷ Be: 58.4±33.1	
OH:Painesville	51.2	0.23	0.03	⁷ Be: 76.5±42.8	
OH:Toledo	40.0	0.04	0.01	ND	
OR:Portland	29.0	0.03	0.01	⁷ Be: 41.5±26.7	
PA:Harrisburg	72.4	0.09	0.02	⁷ Be: 57.8±29.7	
				²¹² Pb: 4.8±4.8	
SC:Barnwell	168.0	0.23	0.06	ND	
SC:Columbia	94.0	0.07	0.03	ND	
TN:Nashville	97.0	0.13	0.03	ND	
TX:El Paso	36.8	0.14	0.02	ND	
UT:Salt Lake City	25.8	0.04	0.01	ND	
VA:Lynchburg	59.6	0.12	0.02	ND	
WA:Olympia	145.0	0.08	0.04	⁷ Be: 74.1±44.4	
WI:Madison	5.6	0.01	0.00	⁷ Be: 72.4±28.4	

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

Table 8
Tritium in Precipitation
October–December 1993

Location	October 1993		November 1993		December 1993	
	nCi/L	$\pm 2\sigma$	nCi/L	$\pm 2\sigma$	nCi/L	$\pm 2\sigma$
AK:Juneau	0.1	0.1	0.1	0.2	0.1	0.1
AL:Montgomery	0.2	0.2	0.2	0.1	0.1	0.2
AR:Little Rock	0.1	0.1	0.2	0.1	0.1	0.2
AZ:Phoenix	0.1	0.1	0.1	0.2	NS	
CA:Berkeley	0.1	0.1	0.1	0.2	0.2	0.2
CO:Denver	0.1	0.2	0.1	0.1	NS	
CT:Hartford	0.1	0.2	0.1	0.1	0.2	0.2
DE:Wilmington	0.2	0.2	0.1	0.2	0.1	0.2
FL:Jacksonville	0.1	0.2	0.1	0.1	NS	
FL:Miami	0.4	0.2	0.2	0.1	0.1	0.2
HI:Honolulu	0.1	0.2	0.1	0.1	NS	
ID:Boise	0.1	0.1	0.1	0.2	NS	
ID:Idaho Falls	0.1	0.2	0.1	0.1	0.2	0.1
IL:Chicago	0.1	0.1	0.2	0.1	0.2	0.1
LA:New Orleans	0.1	0.1	0.2	0.1	0.1	0.1
ME:Augusta	0.2	0.2	0.1	0.2	NS	
MI:Lansing	0.1	0.2	0.3	0.1	NS	
MN:Minneapolis	0.1	0.2	0.2	0.1	0.1	0.1
MO:Jefferson City	0.1	0.2	0.1	0.1	0.1	0.2
MS:Jackson	0.1	0.2	0.1	0.1	0.1	0.1
NC:Charlotte	NS		0.1	0.1	0.1	0.1
NC:Wilmington	0.1	0.1	0.1	0.2	0.1	0.2
ND:Bismarck	NS		0.2	0.1	0.2	0.1
NH:Concord	0.2	0.2	NS		NS	
NJ:Trenton	0.1	0.2	0.2	0.2	0.1	0.2
NM:Santa Fe	0.2	0.2	0.2	0.1	NS	
NY:Albany	0.1	0.1	0.2	0.2	0.2	0.1
NY:Niagara Falls	0.1	0.2	0.1	0.1	0.1	0.2
NY:Syracuse	0.1	0.2	0.1	0.2	0.1	0.2
NY:Yaphank	0.3	0.2	0.1	0.1	0.1	0.2
OH:Painesville	0.1	0.1	0.1	0.1	0.2	0.1
OH:Toledo	0.1	0.2	0.2	0.1	0.1	0.1
OR:Portland	0.1	0.2	0.1	0.2	0.1	0.1
PA:Harrisburg	0.3	0.2	0.1	0.1	0.1	0.1
SC:Barnwell	0.3	0.1	0.4	0.1	1.2	0.2
SC:Columbia	0.1	0.2	0.3	0.1	0.2	0.2
TN:Knoxville	0.1	0.2	0.1	0.2	NS	
TN:Nashville	0.1	0.2	0.2	0.1	0.1	0.2
TX:Austin	0.1	0.1	0.2	0.1	NS	
TX:El Paso	NS		0.2	0.1	0.1	0.1
UT:Salt Lake City	0.2	0.2	0.2	0.2	0.1	0.1

Table 8 (continued)
Tritium in Precipitation
October–December 1993

Location	October 1993		November 1993		December 1993	
	nCi/L	$\pm 2\sigma$	nCi/L	$\pm 2\sigma$	nCi/L	$\pm 2\sigma$
VA:Lynchburg	0.1	0.1	0.2	0.1	0.1	0.1
WA:Olympia	0.1	0.1	0.1	0.2	0.1	0.1
WI:Madison	0.1	0.1	0.1	0.1	0.1	0.2

Note: σ = Counting Error. NS = No Sample.

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.

Table 9 contains the plutonium and uranium results for the period July–December 1993.

Table 9
Plutonium and Uranium In Airborne Particulates
July-December 1993 Composites

Location	^{238}Pu		$^{239-240}\text{Pu}$		^{234}U		^{235}U		^{238}U	
	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$
AK:Anchorage	ND		2.8	3.1	34.1	11.4	0.3	2.0	9.4	6.6
AK:Juneau	0.2	0.3	ND		3.6	0.8	0.3	0.2	3.0	0.7
AL:Montgomery	0.4	0.5	ND		12.4	1.5	0.5	0.3	11.7	1.5
AR:Little Rock	ND		ND		25.7	3.3	2.1	0.9	19.7	2.8
AZ:Phoenix	0.3	0.7	0.3	0.4	40.2	5.0	2.1	1.0	34.0	4.5
CA:Berkeley	0.1	0.4	0.1	0.2	9.4	1.1	0.8	0.3	7.3	1.0
CA:Los Angeles	0.3	0.5	0.1	0.3	20.4	2.7	0.9	0.5	19.3	2.6
CO:Denver	0.3	0.4	0.1	0.2	24.6	2.3	1.0	0.4	22.5	2.2
CT:Hartford	0.1	0.1	ND		2.7	0.5	0.1	0.1	2.2	0.4
DE:Wilmington	ND		0.2	0.4	15.9	2.8	0.4	0.4	14.0	2.6
FL:Jacksonville	0.4	0.3	ND		13.0	1.4	1.0	0.3	11.6	1.3
FL:Miami	ND		0.1	0.1	15.5	1.8	1.5	0.5	12.2	1.5
HI:Honolulu	0.2	0.2	ND		2.9	0.6	0.2	0.2	1.8	0.5
IA:Iowa City	0.1	0.5	ND		16.8	2.5	1.0	0.6	14.0	2.3
ID:Boise	0.3	0.5	0.2	0.3	22.6	3.5	1.3	0.8	18.6	3.1
ID:Idaho Falls	0.2	0.5	0.1	0.2	21.2	2.8	0.7	0.5	16.1	2.4
IL:Chicago	ND		0.1	0.3	27.8	3.4	1.2	0.6	23.0	3.0
IN:Indianapolis	0.5	0.6	0.1	0.2	23.4	3.5	1.3	0.8	21.5	3.3
KS:Topeka	ND		ND		13.6	1.7	0.7	0.4	12.6	1.7
KY:Frankfort	0.4	0.4	0.4	0.3	12.4	2.1	0.7	0.5	11.0	1.9
LA:New Orleans	0.3	0.3	0.1	0.1	13.2	1.6	0.5	0.3	10.3	1.4
MA:Lawrence	0.3	0.3	ND		8.7	1.4	0.3	0.2	8.9	1.4
ME:Augusta	0.1	0.1	0.6	0.3	8.9	1.4	0.3	0.2	9.0	1.4
MI:Lansing	0.1	0.2	ND		8.7	1.3	0.5	0.3	7.3	1.2
MN:Minneapolis	ND		0.2	0.2	11.5	1.6	0.6	0.3	8.6	1.4
MO:Jefferson City	0.3	0.4	ND		13.6	1.9	1.0	0.5	14.4	2.0
MS:Jackson	0.6	0.9	0.4	0.5	18.8	3.0	1.2	0.7	15.8	2.7
NC:Charlotte	ND		ND		19.0	2.2	1.0	0.4	17.3	2.1
NC:Wilmington	0.1	0.2	0.1	0.1	11.2	1.5	0.7	0.3	8.5	1.3
ND:Bismarck	0.3	0.4	ND		14.8	1.8	0.4	0.3	13.9	1.8
NE:Lincoln	ND		0.1	0.2	15.0	2.6	0.5	0.5	14.2	2.5
NH:Concord	0.2	0.3	0.3	0.3	8.8	1.3	0.4	0.2	7.4	1.2
NJ:Trenton	0.2	0.3	0.1	0.1	5.6	0.9	0.4	0.2	5.9	0.9
NM:Santa Fe	ND		0.1	0.2	22.2	2.7	1.7	0.7	22.4	2.8
NV:Las Vegas	1.8	2.5	0.6	1.1	184	17	3.2	1.8	105	12
NY:Albany	0.7	0.6	0.1	0.2	14.5	2.4	0.2	0.3	12.9	2.3
NY:Niagara Falls	0.2	0.3	ND		26.1	2.8	1.6	0.5	26.0	2.8

Table 9 (continued)

Plutonium and Uranium In Airborne Particulates

July–December 1993 Composites

Location	^{238}Pu		$^{239-240}\text{Pu}$		^{234}U		^{235}U		^{238}U	
	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$	aCi/m ³	$\pm 2\sigma$
NY:Syracuse	0.3	0.3	0.1	0.2	11.3	1.3	0.4	0.2	9.9	1.2
NY:Yaphank	0.2	0.4	0.4	0.3	8.4	1.4	0.5	0.3	6.3	1.2
OH:Columbus	0.3	0.4	0.1	0.2	15.9	1.9	0.6	0.3	17.0	1.9
OH:Painesville	0.1	0.3	ND		10.9	1.4	0.5	0.3	9.8	1.3
OH:Ross	0.1	0.7	0.2	0.3	35.1	4.0	1.3	0.7	29.5	3.6
OH:Toledo	ND		0.2	0.2	17.9	2.5	0.8	0.5	15.8	2.3
OR:Portland	0.2	0.5	ND		12.2	1.9	0.5	0.4	11.0	1.8
PA:Harrisburg	0.2	0.2	0.1	0.1	8.9	1.3	0.6	0.3	8.5	1.3
PA:Pittsburgh	0.6	0.8	0.3	0.4	15.1	2.9	1.0	0.7	11.5	2.5
SC:Barnwell	ND		0.1	0.1	5.2	0.6	0.3	0.1	5.1	0.6
SC:Columbia	0.5	0.4	ND		21.9	2.5	1.4	0.5	19.9	2.4
SD:Pierre	ND		0.4	0.3	10.7	1.8	0.6	0.4	9.5	1.7
TN:Knoxville	0.1	0.4	ND		16.2	2.2	0.8	0.5	12.9	2.0
TN:Nashville	ND		0.6	0.5	21.4	3.7	0.6	0.6	17.6	3.3
TX:Austin	ND		ND		11.4	1.4	0.7	0.3	11.3	1.4
TX:El Paso	ND		0.3	0.8	56.4	8.2	2.6	2.0	45.5	7.4
UT:Salt Lake City	0.6	0.7	ND		31.3	4.1	1.9	0.9	21.7	3.3
VA:Lynchburg	0.3	0.3	0.1	0.1	67.9	5.4	4.2	0.9	9.6	1.4
VA:Virginia Beach	0.3	0.4	ND		14.7	1.9	1.3	0.5	13.0	1.8
WA:Olympia	0.3	0.3	0.3	0.2	5.1	1.0	0.2	0.2	4.7	0.9
WA:Spokane	0.1	0.5	0.3	0.3	20.2	3.2	0.7	0.6	17.6	3.0
WI:Madison	0.1	0.2	0.1	0.1	11.0	1.7	1.1	0.5	11.2	1.7

Note: σ = Counting Error. NA = No Analysis. ND = Not Detectable.

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 10 contains the tritium concentration data for October–December 1993. Table 11 contains the surface water annual gamma results for January–December 1993.

Table 10
Tritium in Surface Water
October–December 1993

Location	Source	Date Collected	³ H	
			nCi/L	±2σ
AL:Decatur	Tennessee River	10/05/93	0.1	0.2
AL:Dothan	Chattahoochee River	10/12/93	0.1	0.1
AL:Scottsboro	Tennessee River	10/05/93	0.1	0.1
AR:Little Rock	Arkansas River	10/07/93	0.1	0.1
CA:Clay Station	Folsom S. Canal	10/26/93	0.2	0.2
CA:Diablo Canyon	Pacific Ocean	12/29/93	0.1	0.1
CA:Eureka	Humboldt Bay	10/12/93	0.1	0.2
CA:Eureka	Humboldt Bay	12/29/93	0.1	0.1
CO:Platteville	South Platte River	10/15/93	0.2	0.1
CT:East Haddam	Connecticut River	10/25/93	0.2	0.2
CT:Waterford	Long Island Sound	10/25/93	0.1	0.1
FL:Crystal River	Gulf Of Mexico	10/19/93	0.1	0.1
FL:Ft. Pierce	Atlantic Ocean	11/07/93	0.1	0.2
FL:Homestead	Biscayne Bay	10/14/93	0.1	0.1
GA:Baxley	Altamaha River	10/06/93	0.2	0.2
IA:Cedar Rapids	Cedar River	11/02/93	0.1	0.2
ID:Buhl	Snake River	10/19/93	0.1	0.1
IL:E. Moline	Mississippi River	10/28/93	0.1	0.2
IL:Morris	Illinois River	11/07/93	0.1	0.2
IL:Zion	Lake Michigan	12/21/93	0.1	0.1
IL:Zion	Lake Michigan	10/01/93	0.1	0.1
KS:Leroy	Neosho River	12/21/93	0.1	0.1
LA:New Orleans	Mississippi River	11/08/93	0.1	0.1
MA:Plymouth	Cape Cod Bay	10/21/93	0.2	0.2
MD:Conowingo	Susquehanna River	10/19/93	0.2	0.2
MD:Lusby	Chesapeake Bay	10/19/93	0.2	0.2
ME:Wiscasset	Montseway Bay	10/05/93	0.1	0.2
MI:Bridgman	Lake Michigan	10/10/93	0.1	0.1
MI:Charlevoix	Lake Michigan	10/14/93	0.1	0.1
MI:Charlevoix	Lake Michigan	12/31/93	0.2	0.2
MI:Monroe	Lake Erie	10/10/93	0.1	0.2
MI:South Haven	Lake Michigan	10/11/93	0.1	0.2
MN:Monticello	Mississippi River	11/09/93	0.1	0.1
MN:Red Wing	Mississippi River	10/07/93	0.1	0.1
MS:Port Gibson	Mississippi River	10/12/93	0.2	0.2
NC:Charlotte	Catawba River	10/13/93	0.5	0.2
NC:Southport	Atlantic Ocean	10/05/93	0.1	0.2

Table 10 (continued)
Tritium in Surface Water
October–December 1993

Location	Source	Date Collected	³ H	
			nCi/L	±2σ
NE:Rulo	Missouri River	10/01/93	0.1	0.2
NJ:Bayside	Delaware River	10/18/93	0.1	0.2
NJ:Oyster Creek	Oyster Creek	10/28/93	0.4	0.2
NV:Boulder City	Colorado River	10/05/93	0.1	0.1
NY:Chelsea	Hudson River	10/19/93	0.2	0.1
NY:Ossining	Hudson River	10/13/93	0.1	0.2
NY:Oswego	Lake Ontario	12/21/93	0.2	0.1
NY:Oswego	Lake Ontario	10/04/93	0.3	0.2
OH:Toledo	Lake Erie	10/07/93	0.1	0.1
OR:Bradwood	Columbia River	10/21/93	0.2	0.2
PA:Danville	Susquehanna River	10/20/93	0.1	0.2
PA:Philadelphia	Schuylkill R.-Baxter	10/28/93	0.3	0.2
PA:Philadelphia	Schuylkill R.-Queen	10/28/93	0.3	0.2
PA:Philadelphia	Delaware R.	10/28/93	0.3	0.2
SC:Allendale	Savannah River	10/28/93	1.0	0.2
SC:Broad River	Broad River	10/19/93	0.1	0.1
SC:Hartsville	Lake Robinson	10/04/93	2.7	0.2
TN:Daisy	Tennessee River	10/27/93	0.1	0.1
TN:Kingston	Clinch River	10/05/93	0.1	0.1
TN:Oak Ridge	Clinch River	11/15/93	0.4	0.2
TX:Matagorda	Colorado River	10/04/93	0.1	0.1
VA:Doswell	North Anna River	10/15/93	2.3	0.3
VA:Doswell	North Anna River	10/07/93	2.5	0.2
VT:Vernon	Connecticut River	10/07/93	0.1	0.1
WA:Northport	Columbia River	11/16/93	0.1	0.1
WA:Richland	Columbia River	10/11/93	0.3	0.2
WA:Richland	Columbia River	11/15/93	0.3	0.2
WI:Two Creeks	Lake Michigan	10/18/93	0.2	0.2
WI:Victory	Mississippi River	10/11/93	0.1	0.1
WV:Wheeling	Ohio River	10/05/93	0.1	0.2

Note: σ = Counting Error.

Table 11
Surface Water
Annual Gamma Analysis
January–December 1993

Location	Source	Date Collected	Specific Gamma Activity pCi/L $\pm 2\sigma$
AL:Decatur	Tennessee River	04/01/93	ND
AL:Dothan	Chattahoochee River	04/06/93	ND
AL:Scottsboro	Tennessee River	04/01/93	ND
AR:Little Rock	Arkansas River	04/12/93	ND
CA:Clay Station	Folsom S. Canal	04/07/93	ND
CA:Diablo Canyon	Pacific Ocean	03/30/93	⁴⁰ K: 295 \pm 55
CA:Eureka	Humboldt Bay	04/01/93	⁴⁰ K: 266 \pm 37
CA:San Onofre	Pacific Ocean	03/11/93	⁴⁰ K: 306 \pm 48
CA:San Onofre	Pacific Ocean	06/22/93	⁴⁰ K: 339 \pm 46
CO:Platteville	South Platte River	04/08/93	ND
CT:East Haddam	Connecticut River	03/30/93	ND
CT:Waterford	Long Island Sound	03/30/93	⁴⁰ K: 207 \pm 61
FL:Crystal River	Gulf Of Mexico	04/07/93	ND
FL:Ft. Pierce	Atlantic Ocean	04/22/93	ND
FL:Homestead	Biscayne Bay	04/19/93	⁴⁰ K: 330 \pm 46
IA:Cedar Rapids	Cedar River	04/27/93	ND
ID:Buhl	Snake River	04/22/93	ND
IL:E. Moline	Mississippi River	04/06/93	ND
IL:Morris	Illinois River	05/20/93	ND
IL:Zion	Lake Michigan	06/30/93	²¹⁴ Pb: 19.6 \pm 6.1 ²¹⁴ Bi: 26.4 \pm 7.2
KS:Leroy	Neosho River	03/30/93	ND
KS:Leroy	Neosho River	06/29/93	ND
LA:New Orleans	Mississippi River	05/31/93	ND
MA:Plymouth	Cape Cod Bay	04/15/93	ND
MD:Conowingo	Susquehanna River	04/05/93	ND
MD:Lusby	Chesapeake Bay	03/30/93	⁴⁰ K: 84.8 \pm 30.5
ME:Wiscasset	Montseway Bay	05/13/93	⁴⁰ K: 151 \pm 34
MI:Bridgman	Lake Michigan	03/29/93	ND
MI:Charlevoix	Lake Michigan	03/25/93	ND
MI:Monroe	Lake Erie	03/28/93	ND
MI:South Haven	Lake Michigan	03/30/93	ND
MN:Monticello	Mississippi River	05/13/93	ND
MN:Red Wing	Mississippi River	04/21/93	ND
MS:Port Gibson	Mississippi River	04/06/93	ND
NC:Charlotte	Catawba River	04/15/93	ND
NC:Southport	Atlantic Ocean	04/01/93	⁴⁰ K: 49.8 \pm 32.9

Table 11 (continued)
 Surface Water
 Annual Gamma Analysis
 January–December 1993

Location	Source	Date Collected	Specific Gamma Activity pCi/L $\pm 2\sigma$
NE:Rulo	Missouri River	04/22/93	ND
NJ:Bayside	Delaware River	04/13/93	ND
NJ:Oyster Creek	Oyster Creek	04/22/93	⁴⁰ K: 162±44
NV:Boulder City	Colorado River	03/31/93	ND
NY:Chelsea	Hudson River	04/02/93	ND
NY:Ossining	Hudson River	04/29/93	ND
NY:Oswego	Lake Ontario	06/24/93	ND
NY:Oswego	Lake Ontario	03/24/93	²¹² Pb: 7.2±5.2
OH:Toledo	Lake Erie	04/06/93	ND
OR:Bradwood	Columbia River	04/28/93	ND
PA:Danville	Susquehanna River	04/07/93	ND
PA:Philadelphia	Delaware R.	04/14/93	ND
PA:Philadelphia	Schuylkill R.-Queen	04/14/93	ND
PA:Philadelphia	Schuylkill R.-Belmont	04/15/93	ND
SC:Allendale	Savannah River	04/30/93	ND
SC:Broad River	Broad River	04/23/93	ND
SC:Hartsville	Lake Robinson	04/19/93	ND
TN:Kingston	Clinch River	04/28/93	ND
TX:El Paso	Rio Grande	04/02/93	ND
TX:Matagorda	Colorado River	04/08/93	ND
VA:Doswell	North Anna River	04/07/93	ND
VA:Newport News	James River	04/15/93	ND
VT:Vernon	Connecticut River	04/09/93	ND
WI:Two Creeks	Lake Michigan	03/31/93	ND
WI:Victory	Mississippi River	04/06/93	ND
WV:Wheeling	Ohio River	04/01/93	ND

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

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 12 contains the data from drinking water samples for October–December 1993. Table 13 contains the data on gross alpha, gross beta, strontium-90, and radium-226 in drinking water for January–December 1993. Table 14 contains the plutonium and uranium in drinking water data for January–December 1993. Table 15 contains the I-131 in drinking water results for January–December 1993.

Table 12
Tritium in Drinking Water
October-December 1993

Location	Date Collected	³ H	
		nCi/L	±2σ
AK:Fairbanks	10/05/93	0.1	0.1
AL:Dothan	10/12/93	0.1	0.2
AL:Montgomery	10/08/93	0.1	0.1
AL:Muscle Shoals	10/05/93	0.1	0.2
AL:Scottsboro	10/05/93	0.1	0.2
AR:Little Rock	10/07/93	0.1	0.1
CA:Berkeley	12/23/93	0.1	0.1
CA:Los Angeles	10/04/93	0.1	0.2
CO:Denver	10/14/93	0.1	0.1
CO:Platteville	10/14/93	0.1	0.1
CT:Hartford	10/01/93	0.1	0.2
CT:Hartford	12/30/93	0.2	0.1
DC:Washington	10/14/93	0.1	0.1
DE:Dover	10/05/93	0.1	0.2
FL:Miami	10/04/93	0.1	0.2
FL:Tampa	10/04/93	0.1	0.1
GA:Baxley	10/06/93	0.1	0.2
GA:Savannah	11/19/93	0.2	0.2
HI:Honolulu	10/04/93	0.1	0.2
IA:Cedar Rapids	11/02/93	0.1	0.1
ID:Boise	10/12/93	0.1	0.2
ID:Idaho Falls	10/13/93	0.2	0.2
IL:Morris	10/07/93	0.1	0.2
IL:W. Chicago	11/02/93	0.1	0.2
KS:Topeka	10/04/93	0.1	0.1
LA:New Orleans	10/05/93	0.1	0.1
MA:Lawrence	10/14/93	0.1	0.1
MD:Baltimore	10/04/93	0.2	0.2
MD:Conowingo	10/19/93	0.1	0.1
ME:Augusta	10/21/93	0.1	0.2
MI:Grand Rapids	10/18/93	0.2	0.1
MN:Minneapolis	10/25/93	0.1	0.2
MN:Red Wing	10/21/93	0.1	0.2
MO:Jefferson City	10/04/93	0.2	0.2
MS:Jackson	10/13/93	0.1	0.1
MS:Port Gibson	10/12/93	0.1	0.1
NC:Charlotte	10/13/93	0.5	0.2
NC:Wilmington	10/15/93	0.1	0.2
ND:Bismarck	10/01/93	0.1	0.1
NE:Lincoln	11/09/93	0.2	0.2
NH:Concord	10/14/93	0.1	0.1

Table 12 (continued)
Tritium in Drinking Water
October-December 1993

Location	Date Collected	³ H	
		nCi/L	±2σ
NJ:Trenton	10/05/93	0.1	0.1
NJ:Waretown	10/28/93	0.3	0.2
NM:Santa Fe	12/21/93	0.1	0.1
NV:Las Vegas	10/05/93	0.1	0.2
NY:Albany	10/01/93	0.1	0.1
NY:New York City	10/05/93	0.2	0.2
NY:Niagara Falls	10/19/93	0.2	0.2
OH:Cincinnati	12/22/93	0.1	0.1
OH:Columbus	10/28/93	0.2	0.2
OH:East Liverpool	10/28/93	0.2	0.2
OH:Painesville	10/11/93	0.1	0.2
OH:Toledo	10/05/93	0.1	0.2
OK:Oklahoma City	11/02/93	0.1	0.1
OR:Portland	10/19/93	0.1	0.2
PA:Columbia	10/21/93	0.1	0.1
PA:Harrisburg	10/21/93	0.1	0.2
PA:Philadelphia-Queen	10/28/93	0.3	0.2
PA:Philadelphia-Baxter	10/28/93	0.3	0.2
PA:Philadelphia	10/28/93	0.2	0.2
PA:Pittsburgh	10/28/93	0.3	0.2
PC:Corozal	10/07/93	0.2	0.2
RI:Providence	10/05/93	0.1	0.2
SC:Barnwell	10/05/93	0.1	0.2
SC:Columbia	10/04/93	0.3	0.2
SC:Hartsville	10/11/93	0.1	0.1
SC:Jenkinsville	10/14/93	0.1	0.2
SC:Seneca	10/12/93	0.1	0.1
TN:Chattanooga	11/08/93	0.1	0.2
TN:Knoxville	10/01/93	0.2	0.2
TX:Austin	10/06/93	0.1	0.2
VA:Doswell	12/21/93	0.1	0.1
VA:Lynchburg	10/04/93	0.2	0.2
VA:Virginia Beach	10/20/93	0.1	0.2
WA:Richland	11/15/93	0.1	0.2
WA:Richland	10/11/93	0.2	0.1
WA:Seattle	10/05/93	0.1	0.2
WI:Genoa City	10/08/93	0.1	0.2
WI:Madison	10/04/93	0.1	0.2

Note: σ = Counting Error.

Table 13
Drinking Water
Alpha, Beta, Gamma, Sr-90, and Ra-226 Concentrations
January–December 1993 Composites

Location	Total Solids (mg/L)	Gross Beta		Gross Alpha		⁹⁰ Sr		²²⁶ Ra		Specific Gamma Activity	
		pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
AK:Fairbanks	135.0	3.0	0.7	0.8	1.0	0.2	0.3	NA		NA	
AL:Dothan	196.0	2.2	0.8	1.4	1.4	0.0	0.2	NA		NA	
AL:Montgomery	52.8	1.0	0.6	0.2	0.4	0.2	0.2	NA		NA	
AL:Muscle Shoals	78.6	2.4	0.6	0.8	0.6	0.1	0.2	NA		NA	
AL:Scottsboro	75.0	1.7	0.6	NA		0.1	0.2	NA		NA	
AR:Little Rock	29.8	1.0	0.5	NA		0.3	0.2	NA		NA	
CA:Berkeley	33.0	1.1	0.5	0.3	0.4	0.2	0.2	NA		ND	
CA:Los Angeles	333.0	4.1	1.5	9.6	3.5	0.1	0.2	0.1	0.0	NA	
CO:Denver	128.0	2.7	0.7	2.3	1.2	0.0	0.2	0.1	0.0	NA	
CO:Platteville	760.0	11.9	2.5	20.8	8.1	0.3	0.2	0.6	0.0	NA	
CT:Hartford	33.8	0.6	0.5	0.2	0.4	0.2	0.2	NA		NA	
DC:Washington	139.0	3.5	0.8	0.2	0.8	0.3	0.3	NA		NA	
DE:Dover	166.0	2.8	1.0	NA		0.1	0.2	NA		NA	
FL:Miami	153.0	2.2	0.7	1.9	1.2	0.1	0.2	0.3	0.0	NA	
FL:Tampa	288.0	3.5	0.9	2.3	2.1	0.2	0.2	0.3	0.0	NA	
GA:Baxley	158.0	1.9	0.6	2.8	1.5	0.1	0.4	1.6	0.0	NA	
GA:Savannah	130.0	2.4	0.8	NA		0.1	0.4	NA		NA	
HI:Honolulu	174.0	1.5	1.0	0.0	1.2	NA		NA		NA	
IA:Cedar Rapids	114.0	2.5	0.8	0.0	0.9	0.1	0.4	NA		NA	
ID:Boise	91.0	1.5	0.8	0.7	0.6	NA		NA		NA	
ID:Idaho Falls	202.0	4.0	1.5	1.3	1.4	NA		NA		NA	
IL:Morris	66.0	7.5	1.7	2.5	1.3	0.0	0.3	1.7	0.0	NA	
IL:W. Chicago	269.0	11.6	2.1	7.2	3.4	NA		8.4	0.1	NA	
KS:Topeka	224.0	6.7	1.5	1.0	1.8	0.0	0.2	NA		NA	
LA:New Orleans	146.0	2.7	0.8	1.3	1.0	0.2	0.2	NA		NA	
MA:Lawrence	77.8	1.1	0.6	0.0	0.5	0.2	0.2	NA		NA	
MD:Baltimore	92.5	2.1	0.7	0.3	0.6	0.1	0.2	NA		NA	
MD:Conowingo	170.0	1.5	0.7	0.2	0.9	0.1	0.2	NA		NA	
ME:Augusta	48.5	1.6	0.7	0.4	0.5	0.1	0.2	NA		NA	
MI:Detroit	63.0	1.5	0.7	0.0	0.4	0.4	0.2	NA		NA	
MI:Grand Rapids	138.0	1.8	0.7	0.1	0.7	0.4	0.2	NA		NA	
MN:Minneapolis	93.0	3.3	0.9	NA		NA		NA		NA	
MN:Red Wing	299.0	5.0	1.3	11.5	3.8	0.0	0.2	1.6	0.0	NA	
MO:Jefferson City	185.0	5.7	1.1	NA		0.8	0.7	NA		NA	
MS:Jackson	66.5	2.6	0.8	1.6	0.9	0.2	0.2	0.1	0.0	NA	

Table 13 (continued)
Drinking Water
Alpha, Beta, Gamma, Sr-90, and Ra-226 Concentrations
January–December 1993 Composites

Location	Total Solids (mg/L)	Gross Beta		Gross Alpha		⁹⁰ Sr		²²⁶ Ra		Specific Gamma Activity pCi/L ±2σ
		pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	
MS:Port Gibson	306.0	5.6	1.4	3.4	2.3	NA		0.3	0.0	NA
MT:Helena	56.0	1.2	0.8	0.0	0.5	0.0	0.2	NA		NA
NC:Charlotte	40.7	1.4	0.7	NA		0.2	0.2	NA		NA
NC:Wilmington	93.8	2.2	0.8	NA		0.3	0.2	NA		NA
ND:Bismarck	303.0	4.4	1.1	0.2	1.4	0.0	0.2	NA		NA
NE:Lincoln	294.0	10.1	1.7	6.1	3.1	0.3	0.2	0.3	0.0	NA
NH:Concord	86.2	1.1	0.7	1.0	0.9	0.0	0.2	NA		NA
NJ:Trenton	101.0	2.2	0.7	0.5	0.8	0.1	0.2	NA		NA
NJ:Waretown	45.7	1.6	0.7	1.8	0.8	0.0	0.2	0.6	0.0	NA
NM:Santa Fe	365.0	6.7	1.5	15.2	4.4	NA		0.4	0.0	NA
NV:Las Vegas	621.0	7.0	2.1	4.7	4.1	0.3	0.2	0.3	0.0	NA
NY:Albany	66.5	1.5	0.9	1.0	0.9	0.1	0.2	NA		NA
NY:New York City	39.8	0.1	0.8	0.5	0.7	0.1	0.2	67.5	96.5	NA
NY:Niagara Falls	107.0	2.3	0.9	0.1	1.0	0.4	0.3	NA		NA
NY:Syracuse	87.0	2.0	0.8	0.3	1.1	0.1	0.2	NA		NA
OH:Cincinnati	184.0	3.2	0.9	0.7	1.3	0.1	0.2	NA		NA
OH:Columbus	238.0	4.0	1.3	NA		0.0	0.2	NA		NA
OH:East Liverpool	212.0	2.4	1.3	0.6	1.7	0.2	0.2	NA		NA
OH:Painesville	115.0	3.1	0.9	0.3	1.1	0.4	0.2	NA		NA
OH:Toledo	117.0	2.0	0.6	1.1	1.1	0.4	0.2	NA		NA
OK:Oklahoma City	59.2	3.0	0.7	0.8	0.7	0.2	0.2	NA		NA
OR:Portland	16.6	0.6	0.5	0.4	0.4	0.0	0.2	NA		NA
PA:Columbia	141.0	2.3	0.7	NA		0.1	0.2	NA		NA
PA:Harrisburg	36.2	1.1	0.7	0.7	0.6	0.3	0.2	NA		NA
PA:Philadelphia	93.8	2.0	0.7	0.3	0.8	0.2	0.2	NA		NA
PA:Philadelphia	154.0	2.5	0.8	1.0	1.3	0.1	0.2	NA		NA
PA:Philadelphia	152.0	3.2	0.8	1.3	1.2	0.1	0.2	NA		NA
PA:Pittsburgh	167.0	1.8	0.6	0.4	1.0	0.3	0.2	NA		NA
PC:Corozal	70.2	1.3	0.5	0.2	0.5	NA		NA		NA
RI:Providence	49.8	1.2	0.5	0.3	0.5	0.2	0.2	NA		NA
SC:Barnwell	24.0	1.6	0.7	1.4	0.7	0.2	0.2	NA		NA
SC:Columbia	66.4	2.1	0.6	0.6	0.7	0.3	0.2	NA		NA
SC:Hartsville	27.0	0.9	0.5	1.4	0.7	NA		NA		NA
SC:Jenkinsville	187.0	4.6	1.0	7.7	2.4	0.1	0.2	1.0	0.0	NA
SC:Seneca	29.5	0.5	0.6	0.1	0.4	NA		NA		NA

Table 13 (continued)
Drinking Water
Alpha, Beta, Gamma, Sr-90, and Ra-226 Concentrations
January–December 1993 Composites

Location	Total Solids (mg/L)	Gross Beta		Gross Alpha		⁹⁰ Sr		²²⁶ Ra		Specific Gamma Activity pCi/L ±2σ
		pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	
TN:Chattanooga	72.5	1.6	0.7	0.1	0.6	0.0	0.2	NA		NA
TN:Knoxville	94.0	1.8	0.6	0.2	0.6	0.3	0.2	NA		NA
TX:Austin	147.0	3.4	1.2	1.1	1.3	0.1	0.2	NA		NA
VA:Doswell	192.0	6.5	1.1	0.2	1.2	0.1	0.2	NA		NA
VA:Lynchburg	45.6	0.5	0.5	0.3	0.4	0.1	0.2	NA		NA
VA:Virginia Beach	96.6	2.1	0.6	1.0	1.0	0.2	0.2	NA		NA
WA:Richland	94.8	1.2	0.7	1.2	1.0	0.1	0.2	NA		NA
WA:Seattle	30.2	0.5	0.5	0.3	0.4	0.2	0.2	NA		NA
WI:Genoa City	135.0	1.2	0.5	2.8	1.3	0.1	0.2	0.6	0.0	NA
WI:Madison	193.0	1.3	0.7	2.8	1.6	0.1	0.2	0.6	0.0	NA

Note: σ = Counting Error. NA = No Analysis. ND = Not Detectable.

Table 14
Plutonium and Uranium Analyses
Selected Drinking Water Composite Samples
January–December 1993

Location	²³⁸ Pu		^{239–240} Pu		²³⁴ U		²³⁵ U		²³⁸ U	
	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
CA:Los Angeles	0.004	0.011	0.006	0.011	2.470	0.238	0.137	0.043	2.000	0.205
CO:Denver	0.010	0.013	0.006	0.008	0.672	0.095	0.017	0.014	0.462	0.077
CO:Platteville	0.013	0.023	0.008	0.014	7.070	0.597	0.183	0.067	5.350	0.486
FL:Miami	0.001	0.007	0.005	0.008	0.433	0.094	0.019	0.018	0.260	0.071
FL:Tampa	0.005	0.012	0.013	0.011	0.115	0.038	0.003	0.009	0.110	0.036
GA:Baxley	0.009	0.010	0.009	0.010	0.157	0.046	0.007	0.018	0.031	0.037
IL:Morris	0.038	0.033	ND		0.660	0.118	0.027	0.022	0.139	0.051
IL:W. Chicago	ND		ND		1.500	0.174	0.018	0.016	0.117	0.041
MN:Red Wing	0.031	0.023	ND		0.235	0.051	0.010	0.011	0.067	0.027
MS:Jackson	0.015	0.018	0.003	0.006	0.217	0.061	0.008	0.012	0.072	0.035
MS:Port Gibson	0.008	0.018	0.005	0.009	0.295	0.073	0.025	0.022	0.143	0.049
NE:Lincoln	0.021	0.023	0.014	0.014	3.690	0.347	0.090	0.042	2.370	0.252
NJ:Waretown	0.015	0.018	ND		0.195	0.048	0.036	0.020	0.079	0.029
NM:Santa Fe	0.003	0.023	0.030	0.025	12.900	0.964	0.430	0.104	7.980	0.650
NV:Las Vegas	0.008	0.011	ND		3.150	0.325	0.100	0.041	1.810	0.219
SC:Jenkinsville	0.021	0.019	0.004	0.007	0.765	0.106	0.019	0.018	0.419	0.076
WI:Genoa City	0.007	0.012	0.001	0.005	0.390	0.079	0.015	0.018	0.218	0.059
WI:Madison	0.001	0.016	ND		1.420	0.114	0.032	0.015	0.331	0.051

Table 15
Iodine-131 in Drinking Water
January–December 1993

Location	Date Collected	pCi/L $\pm 2\sigma$
AK:Fairbanks	10/05/93	ND
AL:Dothan	10/12/93	ND
AL:Montgomery	07/08/93	ND
AL:Muscle Shoals	01/06/93	0.4 0.3
AL:Scottsboro	01/06/93	ND
AR:Little Rock	01/04/93	0.2 0.2
CA:Berkeley	03/25/93	0.2 0.4
CA:Los Angeles	01/04/93	ND
CO:Denver	01/07/93	0.1 0.4
CO:Platteville	10/14/93	0.2 0.2
CT:Hartford	03/24/93	ND
DC:Washington	10/14/93	ND
DE:Dover	07/15/93	0.1 0.1
FL:Miami	01/07/93	0.2 0.3
FL:Tampa	04/26/93	ND
GA:Baxley	10/06/93	ND
GA:Savannah	11/19/93	ND
HI:Honolulu	10/04/93	ND
IA:Cedar Rapids	01/05/93	0.1 0.2
ID:Boise	03/25/93	ND
ID:Idaho Falls	07/22/93	0.3 0.3
IL:Morris	09/30/93	ND
IL:W. Chicago	11/02/93	0.1 0.1
KS:Topeka	01/06/93	ND
LA:New Orleans	07/02/93	0.1 0.1
MA:Lawrence	07/26/93	0.3 0.5
MD:Baltimore	01/04/93	ND
MD:Conowingo	10/19/93	0.1 0.2
ME:Augusta	07/21/93	0.2 0.4
MI:Detroit	03/26/93	0.2 0.3
MI:Grand Rapids	10/18/93	0.4 0.2
MN:Minneapolis	01/04/93	ND
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	ND
MS:Port Gibson	01/05/93	ND
MT:Helena	03/22/93	0.1 0.2
NC:Charlotte	07/15/93	0.1 0.1
NC:Wilmington	10/15/93	ND
ND:Bismarck	01/04/93	0.1 0.2

Table 15 (continued)
Iodine-131 in Drinking Water
January-December 1993

Location	Date Collected	pCi/L	$\pm 2\sigma$
NE:Lincoln	03/26/93	ND	
NH:Concord	03/22/93	ND	
NJ:Trenton	07/13/93	ND	
NJ:Waretown	04/22/93	ND	
NM:Santa Fe	01/05/93	0.1	0.2
NV:Las Vegas	01/04/93	ND	
NY:Albany	10/01/93	ND	
NY:New York City	10/05/93	ND	
NY:Niagara Falls	01/05/93	ND	
NY:Syracuse	09/28/93	ND	
OH:Cincinnati	04/22/93	ND	
OH:Columbus	04/05/93	0.1	0.3
OH:East Liverpool	07/23/93	ND	
OH:Painesville	03/22/93	ND	
OH:Toledo	04/06/93	0.2	0.4
OK:Oklahoma City	08/12/93	ND	
OR:Portland	10/19/93	0.1	0.1
PA:Columbia	07/22/93	0.1	0.2
PA:Harrisburg	07/22/93	0.2	0.2
PA:Philadelphia	07/22/93	ND	
PA:Philadelphia	10/28/93	ND	
PA:Philadelphia-Baxter	07/22/93	0.3	0.3
PA:Philadelphia-Baxter	10/28/93	ND	
PA:Philadelphia-Queen	07/22/93	0.7	0.5
PA:Philadelphia-Queen	10/28/93	0.1	0.1
PA:Pittsburgh	04/27/93	0.1	0.1
PC:Corozal	10/07/93	0.3	1.8
RI:Providence	10/05/93	0.1	0.1
RI:Providence	06/30/93	ND	
SC:Barnwell	07/22/93	ND	
SC:Columbia	01/05/93	ND	
SC:Hartsville	07/12/93	0.1	0.1
SC:Jenkinsville	01/08/93	0.1	0.3
SC:Seneca	04/20/93	ND	
TN:Chattanooga	07/16/93	ND	
TN:Knoxville	03/26/93	ND	
TX:Austin	04/07/93	0.1	0.4
VA:Doswell	01/04/93	ND	
VA:Lynchburg	01/07/93	ND	
VA:Virginia Beach	04/06/93	0.1	0.4

Table 15 (continued)
Iodine-131 in Drinking Water
January–December 1993

Location	Date Collected	pCi/L $\pm 2\sigma$
WA:Richland	10/11/93	ND
WA:Seattle	10/05/93	ND
WI:Genoa City	07/16/93	ND
WI:Madison	01/04/93	ND

σ = Counting Error.
ND = Not Detectable.

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.

† 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 16-18 contain the concentrations of radionuclides in pasteurized milk for October-December 1993. Table 19 contains the concentrations of strontium-90 in pasteurized milk EPA Regional Composites for October 1993.

Table 16
Radionuclides in Pasteurized Milk
October 1993

Location	Date Collected	K		¹³⁷ Cs	¹⁴⁰ Ba	¹³¹ I
		g/L	±2σ	pCi/L ±2σ	pCi/L ±2σ	pCi/L ±2σ
AL:Montgomery	10/08/93	1.50	0.09	ND	ND	ND
AR:Little Rock	10/11/93	1.61	0.08	ND	ND	ND
AZ:Phoenix	10/07/93	1.53	0.09	ND	ND	ND
CA:Los Angeles	10/04/93	1.72	0.08	ND	ND	ND
CA:Sacramento	10/04/93	1.31	0.06	ND	ND	ND
CA:San Francisco	10/05/93	1.62	0.08	ND	ND	ND
CO:Denver	10/15/93	1.44	0.08	ND	ND	ND
CT:Hartford	10/04/93	1.54	0.09	ND	ND	ND
DE:Wilmington	10/05/93	1.51	0.08	ND	ND	ND
FL:Tampa	10/04/93	1.38	0.08	ND	ND	ND
GA:Atlanta	10/12/93	1.32	0.08	ND	ND	ND
HI:Honolulu	10/08/93	1.63	0.08	ND	ND	ND
IA:Des Moines	10/04/93	1.45	0.08	ND	ND	ND
IL:Chicago	10/07/93	1.48	0.06	ND	ND	ND
IN:Indianapolis	10/04/93	1.49	0.09	ND	ND	ND
KS:Wichita	10/07/93	1.45	0.09	ND	ND	ND
LA:New Orleans	10/26/93	1.64	0.08	ND	ND	ND
MA:Boston	10/04/93	1.33	0.08	ND	ND	ND
ME:Portland	10/06/93	1.55	0.08	ND	ND	ND
MI:Detroit	10/09/93	1.37	0.08	ND	ND	ND
MI:Grand Rapids	10/04/93	1.60	0.07	ND	ND	ND
MN:St. Paul	10/06/93	1.50	0.14	ND	ND	ND
MO:Kansas City	10/13/93	1.35	0.08	ND	ND	ND
MS:Jackson	10/11/93	1.54	0.08	ND	ND	ND
MT:Helena	10/21/93	1.50	0.08	ND	ND	ND
NC:Charlotte	10/28/93	1.62	0.06	ND	ND	ND
ND:Minot	10/26/93	1.60	0.08	ND	ND	ND
NJ:Trenton	10/07/93	1.53	0.09	ND	ND	ND
NM:Albuquerque	10/13/93	1.30	0.08	ND	ND	ND
NV:Las Vegas	10/05/93	1.56	0.08	ND	ND	ND
NY:Buffalo	10/05/93	1.50	0.10	ND	ND	ND
NY:Syracuse	10/05/93	1.51	0.09	ND	ND	ND
OH:Cincinnati	10/20/93	1.56	0.09	ND	ND	ND
OH:Cleveland	10/07/93	1.43	0.08	ND	ND	ND
OR:Portland	10/04/93	1.63	0.07	ND	ND	ND
PA:Philadelphia	10/04/93	1.58	0.05	ND	ND	ND
PA:Pittsburgh	10/06/93	1.58	0.09	ND	ND	ND

Table 16 (continued)
Radionuclides in Pasteurized Milk
October 1993

Location	Date Collected	K		¹³⁷ Cs		¹⁴⁰ Ba		¹³¹ I	
		g/L	$\pm 2\sigma$	pCi/L	$\pm 2\sigma$	pCi/L	$\pm 2\sigma$	pCi/L	$\pm 2\sigma$
PC:Cristobal	10/06/93	1.61	0.08	4	2	ND		ND	
PR:San Juan	10/06/93	1.48	0.10	ND		ND		ND	
SC:Charleston	10/06/93	1.56	0.08	ND		ND		ND	
SD:Rapid City	10/11/93	1.44	0.06	ND		ND		ND	
TN:Chattanooga	10/06/93	1.51	0.06	ND		ND		ND	
TN:Knoxville	10/11/93	1.52	0.06	ND		ND		ND	
TN:Memphis	10/05/93	1.44	0.14	ND		ND		ND	
TX:Ft. Worth	10/05/93	1.67	0.07	ND		ND		ND	
VA:Norfolk	10/01/93	1.55	0.09	ND		ND		ND	
VT:Burlington	10/15/93	1.54	0.08	ND		ND		ND	
WA:Seattle	10/04/93	1.50	0.14	ND		ND		ND	
WA:Spokane	10/04/93	1.55	0.09	ND		ND		ND	
WV:Charleston	10/04/93	1.53	0.09	ND		ND		ND	

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

Table 17
Radionuclides in Pasteurized Milk
November 1993

Location	Date Collected	K		¹³⁷ Cs		¹⁴⁰ Ba		¹³¹ I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
AL:Montgomery	11/08/93	1.58	0.08	ND		ND		ND	
AR:Little Rock	11/02/93	1.50	0.11	ND		ND		ND	
CA:Los Angeles	11/04/93	1.64	0.08	ND		ND		ND	
CA:Sacramento	11/03/93	1.42	0.08	ND		ND		ND	
CA:San Francisco	11/02/93	1.66	0.08	ND		ND		ND	
CO:Denver	11/19/93	1.55	0.05	ND		ND		ND	
CT:Hartford	11/02/93	1.60	0.14	ND		ND		ND	
DE:Dover	11/02/93	1.60	0.08	ND		ND		ND	
FL:Tampa	11/02/93	1.61	0.08	ND		ND		ND	
GA:Atlanta	11/10/93	1.60	0.09	ND		ND		ND	
HI:Honolulu	11/08/93	1.60	0.05	ND		ND		ND	
IA:Des Moines	11/01/93	1.60	0.06	ND		ND		ND	
IL:Chicago	11/04/93	1.60	0.14	ND		ND		ND	
IN:Indianapolis	11/08/93	1.51	0.06	ND		ND		ND	
KS:Wichita	11/09/93	1.61	0.06	ND		ND		ND	
KY:Louisville	11/02/93	1.54	0.07	ND		ND		ND	
LA:New Orleans	11/18/93	1.49	0.08	ND		ND		ND	
MA:Boston	11/09/93	1.56	0.08	ND		ND		ND	
MD:Baltimore	11/04/93	1.57	0.08	ND		ND		ND	
ME:Portland	11/02/93	1.54	0.14	ND		ND		ND	
MI:Detroit	11/12/93	1.61	0.08	ND		ND		ND	
MI:Grand Rapids	11/08/93	1.62	0.09	ND		ND		ND	
MN:St. Paul	11/03/93	1.60	0.08	ND		ND		ND	
MO:Kansas City	11/30/93	1.57	0.08	ND		ND		ND	
MS:Jackson	11/02/93	1.60	0.08	ND		ND		ND	
MT:Helena	11/16/93	1.42	0.13	ND		ND		ND	
ND:Minot	11/29/93	1.60	0.09	ND		ND		ND	
NJ:Trenton	11/04/93	1.63	0.06	ND		ND		ND	
NM:Albuquerque	11/16/93	1.54	0.07	ND		ND		ND	
NY:Buffalo	11/16/93	1.67	0.08	ND		ND		ND	
NY:Syracuse	11/08/93	1.57	0.09	ND		ND		ND	
OH:Cincinnati	11/23/93	1.63	0.08	ND		ND		ND	
OH:Cleveland	11/23/93	1.74	0.08	ND		ND		ND	
OR:Portland	11/01/93	1.61	0.09	ND		ND		ND	
PA:Philadelphia	11/08/93	1.61	0.14	ND		ND		ND	
PA:Pittsburgh	11/06/93	1.53	0.06	ND		ND		ND	
PC:Cristobal	11/04/93	1.39	0.08	5	3	ND		ND	

Table 17 (continued)
 Radionuclides in Pasteurized Milk
 November 1993

Location	Date Collected	K		¹³⁷ Cs	¹⁴⁰ Ba	¹³¹ I
		g/L	±2σ	pCi/L ±2σ	pCi/L ±2σ	pCi/L ±2σ
PR:San Juan	11/05/93	1.69	0.07	ND	ND	ND
SC:Charleston	11/10/93	1.36	0.14	ND	ND	ND
SD:Rapid City	11/01/93	1.50	0.08	ND	ND	ND
TN:Chattanooga	11/01/93	1.58	0.09	ND	ND	ND
TN:Knoxville	11/02/93	1.54	0.06	ND	ND	ND
TN:Memphis	11/01/93	1.56	0.05	ND	ND	ND
TX:Austin	11/10/93	1.53	0.06	ND	ND	ND
TX:Ft. Worth	11/09/93	1.53	0.09	ND	ND	ND
VA:Norfolk	11/02/93	1.62	0.08	ND	ND	ND
VT:Montpelier	11/08/93	1.55	0.09	ND	ND	ND
WA:Seattle	11/02/93	1.58	0.09	ND	ND	ND
WA:Spokane	11/10/93	1.56	0.07	ND	ND	ND
WV:Charleston	11/09/93	1.61	0.08	ND	ND	ND

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

Table 18
Radionuclides in Pasteurized Milk
 December 1993

Location	Date Collected	K		¹³⁷ Cs		¹⁴⁰ Ba		¹³¹ I	
		g/L	±2σ	pCi/L	±2σ	pCi/L	±2σ	pCi/L	±2σ
AL:Montgomery	12/07/93	1.68	0.09	ND		ND		ND	
AR:Little Rock	12/02/93	1.62	0.05	ND		ND		ND	
AZ:Phoenix	12/07/93	1.72	0.09	ND		ND		ND	
CA:Los Angeles	12/13/93	1.60	0.09	ND		ND		ND	
CA:Sacramento	12/06/93	1.69	0.09	ND		ND		ND	
CO:Denver	12/20/93	1.55	0.09	ND		ND		ND	
DE:Dover	12/14/93	1.58	0.09	ND		ND		ND	
FL:Tampa	12/06/93	1.64	0.07	3	2	ND		ND	
GA:Atlanta	12/13/93	1.43	0.08	ND		ND		ND	
HI:Honolulu	12/06/93	1.60	0.06	ND		ND		ND	
IA:Des Moines	12/27/93	1.56	0.08	ND		ND		ND	
IN:Indianapolis	12/06/93	1.64	0.09	ND		ND		ND	
KS:Wichita	12/21/93	1.60	0.08	ND		ND		ND	
KY:Louisville	12/07/93	1.55	0.09	ND		ND		ND	
MA:Boston	12/20/93	1.56	0.08	ND		ND		ND	
MD:Baltimore	12/03/93	1.74	0.08	ND		ND		ND	
ME:Portland	12/06/93	1.68	0.09	ND		ND		ND	
MI:Detroit	12/15/93	1.68	0.06	ND		ND		ND	
MI:Grand Rapids	12/06/93	1.60	0.09	ND		ND		ND	
MN:St. Paul	12/01/93	1.64	0.09	ND		ND		ND	
MO:Kansas City	12/28/93	1.53	0.14	ND		ND		ND	
MS:Jackson	12/09/93	1.58	0.08	ND		ND		ND	
MT:Helena	12/17/93	1.56	0.09	ND		ND		ND	
ND:Minot	12/10/93	1.63	0.08	ND		ND		ND	
NJ:Trenton	12/09/93	1.57	0.09	ND		ND		ND	
NM:Albuquerque	12/13/93	1.56	0.09	ND		ND		ND	
NV:Las Vegas	12/07/93	1.64	0.06	ND		ND		ND	
NY:Buffalo	12/27/93	1.61	0.06	ND		ND		ND	
NY:Syracuse	12/16/93	1.66	0.08	ND		ND		ND	
OH:Cincinnati	12/22/93	1.69	0.08	ND		ND		ND	
OR:Portland	12/06/93	1.62	0.08	ND		ND		ND	
PA:Philadelphia	12/06/93	1.68	0.06	ND		ND		ND	
PA:Pittsburgh	12/08/93	1.62	0.08	ND		ND		ND	
PC:Cristobal	12/22/93	1.56	0.06	8	2	ND		ND	
PR:San Juan	12/09/93	1.57	0.09	ND		ND		ND	
SC:Charleston	12/09/93	1.64	0.09	ND		ND		ND	
SD:Rapid City	12/06/93	1.57	0.09	ND		ND		ND	

Table 18 (continued)
Radionuclides in Pasteurized Milk
December 1993

Location	Date Collected	K		¹³⁷ Cs	¹⁴⁰ Ba	¹³¹ I
		g/L	$\pm 2\sigma$	pCi/L $\pm 2\sigma$	pCi/L $\pm 2\sigma$	pCi/L $\pm 2\sigma$
TN:Chattanooga	12/06/93	1.62	0.09	ND	ND	ND
TN:Knoxville	12/06/93	1.61	0.08	ND	ND	ND
TN:Memphis	12/08/93	1.48	0.14	ND	ND	ND
VA:Norfolk	12/03/93	1.57	0.06	ND	ND	ND
VT:Montpelier	12/07/93	1.66	0.09	ND	ND	ND
WA:Seattle	12/08/93	1.70	0.09	ND	ND	ND
WA:Spokane	12/06/93	1.63	0.09	ND	ND	ND
WV:Charleston	12/06/93	1.58	0.08	ND	ND	ND

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

Table 19
Strontium-90 in Pasteurized Milk
EPA Regional Composites

October 1993

EPA Region	Collection Date	⁹⁰ Sr	
		pCi/L	±2σ
I	10/07/93	2.0	0.4
II	10/06/93	1.2	0.5
III	10/04/93	1.1	0.5
IV	10/09/93	0.9	0.5
V	10/08/93	1.2	0.4
VI	10/14/93	1.3	0.4
VII	10/08/93	1.4	0.4
VIII	10/18/93	0.8	0.4
IX	10/06/93	0.5	0.3
X	10/04/93	1.1	0.4

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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