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April 30, 1991

U.S. Nuclear Regulatory Commission
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Gentlemen: ULNRC-2402

DOCKET NUMBER 50-483
CALLAWAY PLANT
FACILITY OPERATING LICENSE NPF-30
1990 ANNUAL ENVIRONMENTAL OPERATING REPORT

Please find enclosed the 1990 Annual Environmental Operating Report for the Callaway Plant. This report is submitted in accordance with Section 6.9.1.6 of the Technical Specifications and Appendix B to the Callaway Plant Operating License.

Very truly yours,

A C Passwater
for
Donald F. Schnell

BFH/kea

Enclosure

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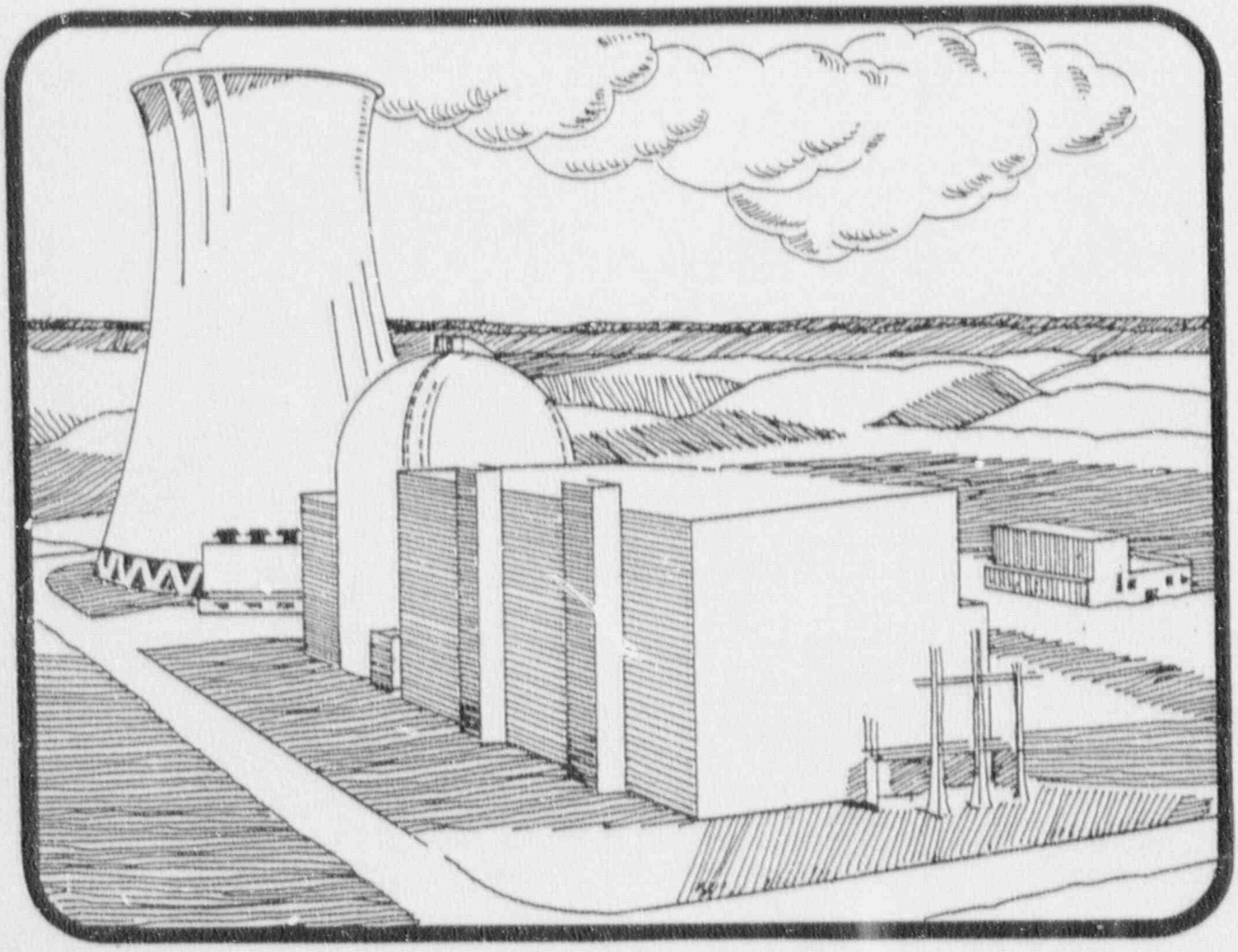
CALLAWAY PLANT

ANNUAL ENVIRONMENTAL OPERATING REPORT

1990



DOCKET NO. 50-483

UNION ELECTRIC

CALLAWAY PLANT

ANNUAL ENVIRONMENTAL OPERATING REPORT

1990

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1.0 INTRODUCTION

The Callaway Plant received an Operating License on June 11, 1984. This report presents the analytical data from the environmental monitoring programs with appropriate interpretation for 1990 and the environmental evaluations for plant modifications completed during 1990.

The third section of this report summarizes and interprets the results of the radiological environmental monitoring program conducted in accordance with Administrative Procedure APA-ZZ-01003, "OFFSITE DOSE CALCULATION MANUAL", Section 9.11. Section four describes non-radiological environmental monitoring and its results conducted in accordance with Section 2.2 of Appendix B to the Callaway Plant Operating License. The fifth section of this report describes changes in plant design or operation, tests, and experiments made in accordance with Section 3.1 of Appendix B of the Callaway Plant Operating License.

This Annual Environmental Operating Report is submitted in accordance with Section 6.9.1.6 of the Technical Specifications and Appendix B to the Callaway Plant Operating License.

2.0 CONCLUSION

The third section of this report contains all the radiological environmental monitoring conducted in the vicinity of the Callaway Plant during 1990. The comparison of the results for the radiological environmental monitoring conducted during 1990 to the preoperational data and data from previous years of operation showed no unexpected or adverse effects from the operation of the Callaway Plant on the environment.

There was no non-radiological monitoring conducted in the vicinity of the Callaway Plant during 1990.

There were no plant modifications completed during 1990 with an unreviewed environmental question as shown in section five of this report.

SECTION 3.0

RADIOLOGICAL

ENVIRONMENTAL MONITORING

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT

RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM

ANNUAL REPORT

1990

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TABLES

FIGURES

Abstract

This report presents the data obtained from analysis of environmental samples collected through the Callaway Plant Radiological Environmental Monitoring Program (REMP) in 1990.

Evaluation of radiation levels in the environs around Union Electric Company's (UEC) Callaway Plant entailed sampling at strategic points in various exposure pathways. The following types of samples were collected and analyzed: milk, vegetation, surface water, well water, bottom sediment, bedload sediment, washload sediment, fish, airborne particulates, airborne radioiodine, direct radiation (TLD) and soil.

Analytical results are presented and discussed along with other pertinent information. Possible trends and anomalous results, as interpreted by Union Electric Company personnel, are discussed.

1.0 Introduction

This report presents an analysis of the results of the REMP conducted during 1990 for Union Electric Company, Callaway Plant.

In compliance with federal and state regulations and in its concern to maintain the quality of the local environment UEC began its radiological monitoring program in April, 1982.

The objectives of the REMP are to monitor potential critical pathways of radioeffluent to man and to determine radiological impact on the environment caused by operation of the Callaway Plant.

The Callaway plant consists of one 1239 MWe pressurized water reactor, which achieved initial criticality on October 2, 1984. The plant is located on a plateau approximately ten miles southeast of the City of Fulton in Callaway County, Missouri and approximately eighty miles west of the St. Louis metropolitan area. The Missouri River flows by the site in an easterly direction approximately five miles south of the site at its closest point.

2.0 Radiological Environmental Monitoring Program

2.1 Program Design

The purpose of the operational REMP at the Callaway Plant is to assess the impact of plant operation on the environment. For this purpose samples are collected from waterborne, airborne, ingestion and direct radiation pathways. Sampling media are selected which are likely to show effects of plant effluents and which are sensitive to changes in radioactivity levels. The types of sample media collected are: milk, surface water, groundwater, shoreline sediment, bottom sediment, bedload sediment, washload sediment, soil, fish, vegetation, airborne particulate, airborne radioiodine and direct radiation (TLD).

Samples are collected by Union Electric personnel and shipped to Teledyne Isotopes Midwest Laboratory (TIML) for analysis. TLD's are analyzed by Union Electric Personnel. The data obtained are reported monthly and summarized in the annual report.

Environmental sample locations are divided into two types, indicator and control. Indicator samples are those collected from locations which would be expected to manifest plant effects, if any. Control samples are collected at locations which are expected to be unaffected by plant operation.

2.2 Program Description

Sample locations for the REMP are shown in Figures 1 and 2. Table I describes the sample locations, direction and distance from the plant, which are control and which are indicator locations, and the types of samples collected at each location. Sample collection frequencies for each of the monitoring locations are given in Table II. The collections and analyses that comprise the program are described in the following pages.

Identification of sample type codes used in Table I are as follows:

Code	Sample Collected
AIO	Air Iodine
AFT	Air Particulate
AQF	Fish
AQS	Sediment
FPL	Leafy Green Vegetables
IDM	TLD
MLK	Milk
SOL	Soil
SWA	Surface Water
WWA	Ground Water

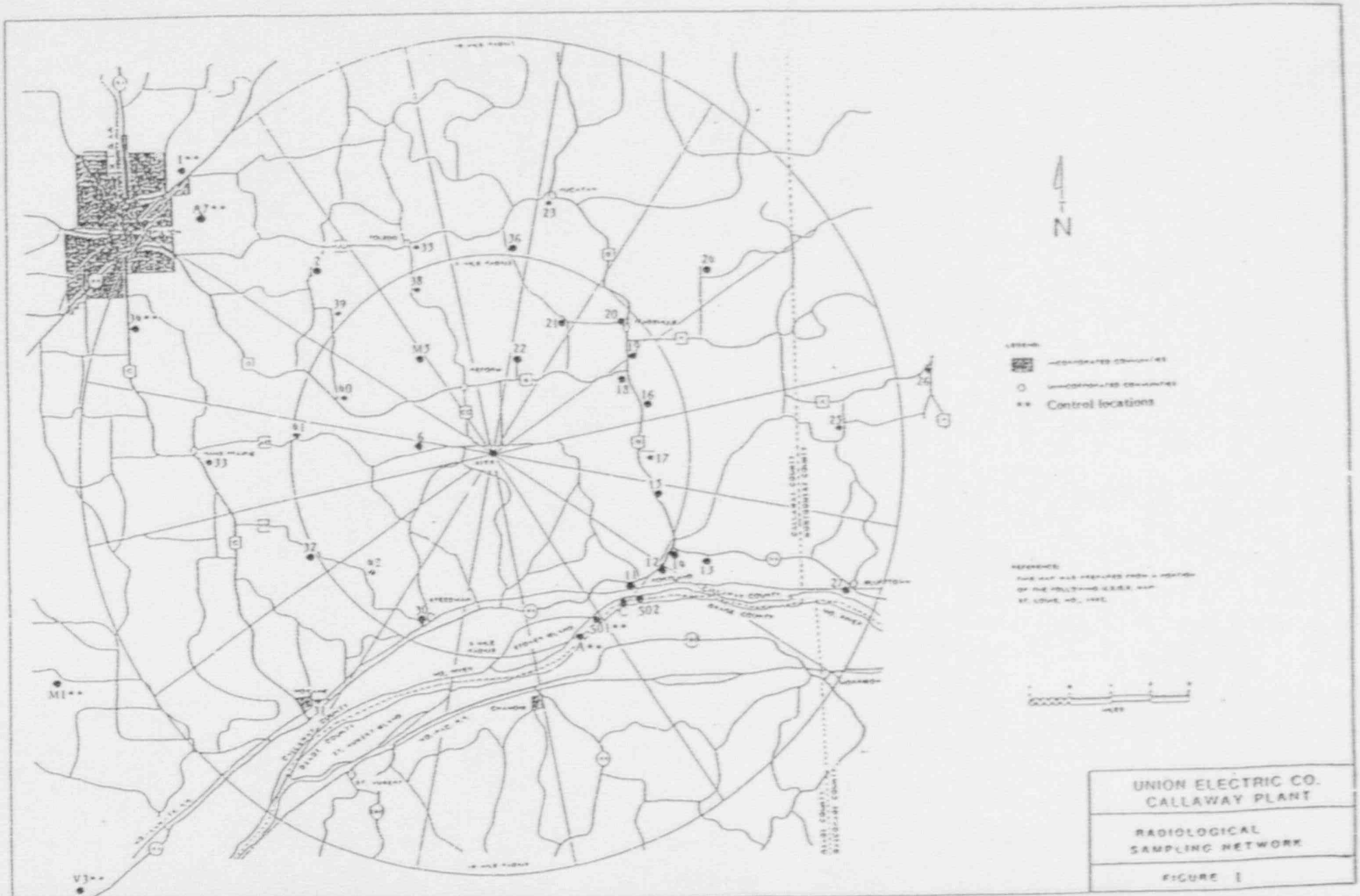
2.2.1 Waterborne Pathway

Surface Water

Monthly composite samples of surface water from the Missouri River are collected from one indicator location (S02) and from one control location (S01). In addition, a monthly grab sample is collected from one location (S03) near the St. Louis City water intake. The samples are analyzed for gross alpha, gross beta, tritium, Strontium-89, Strontium-90, and by gamma spectrometry.

Ground Water

Ground water samples are collected monthly from two on-site wells (F05 and F15) and one off-site well used for drinking water (D01). The on-site ground water samples are collected using a manual grab sampler which is lowered into the well. The off-site ground water sample is collected from a faucet after allowing the line to flush for two minutes. Ground water samples are analyzed for gross alpha, gross beta, tritium, strontium-89, strontium-90, and gamma emitting nuclides.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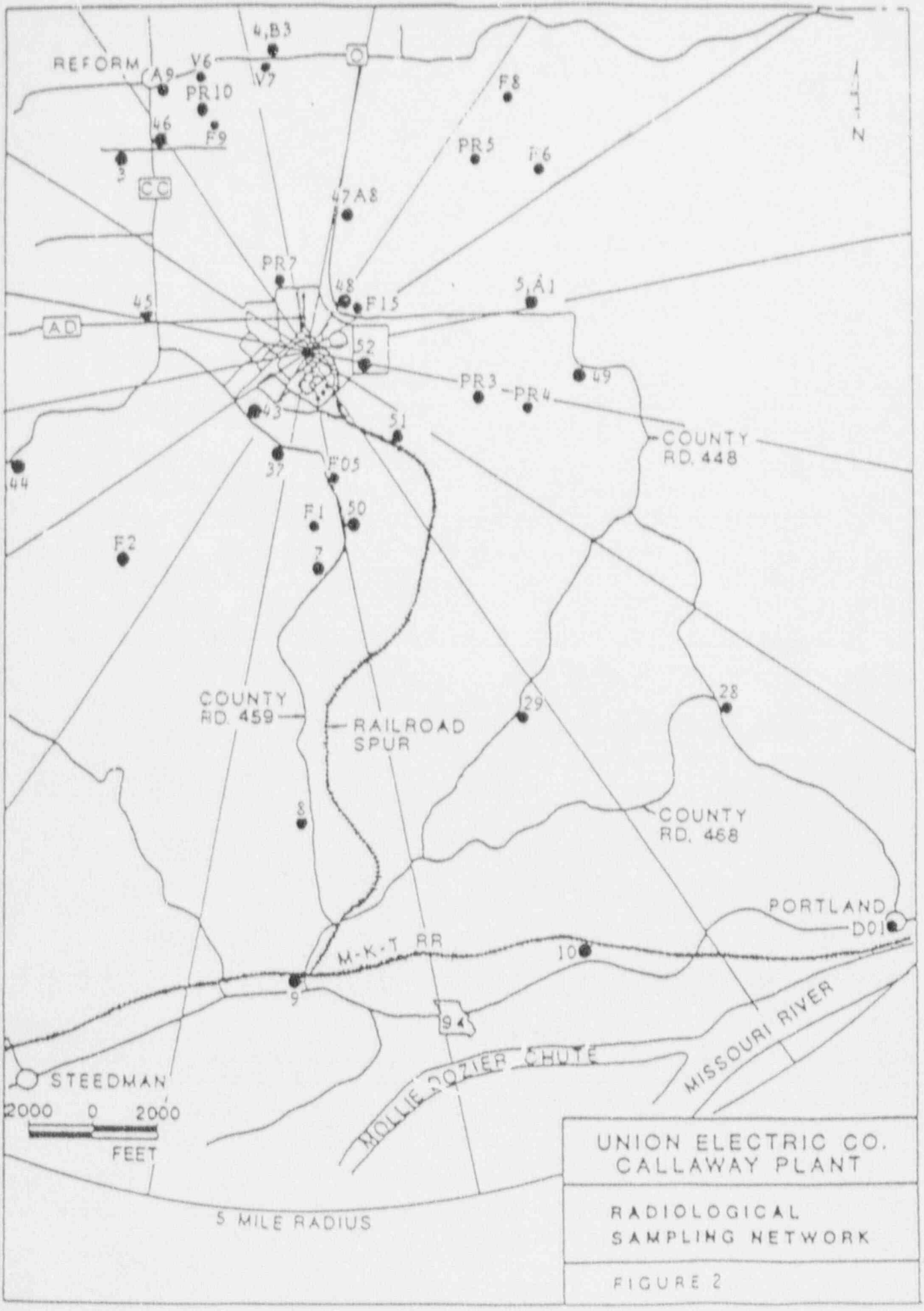
** Control locations
UNION ELECTRIC CO.
CALLAWAY PLANT
RADIOLOGICAL
SAMPLING NETWORK
FIGURE 1


REFORM
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COUNTY
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PORTLAND
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5 MILE RADIUS
UNION ELECTRIC CO.
CALLAWAY PLANT
RADIOLOGICAL
SAMPLING NETWORK
FIGURE 2

TABLE I

SAMPLING LOCATIONS

Location Code	Description	Sample Types
1**	11 mi NW, City Limits of Fulton on Hwy Z, 0.8 mi East of Business 54.	IDM
2	6.6 mi NW; County Road 111, 0.6 mi South of Hwy UU, Callaway Electric Cooperative Utility Pole No. 17571.	IDM
3	1.3 mi NW; 0.1 mi West of Hwy CC on Gravel Road, 0.8 mi South Hwy O, Callaway Electric Cooperative Utility Pole No. 18559.	IDM
4,B3	1.9 mi N;0.3 mi East of the O and CC Junction, Callaway Electric Cooperative Utility Pole No. 18892.	IDM,APT,A10
5,A1	1.3 mi ENE; Primary Meteorological Tower.	IDM,APT,A10
6	2.0 mi W; County Road 428, 1.2 mi West of Hwy CC, Callaway Electric Cooperative Utility Pole No. 18609.	IDM
7	1.3 mi S; County Road 459, 2.6 mi North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 35097	IDM
8	2.9 mi S; County Road 459, 1.4 mi North of Hwy 94, Callaway Electrical Cooperative Utility Pole No. 06823.	IDM
9	3.7 mi S; NW Side of the County Road 459 and 94 Junction, Callaway Electric Cooperative Utility Pole No. 06754.	IDM
10	4.0 mi SSE; Hwy 94, 1.8 mi East of County Road 459, Callaway Electric Cooperative Utility Pole No. 12182.	IDM
11	4.8 mi SE; City of Portland, Callaway Electric Cooperative Utility Pole No. 12112.	IDM
12	5.3 mi SE; Hwy 94, 0.6 mi South of Hwy D, Utility Pole on East side of Hwy.	IDM
13	5.6 mi ESE; Hwy 94, 0.75 mi East of Hwy D, Kingdom Telephone Pole No. 2X1.	IDM

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
14	5.0 mi ESE; SE Side of Intersection D and 94, Callaway Electric Cooperative Utility Pole No. 11940.	IDM
15	4.2 mi ESE; Hwy D, 2.5 mi North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 27379.	IDM
16	4.1 mi ENE; Hwy D, 3.6 mi North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 12976.	IDM
17	4.0 mi E; County Road 4053, 0.3 mi East of Hwy 94, Kingdom Telephone Company Pole No. 3X12.	IDM
18	3.8 mi ENE; Hwy D, 0.4 mi South of O, Callaway Electric Cooperative Utility Pole No. 12952.	IDM
19	4.2 mi NE; Hwy D, 0.3 mi North of Hwy O, Callaway Electric Cooperative Utility Pole No. 12918.	IDM
20	4.8 mi NE; City of Readsville, Callaway Electric Cooperative Utility Pole No. 12830.	IDM
21	4.0 mi NNE; County Road 155, 1.9 mi North of Hwy O, Callaway Electric Cooperative Utility Pole No. 19100.	IDM
22	2.5 mi NNE; County Road 150, 0.5 mi North of Hwy O, Callaway Electric Cooperative Utility Pole No. 19002.	IDM
23	6.7 mi NNE; City of Yucation, Callaway Electric Cooperative Utility Pole No. 12670	IDM
24	7.0 mi NE; County Road 191, 2.1 mi North of Hwy K, Callaway Electric Cooperative Utility Pole No. 12498.	IDM
25	8.7 mi E; County Road 289, 0.3 mi South of County Road 287, Callaway Electric Cooperative Utility Pole No. 11295.	IDM

TABLE 1 (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
26	12.1 mi E; Town of Americus, Callaway Electric Cooperative Utility Pole No. 11159.	IDM
27	9.5 mi ESE, Town of Bluffton, Callaway Electric Cooperative Utility Pole No. 11496.	IDM
28	3.3 mi SE; County Road 469, 2.0 mi North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 06896.	IDM
29	2.7 mi SSW; County Road 448, 1.2 mi North of County Road 459, Callaway Electric Cooperative Utility Pole No. 06851.	IDM
30	4.6 mi SSE; W side of County Road 447 and 463 Junction, Kingdom Telephone Company Pole No. 2K1.	IDM
31	7.6 Mi SW; City of Mokane, Callaway Electric Cooperative Utility Pole No. 06039.	IDM
32	5.4 mi WSW; Hwy VV, 0.6 mi West of County Road 447, Callaway Electric Cooperative Utility Pole No. 27031.	IDM
33	7.3 mi W; City of Hams Prairie, SE of Hwy C and AD Junction.	IDM
34**	9.7 mi WNW; NE Side of Hwy C and County Road 408 Junction.	IDM
35	5.8 mi NNW; City of Toledo, Callaway Electric Cooperative Utility Pole No. 17684.	IDM
36	5.2 mi N; County Road 155, 0.8 mi South of County Road 132, Callaway Electric Cooperative Utility Pole No. 19137.	IDM
37	0.7 mi SSW; County Road 459, 0.9 mi South of Hwy CC, Callaway Electric Cooperative Utility Pole No. 35077.	IDM

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
38	4.8 mi NNW; County Road 133, 1.5 mi South of Hwy UU, Callaway Electric Cooperative Utility Pole No. 34708.	IDM
39	5.4 mi NW; County Road 112, 0.7 mi East of County Road 111, Callaway Electric Cooperative Utility Pole No. 17516.	IDM
40	4.2 mi WNW; NE Side of County Road 112 and Hwy O, Callaway Electric Cooperative Utility Pole No. 06326.	IDM
41	4.8 mi W; Hwy AD, 2.8 mi East of Hwy C, Callaway Electric Cooperative Utility Pole No. 18239.	IDM
42	4.4 mi SW; County Road 447, 2.6 mi North of County Road 463, Callaway Electric Cooperative Utility Pole No. 06326.	IDM
43	0.5 mi SW; County Road 459, 0.7 mi South of Hwy CC, Callaway Electric Cooperative Utility Pole No. 35073.	IDM
44	1.7 mi WSW; Hwy CC, 1.0 mi South of County Road 459, Callaway Electric Cooperative Utility Pole No. 18769.	IDM
45	1.0 mi WNW; County Road 428, 0.1 mi West of Hwy CC, Callaway Electric Cooperative Utility Pole No. 18580.	IDM
46	1.5 mi NNW; NE Side of Hwy CC and County Road 466 Intersection, Callaway Electric Cooperative Utility Pole No. 28242.	IDM
47	0.9 mi NNE; County Road 448, 0.9 mi South of Hwy O, Callaway Electric Cooperative Utility Pole No. 28151.	IDM
48	0.4 mi NE; County Road 448, 1.5 mi South of Hwy O, Plant Security Sign Post.	IDM
49	1.7 mi E; County Road 448, Callaway Electric Cooperative Utility Pole No. 06959, Reform Wildlife Management Parking Area.	IDM

TABLE 1 (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
50	0.9 mi SSE; County Road 459, 3.3 mi North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 35086.	IDM
51	0.7 mi SE; Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon.	IDM
52	0.4 mi ESE; Light Pole Near the East Plant Security Fence.	IDM
A7**	9.5 mi NW; C. Bartley Farm	AFT,AIO
A8	0.9 mi NNE; County Road 448, 0.9 miles South of Hwy O.	AFT,AIO
A9	1.7 mi NNW; Community of Reform	AFT,AIO
D01	5.1 mi SE; Holzhouser Grocery Store/Tavern (Portland, MO).	WWA
F05	1.0 mi SSE; Onsite Groundwater Monitoring Well.	WWA
F15	5.5 mi NE; Onsite Groundwater Monitoring Well.	WWA
M1**	12.3 mi WSW; Green's Farm.	MLK
M5	3.1 mi NW; Schneider Farm.	MLK
V3**	15.0 mi SW; Beazley Farm.	FPL,SOL
V6	1.8 mi NNW; Becker Farm.	FPL
V7	1.8 mi N; Meehan.	FPL
A**	4.9 mi SSE; 0.6 River Miles Upstream of Discharge North Bank.	AQS,AQF
C	5.1 mi SE; 1.0 River Miles Downstream of Discharge North Bank.	AQS,AQF
D	53.0 mi ESE; 59.5 River Miles Downstream of Discharge South Bank.	AQS,AQF

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
S01**	4.8 mi SE; 84 feet Upstream of Discharge North Bank.	SWA
S02	5.2 mi SE; 1.1 River Miles Downstream of Discharge North Bank.	SWA
S03	68 mi E; City of St. Louis Water Intake.	SWA
F1	0.98 mi S; Callaway Plant Forest Ecology Plot F1.	SOL
F2	1.64 mi SW; Callaway Plant Forest Ecology Plot F2.	SOL
F6	1.72 mi NE; Callaway Plant Forest Ecology Plot F6.	SOL
F8	1.50 mi NE; Callaway Plant Forest Ecology Plot F8.	SOL
F9	1.45 mi NNW; Callaway Plant Forest Ecology Plot F9.	SOL
PR3	1.02 mi ESE; Callaway Plant Prairie Ecology Plot PR3.	SOL
PR4	1.34 mi ESE; Callaway Plant Prairie Ecology Plot PR4.	SOL
PR5	1.89 mi NE; Callaway Plant Prairie Ecology Plot PR5.	SOL
PR7	0.45 mi NNW; Callaway Plant Prairie Ecology Plot PR7.	SOL
PR10	1.55 mi NNW; Callaway Plant Prairie Ecology Plot PR10	SOL

*All distances are measured from the center line of the reactor
**Control locations

TABLE II

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Ground Water	Surface Water	Sediment	Fish	Milk	Vegetation	Soil
A1, Primary Meteorological Tower	W	W							
A7, C. Bartley Farm	W	W							
A8, County Rd. 448, 0.9 miles South of Hwy 0	W	W							
A9, Community of Reform	W	W							
B3, 0.6 miles East of 0 and CC Junction	W	W							
D01, Holzhouser Grocery Store/Tavern			M						
F05, Onsite Groundwater Monitoring Well			M						
F15, Onsite Groundwater Monitoring Well			M						
M1, Green's Farm							SM/M		
M5, Schneider Farm							SM/M		

Q=Quarterly W=Weekly M=Monthly SM/M=Semi Monthly when cows are on Pasture, Monthly otherwise A=Annually

TABLE II (Cont'd.)

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Ground Water	Surface Water	Sediment	Fish	Milk	Vegetation	Soil
V3. Bearley Farm								M	A
V6. Becker Farm								M	
V7. Meehan Farm								M	
A,0.6 River miles Upstream of Discharge North Bank					Q	M			
C,1.0 River miles Downstream of Discharge North Bank					Q	M			
D,59.5 River miles Downstream of Discharge South Bank					Q	M			
S01, 84 feet Upstream of Discharge North Bank			M						
S02, 1.1 River miles Downstream of Discharge North Bank			M						
S03, City of St. Louis Water Intake (grab)			M						
F1, Callaway Plant Forest Ecology plot F1									A
F2, Callaway Plant Forest Ecology Plot F2									A

Q=Quarterly W=Weekly M=Monthly SM/M=Semi Monthly when cows are on Pasture, Monthly otherwise A=Annually

TABLE II (Cont'd.)

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Ground Water	Surface Water	Sediment	Fish	Milk	Vegetation	Soil
F6, Callaway Plant Forest Ecology Plot F6									A
F8, Callaway Plant Forest Ecology Plot F8									A
F9, Callaway Plant Forest Ecology Plot F9									A
PR3, Callaway Plant Prairie Ecology Plot PR3									A
PR4, Callaway Plant Prairie Ecology Plot PR4									A
PR5, Callaway Plant Prairie Ecology Plant PR5									A
PR7, Callaway Plant Prairie Ecology Plot PR7									A
PR10, Callaway Plant Prairie Ecology Plot PR10									A

Q=Quarterly W=Weekly M=Monthly SM/M=Semi Monthly when cows are on Pasture, Monthly otherwise A=Annually

Washload Sediment

Washload sediment sampling is performed quarterly by collecting six gallons of surface water at two indicator locations (C and D) and at one control location (A). The water samples are placed in a settling flask to allow the suspended solids to settle out. The solids collected are analyzed for gross alpha, gross beta, gamma isotopic, strontium-89, and strontium-90.

Bedload Sediment

Bedload sediment samples are taken quarterly by submerging a hose to the bottom of the river and collecting four gallons of water at the same locations as washload sediment. The samples are placed in a settling flask to allow the suspended solids to settle out. The solids collected are analyzed for gross alpha, gross beta, strontium-89, strontium-90, and gamma isotopic.

Bottom Sediment

Bottom sediment samples are collected quarterly at the same locations as washload sediment. The samples are taken from water at least 2 meters deep to prevent influence of bank erosion. A Ponar dredge is used to obtain the samples, all of which consisted of the uppermost layer of sediment. Each sample is placed, without preservative, in a plastic bag and sealed. Bottom sediment samples are analyzed for gross alpha, gross beta, Strontium-89, Strontium-90, and gamma isotopic.

Shoreline Sediment

Shoreline sediment samples are collected semi-annually from one indicator location (C) and one control location (A). The samples are collected within two feet of the waters edge and consist of 2 six inch diameter by 2 inch deep sediment plugs. Each sample is placed in a plastic bag and sealed. Shoreline sediment samples are analyzed for gamma isotopic.

2.2.2 Airborne Pathway

Airborne Particulates

Airborne particulate samples are collected on a 47mm diameter glass fiber filter type A/E (99 percent removal efficiency at 1 micron particulate) at a volumetric rate of one and one half (1.5) cubic feet per minute at five (5) locations. The particulate

filters are collected weekly and shipped to TIML for analyses. The filters are analyzed for gross beta activity approximately five days after collection to allow for decay of naturally-occurring short-lived radionuclides. Quarterly composites of filters by location are gamma-scanned and analyzed for Strontium-89 and Strontium-90. Four of the five locations are indicator locations (A1, A8, A9, and B3) and one location is a control location (A7). One of the indicators (A9) is located at the community with the highest D/Q.

Airborne Iodine

Each air sampler is equipped with a charcoal cartridge in-line after the particulate filter holder. The charcoal cartridge at each location is collected at the same time as the particulate filter and analyzed for iodine-131 within eight days after collection.

2.2.3 Ingestion Pathway

Milk

Two gallon milk samples are collected semi-monthly during the pasture season (April through September) and monthly during the winter from one indicator location (M5) and one control location (M1). The indicator location supplies goat's milk and the control location supplies cow's milk. The milk samples are shipped in an ice chest to be received by TIML within 48 hours of collection. Analyses for iodine-131, elemental calcium, strontium-89, strontium-90, and gamma emitting nuclides are performed on all milk samples.

Fish

The five most abundant fish species are collected monthly at two indicator locations (C and D) and at one control location (A). The fish samples are filleted and the fillets are analyzed for gross alpha, gross beta, strontium-89, strontium-90 and gamma isotopic.

Vegetation

Monthly, during the growing season, green leafy vegetation is collected from two indicator locations (V6 and V7) and from one control location (V1). Vegetation samples consist of mustard greens, turnip greens, cabbage, lettuce, and spinach. The vegetation samples are analyzed for gross alpha, gross beta, iodine-131, and by gamma spectrometry.

Soil

Once a year soil samples are collected from ten indicator locations (F1, F2, PR3, PR4, PR5, F6, PR7, F8, F9 and PR10) and one control location (V3). To ensure that only the most recent deposition was sampled, only the uppermost two-inch layer of soil was taken at each location. Sampling consists of 2 six inch square soil plugs. The litter at the surface and the root mat is considered part of the sample. The samples are placed in plastic bags and sealed. Each soil sample is analyzed for gross alpha, gross beta, and gamma isotopic.

2.2.4 Direct Radiation

Thermoluminescent Dosimetry

Thermoluminescent Dosimetry (TLD) is employed to determine direct radiation levels in and around the Callaway site. Panasonic model UD-814 TLD's sealed in plastic bags are placed in polypropylene mesh cylindrical holders at fifty two locations and exchanged quarterly and annually. Fifty of the fifty two locations are indicators (2 through 33 and 35 through 52) and two locations are controls (1 and 34).

2.3 Program Execution

The program was executed as described in the preceding section with the following exceptions:

1. No milk samples were available from location M5 during the months of January, February, March, November and December. Goats were not producing during these months.

2. The upstream surface water composite sampler (S01) was inoperable from 01/04/90 to 03/22/90 due to mechanical problems with the sampler. Daily grab samples were taken while the composite sampler was out of service.

3. The downstream surface water composite sampler (S02) was inoperable from 01/04/90 to 02/01/90 due to a frozen sample line. Daily grab samples were taken while the composite sampler was out of service.

4. There was no direct radiation data from Location 11 for the first quarter because of vandalism to the TLD station.

5. The downstream surface water composite sampler (S02) was inoperable from 05/17/90 to 06/14/90 due to sampler flooding. Daily grab samples were taken while the composite sampler was out of service.

6. The air particulate and airborne iodine sample results from location A7 for the collection period ending 06/01/90 are questionable because the sampler power was off when the sample was collected. The sampler hour meter showed the sampler had operated for 35 hours.

7. The upstream surface water composite sampler (S01) was inoperable from 07/05/90 to 08/16/90 due to a malfunction of the sampling equipment. Daily grab samples were taken while the composite sampler was out of service.

8. The downstream surface water composite sampler (S02) was inoperable from 07/05/90 to 12/31/90 because the sample lines in the river separated from the anchoring peirs and kinking. Daily grab samples were taken while the composite sampler was out of service.

9. There were no air particulate or airborne iodine samples from A1 for the collection periods ending 08/24/90, 08/30/90, and 09/06/90 due to loss of electrical power to the sampling station.

10. No green leafy vegetation samples were available from location V6 during August and V3 during September due to plants not producing.

11. The lower limit of detection for airborne iodine samples from location A1 for the collection periods ending 09/13/90 and 12/13/90 was not reached due to low sample volume.

12. The upstream surface water composite sampler (S01) was out of service from 10/25/90 to 11/29/90. Daily grab samples were taken while the composite sampler was inoperable.

13. The well water sample from location F15 was not collected in December due to sampler malfunction.

14. There was no direct radiation data from location 30 for the fourth quarter due to vandalism of the TLD station.

15. The data for the annual TLD's for locations 11 and 30 was lost due to vandalism of the TLD station.

2.4 Analytical Procedures

Analytical procedures and counting methods employed by the contractor Laboratory follow those recommended by

the U.S. Public Health Service publication, Radioassay Procedures for Environmental Samples, January 1967; and the U.S. Atomic Energy Commission health and Safety Laboratory, HASL Procedures Manual, (HASL-300), 1972.

A synopsis of the routinely used analytical procedures for sample analyses is presented below.

2.4.1 Airborne

2.4.1.1 Gross Beta

The glass fiber filter type A/E (99 percent removal efficiency at 1 micron particulate), is placed into a stainless steel planchet and counted for Gross Beta radioactivity using a proportional counter.

2.4.1.2 Gamma Spectrometry

The filters are composited according to station and counted using a germanium detector which is coupled to a computer based, multi-channel analyzer. The resulting spectrum is then analyzed by the computer and specific nuclides, if present, identified and quantified.

2.4.1.3 Strontium-89 and Strontium-90

The composited filters, with stable strontium and barium carriers added, are leached in nitric acid to bring deposits into solution. After filtration, filtrate is reduced in volume by evaporation. The residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from nitric acid, the nitrates are dissolved in acid again with added yttrium carrier and are stored for ingrowth period, the yttrium is precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on a No. 42 (2.4 cm) Whatman filter. The filters are counted using a low background proportional counter and the Strontium-90 activity is calculated from the oxalate data. The Strontium-89 activity is

determined by subtracting the previously calculated Strontium-90 activity from the measured gross Strontium activity calculated from the carbonate.

2.4.1.4 Iodine-131

Each Charcoal cartridge is placed on the germanium detector and counted. A peak of 0.36 MeV is used to calculate the concentration at counting time. The equilibrium concentration at the end of collection is then calculated. Decay correction between the end of collection period and the counting time is then made.

2.4.2 Direct Radiation

Direct radiation measurements are taken by UEC using Thermoluminescent Dosimeters (TLD's). The UEC program employs the Panasonic Model UD-814 TLD and Model UD-710 automatic dosimeter reader. Each dosimeter consists of three elements of $CaSO_4$:Tm and one element of $Li_2B_4O_7$:Cu. The dosimeters are sealed in a moisture resistant plastic bag and placed inside a polypropylene mesh cylindrical holder in the environment. After exposure in the environment the dosimeters are read and the exposure for the time period is determined from the $CaSO_4$:Tm elements. The $Li_2B_4O_7$:Cu element is not used to determine exposure during routine operations.

2.4.3 Vegetation

2.4.3.1 Iodine-131

A suitable aliquot of wet (as received) sample is placed into a standard calibrated container and counted using a germanium detector which is coupled to a computer based, multi-channel analyzer. A peak of 0.36 MeV is used to calculate the concentration at counting time. The equilibrium concentration at the end of collection is calculated by decay correcting between the end of the collection period and the counting time.

2.4.3.2 Gross Alpha and Gross Beta

A suitable aliquot of ashed sample is transferred to a two-inch ringed planchet. The planchet is counted for Gross Alpha and Gross Beta activity using a proportional counter.

2.4.3.3 Gamma Spectrometry

A suitable aliquot of wet (as received) sample is placed into a standard calibrated container and specific nuclides, if present, identified and quantified using a germanium detector which is coupled to a computer based, multi-channel analyzer.

2.4.4 Milk

2.4.4.1 Iodine-131

Two liters of milk containing standardized Iodine carrier are stirred with anion exchange resin for one hour. The resin is washed with NACl and the iodine is eluted with sodium hypochlorite. Iodine in the iodate form is reduced to I_2 and the elemental iodi.- extracted into CCl_4, back-extracted into water, then precipitated as palladium iodide. The precipitate is counted for I-131 using a proportional counter.

2.4.4.2 Strontium-89 and Strontium-90

One liter of milk containing strontium and barium carriers is passed through a cation-exchange resin column.

Strontium, barium and calcium are eluted from the cation-exchange resin with sodium chloride solution. Following dilution of the eluate, the alkaline earths are precipitated as carbonates. The carbonates are then converted to nitrates, and strontium and barium nitrate are precipitated. The nitrate precipitate is dissolved, and barium is precipitated as the chromate, purified as the chloride, and then counted to determine the barium 140 (if required). From the supernate, strontium is precipitated as the nitrate, dissolved in water and reprecipitated as strontium nitrate. The nitrate is converted to the carbonate, which

is filtered, weighted to determine strontium carrier recovery, and counted for "total radiostrontium" using a proportional counter.

After counting total radiostrontium the second time after six to eight days, Sr-89 concentrations are calculated. If the Sr-89 concentration shows a positive result, the precipitate is dissolved, yttrium carrier added and the sample is stored for six to eight days to allow for additional yttrium ingrowth. Yttrium is separated from strontium, precipitated as yttrium oxalate and counted to determine Sr-90 concentrations.

The concentration of Sr-89 is calculated as the difference between the activity for "total radiostrontium" and the activity due to Sr-90.

2.4.4.3 Gamma Spectrometry

3.5 liters or 500 ml aliquot of milk is placed in a standard counting container and specific nuclides identified and quantified using a germanium detector which is coupled to a computer based, multi-channel analyzer.

2.4.4.4 Elemental Calcium

Strontium, barium, and calcium are absorbed on the cation-exchange resin, then eluted with sodium chloride solution. An aliquot of the eluate is diluted to reduce the high sodium ion concentration. From this diluted aliquot, calcium oxalate is precipitated, dissolved in dilute hydrochloric acid, and the oxalate is titrated with standardized potassium permaganate.

2.4.5 Surface and Ground Water

2.4.5.1 Gross Alpha and Gross Beta

A suitable aliquot of water is evaporated to dryness and the residue transferred to a tarred planchet. The planchet is counted for Gross Alpha and Gross Beta activity using a proportional counter.

2.4.5.2 Tritium

A 60-70 ml aliquot of the water sample is purified by distillation, a portion of the distillate is transferred to a counting vial and the scintillation fluid added. The contents of the vial are thoroughly mixed and counted in a liquid scintillation counter.

2.4.5.3 Strontium-89 and Strontium-90

The acidified 1 liter sample of clear water with stable strontium, barium, and calcium carriers is treated with oxalic acid to precipitate insoluble oxalates. The oxalates are dissolved in nitric acid, and strontium nitrate is separated from calcium as a precipitate in nitric acid. The residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from nitric acid, the nitrates are dissolved in acid with added yttrium carrier and are stored for ingrowth of yttrium-90. The yttrium is again precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on No. 42 (2.4 cm) Whatman filter for counting using a low background proportional counter. The Strontium-90 concentration is determined from the yttrium oxalate counting results and the strontium 89 concentration is calculated as the difference between the strontium carbonate activity and the activity due to strontium-90.

2.4.5.4 Gamma Spectrometry

3.5 liters or 500 ml aliquot of the water sample is placed in a standard counting container and specific nuclides identified and quantified using the Method described in Section 2.4.1.2.

2.4.6 Fish

2.4.6.1 Gross Alpha and Gross Beta

A suitable aliquot of ashed fish sample is transferred to a two-inch ringed planchet. The planchet is counted for Gross Alpha and Gross Beta activity using a proportional counter.

2.4.6.2 Strontium-89 and Strontium-90

A suitable aliquot of ashed sample transferred to a 250 ml beak[illegible] nd Strontium-Yttrium carriers added. The Sample is leached in nitric acid and filtered. After filtration, filtrate is reduced in volume by evaporation. The residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from nitric acid, the nitrates are dissolved in acid again with added yttrium carrier and are stored for ingrowth or yttrium-90. The yttrium is precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on No. 42 (2.4 cm) Whatman filter for counting using a low background proportional counter. The strontium-90 concentration is determined from the yttrium oxalate counting results and the strontium-89 concentration is calculated as the difference between the strontium carbonate activity and the activity due to strontium-90.

2.4.6.3 Gamma Spectrometry

A suitable aliquot of prepared sample is placed in standard calibrated container and specific nuclides identified and quantified using a germanium detector which is coupled to a computer based, multi-channe analyzer.

2.4.7 Bottom, Bedload and Washload Sediment

2.4.7.1 Gross Alpha and Gross Beta

A suitable aliquot of ashed sample is transferred to a two-inch ringed planchet. The planchet is counted for Gross Alpha and Gross Beta activity using a proportional counter.

2.4.7.2 Strontium-89 and Strontium-90

A suitable aliquot of ashed sample is transferred to a 250 ml beaker and Strontium-Yttrium carriers added. The sample [illegible]s leached in nitric acid and filtered.

After filtration, filtrate is reduced in volume by evaporation. The residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from nitric acid, the nitrates are dissolved in acid again with added yttrium carrier and are stored for ingrowth of yttrium-90. The yttrium is precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on No. 42 (2.4 cm) Whatman filter for counting using a low background proportional counter. The strontium-90 concentration is determined from the yttrium oxalate counting results and the strontium-89 concentration is calculated as the difference between the strontium carbonate activity and the activity due to strontium-90.

2.4.7.3 Gamma Spectrometry

A suitable aliquot of prepared sample is placed in standard calibrated container and specific nuclides identified and quantified using a germanium detector which is coupled to a computer based, multi-channel analyzer.

2.5 Program Modifications

There were no changes to the program during 1990.

3.0 Isotopic Detection Limits and Activity Determinations

A discussion of the calculations used in determining detection limits and activity by the Contractor Laboratory is found in Appendix C.

Table III gives the required detection limits for radiological environmental sample analysis. For each sample type, the table lists the detection level for each isotope.

TABLE III

DETECTION CAPABILITIES FOR RADIOLOGICAL ENVIRONMENTAL SAMPLE ANALYSIS

ANALYSIS	WATER (pC/l)	AIRBORNE (pC/m^3)	FISH (pCi/kg wet)	MILK (pC/l)	FOOD PRODUCTS (pCi/kg wet)	SEDIMENT (pCi/kg dry)
Gross beta	4	0.01				
H-3	500					
Mn-54	15		130			
Fe-59	30		260			
Co-58,-60	15		130			
Zr-Nb-95	15*					
I-131	1	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15*			5*		

NOTE: This list does not mean only these nuclides will be detected and reported. Other peaks which are measurable and identifiable together with above nuclides, will also be identified and reported.

* Total activity, parent plus daughter activity.

4.0 Quality Control Program

To insure the validity of the data, the contractor laboratory maintains a quality control (QC) program which employs quality control checks, with documentation, of the analytical phase of its environmental monitoring studies. The program is defined in the Quality Control Program, and procedures are specified in the QC Procedures Manual.

The QC Program includes laboratory procedures designed to prevent cross-contamination and to ensure accuracy and precision of analyses. The quality control checks include blind samples, duplicate samples, and spiked samples as necessary to verify that laboratory analysis activities are being maintained at a high level of accuracy.

The Quality Control Program is in compliance with USNRC Regulatory Guide 4.15 and includes appropriate control charts with specified acceptance levels for instrument source checks, background, efficiency, etc. for counting equipment.

The Laboratory participates in the USEPA Interlaboratory Comparison Program (crosscheck program) by analyzing radioactive samples distributed for that purpose. The results of the crosscheck program are presented in Appendix B.

5.0 Data Interpretations

In interpreting the data, effects due to the Callaway Plant must be distinguished from those due to other sources.

The principal interpretation method used in assessment of those effects is the indicator-control concept design of the monitoring program at the Callaway Plant. Most sample types are collected at both indicator locations (areas potentially affected by plant operations) and at control locations (areas not affected by plant discharge). A possible plant effect would be indicated if the radiation level at an indicator location was significantly larger than that at the control location. The difference would have to be greater than what could be accounted for by typical fluctuations in radiation levels arising from other sources.

An additional interpretation method involves analysis for specific radionuclides present in the environmental samples collected around the plant site. For certain isotopes it can be determined if the activity is the

result of weapons testing or plant operations because of the different characteristic proportions in which these isotopes appear in the fission product mix produced by a nuclear reactor and that produced by a nuclear detonation.

Other means of distinguishing sources of environmental radiation can be employed in interpretation of the data. Current radiation levels can be compared with preoperational levels. Results can be related to those obtained in other parts of the country. Finally, results can be related to events known to have caused elevated levels of radiation in the environment.

6.0 Results and Discussion

The analytical results for the reporting period January to December 1990 are present in summary form in Appendix D. For each type of analysis of each sampled medium, this table shows the annual mean and range for all indicator locations and for all control locations. The location with the highest annual mean and the results for this location are also given.

The discussion of the results has been divided into four pathways; waterborne, airborne, ingestion, and direct radiation. The individual samples and analyses within each category provides an adequate means of estimating radiation dose to individuals from the principal pathways. The data for individual samples are presented in tabular form in Appendix E.

6.1 Waterborne Pathway

The water pathway of exposure from the Callaway Plant was evaluated by analyzing surface water, well water, washload sediment, bedload sediment, bottom sediment, and shoreline sediment.

Surface Water

Analysis for alpha emitters showed detectable activity in twenty-six of the thirty-six samples, with results ranging from 1.5 to 5.1 pCi/l. The average sample concentration at indicator locations was 3.2 pCi/l and at control locations was 3.1 pCi/l. The values are similar to those measured in previous years and can be attributed to natural occurring isotopes.

The average gross beta activity in all surface water samples ranged from 4.2 to 11.2 pCi/l. The average activity was nearly identical in both the control locations (6.5 pCi/l) and the indicator locations (6.6 pCi/l) Essentially similar results were obtained in 1983, 1984, 1985, 1986, 1987, 1988, and 1989.

The analysis of tritium in surface water showed detectable activity in eleven of thirty-six samples with results ranging from 182.0 to 605.0 pCi/l. The mean tritium concentration at indicator locations was 249.9 pCi/liter and at control location was 443.2 pCi/l. The LLDs for the other samples ranged from 176.0 to 202.0 pCi/l.

There were no gamma emitting nuclides detected in any surface water samples.

Strontium-89 activity was below the detection limit in all samples. Strontium-90 activity was detected in three of the thirty-six samples and ranged from 0.5 to 1.2 pCi/l. The mean sample concentration was 0.8 pCi/l for the indicator locations.

The levels of activity detected in surface water samples were consistent with previously accumulated radiological environmental data and indicate no influence from plant operations.

Ground Water

In ground water samples, gross alpha was detected in twenty-four of thirty-five samples with the results ranging from 1.1 to 3.8 pCi/l. The mean activity for indicator locations was 2.1 pCi/l and for control locations was 1.8 pCi/l. Gross beta results showed positive values in thirty-five of thirty-five samples with the results ranging from 1.8 to 11.3 pCi/l. The average activity for indicator locations was 6.3 pCi/l and for control location was 8.3 pCi/l. The gross alpha and gross beta values are similar to those measured in previous years.

Tritium results were below the detection limit which ranged from 176.0 to 198.0 pCi/l.

There were no gamma emitting nuclides detected in any ground water samples.

No Strontium-89 activity was observed above the detection limit in any of the ground water samples. Strontium-90 was detected in three of the thirty-five samples and ranged from 0.6 pCi/l to 0.7 pCi/l. The mean sample concentration at indicator locations was 0.7 pCi/l and at the control location was 0.6 pCi/l. Similar Strontium-90 results were observed in 1984, 1985, 1986 and 1989. There was no indication of a plant effect on ground water.

Washload Sediment

All washload sediment samples showed positive values for gross alpha that ranged from 7603.0 to 18630.0 pCi/kg. The average gross alpha activity for indicator and control locations was 12658.8 pCi/kg and 12943.0 pCi/kg respectively. Gross Beta activity was detected in all samples with a range of 21091.0 to 27478.0 pCi/kg. The average gross beta activity for indicator locations was 23525.4 pCi/kg and for the control location was 24644.5 pCi/kg.

Five washload sediment samples showed positive values for Cesium-137 that ranged from 191.0 pCi/kg to 1199.0 pCi/kg. The average Cs-137 activity for indicator locations was 771.8 pCi/kg and for the control location was 575.0 pCi/kg. All other samples were below the LLD which ranged from 99.0 to 343.0 pCi/kg. The high LLD was due to low concentrations of suspended solids in river.

Strontium-89 was below the limit of detection in all samples. Strontium-90 activity was indicated in seven of the twelve samples with the results ranging from 37.2 pCi/kg to 97.5 pCi/kg. The mean activity for indicator locations was 55.4 pCi/kg and for the control location was 76.2 pCi/kg.

The levels of activity detected were within the ranges of activities observed during preoperational monitoring. No plant effects were indicated.

Bedload Sediment

Detectable concentration of gross alpha activity were observed in eleven of twelve bedload sediment samples with the results ranging from 6893.0 to 18951.0 pCi/kg. The mean activity for the indicator locations was 11250.3 pCi/kg and for the control location was 13466.5 pCi/kg.

Gross beta activity was indicated in all samples with the results ranging from 16518.0 to 26346.0 pCi/kg. The average gross beta activity for indicator and control locations was 22010.9 pCi/kg and 19652.2 pCi/kg, respectively.

Gamma Spectrometry indicated Cesium-137 activity in seven of the twelve samples. The mean activity at the indicator locations was 183.2 pCi/kg and 450.7 pCi/kg at the control location. The highest Cesium-137 activity, 630.0 pCi/kg, was detected at the control location A, 0.6 miles upstream of discharge.

Strontium 89 was below the detection limit in all samples. Strontium-90 activity was detected in six indicator samples with average sample concentration of 23.9 pCi/kg.

The activities detected in bedload sediment samples during 1990 were similar to those measured in previous 2years and there was no indication of an effect from plant operations.

Bottom Sediment

Gross alpha analyses of bottom sediment showed positive values for all samples. The alpha activity ranged from 4793.0 to 17062.0 pCi/kg. The average gross alpha activity for indicator locations was 11467.9 pCi/kg and for the control location was 6303.5 pCi/kg. Gross beta activity was detected in all samples with the results ranging from 12111.0 to 24457.0 pCi/kg. The mean beta activity for indicator and control locations was 20330.4 pCi/kg and 17632.2 pCi/kg, respectively. The location with the highest mean alpha (13891.0 pCi/kg) and beta (21129.8 pCi/kg) was indicator location D, 59.5 miles downstream of discharge.

Cesium-137 activity was detected in eight of the twelve samples with a mean concentration for indicator locations of 129.0 pCi/kg and for the control location of 75.5 pCi/kg. The range of results was 44.0 to 201.0 pCi/kg. The location with the highest mean (136.0 pCi/kg) was indicator location D.

Strontium-89 was below the limits of detection in all samples. Strontium-90 activity was indicated in seven of the twelve samples with the results ranging from 7.7 pCi/kg to 21.0 pCi/kg. The average activity for indicator locations was 16.2 pCi/kg and for the control location was 7.7 pCi/kg.

The levels of activity are within the range of activities observed during preoperational monitoring. No plant effect was indicated.

Shoreline Sediment

Shoreline Sediment sample collections were made in May and November, 1990 and analyzed for gamma emitting isotopes. One shoreline sediment sample collected in May from location A showed a positive activity of Cesium-137 (135.0 pCi/kg). There were no gamma emitting nuclides detected in shoreline sediment samples collected in November. Similar levels of activity were observed in 1984, 1985, 1987, 1988 and 1989.

6.2 Airborne Pathway

The airborne pathways of exposure from Callaway Plant were evaluated by analyzing samples of air particulate and air iodine cartridges.

Airborne Particulate

The gross beta activity in airborne particulate ranged from 0.006 to 0.075 pCi/m^3 in all samples. The average gross beta was similar at both indicator locations (0.020 pCi/m^3) and control location (0.019 pCi/m^3). The highest annual average (0.022 pCi/m^3) was measured at indicator location A8, 0.9 miles NNE of the plant.

The airborne particulate sample from location A8 for the collection period ending 02/01/90 showed three times the normal beta activity for this location. Gamma Spectrometry of the filter indicated Cobalt-60 activity of 0.064 pCi/m^3 and Beryllium-7 activity of 0.097 pCi/m^3. An investigation into the Cobalt-60 activity could not determine the origin of the activity; however, we have concluded that this activity was not attributed to plant releases. This conclusion is based on the fact that Callaway Plant plant gaseous effluent samples for this time period did not indicate any Cobalt-60 activity above the detection limit of 1.0E-04 µCi/ml.

Gamma spectral analysis of quarterly composites of air particulate filters showed Beryllium-7 in all samples. The average Beryllium-7 activity for indicator locations was 0.046 pCi/m^3 and for control locations was 0.042 pCi/m^3. The presence of Beryllium-7 can be attributed to cosmic ray activity. Cobalt-60 activity was detected in two samples from indicator locations with a mean concentration of 0.003 pCi/m^3. Cobalt-60 is an activation product and was detected twice in trace amounts so that no firm attribution to a plant release can be made. No other gamma emitting isotopes of interest were detected in the quarterly composites.

The Strontium-89 and Strontium-90 analyses performed on the quarterly composites showed all activities to be below their respective detection limits.

Levels and distribution of activity in the air particulate samples are similar to the previously accumulated data and indicate no influence from the plant.

Airborne Iodine

Airborne Iodine-131 results were below the detection limit of 0.07 pCi/m^3 in all samples. Thus, there was no indication of a plant effect.

6.3 Ingestion Pathway

Potential ingestion pathways of exposure for Callaway Plant were evaluated by analyzing samples of milk, fish, vegetation, and soil.

Milk

A total of thirty-one analyses for Iodine-131 in milk were performed during 1990. All samples were below the LLD which ranged from 0.3 to 0.5 pCi/l.

Naturally occurring Potassium-40 was the only gamma emitting isotope found in milk samples. Concentrations ranged from 770.0 to 1910.0 pCi/l. The average concentration at indicator location (Goats milk) was 1665.4 pCi/l and at control location (cows milk) was 1063.9 pCi/l.

Strontium-89 results were below the LLD for all samples. The LLDs ranged from 0.5 to 1.4 pCi/l. Strontium-90 was detected in all milk samples averaging 5.7 pCi/l at indicator location (Goats milk) and 2.8 pCi/l at control location (Cows milk). The range of detectable results was 1.5 to 7.8 pCi/l.

Calcium was analyzed in all milk samples with levels ranging from 0.64 to 1.18 gm/l. The average calcium concentration at indicator location was 0.84 gm/l and at control location was 0.84 gm/l.

In summary, the milk data for 1990 show no radiological effects of the plant operation, but the presence of Strontium-90 in milk samples does exhibit a long range residual effect of previous atmospheric nuclear tests.

Fish

The types of fish species collected during 1990 were: River Carpsucker, Gizzard Shad, Channel Catfish, Shortnose Gar, Bigmouth Buffalo, Blue catfish, Paddlefish, Longnose Gar, Smallmouth Buffalo, Freshwater Drum, Flathead Catfish, Carp, Shorthead Redhorse, Blue Sucker, Goldeye and White Bass.

Eighty-five of one hundred-eighty samples analyzed for gross alpha showed detectable activity. Concentrations ranged from 27.0 to 209.0 pCi/kg-wet. The mean activity at indicator locations was 92.1 pCi/kg-wet and at the control location was 84.5 pCi/kg-wet.

All fish samples indicated positive gross beta concentrations with the levels ranging from 1990.0 to 3717.0 pCi/kg-wet. The average beta activity in fish was similar for indicator and control locations (2961.1 and 2902.2 pCi/kg-wet, respectively).

Potassium-40 was the only gamma emitting isotope detected. The mean Potassium-40 activity was 2690.0 pCi/kg-wet for the indicator locations and 2695.6 pCi/kg-wet for the control location.

No Strontium-89 activity was detected in the fish samples collected during 1990. Strontium-90 activity was detected in five of the one hundred eighty samples analyzed with results ranging from 1.1 to 6.9 pCi/kg-wet. The mean concentration at the indicator locations was 1.8 pCi/kg-wet and at the control location was 5.0 pCi/kg-wet.

Activities detected in fish samples were consistent with levels and fluctuations of previously accumulated environmental data. The Gross Alpha and Gross Beta activity can be attributed to naturally occurring isotopes (e.g. Potassium-40). The Strontium-90 activity present in some samples can be attributed to worldwide fallout from atmospheric nuclear testing. It therefore can be concluded that the operation of the plant has had no effect on fish samples.

Vegetation

The vegetation samples collected during 1990 consisted of mustard greens, turnip greens, lettuce, cabbage, and spinach.

Gross alpha activity was observed in thirty-three of fifty-four vegetation samples with the results ranging from 37.0 to 872.0 pCi/kg-wet. The average activity for indicator locations was 142.4 pCi/kg-wet and for the control location was 184.6 pCi/kg-wet.

Gross beta activity was detected in all vegetation samples with results ranging from 2129.0 to 8023.0 pCi/kg-wet. The average gross beta activity for indicator locations was 4702.4 pCi/kg-wet and for the control was 4809.9 pCi/kg-wet.

Iodine-131 activity was below the detection limit in all samples.

Naturally occurring Potassium-40 was found in all vegetation samples. Concentrations ranged from 1780.0 to 7845.0 pCi/kg-wet and averaged 4217.8 and 4349.5 pCi/kg-wet at indicator and control locations respectively. All other gamma emitting isotopes were below their detection limit.

None of the vegetation sample results show statistically significant differences between indicator and control locations and the levels of activities were consistent with previously accumulated data. Therefore, no plant effect was indicated.

Soil

Gross alpha results ranged from 9208.0 to 19344.0 pCi/kg for all eleven samples. The mean activity for indicator locations was 13395.0 pCi/kg and for the control location was 11296.0 pCi/kg. Gross beta activity was also detected in all eleven samples ranging from 20265.0 to 25260.0 pCi/kg. The average gross beta activities was 22527.0 and 25260.0 pCi/kg at indicator and control locations respectively.

Gamma Spectral analysis of the soil samples showed Cesium-137 and Potassium-40 in all samples. Cesium-137 results ranged from 510.0 to 2219.0 pCi/kg. The average concentration was 1403.0 pCi/kg at the indicator locations and 510.0 pCi/kg at the control location. Potassium-40 results ranged from 9275.0 to 14420.0 pCi/kg. The average concentration for indicator location was 10424.2 pCi/kg and for control location was 14420.0 pCi/kg.

The Gross Alpha and Gross Beta activity can be attributed to naturally occurring isotopes (e.g. Potassium-40). The Cesium-137 activity present can be attributed to worldwide fallout from atmospheric nuclear testing. The level of activity and distribution pattern is very similar to previously accumulated data and indicate no influence from the plant.

6.4 Direct Radiation

All TLD results present in this report have been normalized to a 90-day quarter (standard quarter) to eliminate the apparent differences in data caused by variations in length of exposure period.

The range of quarterly TLD results for indicator locations was 6.4 to 28.1 mRem/standard quarter and 11.1 to 18.1 mRem/standard quarter for control locations. The quarterly TLD analyses yielded an average exposure level of 16.1 mRem/standard quarter at all indicator locations and an average exposure level of 15.4 mRem/standard quarter at all control locations.

The annual TLD results ranged from 6.1 to 11.1 mRem/standard quarter. The average exposure levels were nearly identical at the indicator locations and control locations (11.3 mRem/standard quarter and 11.0 mRem/standard quarter, respectively).

There was no statistically significant difference between indicator and control locations for the TLD's during 1990. The exposure levels were consistent with previously accumulated data and no plant effects were indicated.

APPENDIX A

1990 LAND USE CENSUS

APPENDIX A

UNION ELECTRIC COMPANY

CALLAWAY PLANT

1990 LAND USE CENSUS

Prepared by Brian F. Hallsness 02-11-91

Approved by [signature] 2/12/91

1. INTRODUCTION

In accordance with Technical Specification 3.12.2, the annual Land Use Census within a 5 mile radius of the Callaway Plant was performed during September, 1990 by the Union Electric Real Estate Department. Observations were made in each of the 16 meteorological sectors of the nearest milking animals (cows and goats) nearest residence, and the nearest garden of greater than 50m² (500 ft²) producing broad leaf vegetation. This census was completed by contacting the families identified in the 1989 census and driving the roads within a 5 mile radius of the Callaway Plant noting the location of the above-mentioned items.

The results of the Land Use Census are presented in Table 1 thru 3 and discussed below. In the tables, the radial direction and mileage from the Callaway Plant containment are presented for each location. The radial direction is one of the 16 different compass points. The mileage was estimated from map position for each location.

2. CENSUS RESULTS

2.1 Milking Animals

Table 1 presents the locations where milking animals were observed within the 5 mile radius of the Callaway Plant. All milking animals, whose milk is not used for human consumption and/or not yielding milk, are identified on Table 1. There were several changes in the location and number of milking animals observed during the 1990 census. However, none of the changes observed resulted in changes to the current milk sampling locations.

2.2 Nearest Resident

Table 2 presents the location of the nearest resident to the Callaway Plant in each of the 16 meteorological sectors. There was one change in the nearest resident noted in the 1990 census. This change was in the WNW radial direction.

2.3 Vegetable Gardens

The location of the nearest vegetable garden of greater than 50m² producing broad leaf vegetation is presented in Table 3. One change was noted in the garden locations during the 1990 census. However, the change noted did not result in changes to the current vegetable sampling locations.

TABLE 1

NEAREST MILKING ANIMALS WITHIN FIVE MILES OF THE CALLAWAY PLANT

1990

Meterological Sector	Radial Mileage	Number of Cows	Number of Goats
ENE	3.80	None	20 *
ESE	2.28	75 *	None
S	2.90	5 **	None
SSW	3.30	38 *	None
WSW	1.35	3 *	None
NW	3.10	4 ***	7 ***

* Milk producing animals whose milk is not used for human consumption and/or for milk producing animals that are not yielding milk.

** Milk from one cow is being used for human consumption.

*** Milk from two milk producing animals is being used for human consumption.

TABLE 2

NEAREST RESIDENCE WITHIN FIVE MILES OF THE CALLAWAY PLANT

1990

Meteorological Sector	Radial Mileage
N	1.76
NNE	2.00
NE	2.00
ENE	3.80
E	3.37
ESE	2.28
SE	2.38
SSE	2.58
S	2.64
SSW	2.60
SW	2.57
WSW	1.35
W	1.60
WNW	2.60
NNW	3.10
NNW	1.78

TABLE 3

NEAREST GARDEN WITHIN FIVE MILES OF THE CALLAWAY PLANT

1990

Meteorological Sector	Radial Mileage
N	1.76
NNE	2.00
NE	2.00
ENE	3.30
E	---
ESE	2.28
SE	---
SSE	---
S	2.64
SSW	---
SW	---
WSW	1.80
W	---
WNW	---
NW	3.10
NNW	1.78

APPENDIX B

EPA CROSS-CHECK RESULTS

1990

TABLE B1

EPA INTERCOMPARISON STUDY RESULTS
1990

SAMPLE TYPE	STUDY DATE	ANALYSIS	TIML RESULTS ± 2σ[a]	EPA RESULTS[b] 1s, N=1	CONTROL LIMITS	UNITS
WATER	JAN 1990	SR-89	22.7 ± 5.0	25.0 ± 5.0	16.3 - 33.7	pCi/l
		SR-90	17.3 ± 1.2	20.0 ± 1.5	17.4 - 22.6	pCi/l[c]
WATER	JAN 1990	GR. ALPHA	10.3 ± 3.0	12.0 ± 5.0	3.3 - 20.7	pCi/l
		GR. BETA	12.3 ± 1.2	12.0 ± 5.0	3.3 - 20.7	pCi/l
WATER	JAN 1990	CO-60	14.7 ± 2.3	15.0 ± 5.0	6.3 - 23.7	pCi/l
		ZN-65	135.0 ± 6.9	139.0 ± 14.0	114.8 - 163.2	pCi/l
		RU-106	133.3 ± 13.4	139.0 ± 14.0	114.8 - 163.2	pCi/l
		CS-134	17.3 ± 1.2	18.0 ± 5.0	9.3 - 26.7	pCi/l
		CS-137	19.3 ± 1.2	18.0 ± 5.0	9.3 - 26.7	pCi/l
		BA-133	78.0 ± 0.0	74.0 ± 7.0	61.9 - 86.1	pCi/l
WATER	FEB 1990	H-3	4827.0 ± 83.0	4976.0 ± 498.0	4113.0 - 5839.0	pCi/l
WATER	MAR 1990	RA-226	5.0 ± 0.2	4.9 ± 0.7	4.1 - 5.7	pCi/l
		RA-228	13.5 ± 0.7	12.7 ± 1.9	9.4 - 16.0	pCi/l
WATER	MAR 1990	U	4.0 ± 0.0	4.0 ± 6.0	0.0 - 14.4	pCi/l
AIR FILTER	MAR 1990	GR. ALPHA	7.3 ± 1.2	5.0 ± 5.0	0.0 - 13.7	pCi/Filter
		GR. BETA	34.0 ± 0.0	31.0 ± 5.0	22.3 - 39.7	pCi/Filter
		SR-90	10.0 ± 0.0	10.0 ± 1.5	7.4 - 12.6	pCi/Filter
		CS-137	9.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7	pCi/Filter
WATER	APR 1990	GR. ALPHA	81.0 ± 3.5	90.0 ± 23.0	50.1 - 129.9	pCi/l
		RA-226	4.9 ± 0.4	5.0 ± 0.8	3.6 - 6.4	pCi/l
		RA-228	10.6 ± 0.3	10.2 ± 1.5	7.6 - 12.8	pCi/l
		U	18.7 ± 3.0	20.0 ± 6.0	9.6 - 30.4	pCi/l
WATER	APR 1990	GR. BETA	51.0 ± 10.1	52.0 ± 5.0	43.3 - 60.7	pCi/l
		SR-89	9.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7	pCi/l
		SR-90	10.3 ± 3.1	10.0 ± 1.5	8.3 - 11.7	pCi/l
		CS-134	16.0 ± 0.0	15.0 ± 5.0	6.3 - 23.7	pCi/l
		CS-137	19.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7	pCi/l
MILK	APR 1990	SR-89	21.7 ± 3.1	23.0 ± 5.0	14.3 - 31.7	pCi/l
		SR-90	21.0 ± 7.0	23.0 ± 5.0	14.3 - 31.7	pCi/l
		I-131	98.7 ± 1.2	99.0 ± 10.0	81.7 - 116.3	pCi/l
		CS-137	26.0 ± 6.0	24.0 ± 5.0	15.3 - 32.7	pCi/l
		K	1300.0 ± 69.2	1550.0 ± 78.0	1414.7 - 1685.3	mg/l[c]

TABLE B1 (Cont.)

EPA INTERCOMPARISON STUDY RESULTS
1990

SAMPLE TYPE	STUDY DATE	ANALYSIS	TIML RESULTS ± 2σ[a]	EPA RESULTS[b] 1s, N=1	CONTROL LIMITS	UNITS
WATER	MAY 1990	SR-89	6.0 ± 2.0	7.0 ± 5.0	0.0 - 15.7	pCi/l
		SR-90	6.7 ± 1.2	7.0 ± 5.0	0.0 - 15.7	pCi/l
WATER	MAY 1990	GR. ALPHA	11.0 ± 2.0	22.0 ± 6.0	11.6 - 32.4	pCi/l[c]
		GR. BETA	12.3 ± 1.2	15.0 ± 5.0	6.3 - 23.7	pCi/l
WATER	JUN 1990	CO-60	25.3 ± 2.3	24.0 ± 5.0	15.3 - 32.7	pCi/l
		ZN-65	155.0 ± 10.6	148.0 ± 15.0	130.6 - 165.4	pCi/l
		RU-106	202.7 ± 17.2	210.0 ± 21.0	173.6 - 246.4	pCi/l
		CS-134	23.7 ± 1.2	24.0 ± 5.0	18.2 - 29.8	pCi/l
		CS-137	27.7 ± 3.1	25.0 ± 5.0	16.3 - 33.7	pCi/l
		BA-133	100.7 ± 8.1	99.0 ± 10.0	81.7 - 116.3	pCi/l
WATER	JUN 1990	H-3	2927.0 ± 306.0	2933.0 ± 358.0	2312.0 - 3554.0	pCi/l
WATER	JUL 1990	RA-226	11.8 ± 0.9	12.1 ± 1.8	9.0 - 15.2	pCi/l
		RA-228	4.1 ± 1.4	5.1 ± 1.3	2.8 - 7.4	pCi/l
WATER	JUL 1990	U	20.3 ± 1.7	20.8 ± 3.0	15.6 - 26.0	pCi/l
WATER	AUG 1990	I-131	43.0 ± 1.2	39.0 ± 6.0	28.6 - 49.4	pCi/l
WATER	AUG 1990	PU-239	10.0 ± 1.7	9.1 ± 0.9	7.5 - 10.7	pCi/l
AIR FILTER	AUG 1990	GR. ALPHA	14.0 ± 0.0	10.0 ± 5.0	1.3 - 18.7	pCi/Filter
		GR. BETA	65.3 ± 1.2	62.0 ± 5.0	53.3 - 70.7	pCi/Filter
		SR-90	19.0 ± 6.9	20.0 ± 5.0	11.3 - 28.7	pCi/Filter
		CS-137	19.0 ± 2.0	20.0 ± 5.0	11.3 - 28.7	pCi/Filter
WATER	SEP 1990	SR-89	9.0 ± 2.0	10.0 ± 5.0	1.3 - 18.7	pCi/l
		SR-90	9.0 ± 2.0	9.0 ± 5.0	0.3 - 17.7	pCi/l
WATER	SEP 1990	GR. ALPHA	8.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7	pCi/l
		GR. BETA	10.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7	pCi/l
MILK	SEP 1990	SR-89	11.7 ± 3.1	16.0 ± 5.0	7.3 - 24.7	pCi/l
		SR-90	15.0 ± 0.0	20.0 ± 5.0	11.3 - 28.7	pCi/l
		I-131	63.0 ± 6.0	58.0 ± 6.0	47.6 - 68.4	pCi/l
		CS-137	20.0 ± 2.0	20.0 ± 5.0	11.3 - 28.7	pCi/l
		K	1673.3 ± 70.2	1700.0 ± 85.0	1552.5 - 1847.5	mg/l

TABLE B1 (Cont.)

EPA INTERCOMPARISON STUDY RESULTS
1990

SAMPLE TYPE	STUDY DATE	ANALYSIS	TIML RESULTS ± 2σ[a]	EPA RESULTS[b] 1s, N=1	CONTROL LIMITS	UNITS
WATER	OCT 1990	CO-60	20.3 ± 3.1	20.0 ± 5.0	11.3 - 28.7	pCi/l
		ZN-65	115.3 ± 12.2	115.0 ± 12.0	94.2 - 135.8	pCi/l
		RU-106	152.0 ± 8.0	151.0 ± 15.0	125.0 - 177.0	pCi/l
		CS-134	11.0 ± 0.0	12.0 ± 5.0	3.3 - 20.7	pCi/l
		CS-137	14.0 ± 2.0	12.0 ± 5.0	3.3 - 20.7	pCi/l
		BA-133	116.7 ± 9.9	110.0 ± 11.0	90.9 - 129.1	pCi/l
WATER	OCT 1990	H-3	7167.0 ± 330.0	7203.0 ± 720.0	5954.0 - 8452.0	pCi/l
WATER	OCT 1990	GR. ALPHA	68.7 ± 7.2	62.0 ± 16.0	34.2 - 89.8	pCi/l
		RA-226	12.9 ± 0.3	13.6 ± 2.0	10.1 - 17.1	pCi/l
		RA-228	4.2 ± 0.6	5.0 ± 1.3	2.7 - 7.3	pCi/l
		U	10.4 ± 0.6	10.2 ± 3.0	5.0 - 15.4	pCi/l
WATER	OCT 1990	GR. BETA	55.0 ± 8.7	53.0 ± 5.0	44.3 - 61.7	pCi/l
		SR-89	15.7 ± 2.9	20.0 ± 5.0	11.3 - 28.7	pCi/l
		SR-90	12.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7	pCi/l
		CS-134	9.0 ± 1.7	7.0 ± 5.0	0.0 - 15.7	pCi/l
		CS-137	7.7 ± 1.2	5.0 ± 5.0	0.0 - 13.7	pCi/l
WATER	NOV 1990	RA-226	6.8 ± 1.0	7.4 ± 1.1	5.5 - 9.3	pCi/l
		RA-228	5.3 ± 1.7	7.7 ± 1.9	4.4 - 11.0	pCi/l
WATER	NOV 1990	U	35.0 ± 0.4	35.5 ± 3.6	29.3 - 41.7	pCi/l

a Unless otherwise indicated, the TIML results are given as the mean ± 2 standard deviations for three determinations.
b EPA results are presented as the known value and expected laboratory precision (1s, 1 determination) and control limits as defined by EPA.
c See Addendum to appendix B for explanation of the reason why the sample results were outside the control limits specified by EPA.

ADDENDUM TO APPENDIX B
1990

SAMPLE TYPE	STUDY DATE	ANALYSIS	EXPLANATION
WATER	JAN 1990	Sr-90	Sample was reanalyzed in triplicate; results of reanalyses 18.8±1.5 pCi/l. No further action is planned.
MILK	APR 1990	K	Sample was reanalyzed in triplicate. Results of reanalyses 1421.7±95.3 mg/l. The cause of low results is unknown.
WATER	MAY 1990	GR. ALPHA	Sample was reanalyzed in triplicate. Results of reanalyses 13.4±1.0 pCi/l. no further action is planned.

APPENDIX C

Isotopic Detection Limits

And

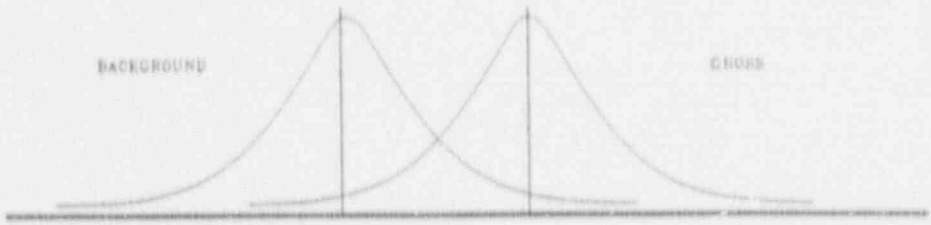
Activity Determinations

Isotopic Detection Limits and Activity Determinations

Making a reasonable estimate of the limits of detection for a counting procedure or a radiochemical method is usually complicated by the presence of significant background.

It must be considered that the background or blank is not a fixed value but that a series of replicates would be normally distributed. The desired net activity is thus the difference between the gross sample activity and background activity distributions.

The interpretation of this difference becomes a problem if the two distributions intersect as indicated in the diagram.



If a sufficient number of replicate analyses are run, it is to be expected that the results would fall in a normal Gaussian distribution. In routine analysis such replication is not carried out. Standard statistics allow an estimate of the probability of any particular deviation from the mean value. It is common practice to report the mean $\pm$ one or two standard deviations as the final result.

Analytical detection limits are governed by a number of factors including:

1. Sample Size

2. Counting Efficiency

   The fundamental quality in the measurement of a radioactive substance is the number of disintegrations per unit time. As with most physical measurements in analytical chemistry, it is seldom possible to make an absolute measurement of the disintegration rate. but rather, it is necessary to compare the sample with one or more standards. The standards determine the counter efficiency which may then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

3. Background Count Rate

Any counter will show a certain counting rate without a sample in position. This background counting rate comes from several sources: 1) natural environmental radiation from the surroundings, 2) cosmic radiation, and 3) the natural radioactivity in the counter material itself. The background counting rate will depend on the amounts of these types of radiation and sensitivity of the counter to the radiation.

4. Background and Sample Counting Time

The amount of time devoted to the counting of the background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample.

5. Time Interval Between Sample Collection and Counting

Decay measurements are useful in identifying certain short-lived isotopes. This disintegration constant is one of the basic characteristics of a specific radionuclide and is readily determined, if the half-life is sufficiently short.

6. Chemical Recovery of the Analytical Procedures

Most radiochemical analyses are carried out in such a way that losses occur during the separations. These losses occur due to a large number of contaminants that may be present and interfere during chemical separations. Thus it is necessary to include a technique for estimating these losses in the development of the analytical procedure.

The following method was used to determine lower limit of detection (LLD) as per NRC Regulatory Guide 4.1, Rev. 1, "Program for Monitoring Radioactivity in the Environs of Nuclear Power Plants", and the NRC Branch Technical Position, November 1979, "An acceptable Radiological Environmental Monitoring Program". The LLD is defined, for purposes of this guide, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 * s_b}{E * V * 2.22 * Y * \exp(-\lambda \Delta t)}$$

WHERE:

LLD = "A prior" lower limit of detection as defined above (as pCi per unit mass or volume).

s_b = Standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute).

E = Counting efficiency (as counts per disintegration).

V = Sample size (in units of mass or volume).

2.22 = Number of disintegrations per minute per picocurie.

Y = Fractional radiochemical yield (when applicable).

λ = Radioactive decay constant for the particular radioisotope.

Δt = Elapsed time between sample collection (or end of the sample collection period and time of counting.

The value of s_b used in the calculation of the LLD for a particular measurement system is based on the actual observed variance of the background counting rate, or, of the counting rate of the blank sample, (as appropriate), rather than on an unverified theoretically predicated variance.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background included the typical contributions of other nuclides normally present in the samples.

Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where x = value of the measurement;

s = 2 counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is found to be below the lower limit to detection L it is reported as

$$<L$$

where L = is the lower limit of detection based on 4.66 uncertainty for a background sample.

Duplicate Analysis

1. Individual result: $x_1 \pm s_1$

$x_2 \pm s_2$

$x \pm s$

Reported result:

where $x = (1/2)(x_1 + x_2)$

$$s = (1/2)\sqrt{s_1^2 + s_2^2}$$

2. Individual results: $<L_1$
$<L_2$

Reported result $<L$

where L = lower of L_1 and L_2

3. Individual results: $x \pm s$
$<L$

Reported result: $x \pm s$ if $x \geq L$;
$<L$ otherwise

Computation of Averages and Standard Deviations

Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average x and standard deviation(s) of a set of n numbers x_1, x_2, ...

x_n are defined as follows:

$$\bar{X} = \frac{1}{n} \Sigma X$$

$$S = \sqrt{\frac{\Sigma (X-\bar{X})^2}{n-1}}$$

Values below the highest lower limit of detection are not included in the average.

If all of the values in the averaging group are less than the highest LLD, the highest LLD is reported.

If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

In rounding off, the following rules are followed:

1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

2. If the figure following those to be retained is greather than 5, the figure is dropped, and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45.

3. If the figure following those to be retained is 5, and if there are not figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an off number or it is kept unchanged if an even number. As an example, 11.435 is rounded off to 11.44, while 11.425 is rounded off to 11.42.

APPENDIX D

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
ANNUAL SUMMARY
1990

APPENDIX D

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Callaway Plant Docket No.: 50-483

Location of Facility: Callaway County, Missouri (county, state) Reporting Period: 1990

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Surface Water (pCi/l)	Gross Alpha (36)	0.7	3.2 (18/24) (1.5 - 5.1)	53.0 mi ESE; 59.5 mi down-stream of discharge	3.3 (7/12) (1.5 - 5.1)	3.1 (8/12) (1.7 - 3.9)	0
	Gross Beta (36)	--	6.6 (24/24) (4.2 - 11.2)	5.2 mi SE; 1.1 mi downstream of discharge	7.2 (12/12) (5.4 - 10.6)	6.5 (12/12) (5.5 - 7.7)	0
	H-3 (36)	176.0	249.9 (7/24) (182.0 - 353.0)	4.8 mi SE; 1.1 ft upstream of discharge	443.2 (4/12) (193.0 - 605.0)	443.2 (4/12) (193.0 - 605.0)	0
	Gamma (36)	--	-- (0/24)	NA	NA	-- (0/12)	0
	Sr-89 (36)	0.5	-- (0/24)	NA	NA	-- (0/12)	0
	Sr-90 (36)	0.4	0.8 (3/24) (0.5 - 1.2)	53.0 mi ESE; 59.5 mi down-stream of discharge	0.8 (2/12) (0.5 - 1.2)	-- (0/12) --	0
Ground Water (pCi/l)	Gross Alpha (35)	1.0	2.1 (17/24) (1.1 - 3.8)	5.1 mi SE; Portland, MO.	2.4 (9/12) (1.1 - 3.4)	1.8 (7/11) (1.3 - 2.5)	0

RADIOLOGICAL ENVIRONMENTAL MONITOPING PROGRAM ANNUAL SUMMARY

Name of Facility: Callaway Plant Docket No.: 50-483

Location of Facility: Callaway County, Missouri (county, state) Reporting Period: 1990

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gross Beta (35)	--	6.3 (24/24) (1.8 - 11.3)	1.0 mi SSE; Onsite well	9.8 (12/12) (6.9 - 11.3)	8.3 (11/11) (6.8 - 9.6)	0
	H-3 (35)	176.0	-- (0/24)	NA	NA	-- (0/12)	0
	Gamma (35)	--	-- (0/24)	NA	NA	-- (0/12)	0
	Sr-89 (35)	0.4	-- (0/24)	NA	NA	-- (0/12)	0
	Sr-90 (35)	0.4	0.7 (2/24) (0.7 - 0.7)	1.0 mi SSE; Onsite well	0.7 (2/12) (0.7 - 0.7)	0.6 (1/11) --	0
Washload Sediment (pCi/kg)	Gross Alpha (12)	--	12658.8 (8/8) (7603.0 - 18630.0)	5.1 mi SE; 1.0 mi downstream of discharge	14692.0 (4/4) 11097.0-18630.0)	12943.0 (4/4) (9002.0 - 15468.0)	0
	Gross Beta (12)	--	23525.4 (8/8) (21091.0 - 25477.0)	4.9 mi SSE; 0.6 mi up-stream of discharge	24644.5 (4/4) 2434.0 - 27478.0)	24644.5 (4/4) (22434.0 - 27478.0)	0

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Callaway Plant Docket No.: 50-483

Location of Facility: Callaway County, Missouri (county, state) Reporting Period: 1990

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gamma (12) Cs-137	99.0	771.8 (4/8) (191.0 - 1199.0)	53.0 mi ESE; 59.5 mi downstream of discharge	983.0 (2/4) (767.0 - 1199.0)	575.0 (1/4) --	0
	Sr-89 (2)	66.3	-- (0/8)	NA	NA	-- (0/1)	0
	Sr-90 (2)	58.2	55.4 (5/8) (37.2 - 81.5)	5.1 mi SE; 1.0 mi downstream of discharge	64.7 (2/4) (47.9 - 81.5)	76.2 (2/4) (55.0 - 97.5)	0
Bedload Sediment (pCi/kg)	Gross Alpha (12)	12575.0	11250.3 (7/8) (6893.0 - 15118.0)	4.9 mi SSE; 0.6 mi upstream of discharge	13466.5 (4/4) (9416.0 - 18951.0)	13466.5 (4/4) (9416.0 - 18951.0)	0
	Gross Beta (12)	--	22010.9 (8/8) (16518.0 - 26346.0)	5.1 mi SE; 1.0 mi downstream of discharge	23790.2 (4/4) 21115.0-26346.0)	19652.2 (4/4) (17560.0 - 22002.0)	0
	Gamma (12) Mn-54	37.0	59.0 (1/8) --	5.1 mi SE; 1.0 mi downstream of discharge	59.0 (1/4) --	-- (0/4)	0

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Callaway Plant Docket No.: 50-483

Location of Facility: Callaway County, Missouri (county, state) Reporting Period: 1990

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Cs-137	65.0	183.2 (4/8) (113.0 - 232.0)	4.9 mi SSE; 0.6 mi up-stream of discharge	450.7 (3/4) (176.0 - 630.0)	450.7 (3/4) (176.0 - 630.0)	0
	Sr-89 (6)	8.2	-- (0/8)	NA	NA	-- (0/4)	0
	Sr-90 (5)	19.7	23.69 (6/8) (11.5 - 40.8)	5.1 mi SE; 1.0 mi downstream of discharge	25.9 (3/4) (11.5 - 40.8)	-- (0/4)	0
Bottom Sediment (pCi/kg)	Gross Alpha (12)	--	11467.9 (8/8) (5745.0 - 17062.0)	53.0 mi ESE; 59.5 mi down-stream of discharge	13891.0 (4/4) 11738.0-17062.0)	6303.5 (4/4) (4793.0 - 7245.0)	0
	Gross Beta (12)	--	20330.0 (8/8) (16808.0 - 24457.0)	53.0 mi ESE; 59.5 mi down-stream of discharge	21129.8 (4/4) 16808.0-24457.0)	17632.2 (4/4) (12111.0 - 21788.0)	0

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Location of Facility: Callaway County, Missouri (county, state) Reporting Period: 1990

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gamma (12) Cs-137	22.0	129.7 (6/8) (44.0 - 201.0)	53.0 mi ESE; 59.5 mi down-stream of discharge	136.0 (3/4) (127.0 - 150.0)	75.5 (2/4) (74.0 - 77.0)	0
	Sr-89 (12)	10.4	-- (0/8)	NA	NA	-- (0/4)	0
	Sr-90 (12)	8.3	16.2 (6/8) (8.4 - 21.0)	53.0 mi ESE; 59.5 mi down-stream of discharge	17.2 (4/4) (9.3 - 21.0)	7.7 (1/4) --	0
Shoreline Sediment (pCi/kg)	Gamma (4) Cs-137	32.0	-- (0/2) --	4.9 mi SSE; 0.6 mi up-stream of discharge	135.0 (1/2) --	135.0 (1/2) --	0
Airborne Particulate (pCi/m³)	Gross Beta (257)	0.010	0.020 (202/205) (0.006 - 0.075)	0.9 mi NNE; Alternate Assembly Area	0.022 (51/52) (0.011 - 0.075)	0.019 (51/52) (0.009 - 0.039)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gamma (20) Be-7	--	0.046 (16/16) (0.037 - 0.063)	0.9 mi NNE; Alternate Assembly Area	0.053 (4/4) 0.038 - 0.063)	0.042 (4/4) (0.034 - 0.050)	0
	Co-60	--	0.003 (2/16) (0.002 - 0.005)	0.9 mi NNE; Alternate Assembly Area	0.005 (1/4) --	-- (0/4)	0
	Sr-89 (20)	0.0002	-- (0/16)	NA	NA	-- (0/4)	0
	Sr-90 (20)	0.0002	-- (0/16)	NA	NA	-- (0/4)	0
Airborne Iodine (pCi/m³)	I-131 (257)	0.007	-- (0/205)	NA	NA	-- (0/52)	0
Milk (pCi/l)	I-131 (31)	0.3	-- (0/13)	NA	NA	-- (0/18)	0
	Gamma (31) K-40		1665.4 (13/13) (1470.0 - 1910.0)	3.1 mi NW; Goats milk Schneiders farm	1665.4 (13/13) (1470.0 - 1910.0)	1063.9 (18/18) (770.0 - 1280.0)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Sr-89 (31)	0.5	-- (0/13)	NA	NA	-- (0/18)	0
	Sr-90 (31)	--	5.7 (13/13) (3.3 - 7.8)	3.1 mi NW; Goats milk Schneiders farm	5.7 (13/13) (3.3 - 7.8)	2.8 (18/18) (1.5 - 5.1)	0
(grams/liter)	Ca (31)	--	0.84 (13/13) (0.73 - 1.00)	12.3 mi WSW; Cows milk Green's farm	0.84 (18/18) (0.64 - 1.18)	0.84 (18/18) (0.54 - 1.18)	0
Fish (pCi/kg - wet)	Gross Alpha (180)	19.0	92.1 (63/120) (27.0 - 209.0)	5.1 mi SE; 1.0 mi downstream of discharge	94.8 (34/60) (27.0 - 209.0)	84.5 (22/60) (48.0 - 162.0)	0
	Gross Beta (180)	--	2961.1 (120/120) (1999.0 - 3717.0)	5.1 mi SE; 1.0 mi downstream of discharge	2975.2 (60/60) (1999.0 - 3717.0)	2902.2 (60/60) (2109.0 - 3478.0)	0
	Gamma (180) K-40	--	2690.5 (120/120) (1611.0 - 3357.0)	4.9 mi SSE; 0.6 mi up-stream of discharge	2695.6 (60/60) (1697.0 - 3353.0)	2695.6 (60/60) (1697.0 - 3353.0)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Sr-89 (180)	1.1	-- (0/109)	NA	NA	-- (0/60)	0
	Sr-90 (180)	0.9	1.8 (3/120) (1.1 - 2.6)	4.9 mi SSE; 0.6 mi up-stream of discharge	5.0 (2/60) (3.1 - 6.9)	5.0 (2/60) (3.1 - 6.9)	0
Vegetation (pCi/kg - wet)	Gross Alpha (44)	24.0	142.4 (20/25) (66.0 - 274.0)	15.0 mi SW; Beazley farm	184.6 (13/19) (37.0 - 872.0)	184.6 (13/19) (37.0 - 872.0)	0
	Gross Beta (44)	--	4702.4 (25/25) (2576.0 - 8023.0)	1.8 mi N; Meehan farm	4892.1 (15/15) (2576.0 - 8023.0)	4809.0 (19/19) (2129.0 - 7888.0)	0
	I-131 (44)	3.8	-- (0/29)	NA	NA	-- (0/22)	0
	Gamma (44) K-40	--	4217.8 (25/25) (2070.0 - 6240.0)	1.8 mi NNW; Becker farm	4539.0 (10/10) (3480.0 - 5420.0)	4349.5 (19/19) (1780.0 - 7845.0)	0
Soil (pCi/kg)	Gross Alpha (11)	--	13395.0 (10/10) (9208.0 - 19344.0)	1.89 mi NE; Prairie ecology plot PR5	19344.0 (1/1) --	11296.0 (1/1) --	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gross Beta (11)	--	22527.6 (10/10) (20265.0 - 24654.0)	15.0 mi SW; Beazley farm	25260.0 (1/1) --	25260.0 (1/1) --	0
	Gamma (11) K-40	--	10424.2 (10/10) (9275.0 - 11490.0)	15.0 mi SW; Beazley farm	14420.0 (1/1) --	14420.0 (1/1) --	0
	Cs-137	--	1403.0 (10/10) (586.0 - 2219.0)	1.72 mi NE; Forest ecology plot F6	2219.0 (1/1) --	510.0 (1/1) --	0
Direct Radiation (mRem/Standard Quarter)	Quarterly TLDs (206)	10	16.1 (198/198) (6.4 - 28.1)	3.3 mi SE; 2.0 mi N of HWY 94 on county road 469	20.9 (4/4) (12.9 - 28.1)	15.4 (8/8) (11.1 - 18.1)	0
	Annual TLDs (50)	10	11.3 (48/48) (6.1 - 13.1)	5.6 mi ESE; 0.75 mi E of HWY D on HWY 94	13.1 (1/1) --	11.0 (2/2) (10.9 - 11.1)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION[1] (LLD)	ALL INDICATOR LOCATIONS MEAN (f)[2] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS

(1) The LLDs quoted are the lowest actual LLD obtained in the various media during the reporting period. The required LLDs for radiological environmental sample analysis is found in Table III. Where all nuclides were LLD for a specific media, no LLD was listed.

(2) Mean and range are based upon detectable measurements only. Fraction of detectable measurements is indicated in parentheses.

APPENDIX E

DATA TABLES

1990

APPENDIX E

LIST OF TABLES

Definition of the term used in the data tables are as follows:

Wet Weight	A reporting unit used with organic tissue samples such as vegetation and animal samples in which the amount of sample is taken to be the weight as received from the field with no moisture removed.
Dry Weight	A reporting unit used for soil and sediment in which the amount of sample is taken to be the weight of the sample after removal of moisture by drying in an oven.
pCi/m^3	A reporting unit used with air particulate and radioiodine data which refers to the radioactivity content expressed in picocuries per cubic meter of air passed through the filter and/or the charcoal trap. Note that the volume is not corrected to standard conditions.
Gamma Emitters or Gamma Isotopic	Samples were analyzed by high resolution (GeLi) gamma spectrometry. The resulting spectrum is analyzed by a computer program which scans from about 50 to 2000 KeV and lists the energy peaks of any nuclides present in concentrations exceeding the sensitivity limits set for that particular experiement.
Error Terms	Figures following " $\pm$ " are error terms based on counting uncertainties at the 95 percent confidence level. Values preceded by the "<" symbol were below the stated concentration at the 99 percent confidence level.
Sensitivity	In general, all analyses meet the sensitivity requirements of the program as given in Table 3.1. For the few samples that do not (because of inadequate sample quantities, analytical interference, etc.) the sensitivity actually obtained in the analysis is given.

TABLE E1

AIRBORNE IODINE-131 and GROSS BETA in AIR PARTICULATE FILTERS (pCi/m^3)
1990

COLLECTION DATE	CA-API-A1 Vol. (M^3)	CA-API-A1 GROSS BETA	CA-API-A1 I-131	CA-API-A7 Vol. (M^3)	CA-API-A7 GROSS BETA	CA-API-A7 I-131	CA-API-A8 Vol. (M^3)	CA-API-A8 GROSS BETA	CA-API-A8 I-131	CA-API-A9 Vol. (M^3)	CA-API-A9 GROSS BETA	CA-API-A9 I-131	CA-API-B3 Vol. (M^3)	CA-API-B3 GROSS BETA	CA-API-B3 I-131
01/04/90	418	0.025 ± 0.003	<0.070	433	0.025 ± 0.003	<0.070	426	0.029 ± 0.003	<0.070	418	0.027 ± 0.003	<0.070	421	0.026 ± 0.003	<0.070
01/11/90	426	0.017 ± 0.003	<0.070	423	0.026 ± 0.003	<0.070	426	0.032 ± 0.004	<0.070	428	0.029 ± 0.003	<0.070	428	0.010 ± 0.003	<0.070
01/18/90	428	0.015 ± 0.002	<0.070	426	0.016 ± 0.002	<0.070	428	0.019 ± 0.002	<0.070	428	0.015 ± 0.002	<0.070	428	0.010 ± 0.002	<0.070
01/25/90	431	0.021 ± 0.002	<0.070	436	0.024 ± 0.003	<0.070	428	0.026 ± 0.003	<0.070	428	0.024 ± 0.003	<0.070	433	0.023 ± 0.003	<0.070
02/01/90	426	0.017 ± 0.002	<0.070	423	0.020 ± 0.002	<0.070	433	0.025 ± 0.003	<0.070	431	0.020 ± 0.002	<0.070	426	0.018 ± 0.002	<0.070
02/08/90	431	0.012 ± 0.002	<0.070	431	0.016 ± 0.002	<0.070	428	0.022 ± 0.003	<0.070	431	0.019 ± 0.002	<0.070	431	0.015 ± 0.002	<0.070
02/15/90	428	0.010 ± 0.002	<0.070	426	0.013 ± 0.002	<0.070	428	0.014 ± 0.002	<0.070	426	0.012 ± 0.002	<0.070	428	0.009 ± 0.001	<0.070
02/22/90	428	0.018 ± 0.002	<0.070	426	0.024 ± 0.003	<0.070	426	0.026 ± 0.003	<0.070	426	0.022 ± 0.002	<0.070	428	0.018 ± 0.002	<0.070
03/02/90	489	0.008 ± 0.002	<0.070	489	0.023 ± 0.002	<0.070	489	0.019 ± 0.002	<0.070	489	0.014 ± 0.002	<0.070	489	0.019 ± 0.002	<0.070
03/08/90	375	0.018 ± 0.003	<0.070	371	0.024 ± 0.003	<0.070	375	0.018 ± 0.003	<0.070	371	0.024 ± 0.003	<0.070	373	0.013 ± 0.003	<0.070
03/16/90	479	0.012 ± 0.002	<0.070	487	0.012 ± 0.002	<0.070	482	0.016 ± 0.003	<0.070	485	0.013 ± 0.002	<0.070	482	0.010 ± 0.002	<0.070
03/22/90	367	0.014 ± 0.003	<0.070	367	0.017 ± 0.003	<0.070	370	0.029 ± 0.004	<0.070	370	0.017 ± 0.003	<0.070	370	0.019 ± 0.003	<0.070
03/29/90	426	0.015 ± 0.002	<0.070	426	0.022 ± 0.002	<0.070	426	0.026 ± 0.002	<0.070	423	0.027 ± 0.002	<0.070	426	0.019 ± 0.002	<0.070
04/05/90	428	0.011 ± 0.002	<0.070	410	0.014 ± 0.002	<0.070	426	0.019 ± 0.002	<0.070	423	0.014 ± 0.002	<0.070	423	0.014 ± 0.002	<0.070
04/12/90	431	0.015 ± 0.003	<0.070	446	0.022 ± 0.003	<0.070	436	0.024 ± 0.003	<0.070	433	0.025 ± 0.003	<0.070	433	0.019 ± 0.003	<0.070
04/19/90	428	0.011 ± 0.002	<0.070	428	0.022 ± 0.003	<0.070	426	0.023 ± 0.003	<0.070	428	0.032 ± 0.003	<0.070	428	0.021 ± 0.003	<0.070
04/26/90	423	0.019 ± 0.003	<0.070	426	0.039 ± 0.004	<0.070	423	0.023 ± 0.003	<0.070	425	0.021 ± 0.003	<0.070	425	0.021 ± 0.003	<0.070
05/04/90	331	0.018 ± 0.003	<0.070	496	0.013 ± 0.002	<0.070	498	0.017 ± 0.002	<0.070	496	0.017 ± 0.002	<0.070	497	0.017 ± 0.002	<0.070
05/10/90	362	0.024 ± 0.003	<0.070	361	0.017 ± 0.003	<0.070	361	0.019 ± 0.003	<0.070	359	0.018 ± 0.003	<0.070	360	0.020 ± 0.003	<0.070
05/17/90	426	0.007 ± 0.002	<0.070	421	0.013 ± 0.002	<0.070	423	0.013 ± 0.002	<0.070	426	0.010 ± 0.002	<0.070	421	0.012 ± 0.002	<0.070
05/24/90	433	0.013 ± 0.002	<0.070	431	0.014 ± 0.002	<0.070	433	0.012 ± 0.002	<0.070	433	0.012 ± 0.002	<0.070	433	0.014 ± 0.002	<0.070
06/01/90	489	0.016 ± 0.002	<0.070	89	<0.010	<0.070	489	0.017 ± 0.002	<0.070	489	0.011 ± 0.002	<0.007	489	0.011 ± 0.002	<0.070
06/07/90	370	0.013 ± 0.002	<0.070	367	0.009 ± 0.002	<0.070	367	0.011 ± 0.002	<0.070	370	0.012 ± 0.002	<0.070	367	0.014 ± 0.002	<0.070
06/14/90	421	0.006 ± 0.002	<0.070	423	0.015 ± 0.003	<0.070	421	0.017 ± 0.003	<0.070	423	0.014 ± 0.003	<0.070	426	0.013 ± 0.003	<0.070
06/21/90	433	0.018 ± 0.002	<0.070	426	0.014 ± 0.002	<0.070	426	0.015 ± 0.002	<0.070	428	0.013 ± 0.002	<0.070	423	0.014 ± 0.002	<0.070
06/28/90	428	0.019 ± 0.002	<0.070	428	0.018 ± 0.002	<0.070	428	0.017 ± 0.002	<0.070	426	0.014 ± 0.002	<0.070	426	0.017 ± 0.002	<0.070

Notes:

TABLE E1 (Cont.)

AIRBORNE IODINE-131 and GROSS BETA in AIR PARTICULATE FILTERS (pCi/m^3)
1990

COLLECTION DATE	CA-API-A1 Vol. (M^3)	CA-API-A1 GROSS BETA	CA-API-A1 I-131	CA-API-A7 Vol. (M^3)	CA-API-A7 GROSS BETA	CA-API-A7 I-131	CA-API-A8 Vol. (M^3)	CA-API-A8 GROSS BETA	CA-API-A8 I-131	CA-API-A9 Vol. (M^3)	CA-API-A9 GROSS BETA	CA-API-A9 I-131	CA-API-B3 Vol. (M^3)	CA-API-B3 GROSS BETA	CA-API-B3 I-131
07/05/90	428	0.026 ± 0.003	<0.070	431	0.024 ± 0.003	<0.070	426	0.026 ± 0.003	<0.070	433	0.024 ± 0.002	<0.070	423	0.016 ± 0.002	<0.070
07/12/90	426	0.017 ± 0.002	<0.070	428	0.017 ± 0.002	<0.070	426	0.020 ± 0.002	<0.070	423	0.017 ± 0.002	<0.070	438	0.017 ± 0.002	<0.070
07/19/90	428	0.020 ± 0.002	<0.070	426	0.012 ± 0.002	<0.070	426	0.017 ± 0.002	<0.070	428	0.016 ± 0.002	<0.070	428	0.015 ± 0.002	<0.070
07/26/90	423	0.017 ± 0.002	<0.070	438	0.013 ± 0.002	<0.070	438	0.011 ± 0.002	<0.070	438	0.014 ± 0.002	<0.070	438	0.015 ± 0.002	<0.070
08/02/90	410	0.030 ± 0.003	<0.070	423	0.014 ± 0.002	<0.070	418	0.025 ± 0.003	<0.070	418	0.024 ± 0.003	<0.070	418	0.016 ± 0.003	<0.070
08/09/90	430	0.015 ± 0.003	<0.070	427	0.014 ± 0.003	<0.070	433	0.016 ± 0.003	<0.070	430	0.012 ± 0.002	<0.070	432	0.012 ± 0.002	<0.070
08/16/90	307	0.027 ± 0.003	<0.070	433	0.019 ± 0.002	<0.070	431	0.025 ± 0.003	<0.070	433	0.017 ± 0.002	<0.070	428	0.022 ± 0.002	<0.070
08/24/90	0	ND	ND	479	0.012 ± 0.002	<0.070	482	0.015 ± 0.002	<0.070	482	0.014 ± 0.002	<0.070	484	0.012 ± 0.002	<0.070
08/30/90	0	ND	ND	375	0.024 ± 0.003	<0.070	372	0.031 ± 0.003	<0.070	372	0.020 ± 0.003	<0.070	372	0.020 ± 0.003	<0.070
09/06/90	0	ND	ND	428	0.025 ± 0.003	<0.070	428	0.033 ± 0.003	<0.070	426	0.022 ± 0.003	<0.070	426	0.017 ± 0.002	<0.070
09/13/90	48	0.048 ± 0.015	<0.080 [1]	423	0.026 ± 0.003	<0.070	423	0.031 ± 0.003	<0.070	423	0.023 ± 0.002	<0.070	423	0.021 ± 0.002	<0.070
09/20/90	436	0.021 ± 0.002	<0.070	433	0.014 ± 0.002	<0.070	433	0.020 ± 0.002	<0.070	438	0.016 ± 0.002	<0.070	436	0.021 ± 0.002	<0.070
09/27/90	421	0.020 ± 0.002	<0.070	423	0.022 ± 0.002	<0.070	423	0.026 ± 0.003	<0.070	421	0.020 ± 0.002	<0.070	421	0.017 ± 0.002	<0.070
10/04/90	428	0.039 ± 0.004	<0.070	433	0.031 ± 0.003	<0.070	431	0.025 ± 0.003	<0.070	431	0.027 ± 0.003	<0.070	433	0.025 ± 0.003	<0.070
10/11/90	431	0.014 ± 0.002	<0.070	431	0.014 ± 0.002	<0.070	431	0.016 ± 0.002	<0.070	433	0.012 ± 0.002	<0.070	431	0.012 ± 0.002	<0.070
10/18/90	421	0.029 ± 0.003	<0.070	421	0.030 ± 0.003	<0.070	423	<0.003	<0.070	423	0.024 ± 0.003	<0.070	421	0.021 ± 0.003	<0.070
10/25/90	428	0.026 ± 0.003	<0.070	428	0.022 ± 0.003	<0.070	428	0.016 ± 0.002	<0.070	428	0.020 ± 0.003	<0.070	428	0.016 ± 0.002	<0.070
11/01/90	431	0.029 ± 0.003	<0.070	431	0.024 ± 0.003	<0.070	431	0.021 ± 0.003	<0.070	431	0.022 ± 0.003	<0.070	431	0.027 ± 0.003	<0.070
11/08/90	431	0.027 ± 0.003	<0.070	431	0.022 ± 0.002	<0.070	431	0.017 ± 0.002	<0.070	428	0.015 ± 0.002	<0.070	431	0.023 ± 0.003	<0.070
11/15/90	431	0.038 ± 0.003	<0.070	431	0.035 ± 0.003	<0.070	431	0.024 ± 0.003	<0.070	431	0.033 ± 0.003	<0.070	431	0.035 ± 0.003	<0.070
11/23/90	489	0.027 ± 0.002	<0.070	487	0.024 ± 0.002	<0.070	489	0.017 ± 0.002	<0.070	492	0.024 ± 0.002	<0.070	489	0.026 ± 0.002	<0.070
11/29/90	367	0.027 ± 0.003	<0.070	364	0.023 ± 0.003	<0.070	364	0.016 ± 0.003	<0.070	364	0.017 ± 0.003	<0.070	367	0.023 ± 0.003	<0.070
12/07/90	0	ND	ND	487	0.012 ± 0.002	<0.070	489	0.016 ± 0.002	<0.070	489	0.019 ± 0.002	<0.070	489	0.020 ± 0.002	<0.070
12/13/90	3	<0.460	<1.610 [1]	367	0.015 ± 0.003	<0.070	367	0.020 ± 0.003	<0.070	367	0.022 ± 0.003	<0.070	364	0.024 ± 0.003	<0.070
12/20/90	451	0.035 ± 0.003	<0.070	433	0.016 ± 0.002	<0.070	428	0.025 ± 0.003	<0.070	433	0.032 ± 0.003	<0.070	436	0.031 ± 0.003	<0.070
12/27/90	428	<0.003	<0.070	428	0.011 ± 0.002	<0.070	428	0.047 ± 0.004	<0.070	426	0.040 ± 0.003	<0.070	423	0.042 ± 0.004	<0.070

Notes: 1. LLD was not achived. See section 2.3 for explination.

2. ND = No Data. See section 2.3 for explination.

TABLE E2

AIRBORNE PARTICULATE - QUARTERLY COMPOSITES (pCi/m^3)
1990

JANUARY - MARCH 1990

Analysis	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5552	5564	5565	5554	5563
Sr-89	<0.0004	<0.0004	<0.0004	<0.0005	<0.0005
Sr-90	<0.0003	<0.0003	<0.0002	<0.0003	<0.0003
Be-7	0.0390 ± 0.0070	0.0500 ± 0.0060	0.0630 ± 0.0100	0.0440 ± 0.0060	0.0370 ± 0.0060
Co-58	<0.0006	<0.0005	<0.0009	<0.0005	<0.0003
Co-60	<0.0005	<0.0004	0.0050 ± 0.0010	<0.0004	<0.0006
Zr-95	<0.0012	<0.0009	<0.0016	<0.0009	<0.0013
Cs-134	<0.0005	<0.0003	<0.0007	<0.0003	<0.0005
Cs-137	<0.0006	<0.0003	<0.0007	<0.0005	<0.0006
Ba-La-140	<0.0012	<0.0008	<0.0011	<0.0007	<0.0012
Ce-144	<0.0028	<0.0014	<0.0030	<0.0006	<0.0016

APRIL - JUNE 1990

Analysis	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5403	5152	5557	5559	5551
Sr-89	<0.0005	<0.0005	<0.0005	<0.0006	<0.0014
Sr-90	<0.0003	<0.0002	<0.0002	<0.0003	<0.0006
Be-7	0.0480 ± 0.0070	0.0460 ± 0.0090	0.0600 ± 0.0110	0.0500 ± 0.0120	0.0540 ± 0.0070
Co-58	<0.0008	<0.0010	<0.0008	<0.0008	<0.0007
Co-60	<0.0007	<0.0011	<0.0005	0.0028 ± 0.0013	<0.0006
Zr-95	<0.0009	<0.0014	<0.0013	<0.0016	<0.0013
Cs-134	<0.0005	<0.0005	<0.0007	<0.0007	<0.0005
Cs-137	<0.0004	<0.0003	<0.0007	<0.0010	<0.0006
Ba-La-140	<0.0012	<0.0012	<0.0021	<0.0012	<0.0016
Ce-144	<0.0029	<0.0023	<0.0043	<0.0041	<0.0021

Notes:

TABLE E2 (Cont.)

AIRBORNE PARTICULATE - QUARTERLY COMPOSITES (pCi/m^3)
1990

JULY - SEPTEMBER 1990

Analysis	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	3757	5567	5559	5565	5567
Sr-89	<0.0004	<0.0003	<0.0003	<0.0004	<0.0003
Sr-90	<0.0003	<0.0002	<0.0002	<0.0002	<0.0002
Be-7	0.0560 ± 0.0090	0.0390 ± 0.0070	0.0510 ± 0.0080	0.0420 ± 0.0080	0.0400 ± 0.0110
Co-58	<0.0012	<0.0011	<0.0008	<0.0007	<0.0012
Co-60	<0.0012	<0.0008	<0.0006	<0.0006	<0.0009
Zr-95	<0.0019	<0.0022	<0.0012	<0.0014	<0.0023
Cs-134	<0.0010	<0.0007	<0.0005	<0.0004	<0.0007
Cs-137	<0.0010	<0.0010	<0.0007	<0.0006	<0.0007
Ba-La-140	<0.0026	<0.0019	<0.0020	<0.0021	<0.0018
Ce-144	<0.0047	<0.0050	<0.0029	<0.0016	<0.0038

OCTOBER - DECEMBER 1990

Analysis	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5162	6000	6002	6007	6005
Sr-89	<0.0003	<0.0002	<0.0002	<0.0002	<0.0002
Sr-90	<0.0003	<0.0002	<0.0002	<0.0002	<0.0002
Be-7	0.0380 ± 0.0100	0.0340 ± 0.0070	0.0380 ± 0.0050	0.0460 ± 0.0009	0.0450 ± 0.0012
Co-58	<0.0011	<0.0010	<0.0005	<0.0010	<0.0010
Co-60	<0.0011	<0.0009	<0.0005	<0.0009	<0.0009
Zr-95	<0.0016	<0.0016	<0.0010	<0.0019	<0.0013
Cs-134	<0.0006	<0.0006	<0.0004	<0.0007	<0.0007
Cs-137	<0.0007	<0.0010	<0.0005	<0.0008	<0.0008
Ba-La-140	<0.0016	<0.0016	<0.0011	<0.0020	<0.0014
Ce-144	<0.0040	<0.0029	<0.0023	<0.0042	<0.0041

Notes:

TABLE E3

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (01/09/90)	CA-MLK-M5B (01/09/90)
I-131	<0.4	ND
Sr-89	<0.7	ND
Sr-90	1.5 ± 0.5	ND
K-40	1040.0 ± 80.0	ND
Zn-65	<8.2	ND
Cs-134	<3.2	ND
Cs-137	<3.8	ND
Ba-La-140	<14.9	ND
Ca (g/l)	0.77	ND

Analysis	CA-MLK-M1 (02/13/90)	CA-MLK-M5B (02/13/90)
I-131	<0.4	ND
Sr-89	<0.8	ND
Sr-90	1.8 ± 0.6	ND
K-40	1140.0 ± 130.0	ND
Zn-65	<14.3	ND
Cs-134	<5.2	ND
Cs-137	<6.5	ND
Ba-La-140	<5.8	ND
Ca (g/l)	0.84	ND

Notes:
ND = No Data. See section 8.0 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (03/13/90)	CA-MLK-M5B (03/13/90)
I-131	<0.3	ND
Sr-89	<0.7	ND
Sr-90	2.2 ± 0.5	ND
K-40	890.0 ± 120.0	ND
Zn-65	<8.3	ND
Cs-134	<4.4	ND
Cs-137	<5.6	ND
Ba-La-140	<4.2	ND
Ca (g/l)	0.77	ND

Analysis	CA-MLK-M1 (04/10/90)	CA-MLK-M5B (04/09/90)
I-131	<0.3	<0.3
Sr-89	<1.0	<0.7
Sr-90	1.7 ± 0.7	3.6 ± 0.8
K-40	1010.0 ± 120.0	1470.0 ± 110.0
Zn-65	<13.0	<9.7
Cs-134	<4.0	<3.3
Cs-137	<5.0	<4.5
Ba-La-140	<2.2	<3.2
Ca (g/l)	0.78	0.83

Notes:
ND = No Data. See section 8.0 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (04/24/90)	CA-MLK-M5B (04/23/90)
I-131	<0.4	<0.4
Sr-89	<0.8	<0.7
Sr-90	1.9 ± 0.7	7.8 ± 1.2
K-40	860.0 ± 110.0	1470.0 ± 110.0
Zn-65	<14.3	<12.9
Cs-134	<5.2	<5.1
Cs-137	<6.2	<4.7
Ba-La-140	<6.8	<6.2
Ca (g/l)	0.82	0.86

Analysis	CA-MLK-M1 (05/07/90)	CA-MLK-M5B (05/07/90)
I-131	<0.4	<0.5
Sr-89	<0.7	<0.8
Sr-90	2.4 ± 0.5	7.0 ± 1.1
K-40	1030.0 ± 70.0	1510.0 ± 130.0
Zn-65	<11.3	<10.4
Cs-134	<3.7	<5.2
Cs-137	<5.3	<5.3
Ba-La-140	<2.5	<5.2
Ca (g/l)	0.79	0.84

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (05/22/90)	CA-MLK-M5B (05/22/90)
I-131	<0.4	<0.5
Sr-89	<1.0	<0.9
Sr-90	2.0 ± 0.8	5.3 ± 1.0
K-40	1110.0 ± 90.0	1500.0 ± 110.0
Zn-65	<7.6	<12.3
Cs-134	<3.4	<4.3
Cs-137	<4.2	<5.2
Ba-La-140	<2.5	<3.1
Ca (g/l)	0.82	1.00

Analysis	CA-MLK-M1 (06/12/90)	CA-MLK-M5B (06/12/90)
I-131	<0.5	<0.4
Sr-89	<0.6	<0.9
Sr-90	1.8 ± 0.5	6.4 ± 1.2
K-40	1040.0 ± 80.0	1530.0 ± 130.0
Zn-65	<10.0	<10.1
Cs-134	<3.2	<5.2
Cs-137	<4.9	<5.3
Ba-La-140	<2.7	<5.8
Ca (g/l)	0.64	0.75

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (06/26/90)	CA-MLK-M5B (06/24/90)
I-131	<0.3	<0.3
Sr-89	<0.9	<0.7
Sr-90	2.8 ± 0.9	5.6 ± 1.0
K-40	1080.0 ± 130.0	1780.0 ± 160.0
Zn-65	<12.6	<13.6
Cs-134	<3.7	<4.4
Cs-137	<4.8	<7.4
Ba-La-140	<3.5	<4.0
Ca (g/l)	0.76	0.76

Analysis	CA-MLK-M1 (07/10/90)	CA-MLK-M5B (07/10/90)
I-131	<0.4	<0.4
Sr-89	<0.6	<0.5
Sr-90	4.4 ± 0.7	6.0 ± 0.7
K-40	950.0 ± 100.0	1910.0 ± 170.0
Zn-65	<9.2	<16.0
Cs-134	<3.8	<4.6
Cs-137	<5.1	<7.2
Ba-La-140	<2.8	<5.7
Ca (g/l)	0.79	0.73

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (07/24/90)	CA-MLK-M5B (07/24/90)
I-131	<0.3	<0.3
Sr-89	<0.6	<0.8
Sr-90	5.1 ± 0.6	6.6 ± 1.2
K-40	950.0 ± 110.0	1690.0 ± 130.0
Zn-65	<13.8	<14.7
Cs-134	<5.3	<5.3
Cs-137	<5.6	<5.0
Ba-La-140	<6.2	<4.8
Ca (g/l)	0.84	0.83

Analysis	CA-MLK-M1 (08/14/90)	CA-MLK-M5B (08/12/90)
I-131	<0.3	<0.4
Sr-89	<0.5	<0.8
Sr-90	4.7 ± 0.6	5.9 ± 0.9
K-40	770.0 ± 120.0	1670.0 ± 160.0
Zn-65	<8.4	<23.4
Cs-134	<4.3	<8.9
Cs-137	<5.6	<10.1
Ba-La-140	<3.4	<7.0
Ca (g/l)	1.18	0.91

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (08/28/90)	CA-MLK-M5B (08/28/90)
I-131	<0.4	<0.4
Sr-89	<0.5	<0.5
Sr-90	2.6 ± 0.5	6.7 ± 0.7
K-40	1190.0 ± 140.0	1650.0 ± 160.0
Zn-65	<12.8	<18.8
Cs-134	<4.1	<8.4
Cs-137	<4.8	<10.0
Ba-La-140	<3.7	<7.2
Ca (g/l)	1.02	0.92

Analysis	CA-MLK-M1 (09/11/90)	CA-MLK-M5B (09/09/90)
I-131	<0.5	<0.4
Sr-89	<0.8	<0.8
Sr-90	2.6 ± 0.5	4.2 ± 0.6
K-40	1210.0 ± 150.0	1900.0 ± 170.0
Zn-65	<22.4	<17.0
Cs-134	<6.9	<4.2
Cs-137	<7.8	<7.0
Ba-La-140	<14.9	<10.0
Ca (g/l)	0.85	0.78

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (09/21/90)	CA-MLK-M5B (09/21/90)
I-131	<0.4	<0.4
Sr-89	<0.7	<0.7
Sr-90	3.6 ± 0.6	5.6 ± 0.7
K-40	1260.0 ± 150.0	1750.0 ± 160.0
Zn-65	<16.9	<24.4
Cs-134	<6.3	<9.0
Cs-137	<6.7	<10.9
Ba-La-140	<7.9	<8.1
Ca (g/l)	0.97	0.80

Analysis	CA-MLK-M1 (10/09/90)	CA-MLK-M5B (10/08/90)
I-131	<0.4	<0.4
Sr-89	<1.4	<0.7
Sr-90	3.7 ± 0.7	3.3 ± 0.6
K-40	1260.0 ± 90.0	1820.0 ± 160.0
Zn-65	<12.7	<23.1
Cs-134	<4.4	<8.1
Cs-137	<4.3	<9.8
Ba-La-140	<2.2	<6.9
Ca (g/l)	0.64	0.91

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1990

Analysis	CA-MLK-M1 (11/13/90)	CA-MLK-M5B (11/13/90)
I-131	<0.4	ND
Sr-89	<0.9	ND
Sr-90	2.2 ± 0.8	ND
K-40	1080.0 ± 140.0	ND
Zn-65	<14.6	ND
Cs-134	<5.4	ND
Cs-137	<5.4	ND
Ba-La-140	<7.2	ND
Ca (g/l)	0.90	ND

Analysis	CA-MLK-M1 (12/17/90)	CA-MLK-M5B (12/17/90)
I-131	<0.3	ND
Sr-89	<0.5	ND
Sr-90	3.1 ± 0.5	ND
K-40	1280.0 ± 140.0	ND
Zn-65	<13.8	ND
Cs-134	<3.1	ND
Cs-137	<4.6	ND
Ba-La-140	<4.2	ND
Ca (g/l)	1.02	ND

Notes:
ND = No Data. See section 8.0 for explanation.

TABLE E4

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V3 LETTUCE (05/31/90)	CA-FPL-V3 MUSTARD GREENS (05/31/90)	CA-FPL-V3 TURNIP GREENS (05/31/90)
Gross Alpha	872.0 ± 352.0	266.0 ± 144.0	198.0 ± 86.0
Gross Beta	6918.0 ± 514.0	5013.0 ± 294.0	4229.0 ± 198.0
I-131	<5.6	<3.8	<5.5
K-40	4656.0 ± 106.0	4439.0 ± 94.0	3700.0 ± 143.0
Mn-54	<5.4	<3.0	<5.6
Co-58	<5.5	<3.1	<5.4
Co-60	<5.3	<3.?	<5.1
Cs-134	<4.2	<2.4	<4.8
Cs-137	<6.6	<3.4	<5.2

Analysis	CA-FPL-V3 SPINACH (05/31/90)	CA-FPL-V6 MUSTARD GREENS (05/31/90)	CA-FPL-V7 TURNIP GREENS (05/31/90)
Gross Alpha	107.0 ± 77.0	153.0 ± 84.0	124.0 ± 70.0
Gross Beta	5654.0 ± 265.0	4129.0 ± 207.0	3022.0 ± 154.0
I-131	<4.5	<7.3	<5.4
K-40	6689.0 ± 172.0	3480.0 ± 151.0	2885.0 ± 102.0
Mn-54	<5.3	<6.9	<3.8
Co-58	<4.8	<7.0	<3.9
Co-60	<4.8	<6.3	<3.7
Cs-134	<3.8	<6.2	<3.3
Cs-137	<4.9	<6.8	<4.4

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V7 MUSTARD GREENS (05/31/90)	CA-FPL-V3 CABBAGE (06/28/90)	CA-FPL-V3 LETTUCE (06/28/90)
Gross Alpha	128.0 ± 71.0	38.0 ± 27.0	<51.0
Gross Beta	3983.0 ± 176.0	2129.0 ± 90.0	4128.0 ± 168.0
I-131	<4.9	<15.7	<25.7
K-40	4020.0 ± 142.0	1780.0 ± 217.0	5240.0 ± 465.0
Mn-54	<4.1	<11.4	<17.7
Co-58	<4.3	<12.4	<16.9
Co-60	<4.6	<11.1	<19.8
Cs-134	<4.0	<11.5	<14.9
Cs-137	<4.3	<11.5	<15.9

Analysis	CA-FPL-V3 SPINACH (06/28/90)	CA-FPL-V3 TURNIP GREENS (06/28/90)	CA-FPL-V3 MUSTARD GREENS (06/28/90)
Gross Alpha	190.0 ± 69.0	140.0 ± 92.0	<69.0
Gross Beta	7888.0 ± 215.0	6240.0 ± 279.0	5015.0 ± 208.0
I-131	<20.1	<28.5	<15.9
K-40	7845.0 ± 316.0	4950.0 ± 394.0	4200.0 ± 330.0
Mn-54	<13.1	<22.6	<13.7
Co-58	<14.1	<20.9	<13.8
Co-60	<14.0	<24.6	<13.7
Cs-134	<12.7	<20.3	<12.4
Cs-137	<12.8	<21.9	<13.2

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V6 LETTUCE (06/28/90)	CA-FPL-V6 MUSTARD GREENS (06/28/90)	CA-FPL-V6 TURNIP GREENS (06/28/90)
Gross Alpha	90.0 ± 58.0	<106.0	128.0 ± 75.0
Gross Beta	4346.0 ± 193.0	3645.0 ± 222.2	4618.0 ± 212.0
I-131	<24.6	<37.0	<15.8
K-40	4221.0 ± 350.0	4460.0 ± 456.0	5420.0 ± 358.0
Mn-54	<14.6	<27.4	<13.5
Co-58	<11.9	<29.1	<14.2
Co-60	<15.2	<27.4	<14.4
Cs-134	<11.5	<25.2	<13.6
Cs-137	<14.6	<29.8	<13.2

Analysis	CA-FPL-V7 CABBAGE (06/28/90)	CA-FPL-V7 LETTUCE (06/28/90)	CA-FPL-V7 MUSTARD GREENS (06/28/90)
Gross Alpha	136.0 ± 57.0	<67.0	274.0 ± 112.0
Gross Beta	3039.0 ± 135.0	5927.0 ± 224.0	5033.0 ± 263.0
I-131	<28.0	<19.1	<17.3
K-40	2756.0 ± 307.0	5367.0 ± 338.0	4319.0 ± 305.0
Mn-54	<13.1	<12.0	<13.0
Co-58	<14.8	<12.6	<12.9
Co-60	<14.9	<14.0	<14.3
Cs-134	<11.4	<11.1	<10.8
Cs-137	<15.3	<13.9	<14.8

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V3 CABBAGE (07/30/90)	CA-FPL-V3 MUSTARD GREENS (07/30/90)	CA-FPL-V3 TURNIP GREENS (07/30/90)
Gross Alpha	<24.0	83.0 ± 60.0	95.0 ± 66.0
Gross Beta	2827.0 ± 108.0	4402.0 ± 187.0	4887.0 ± 210.0
I-131	<34.1	<45.2	<38.1
K-40	2320.0 ± 333.0	4349.0 ± 319.0	4290.0 ± 443.0
Mn-54	<13.6	<14.1	<17.4
Co-58	<17.2	<13.7	<16.7
Co-60	<17.5	<13.7	<18.6
Cs-134	<14.9	<10.0	<15.1
Cs-137	<16.6	<14.6	<18.5

Analysis	CA-FPL-V6 MUSTARD GREENS (07/30/90)	CA-FPL-V7 LETTUCE (07/30/90)	CA-FPL-V7 MUSTARD GREENS (07/30/90)
Gross Alpha	68.0 ± 32.0	104.0 ± 41.0	217.0 ± 82.0
Gross Beta	4419.0 ± 114.0	2912.0 ± 97.0	5698.0 ± 189.0
I-131	<33.3	<33.7	<35.0
K-40	4445.0 ± 247.0	2773.0 ± 253.0	2773.0 ± 253.0
Mn-54	<14.9	<10.1	<19.3
Co-58	<15.8	<9.6	<20.4
Co-60	<14.9	<9.1	<16.5
Cs-134	<14.5	<8.6	<12.4
Cs-137	<13.8	<11.5	<16.9

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V7 CABBAGE (07/30/90)	CA-FPL-V3 TURNIP GREENS (08/29/90)	CA-FPL-V3 CABBAGE (08/29/90)
Gross Alpha	114.0 ± 60.0	181.0 ± 82.0	37.0 ± 20.0
Gross Beta	3316.0 ± 154.0	4915.0 ± 194.0	2510.0 ± 74.0
I-131	<40.0	<16.6	<9.9
K-40	2094.0 ± 250.0	4540.0 ± 455.0	1805.0 ± 143.0
Mn-54	<13.2	<18.0	<10.3
Co-58	<15.5	<16.9	<10.4
Co-60	<14.0	<18.6	<9.7
Cs-134	<10.8	<15.5	<9.6
Cs-137	<14.3	<18.6	<9.6

Analysis	CA-FPL-V3 MUSTARD GREENS (08/29/90)	CA-FPL-V7 CABBAGE (08/29/90)	CA-FPL-V7 MUSTARD GREENS (08/29/90)
Gross Alpha	110.0 ± 68.0	80.0 ± 37.0	267.0 ± 100.0
Gross Beta	5198.0 ± 198.0	2576.0 ± 92.0	5843.0 ± 212.0
I-131	<14.9	<19.4	<18.6
K-40	4372.0 ± 278.0	2070.0 ± 241.0	5105.0 ± 371.0
Mn-54	<11.2	<17.1	<14.5
Co-58	<11.0	<16.1	<11.4
Co-60	<10.7	<15.4	<13.3
Cs-134	<9.6	<16.2	<12.7
Cs-137	<11.8	<17.4	<14.8

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V6 MUSTARD GREENS (09/25/90)	CA-FPL-V7 MUSTARD GREENS (09/25/90)	CA-FPL-V3 MUSTARD GREENS (10/29/90)
Gross Alpha	<71.0	<104.0	<64.0
Gross Beta	4849.0 ± 201.0	6041.0 ± 273.0	4852.0 ± 207.0
I-131	<9.9	<19.7	<14.3
K-40	4850.0 ± 296.0	4954.0 ± 490.0	4530.0 ± 464.0
Mn-54	<10.3	<20.6	<19.1
Co-58	<8.9	<22.5	<13.8
Co-60	<10.6	<21.4	<11.9
Cs-134	<7.0	<14.6	<11.7
Cs-137	<10.7	<18.6	<14.0

Analysis	CA-FPL-V3 TURNIP GREENS (10/29/90)	CA-FPL-V6 TURNIP GREENS (10/29/90)	CA-FPL-V6 MUSTARD GREENS (10/29/90)
Gross Alpha	<97.0	130.0 ± 77.0	96.0 ± 56.0
Gross Beta	5061.0 ± 236.0	4817.0 ± 202.0	5575.0 ± 169.0
I-131	<16.0	<21.4	<22.6
K-40	4265.0 ± 436.0	4420.0 ± 503.0	4822.0 ± 389.0
Mn-54	<16.0	<20.7	<16.3
Co-58	<16.4	<23.0	<15.7
Co-60	<22.9	<27.6	<18.3
Cs-134	<12.9	<22.4	<15.0
Cs-137	<17.3	<23.6	<17.3

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V7 TURNIP GREENS (10/29/90)	CA-FPL-V7 MUSTARD GREENS (10/29/90)	CA-FPL-V3 MUSTARD GREENS (11/15/90)
Gross Alpha	236.0 ± 75.0	66.0 ± 47.0	<61.0
Gross Beta	6408.0 ± 179.0	5799.0 ± 171.0	5058.0 ± 104.0
I-131	<15.9	<16.7	<29.2
K-40	5720.0 ± 410.0	4630.0 ± 463.0	4290.0 ± 364.0
Mn-54	<15.3	<19.3	<15.7
Co-58	<16.3	<18.4	<22.2
Co-60	<17.5	<22.7	<21.5
Cs-134	<19.8	<16.2	<14.4
Cs-137	<15.5	<17.5	<17.7

Analysis	CA-FPL-V3 TURNIP GREENS (11/15/90)	CA-FPL-V6 TURNIP GREENS (11/15/90)	CA-FPL-V6 MUSTARD GREENS (11/15/90)
Gross Alpha	83.0 ± 48.0	77.0 ± 37.0	<68.0
Gross Beta	4464.0 ± 130.0	3166.0 ± 94.0	4614.0 ± 144.0
I-131	<24.7	<30.0	<23.1
K-40	4380.0 ± 405.0	4550.0 ± 543.0	4722.0 ± 629.0
Mn-54	<18.2	<27.4	<19.1
Co-58	<19.5	<27.9	<21.9
Co-60	<20.4	<34.1	<17.1
Cs-134	<21.2	<25.5	<18.9
Cs-137	<20.8	<25.9	<18.8

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1990

Analysis	CA-FPL-V7 MUSTARD GREENS (11/15/90)	CA-FPL-V7 TURNIP GREENS (11/15/90)
Gross Alpha	159.0 ± 77.0	201.0 ± 65.0
Gross Beta	8023.0 ± 234.0	5762.0 ± 153.0
I-131	<25.2	<25.7
K-40	4350.0 ± 507.0	6240.0 ± 495.0
Mn-54	<21.4	<21.9
Co-58	<24.2	<22.4
Co-60	<24.3	<24.2
Cs-134	<22.8	<20.8
Cs-137	<22.8	<22.2

Notes:

TABLE E5

SOIL (pCi/kg dry)
1990

Analysis	CA-SOL-F1 (11/27/90)	CA-SOL-F2 (11/27/90)	CA-SOL-F6 (11/27/90)
Gross Alpha	13729.0 ± 3751.0	11655.0 ± 3600.0	12814.0 ± 3714.0
Gross Beta	22527.0 ± 2334.0	24654.0 ± 2515.0	24017.0 ± 2435.0
K-40	11290.0 ± 963.0	11310.0 ± 896.0	9663.0 ± 1060.0
Mn-54	<57.4	<47.3	<48.5
Co-58	<62.0	<41.9	<51.3
Co-60	<57.0	<48.6	<54.0
Cs-134	<48.1	<39.5	<52.2
Cs-137	1773.0 ± 129.0	1807.0 ± 104.0	2219.0 ± 133.0

Analysis	CA-SOL-F8 (11/27/90)	CA-SOL-F9 (11/27/90)	CA-SOL-PR10 (11/27/90)
Gross Alpha	15435.0 ± 3950.0	15472.0 ± 4018.0	12932.0 ± 4104.0
Gross Beta	20567.0 ± 2054.0	23024.0 ± 2458.0	20265.0 ± 2493.0
K-40	10810.0 ± 1245.0	10990.0 ± 908.0	9275.0 ± 917.0
Mn-54	<58.9	<47.9	<49.8
Co-58	<57.3	<45.4	<44.5
Co-60	<78.0	<55.0	<55.0
Cs-134	<59.7	<41.2	<46.8
Cs-137	2172.0 ± 149.0	1507.0 ± 106.0	1203.0 ± 97.0

Notes:

TABLE E5 (Cont.)

SOIL (pCi/kg dry)
1990

Analysis	CA-SOL-PR3 (11/27/90)	CA-SOL-PR4 (11/27/90)	CA-SOL-PR5 (11/27/90)
Gross Alpha	9208.0 ± 3420.0	13317.0 ± 2692.0	19344.0 ± 4564.0
Gross Beta	20306.0 ± 2544.0	23828.0 ± 1746.0	24631.0 ± 2638.0
K-40	10100.0 ± 831.0	9448.0 ± 662.0	11490.0 ± 1086.0
Mn-54	<49.0	<45.4	<55.9
Co-58	<48.2	<47.2	<58.6
Co-60	<66.9	<59.4	<65.2
Cs-134	<68.4	<47.4	<57.8
Cs-137	586.0 ± 57.0	1033.0 ± 68.0	1111.0 ± 103.0

Analysis	CA-SOL-PR7 (11/27/90)	CA-SOL-V3 (11/27/90)
Gross Alpha	10044.0 ± 3498.0	11296.0 ± 3558.0
Gross Beta	21457.0 ± 2448.0	25260.0 ± 2534.0
K-40	9866.0 ± 878.0	14420.0 ± 938.0
Mn-54	<50.0	<44.6
Co-58	<41.4	<42.9
Co-60	<50.7	<55.6
Cs-134	<38.6	<42.4
Cs-137	619.0 ± 71.0	510.0 ± 62.0

Notes:

TABLE E6

SURFACE WATER (pCi/l)
1990

Analysis	CA-SWA-S01 (01/09/90)	CA-SWA-S02 (01/09/90)	CA-SWA-S03 (01/10/90)
Gross Alpha	3.1 ± 1.5	3.4 ± 1.6	2.8 ± 1.5
Gross Beta	5.6 ± 1.0	7.9 ± 1.1	5.7 ± 1.0
H-3	<183.0	<183.0	182.0 ± 98.0
Sr-89	<0.7	<0.7	<0.9
Sr-90	<0.6	<0.6	<0.7
Mn-54	<4.0	<5.6	<5.1
Fe-59	<10.6	<13.2	<14.8
Co-58	<4.5	<6.2	<5.0
Co-60	<3.3	<5.2	<6.6
Zr-Nb-95	<9.8	<8.4	<9.0
Cs-134	<2.6	<5.0	<4.0
Cs-137	<4.4	<5.8	<4.3
Ba-La-140	<6.5	<7.3	<9.1

Analysis	CA-SWA-S01 (02/13/90)	CA-SWA-S02 (02/13/90)	CA-SWA-S03 (02/23/90)
Gross Alpha	<2.5	2.6 ± 2.2	<0.7
Gross Beta	5.5 ± 1.7	6.6 ± 1.8	4.2 ± 0.6
H-3	<176.0	333.0 ± 104.0	202.0 ± 99.0
Sr-89	<0.5	<0.5	<0.9
Sr-90	<0.6	<0.6	<0.8
Mn-54	<4.3	<5.2	<3.9
Fe-59	<8.4	<13.3	<9.5
Co-58	<4.1	<5.8	<4.2
Co-60	<4.0	<3.8	<3.7
Zr-Nb-95	<6.9	<6.8	<7.5
Cs-134	<4.1	<4.0	<3.6
Cs-137	<4.3	<4.5	<3.9
Ba-La-140	<2.2	<6.0	<13.5

Notes:

TABLE E6 (Cont.)

SURFACE WATER (pCi/l)
1990

Analysis	CA-SWA-S01 (03/13/90)	CA-SWA-S02 (03/13/90)	CA-SWA-S03 (03/14/90)
Gross Alpha	3.7 ± 0.8	2.6 ± 0.7	1.5 ± 0.6
Gross Beta	6.7 ± 0.6	5.4 ± 0.6	4.7 ± 0.6
H-3	<185.0	268.0 ± 102.0	<179.0
Sr-89	<1.0	<0.7	<0.7
Sr-90	<1.3	<0.7	<0.7
Mn-54	<5.6	<7.2	<3.3
Fe-59	<9.6	<11.6	<7.6
Co-58	<4.8	<8.4	<3.3
Co-60	<4.4	<7.6	<3.9
Zr-Nb-95	<7.8	<14.3	<7.2
Cs-134	<3.3	<7.5	<3.6
Cs-137	<5.4	<8.0	<4.3
Ba-La-140	<4.9	<6.8	<3.8

Analysis	CA-SWA-S01 (04/10/90)	CA-SWA-S02 (04/10/90)	CA-SWA-S03 (04/25/90)
Gross Alpha	2.8 ± 1.4	<1.8	<1.9
Gross Beta	7.7 ± 1.0	6.6 ± 1.0	5.2 ± 0.8
H-3	<190.0	<190.0	<190.0
Sr-89	<1.2	<0.9	<1.0
Sr-90	<0.9	<0.7	<0.7
Mn-54	<3.2	<4.2	<4.1
Fe-59	<7.3	<12.1	<9.8
Co-58	<3.9	<5.2	<4.3
Co-60	<4.0	<3.9	<3.5
Zr-Nb-95	<5.7	<7.2	<9.0
Cs-134	<3.4	<3.3	<4.0
Cs-137	<3.0	<4.1	<5.1
Ba-La-140	<3.9	<5.7	<3.0

Notes:

TABLE E6 (Cont.)

SURFACE WATER (pCi/l)
1990

Analysis	CA-SWA-SO1 (05/08/90)	CA-SWA-SO2 (05/08/90)	CA-SWA-SO3 (05/04/90)
Gross Alpha	<1.6	3.4 ± 1.6	<1.3
Gross Beta	6.5 ± 1.2	5.9 ± 1.2	4.9 ± 1.1
H-3	<184.0	<192.0	<184.0
Sr-89	<0.8	<1.0	<1.1
Sr-90	<0.7	<0.9	<1.0
Mn-54	<3.7	<4.2	<3.8
Fe-59	<9.0	<7.8	<8.9
Co-58	<4.7	<3.8	<4.8
Co-60	<4.1	<3.6	<3.9
Zr-Nb-95	<10.5	<7.7	<8.1
Cs-134	<3.2	<3.4	<4.6
Cs-137	<4.4	<4.8	<4.9
Ba-La-140	<3.5	<5.2	<6.6

Analysis	CA-SWA-SO1 (06/12/90)	CA-SWA-SO2 (06/12/90)	CA-SWA-SO3 (06/25/90)
Gross Alpha	<2.0	4.0 ± 2.0	5.0 ± 0.9
Gross Beta	6.1 ± 1.0	10.6 ± 1.2	11.2 ± 0.7
H-3	414.0 ± 110.0	<190.0	<202.0
Sr-89	<1.1	<1.1	<1.0
Sr-90	<0.9	<0.9	1.2 ± 0.6
Mn-54	<5.6	<7.1	<8.7
Fe-59	<12.2	<13.5	<16.3
Co-58	<6.0	<8.6	<7.9
Co-60	<5.9	<7.6	<6.9
Zr-Nb-95	<10.4	<15.0	<14.5
Cs-134	<5.8	<7.5	<8.1
Cs-137	<6.6	<7.5	<8.6
Ba-La-140	<12.5	<10.1	<7.2

Notes:

TABLE E6 (Cont.)

SURFACE WATER (pCi/l)
1990

Analysis	CA-SWA-SO1 (07/10/90)	CA-SWA-SO2 (07/10/90)	CA-SWA-SO3 (07/19/90)
Gross Alpha	3.9 ± 2.0	2.7 ± 1.2	<1.6
Gross Beta	7.3 ± 1.3	6.1 ± 1.0	4.8 ± 1.2
H-3	561.0 ± 120.0	216.0 ± 107.0	<201.0
Sr-89	<0.9	<1.1	<0.8
Sr-90	<0.5	<0.5	0.5 ± 0.3
Mn-54	<3.6	<4.0	<4.6
Fe-59	<8.7	<11.6	<9.4
Co-58	<4.8	<4.7	<4.8
Co-60	<4.1	<4.0	<3.5
Zr-Nb-95	<8.7	<8.5	<8.1
Cs-134	<3.8	<3.5	<4.7
Cs-137	<4.1	<4.0	<4.6
Ba-La-140	<14.2	<14.4	<11.1

Analysis	CA-SWA-SO1 (08/14/90)	CA-SWA-SO2 (08/14/90)	CA-SWA-SO3 '08/01/90)
Gross Alpha	3.9 ± 0.9	4.8 ± 0.8	3.8 ± 0.8
Gross Beta	7.7 ± 0.6	8.5 ± 0.6	6.9 ± 0.6
H-3	<177.0	195.0 ± 96.0	<178.0
Sr-89	<1.8	<2.1	<1.5
Sr-90	<0.7	<0.9	<0.5
Mn-54	<6.1	<7.3	<3.7
Fe-59	<15.4	<16.4	<11.3
Co-58	<4.6	<8.1	<5.2
Co-60	<7.1	<6.0	<3.6
Zr-Nb-95	<11.5	<14.5	<8.5
Cs-134	<5.7	<7.1	<3.3
Cs-137	<5.8	<7.4	<4.5
Ba-La-140	<13.2	<8.5	<11.6

Notes:

TABLE E6 (Cont.)

SURFACE WATER (pCi/l)
1990

Analysis	CA-SWA-SO1 (09/11/90)	CA-SWA-SO2 (09/11/90)	CA-SWA-SO3 (09/19/90)
Gross Alpha	2.6 ± 1.2	3.3 ± 0.5	5.1 ± 0.9
Gross Beta	5.9 ± 1.0	8.2 ± 0.4	7.3 ± 0.6
H-3	605.0 ± 109.0	<186.0	<186.0
Sr-89	<0.9	<0.7	<0.8
Sr-90	<0.5	<0.5	<0.5
Mn-54	<7.4	<4.0	<4.8
Fe-59	<20.7	<8.4	<11.7
Co-58	<8.0	<4.4	<5.4
Co-60	<8.0	<3.5	<6.0
Zr-Nb-95	<14.9	<8.0	<10.1
Cs-134	<6.9	<3.7	<4.9
Cs-137	<7.7	<4.2	<5.5
Ba-La-140	<13.9	<6.6	<9.6

Analysis	CA-SWA-SO1 (10/09/90)	CA-SWA-SO2 (10/09/90)	CA-SWA-SO3 (10/08/90)
Gross Alpha	<1.9	2.1 ± 0.8	2.4 ± 0.7
Gross Beta	6.2 ± 1.0	6.7 ± 0.6	5.9 ± 0.6
H-3	193.0 ± 95.0	353.0 ± 101.0	<176.0
Sr-89	<1.0	<0.9	<1.1
Sr-90	<0.5	<0.4	<0.5
Mn-54	<5.3	<6.8	<6.1
Fe-59	<12.0	<13.0	<11.1
Co-58	<6.0	<7.6	<6.5
Co-60	<5.0	<6.9	<6.0
Zr-Nb-95	<9.1	<13.3	<11.2
Cs-134	<5.4	<6.9	<6.6
Cs-137	<6.6	<7.4	<6.7
Ba-La-140	<9.1	<7.6	<10.9

Notes:

TABLE E6 (Cont.)

SURFACE WATER (pCi/l)
1990

Analysis	CA-SWA-S01 (11/13/90)	CA-SWA-S02 (11/13/90)	CA-SWA-S03 (11/15/90)
Gross Alpha	3.0 ± 0.9	2.2 ± 0.8	<1.8
Gross Beta	6.2 ± 0.6	6.4 ± 0.6	6.0 ± 1.0
H-3	<179.0	<179.0	<179.0
Sr-89	<0.8	<0.7	<0.7
Sr-90	<0.6	<0.5	<0.4
Mn-54	<4.5	<6.5	<7.4
Fe-59	<9.2	<13.5	<12.7
Co-58	<4.8	<8.3	<7.8
Co-60	<3.9	<6.6	<6.5
Zr-Nb-95	<9.0	<15.0	<11.7
Cs-134	<4.8	<7.4	<6.4
Cs-137	<4.5	<8.6	<6.7
Ba-La-140	<6.3	<9.4	<8.5

Analysis	CA-SWA-S01 (12/19/90)	CA-SWA-S02 (12/19/90)	CA-SWA-S03 (12/10/90)
Gross Alpha	1.7 ± 0.8	3.9 ± 0.8	2.2 ± 1.2
Gross Beta	6.8 ± 0.6	6.9 ± 0.5	5.4 ± 0.8
H-3	<188.0	<188.0	<188.0
Sr-89	<0.5	<0.5	<0.6
Sr-90	<0.5	0.6 ± 0.3	<0.4
Mn-54	<6.3	<6.3	<5.7
Fe-59	<10.1	<13.2	<12.1
Co-58	<6.4	<6.6	<5.4
Co-60	<6.6	<7.6	<6.8
Zr-Nb-95	<11.1	<11.5	<10.5
Cs-134	<6.2	<5.8	<5.8
Cs-137	<5.5	<6.6	<6.4
Ba-La-140	<8.6	<10.2	<7.4

Notes:

TABLE E7

GROUND WATER (pCi/l)
1990

Analysis	CA-WWA-F15 (01/09/90)	CA-WWA-F05 (01/09/90)	CA-WWA-D01 (01/09/90)
Gross Alpha	1.3 ± 1.1	1.1 ± 0.9	2.7 ± 1.1
Gross Beta	8.3 ± 1.1	9.3 ± 1.2	3.5 ± 0.7
H-3	<183.0	<183.0	<183.0
Sr-89	<0.7	<0.8	<0.7
Sr-90	<0.6	<0.7	<0.8
Mn-54	<3.8	<4.7	<3.8
Fe-59	<8.7	<13.4	<7.8
Co-58	<3.8	<6.0	<4.7
Co-60	<2.5	<3.8	<3.8
Zr-Nb-95	<6.4	<8.8	<7.9
Cs-134	<3.1	<4.8	<3.3
Cs-137	<4.2	<6.4	<4.8
Ba-La-140	<5.4	<5.6	<5.0

Analysis	CA-WWA-F15 (02/13/90)	CA-WWA-F05 (02/13/90)	CA-WWA-D01 (02/13/90)
Gross Alpha	<2.4	<1.9	<2.5
Gross Beta	9.6 ± 1.4	9.3 ± 1.9	2.7 ± 1.6
H-3	<184.0	<176.0	<176.0
Sr-89	<0.5	<0.5	<1.2
Sr-90	<0.5	<0.6	<1.8
Mn-54	<4.1	<2.7	<2.9
Fe-59	<8.6	<7.4	<7.1
Co-58	<4.3	<2.8	<4.1
Co-60	<4.2	<2.9	<3.7
Zr-Nb-95	<8.2	<6.3	<7.5
Cs-134	<4.0	<3.0	<2.9
Cs-137	<4.9	<3.7	<3.2
Ba-La-140	<5.0	<4.1	<4.4

Notes:

TABLE E7 (Cont.)

GROUND WATER (pCi/l)
1990

Analysis	CA-WWA-F15 (03/13/90)	CA-WWA-F05 (03/13/90)	CA-WWA-D01 (03/13/90)
Gross Alpha	2.5 ± 0.7	2.1 ± 0.6	2.8 ± 0.9
Gross Beta	8.9 ± 0.7	10.1 ± 0.6	2.5 ± 0.6
H-3	<185.0	<185.0	<185.0
Sr-89	<0.7	<0.7	<0.6
Sr-90	<0.7	<0.8	<0.6
Mn-54	<3.1	<3.9	<4.8
Fe-59	<7.0	<7.4	<8.3
Co-58	<3.4	<3.5	<4.1
Co-60	<3.8	<3.4	<4.2
Zr-Nb-95	<7.2	<6.8	<9.2
Cs-134	<3.5	<4.2	<6.0
Cs-137	<4.7	<3.9	<4.9
Ba-La-140	<3.6	<4.3	<5.1

Analysis	CA-WWA-F15 (04/10/90)	CA-WWA-F05 (04/10/90)	CA-WWA-D01 (04/10/90)
Gross Alpha	<2.0	1.3 ± 0.9	<1.6
Gross Beta	8.0 ± 1.1	10.3 ± 1.2	1.8 ± 0.7
H-3	<190.0	<190.0	<190.0
Sr-89	<1.3	<1.0	<1.0
Sr-90	<1.0	<0.8	<0.7
Mn-54	<5.2	<5.8	<5.0
Fe-59	<12.9	<12.0	<12.2
Co-58	<5.1	<6.0	<6.5
Co-60	<4.9	<5.6	<5.4
Zr-Nb-95	<8.6	<9.8	<10.0
Cs-134	<4.8	<5.3	<6.7
Cs-137	<4.8	<5.2	<5.9
Ba-La-140	<9.0	<10.2	<9.5

Notes:

TABLE E7 (Cont.)

GROUND WATER (pCi/l)
1990

Analysis	CA-WWA-F15 (05/08/90)	CA-WWA-F05 (05/08/90)	CA-WWA-D01 (05/08/90)
Gross Alpha	<3.4	<1.5	3.0 ± 1.6
Gross Beta	7.8 ± 1.5	10.9 ± 1.3	3.3 ± 1.1
H-3	<185.0	<185.0	<185.0
Sr-89	<1.0	<0.9	<0.9
Sr-90	<0.7	<0.8	<0.8
Mn-54	<7.1	<5.6	<5.0
Fe-59	<13.0	<11.6	<11.9
Co-58	<7.5	<5.3	<5.5
Co-60	<4.8	<6.3	<5.4
Zr-Nb-95	<11.9	<9.9	<9.4
Cs-134	<7.3	<5.3	<5.9
Cs-137	<7.2	<5.8	<5.1
Ba-La-140	<7.2	<9.2	<5.9

Analysis	CA-WWA-F15 (06/12/90)	CA-WWA-F05 (06/12/90)	CA-WWA-D01 (06/12/90)
Gross Alpha	1.4 ± 0.6	<2.2	2.4 ± 1.0
Gross Beta	7.9 ± 0.6	10.9 ± 1.2	3.0 ± 0.6
H-3	<190.0	<190.0	<190.0
Sr-89	<1.0	<1.0	<0.9
Sr-90	<0.8	<0.8	<0.8
Mn-54	<5.5	<5.9	<4.2
Fe-59	<13.0	<13.1	<8.7
Co-58	<6.8	<5.9	<4.6
Co-60	<6.2	<5.8	<4.8
Zr-Nb-95	<10.7	<11.0	<8.2
Cs-134	<5.6	<5.7	<5.4
Cs-137	<5.9	<6.2	<4.4
Ba-La-140	<10.2	<12.4	<6.3

Notes:

TABLE E7 (Cont.)

GROUND WATER (pCi/l)
1990

Analysis	CA-WWA-F15 (07/10/90)	CA-WWA-F05 (07/10/90)	CA-WWA-D01 (07/10/90)
Gross Alpha	<2.0	<1.0	<2.1
Gross Beta	6.8 ± 1.3	11.0 ± 1.2	2.8 ± 1.1
H-3	<198.0	<198.0	<198.0
Sr-89	<1.0	<1.1	<0.9
Sr-90	<0.5	<0.5	<0.5
Mn-54	<3.5	<4.9	<3.6
Fe-59	<9.2	<12.5	<10.9
Co-58	<4.0	<5.5	<4.6
Co-60	<3.5	<4.9	<2.8
Zr-Nb-95	<7.8	<9.5	<8.4
Cs-134	<4.2	<5.1	<3.7
Cs-137	<4.2	<4.8	<4.3
Ba-La-140	<14.3	<14.2	<9.1

Analysis	CA-WWA-F15 (08/14/90)	CA-WWA-F05 (08/14/90)	CA-WWA-D01 (08/14/90)
Gross Alpha	1.9 ± 0.7	1.6 ± 0.6	2.6 ± 0.8
Gross Beta	8.8 ± 0.6	11.3 ± 0.6	2.4 ± 0.4
H-3	<177.0	<177.0	<185.0
Sr-89	<1.2	<1.0	<1.7
Sr-90	0.6 ± 0.4	<0.4	<0.7
Mn-54	<4.6	<5.6	<6.6
Fe-59	<9.2	<11.9	<19.0
Co-58	<4.8	<5.8	<7.6
Co-60	<5.4	<5.2	<7.1
Zr-Nb-95	<8.6	<9.8	<13.8
Cs-134	<4.8	<5.7	<6.2
Cs-137	<4.6	<6.1	<6.5
Ba-La-140	<9.6	<10.9	<13.4

Notes:

TABLE E7 (Cont.)

GROUND WATER (pCi/l)
1990

Analysis	CA-WWA-F15 (09/11/90)	CA-WWA-F05 (09/11/90)	CA-WWA-D01 (09/11/90)
Gross Alpha	1.4 ± 0.6	3.8 ± 2.2	2.4 ± 1.9
Gross Beta	8.4 ± 0.6	6.9 ± 1.3	2.8 ± 1.2
H-3	<186.0	<186.0	<186.0
Sr-89	<1.0	<1.0	<1.0
Sr-90	<0.6	<0.6	<0.6
Mn-54	<5.4	<5.7	<7.4
Fe-59	<18.3	<12.4	<17.8
Co-58	<5.2	<6.5	<7.6
Co-60	<5.8	<6.8	<7.4
Zr-Nb-95	<9.9	<9.9	<13.1
Cs-134	<4.7	<6.0	<7.8
Cs-137	<5.4	<7.2	<7.4
Ba-La-140	<14.2	<8.7	<13.6

Analysis	CA-WWA-F15 (10/09/90)	CA-WWA-F05 (10/09/90)	CA-WWA-D01 (10/09/90)
Gross Alpha	2.2 ± 0.8	1.2 ± 0.5	1.2 ± 0.8
Gross Beta	8.7 ± 0.6	8.6 ± 0.5	2.7 ± 0.5
H-3	<176.0	<176.0	<176.0
Sr-89	<0.8	<1.0	<1.1
Sr-90	<0.4	<0.5	<0.5
Mn-54	<6.2	<4.0	<7.8
Fe-59	<24.1	<7.6	<13.1
Co-58	<7.9	<3.9	<6.9
Co-60	<6.5	<4.0	<7.6
Zr-Nb-95	<13.4	<7.0	<13.1
Cs-134	<5.8	<2.8	<7.4
Cs-137	<6.5	<3.3	<7.4
Ba-La-140	<12.3	<3.6	<8.2

Notes:

TABLE E7 (Cont.)

GROUND WATER (pCi/l)
1990

Analysis	CA-WWA-F15 (11/13/90)	CA-WWA-F05 (11/13/90)	CA-WWA-D01 (11/13/90)
Gross Alpha	1.7 ± 0.7	1.2 ± 0.6	1.1 ± 0.6
Gross Beta	8.5 ± 0.6	10.9 ± 0.6	1.9 ± 0.4
H-3	<179.0	<179.0	<179.0
Sr-89	<0.8	<0.9	<0.8
Sr-90	<0.5	0.7 ± 0.4	<0.5
Mn-54	<7.2	<8.0	<7.3
Fe-59	<12.7	<14.2	<14.5
Co-58	<7.9	<7.6	<7.6
Co-60	<7.4	<6.2	<5.8
Zr-Nb-95	<11.3	<15.0	<12.0
Cs-134	<6.6	<7.8	<7.7
Cs-137	<6.8	<7.8	<7.1
Ba-La-140	<12.6	<8.9	<8.7

Analysis	CA-WWA-F15 (12/19/90)	CA-WWA-F05 (12/19/90)	CA-WWA-D01 (12/19/90)
Gross Alpha	ND	2.1 ± 0.6	3.4 ± 0.8
Gross Beta	ND	8.3 ± 0.6	3.4 ± 0.5
H-3	ND	<188.0	<188.0
Sr-89	ND	<0.5	<0.4
Sr-90	ND	0.7 ± 0.3	<0.4
Mn-54	ND	<6.3	<8.3
Fe-59	ND	<13.5	<16.0
Co-58	ND	<7.1	<8.0
Co-60	ND	<6.6	<8.0
Zr-Nb-95	ND	<11.0	<12.8
Cs-134	ND	<6.5	<9.6
Cs-137	ND	<6.9	<7.6
Ba-La-140	ND	<8.0	<7.1

Notes:
ND = No Data, See section 8.0 for explanation

TABLE E8

BOTTOM SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (03/13/90)	CA-AQS-C (03/13/90)	CA-AQS-D (03/14/90)
Gross Alpha	4793 ± 3805	8605 ± 4552	17062 ± 6319
Gross Beta	21788 ± 4027	16955 ± 3548	22735 ± 3994
Sr-89	<16.8	<14.3	<16.0
Sr-90	<11.3	<8.3	19.4 ± 7.9
Mn-54	<21.0	<18.0	<28.0
Fe-59	<48.0	<41.0	<67.0
Co-58	<21.0	<18.0	<26.0
Co-60	<24.0	<21.0	<35.0
Zr-Nb-95	<41.0	<35.0	<49.0
Cs-134	<30.0	<14.0	<36.0
Cs-137	<22.0	44.0 ± 16.0	127.0 ± 20.0
Ba-La-140	<70.0	<21.0	<73.0

Analysis	CA-AQS-A (05/24/90)	CA-AQS-C (05/24/90)	CA-AQS-D (05/04/90)
Gross Alpha	7005 ± 4572	5745 ± 2832	11762 ± 5085
Gross Beta	21151 ± 4096	20627 ± 2713	16808 ± 2907
Sr-89	<21.1	<16.2	<14.1
Sr-90	<13.4	<9.7	19.2 ± 6.8
Mn-54	<58.0	<32.0	<37.0
Fe-59	<176.0	<86.0	<95.0
Co-58	<61.0	<30.0	<40.0
Co-60	<72.0	<46.0	<42.0
Zr-Nb-95	<136.0	<66.0	<80.0
Cs-134	<52.0	<28.0	<45.0
Cs-137	77.0 ± 50.0	<34.0	<36.0
Ba-La-140	<298.0	<59.0	<156.0

Notes:

TABLE E8 (Cont.)

BOTTOM SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (08/09/90)	CA-AQS-C (08/09/90)	CA-AQS-D (08/01/90)
Gross Alpha	7245 ± 4256	13055 ± 5517	15002 ± 3862
Gross Beta	12111 ± 2692	22087 ± 3686	24457 ± 2289
Sr-89	<27.7	<31.1	<22.6
Sr-90	<10.2	20.1 ± 8.8	21.0 ± 4.9
Mn-54	<24.0	<46.0	<39.0
Fe-59	<86.0	<150.0	<137.0
Co-58	<28.0	<49.0	<48.0
Co-60	<37.0	<51.0	<46.0
Zr-Nb-95	<64.0	<92.0	<98.0
Cs-134	<22.0	<33.0	<28.0
Cs-137	<26.0	201.0 ± 50.0	150.0 ± 24.0
Ba-La-140	<99.0	<257.0	<338.0

Analysis	CA-AQS-A (11/14/90)	CA-AQS-C (11/14/90)	CA-AQS-D (11/16/90)
Gross Alpha	6171 ± 1563	8774 ± 2031	11738 ± 3672
Gross Beta	15479 ± 1071	18455 ± 1349	20519 ± 2331
Sr-89	<10.4	<12.0	<12.0
Sr-90	7.7 ± 4.4	8.4 ± 5.0	9.3 ± 5.7
Mn-54	<36.0	<37.0	<42.0
Fe-59	<85.0	<86.0	<113.0
Co-58	<30.0	<37.0	<45.0
Co-60	<41.0	<46.0	<58.0
Zr-Nb-95	<92.0	<79.0	<105.0
Cs-134	<33.0	<29.0	<36.0
Cs-137	74.0 ± 34.0	121.0 ± 49.0	131.0 ± 37.0
Ba-La-140	<71.0	<69.0	<69.0

Notes:

TABLE E9

BEDLOAD SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (03/13/90)	CA-AQS-C (03/13/90)	CA-AQS-D (03/14/90)
Gross Alpha	12641 ± 4048	15118 ± 4247	9248 ± 3396
Gross Beta	20756 ± 3136	26346 ± 3124	22224 ± 2913
Sr-89	<182.1	<83.7	<43.4
Sr-90	<82.8	40.8 ± 18.0	27.0 ± 15.3
Mn-54	<148.0	<83.0	<51.0
Fe-59	<377.0	<222.0	<147.0
Co-58	<167.0	<94.0	<63.0
Co-60	<156.0	<96.0	<58.0
Zr-Nb-95	<319.0	<165.0	<110.0
Cs-134	<122.0	<82.0	<65.0
Cs-137	546.0 ± 146.0	<82.0	172.0 ± 35.0
Ba-La-140	<371.0	<298.0	<305.0

Analysis	CA-AQS-A (05/24/90)	CA-AQS-C (05/24/90)	CA-AQS-D (05/04/90)
Gross Alpha	9416 ± 5130	6893 ± 5052	<12575
Gross Beta	17560 ± 3239	21115 ± 3967	17501 ± 4201
Sr-89	<193.4	<89.5	<13.3
Sr-90	<116.6	<49.9	21.0 ± 8.1
Mn-54	<338.0	<209.0	<71.0
Fe-59	<920.0	<655.0	<155.0
Co-58	<380.0	<247.0	<69.0
Co-60	<340.0	<245.0	<68.0
Zr-Nb-95	<756.0	<475.0	<142.0
Cs-134	<274.0	<172.0	<71.0
Cs-137	<349.0	<211.0	<65.0
Ba-La-140	<1146	<1074	<223.0

Notes:
High LLD for gamma isotopes is due to a small sample size.

TABLE E9 (Cont.)

BEDLOAD SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (08/09/90)	CA-AQS-C (08/09/90)	CA-AQS-D (08/01/90)
Gross Alpha	18951 ± 5973	12952 ± 4792	12287 ± 5022
Gross Beta	18291 ± 3170	23636 ± 3017	24683 ± 3540
Sr-89	<234.8	<23.3	<20.5
Sr-90	<88.6	25.3 ± 7.5	17.9 ± 5.8
Mn-54	<190.0	59.0 ± 24.0	<37.0
Fe-59	<497.0	<111.0	<134.0
Co-58	<212.0	<49.0	<43.0
Co-60	<196.0	<43.0	<46.0
Zr-Nb-95	<416.0	<95.0	<87.0
Cs-134	<146.0	<28.0	<28.0
Cs-137	630.0 ± 166.0	216.0 ± 41.0	232.0 ± 41.0
Ba-La-140	<582.0	<115.0	<224.0

Analysis	CA-AQS-A (11/14/90)	CA-AQS-C (11/14/90)	CA-AQS D (11/16/90)
Gross Alpha	12858 ± 2646	11979 ± 3661	10275 ± 3430
Gross Beta	22002 ± 1736	24064 ± 2497	16518 ± 1999
Sr-89	<55.0	<8.2	<31.7
Sr-90	<34.8	11.5 ± 4.0	<19.7
Mn-54	<53.0	<39.0	<144.0
Fe-59	<172.0	<102.0	<355.0
Co-58	<68.0	<47.0	<161.0
Co-60	<63.0	<44.0	<141.0
Zr-Nb-95	<113.0	<86.0	<271.0
Cs-134	<55.0	<30.0	<114.0
Cs-137	176.0 ± 26.0	113.0 ± 39.0	<148.0
Ba-La-140	<360.0	<151.0	<281.0

Notes:
High LLD for gamma isotopes is due to a small sample size.

TABLE E10

WASHLOAD SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (03/13/90)	CA-AQS-C (03/13/90)	CA-AQS-D (03/14/90)
Gross Alpha	12170 ± 3946	14761 ± 4059	11703 ± 4007
Gross Beta	27478 ± 3296	25477 ± 2897	23444 ± 3076
Sr-89	<110.7	<66.3	<109.6
Sr-90	55.0 ± 21.8	47.9 ± 13.8	37.2 ± 22.3
Mn-54	<102.0	<75.0	<179.0
Fe-59	<274.0	<152.0	<373.0
Co-58	<122.0	<76.0	<192.0
Co-60	<113.0	<68.0	<179.0
Zr-Nb-95	<210.0	<142.0	<358.0
Cs-134	<105.0	<49.0	<131.0
Cs-137	<99.0	191.0 ± 56.0	<166.0
Ba-La-140	<402.0	<108.0	<219.0

Analysis	CA-AQS-A (05/24/90)	CA-AQS-C (05/24/90)	CA-AQS-D (05/04/90)
Gross Alpha	15468 ± 5971	11097 ± 5354	7603 ± 5570
Gross Beta	23287 ± 3843	23461 ± 4191	21091 ± 3739
Sr-89	<104.2	<189.6	<75.2
Sr-90	<58.2	<98.0	65.9 ± 33.5
Mn-54	<233.0	<240.0	<537.0
Fe-59	<658.0	<733.0	<1099
Co-58	<290.0	<302.0	<536.0
Co-60	<222.0	<257.0	<553.0
Zr-Nb-95	<529.0	<548.0	<1036
Cs-134	<218.0	<247.0	<423.0
Cs-137	<222.0	<247.0	1199 ± 465.0
Ba-La-140	<1970	<1870	<770.0

Notes:
High LLD for gamma isotopes is due to a very small sample size.

TABLE E10 (Cont.)

WASHLOAD SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (08/09/90)	CA-AQS-C (08/09/90)	CA-AQS-D (08/01/90)
Gross Alpha	15132 ± 5280	18630 ± 5973	13614 ± 5338
Gross Beta	25379 ± 3168	24421 ± 3232	24375 ± 3168
Sr-89	<199.5	<215.5	<102.6
Sr-90	97.5 ± 52.2	81.5 ± 51.0	44.4 ± 24.4
Mn-54	<101.0	<269.0	<182.0
Fe-59	<309.0	<612.0	<507.0
Co-58	<126.0	<305.0	<214.0
Co-60	<106.0	<275.0	<184.0
Zr-Nb-95	<225.0	<565.0	<431.0
Cs-134	<119.0	<218.0	<139.0
Cs-137	575.0 ± 74.0	930.0 ± 255.0	767.0 ± 178.0
Ba-La-140	<817.0	<524.0	<804.0

Analysis	CA-AQS-A (11/14/90)	CA-AQS-C (11/14/90)	CA-AQS-D (11/16/90)
Gross Alpha	9002 ± 3247	14280 ± 3918	9582 ± 3597
Gross Beta	22434 ± 2507	23610 ± 2494	22324 ± 2465
Sr-89	<727.9	<508.5	<615.0
Sr-90	<408.1	<301.7	<377.3
Mn-54	<372.0	<341.0	<382.0
Fe-59	<1200	<1060	<922.0
Co-58	<491.0	<451.0	<468.0
Co-60	<375.0	<337.0	<325.0
Zr-Nb-95	<922.0	<813.0	<911.0
Cs-134	<355.0	<310.0	<225.0
Cs-137	<343.0	<299.0	<311.0
Ba-La-140	<4410	<3780	<1441

Notes:
High LLD for gamma isotopes is due to a very small sample size.

TABLE E11

SHORELINE SEDIMENT (pCi/kg dry)
1990

Analysis	CA-AQS-A (05/24/90)	CA-AQS-C (05/24/90)
Mn-54	<50.0	<32.0
Fe-59	<126.0	<86.0
Co-58	<53.0	<30.0
Co-60	<56.0	<44.0
Zr-Nb-95	<104.0	<71.0
Cs-134	<40.0	<28.0
Cs-137	135.0 ± 57.0	<32.0
Ba-La-140	<148.0	<56.0

Analysis	CA-AQS-A (11/14/90)	CA-AQS-C (11/14/90)
Mn-54	<33.0	<39.0
Fe-59	<83.0	<99.0
Co-58	<37.0	<46.0
Co-60	<41.0	<59.0
Zr-Nb-95	<69.0	<83.0
Cs-134	<29.0	<33.0
Cs-137	<38.0	<40.0
Ba-La-140	<77.0	<90.0

Notes:

TABLE E12

FISH, CA-AQF-A (pCi/kg WET)
1990

Analysis	CARP (01/09/90)	BIGMOUTH BUFFALO (01/09/90)	RIVER CARPSUCKER (01/09/90)	GIZZARD SHAD (01/09/90)	BLUE SUCKER (01/09/90)
Gross Alpha	75.0 ± 31.0	<48.0	<39.0	<55.0	<29.0
Gross Beta	3116.0 ± 93.0	3046.0 ± 134.0	2744.0 ± 118.0	3224.0 ± 154.0	2492.0 ± 102.0
Sr-89	<3.7	<2.0	<2.7	<4.1	<3.1
Sr-90	<3.5	<2.1	<2.0	<3.8	<2.9
K-40	2943.0 ± 241.0	3317.0 ± 292.0	2423.0 ± 356.0	2792.0 ± 283.0	2304.0 ± 302.0
Mn-54	<10.8	<12.7	<15.8	<12.6	<14.1
Fe-59	<42.1	<34.4	<42.9	<28.9	<39.8
Co-58	<14.8	<14.2	<13.9	<10.9	<16.0
Co-60	<6.5	<13.7	<17.2	<10.6	<13.1
Cs-134	<9.9	<11.3	<13.5	<10.1	<9.9
Cs-137	<14.9	<12.0	<16.2	<12.8	<11.9

Analysis	CARP (02/26/90)	RIVER CARPSUCKER (02/26/90)	GIZZARD SHAD (02/26/90)	GOLDEYE (02/26/90)	FRESHWATER DRUM (02/26/90)
Gross Alpha	<19.0	<27.0	<54.0	<52.0	<56.0
Gross Beta	2873.0 ± 41.0	3109.0 ± 63.0	3168.0 ± 148.0	3092.0 ± 146.0	2608.0 ± 123.0
Sr-89	<6.1	<4.8	<3.0	<2.9	<3.1
Sr-90	<6.5	<4.2	<3.1	<2.3	<2.7
K-40	2575.0 ± 176.0	2555.0 ± 227.0	2860.0 ± 307.0	2380.0 ± 257.0	2429.0 ± 408.0
Mn-54	<10.3	<11.4	<12.7	<12.7	<20.2
Fe-59	<23.1	<23.4	<30.1	<31.3	<47.8
Co-58	<10.5	<12.0	<13.4	<14.0	<18.9
Co-60	<11.1	<10.7	<16.4	<15.3	<23.8
Cs-134	<9.6	<10.2	<12.5	<12.6	<13.8
Cs-137	<9.2	<11.2	<13.4	<12.4	<20.6

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-A (pCi/kg WET)
1990

Analysis	BIGMOUTH BUFFALO (03/13/90)	FLATHEAD CATFISH (04/13/90)	GIZZARD SHAD (03/13/90)	RIVER CARPSUCKER (03/13/90)	FRESHWATER DRUM (03/13/90)
Gross Alpha	<52.0	<42.0	121.0 ± 70.0	48.0 ± 22.0	82.0 ± 56.0
Gross Beta	3048.0 ± 142.0	2901.0 ± 128.0	3099.0 ± 167.0	3118.0 ± 71.0	2815.0 ± 149.0
Sr-89	<7.4	<6.6	<9.0	<8.3	<2.6
Sr-90	<7.0	<5.3	<7.3	<8.6	<2.0
K-40	2818.0 ± 373.0	2760.0 ± 420.0	2730.0 ± 333.0	2055.0 ± 182.0	3108.0 ± 510.0
Mn-54	<11.8	<17.4	<17.4	<20.9	<18.0
Fe-59	<49.2	<56.6	<48.1	<47.4	<45.4
Co-58	<14.7	<21.0	<19.2	<22.6	<21.0
Co-60	<20.7	<20.9	<17.8	<21.9	<24.4
Cs-134	<12.9	<20.6	<14.3	<17.4	<17.4
Cs-137	<14.0	<18.4	<15.4	<21.1	<23.0

Analysis	GIZZARD SHAD (04/23/90)	CARP (04/23/90)	CHANNEL CATFISH (04/23/90)	RIVER CARPSUCKER (04/23/90)	BIGMOUTH BUFFALO (04/23/90)
Gross Alpha	<55.0	54.0 ± 38.0	77.0 ± 49.0	67.0 ± 45.0	112.0 ± 40.0
Gross Beta	3231.0 ± 166.0	3453.0 ± 146.0	3190.0 ± 142.0	2742.0 ± 129.0	3462.0 ± 108.0
Sr-89	<2.7	<6.0	<3.0	<2.4	<2.5
Sr-90	3.1 ± 1.8	<5.6	<2.3	<2.1	<2.3
K-40	2770.0 ± 258.0	3230.0 ± 478.0	2870.0 ± 330.0	2610.0 ± 399.0	2874.0 ± 209.0
Mn-54	<11.7	<17.4	<28.2	<17.1	<9.9
Fe-59	<33.6	<59.8	<57.3	<36.0	<30.9
Co-58	<14.7	<20.6	<23.5	<15.8	<10.4
Co-60	<14.9	<20.8	<22.3	<19.6	<11.8
Cs-134	<12.3	<13.5	<21.5	<13.5	<10.2
Cs-137	<13.4	<19.6	<23.3	<15.2	<11.2

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-A (pCi/kg WET)
1990

Analysis	CARP (05/24/90)	FLATHEAD CATFISH (05/24/90)	SMALLMOUTH BUFFALO (05/24/90)	RIVER CARP SUCKER (05/24/90)	FRESHWATER DRUM (05/24/90)
Gross Alpha	<39.0	68.0 ± 30.0	<52.0	77.0 ± 34.0	72.0 ± 44.0
Gross Beta	2778.0 ± 95.0	3478.0 ± 101.0	3232.0 ± 105.0	2885.0 ± 97.0	3040.0 ± 141.0
Sr-89	<4.0	<6.6	<5.1	<4.9	<9.6
Sr-90	<2.4	<3.9	<3.7	<3.1	<4.2
K-40	2944.0 ± 427.0	3112.0 ± 477.0	3193.0 ± 412.0	2735.0 ± 393.0	2864.0 ± 489.0
Mn-54	<17.4	<21.4	<17.5	<16.4	<19.6
Fe-59	<49.1	<54.0	<64.2	<75.9	<62.6
Co-58	<21.8	<19.5	<14.8	<21.6	<15.4
Co-60	<21.2	<18.1	<15.5	<27.4	<24.3
Cs-134	<17.0	<15.9	<31.1	<17.6	<15.8
Cs-137	<19.8	<19.6	<16.6	<18.6	<21.2

Analysis	RIVER CARPSUCKER (06/21/90)	SMALLMOUTH BUFFALO (06/21/90)	FRESHWATER DRUM (06/21/90)	LONGNOSE GAR (06/21/90)	CARP (06/21/90)
Gross Alpha	<39.0	<50.0	<74.0	<71.0	<39.0
Gross Beta	2597.0 ± 127.0	2945.0 ± 135.0	2948.0 ± 144.0	3162.0 ± 147.0	3080.0 ± 101.0
Sr-89	<8.0	<5.2	<6.6	<10.4	<8.1
Sr-90	<3.6	<2.7	<3.1	<5.4	<4.0
K-40	2980.0 ± 352.0	2662.0 ± 262.0	2611.0 ± 363.0	3259.0 ± 720.0	2742.0 ± 243.0
Mn-54	<15.9	<11.2	<12.3	<42.4	<10.9
Fe-59	<43.6	<42.1	<46.7	<99.0	<35.0
Co-58	<17.0	<11.5	<17.3	<51.5	<13.3
Co-60	<18.6	<11.8	<11.3	<38.0	<12.3
Cs-134	<13.1	<11.1	<13.6	<39.2	<8.0
Cs-137	<17.3	<11.6	<14.0	<49.3	<12.7

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-A (pCi/kg WET)
1990

Analysis	CARP (07/19/90)	RIVER CARPSUCKER (07/19/90)	CHANNEL CATFISH (07/19/90)	FLATHEAD CATFISH (07/19/90)	GIZZARD SHAD (07/19/90)
Gross Alpha	55.0 ± 30.0	<65.0	52.0 ± 34.0	106.0 ± 52.0	<79.0
Gross Beta	2478.0 ± 84.0	3120.0 ± 162.0	2818.0 ± 116 ?	3062.0 ± 127.0	3030.0 ± 155.0
Sr-89	<13.6	<3.1	<3.4	<8.3	<17.6
Sr-90	<8.4	<1.4	<1.6	<4.0	<8.0
K-40	2026.0 ± 174.0	2470.0 ± 264.0	2439.0 ± 281.0	2443.0 ± 293.0	2630.0 ± 292.0
Mn-54	<11.3	<12.5	<11.6	<11.3	<14.5
Fe-59	<32.2	<33.6	<40.5	<31.2	<48.8
Co-58	<13.4	<13.6	<14.5	<12.2	<19.7
Co-60	<9.5	<14.1	<12.3	<12.1	<15.5
Cs-134	<9.8	<10.7	<9.0	<8.5	<14.9
Cs-137	<10.3	<12.0	<10.7	<10.5	<15.1

Analysis	CARP (08/09/90)	BLUE SUCKER (08/09/90)	FRESHWATER DRUM (08/09/90)	FLATHEAD CATFISH (08/09/90)	GOLDEYE (08/09/90)
Gross Alpha	<54.0	<67.0	114.0 ± 54.0	<64.0	56.0 ± 40.0
Gross Beta	2838.0 ± 86.0	2216.0 ± 105.0	2997.0 ± 140.0	2673.0 ± 112.0	2597.0 ± 111.0
Sr-89	<5.1	<4.9	<11.1	<2.4	<7.8
Sr-90	<2.3	<1.4	<4.3	<1.1	<3.1
K-40	2632.0 ± 286.0	2010.0 ± 310.0	2310.0 ± 289.0	2622.0 ± 385.0	2178.0 ± 447.0
Mn-54	<17.4	<17.9	<22.5	<17.4	<18.8
Fe-59	<46.2	<44.4	<50.4	<49.3	<63.0
Co-58	<19.4	<20.0	<24.0	<18.5	<20.2
Co-60	<16.9	<18.2	<18.9	<15.3	<20.2
Cs-134	<12.8	<14.4	<20.3	<11.0	<20.7
Cs-137	<15.3	<19.2	<21.2	<13.8	<23.7

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-A (pCi/kg WET)
1990

Analysis	BIGMOUTH BUFFALO (09/18/90)	BLUE SUCKER (09/18/90)	RIVER CARPSUCKER (09/18/90)	CARP (09/18/90)	FRESHWATER DRUM (09/18/90)
Gross Alpha	<41.0	65.0 ± 46.0	106.0 ± 54.0	<49.0	<39.0
Gross Beta	3157.0 ± 94.0	3249.0 ± 148.0	3082.0 ± 142.0	3050.0 ± 148.0	2667.0 ± 129.0
Sr-89	<2.4	<2.5	<4.0	<11.5	<2.4
Sr-90	<1.2	<1.4	<2.1	6.9 ± 4.2	<1.2
K-40	3240.0 ± 201.0	2767.0 ± 452.0	2919.0 ± 368.0	3353.0 ± 454.0	3020.0 ± 408.0
Mn-54	<12.3	<20.6	<15.6	<18.6	<18.6
Fe-59	<29.3	<56.5	<47.8	<40.0	<53.7
Co-58	<11.0	<19.8	<16.7	<20.4	<22.0
Co-60	<11.7	<23.8	<22.2	<21.3	<20.5
Cs-134	<8.5	<17.0	<10.7	<14.9	<17.8
Cs-137	<11.5	<18.8	<15.2	<21.6	<20.8

Analysis	BLUE CATFISH (10/09/90)	RIVER CARPSUCKER (10/09/90)	GIZZARD SHAD (10/09/90)	FRESHWATER DRUM (10/09/90)	CARP (10/09/90)
Gross Alpha	<50.0	53.0 ± 41.0	<98.0	<89.0	<82.0
Gross Beta	2956.0 ± 122.0	2944.0 ± 129.0	2802.0 ± 132.0	2358.0 ± 97.0	2955.0 ± 130.0
Sr-89	<10.2	<4.6	<5.2	<6.5	<4.9
Sr-90	<6.8	<2.9	<2.9	<3.4	<2.5
K-40	2514.0 ± 225.0	2297.0 ± 435.0	2664.0 ± 479.0	2821.0 ± 385.0	3143.0 ± 478.0
Mn-54	<10.4	<17.8	<22.0	<16.6	<22.8
Fe-59	<26.3	<64.2	<62.3	<49.5	<51.9
Co-58	<11.2	<22.8	<23.9	<16.4	<20.8
Co-60	<8.8	<21.0	<17.0	<19.4	<22.8
Cs-134	<9.0	<20.8	<16.0	<14.6	<20.2
Cs-137	<11.3	<21.3	<24.6	<18.3	<25.2

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-A (pCi/kg WET)
1990

Analysis	CHANNEL CATFISH (11/14/90)	CARP (11/14/90)	RIVER CARPSUCKER (11/14/90)	FRESHWATER DRUM (11/14/90)	GIZZARD SHAD (11/14/90)
Gross Alpha	<51.0	<50.0	157.0 ± 60.0	<40.0	<69.0
Gross Beta	3005.0 ± 120.0	2997.0 ± 126.0	3055.0 ± 120.0	2109.0 ± 68.0	2789.0 ± 126.0
Sr-89	<2.2	<1.9	<3.5	<3.7	<2.3
Sr-90	<1.4	<1.2	<2.2	<2.5	<1.5
K-40	2777.0 ± 481.0	2584.0 ± 470.0	2620.0 ± 279.0	2250.0 ± 308.0	2650.0 ± 320.0
Mn-54	<21.6	<20.9	<20.0	<24.1	<26.2
Fe-59	<63.5	<63.3	<50.6	<54.1	<53.6
Co-58	<20.8	<22.8	<22.7	<24.7	<26.2
Co-60	<33.6	<23.9	<21.8	<19.5	<24.3
Cs-134	<19.0	<20.0	<17.4	<17.3	<20.7
Cs-137	<24.9	<22.9	<20.9	<23.2	<23.8

Analysis	CARP (12/17/90)	RIVER CARPSUCKER (12/17/90)	GOLDEYE (12/17/90)	GIZZARD SHAD (12/17/90)	BIGMOUTH BUFFALO (12/17/90)
Gross Alpha	<30.0	<40.0	<42.0	162.0 ± 49.0	79.0 ± 34.0
Gross Beta	2202.0 ± 67.0	2558.0 ± 75.0	2448.0 ± 81.0	2605.0 ± 81.0	2639.0 ± 75.0
Sr-89	<2.9	<3.0	<4.2	<4.1	<3.1
Sr-90	<2.4	<2.4	<3.4	<3.2	<2.4
K-40	3096.0 ± 430.0	1697.0 ± 356.0	3031.0 ± 463.0	2466.0 ± 247.0	2540.0 ± 273.0
Mn-54	<17.6	<18.1	<23.9	<12.3	<17.5
Fe-59	<38.3	<44.5	<67.7	<38.8	<43.1
Co-58	<19.2	<18.0	<24.0	<15.0	<19.2
Co-60	<21.2	<9.3	<23.4	<11.6	<17.1
Cs-134	<15.8	<14.0	<15.4	<10.7	<16.1
Cs-137	<17.9	<17.7	<19.0	<10.7	<17.3

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1990

Analysis	CHANNEL CATFISH (01/09/90)	BIGMOUTH BUFFALO (01/09/90)	RIVER CARPSUCKER (01/09/90)	SHORTHEAD REDHORSE (01/09/90)	GIZZARD SHAD (01/09/90)
Gross Alpha	97.0 ± 55.0	44.0 ± 31.0	98.0 ± 55.0	89.. ± 45.0	95.0 ± 57.0
Gross Beta	3555.0 ± 147.0	2683.0 ± 111.0	3164.0 ± 142.0	3245.0 ± 144.0	3234.0 ± 150.0
Sr-89	<4.2	<2.9	<5.3	<11.3	<5.8
Sr-90	<3.7	<2.5	<4.5	<11.5	<5.2
K-40	2655.0 ± 278.0	2446.0 ± 257.0	2967.0 ± 854.0	1611.0 ± 608.0	3030.0 ± 293.0
Mn-54	<11.5	<13.5	<41.9	<47.6	<12.0
Fe-59	<26.1	<27.8	<108.3	<100.6	<28.5
Co-58	<10.0	<11.0	<58.8	<48.0	<12.8
Co-60	<10.4	<12.4	<40.2	<35.6	<13.1
Cs-134	<9.0	<9.5	<41.8	<35.6	<10.3
Cs-137	<11.0	<11.8	<52.0	<41.3	<12.4

Analysis	FRESHWATER DRUM (02/26/90)	RIVER CARPSUCKER (02/26/90)	GOLDEYE (02/26/90)	GIZZARD SHAD (02/26/90)	BIGMOUTH BUFFALO (02/26/90)
Gross Alpha	58.0 ± 38.0	73.0 ± 30.0	43.0 ± 22.0	99.0 ± 31.0	<41.0
Gross Beta	3153.0 ± 129.0	2747.0 ± 82.0	2850.0 ± 72.0	3145.0 ± 79.0	2694.0 ± 118.0
Sr-89	<5.0	<4.2	<2.9	<7.7	<4.7
Sr-90	<4.2	<4.2	<3.0	<6.1	<4.3
K-40	2515.0 ± 296.0	2612.0 ± 301.0	2362.0 ± 383.0	2050.0 ± 275.0	2237.0 ± 326.0
Mn-54	<14.6	<13.3	<16.8	<23.6	<11.8
Fe-59	<40.9	<38.9	<44.1	<48.2	<33.0
Co-58	<12.5	<10.0	<17.9	<22.4	<13.0
Co-60	<16.2	<13.6	<20.1	<22.6	<9.6
Cs-134	<12.9	<10.2	<14.9	<20.0	<11.4
Cs-137	<15.3	<15.4	<15.3	<21.8	<12.4

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1990

Analysis	CARP (03/13/90)	RIVER CARPSUCKER (03/13/90)	BIGMOUTH BUFFALO (03/13/90)	CHANNEL CATFISH (03/13/90)	GIZZARD SHAD (03/13/90)
Gross Alpha	<40.0	108.0 ± 59.0	78.0 ± 52.0	<45.0	<64.0
Gross Beta	3334.0 ± 145.0	2984.0 ± 134.0	3393.0 ± 147.0	3088.0 ± 134.0	3075.0 ± 165.0
Sr-89	<6.9	<11.9	<9.3	<3.9	<8.3
Sr-90	<5.3	<9.9	<7.9	<3.8	<7.9
K-40	2932.0 ± 466.0	2740.0 ± 286.0	2709.0 ± 234.0	2785.0 ± 281.0	2727.0 ± 367.0
Mn-54	<16.0	<12.9	<8.1	<11.3	<16.0
Fe-59	<52.1	<32.6	<22.7	<32.6	<39.8
Co-58	<22.2	<16.7	<8.3	<13.0	<15.2
Co-60	<22.0	<15.5	<8.4	<12.9	<13.1
Cs-134	<15.7	<13.0	<6.4	<10.7	<12.7
Cs-137	<20.2	<14.2	<8.0	<12.0	<14.5

Analysis	CHANNEL CATFISH (04/23/90)	CARP (04/23/90)	RIVER CARPSUCKER (04/23/90)	GIZZARD SHAD (04/23/90)	SHORTNOSE GAR (04/23/90)
Gross Alpha	27.0 ± 9.0	171.0 ± 65.0	<59.0	<52.0	67.0 ± 49.0
Gross Beta	3468.0 ± 152.0	3717.0 ± 156.0	3680.0 ± 183.0	3267.0 ± 160.0	2544.0 ± 131.0
Sr-89	<4.3	<3.7	<5.6	<3.2	<2.9
Sr-90	<3.2	<3.4	<5.1	<2.8	2.6 ± 1.6
K-40	3086.0 ± 470.0	2860.0 ± 268.0	2803.0 ± 458.0	2754.0 ± 333.0	2070.0 ± 262.0
Mn-54	<17.6	<13.0	<19.4	<11.2	<14.2
Fe-59	<40.3	<33.1	<53.9	<39.2	<30.3
Co-58	<17.0	<14.4	<17.5	<14.6	<14.4
Co-60	<17.8	<13.7	<21.5	<11.4	<14.0
Cs-134	<13.8	<12.1	<18.2	<9.7	<12.7
Cs-137	<16.6	<12.4	<18.7	<12.4	<13.0

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1990

Analysis	CHANNEL CATFISH (05/24/90)	CARP (05/24/90)	FRESHWATER DRUM (05/24/90)	RIVER CARPSUCKER (05/24/90)	GIZZARD SHAD (05/24/90)
Gross Alpha	153.0 ± 64.0	209.0 ± 67.0	204.0 ± 68.0	115.0 ± 42.0	157.0 ± 85.0
Gross Beta	3082.0 ± 139.0	3226.0 ± 137.0	3084.0 ± 143.0	3280.0 ± 107.0	3254.0 ± 175.0
Sr-89	<8.6	<11.0	<9.3	<4.5	<4.9
Sr-90	<5.4	<6.0	<4.6	<2.9	<3.0
K-40	2769.0 ± 416.0	2950.0 ± 462.0	2662.0 ± 419.0	2962.0 ± 311.0	2997.0 ± 469.0
Mn-54	<20.1	<18.0	<12.[illegible]	<23.7	<21.9
Fe-59	<49.9	<62.6	<49.9	<71.4	<72.9
Co-58	<21.0	<18.8	<16.5	<23.2	<23.8
Co-60	<17.9	<16.8	<18.0	<26.8	<24.6
Cs-134	<16.9	<15.3	<12.5	<22.7	<20.8
Cs-137	<18.1	<22.9	<15.8	<24.3	<18.0

Analysis	SMALLMOUTH BUFFALO (06/26/90)	CARP (06/26/90)	RIVER CARPSUCKER (06/26/90)	GOLDEYE (06/26/90)	GIZZARD SHAD (06/26/90)
Gross Alpha	<75.0	<61.0	<58.0	<62.0	<66.0
Gross Beta	3245.0 ± 151.0	2616.0 ± 127.0	2985.0 ± 141.0	3055.0 ± 157.0	3524.0 ± 178.0
Sr-89	<14.3	<15.2	<8.5	<10.6	<5.8
Sr-90	<7.1	<8.8	<4.9	<5.5	<3.0
K-40	2610.0 ± 273.0	2901.0 ± 452.0	2400.0 ± 296.0	2475.0 ± 400.0	2750.0 ± 371.0
Mn-54	<12.8	<18.3	<24.1	<15.3	<16.6
Fe-59	<37.8	<54.4	<55.4	<41.9	<40.8
Co-58	<14.2	<20.5	<26.4	<16.5	<17.0
Co-60	<14.8	<22.7	<22.0	<17.9	<14.6
Cs-134	<13.7	<10.7	<19.7	<14.8	<15.2
Cs-137	<13.9	<15.7	<23.5	<15.4	<17.2

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1990

Analysis	CHANNEL CATFISH (07/19/90)	CARP (07/19/90)	FLATHEAD CATFISH (07/19/90)	SMALLMOUTH BUFFALO (07/19/90)	BLUE SUCKER (07/19/90)
Gross Alpha	<45.0	<60.0	55.0 ± 40.0	<55.0	<50.0
Gross Beta	2855.0 ± 119.0	3307.0 ± 149.0	3025.0 ± 126.0	3127.0 ± 145.0	3033.0 ± 144.0
Sr-89	<7.5	<4.9	<15.1	<4.4	<4.4
Sr-90	<3.6	<2.1	<7.0	<2.0	<1.9
K-40	2485.0 ± 312.0	2958.0 ± 344.0	2760.0 ± 316.0	2370.0 ± 322.0	2840.0 ± 363.0
Mn-54	<13.6	<14.8	<15.0	<15.6	<15.0
Fe-59	<28.9	<36.3	<40.7	<50.4	<46.2
Co-58	<17.8	<14.6	<15.7	<17.9	<20.1
Co-60	<10.6	<14.5	<16.7	<19.1	<20.0
Cs-134	<9.8	<12.4	<13.0	<14.1	<13.8
Cs-137	<12.9	<12.4	<14.5	<16.2	<18.0

Analysis	CARP (08/09/90)	CHANNEL CATFISH (08/09/90)	FLATHEAD CATFISH (08/09/90)	FRESHWATER DRUM (08/09/90)	RIVER CARPSUCKER (08/09/90)
Gross Alpha	<64.0	<55.0	188.0 ± 60.0	<54.0	<76.0
Gross Beta	2602.0 ± 108.0	1999.0 ± 89.0	3082.0 ± 119.0	2394.0 ± 117.0	2760.0 ± 86.0
Sr-89	<4.3	<9.2	<4.5	<3.1	<3.0
Sr-90	<2.7	<4.1	<2.0	<1.3	<1.2
K-40	2620.0 ± 294.0	2304.0 ± 444.0	2370.0 ± 270.0	2605.0 ± 504.0	2772.0 ± 338.0
Mn-54	<24.5	<16.6	<21.3	<22.1	<19.2
Fe-59	<58.4	<43.6	<52.2	<95.5	<75.2
Co-58	<22.5	<24.6	<25.4	<27.1	<20.7
Co-60	<18.8	<27.5	<20.3	<33.4	<16.5
Cs-134	<19.2	<17.3	<16.3	<23.9	<17.0
Cs-137	<21.4	<24.8	<20.2	<25.6	<17.7

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1990

Analysis	CARP (09/18/90)	CHANNEL CATFISH (09/18/90)	BIGMOUTH BUFFALO (09/18/90)	RIVER CARPSUCKER (09/18/90)	BLUE SUCKER (09/18/90)
Gross Alpha	70.0 ± 43.0	49.0 ± 38.0	124.0 ± 56.0	<39.0	138.0 ± 64.0
Gross Beta	3336.0 ± 148.0	2896.0 ± 140.0	3632.0 ± 146.0	2595.0 ± 106.0	3572.0 ± 163.0
Sr-89	<16.1	<3.8	<3.0	<3.4	<3.6
Sr-90	<8.5	<2.2	<1.6	<1.7	<2.0
K-40	3170.0 ± 306.0	2770.0 ± 314.0	2864.0 ± 453.0	3219.0 ± 446.0	2798.0 ± 405.0
Mn-54	<15.7	<14.0	<23.4	<19.6	<15.3
Fe-59	<37.0	<36.0	<63.0	<52.3	<44.1
Co-58	<15.9	<15.3	<20.1	<18.5	<18.3
Co-60	<13.7	<17.5	<19.4	<26.0	<18.5
Cs-134	<14.5	<11.7	<19.6	<15.5	<14.8
Cs-137	<14.4	<15.5	<22.9	<17.4	<17.0

Analysis	CHANNEL CATFISH (10/09/90)	CARP (10/09/90)	GIZZARD SHAD (10/09/90)	RIVER CARPSUCKER (10/09/90)	FRESHWATER DRUM (10/09/90)
Gross Alpha	<64.0	64.0 ± 42.0	112.0 ± 68.0	<122.0	<76.0
Gross Beta	2904.0 ± 102.0	3125.0 ± 137.0	3254.0 ± 160.0	3506.0 ± 175.0	2802.0 ± 85.0
Sr-89	<4.3	<1.1	<10.6	<2.2	<3.6
Sr-90	<2.3	1.1 ± 0.5	<5.8	<1.3	<1.9
K-40	3204.0 ± 569.0	3189.0 ± 514.0	2947.0 ± 561.0	2981.0 ± 460.0	2825.0 ± 313.0
Mn-54	<27.5	<19.7	<26.9	<18.6	<19.7
Fe-59	<57.0	<60.6	<90.0	<57.1	<61.3
Co-58	<24.7	<21.9	<23.3	<19.4	<16.8
Co-60	<24.8	<20.2	<27.1	<24.9	<14.5
Cs-134	<23.3	<16.0	<23.6	<16.6	<14.7
Cs-137	<20.9	<22.4	<28.3	<22.4	<17.7

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1990

Analysis	FRESHWATER DRUM (11/14/90)	CHANNEL CATFISH (11/14/90)	RIVER CARPSUCKER (11/14/90)	GIZZARD SHAD (11/14/90)	SHORTHEAD REDHORSE (11/14/90)
Gross Alpha	73.0 ± 33.0	<43.0	<51.0	63.0 ± 41.0	58.0 ± 32.0
Gross Beta	2310.0 ± 65.0	2418.0 ± 47.0	2370.0 ± 110.0	2403.0 ± 86.0	2328.0 ± 73.0
Sr-89	<3.5	<2.9	<3.0	<2.9	<3.9
Sr-90	<2.3	<1.9	<1.8	<1.6	<2.3
K-40	2625.0 ± 427.0	2740.0 ± 228.0	3083.0 ± 516.0	2520.0 ± 261.0	2900.0 ± 299.0
Mn-54	<20.3	<19.4	<21.9	<12.7	<16.4
Fe-59	<76.6	<48.4	<75.9	<37.5	<42.3
Co-58	<26.9	<20.0	<24.6	<12.9	<16.3
Co-60	<23.8	<19.8	<27.5	<15.3	<15.7
Cs-134	<20.2	<15.9	<16.6	<11.4	<13.1
Cs-137	<22.2	<15.0	<25.2	<13.5	<12.8

Analysis	CARP (12/17/90)	GOLDEYE (12/17/90)	SHORTHEAD REDHORSE (12/17/90)	FRESHWATER DRUM (12/17/90)	RIVER CARPSUCKER (12/17/90)
Gross Alpha	39.0 ± 25.0	<43.0	55.0 ± 30.0	116.0 ± 49.0	63.0 ± 32.0
Gross Beta	2366.0 ± 66.0	2448.0 ± 81.0	2554.0 ± 80.0	2471.0 ± 74.0	2665.0 ± 78.0
Sr-89	<2.7	<2.8	<3.5	<4.2	<2.6
Sr-90	<2.2	<2.4	<3.4	<3.4	<2.3
K-40	2733.0 ± 472.0	2560.0 ± 363.0	2810.0 ± 468.0	1843.0 ± 484.0	2620.0 ± 374.0
Mn-54	<19.7	<18.3	<17.2	<26.8	<19.8
Fe-59	<56.4	<54.6	<59.5	<62.7	<52.6
Co-58	<23.5	<21.0	<25.0	<23.9	<21.8
Co-60	<28.5	<19.4	<23.7	<33.5	<24.4
Cs-134	<19.3	<19.2	<18.0	<22.5	<18.3
Cs-137	<21.9	<20.4	<20.1	<23.3	<18.6

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-D (pCi/kg WET)
1990

Analysis	FRESHWATER DRUM (01/10/90)	CHANNEL CATFISH (01/10/90)	RIVER CARPSUCKER (01/10/90)	CARP (01/10/90)	BLUE CATFISH (01/10/90)
Gross Alpha	<58.0	176.0 ± 57.0	<59.0	114.0 ± 51.0	<46.0
Gross Beta	3116.0 ± 140.0	3061.0 ± 121.0	3246.0 ± 135.0	2869.0 ± 121.0	2977.0 ± 116.0
Sr-89	<3.1	<3.6	<4.1	<2.6	<3.1
Sr-90	<3.5	<3.3	<2.9	<2.5	<2.8
K-40	2380.0 ± 271.0	2711.0 ± 315.0	2588.0 ± 268.0	2470.0 ± 320.0	3035.0 ± 321.0
Mn-54	<12.9	<14.9	<10.0	<15.5	<14.2
Fe-59	<30.0	<36.3	<31.9	<41.3	<44.9
Co-58	<10.0	<13.7	<11.5	<13.5	<13.6
Co-60	<12.4	<10.9	<10.1	<14.7	<14.7
Cs-134	<10.6	<11.4	<9.9	<11.4	<9.2
Cs-137	<13.5	<12.5	<12.4	<14.2	<12.5

Analysis	BLUE CATFISH (02/23/90)	CHANNEL CATFISH (02/23/90)	CARP (02/23/90)	RIVER CARPSUCKER (02/23/90)	GIZZARD SHAD (02/23/90)
Gross Alpha	140.0 ± 20.0	<39.0	58.0 ± 43.0	<50.0	<56.0
Gross Beta	3247.0 ± 49.0	3091.0 ± 127.0	2922.0 ± 135.0	2825.0 ± 136.0	2461.0 ± 136.0
Sr-89	<3.5	<6.8	<5.7	<3.2	<4.1
Sr-90	<2.9	<5.8	<4.8	<2.6	<3.1
K-40	3168.0 ± 297.0	2610.0 ± 504.0	2430.0 ± 261.0	2262.0 ± 245.0	3048.0 ± 404.0
Mn-54	<14.6	<19.8	<14.1	<11.2	<15.7
Fe-59	<41.6	<52.9	<29.9	<29.2	<43.1
Co-58	<16.7	<22.8	<12.3	<12.0	<13.5
Co-60	<21.9	<24.3	<12.5	<13.9	<19.1
Cs-134	<14.9	<16.5	<11.0	<9.8	<13.6
Cs-137	<14.4	<19.6	<12.7	<11.8	<14.6

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-D (pCi/kg WET)
1990

Analysis	CARP (03/14/90)	BLUE CATFISH (03/14/90)	BLUE SUCKER (03/14/90)	RIVER CARPSUCKER (03/14/90)	SMALLMOUTH BUFFALO (03/14/90)
Gross Alpha	<61.0	56.0 ± 39.0	<48.0	83.0 ± 50.0	60.0 ± 44.0
Gross Beta	3334.0 ± 149.0	3235.0 ± 133.0	3098.0 ± 102.0	2753.0 ± 135.0	3270.0 ± 146.0
Sr-89	<5.7	<7.5	<8.4	<3.7	<4.1
Sr-90	<5.0	<6.8	<6.8	<2.7	<3.2
K-40	2765.0 ± 230.0	2778.0 ± 356.0	2225.0 ± 166.0	2375.0 ± 319.0	2550.0 ± 235.0
Mn-54	<10.6	<18.1	<18.4	<16.3	<11.7
Fe-59	<25.4	<46.9	<41.1	<44.4	<29.4
Co-58	<9.1	<18.0	<18.9	<13.7	<12.9
Co-60	<8.0	<20.0	<15.8	<14.8	<14.0
Cs-134	<8.2	<13.7	<15.2	<12.4	<10.8
Cs-137	<10.4	<18.2	<17.4	<14.0	<11.0

Analysis	RIVER CARPSUCKER (04/20/90)	CARP (04/20/90)	SMALLMOUTH BUFFALO (04/20/90)	CHANNEL CATFISH (04/20/90)	PADDLEFISH (04/20/90)
Gross Alpha	127.0 ± 55.0	69.0 ± 47.0	<69.0	46.0 ± 30.0	158.0 ± 71.0
Gross Beta	2918.0 ± 136.0	3036.0 ± 136.0	3234.0 ± 156.0	2893.0 ± 104.0	3439.0 ± 167.0
Sr-89	<2.3	<2.7	<3.4	<3.4	<4.7
Sr-90	<1.6	<2.0	<3.1	<2.3	<3.7
K-40	2586.0 ± 352.0	2764.0 ± 429.0	2470.0 ± 211.0	2602.0 ± 203.0	2560.0 ± 295.0
Mn-54	<16.1	<19.6	<10.3	<11.3	<27.0
Fe-59	<48.4	<43.6	<27.4	<29.1	<60.0
Co-58	<18.8	<22.6	<10.9	<11.7	<26.5
Co-60	<17.6	<21.0	<10.6	<11.0	<24.6
Cs-134	<12.6	<17.2	<9.6	<9.6	<21.0
Cs-137	<15.7	<19.6	<10.0	<11.6	<21.0

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-D (pCi/kg WET)
1990

Analysis	CHANNEL CATFISH (05/04/90)	FRESHWATER DRUM (05/04/90)	CARP (05/04/90)	WHITE BASS (05/04/90)	GIZZARD SHAD (05/04/90)
Gross Alpha	<36.0	<102.0	<112.0	82.0 ± 45.0	162.0 ± 76.0
Gross Beta	2824.0 ± 90.0	2984.0 ± 137.0	3153.0 ± 146.0	3014.0 ± 140.0	3158.0 ± 156.0
Sr-89	<5.1	<8.3	<4.7	<3.8	<4.3
Sr-90	<4.4	<5.7	<3.3	<2.8	<3.1
K-40	2775.0 ± 214.0	2630.0 ± 348.0	2620.0 ± 257.0	2800.0 ± 204.0	3053.0 ± 243.0
Mn-54	<12.2	<16.5	<12.5	<9.3	<10.7
Fe-59	<31.1	<42.4	<27.0	<22.1	<25.6
Co-58	<12.9	<16.8	<14.5	<9.5	<10.2
Co-60	<12.1	<18.6	<12.3	<8.6	<10.6
Cs-134	<10.1	<14.7	<10.3	<8.5	<10.0
Cs-137	<11.6	<15.9	<12.5	<9.0	<12.0

Analysis	PADDLEFISH (06/25/90)	CHANNEL CATFISH (06/25/90)	SMALLMOUTH BUFFALO (06/25/90)	CARP (06/25/90)	FRESHWATER DRUM (06/25/90)
Gross Alpha	77.0 ± 49.0	56.0 ± 42.0	54.0 ± 40.0	<52.0	70.0 ± 44.0
Gross Beta	2650.0 ± 133.0	2952.0 ± 134.0	2837.0 ± 134.0	2807.0 ± 93.0	2770.0 ± 129.0
Sr-89	<6.3	<5.0	<6.6	<6.0	<8.3
Sr-90	<3.2	<2.3	<3.2	<3.2	<4.1
K-40	2264.0 ± 346.0	2888.0 ± 261.0	2300.0 ± 284.0	2634.0 ± 271.0	2630.0 ± 356.0
Mn-54	<13.6	<11.8	<23.5	<16.3	<31.4
Fe-59	<65.0	<32.0	<55.3	<41.8	<74.2
Co-58	<17.9	<12.6	<20.6	<15.4	<34.1
Co-60	<14.3	<12.5	<19.7	<16.9	<29.8
Cs-134	<11.0	<10.1	<19.7	<13.6	<24.3
Cs-137	<15.5	<11.8	<20.6	<16.4	<25.7

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-D (pCi/kg WET)
1990

Analysis	CHANNEL CATFISH (07/13/90)	CARP (07/13/90)	SMALLMOUTH BUFFALO (07/13/90)	GIZZARD SHAD (07/13/90)	LONGNOSE GAR (07/13/90)
Gross Alpha	<50.0	90.0 ± 49.0	154.0 ± 68.0	113.0 ± 70.0	75.0 ± 43.0
Gross Beta	3210.0 ± 132.0	3528.0 ± 156.0	3257.0 ± 155.0	3479.0 ± 191.0	2933.0 ± 128.0
Sr-89	<4.7	<7.9	<15.4	<24.9	<3.9
Sr-90	<2.0	<3.3	<7.1	<10.9	<1.5
K-40	2570.0 ± 291.0	3357.0 ± 470.0	3019.0 ± 422.0	1930.0 ± 290.0	2280.0 ± 320.0
Mn-54	<22.8	<18.4	<19.0	<27.7	<24.7
Fe-59	<54.8	<47.0	<39.7	<66.0	<69.3
Co-58	<25.5	<20.0	<16.2	<28.8	<30.2
Co-60	<22.4	<21.3	<20.1	<20.3	<26.3
Cs-134	<18.4	<11.8	<13.4	<21.0	<20.7
Cs-137	<21.1	<16.7	<18.2	<23.7	<27.1

Analysis	CHANNEL CATFISH (08/01/90)	WHITE BASS (08/01/90)	FRESHWATER DRUM (08/01/90)	SMALLMOUTH BUFFALO (08/01/90)	CARP (08/01/90)
Gross Alpha	<44.0	<50.0	<68.0	<77.0	<56.0
Gross Beta	2445.0 ± 70.0	3200.0 ± 133.0	2653.0 ± 113.0	2540.0 ± 122.0	2765.0 ± 129.0
Sr-89	<2.4	<2.9	<4.3	<7.8	<6.7
Sr-90	<0.9	<1.2	<1.8	<3.4	<2.6
K-40	2580.0 ± 221.0	2360.0 ± 313.0	2880.0 ± 469.0	3148.0 ± 540.0	2310.0 ± 314.0
Mn-54	<26.2	<23.3	<18.1	<26.4	<27.6
Fe-59	<67.6	<76.8	<78.5	<77.4	<88.8
Co-58	<33.3	<32.0	<21.7	<23.6	<32.2
Co-60	<25.6	<23.1	<18.9	<27.1	<25.3
Cs-134	<20.2	<21.7	<18.6	<17.2	<22.5
Cs-137	<25.7	<26.4	<24.8	<30.4	<22.4

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-D (pCi/kg WET)
1990

Analysis	CARP (09/19/90)	FRESHWATER DRUM (09/19/90)	RIVER CARPSUCKER (09/19/90)	SMALLMOUTH BUFFALO (09/19/90)	CHANNEL CATFISH (09/19/90)
Gross Alpha	<51.0	<51.0	<64.0	70.0 ± 50.0	40.0 ± 32.0
Gross Beta	2905.0 ± 92.0	2770.0 ± 127.0	3225.0 ± 160.0	3460.0 ± 150.0	3130.0 ± 128.0
Sr-89	<4.5	<9.7	<13.0	<15.5	<12.1
Sr-90	<2.1	<5.0	<6.4	<6.9	<5.9
K-40	2834.0 ± 215.0	2670.0 ± 348.0	2730.0 ± 287.0	2745.0 ± 400.0	2939.0 ± 360.0
Mn-54	<12.1	<26.2	<21.4	<18.2	<15.4
Fe-59	<31.3	<61.0	<50.8	<56.0	<42.8
Co-58	<13.3	<24.4	<22.7	<19.8	<13.8
Co-60	<11.1	<23.7	<18.5	<18.5	<13.2
Cs-134	<9.3	<24.3	<19.1	<14.6	<10.3
Cs-137	<9.6	<23.9	<20.5	<17.6	<15.4

Analysis	BLUE CATFISH (10/05/90)	CARP (10/05/90)	CHANNEL CATFISH (10/05/90)	FRESHWATER DRUM (10/05/90)	SMALLMOUTH BUFFALO (10/05/90)
Gross Alpha	<63.0	<68.0	<69.0	<80.0	<77.0
Gross Beta	2728.0 ± 97.0	2835.0 ± 107.0	2948.0 ± 116.0	2676.0 ± 114.0	2693.0 ± 85.0
Sr-89	<4.3	<6.0	<15.9	<6.9	<3.5
Sr-90	<2.0	<2.4	<9.4	<3.9	<1.8
K-40	2600.0 ± 328.0	3090.0 ± 389.0	3110.0 ± 352.0	2885.0 ± 404.0	3106.0 ± 266.0
Mn-54	<23.9	<16.3	<17.3	<18.1	<12.9
Fe-59	<58.3	<50.0	<40.6	<57.0	<41.3
Co-58	<23.5	<20.7	<17.3	<18.0	<14.0
Co-60	<21.0	<26.6	<16.9	<20.2	<11.3
Cs-134	<18.3	<15.4	<14.6	<13.0	<13.0
Cs-137	<23.5	<17.0	<17.0	<19.0	<11.8

Notes:

TABLE E12 (Cont.)

FISH, CA-AQF-D (pCi/kg WET)
1990

Analysis	FLATHEAD CATFISH (11/16/90)	CHANNEL CATFISH (11/16/90)	FRESHWATER DRUM (11/16/90)	CARP (11/16/90)	SMALLMOUTH BUFFALO (11/16/90)
Gross Alpha	60.0 ± 27.0	<43.0	69.0 ± 46.0	<50.0	132.0 ± 55.0
Gross Beta	2694.0 ± 68.0	2792.0 ± 104.0	2698.0 ± 115.0	2968.0 ± 118.0	3070.0 ± 126.0
Sr-89	<3.0	<2.0	<2.2	<2.9	<2.3
Sr-90	<1.8	<1.2	<1.3	<1.8	1.6 ± 1.0
K-40	2740.0 ± 228.0	3051.0 ± 410.0	2285.0 ± 424.0	2858.0 ± 488.0	3093.0 ± 392.0
Mn-54	<11.5	<17.1	<24.9	<21.9	<19.7
Fe-59	<32.6	<55.7	<77.1	<65.2	<58.8
Co-58	<11.6	<16.3	<21.2	<24.5	<20.2
Co-60	<12.8	<20.8	<19.4	<20.7	<20.5
Cs-134	<10.1	<11.4	<17.7	<21.6	<14.3
Cs-137	<11.3	<18.5	<20.1	<24.0	<20.5

Analysis	CARP (12/07/90)	CHANNEL CATFISH (12/07/90)	BLUE SUCKER (12/07/90)	FRESHWATER DRUM (12/07/90)	GIZZARD SHAD (12/07/90)
Gross Alpha	<38.0	<38.0	51.0 ± 31.0	41.0 ± 27.0	116.0 ± 42.0
Gross Beta	2624.0 ± 54.0	2306.0 ± 62.0	2746.0 ± 80.0	2520.0 ± 76.0	2847.0 ± 89.0
Sr-89	<4.2	<4.2	<4.5	<4.5	<1.1
Sr-90	<3.6	<3.7	<3.7	<3.6	<0.9
K-40	2720.0 ± 314.0	2723.0 ± 469.0	2400.0 ± 259.0	2694.0 ± 312.0	2320.0 ± 398.0
Mn-54	<17.9	<25.2	<19.5	<21.9	<22.7
Fe-59	<54.4	<45.7	<43.3	<32.5	<56.1
Co-58	<17.4	<21.3	<18.2	<64.1	<19.0
Co-60	<11.7	<25.5	<17.6	<11.9	<14.8
Cs-134	<15.5	<17.0	<16.4	<11.3	<13.9
Cs-137	<18.2	<19.1	<16.8	<16.9	<21.9

Notes:

TABLE E13

THERMOLUMINESCENT DOSIMETRY
1990

LOCATION CODE	FIRST QUARTER FIELD TIME (DAYS)	FIRST QUARTER TOTAL EXPOSURE (MREM ± 2σ)	FIRST QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	SECOND QUARTER FIELD TIME (DAYS)	SECOND QUARTER TOTAL EXPOSURE (MREM ± 2σ)	SECOND QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	THIRD QUARTER FIELD TIME (DAYS)	THIRD QUARTER TOTAL EXPOSURE (MREM ± 2σ)	THIRD QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	FOURTH QUARTER FIELD TIME (DAYS)	FOURTH QUARTER TOTAL EXPOSURE (MREM ± 2σ)	FOURTH QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	ANNUAL FIELD TIME (DAYS)	ANNUAL TOTAL EXPOSURE (MREM ± 2σ)	ANNUAL NET EXPOSURE (MREM/STD QTR ± 2σ)
CA-IDM-01	95.9	16.4 ± 1.9	15.4 ± 1.8	84.1	15.5 ± 0.6	16.6 ± 0.6	92.1	18.5 ± 0.5	18.1 ± 0.5	98.0	13.3 ± 0.8	12.3 ± 0.8	370	45.5 ± 2.2	11.1 ± 0.5
CA-IDM-02	95.9	17.8 ± 2.1	16.7 ± 2.0	84.0	16.9 ± 0.7	18.1 ± 0.7	92.1	18.8 ± 0.8	18.3 ± 0.8	97.9	14.6 ± 0.9	13.4 ± 0.8	370	49.2 ± 1.9	12.0 ± 0.5
CA-IDM-03	90.0	17.2 ± 2.3	17.2 ± 2.3	90.0	16.8 ± 0.4	16.8 ± 0.4	92.0	19.6 ± 0.7	19.1 ± 0.7	98.0	14.5 ± 0.6	13.3 ± 0.5	370	50.9 ± 2.0	12.4 ± 0.5
CA-IDM-04	90.0	14.6 ± 1.6	14.6 ± 1.6	90.0	14.6 ± 0.5	14.6 ± 0.5	92.0	16.3 ± 0.8	15.9 ± 0.8	98.0	11.8 ± 0.7	10.8 ± 0.6	370	39.9 ± 1.7	9.7 ± 0.4
CA-IDM-05	90.0	13.1 ± 1.9	13.1 ± 1.9	89.9	14.4 ± 0.4	14.4 ± 0.4	92.0	15.3 ± 0.4	14.9 ± 0.4	98.0	10.1 ± 0.9	9.3 ± 0.8	370	34.4 ± 1.3	8.4 ± 0.3
CA-IDM-06	95.9	16.9 ± 2.0	15.8 ± 1.9	84.0	16.4 ± 0.8	17.5 ± 0.8	91.8	18.8 ± 0.5	18.4 ± 0.5	98.0	14.3 ± 0.6	13.1 ± 0.5	370	50.7 ± 2.7	12.3 ± 0.7
CA-IDM-07	90.0	17.1 ± 2.1	17.1 ± 2.1	89.9	16.7 ± 0.4	16.7 ± 0.4	92.1	18.4 ± 0.6	18.0 ± 0.6	98.0	14.1 ± 2.3	12.9 ± 2.1	370	47.4 ± 2.7	11.5 ± 0.7
CA-IDM-08	90.0	17.7 ± 2.1	17.7 ± 2.1	89.9	16.9 ± 1.0	17.0 ± 1.0	92.1	20.3 ± 1.0	19.9 ± 1.0	98.0	15.0 ± 1.0	13.8 ± 0.9	370	51.7 ± 3.9	12.6 ± 0.9
CA-IDM-09	90.0	18.4 ± 2.2	18.4 ± 2.2	89.9	17.3 ± 0.7	17.3 ± 0.7	92.0	20.4 ± 0.8	19.9 ± 0.8	98.0	15.8 ± 0.9	14.5 ± 0.8	370	50.6 ± 0.6	12.3 ± 0.2
CA-IDM-10	90.0	17.5 ± 1.8	17.5 ± 1.8	89.9	15.9 ± 1.0	15.9 ± 1.0	92.0	18.5 ± 0.7	18.1 ± 0.7	98.0	13.8 ± 0.2	12.7 ± 0.2	370	51.7 ± 3.8	12.6 ± 0.9
CA-IDM-11	90.0	ND	ND	89.9	17.8 ± 0.5	17.8 ± 0.5	92.0	22.6 ± 2.5	22.1 ± 2.4	98.0	16.3 ± 0.6	14.9 ± 0.5	370	ND	ND
CA-IDM-12	90.0	18.1 ± 1.6	18.1 ± 1.6	89.9	16.6 ± 0.8	16.6 ± 0.8	92.1	19.7 ± 0.6	19.3 ± 0.6	98.0	15.3 ± 0.5	14.0 ± 0.5	370	51.2 ± 3.3	12.5 ± 0.8
CA-IDM-13	90.0	18.7 ± 1.8	18.6 ± 1.8	89.9	17.7 ± 0.9	17.7 ± 0.9	92.1	20.2 ± 0.7	19.7 ± 0.6	98.0	15.0 ± 0.6	13.8 ± 0.5	370	53.9 ± 2.2	13.1 ± 0.5
CA-IDM-14	90.0	17.3 ± 1.7	17.3 ± 1.7	89.9	17.7 ± 0.9	17.8 ± 0.9	92.0	19.3 ± 0.4	18.9 ± 0.4	98.0	14.9 ± 0.4	13.7 ± 0.4	370	51.0 ± 1.6	12.4 ± 0.4
CA-IDM-15	90.0	16.2 ± 2.7	16.2 ± 2.7	89.9	16.8 ± 0.6	16.9 ± 0.6	92.0	21.2 ± 6.7	20.7 ± 6.5	98.0	12.9 ± 1.2	11.8 ± 1.1	370	45.9 ± 2.4	11.2 ± 0.6
CA-IDM-16	90.0	16.4 ± 1.9	16.4 ± 1.9	89.9	15.2 ± 0.6	15.2 ± 0.6	92.0	17.4 ± 0.5	17.0 ± 0.5	98.0	11.6 ± 0.4	10.7 ± 0.4	370	43.7 ± 2.9	10.6 ± 0.7
CA-IDM-17	90.0	16.4 ± 1.9	16.4 ± 1.9	89.9	15.7 ± 0.6	15.7 ± 0.6	92.0	19.0 ± 0.5	18.6 ± 0.5	98.0	14.1 ± 1.1	12.9 ± 1.0	370	48.9 ± 2.9	11.9 ± 0.7
CA-IDM-18	90.0	17.9 ± 1.5	17.9 ± 1.5	89.9	16.6 ± 1.4	16.6 ± 1.4	92.0	19.0 ± 0.7	18.5 ± 0.7	98.0	14.4 ± 0.8	13.3 ± 0.7	370	49.7 ± 2.7	12.1 ± 0.6
CA-IDM-19	90.0	17.2 ± 2.1	17.2 ± 2.1	89.9	16.7 ± 0.6	16.7 ± 0.6	92.0	19.2 ± 0.6	18.8 ± 0.6	98.0	14.2 ± 0.3	13.1 ± 0.3	370	49.4 ± 2.3	12.0 ± 0.6
CA-IDM-20	90.0	17.6 ± 2.0	17.6 ± 2.0	90.0	16.4 ± 0.6	16.4 ± 0.6	92.0	19.2 ± 0.6	18.8 ± 0.6	98.0	14.4 ± 1.3	13.2 ± 1.2	370	50.8 ± 3.1	12.4 ± 0.7
CA-IDM-21	90.0	17.1 ± 1.5	17.1 ± 1.5	90.0	17.4 ± 0.9	17.4 ± 0.9	92.0	18.8 ± 1.0	18.4 ± 1.0	98.0	13.7 ± 1.2	12.6 ± 1.1	370	46.4 ± 1.8	11.3 ± 0.4
CA-IDM-22	90.0	17.8 ± 1.7	17.8 ± 1.7	90.0	17.6 ± 0.6	17.6 ± 0.6	92.0	19.1 ± 0.6	18.7 ± 0.6	98.0	14.4 ± 0.7	13.2 ± 0.7	370	51.0 ± 3.1	12.4 ± 0.7
CA-IDM-23	90.0	17.2 ± 2.1	17.2 ± 2.1	90.0	17.2 ± 0.5	17.2 ± 0.5	92.0	19.3 ± 0.4	18.9 ± 0.4	98.0	16.6 ± 3.8	15.3 ± 3.5	370	52.7 ± 2.9	12.8 ± 0.7
CA-IDM-24	90.0	15.8 ± 2.3	15.8 ± 2.3	90.0	15.9 ± 0.7	15.9 ± 0.7	92.0	16.9 ± 0.6	16.5 ± 0.6	98.0	12.2 ± 0.7	11.2 ± 0.7	370	40.9 ± 2.1	9.9 ± 0.5
CA-IDM-25	90.0	18.0 ± 1.3	18.0 ± 1.3	89.9	16.3 ± 0.8	16.3 ± 0.8	92.0	18.5 ± 0.5	18.1 ± 0.5	98.0	13.8 ± 0.9	12.7 ± 0.8	370	45.5 ± 1.8	11.1 ± 0.4
CA-IDM-26	90.0	11.4 ± 1.7	11.4 ± 1.7	89.9	14.4 ± 0.4	14.4 ± 0.4	92.0	12.7 ± 0.3	12.4 ± 0.3	98.0	7.0 ± 0.4	6.4 ± 0.4	370	24.9 ± 2.1	6.1 ± 0.5

Notes: 1. ND = No Data. See section 2.3 for explination.

TABLE E13 (Cont.)

THERMOLUMINESCENT DOSIMETRY
1990

LOCATION CODE	FIRST QUARTER FIELD TIME (DAYS)	FIRST QUARTER TOTAL EXPOSURE (MREM ± 2σ)	FIRST QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	SECOND QUARTER FIELD TIME (DAYS)	SECOND QUARTER TOTAL EXPOSURE (MREM ± 2σ)	SECOND QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	THIRD QUARTER FIELD TIME (DAYS)	THIRD QUARTER TOTAL EXPOSURE (MREM ± 2σ)	THIRD QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	FOURTH QUARTER FIELD TIME (DAYS)	FOURTH QUARTER TOTAL EXPOSURE (MREM ± 2σ)	FOURTH QUARTER NET EXPOSURE (MREM/STD QTR ± 2σ)	ANNUAL FIELD TIME (DAYS)	ANNUAL TOTAL EXPOSURE (MREM ± 2σ)	ANNUAL NET EXPOSURE (MREM/STD QTR ± 2σ)
CA-IDM-27	90.0	17.8 ± 1.4	17.8 ± 1.4	89.9	17.7 ± 1.1	17.8 ± 1.1	92.0	19.8 ± 0.6	19.3 ± 0.6	98.0	14.3 ± 0.6	13.2 ± 0.6	370	49.1 ± 3.3	11.9 ± 0.8
CA-IDM-28	90.0	23.5 ± 2.5	23.5 ± 2.5	180	56.2 ± 2.7	28.1 ± 1.3	92.1	19.5 ± 0.5	19.1 ± 0.5	97.9	14.0 ± 1.6	12.9 ± 1.5	370	49.1 ± 3.6	12.0 ± 0.9
CA-IDM-29	90.0	15.2 ± 2.1	15.1 ± 2.1	89.9	16.2 ± 1.0	16.2 ± 1.0	92.0	16.9 ± 0.5	16.5 ± 0.5	98.0	12.0 ± 0.8	11.1 ± 0.7	370	42.3 ± 1.8	10.3 ± 0.4
CA-IDM-30	90.0	16.9 ± 2.3	16.9 ± 2.3	89.9	22.8 ± 2.0	22.8 ± 2.0	92.1	18.2 ± 0.4	17.8 ± 0.4	98.0	ND	ND	370	ND	ND
CA-IDM-31	90.0	16.6 ± 2.0	16.6 ± 2.0	89.9	17.6 ± 0.8	17.6 ± 0.8	92.1	19.5 ± 0.6	19.0 ± 0.6	97.9	13.6 ± 0.6	12.5 ± 0.5	370	46.3 ± 3.3	11.3 ± 0.8
CA-IDM-32	90.0	17.1 ± 1.5	17.1 ± 1.5	89.9	20.2 ± 4.7	20.2 ± 4.7	92.1	19.1 ± 0.8	18.6 ± 0.7	97.9	12.9 ± 0.9	11.9 ± 0.9	370	49.4 ± 2.5	12.0 ± 0.6
CA-IDM-33	90.0	17.1 ± 1.9	17.1 ± 1.9	89.9	16.6 ± 0.7	16.6 ± 0.7	92.1	18.4 ± 0.6	18.0 ± 0.6	97.9	13.0 ± 0.6	12.0 ± 0.5	370	48.8 ± 2.1	11.9 ± 0.5
CA-IDM-34	95.9	16.1 ± 1.7	15.1 ± 1.6	84.1	16.0 ± 0.6	17.1 ± 0.7	92.1	17.9 ± 0.8	17.5 ± 0.7	98.0	12.1 ± 0.7	11.1 ± 0.6	370	44.6 ± 2.0	10.9 ± 0.5
CA-IDM-35	95.9	15.7 ± 2.4	14.7 ± 2.3	90.1	15.8 ± 0.5	15.8 ± 0.5	92.1	18.0 ± 1.0	17.6 ± 1.0	97.9	11.9 ± 0.6	10.9 ± 0.6	370	43.2 ± 2.6	10.5 ± 0.6
CA-IDM-36	90.0	16.9 ± 2.1	16.9 ± 2.1	90.0	17.1 ± 0.7	17.1 ± 0.7	92.0	18.9 ± 0.8	18.5 ± 0.8	98.0	13.1 ± 0.9	12.0 ± 0.8	370	45.2 ± 1.4	11.0 ± 0.4
CA-IDM-37	90.0	17.5 ± 1.8	17.5 ± 1.8	89.9	17.0 ± 0.5	17.0 ± 0.5	92.1	18.4 ± 0.7	18.0 ± 0.7	98.0	13.3 ± 0.8	12.3 ± 0.7	370	47.3 ± 2.1	11.5 ± 0.5
CA-IDM-38	95.9	13.3 ± 2.1	12.5 ± [illegible].0	84.0	14.4 ± 0.4	15.4 ± 0.4	92.1	13.9 ± 0.3	13.6 ± 0.3	97.9	8.9 ± 0.7	8.2 ± 0.7	370	29.8 ± 2.3	7.3 ± 0.6
CA-IDM-39	95.9	17.6 ± 2.1	16.5 ± [illegible].0	84.0	16.1 ± 0.4	17.2 ± 0.5	92.1	18.9 ± 0.8	18.5 ± 0.8	97.9	14.1 ± 0.6	13.0 ± 0.5	370	45.9 ± 2.3	11.2 ± 0.6
CA-IDM-40	95.9	18.1 ± 2.5	17.0 ± 2.3	84.0	16.5 ± 0.4	17.6 ± 0.4	92.1	19.0 ± 0.4	18.6 ± 0.4	97.9	13.7 ± 0.8	12.6 ± 0.7	370	49.0 ± 2.5	11.9 ± 0.6
CA-IDM-41	90.0	16.8 ± 1.8	16.8 ± 1.8	89.9	16.7 ± 0.5	16.7 ± 0.5	92.1	18.2 ± 0.7	17.8 ± 0.7	97.9	12.5 ± 0.7	11.5 ± 0.6	370	44.1 ± 2.1	10.7 ± 0.5
CA-IDM-42	90.0	13.5 ± 1.8	13.5 ± 1.8	89.9	14.7 ± 0.4	14.7 ± 0.4	92.1	16.2 ± 0.4	15.9 ± 0.4	97.9	10.4 ± 0.6	9.5 ± 0.6	370	34.8 ± 2.3	8.5 ± 0.6
CA-IDM-43	90.0	15.8 ± 1.9	15.8 ± 1.9	89.9	16.8 ± 0.6	16.8 ± 0.6	92.1	18.5 ± 0.8	18.1 ± 0.7	98.0	13.5 ± 0.9	12.4 ± 0.8	370	47.8 ± 2.4	11.6 ± 0.6
CA-IDM-44	90.0	16.5 ± 1.8	16.5 ± 1.8	89.9	17.6 ± 1.1	17.6 ± 1.1	92.1	18.9 ± 0.2	18.4 ± 0.2	98.0	13.1 ± 0.7	12.0 ± 0.6	370	49.1 ± 1.8	11.9 ± 0.4
CA-IDM-45	95.9	16.9 ± 2.0	15.9 ± 1.8	84.0	16.9 ± 0.6	18.1 ± 0.7	91.8	19.1 ± 0.7	18.7 ± 0.7	98.0	13.2 ± 0.8	12.1 ± 0.7	370	43.8 ± 2.8	10.7 ± 0.7
CA-IDM-46	90.0	17.8 ± 1.7	17.8 ± 1.7	90.0	17.2 ± 0.5	17.2 ± 0.5	92.0	19.2 ± 0.5	18.7 ± 0.5	98.0	13.8 ± 0.7	12.7 ± 0.6	370	47.7 ± 2.1	11.6 ± 0.5
CA-IDM-47	90.0	15.9 ± 1.6	15.9 ± 1.6	89.9	16.5 ± 0.8	16.5 ± 0.8	92.0	17.9 ± 0.5	17.5 ± 0.5	98.0	12.8 ± 0.6	11.7 ± 0.6	370	44.1 ± 1.4	10.7 ± 0.3
CA-IDM-48	90.0	16.5 ± 1.9	16.5 ± 1.9	89.9	17.3 ± 0.7	17.3 ± 0.7	92.0	19.4 ± 0.6	19.0 ± 0.6	98.0	15.5 ± 1.7	14.2 ± 1.5	370	49.0 ± 2.4	11.9 ± 0.6
CA-IDM-49	90.0	16.5 ± 1.5	16.5 ± 1.5	89.9	16.4 ± 0.7	16.4 ± 0.7	92.0	18.4 ± 0.9	18.0 ± 0.9	98.0	13.1 ± 0.7	12.1 ± 0.7	370	47.0 ± 2.2	11.4 ± 0.5
CA-IDM-50	90.0	16.7 ± 2.0	16.7 ± 2.0	89.9	16.4 ± 0.6	16.4 ± 0.4	92.1	18.9 ± 0.5	18.5 ± 0.5	98.0	13.9 ± 0.8	12.8 ± 0.7	370	46.9 ± 2.7	11.4 ± 0.7
CA-IDM-51	96.2	17.3 ± 2.4	16.2 ± 2.2	84.0	16.0 ± 1.0	17.2 ± 1.0	91.8	19.5 ± 1.1	19.1 ± 1.0	98.0	14.1 ± 0.7	12.9 ± 0.6	370	49.1 ± 2.5	11.9 ± 0.6
CA-IDM-52	96.2	17.1 ± 1.3	16.0 ± 1.2	85.8	15.8 ± 0.9	16.6 ± 0.9	90.0	18.6 ± 0.3	18.6 ± 0.3	98.0	13.3 ± 0.4	12.2 ± 0.4	370	44.3 ± 2.3	10.8 ± 0.6

Notes: 1. ND = No Data. See section 2.3 for explination.

SECTION 4.0

NON-RADIOLOGICAL ENVIRONMENTAL MONITORING

SECTION 4.0

UNION ELECTRIC COMPANY

CALLAWAY PLANT

NONRADIOLOGICAL ENVIRONMENTAL MONITORING

1990

1.0 INTRODUCTION

During 1990 there was no nonradiological environmental monitoring conducted in the vicinity of the Callaway Plant. This is in agreement with Section 4.2 of Appendix B of the Callaway Plant Operating License. Section 4.2 requires aerial photographic monitoring during the first July 15 - September 15 period after the plant has been in operation for one year and the program repeated once the following year and alternate years for three additional periods. The aerial photographic monitoring was conducted during 1986 and 1987 which satisfied the first two requirements and was conducted during 1989 and will be conducted during 1991, and 1993 to satisfy the last requirement.

SECTION 5.0

PLANT MODIFICATION

ENVIRONMENTAL EVALUATION

SECTION 5.0

UNION ELECTRIC COMPANY

CALLAWAY PLANT

PLANT MODIFICATION

ENVIRONMENTAL EVALUATION

1990

1.0 INTRODUCTION

In accordance with Appendix B, Section 5.4.1 of the Callaway Plant Operating License, the following report was prepared by Union Electric on all changes in plant design, operation, tests or experiments which involved a potentially significant unreviewed environmental question in accordance with Section 3.1 of Appendix B.

The report covers all plant modifications/changes that were completed for January 1, 1990, through December 31, 1990.

During 1990 there were three plant modifications/changes that involved a potentially significant unreviewed environmental question. The interpretations and conclusions regarding these plant modification/changes along with a description of the changes are presented below.

2.0 ENVIRONMENTAL EVALUATIONS

2.1 Callaway Modification Package 87-1022

2.1.1 Description of Change

This change involved relocating the plant security fence, security hardware and utilities to accommodate the expansion of the service building.

2.1.2 Evaluation of Change

The relocating of the plant security fence, security hardware and utilities did not result in a significant increase in any adverse environmental impact, since all measurable non-radiological environmental effects were confined to the areas previously disturbed during site preparation and plant construction. Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating License.

2.2 Callaway Modification Package 89-2007

2.2.1 Description of Change

This change involved rerouting the overflow from the oily waste storage tank and demineralization waste pump station to the equalization basin. Both of the above changes will protect against overflows to the ground or a direct discharge which could result in a violation of the NPDES permit.

2.2.2 Evaluation of Change

Routing of overflows from the oily waste storage tank and demineralization waste pump station to the equalization basin will eliminate violations of the NPDES permit from overflow of untreated waste to the ground or to the plant discharge line. The Missouri Department of Natural Resources (DNR) has reviewed these changes and had no objection to the implementation of this modification. Any modification or construction activity will be confined to areas already disturbed during plant construction and will not impact any cultural resources. Therefore, this change does not constitute an unreviewed environmental question per section 3.1 of Appendix B to the Callaway Plant Operating License.

2.3 Request for Resolution 08388

2.3.1 Description of Change

This change involves temporarily locating three Eastern Technologies, Inc. laundry trailers on site adjacent to the diesel generator building during refuel IV. These trailers were used for wet water washing of protective clothing during refuel IV.

2.3.2 Evaluation of Change

This change is temporary and will not require any changes to plant systems. Water will be supplied to the trailers approximately once per week from the demineralized water system using a temporary hose. Approximately 500-700 gallons of waste water will have to be drained from the trailers holding tanks. This water will be drained using temporary hose to a floor drain located in the auxiliary building which will allow the waste water to be processed by radwaste systems. Since all the utilities required by these trailers will be routed above ground within the plant site, there will be no adverse environmental affects nor will it impact the Callaway Plant NPDES permit. Therefore, this change does not constitute an unreviewed environmental question per section 3.1 of Appendix B to the Callaway Plant Operating License.

2.4 Temporary Modification TM-90-M030

2.4.1 Description of Change

This change involves the temporary routing of the sewage treatment plant effluent to manhole 86-5A located near the sludge valve pit rather than directly to the plant discharge line due to a temporary upset of

the system. This temporary modification will recycle the effluent to the sludge lagoon where it can later be processed and used as make-up to the cooling tower.

2.4.2 Evaluation of Change

This temporary modification will temporarily eliminate outfall 007 which will result in a reduction in adverse impact because it will eliminate the direct discharge of outfall 007 during this upset condition. The Missouri Department of Natural Resources (DNR) has been notified of our intent to utilize this temporary modification and has approved its use. Any modification or construction activity will be confined to areas already disturbed during plant construction and will not impact any cultural resources. Therefore, this change did not constitute an unreviewed environmental question per section 3.1 of Appendix B to the Callaway Plant Operating License.