1901 Chouteau Avenue
Post Office Box 149
St. Louis, Missouri 63166
314-554-2650

UNION ELECTRIC

Donald F. Schnell
Senior Vice President
Nuclear

April 30, 1993

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

ULNRC-2797

Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT
FACILITY OPERATING LICENSE NPF-30
1992 ANNUAL ENVIRONMENTAL OPERATING REPORT

Please find enclosed the 1992 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,

for Donald F. Schnell

NGS/dls

Enclosure

050038

cc: T. A. Baxter, Esq.
Shaw, Pittman, Potts & Trowbridge
2300 N. Street, N.W.
Washington, D.C. 20037

Dr. J. O. Cermak
CFA, Inc.
18225-A Flower Hill Way
Gaithersburg, MD 20879-5334

R. C. Knop
Chief, Reactor Project Branch 1
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Bruce Bartlett
Callaway Resident Office
U.S. Nuclear Regulatory Commission
RR#1
Steedman, Missouri 65077

L. R. Wharton (2)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
1 White Flint, North, Mail Stop 13E21
11555 Rockville Pike
Rockville, MD 20852

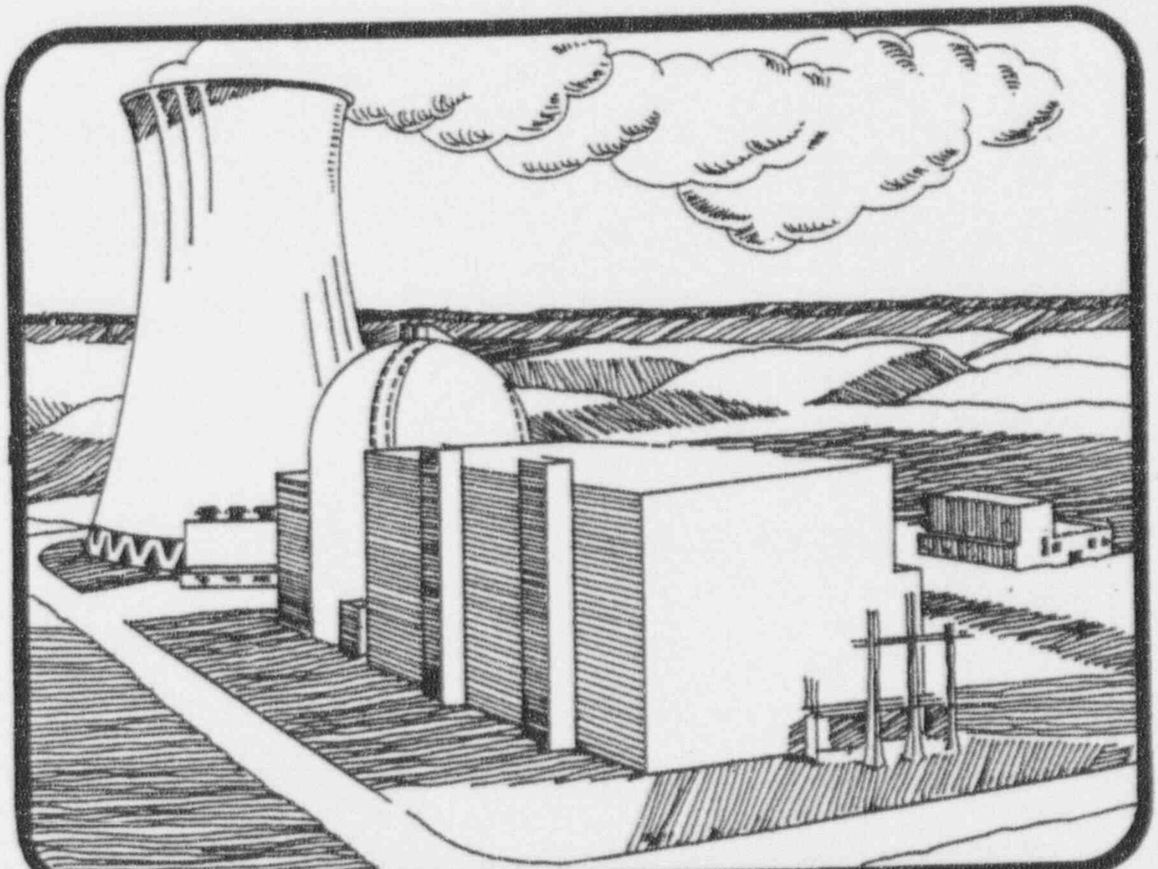
Manager, Electric Department
Missouri Public Service Commission
P.O. Box 360
Jefferson City, MO 65102

Bob Hentges
Regional Administrator
Department of Natural Resources
Central Regional Office
P.O. Box 176
Jefferson City, MO 65102

CALLAWAY PLANT

ANNUAL ENVIRONMENTAL OPERATING REPORT

1992



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CALLAWAY PLANT

ANNUAL ENVIRONMENTAL OPERATING REPORT

1992

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UNION ELECTRIC

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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 1992 and the environmental evaluations for plant modifications completed during 1992.

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 nonradiological environmental monitoring and its results conducted in accordance with 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 1992. The comparison of the results for the radiological environmental monitoring conducted during 1992 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 nonradiological monitoring conducted in the vicinity of the Callaway Plant during 1992.

There were no plant modifications completed during 1992 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

SECTION 3.0

RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM

ANNUAL REPORT

1992

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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 1992.

Evaluation of radiation levels in the environs around Union Electric Company's (UEC) Callaway Plant has 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, shoreline sediment, fish, airborne particulates, airborne radioiodine, direct radiation (TLD), soil and wetlands.

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 result of the REMP conducted during 1992 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 Environment 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, soil, wetlands, 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
APT	Air Particulate
AQF	Fish
AQS	Sediment
FPL	Leafy Green Vegetables
IDM	TLD
MLK	Milk
SOL	Soil
SWA	Surface Water
WWA	Ground Water

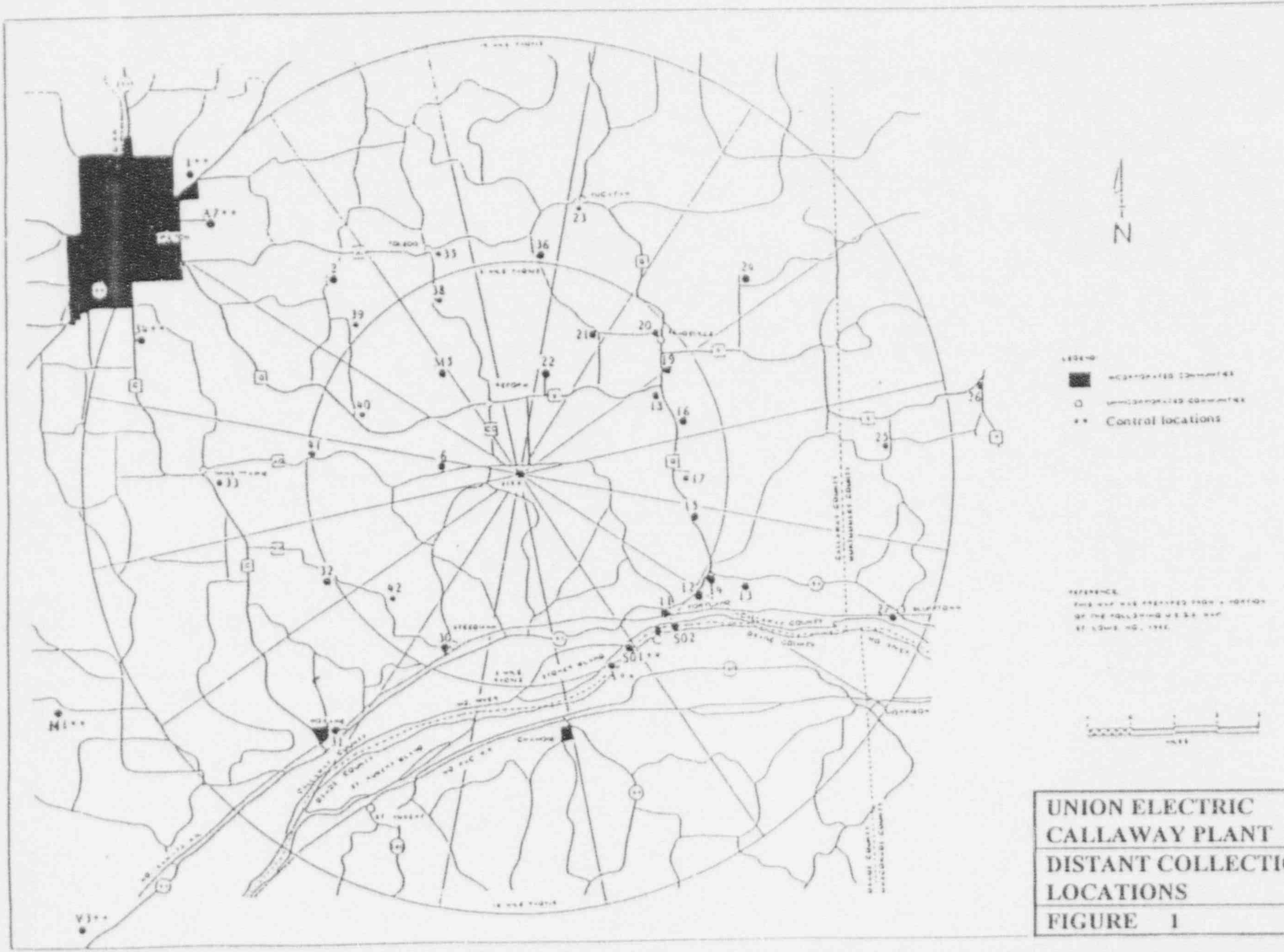
2.2.1 Waterborne Pathway

Surface Water

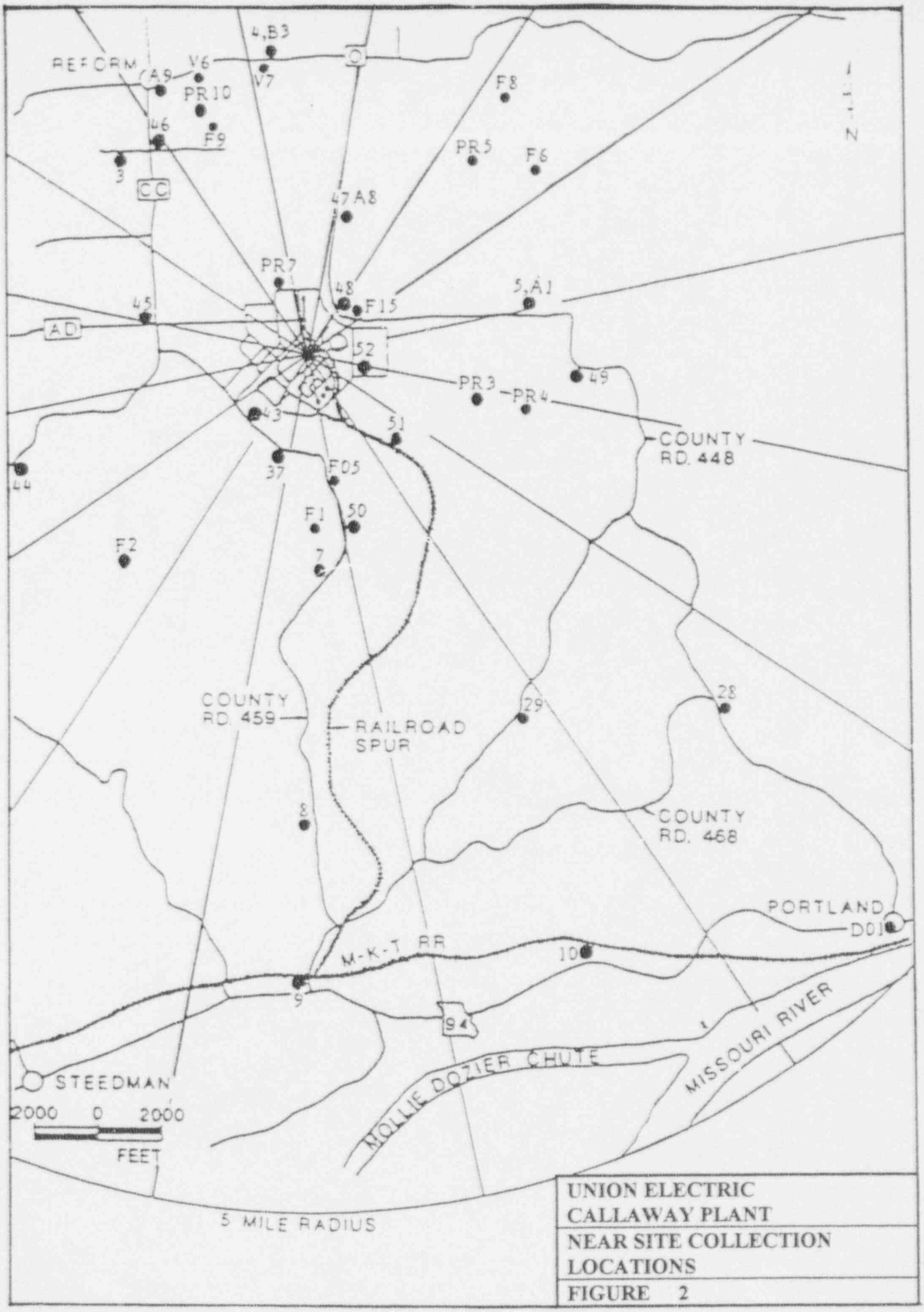
Monthly composite samples of surface water from the Missouri River are collected from one indicator location (SO2) and from one control location (SO1). The samples are analyzed for tritium and by gamma spectrometry.

Ground Water

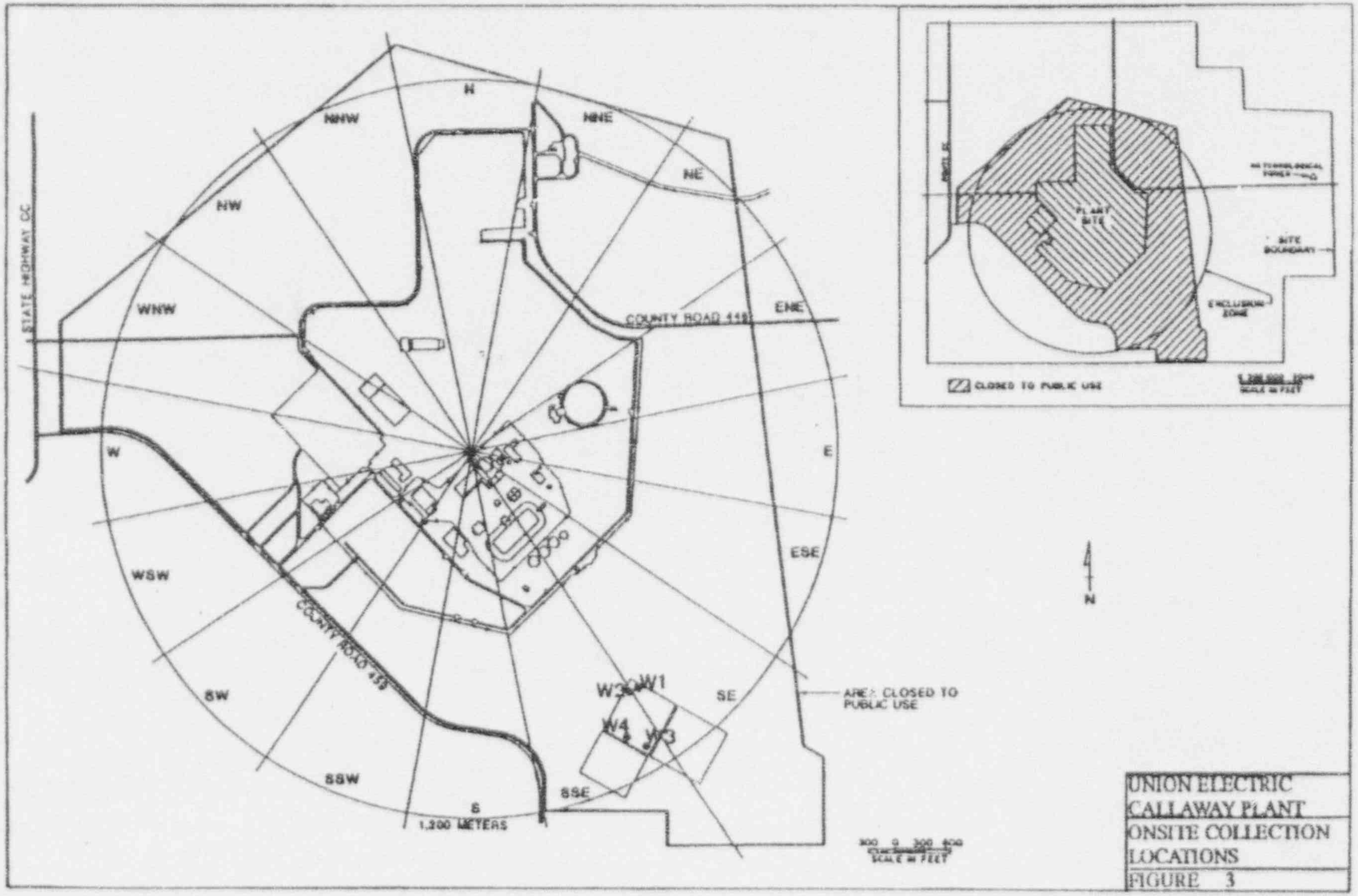
Ground water samples are collected monthly from two on-site wells (F05 and F15) and one off-site well used for drinking water (D01). The on-site ground water samples are collected using a manual grab sampler which is lowered into the well. The off-site ground water sample is collected from a faucet after allowing the line to flush for two minutes. Ground water samples are analyzed for Tritium and gamma emitting nuclides.



UNION ELECTRIC
CALLAWAY PLANT
DISTANT COLLECTION
LOCATIONS
FIGURE 1



UNION ELECTRIC
CALLAWAY PLANT
NEAR SITE COLLECTION
LOCATIONS
FIGURE 2



UNION ELECTRIC
CALLAWAY PLANT
ONSITE COLLECTION LOCATIONS
FIGURE 3

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 0, 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,AIO
5,A1	1.3 mi ENE; Primary Meteorological Tower.	IDM,APT,AIO
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.[illegible] 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 on 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.	
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

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
25	8.7 mi E; County Road 289, 0.3 mi South of County Road 287, Callaway Electric Cooperative Utility Pole No. 11295.	IDM
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

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
37	0.7 mi SSW; County Road 459, 0.9 mi South of Hwy CC, Callaway Electric Cooperative Utility Pole No. 35077.	IDM
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 Electiic 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. 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

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
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
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.	APT,AIO
A8	0.9 mi NNE; County Road 448, 0.9 miles South of Hwy O.	APT,AIO
A9 APT,AIO	1.7 mi NNW; Community of Reform.	
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 Farm.	FPL

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
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
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
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

TABLE I (Cont'd.)

SAMPLING LOCATIONS

Location Code	Description	Sample Types
W1**	0.61 mi SE; Callaway Plant Wetlands, High Ground	SOL
W2	0.60 mi SE; Callaway Plant Wetlands, Inlet Area	SOL
W3	0.72 mi SSE; Callaway Plant Wetlands, Discharge Area	SOL
W4	0.68 mi SSE; Callaway Plant Wetlands, SW Bank	SOL

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

TABLE II

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Well 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 O	W	W							
A9, Community of Reform	W	W							
B3, 0.6 miles East of O and CC Junction	W	W							
D01, Holzhouser Grocery Store/Tavern			Q						
F05, Onsite Groundwater Monitoring Well			Q						
F15, Onsite Groundwater Monitoring Well			Q						
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 SA = Semi Annually

TABLE II (Cont'd.)

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Well Water	Surface Water	Sediment	Fish	Milk	Vegetation	Soil
V3, Beazley Farm								M	A
V6, Becker Farm								M	
V7, Meehan Farm								M	
A,0.6 River miles Upstream of Discharge North Bank					SA	SA			
C,1.0 River miles Downstream of Discharge North Bank					SA	SA			
S01, 84 feet Upstream of Discharge North Bank			M						
S02, 1.1 River miles Downstream of Discharge North Bank			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 SA = Semi Annually

TABLE II (Cont'd.)

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Well 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 SA = Semi Annually

TABLE II (Cont'd.)

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Well Water	Surface Water	Sediment	Fish	Milk	Vegetation	Soil
W1, Callaway Wetlands, High Ground									A
W2, Callaway Wetlands, Inlet Area									A
W3, Callaway Wetlands, Discharge Area									A
W4, Callaway Wetlands, Southwest Bank									A

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

Bottom Sediment

Bottom sediment samples are collected semi-annually from one indicator location (C) and one control location (A). 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 gamma isotopic.

Shoreline Sediment

Shoreline sediment samples are collected semi-annually at the same locations as bottom sediment. The samples are collected within two feet of the waters edge and consist of 2 six inch diameter by two inch deep sediment plugs. Each sample is placed in a plastic bag and sealed. Shoreline sediment samples are analyzed for gamma isotopic.

Wetlands Soil

Wetlands Soil Samples are collected annually from 3 indicator locations (W2, W3, and W4) and one control location (W1). Two 6 inch square soil plugs consisting of the uppermost two-inch layer of soil are taken at each location. The samples are placed in plastic bags and sealed. The wetlands soil samples are analyzed for gross alpha, gross beta, and 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 cubic feet per minute at five 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 goat milk location near the Plant (M5) and one cow milk location away from the Plant (M1). The milk samples are shipped in 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 recreational or commercial fish species are collected semi-annually from one indicator location (C) and one control location (A). The fish samples are filleted and the fillets are analyzed for 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. Samples consist 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;

Surface Water

1. The downstream composite sampler (S02) was inoperable from 12/26/91 to 01/14/92 and from 03/26/92 to 06/04/92 due to sampler malfunction.

2. The downstream composite sampler (S02) was inoperable from 01/14/92 to 02/06/92 due to frozen sample lines.

3. The downstream composite sample (S02) was inoperable from 06/11/92 to 12/31/92 due to the sample line dislodging from the mooring and kinking.

While the composite samplers were inoperable, daily grab samples were taken and composited monthly.

Ground Water

1. During the third quarter, well water sample from location D01 was not collected due to human error.

Airborne

1. The air particulate and airborne iodine sample results from location A8 for the collection periods ending 06/25/92 and 07/02/92 are questionable because the sampler power was not on during the entire sampling period. The sampler hour meter showed the sampler had operated for 151 hours and 70 hours, respectively.

2. There were no air particulate or airborne iodine samples from A7 for the collection period ending 08/13/92 due to a malfunction of sampling equipment.

3. The air particulate and airborne iodine sample results from location A8 for the collection period ending 11/05/92 are questionable because the sampler power was not on during the entire sampling period. The sampler hour meter showed the sampler had operated for 67 hours.

Milk

1. No milk samples were available from location M5B during the months of January, February, March, and April. Goats were not producing during these months.

2. No milk sample was available from location M1 for the collection period ending 09/08/92.

Vegetation

1. No green leafy vegetation samples were available from location V3 during August and October due to lack of plant growth.

2. There were no green leafy vegetation samples collected from location V7 in September and October due to the lack of plant growth.

Direct Radiation

1. The data for the second quarter, third quarter and annual TLD's for location 30 were lost due to vandalism of the TLD station.

2. There was no direct radiation data from Location 44 for the third quarter and annual because of vandalism to 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 iodine 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 adsorbed 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 permanganate.

2.4.5 Surface and Ground Water

2.4.5.1 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.

2.4.5.2 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 beaker and 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 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.

2.4.6.3 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-channel analyzer.

2.4.7 Bottom and Shoreline Sediment

2.4.7.1 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.

2.4.8 Soil and Wetlands

2.4.8.1 Gross Alpha and Gross Beta

A suitable aliquot of dried sample is transferred to a two-inch ringed planchet. The planchet is counted for gross alpha and gross beta activity using a proportional counter.

2.4.8.2 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

During this year two modifications were made to the monitoring program. The first modification involved the addition of four wetlands soil sampling locations in what was formally water treatment plant sludge lagoon 1. Sludge lagoon 1 has evolved into a wetlands

in which Union Electric has implemented a tertiary/polishing treatment test program for the plant's sewage treatment plant.

The second change involved the deletion of milk samples collected from location M5 after the September collection. The milk samples were discontinued due to the Farmer's request to stop participating in the REMP milk sampling program.

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)	SOIL AND 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*			15*		

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 1992 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, bottom sediment, shoreline sediment and wetlands.

Surface Water

The analysis of Tritium in surface water showed detectable activity in thirteen of twenty-four samples with results ranging from 131.0 to 2711.0 pCi/l. The mean Tritium concentration at the indicator location was 381.3 pCi/liter and at the control location was 733.3 pCi/l. The LLDs for other samples ranged from 169.0 to 185.0 pCi/l. The tritium activity at the control location is due to recirculation of the plant

discharge into the upstream intake Bay most likely via the fish escape openings. The control location sample point is located in the farthest upstream pump bay. This condition varies depending on river flow rate and which intake pumps are running.

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

The levels of activity detected in surface water samples during 1992 were consistent with previously accumulated radiological environmental data and indicate no influence from plant operations.

<u>Ground Water</u>

In ground water samples, tritium results for all thirteen samples were below the detection limit which ranged from 164.0 to 182.0 pCi/l.

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

There was no indication of a plant effect on ground water.

<u>Bottom Sediment</u>

The analysis of bottom sediment collected in April and October showed positive Cesium-137 activity in one sample with a concentration of 87.4 pCi/kg. There were no other gamma emitting nuclides detected in Bottom Sediment samples. The presence of Cesium-137 in bottom sediment exhibits a long term residual effect of previous atmospheric nuclear tests and not an effect from plant operations.

<u>Shoreline Sediment</u>

Shoreline Sediment sample collections were made in April and October, 1992 and analyzed for gamma emitting isotopes. One shoreline sediment sample collected in October from location C showed a positive activity of Cesium-137 (58.4 pCi/kg). There were no gamma emitting nuclides detected in shoreline sediment samples collected in April. Similar levels of Cesium-137 activity due to fallout from atmospheric nuclear testing were observed in 1984, 1985, 1987, 1988, 1989, 1990 and 1991.

Wetlands

Analysis for alpha emitters showed detectable activity in all samples, with results ranging from 8280.0 to 15750.0 pCi/kg. The average sample concentration at the indicator location was 14786.7 pCi/kg and at the control location was 8280.0 pCi/kg.

The average gross beta activity in all wetlands samples ranged from 18050.0 to 24890.0 pCi/kg. The average activity at the control location was 24890.0 pCi/kg and at the indicator location was 20086.7 pCi/kg.

Potassium-40 and Cesium-137 were the only gamma emitting isotopes detected. Potassium-40 was detected in all samples with the results ranged from 10800.0 to 19570.0 pCi/kg. The average concentration for indicator locations was 13996.7 pCi/kg and for the control location was 19570.0 pCi/kg.

One wetlands sample collected from location W4 showed positive activity of Cesium-137 (295.0 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.

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 0.004 to 0.054 pCi/m^3 in all samples. The average gross beta activity was similar at both indicator locations (0.018 pCi/m^3) and control location (0.019 pCi/m^3). The highest annual average (0.20 pCi/m^3) was measured at indicator location A1, 1.3 miles ENE of the plant.

Gamma spectral analysis of quarterly composites of air particulate filters showed Beryllium-7 in all samples. The average Beryllium-7 activity for indicator locations and for control locations was 0.054 pCi/m^3. The presence of Beryllium-7 can be attributed to cosmic ray activity. No other gamma emitting isotopes of interest were detected in the quarterly composities.

The Strontium-89 analyses performed on the quarterly composites showed all activities to be below the detection limits. Strontium-90 activity was indicated in three of the 16 indicator locations composite samples. The activity ranged form 0.0003 pCi/m^3 to 0.0007 pCi/m^3 with an average concentration of 0.0004 pCi/m^3. The Strontium-90 activity can be attributed to the resuspension of Strontium-90 in the soil from previous atmospheric nuclear tests by farming activities in the vicinity of the sample location. Strontium-90 was detected in the preoperational radiological monitoring program.

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 twenty-seven analyses for Iodine-131 in milk were performed during 1992. All samples were below the LLD which ranged from 0.2 to 0.9 pCi/l.

Naturally occurring Potassium-40 was the only gamma emitting isotope found in milk samples. Concentrations ranged from 950.0 to 1980.0 pCi/l. The average concentration for goats milk was 1775.0 pCi/l and for cows milk was 1247.6 pCi/l.

Strontium-89 results were below the LLD for all samples. The LLDs ranged from 0.4 to 2.3 pCi/l. Strontium-90 was detected in all milk samples averaging 5.3pCi/l for goats milk and 3.5pCi/l for cows milk. The range of detectable results was 1.7 to 6.9 pCi/l.

Calcium was analyzed in all milk samples with levels ranging from 0.44 to 1.20 gm/l. The average calcium concentration for goats milk was 0.91 gm/l and for cow's milk was 0.92 gm/l.

In summary, the milk data for 1992 show no radiological effects from plant operation. The presence of Strontium-90 in milk samples exhibits a long range residual effect of previous atmospheric nuclear tests.

Fish

The types of fish species collected during 1992 were: River Carpsucker, Gizzard Shad, Channel Catfish, Largemouth Buffalo, Freshwater Drum, and Carp.

All fish samples indicated positive Potassium-40 activity with levels ranging from 1759.0 pCi/kg-wet to 3400.0 pCi/kg-wet. The mean Potassium-40 activity was 2582.4 pCi/kg-wet for the indicator location and 2613.9 pCi/kg-wet for the control location.

No Strontium-89 activity was detected in the fish samples collected during 1992. Strontium-90 activity was detected in two samples collected at location C with mean results of 3.6 pCi/kg-wet.

Activities detected in fish samples were consistent with the levels and fluctuations of previously accumulated environmental data. The Strontium-90 activity present in some samples can be attributed to worldwide fallout from atmospheric nuclear testing. It can be concluded that operation of the plant has had no effect on fish samples.

Vegetation

The vegetation samples collected during 1992 consisted of mustard greens, turnip greens, lettuce, cabbage, and spinach.

Gross alpha activity was observed in twenty-one of thirty-five vegetation samples with the results ranging from 25.0 to 343.0 pCi/kg-wet. The average activity for indicator locations was 149.2 pCi/kg-wet and for the control location was 234.7 pCi/kg-wet.

Gross beta activity was detected in all vegetation samples with results ranging from 1144.0 to 7720.0

pCi/kg-wet. The average gross beta activity was similar at both indicator locations (4340.6 pCi/kg-wet) and control location (4316.9 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 2020.0 to 7720.0 pCi/kg-wet and averaged 4371.0 and 4441.6 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, except for gross alpha. The average gross alpha activity difference between indicator and control locations is due to the limited number of samples available at the control location which showed activity above the detection limit. The upper range of gross alpha activity was similar at both indicator locations (318.0 pCi/Kg-wet) and control location (343 pCi/Kg-wet). The levels of activity were consistent with previously accumulated data and no plant effect was indicated.

Soil

Gross alpha results ranged from 9159.0 to 15802.0 pCi/kg for all eleven samples. The mean activity for indicator locations was 11734.4 pCi/kg and for the control location was 11391.0 pCi/kg. Gross beta activity was also detected in all eleven samples ranging from 13027.0 to 24579.0 pCi/kg. The average gross beta activity was 20614.2 and 24579.0 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 389.0 to 1660.0 pCi/kg. The average concentration was 1017.6 pCi/kg at the indicator locations and 389.0 pCi/kg at the control location. Potassium-40 results ranged from 1600.0 to 17400.0 pCi/kg. The average concentration for indicator locations was 11473.1 pCi/kg and for the control location was 17400.0 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 indicates 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 9.9 to 36.3 mRem/standard quarter and 15.3 to 26.0 mRem/standard quarter for control locations. The quarterly TLD analyses yielded an average exposure level of 18.5 mRem/standard quarter at all indicator locations and an average exposure level of 18.2 mRem/standard quarter at all control locations.

The annual TLD results ranged from 12.5 to 22.9 mRem/standard quarter. The average exposure levels were nearly identical at the indicator locations and control locations (17.8 mRem/standard quarter and 16.7 mRem/standard quarter, respectively).

There was no significant difference between indicator and control locations for the TLD's during 1992. The exposure levels were consistent with previously accumulated data and no plant effects were indicated.

APPENDIX A

1992 LAND USE CENSUS

APPENDIX A

UNION ELECTRIC COMPANY

CALLAWAY PLANT

1992 LAND USE CENSUS

Prepared by [signature]

Approved by [signature]

1.0 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 July and August, 1992 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 $50m^2$ (500 ft^2) producing broad leaf vegetation. This census was completed by contacting the families identified in the 1991 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.

2.0 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 1992 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 were two changes in the nearest residents noted in the 1992 census. The changes were in the NE and ENE radial directions.

2.3 Vegetable Gardens

The location of the nearest vegetable garden of greater than $50m^2$ producing broad leaf vegetation is presented in Table 3. Two changes were noted in the garden locations during the 1992 census. However, the changes noted did not result in changes to the current vegetable sampling locations.

TABLE 1

NEAREST MILKING ANIMALS WITHIN FIVE MILES OF
THE CALLAWAY PLANT

1992

Meteorological Sector	Radial Mileage	Number of Cows	Number of Goats
NE	4.70	50*	None
ENE	4.97	6*	None
E	3.92	55*	None
ESE	2.28	45*	None
SE	2.38	100*	None
SSE	2.80	1	None
SW	2.72	5*	None
WNW	2.80	18*	None
NW	3.10	6**	5

* 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.

TABLE 2

NEAREST RESIDENCE WITHIN FIVE MILES OF THE CALLAWAY PLANT

1992

Meteorological Sector	Radial Mileage
N	1.76
NNE	2.00
NE	4.70
ENE	4.97
E	3.92
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
NW	3.10
NNW	1.78

TABLE 3

NEAREST GARDEN WITHIN FIVE MILES OF THE CALLAWAY PLANT

1992

Meteorological Sector	Radial Mileage
N	1.76
NNE	2.00
NE	4.70
ENE	4.97
E	3.92*
ESE	2.28
SE	5.00
SSE	2.58*
S	3.44
SSW	3.30
SW	2.57
WSW	1.80
W	1.92*
WNW	2.80*
NW	3.10
NNW	1.78

* In this sector there were no gardens noted within five miles producing "broad leaf vegetation." The distance noted is the distance to the nearest residence.

APPENDIX B

EPA CROSS-CHECK RESULTS

1992

TABLE B1

EPA INTERCOMPARISON STUDY RESULTS
1992

SAMPLE TYPE	STUDY DATE	ANALYSIS	TIML RESULTS 2σ[a]		EPA RESULTS[b] 1s, N=1		CONTROL LIMITS	UNITS
WATER	JAN 1992	SR-89	42.7	6.4	51.0	5.0	42.3 - 59.7	pCi/l
		SR-90	18.3	3.1	20.0	5.0	11.3 - 28.7	pCi/l
WATER	JAN 1992	PU-239	16.1	0.8	16.8	1.7	13.9 - 19.7	pCi/l
WATER3	JAN 1992	GR. ALPHA	23.7	9.2	30.0	8.0	16.1 - 43.9	pCi/l
		GR. BETA	27.7	4.2	30.0	5.0	21.3 - 38.7	pCi/l
WATER	FEB 1992	I-131	60.3	4.2	59.0	6.0	48.6 - 69.4	pCi/l
WATER	FEB 1992	CO-60	40.3	5.0	40.0	5.0	31.3 - 48.7	pCi/l
		ZN-65	148.0	15.0	150.7	6.1	122.0 - 174.0	pCi/l
		RU-106	188.7	28.8	203.0	20.0	168.3 - 237.7	pCi/l
		CS-134	31.7	4.2	31.0	5.0	22.3 - 39.7	pCi/l
		CS-137	51.0	3.4	49.0	5.0	40.3 - 57.7	pCi/l
		BA-133	79.0	3.4	76.0	8.0	62.1 - 89.9	pCi/l
WATER3	FEB 1992	H-3	7714.0	119.6	7904.0	790.0	6533.4 - 9274.6	pCi/l
WATER	MAR 1992	RA-226	9.0	0.4	10.1	1.5	7.5 - 12.7	pCi/l
		RA-228	18.8	0.6	15.5	3.9	8.7 - 22.3	pCi/l
WATER	MAR 1992	RN-222	0.0	0.0	0.0	0.0	0.0 - 0.0	pCi/l[c]
WATER3	MAR 1992	U	25.1	1.9	25.3	3.0	20.1 - 30.5	pCi/l
WATER4	MAR 1992	RN-222	0.0	0.0	0.0	0.0	0.0 - 0.0	pCi/l[c]
AIR FILTER	MAR 1992	GR. ALPHA	7.0	0.0	7.0	5.0	0.0 - 15.7	pCi/Filter
		GR. BETA	39.3	1.6	41.0	5.0	32.3 - 49.7	pCi/Filter
		SR-90	13.7	1.6	15.0	5.0	6.3 - 23.7	pCi/Filter
		CS-137	10.0	0.0	10.0	5.0	1.3 - 18.7	pCi/Filter
WATER	APR 1992	GR. ALPHA	35.7	6.1	40.0	10.0	22.7 - 57.3	pCi/l
		RA-226	12.7	1.2	14.9	2.2	11.1 - 18.7	pCi/l
		RA-228	14.5	2.1	14.0	3.5	7.9 - 20.1	pCi/l
		U	3.9	0.2	4.0	3.0	0.0 - 9.2	pCi/l
WATER	APR 1992	GR. BETA	113.0	7.2	140.0	21.0	103.6 - 176.4	pCi/l
		SR-89	12.3	4.2	15.0	5.0	6.3 - 23.7	pCi/l
		SR-90	15.0	1.2	17.0	5.0	8.3 - 25.7	pCi/l
		CO-60	61.0	4.0	56.0	5.0	47.3 - 64.7	pCi/l
		CS-134	24.3	1.2	24.0	5.0	15.3 - 32.7	pCi/l
		CS-137	24.0	2.0	22.0	5.0	13.3 - 30.7	pCi/l

TABLE B1 (Cont.)

EPA INTERCOMPARISON STUDY RESULTS
1992

SAMPLE TYPE	STUDY DATE	ANALYSIS	TIML RESULTS 2σ[a]		EPA RESULTS[b] 1s, N=1		CONTROL LIMITS	UNITS
MILK	APR 1992	SR-89	25.3	7.6	38.0	5.0	29.3 - 46.7	pCi/l[c]
		SR-90	24.3	3.1	29.0	5.0	20.3 - 37.7	pCi/l
		I-131	78.7	9.5	78.0	8.0	64.1 - 91.9	pCi/l
		CS-137	39.3	2.3	39.0	5.0	30.3 - 47.7	pCi/l
		K	1610.0	72.1	1710.0	86.0	1560.8 - 1859.2	mg/l
WATER	MAY 1992	SR-89	24.0	4.0	29.0	5.0	20.3 - 37.7	pCi/l
		SR-90	6.7	1.2	8.0	5.0	0.0 - 16.7	pCi/l
WATER	MAY 1992	GR. ALPHA	12.3	2.1	15.0	5.0	6.3 - 23.7	
		GR. BETA	46.0	5.0	44.0	5.0	35.3 - 52.7	
WATER	JUN 1992	CO-60	20.3	1.2	20.0	5.0	11.3 - 28.7	pCi/l
		ZN-65	103.3	10.6	99.0	10.0	81.7 - 116.3	pCi/l
		RU-106	142.7	23.7	141.0	14.0	116.7 - 165.3	pCi/l
		CS-134	14.3	2.3	15.0	5.0	6.3 - 23.7	pCi/l
		CS-137	15.0	2.0	15.0	5.0	6.3 - 23.7	pCi/l
		BA-133	92.7	11.0	98.0	10.0	80.7 - 115.3	pCi/l
WATER	JUN 1992	H-3	2153.3	144.6	2125.0	347.0	1523.0 - 2727.0	pCi/l
WATER	JUL 1992	RA-226	22.3	2.2	24.9	3.7	18.5 - 31.3	pCi/l
		RA-228	16.7	3.1	16.7	4.2	9.4 - 24.0	pCi/l
WATER	JUL 1992	U	3.6	0.3	4.0	3.0	0.0 - 9.2	pCi/l
WATER	AUG 1992	I-131	47.0	3.5	45.0	6.0	34.6 - 55.4	pCi/l
WATER	AUG 1992	PU-239	8.5	0.9	9.0	0.9	7.4 - 10.6	pCi/l
AIR FILTER	AUG 1992	GR. ALPHA	25.7	1.2	30.0	8.0	16.1 - 43.9	pCi/Filter
		GR. BETA	69.0	2.0	69.0	10.0	51.7 - 86.3	pCi/Filter
		SR-90	26.0	4.0	25.0	5.0	16.3 - 33.7	pCi/Filter
		CS-137	16.0	0.0	18.0	5.0	9.3 - 26.7	pCi/Filter
WATER	SEP 1992	SR-89	16.0	4.0	20.0	5.0	11.3 - 28.7	pCi/l
		SR-90	14.3	3.1	15.0	5.0	6.3 - 23.7	pCi/l
WATER	SEP 1992	GR. ALPHA	43.0	13.1	45.0	11.0	25.9 - 64.1	pCi/l
		GR. BETA	41.3	18.6	50.0	5.0	41.3 - 58.7	pCi/l

TABLE B1 (Cont.)

EPA INTERCOMPARISON STUDY RESULTS
1992

SAMPLE TYPE	STUDY DATE	ANALYSIS	TIML RESULTS 2σ[a]		EPA RESULTS[b] 1s, N=1		CONTROL LIMITS	UNITS
MILK	SEP 1992	SR-89	11.0	3.5	15.0	5.0	6.3 - 23.7	pCi/l
		SR-90	12.7	1.2	15.0	5.0	6.3 - 23.7	pCi/l
		I-131	109.7	19.4	100.0	10.0	82.7 - 117.3	pCi/l
		CS-137	14.0	3.5	15.0	5.0	6.3 - 23.7	pCi/l
		K	1540.0	103.9	1750.0	88.0	1597.3 - 1902.7	mg/l[c]
WATER	OCT 1992	CO-60	11.3	2.3	10.0	5.0	1.3 - 18.7	pCi/l
		ZN-65	169.7	25.0	148.0	15.0	122.0 - 174.0	pCi/l
		RU-106	170.1	2.3	175.0	18.0	143.8 - 206.2	pCi/l
		CS-134	9.7	2.3	8.0	5.0	0.0 - 16.7	pCi/l
		CS-137	9.7	1.2	8.0	5.0	0.0 - 16.7	pCi/l
		BA-133	80.3	9.0	74.0	7.0	61.9 - 86.1	pCi/l
WATER	OCT 1992	H-3	5896.7	136.2	5962.0	596.0	4928.0 - 6996.0	pCi/l
WATER	OCT 1992	GR. ALPHA	24.7	5.0	29.0	7.0	16.9 - 41.1	pCi/l
		RA-226	7.1	0.4	7.4	1.1	5.5 - 9.3	pCi/l
		RA-228	11.5	1.0	10.0	2.5	5.7 - 14.3	pCi/l
		U	9.7	0.5	10.2	3.0	5.0 - 15.4	pCi/l
WATER	OCT 1992	GR. BETA	42.7	8.1	53.0	10.0	35.7 - 70.3	pCi/l
		SR-89	6.7	1.2	8.0	5.0	0.0 - 16.7	pCi/l
		SR-90	10.0	2.0	10.0	5.0	1.3 - 18.7	pCi/l
		CO-60	15.0	2.0	15.0	5.0	6.3 - 23.7	pCi/l
		CS-134	5.7	1.2	5.0	5.0	0.0 - 13.7	pCi/l
		CS-137	8.0	2.0	8.0	5.0	0.0 - 16.7	pCi/l
WATER	NOV 1992	RA-226	7.5	0.8	7.5	1.1	5.6 - 9.4	pCi/l
		RA-228	5.8	0.7	5.0	1.3	2.7 - 7.3	pCi/l
WATER	NOV 1992	U	15.5	1.1	15.2	3.0	10.0 - 20.4	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
1992

SAMPLE TYPE	STUDY DATE	ANALYSIS	EXPLANATION
WATER	MAR 1992	RN-222	No Data; Special EPA Testing.
WATER4	MAR 1992	RN-222	No Data; Special EPA Testing.
MILK	APR 1992	SR-89	The cause of low result is unknown. Data was checked for errors. The In-house spike sample was prepared with activity of Sr-89 41.0 10.0pCi /l. results of the analysis was 37.2 3.6 pCi/l.
MILK	SEP 1992	K	ACTIVITY WAS CALCULATED USING THE WRONG VOLUME (3.5L), INSTEAD OF 3.25 L. CORRECTION FOR VOLUME RESULTED IN A VALUE OF 1660.0 110.1 MG/L; WITHIN EPA CONTROL LIMITS.

APPENDIX C

Isotopic Detection Limits

And

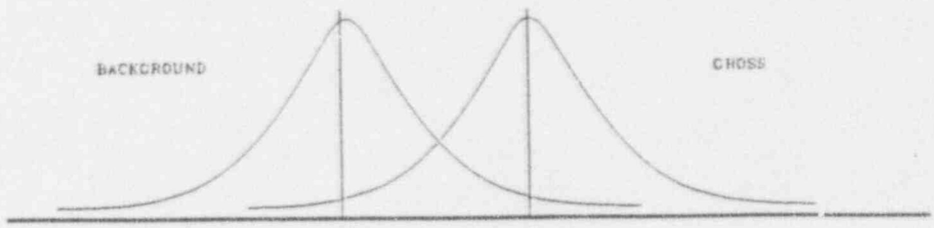
Activity Determinations

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: $x_1 \pm s_1$

   $x_2 \pm s_2$

   Reported result: $x \pm s$

   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:

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

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

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
1992

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: 1992

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)	H-3 (24)	169.0	381.3 (3/12) (161.0 - 794.0)	4.8 mi SE; 1.1 ft upstream of discharge	733.3 (10/12) (131.0 - 2711.0)	733.3 (10/12) (131.0 - 2711.0)	0
	Gamma (36)	--	-- (0/24)	NA	NA	-- (0/12)	0
Well Water (pCi/l)	H-3 (13)	164.0	-- (0/24)	NA	NA	-- (0/12)	0
	Gamma (13)	--	-- (0/24)	NA	NA	-- (0/12)	0
Bottom Sediment (pCi/kg)	Gamma (4) Cs-137	24.1	87.4 (1/2) ---	5.1 mi SE; 1.0 mi downstream of discharge	87.4 (1/2) ---	-- (0/2) --	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: 1992

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	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Shoreline Sediment (pCi/kg)	Gamma (4)						
	Cs-137	30.3	58.4 (1/2) --	5.1 mi SE; 1.0 mi downstream of discharge	58.4 (1/2) --	--- (0/2) --	0
Airborne Particulate (pCi/m³)	Gross Beta (264)		0.018 (212/212) (0.004 - 0.054)	1.3 mi ENE; Primary Meteorological Tower	0.020 (53/53) (0.009 - 0.054)	0.019 (52/52) (0.009 - 0.041)	0
	Gamma (20)						
	Be-7	---	0.054 (16/16) (0.029 - 0.098)	1.3 mi ENE; Primary Meteorological Tower	0.065 (4/4) (0.051 - 0.090)	0.054 (4/4) (0.041 - 0.069)	0
	Sr-89 (20)	0.0002	-- (0/16)	NA	NA	-- (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: 1992

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	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Sr-90 (20)	0.0001	0.0004 (3/16) (0.0003 - 0.0007)	1.3 mi ENE; Primary Meteorological Tower	0.0007 (1/4) ---	-- (0/4)	0
Airborne Iodine (pCi/m³)	I-131 (258)	0.070	-- (0/207)	NA	NA	-- (0/51)	0
Milk (pCi/l)	I-131 (27)	0.2	-- (0/10)	NA	NA	-- (0/17)	0
	Gamma (27) K-40	---	1775.0 (10/10) (1640.0 - 1980.0)	3.1 mi NW; Goats milk Schneiders farm	1775.0 (10/10) (1640.0 - 1980.0)	1247.6 (17/17) (950.0 - 1760.0)	0
	Sr-89 (27)	0.4	-- (0/10)	NA	NA	-- (0/17)	0
	Sr-90 (27)	1.0	5.3 (10/10) (1.7 - 6.9)	3.1 mi NW; Goats milk Schneiders farm	5.3 (10/10) (1.7 - 6.9)	3.5 (17/17) (2.3 - 4.8)	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: 1992

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	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
(grams/liter)	Ca (27)	---	0.91 (10/10) (0.60 - 1.08)	12.3 mi WSW; Cows milk greens farm	0.92 (17/17) (0.44 - 1.20)	0.92 (17/17) (0.44 - 1.20)	0
Fish (pCi/kg - wet)	Gamma (20) K-40		2582.4 (10/10) (1759.0 - 3400.0)	4.9 mi SSE; 0.6 mi upstream of discharge	2613.9 (10/10) (2237.0 - 2940.0)	2613.9 (10/10) (2237.0 - 2940.0)	0
	Sr-89 (20)	2.5	-- (0/10)	NA	NA	-- (0/10)	0
	Sr-90 (20)	1.5	3.6 (2/10) (2.1 - 5.0)	5.1 mi SE; 1.0 mi downstream of discharge	3.6 (2/10) (2.1 - 5.0)	--- (0/10) ---	0
Vegetation (pCi/kg - wet)	Gross Alpha (35)	23.0	149.2 (18/27) (25.0 - 318.0)	15.0 mi SW; Beazley farm	234.7 (3/8) (178.0 - 343.0)	234.7 (3/8) (178.0 - 343.0)	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: 1992

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	LOCATION WITH HIGHEST ANNUAL MEAN: MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gross Beta (35)	---	4340.6 (27/27) (1144.0 - 7720.0)	1.8 mi N; Meehan farm	4841.6 (11/11) (2570.0 - 7720.0)	4316.9 (8/8) (2141.0 - 7396.0)	0
	I-131 (35)	13.4	-- (0/29)	NA	NA	-- (0/22)	0
	Gamma (51) K-40		4371.0 (27/27) (2020.0 - 7720.0)	15.0 mi SW; Beazley farm	4441.6 (8/8) (2440.0 - 6640.0)	4441.6 (8/8) (2440.0 - 6640.0)	0
Soil (pCi/kg)	Gross Alpha (11)		11734.4 (10/10) (9159.0 - 15802.0)	1.89 mi NE; Prairie ecology plot PR5	15802.0 (1/1) --	11391.0 (1/1) --	0
	Gross Beta (11)		20614.2 (10/10) (13027.0 - 24553.0)	15.0 mi SW; Beazley farm	24579.0 (1/1) --	24579.0 (1/1) --	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: 1992

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	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gamma (11)						
	K-40		11473.1 (10/10) (1600.0 - 14190.0)	15.0 mi SW; Beazley fram	17400.0 (1/1) --	17400.0 (1/1) --	0
	Cs-137		1017.6 (10/10) (425.0 - 1660.0)	1.50 mi NE; Forest ecology plot F8	1660.0 (1/1) --	389.0 (1/1) --	0
Wetlands (pCi/kg)	Gross Alpha (4)		14786.7 (3/3) (12950.0 - 15750.0)	0.68 mi SSE; Wetlands SW bank	15750.0 (1/1) --	8280.0 (1/1) --	0
	Gross Beta (4)		20086.7 (3/3) (18050.0 - 23160.0)	0.61 mi SE; Wetlands, high ground	24890.0 (1/1) --	24890.0 (1/1) --	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: 1992

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	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (f)[2] RANGE	CONTROL LOCATION MEAN (f)[2] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	Gamma (4)						
	K-40		13966.7 (3/3) (10800.0 - 18000.0)	0.61 mi SE; Wetlands, high ground	19570.0 (1/1) --	19570.0 (1/1) --	0
	Cs-137		295.0 (1/3) ---	0.68 mi SSE; Wetlands SW bank	295.0 (1/3) --	--- (0/1) --	0
DIRECT RADIATION (mRem/Standard Quarter)	Quarterly TLDs (205)	10	18.5 (197/197) (9.9 - 36.3)	4.8 mi NE; City of Readsville	23.8 (4/4) (18.1 - 36.3)	18.2 (8/8) (15.3 - 26.0)	0
	Annual TLDs (50)	10	17.8 (48/48) (12.5 – 22.9)	4.8 mi SE; City of Portland	22.9 (1/1) --	16.7 (2/2) (15.8 – 17.6)	0

(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

INDIVIDUAL SAMPLE RESULTS

DATA TABLES

1992

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 during 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 experiment.
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)
1992

COLLECTION	CA-APT-A1			CA-APT-A7			CA-APT-A8			CA-APT-A9			CA-APT-B3		
DATE	Vol. (M^3)	GROSS BETA	I-131	Vol. (M^3)	GROSS BETA	I-131	Vol. (M^3)	GROSS BETA	I-131	Vol. (M^3)	GROSS BETA	I-131	Vol. (M^3)	GROSS BETA	I-131
01/02/92	426	0.024 ± 0.003	<0.070	426	0.027 ± 0.003	<0.070	428	0.030 ± 0.003	<0.070	426	0.027 ± 0.003	<0.070	426	0.016 ± 0.002	<0.070
01/09/92	428	0.029 ± 0.003	<0.070	431	0.036 ± 0.003	<0.070	426	0.036 ± 0.003	<0.070	426	0.032 ± 0.003	<0.070	428	0.024 ± 0.003	<0.070
01/16/92	431	0.024 ± 0.003	<0.070	431	0.028 ± 0.003	<0.070	431	0.025 ± 0.003	<0.070	433	0.024 ± 0.003	<0.070	431	0.016 ± 0.002	<0.070
01/23/92	431	0.019 ± 0.002	<0.070	426	0.014 ± 0.002	<0.070	431	0.027 ± 0.003	<0.070	431	0.023 ± 0.003	<0.070	431	0.022 ± 0.002	<0.070
01/30/92	428	0.017 ± 0.002	<0.070	431	0.013 ± 0.002	<0.070	431	0.023 ± 0.003	<0.070	428	0.018 ± 0.002	<0.070	428	0.021 ± 0.003	<0.070
02/06/92	436	0.018 ± 0.002	<0.070	438	0.012 ± 0.002	<0.070	436	0.024 ± 0.003	<0.070	436	0.023 ± 0.003	<0.070	438	0.023 ± 0.003	<0.070
02/14/92	479	0.014 ± 0.002	<0.070	477	0.019 ± 0.002	<0.070	479	0.017 ± 0.002	<0.070	482	0.020 ± 0.002	<0.070	477	0.015 ± 0.002	<0.070
02/20/92	370	0.010 ± 0.002	<0.070	372	0.011 ± 0.002	<0.070	367	0.009 ± 0.002	<0.070	364	0.015 ± 0.003	<0.070	370	0.008 ± 0.002	<0.070
02/28/92	487	0.020 ± 0.002	<0.070	487	0.020 ± 0.002	<0.070	489	0.018 ± 0.002	<0.070	489	0.022 ± 0.002	<0.070	487	0.024 ± 0.002	<0.070
03/05/92	367	0.015 ± 0.003	<0.070	364	0.013 ± 0.002	<0.070	367	0.012 ± 0.002	<0.070	367	0.018 ± 0.003	<0.070	370	0.013 ± 0.002	<0.070
03/12/92	436	0.016 ± 0.002	<0.070	433	0.013 ± 0.002	<0.070	436	0.010 ± 0.002	<0.070	433	0.015 ± 0.002	<0.070	433	0.015 ± 0.002	<0.070
03/20/92	489	0.018 ± 0.002	<0.070	487	0.014 ± 0.002	<0.070	487	0.011 ± 0.002	<0.070	489	0.008 ± 0.002	<0.070	489	0.017 ± 0.002	<0.070
03/26/92	359	0.020 ± 0.003	<0.070	367	0.016 ± 0.003	<0.070	367	0.011 ± 0.002	<0.070	367	0.018 ± 0.003	<0.070	367	0.017 ± 0.003	<0.070
04/02/92	431	0.016 ± 0.002	<0.070	428	0.017 ± 0.002	<0.070	428	0.014 ± 0.002	<0.070	428	0.017 ± 0.002	<0.070	428	0.006 ± 0.002	<0.070
04/09/92	426	0.023 ± 0.003	<0.070	431	0.020 ± 0.002	<0.070	426	0.013 ± 0.002	<0.070	426	0.021 ± 0.002	<0.070	426	0.019 ± 0.002	<0.070
04/15/92	362	0.024 ± 0.003	<0.070	362	0.018 ± 0.003	<0.070	364	0.017 ± 0.003	<0.070	364	0.024 ± 0.003	<0.070	362	0.009 ± 0.002	<0.070
04/23/92	487	0.013 ± 0.002	<0.070	487	0.011 ± 0.002	<0.070	487	0.008 ± 0.002	<0.070	487	0.014 ± 0.002	<0.070	489	0.011 ± 0.002	<0.070
04/30/92	428	0.014 ± 0.002	<0.070	431	0.014 ± 0.002	<0.070	428	0.012 ± 0.002	<0.070	428	0.013 ± 0.002	<0.070	428	0.014 ± 0.002	<0.070
05/07/92	426	0.016 ± 0.002	<0.070	426	0.013 ± 0.002	<0.070	426	0.009 ± 0.002	<0.070	426	0.016 ± 0.002	<0.070	426	0.012 ± 0.002	<0.070
05/15/92	497	0.018 ± 0.002	<0.070	497	0.018 ± 0.002	<0.070	497	0.012 ± 0.002	<0.070	497	0.019 ± 0.002	<0.070	497	0.015 ± 0.002	<0.070
05/21/92	370	0.020 ± 0.003	<0.070	370	0.019 ± 0.003	<0.070	370	0.005 ± 0.002	<0.070	370	0.021 ± 0.003	<0.070	367	0.016 ± 0.002	<0.070
05/28/92	421	0.012 ± 0.002	<0.070	421	0.012 ± 0.002	<0.070	421	0.008 ± 0.002	<0.070	421	0.016 ± 0.002	<0.070	423	0.012 ± 0.002	<0.070
06/04/92	428	0.019 ± 0.002	<0.070	428	0.019 ± 0.002	<0.070	428	0.014 ± 0.002	<0.070	428	0.017 ± 0.002	<0.070	428	0.008 ± 0.002	<0.070
06/11/92	428	0.020 ± 0.003	<0.070	426	0.010 ± 0.002	<0.070	428	0.012 ± 0.002	<0.070	428	0.020 ± 0.003	<0.070	428	0.018 ± 0.002	<0.070
06/18/92	426	0.020 ± 0.002	<0.070	431	0.014 ± 0.002	<0.070	426	0.004 ± 0.002	<0.070	426	0.022 ± 0.003	<0.070	426	0.019 ± 0.002	<0.070
06/25/92	431	0.018 ± 0.002	<0.070	428	0.013 ± 0.002	<0.070	385	0.012 ± 0.002	<0.070	431	0.016 ± 0.002	<0.070	431	0.016 ± 0.002	<0.070
07/02/92	428	0.018 ± 0.002	<0.070	426	0.015 ± 0.002	<0.070	178	0.050 ± 0.006	<0.070	428	0.015 ± 0.002	<0.070	428	0.020 ± 0.002	<0.070

Notes:

TABLE E1 (Cont.)

AIRBORNE IODINE-131 and GROSS BETA in AIR PARTICULATE FILTERS (pCi/m^3)
1992

COLLECTION DATE	CA-APT-A1 Vol. (M^3)	GROSS BETA	I-131	CA-APT-A7 Vol. (M^3)	GROSS BETA	I-131	CA-APT-A8 Vol. (M^3)	GROSS BETA	I-131	CA-APT-A9 Vol. (M^3)	GROSS BETA	I-131	CA-APT-B3 Vol. (M^3)	GROSS BETA	I-131
07/09/92	418	0.017 ± 0.002	<0.070	428	0.016 ± 0.002	<0.070	426	0.012 ± 0.002	<0.070	428	0.018 ± 0.002	<0.070	426	0.017 ± 0.002	<0.070
07/16/92	410	0.020 ± 0.002	<0.070	431	0.011 ± 0.002	<0.070	436	0.012 ± 0.002	<0.070	433	0.014 ± 0.002	<0.070	436	0.018 ± 0.002	<0.070
07/23/92	426	0.013 ± 0.002	<0.070	431	0.013 ± 0.002	<0.070	426	0.009 ± 0.002	<0.070	426	0.010 ± 0.002	<0.070	423	0.007 ± 0.002	<0.070
07/30/92	423	0.018 ± 0.002	<0.070	423	0.010 ± 0.002	<0.070	423	0.012 ± 0.002	<0.070	423	0.013 ± 0.002	<0.070	423	0.007 ± 0.002	<0.070
08/06/92	428	0.018 ± 0.002	<0.070	431	0.009 ± 0.002	<0.070	431	0.011 ± 0.002	<0.070	431	0.012 ± 0.002	<0.070	431	0.017 ± 0.002	<0.070
08/13/92	431	0.020 ± 0.003	<0.070	0	ND	ND	431	0.011 ± 0.002	<0.070	431	0.011 ± 0.002	<0.070	431	0.018 ± 0.003	<0.070
08/20/92	428	0.013 ± 0.002	<0.070	423	0.014 ± 0.002	<0.070	431	0.012 ± 0.002	<0.070	426	0.010 ± 0.002	<0.070	426	0.016 ± 0.002	<0.070
08/27/92	423	0.024 ± 0.003	<0.070	426	0.018 ± 0.002	<0.070	423	0.021 ± 0.002	<0.070	423	0.016 ± 0.002	<0.070	426	0.022 ± 0.003	<0.070
09/03/92	433	0.023 ± 0.003	<0.070	431	0.020 ± 0.003	<0.070	433	0.018 ± 0.003	<0.070	433	0.014 ± 0.002	<0.070	431	0.023 ± 0.003	<0.070
09/10/92	421	0.020 ± 0.003	<0.070	423	0.013 ± 0.002	<0.070	423	0.019 ± 0.003	<0.070	423	0.013 ± 0.002	<0.070	423	0.022 ± 0.003	<0.070
09/17/92	433	0.025 ± 0.003	<0.070	431	0.021 ± 0.002	<0.070	431	0.016 ± 0.002	<0.070	431	0.012 ± 0.002	<0.070	431	0.017 ± 0.002	<0.070
09/24/92	418	0.009 ± 0.002	<0.070	423	0.017 ± 0.002	<0.070	423	0.015 ± 0.003	<0.070	421	0.009 ± 0.002	<0.070	423	0.009 ± 0.002	<0.070
10/01/92	436	0.017 ± 0.002	<0.070	436	0.017 ± 0.002	<0.070	436	0.014 ± 0.002	<0.070	436	0.017 ± 0.002	<0.070	433	0.010 ± 0.002	<0.070
10/08/92	428	0.033 ± 0.003	<0.070	428	0.032 ± 0.003	<0.070	428	0.010 ± 0.002	<0.070	431	0.020 ± 0.003	<0.070	431	0.022 ± 0.003	<0.070
10/15/92	423	0.021 ± 0.003	<0.070	423	0.022 ± 0.003	<0.070	426	0.020 ± 0.002	<0.070	426	0.023 ± 0.003	<0.070	426	0.006 ± 0.002	<0.070
10/22/92	431	0.029 ± 0.003	<0.070	431	0.031 ± 0.003	<0.070	428	0.028 ± 0.003	<0.070	428	0.034 ± 0.003	<0.070	428	0.026 ± 0.003	<0.070
10/29/92	428	0.015 ± 0.002	<0.070	428	0.037 ± 0.003	<0.070	428	0.029 ± 0.003	<0.070	428	0.038 ± 0.003	<0.070	428	0.026 ± 0.003	<0.070
11/05/92	426	0.027 ± 0.003	<0.070	428	0.027 ± 0.003	<0.070	426	0.018 ± 0.002	<0.070	426	0.026 ± 0.003	<0.070	426	0.021 ± 0.002	<0.070
11/12/92	431	0.020 ± 0.002	<0.070	494	0.021 ± 0.002	<0.070	494	0.013 ± 0.002	<0.070	459	0.018 ± 0.002	<0.070	428	0.013 ± 0.002	<0.070
11/19/92	479	0.019 ± 0.002	<0.070	428	0.026 ± 0.003	<0.070	413	0.030 ± 0.003	<0.070	431	0.028 ± 0.003	<0.070	431	0.018 ± 0.002	<0.070
11/27/92	489	0.020 ± 0.002	<0.070	489	0.019 ± 0.002	<0.070	489	0.017 ± 0.002	<0.070	489	0.017 ± 0.002	<0.070	489	0.012 ± 0.002	<0.070
12/03/92	367	0.034 ± 0.003	<0.070	367	0.038 ± 0.003	<0.070	364	0.026 ± 0.003	<0.070	367	0.031 ± 0.003	<0.070	367	0.024 ± 0.003	<0.070
12/10/92	428	0.020 ± 0.002	<0.070	428	0.020 ± 0.002	<0.070	428	0.019 ± 0.002	<0.070	426	0.018 ± 0.002	<0.070	428	0.015 ± 0.002	<0.070
12/17/92	428	0.025 ± 0.003	<0.070	428	0.020 ± 0.003	<0.070	431	0.022 ± 0.003	<0.070	433	0.016 ± 0.002	<0.070	431	0.010 ± 0.002	<0.070
12/23/92	364	0.054 ± 0.004	<0.070	364	0.041 ± 0.003	<0.070	364	0.038 ± 0.003	<0.070	364	0.046 ± 0.004	<0.070	364	0.038 ± 0.003	<0.070
12/31/92	497	0.024 ± 0.002	<0.070	494	0.027 ± 0.003	<0.070	497	0.024 ± 0.002	<0.070	494	0.026 ± 0.002	<0.070	494	0.010 ± 0.002	<0.070

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

TABLE E2

AIRBORNE PARTICULATE - QUARTERLY COMPOSITES (pCi/m^3)
1992

JANUARY - MARCH 1992					
	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5572	5572	5575	5573	5577
Analysis					
Sr-89	<0.0002	<0.0003	<0.0002	<0.0002	<0.0003
Sr-90	<0.0001	<0.0002	<0.0001	<0.0001	<0.0002
Be-7	0.0510 ± 0.0070	0.0410 ± 0.0070	0.0380 ± 0.0070	0.0340 ± 0.0050	0.0490 ± 0.0100
Co-58	<0.0008	<0.0005	<0.0009	<0.0006	<0.0011
Co-60	<0.0007	<0.0005	<0.0005	<0.0006	<0.0009
Zr-95	<0.0014	<0.0009	<0.0012	<0.0011	<0.0020
Cs-134	<0.0005	<0.0004	<0.0004	<0.0004	<0.0006
Cs-137	<0.0005	<0.0005	<0.0005	<0.0005	<0.0009
Ba-La-140	<0.0047	<0.0043	<0.0052	<0.0014	<0.0078
Ce-144	<0.0023	<0.0021	<0.0036	<0.0015	<0.0051

APRIL - JUNE 1992					
	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5558	5564	5264	5560	5559
Analysis					
Sr-89	<0.0003	<0.0007	<0.0006	<0.0006	<0.0003
Sr-90	<0.0002	<0.0004	<0.0003	<0.0003	<0.0002
Be-7	0.0900 ± 0.0210	0.0690 ± 0.0160	0.0410 ± 0.0090	0.0980 ± 0.0220	0.0580 ± 0.0120
Co-58	<0.0016	<0.0012	<0.0012	<0.0012	<0.0014
Co-60	<0.0022	<0.0011	<0.0008	<0.0009	<0.0012
Zr-95	<0.0039	<0.0026	<0.0016	<0.0031	<0.0025
Cs-134	<0.0013	<0.0010	<0.0007	<0.0011	<0.0006
Cs-137	<0.0012	<0.0010	<0.0007	<0.0012	<0.0010
Ba-La-140	<0.0047	<0.0028	<0.0025	<0.0038	<0.0014
Ce-144	<0.0083	<0.0078	<0.0019	<0.0087	<0.0028

Notes:

TABLE E2 (Cont.)

AIRBORNE PARTICULATE - QUARTERLY COMPOSITES (pCi/m^3)
1992

JULY - SEPTEMBER 1992

	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5528	5137	5573	5565	5563
Analysis					
Sr-89	<0.0005	<0.0006	<0.0006	<0.0005	<0.0006
Sr-90	<0.0002	<0.0002	0.0003 ± 0.0002	0.0003 ± 0.0002	<0.0002
Be-7	0.0620 ± 0.0150	0.0570 ± 0.0230	0.0530 ± 0.0160	0.0440 ± 0.0100	0.0640 ± 0.0170
Co-58	<0.0017	<0.0025	<0.0020	<0.0014	<0.0012
Co-60	<0.0007	<0.0023	<0.0016	<0.0011	<0.0011
Zr-95	<0.0037	<0.0035	<0.0031	<0.0027	<0.0029
Cs-134	<0.0013	<0.0016	<0.0012	<0.0010	<0.0012
Cs-137	<0.0011	<0.0020	<0.0016	<0.0011	<0.0014
Ba-La-140	<0.0043	<0.0047	<0.0029	<0.0030	<0.0032
Ce-144	<0.0092	<0.0120	<0.0077	<0.0064	<0.0078

OCTOBER - DECEMBER 1992

	CA-APT-A1	CA-APT-A7	CA-APT-A8	CA-APT-A9	CA-APT-B3
Volume (Cubic Feet):	5619	5564	5616	5602	5571
Analysis					
Sr-89	<0.0005	<0.0004	<0.0003	<0.0004	<0.0004
Sr-90	0.0007 ± 0.0003	<0.0005	<0.0003	<0.0004	<0.0004
Be-7	0.0570 ± 0.0180	0.0480 ± 0.0095	0.0400 ± 0.0110	0.0530 ± 0.0092	0.0290 ± 0.0130
Co-58	<0.0023	<0.0012	<0.0016	<0.0010	<0.0021
Co-60	<0.0036	<0.0014	<0.0015	<0.0011	<0.0021
Zr-95	<0.0055	<0.0020	<0.0029	<0.0014	<0.0037
Cs-134	<0.0018	<0.0010	<0.0015	<0.0007	<0.0018
Cs-137	<0.0019	<0.0010	<0.0014	<0.0007	<0.0013
Ba-La-140	<0.0099	<0.0033	<0.0047	<0.0035	<0.0048
Ce-144	<0.0100	<0.0048	<0.0078	<0.0023	<0.0088

Notes:

TABLE E3

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (01/14/92)	CA-MLK-M5B (01/14/92)
I-131	<0.3	ND
Sr-89	<0.5	ND
Sr-90	2.6 ± 0.5	ND
K-40	1180.0 ± 150.0	ND
Zn-65	<9.6	ND
Cs-134	<4.6	ND
Cs-137	<4.0	ND
Ba-La-140	<6.9	ND
Ca (g/l)	0.64	ND

Analysis	CA-MLK-M1 (02/11/92)	CA-MLK-M5B (02/11/92)
I-131	<0.2	ND
Sr-89	<0.5	ND
Sr-90	3.0 ± 0.6	ND
K-40	1200.0 ± 160.0	ND
Zn-65	<13.9	ND
Cs-134	<5.2	ND
Cs-137	<4.8	ND
Ba-La-140	<5.8	ND
Ca (g/l)	0.89	ND

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (03/11/92)	CA-MLK-M5B (03/11/92)
I-131	<0.2	ND
Sr-89	<0.4	ND
Sr-90	2.6 ± 0.5	ND
K-40	990.0 ± 130.0	ND
Zn-65	<14.9	ND
Cs-134	<6.2	ND
Cs-137	<7.7	ND
Ba-La-140	<6.2	ND
Ca (g/l)	1.05	ND

Analysis	CA-MLK-M1 (04/14/92)	CA-MLK-M5B (04/14/92)
I-131	<0.3	ND
Sr-89	<0.6	ND
Sr-90	3.8 ± 0.6	ND
K-40	1080.0 ± 100.0	ND
Zn-65	<11.9	ND
Cs-134	<4.0	ND
Cs-137	<5.1	ND
Ba-La-140	<4.7	ND
Ca (g/l)	0.91	ND

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (04/28/92)	CA-MLK-M5B (04/28/92)
I-131	<0.2	ND
Sr-89	<0.6	ND
Sr-90	4.5 ± 0.6	ND
K-40	1130.0 ± 130.0	ND
Zn-65	<12.0	ND
Cs-134	<3.9	ND
Cs-137	<5.2	ND
Ba-La-140	<3.2	ND
Ca (g/l)	1.20	ND

Analysis	CA-MLK-M1 (05/12/92)	CA-MLK-M5B (05/12/92)
I-131	<0.3	<0.3
Sr-89	<0.5	<0.5
Sr-90	4.3 ± 0.6	5.9 ± 0.8
K-40	1210.0 ± 160.0	1640.0 ± 130.0
Zn-65	<18.1	<10.7
Cs-134	<6.8	<4.1
Cs-137	<7.5	<5.2
Ba-La-140	<7.9	<3.2
Ca (g/l)	0.88	1.08

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (05/26/92)	CA-MLK-M5B (05/26/92)
I-131	<0.4	<0.3
Sr-89	<0.5	<0.5
Sr-90	4.0 ± 0.6	6.6 ± 0.5
K-40	1120.0 ± 130.0	1830.0 ± 120.0
Zn-65	<13.4	<16.1
Cs-134	<4.0	<5.1
Cs-137	<5.3	<5.8
Ba-La-140	<4.9	<5.0
Ca (g/l)	1.05	1.04

Analysis	CA-MLK-M1 (06/06/92)	CA-MLK-M5B (06/06/92)
I-131	<0.4	<0.4
Sr-89	<1.7	<1.0
Sr-90	4.1 ± 1.2	6.9 ± 0.8
K-40	950.0 ± 170.0	1690.0 ± 120.0
Zn-65	<15.9	<13.9
Cs-134	<5.5	<4.2
Cs-137	<7.7	<7.2
Ba-La-140	<5.3	<5.4
Ca (g/l)	0.94	0.94

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (06/23/92)	CA-MLK-M5B (06/23/92)
I-131	<0.3	<0.2
Sr-89	<1.2	<2.3
Sr-90	2.8 ± 0.5	3.5 ± 0.7
K-40	1100.0 ± 110.0	1770.0 ± 160.0
Zn-65	<10.6	<12.6
Cs-134	<4.2	<4.8
Cs-137	<3.8	<5.8
Ba-La-140	<6.0	<6.2
Ca (g/l)	1.18	0.60

Analysis	CA-MLK-M1 (07/14/92)	CA-MLK-M5B (07/14/92)
I-131	<0.3	<0.3
Sr-89	<0.8	<0.9
Sr-90	4.8 ± 0.7	6.1 ± 0.9
K-40	1160.0 ± 150.0	1680.0 ± 190.0
Zn-65	<18.5	<25.5
Cs-134	<6.4	<7.3
Cs-137	<7.5	<7.1
Ba-La-140	<8.9	<10.8
Ca (g/l)	1.01	1.03

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (07/28/92)	CA-MLK-M5B (07/26/92)
I-131	<0.3	<0.4
Sr-89	<1.4	<1.4
Sr-90	2.3 ± 0.7	6.2 ± 0.9
K-40	1300.0 ± 110.0	1850.0 ± 170.0
Zn-65	<13.4	<21.7
Cs-134	<5.6	<6.0
Cs-137	<4.6	<6.4
Ba-La-140	<6.0	<13.5
Ca (g/l)	0.93	0.85

Analysis	CA-MLK-M1 (08/14/92)	CA-MLK-M5B (08/14/92)
I-131	<0.3	<0.4
Sr-89	<1.1	<1.5
Sr-90	4.3 ± 0.9	5.2 ± 1.2
K-40	1560.0 ± 130.0	1980.0 ± 210.0
Zn-65	<11.8	<25.8
Cs-134	<5.3	<7.9
Cs-137	<5.7	<8.9
Ba-La-140	<3.7	<13.0
Ca (g/l)	0.90	0.95

Notes:

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (08/25/92)	CA-MLK-M5B (08/25/92)
I-131	<0.9	<0.9
Sr-89	<0.9	<1.0
Sr-90	3.9 ± 0.8	5.1 ± 1.1
K-40	1760.0 ± 60.0	1910.0 ± 70.0
Zn-65	<6.1	<5.0
Cs-134	<2.0	<1.9
Cs-137	<2.1	<2.3
Ba-La-140	<11.3	<11.1
Ca (g/l)	1.00	0.96

Analysis	CA-MLK-M1 (09/08/92)	CA-MLK-M5B (09/08/92)
I-131	ND	<0.6
Sr-89	ND	<1.2
Sr-90	ND	1.7 ± 0.6
K-40	ND	1700.0 ± 180.0
Zn-65	ND	<21.8
Cs-134	ND	<6.3
Cs-137	ND	<7.6
Ba-La-140	ND	<10.5
Ca (g/l)	ND	0.78

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (09/21/92)	CA-MLK-M5B (09/21/92)
I-131	<0.5	<0.4
Sr-89	<1.1	<2.2
Sr-90	2.3 ± 0.7	5.4 ± 1.1
K-40	1510.0 ± 160.0	1700.0 ± 180.0
Zn-65	<21.4	<26.3
Cs-134	<7.1	<7.5
Cs-137	<7.3	<7.5
Ba-La-140	<8.6	<10.5
Ca (g/l)	0.60	0.84

Analysis	CA-MLK-M1 (10/20/92)	CA-MLK-M5B (10/20/92)
I-131	<0.3	ND
Sr-89	<1.7	ND
Sr-90	2.3 ± 0.8	ND
K-40	1330.0 ± 160.0	ND
Zn-65	<12.5	ND
Cs-134	<5.4	ND
Cs-137	<5.9	ND
Ba-La-140	<4.1	ND
Ca (g/l)	0.44	ND

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E3 (Cont.)

MILK (pCi/kg dry)
1992

Analysis	CA-MLK-M1 (11/10/92)	CA-MLK-M5B (11/10/92)
I-131	<0.3	ND
Sr-89	<0.9	ND
Sr-90	4.1 ± 0.8	ND
K-40	1260.0 ± 160.0	ND
Zn-65	<15.8	ND
Cs-134	<5.9	ND
Cs-137	<6.6	ND
Ba-La-140	<2.3	ND
Ca (g/l)	1.01	ND

Analysis	CA-MLK-M1 (12/08/92)	CA-MLK-M5B (12/08/92)
I-131	<0.2	ND
Sr-89	<0.8	ND
Sr-90	4.5 ± 0.7	ND
K-40	1370.0 ± 160.0	ND
Zn-65	<12.3	ND
Cs-134	<4.5	ND
Cs-137	<6.1	ND
Ba-La-140	<7.6	ND
Ca (g/l)	0.95	ND

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E4

VEGETATION (pCi/kg wet)
1992

Analysis	CA-FPL-V3 LETTUCE (06/09/92)	CA-FPL-V3 SPINACH (06/09/92)	CA-FPL-V6 MUSTARD GREENS (06/08/92)
Gross Alpha	<58.0	178.0 ± 117.0	<124.0
Gross Beta	3126.0 ± 130.0	7396.0 ± 298.0	4489.0 ± 192.0
I-131	<15.3	<21.0	<16.0
K-40	3950.0 ± 317.0	6640.0 ± 473.0	3980.0 ± 272.0
Mn-54	<11.9	<15.8	<10.4
Co-58	<12.7	<17.1	<10.7
Co-60	<13.2	<19.7	<11.5
Cs-134	<12.2	<15.4	<11.7
Cs-137	<11.7	<15.6	<10.6

Analysis	CA-FPL-V6 SPINACH (06/08/92)	CA-FPL-V6 LETTUCE (06/08/92)	CA-FPL-V6 CABBAGE (06/08/92)
Gross Alpha	181.0 ± 99.0	<46.0	25.0 ± 19.0
Gross Beta	6697.0 ± 250.0	3279.0 ± 125.0	1347.0 ± 56.0
I-131	<19.7	<17.4	<14.8
K-40	6380.0 ± 487.0	3980.0 ± 363.0	2472.0 ± 274.0
Mn-54	<18.3	<15.3	<13.2
Co-58	<18.4	<15.4	<12.4
Co-60	<23.7	<19.5	<11.3
Cs-134	<15.3	<13.5	<9.5
Cs-137	<16.7	<14.0	<10.0

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1992

Analysis	CA-FPL-V6 TURNIP GREENS (06/08/92)	CA-FPL-V7 LETTUCE (06/08/92)	CA-FPL-V7 MUSTARD GREENS (06/08/92)
Gross Alpha	237.0 ± 92.0	<63.0	<53.0
Gross Beta	4519.0 ± 170.0	2570.0 ± 107.0	4667.0 ± 136.0
I-131	<18.8	<13.8	<16.7
K-40	4221.0 ± 276.0	2500.0 ± 220.0	5131.0 ± 408.0
Mn-54	<11.8	<9.8	<14.0
Co-58	<11.7	<9.8	<15.0
Co-60	<9.2	<12.2	<15.1
Cs-134	<9.5	<9.5	<11.5
Cs-137	<10.5	<10.3	<12.6

Analysis	CA-FPL-V7 SPINACH (06/08/92)	CA-FPL-V7 CABBAGE (06/08/92)	CA-FPL-V3 LETTUCE (07/14/92)
Gross Alpha	71.0 ± 48.0	129.0 ± 93.0	<82.0
Gross Beta	6670.0 ± 173.0	5148.0 ± 238.0	5038.0 ± 185.0
I-131	<20.0	<19.1	<16.7
K-40	6677.0 ± 330.0	4010.0 ± 312.0	4807.0 ± 297.0
Mn-54	<12.5	<15.4	<14.5
Co-58	<13.4	<14.6	<11.1
Co-60	<11.6	<15.5	<11.1
Cs-134	<9.4	<13.0	<10.8
Cs-137	<9.9	<14.1	<11.2

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1992

Analysis	CA-FPL-V3 TURNIP GREENS (07/14/92)	CA-FPL-V3 MUSTARD GREENS (07/14/92)	CA-FPL-V3 CABBAGE (07/14/92)
Gross Alpha	343.0 ± 204.0	183.0 ± 108.0	<45.0
Gross Beta	4626.0 ± 290.0	4980.0 ± 245.0	2255.0 ± 90.0
I-131	<25.2	<17.3	<18.6
K-40	4980.0 ± 493.0	4963.0 ± 458.0	3793.0 ± 408.0
Mn-54	<21.1	<15.6	<16.2
Co-58	<20.8	<15.6	<15.3
Co-60	<22.0	<17.9	<18.6
Cs-134	<19.4	<12.6	<13.4
Cs-137	<19.0	<14.4	<15.7

Analysis	CA-FPL-V6 MUSTARD GREENS (07/13/92)	CA-FPL-V6 CABBAGE (07/13/92)	CA-FPL-V6 LETTUCE (07/13/92)
Gross Alpha	140.0 ± 86.0	<43.0	<72.0
Gross Beta	3606.0 ± 171.0	2349.0 ± 99.0	4770.0 ± 190.0
I-131	<20.4	<18.1	<31.1
K-40	4886.0 ± 322.0	2320.0 ± 265.0	5070.0 ± 555.0
Mn-54	<14.3	<13.7	<20.1
Co-58	<14.1	<14.7	<23.2
Co-60	<13.0	<14.3	<25.8
Cs-134	<11.6	<13.6	<20.4
Cs-137	<13.2	<15.0	<21.5

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1992

Analysis	CA-FPL-V6 TURNIP GREENS (07/13/92)	CA-FPL-V7 CABBAGE (07/13/92)	CA-FPL-V7 TURNIP GREENS (07/13/92)
Gross Alpha	127.0 ± 73.0	176.0 ± 106.0	158.0 ± 108.0
Gross Beta	4416.0 ± 179.0	4898.0 ± 204.0	3960.0 ± 226.0
I-131	<21.2	<21.1	<13.4
K-40	3830.0 ± 346.0	3970.0 ± 345.0	3160.0 ± 239.0
Mn-54	<14.5	<15.7	<11.5
Co-58	<15.6	<16.8	<11.3
Co-60	<18.6	<14.1	<11.6
Cs-134	<14.7	<15.9	<12.2
Cs-137	<15.8	<13.8	<10.1

Analysis	CA-FPL-V7 SPINACH (07/13/92)	CA-FPL-V7 LETTUCE (07/13/92)	CA-FPL-V7 MUSTARD GREENS (07/13/92)
Gross Alpha	248.0 ± 114.0	121.0 ± 63.0	137.0 ± 78.0
Gross Beta	7720.0 ± 263.0	3800.0 ± 140.0	4082.0 ± 176.0
I-131	<15.8	<20.0	<22.5
K-40	7720.0 ± 401.0	3910.0 ± 390.0	4010.0 ± 429.0
Mn-54	<13.3	<16.3	<19.9
Co-58	<13.5	<16.9	<18.3
Co-60	<14.2	<17.8	<21.3
Cs-134	<13.2	<14.6	<16.9
Cs-137	<13.3	<16.0	<16.6

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1992

Analysis	CA-FPL-V6 CABBAGE (08/14/92)	CA-FPL-V6 TURNIP GREENS (08/14/92)	CA-FPL-V7 MUSTARD GREENS (08/14/92)
Gross Alpha	<23.0	<181.0	178.0 ± 100.0
Gross Beta	1144.0 ± 53.0	7319.0 ± 385.0	3997.0 ± 193.0
I-131	<28.3	<28.5	<24.2
K-40	2510.0 ± 362.0	7340.0 ± 511.0	4460.0 ± 455.0
Mn-54	<20.4	<17.8	<19.3
Co-58	<18.5	<19.3	<20.6
Co-60	<20.4	<20.7	<19.7
Cs-134	<18.8	<15.7	<15.9
Cs-137	<16.7	<15.7	<18.4

Analysis	CA-FPL-V7 TURNIP GREENS (08/14/92)	CA-FPL-V3 CABBAGE (09/08/92)	CA-FPL-V3 MUSTARD (09/08/92)
Gross Alpha	<173.0	<46.0	<86.0
Gross Beta	5746.0 ± 296.0	2141.0 ± 85.0	4973.0 ± 206.0
I-131	<19.2	<19.1	<26.5
K-40	2840.0 ± 319.0	2440.0 ± 313.0	3960.0 ± 471.0
Mn-54	<14.4	<14.8	<21.4
Co-58	<16.1	<15.1	<23.0
Co-60	<15.2	<18.3	<22.7
Cs-134	<12.8	<13.1	<18.7
Cs-137	<13.8	<12.7	<20.5

Notes:

TABLE E4 (Cont.)

VEGETATION (pCi/kg wet)
1992

Analysis	CA-FPL-V6 TURNIP GREENS (09/07/92)	CA-FPL-V6 CABBAGE (09/07/92)	CA-FPL-V6 MUSTARD (10/13/92)
Gross Alpha	318.0 ± 192.0	90.0 ± 39.0	77.0 ± 42.0
Gross Beta	6346.0 ± 360.0	2116.0 ± 81.0	2585.0 ± 108.0
I-131	<55.8	<19.3	<24.3
K-40	6650.0 ± 737.0	2020.0 ± 281.0	4090.0 ± 405.0
Mn-54	<34.0	<13.6	<17.5
Co-58	<37.9	<16.7	<16.7
Co-60	<36.2	<21.1	<16.8
Cs-134	<35.3	<12.4	<16.1
Cs-137	<33.0	<13.8	<17.0

Analysis	CA-FPL-V6 CABBAGE (10/13/92)	CA-FPL-V6 SPINACH (10/13/92)	( )
Gross Alpha	117.0 ± 54.0	155.0 ± 72.0	
Gross Beta	3141.0 ± 123.0	5816.0 ± 186.0	
I-131	<17.4	<54.2	
K-40	3050.0 ± 322.0	6830.0 ± 816.0	
Mn-54	<14.6	<34.4	
Co-58	<14.0	<43.5	
Co-60	<19.5	<40.1	
Cs-134	<12.5	<37.2	
Cs-137	<13.5	<31.9	

Notes:

TABLE E5

SOIL (pCi/kg dry)
1992

Analysis	CA-SOL-F1 (12/15/92)	CA-SOL-F2 (12/15/92)	CA-SOL-F6 (12/15/92)
Gross Alpha	11289.0 ± 4264.0	9159.0 ± 3116.0	11007.0 ± 3478.0
Gross Beta	22417.0 ± 2810.0	22374.0 ± 2174.0	24553.0 ± 2515.0
K-40	12900.0 ± 748.0	14190.0 ± 1122.0	13100.0 ± 993.0
Mn-54	<39.4	<41.2	<55.8
Co-58	<46.5	<45.8	<62.2
Co-60	<49.8	<50.9	<65.4
Cs-134	<59.6	<37.2	<73.2
Cs-137	1080.0 ± 55.0	727.0 ± 75.0	1460.0 ± 80.0

Analysis	CA-SOL-F8 (12/15/92)	CA-SOL-F9 (12/15/92)	CA-SOL-PR10 (12/15/92)
Gross Alpha	12994.0 ± 3540.0	11167.0 ± 3615.0	12230.0 ± 4224.0
Gross Beta	21877.0 ± 2268.0	21927.0 ± 2445.0	21215.0 ± 2620.0
K-40	11700.0 ± 787.0	13690.0 ± 1329.0	1600.0 ± 972.0
Mn-54	<45.5	<62.0	<56.0
Co-58	<52.4	<57.7	<70.1
Co-60	<56.9	<69.2	<72.4
Cs-134	<64.3	<47.1	<91.7
Cs-137	1660.0 ± 72.0	1134.0 ± 105.0	992.0 ± 70.0

Notes:

TABLE E5 (Cont.)

SOIL (pCi/kg dry)
1992

Analysis	CA-SOL-PR3 (12/15/92)	CA-SOL-PR4 (12/15/92)	CA-SOL-PR5 (12/15/92)
Gross Alpha	9688.0 ± 3353.0	14753.0 ± 3458.0	15802.0 ± 4393.0
Gross Beta	17287.0 ± 2383.0	13027.0 ± 1461.0	21555.0 ± 2704.0
K-40	11820.0 ± 1128.0	12500.0 ± 679.0	13460.0 ± 1147.0
Mn-54	<56.4	<37.2	<51.3
Co-58	<57.7	<43.8	<51.0
Co-60	<63.0	<44.0	<54.8
Cs-134	<41.0	<54.0	<40.6
Cs-137	948.0 ± 86.0	661.0 ± 41.0	1089.0 ± 83.0

Analysis	CA-SOL-PR7 (12/15/92)	CA-SOL-V3 (12/15/92)
Gross Alpha	9255.0 ± 4009.0	11391.0 ± 3841.0
Gross Beta	19910.0 ± 2670.0	24579.0 ± 2792.0
K-40	9771.0 ± 962.0	17400.0 ± 898.0
Mn-54	<42.6	<43.1
Co-58	<42.7	<48.9
Co-60	<46.4	<59.0
Cs-134	<37.9	<57.5
Cs-137	425.0 ± 59.0	389.0 ± 38.0

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E6

WETLANDS (pCi/kg dry)
1992

Analysis	CA-SOL-W1 (12/22/92)	CA-SOL-W2 (12/22/92)
Gross Alpha	8280.0 ± 3280.0	15660.0 ± 4220.0
Gross Beta	24890.0 ± 3020.0	19050.0 ± 3020.0
K-40	19570.0 ± 1830.0	13100.0 ± 618.0
Mn-54	<80.6	<33.8
Co-58	<74.8	<38.2
Co-60	<91.5	<40.8
Cs-134	<58.2	<48.7
Cs-137	<97.5	<31.1

Analysis	CA-SOL-W3 (12/22/92)	CA-SOL-W4 (12/22/92)
Gross Alpha	12950.0 ± 4380.0	15750.0 ± 4160.0
Gross Beta	18050.0 ± 2870.0	23160.0 ± 2690.0
K-40	10800.0 ± 811.0	18000.0 ± 1180.0
Mn-54	<47.2	<60.7
Co-58	<52.3	<69.8
Co-60	<57.6	<77.3
Cs-134	<67.6	<74.0
Cs-137	<47.4	295.0 ± 47.0

Notes:

TABLE E7

SURFACE WATER (pCi/l)
1992

Analysis	CA-SWA-S01 (01/14/92)	CA-SWA-S02 (01/14/92)
H-3	<180.0	<180.0
Mn-54	<7.1	<7.2
Fe-59	<15.8	<16.3
Co-58	<7.4	<7.2
Co-60	<8.7	<7.6
Zr-Nb-95	<14.0	<13.6
Cs-134	<6.8	<6.2
Cs-137	<7.2	<6.2
Ba-La-140	<15.0	<14.1

Analysis	CA-SWA-S01 (02/11/92)	CA-SWA-S02 (02/11/92)
H-3	169.0 ± 92.0	161.0 ± 65.0
Mn-54	<6.7	<5.2
Fe-59	<19.1	<13.5
Co-58	<7.3	<7.5
Co-60	<9.1	<7.3
Zr-Nb-95	<13.9	<10.8
Cs-134	<6.1	<5.1
Cs-137	<7.3	<6.3
Ba-La-140	<7.9	<8.0

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E7 (Cont.)

SURFACE WATER (pCi/l)
1992

Analysis	CA-SWA-S01 (03/11/92)	CA-SWA-S02 (03/11/92)
H-3	<182.0	<182.0
Mn-54	<6.6	<6.4
Fe-59	<14.9	<11.7
Co-58	<6.0	<5.8
Co-60	<8.6	<7.5
Zr-Nb-95	<11.2	<10.6
Cs-134	<5.6	<6.3
Cs-137	<6.4	<6.1
Ba-La-140	<9.0	<6.7

Analysis	CA-SWA-S01 (04/14/92)	CA-SWA-S02 (04/14/92)
H-3	163.0 ± 90.0	<170.0
Mn-54	<5.7	<6.6
Fe-59	<12.6	<10.2
Co-58	<6.6	<7.1
Co-60	<6.7	<6.5
Zr-Nb-95	<11.4	<11.5
Cs-134	<6.6	<5.7
Cs-137	<6.6	<5.8
Ba-La-140	<8.4	<9.4

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E7 (Cont.)

SURFACE WATER (pCi/l)
1992

Analysis	CA-SWA-S01 (05/12/92)	CA-SWA-S02 (05/12/92)
H-3	248.0 ± 94.0	<169.0
Mn-54	<7.0	<5.3
Fe-59	<15.1	<7.4
Co-58	<6.3	<4.5
Co-60	<6.6	<4.7
Zr-Nb-95	<11.9	<7.9
Cs-134	<5.9	<3.7
Cs-137	<7.1	<5.7
Ba-La-140	<8.4	<4.0

Analysis	CA-SWA-S01 (06/09/92)	CA-SWA-S02 (06/09/92)
H-3	379.0 ± 99.0	<171.0
Mn-54	<4.5	<4.8
Fe-59	<13.8	<11.1
Co-58	<5.4	<5.2
Co-60	<4.0	<4.8
Zr-Nb-95	<9.4	<9.9
Cs-134	<5.4	<5.4
Cs-137	<4.6	<4.1
Ba-La-140	<13.0	<14.1

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E7 (Cont.)

SURFACE WATER (pCi/l)
1992

Analysis	CA-SWA-SO1 (07/14/92)	CA-SWA-SO2 (07/14/92)
H-3	560.0 ± 106.0	<172.0
Mn-54	<1.8	<2.1
Fe-59	<7.0	<6.7
Co-58	<2.4	<2.0
Co-60	<1.7	<1.6
Zr-Nb-95	<3.8	<4.3
Cs-134	<1.4	<1.5
Cs-137	<1.8	<1.4
Ba-La-140	<12.7	<9.8

Analysis	CA-SWA-SO1 (08/14/92)	CA-SWA-SO2 (08/14/92)
H-3	131.0 ± 95.0	<181.0
Mn-54	<6.5	<5.6
Fe-59	<13.3	<11.5
Co-58	<6.3	<6.5
Co-60	<7.1	<5.6
Zr-Nb-95	<11.9	<10.5
Cs-134	<6.4	<6.2
Cs-137	<6.5	<5.5
Ba-La-140	<9.9	<9.4

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E7 (Cont.)

SURFACE WATER (pCi/l)
1992

Analysis	CA-SWA-SO1 (09/08/92)	CA-SWA-SO2 (09/08/92)
H-3	844.0 ± 120.0	<185.0
Mn-54	<5.6	<7.0
Fe-59	<9.0	<14.9
Co-58	<4.8	<6.8
Co-60	<3.2	<6.5
Zr-Nb-95	<6.8	<11.0
Cs-134	<3.1	<6.5
Cs-137	<4.0	<7.2
Ba-La-140	<7.8	<11.3

Analysis	CA-SWA-SO1 (10/13/92)	CA-SWA-SO2 (10/13/92)
H-3	2711 ± 111.0	189.0 ± 89.0
Mn-54	<5.6	<6.5
Fe-59	<13.4	<13.7
Co-58	<5.8	<6.7
Co-60	<6.4	<7.2
Zr-Nb-95	<10.5	<12.9
Cs-134	<5.9	<6.3
Cs-137	<5.3	<6.2
Ba-La-140	<10.5	<13.4

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E7 (Cont.)

SURFACE WATER (pCi/l)
1992

Analysis	CA-SWA-SO1 (11/10/92)	CA-SWA-SO2 (11/10/92)
H-3	1928 ± 147.0	<179.0
Mn-54	<6.9	<6.0
Fe-59	<12.7	<13.4
Co-58	<6.9	<6.4
Co-60	<6.7	<5.9
Zr-Nb-95	<12.9	<9.2
Cs-134	<6.3	<5.5
Cs-137	<5.9	<5.6
Ba-La-140	<10.2	<9.3

Analysis	CA-SWA-SO1 (12/08/92)	CA-SWA-SO2 (12/08/92)
H-3	200.0 ± 96.0	794.0 ± 116.0
Mn-54	<6.6	<7.2
Fe-59	<13.1	<12.3
Co-58	<7.0	<7.4
Co-60	<6.5	<6.8
Zr-Nb-95	<12.6	<13.0
Cs-134	<6.3	<6.4
Cs-137	<6.0	<6.7
Ba-La-140	<9.9	<12.2

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E8

GROUND WATER (pCi/l)
1992

Analysis	CA-WWA-D01 (01/14/92)	CA-WWA-F15 (01/14/92)	CA-WWA-F05 (01/21/92)
H-3	<180.0	<180.0	<180.0
Mn-54	<6.6	<6.8	<4.4
Fe-59	<12.9	<17.1	<8.8
Co-58	<6.6	<7.8	<4.9
Co-60	<6.8	<8.6	<4.4
Zr-Nb-95	<13.2	<12.9	<8.4
Cs-134	<7.0	<6.8	<4.5
Cs-137	<5.9	<7.0	<4.4
Ba-La-140	<11.6	<11.9	<6.1

Analysis	CA-WWA-D01 (03/11/92)	CA-WWA-F15 (03/11/92)	CA-WWA-F05 (03/11/92)
H-3	<182.0	ND	ND
Mn-54	<6.2	ND	ND
Fe-59	<11.4	ND	ND
Co-58	<6.2	ND	ND
Co-60	<7.5	ND	ND
Zr-Nb-95	<10.8	ND	ND
Cs-134	<7.9	ND	ND
Cs-137	<6.9	ND	ND
Ba-La-140	<6.1	ND	ND

Notes:
ND = No Data, See section 2.3 for explanation
Additional well water samples were collected at D01 on 03/11/92 and 05/12/92.

TABLE E8 (Cont.)

GROUND WATER (pCi/l)
1992

Analysis	CA-WWA-D01 (04/14/92)	CA-WWA-F15 (04/14/92)	CA-WWA-F05 (04/14/92)
H-3	<170.0	<170.0	<170.0
Mn-54	<6.6	<5.8	<7.0
Fe-59	<12.5	<10.0	<15.1
Co-58	<6.1	<5.4	<7.3
Co-60	<7.3	<6.0	<9.4
Zr-Nb-95	<11.3	<11.0	<12.4
Cs-134	<8.5	<5.6	<6.9
Cs-137	<6.6	<5.7	<6.4
Ba-La-140	<7.3	<5.8	<7.7

Analysis	CA-WWA-D01 (05/12/92)	CA-WWA-F15 (05/12/92)	CA-WWA-F05 (05/12/92)
H-3	<169.0	ND	ND
Mn-54	<6.0	ND	ND
Fe-59	<14.0	ND	ND
Co-58	<7.6	ND	ND
Co-60	<8.5	ND	ND
Zr-Nb-95	<12.4	ND	ND
Cs-134	<8.5	ND	ND
Cs-137	<7.3	ND	ND
Ba-La-140	<11.7	ND	ND

Notes:
ND = No Data, See section 2.3 for explanation
Additional well water samples were collected at D01 on 03/11/92 and 05/12/92.

TABLE E8 (Cont.)

GROUND WATER (pCi/l)
1992

Analysis	CA-WWA-D01 (07/28/92)	CA-WWA-F15 (07/28/92)	CA-WWA-F05 (07/28/92)
H-3	ND	<172.0	<172.0
Mn-54	ND	<2.0	<2.2
Fe-59	ND	<5.5	<6.2
Co-58	ND	<2.3	<2.6
Co-60	ND	<1.9	<2.4
Zr-Nb-95	ND	<4.3	<4.6
Cs-134	ND	<1.9	<2.0
Cs-137	ND	<1.9	<2.1
Ba-La-140	ND	<8.1	<11.1

Analysis	CA-WWA-D01 (10/20/92)	CA-WWA-F15 (10/20/92)	CA-WWA-F05 (10/20/92)
H-3	<164.0	<164.0	<164.0
Mn-54	<6.3	<6.2	<6.7
Fe-59	<15.8	<12.9	<16.5
Co-58	<6.8	<6.5	<7.8
Co-60	<7.2	<6.5	<7.3
Zr-Nb-95	<11.9	<11.0	<11.8
Cs-134	<6.5	<6.8	<5.7
Cs-137	<5.9	<5.9	<5.8
Ba-La-140	<11.7	<11.2	<12.0

Notes:
ND = No Data, See section 2.3 for explanation
Additional well water samples were collected at D01 on 03/11/92 and 05/12/92.

TABLE E9

BOTTOM SEDIMENT (pCi/kg dry)
1992

Analysis	CA-AQS-A (04/28/92)	CA-AQS-C (04/28/92)
Mn-54	<48.1	<42.1
Fe-59	<144.2	<126.2
Co-58	<48.7	<46.4
Co-60	<49.7	<43.3
Zr-Nb-95	<107.5	<88.9
Cs-134	<39.4	<25.3
Cs-137	<43.7	87.4 ± 28.4
Ba-La-140	<299.8	<389.0

Analysis	CA-AQS-A (10/08/92)	CA-AQS-C (10/08/92)
Mn-54	<28.7	<30.8
Fe-59	<99.9	<134.4
Co-58	<34.8	<38.5
Co-60	<44.3	<35.4
Zr-Nb-95	<61.1	<79.4
Cs-134	<32.9	<20.8
Cs-137	<24.1	<24.5
Ba-La-140	<235.0	<355.5

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E10

SHORELINE SEDIMENT (pCi/kg dry)
1992

Analysis	CA-AQS-A (04/28/92)	CA-AQS-C (04/28/92)
Mn-54	<32.9	<37.8
Fe-59	<158.0	<128.0
Co-58	<50.0	<41.7
Co-60	<43.0	<46.8
Zr-Nb-95	<93.4	<77.1
Cs-134	<44.6	<49.0
Cs-137	<30.3	<31.9
Ba-La-140	<731.0	<242.0

Analysis	CA-AQS-A (10/08/92)	CA-AQS-C (10/08/92)
Mn-54	<41.0	<38.0
Fe-59	<177.0	<146.8
Co-58	<56.6	<49.2
Co-60	<47.9	<47.5
Zr-Nb-95	<104.0	<99.1
Cs-134	<56.3	<31.4
Cs-137	<35.3	58.4 ± 29.9
Ba-La-140	<797.0	<406.4

Notes:

TABLE E11

FISH, CA-AQF-A (pCi/kg WET)
1992

Analysis	BIGMOUTH BUFFALO (04/28/92)	RIVER CARPSUCKER (04/28/92)	CARP (04/28/92)	CHANNEL CATFISH (04/28/92)	FRESHWATER DRUM (04/28/92)
Sr-89	<6.8	<6.4	<5.9	<8.6	<3.9
Sr-90	<2.9	<2.7	<2.3	<3.6	<1.7
K-40	2681.0 ± 488.0	2326.0 ± 315.0	2825.0 ± 235.0	2237.0 ± 440.0	2770.0 ± 378.0
Mn-54	<21.6	<15.1	<15.2	<23.5	<18.9
Fe-59	<63.6	<34.5	<34.8	<66.0	<53.0
Co-58	<24.8	<18.5	<15.5	<19.6	<21.9
Co-60	<29.2	<15.6	<18.5	<17.7	<25.1
Cs-134	<19.9	<10.1	<12.9	<15.0	<14.0
Cs-137	<20.0	<14.0	<15.5	<14.3	<17.3

Analysis	CARP (10/08/92)	RIVER CARPSUCKER (10/08/92)	CHANNEL CATFISH (10/08/92)	FRESHWATER DRUM (10/08/92)	GIZZARD SHAD (10/08/92)
Sr-89	<7.9	<5.0	<4.7	<2.5	<5.3
Sr-90	<2.9	<3.2	<3.0	<1.5	<2.2
K-40	2730.0 ± 403.0	2940.0 ± 317.0	2460.0 ± 348.0	2320.0 ± 325.0	2850.0 ± 392.0
Mn-54	<22.1	<19.2	<15.5	<15.6	<19.7
Fe-59	<52.7	<39.9	<53.1	<44.5	<47.6
Co-58	<21.0	<16.2	<18.9	<17.4	<21.1
Co-60	<25.0	<19.2	<23.9	<16.7	<20.3
Cs-134	<18.2	<14.4	<12.6	<14.3	<16.3
Cs-137	<16.6	<14.9	<17.9	<14.5	<17.9

Notes:

TABLE E11 (Cont.)

FISH, CA-AQF-C (pCi/kg WET)
1992

Analysis	CARP (04/28/92)	CHANNEL CATFISH (04/28/92)	FRESHWATER DRUM (04/28/92)	RIVER CARPSUCKER (04/28/92)	BIGMOUTH BUFFALO (04/28/92)
Sr-89	ND	ND	ND	ND	ND
Sr-90	ND	ND	ND	ND	ND
K-40	2730.0 ± 302.0	2376.0 ± 271.0	2230.0 ± 325.0	2603.0 ± 396.0	2880.0 ± 274.0
Mn-54	<17.8	<14.9	<17.8	<20.5	<14.3
Fe-59	<44.3	<34.4	<59.9	<50.2	<32.5
Co-58	<16.4	<14.1	<21.1	<20.5	<13.9
Co-60	<15.6	<14.3	<18.1	<27.6	<13.2
Cs-134	<15.3	<9.7	<15.4	<17.0	<12.1
Cs-137	<14.4	<11.4	<16.5	<18.6	<12.6

Analysis	CARP (10/08/92)	FRESHWATER DRUM (10/08/92)	CHANNEL CATFISH (10/08/92)	RIVER CARPSUCKER (10/08/92)	GIZZARD SHAD (10/08/92)
Sr-89	<5.3	<5.9	<5.0	<4.2	<6.0
Sr-90	<2.2	<2.5	<2.1	<1.7	5.0 ± 2.0
K-40	3400.0 ± 351.0	2470.0 ± 337.0	2506.0 ± 502.0	1759.0 ± 416.0	2870.0 ± 384.0
Mn-54	<17.4	<21.4	<25.9	<23.0	<21.5
Fe-59	<48.2	<49.2	<82.1	<54.8	<51.6
Co-58	<17.2	<21.8	<28.6	<21.2	<19.0
Co-60	<17.8	<20.4	<24.8	<18.8	<20.9
Cs-134	<14.4	<17.5	<13.5	<16.5	<16.4
Cs-137	<14.1	<19.8	<17.1	<15.7	<17.6

Notes:
ND = No Data. See section 2.3 for explanation.

TABLE E12

THERMOLUMINESCENT DOSIMETRY 1992

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	89.2	25.8 ± 7.5	26.0 ± 7.5	82.9	18.4 ± 0.7	19.9 ± 0.7	99.0	18.5 ± 0.4	16.8 ± 0.3	104	20.4 ± 0.3	17.6 ± 0.2	375	73.4 ± 0.9	17.6 ± 0.2
CA-IDM-02	89.1	17.2 ± 0.4	17.4 ± 0.4	82.7	18.9 ± 0.5	20.5 ± 0.6	99.1	20.1 ± 3.3	18.2 ± 3.0	104	21.1 ± 0.5	18.3 ± 0.4	375	72.4 ± 3.1	17.4 ± 0.7
CA-IDM-03	89.2	18.4 ± 0.6	18.5 ± 0.6	82.9	19.2 ± 0.5	20.9 ± 0.6	98.9	19.8 ± 0.4	18.0 ± 0.4	104	22.4 ± 0.9	19.4 ± 0.8	375	78.9 ± 1.7	18.9 ± 0.4
CA-IDM-04	39.2	16.0 ± 0.4	16.2 ± 0.4	82.9	16.6 ± 0.4	18.0 ± 0.4	98.9	16.6 ± 0.8	15.1 ± 0.7	104	18.6 ± 0.6	16.1 ± 0.5	375	64.6 ± 3.2	15.5 ± 0.8
CA-IDM-05	89.2	15.1 ± 0.3	15.2 ± 0.3	82.9	15.8 ± 0.5	17.2 ± 0.6	99.0	15.7 ± 0.5	14.3 ± 0.4	104	17.8 ± 0.7	15.4 ± 0.6	375	61.6 ± 4.0	14.8 ± 1.0
CA-IDM-06	89.2	17.6 ± 0.3	17.8 ± 0.3	82.9	19.4 ± 0.3	21.1 ± 0.3	99.0	18.9 ± 0.9	17.2 ± 0.8	104	20.9 ± 0.5	18.1 ± 0.4	375	78.3 ± 1.7	18.8 ± 0.4
CA-IDM-07	89.1	18.0 ± 0.5	18.2 ± 0.5	82.8	18.4 ± 0.6	20.0 ± 0.6	99.1	18.6 ± 0.9	16.9 ± 0.8	104	21.8 ± 0.5	18.9 ± 0.4	375	74.3 ± 2.5	17.8 ± 0.6
CA-IDM-08	89.1	19.0 ± 0.5	19.2 ± 0.5	82.8	20.1 ± 0.4	21.8 ± 0.5	99.1	20.0 ± 0.5	18.2 ± 0.4	104	23.2 ± 0.8	20.1 ± 0.7	375	79.0 ± 5.1	18.9 ± 1.2
CA-IDM-09	89.2	21.0 ± 2.9	21.2 ± 2.9	82.8	20.3 ± 0.3	22.1 ± 0.3	99.1	20.3 ± 0.9	18.4 ± 0.8	104	25.1 ± 5.8	21.8 ± 5.0	375	80.0 ± 3.1	19.2 ± 0.7
CA-IDM-10	89.2	18.3 ± 0.5	18.5 ± 0.5	82.8	18.8 ± 0.8	20.4 ± 0.8	99.1	19.0 ± 0.5	17.2 ± 0.4	104	20.7 ± 0.6	17.9 ± 0.6	375	73.6 ± 3.7	17.7 ± 0.9
CA-IDM-11	89.2	19.3 ± 0.5	19.4 ± 0.5	82.8	20.5 ± 0.4	22.3 ± 0.5	99.1	21.0 ± 1.2	19.1 ± 1.1	104	23.7 ± 1.2	20.6 ± 1.0	375	95.5 ± 2.3	22.9 ± 0.5
CA-IDM-12	89.1	18.3 ± 0.5	18.5 ± 0.5	82.8	19.1 ± 0.4	20.7 ± 0.4	99.1	19.2 ± 0.5	17.5 ± 0.5	104	21.6 ± 0.6	18.7 ± 0.6	375	77.1 ± 2.3	18.5 ± 0.6
CA-IDM-13	89.2	18.8 ± 0.4	19.0 ± 0.4	83.0	19.9 ± 0.5	21.5 ± 0.5	98.9	20.6 ± 0.7	18.7 ± 0.7	104	23.1 ± 0.8	20.0 ± 0.7	375	80.7 ± 2.6	19.4 ± 0.6
CA-IDM-14	89.2	18.6 ± 0.5	18.8 ± 0.5	82.9	18.9 ± 0.3	20.5 ± 0.3	99.0	19.5 ± 0.6	17.7 ± 0.6	104	22.0 ± 0.5	19.0 ± 0.4	375	74.9 ± 3.3	18.0 ± 0.8
CA-IDM-15	89.2	18.2 ± 0.4	18.4 ± 0.4	82.8	18.5 ± 0.3	20.1 ± 0.4	99.0	19.3 ± 1.0	17.5 ± 1.0	104	21.6 ± 0.8	18.7 ± 0.7	375	78.6 ± 6.2	18.9 ± 1.5
CA-IDM-16	89.2	16.7 ± 0.4	16.9 ± 0.4	82.8	17.6 ± 0.6	19.1 ± 0.6	99.0	17.8 ± 0.5	16.2 ± 0.5	104	19.5 ± 0.4	16.9 ± 0.3	375	68.1 ± 2.5	16.3 ± 0.6
CA-IDM-17	89.2	17.3 ± 0.7	17.5 ± 0.7	82.8	18.5 ± 0.1	20.1 ± 0.1	99.0	19.2 ± 0.5	17.5 ± 0.4	104	20.8 ± 0.7	18.0 ± 0.6	375	73.2 ± 2.7	17.6 ± 0.7
CA-IDM-18	89.2	18.1 ± 0.4	18.2 ± 0.4	82.8	18.3 ± 0.3	19.8 ± 0.4	99.0	19.2 ± 0.6	17.4 ± 0.5	104	21.5 ± 0.7	18.6 ± 0.6	375	74.8 ± 2.8	17.9 ± 0.7
CA-IDM-19	89.2	18.3 ± 0.5	18.5 ± 0.5	82.8	20.7 ± 2.7	22.4 ± 2.9	99.0	19.5 ± 0.7	17.7 ± 0.6	104	24.7 ± 3.6	21.4 ± 3.1	375	75.4 ± 2.8	18.1 ± 0.7
CA-IDM-20	89.2	36.0 ± 1.4	36.3 ± 1.4	83.0	19.3 ± 0.4	20.9 ± 0.4	98.9	19.9 ± 0.8	18.1 ± 0.7	104	23.0 ± 1.1	19.9 ± 1.0	375	76.6 ± 1.3	18.4 ± 0.3
CA-IDM-21	89.2	18.1 ± 0.7	18.3 ± 0.7	83.0	18.9 ± 0.6	20.5 ± 0.6	98.9	10.9 ± 7.9	9.9 ± 7.2	104	21.3 ± 0.7	18.5 ± 0.6	375	75.2 ± 2.5	18.0 ± 0.6
CA-IDM-22	89.2	18.4 ± 0.3	18.6 ± 0.3	82.9	19.3 ± 0.3	20.9 ± 0.3	99.0	17.7 ± 0.7	16.1 ± 0.6	104	21.3 ± 0.7	18.4 ± 0.6	375	76.3 ± 2.4	18.3 ± 0.6
CA-IDM-23	89.2	18.6 ± 1.2	18.8 ± 1.2	83.0	19.3 ± 0.5	20.9 ± 0.6	98.9	19.6 ± 0.7	17.9 ± 0.7	104	21.6 ± 0.6	18.7 ± 0.5	375	76.0 ± 1.2	18.2 ± 0.3
CA-IDM-24	89.2	16.4 ± 0.4	16.6 ± 0.4	83.0	17.1 ± 0.6	18.6 ± 0.7	98.9	17.8 ± 0.5	16.2 ± 0.5	104	21.7 ± 0.8	18.8 ± 0.7	375	71.1 ± 1.4	17.1 ± 0.3
CA-IDM-25	89.2	17.6 ± 0.3	17.8 ± 0.3	83.0	18.2 ± 0.4	19.8 ± 0.5	98.9	19.0 ± 0.4	17.3 ± 0.4	104	21.7 ± 0.7	18.8 ± 0.6	375	70.5 ± 2.0	16.9 ± 0.5
CA-IDM-26	89.2	12.4 ± 0.3	12.6 ± 0.3	83.0	13.7 ± 0.3	14.9 ± 0.4	98.9	13.4 ± 0.4	12.2 ± 0.3	104	14.8 ± 0.4	12.8 ± 0.3	375	52.1 ± 1.1	12.5 ± 0.3

Notes:

TABLE E12 (Cont.)

THERMOLUMINESCENT DOSIMETRY
1992

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	89.2	19.1 ± 0.6	19.3 ± 0.6	83.0	20.2 ± 0.8	21.9 ± 0.9	98.9	20.5 ± 1.5	18.7 ± 1.4	104	22.1 ± 1.5	19.2 ± 1.3	375	80.5 ± 1.4	19.3 ± 0.3
CA-IDM-28	89.1	18.4 ± 0.6	18.6 ± 0.6	82.9	19.9 ± 0.8	21.6 ± 0.8	99.0	22.0 ± 3.6	20.0 ± 3.3	104	22.3 ± 1.6	19.3 ± 1.4	375	76.5 ± 3.4	18.3 ± 0.8
CA-IDM-29	89.2	16.3 ± 0.7	16.4 ± 0.7	82.9	17.5 ± 0.6	19.0 ± 0.6	99.0	17.5 ± 0.5	15.9 ± 0.5	104	20.2 ± 0.6	17.5 ± 0.5	375	66.8 ± 2.3	16.0 ± 0.6
CA-IDM-30	89.1	18.1 ± 0.8	18.3 ± 0.8	82.9	ND	ND	99.0	18.9 ± 0.6	17.2 ± 0.6	104	ND	ND	375	ND	ND
CA-IDM-31	89.1	18.5 ± 0.6	18.7 ± 0.6	82.9	19.6 ± 0.6	21.2 ± 0.6	99.0	19.9 ± 0.6	18.1 ± 0.5	104	21.5 ± 0.7	18.6 ± 0.6	375	77.2 ± 3.2	18.5 ± 0.8
CA-IDM-32	89.1	18.7 ± 0.6	18.9 ± 0.6	82.9	19.3 ± 0.5	21.0 ± 0.6	99.0	20.9 ± 0.8	19.0 ± 0.8	104	22.2 ± 0.3	19.2 ± 0.3	375	75.9 ± 4.2	18.2 ± 1.0
CA-IDM-33	89.1	17.9 ± 0.4	18.1 ± 0.4	82.9	19.2 ± 0.8	20.9 ± 0.8	99.0	19.6 ± 0.8	17.9 ± 0.8	104	20.9 ± 0.6	18.1 ± 0.5	375	72.2 ± 1.2	17.3 ± 0.3
CA-IDM-34	89.2	15.4 ± 0.8	15.6 ± 0.8	82.9	17.0 ± 0.3	18.4 ± 0.4	99.0	16.8 ± 0.6	15.3 ± 0.6	104	18.5 ± 0.5	16.0 ± 0.4	375	65.7 ± 3.0	15.8 ± 0.7
CA-IDM-35	89.2	16.4 ± 0.5	16.5 ± 0.5	82.7	17.1 ± 0.5	18.6 ± 0.6	99.1	18.0 ± 0.6	16.4 ± 0.6	104	19.7 ± 0.5	17.0 ± 0.4	375	68.8 ± 1.4	16.5 ± 0.3
CA-IDM-36	89.2	17.8 ± 0.7	17.9 ± 0.7	83.0	18.6 ± 0.5	20.2 ± 0.5	98.9	19.5 ± 0.7	17.7 ± 0.7	104	21.0 ± 0.8	18.2 ± 0.7	375	71.9 ± 2.0	17.3 ± 0.5
CA-IDM-37	89.1	17.3 ± 0.4	17.5 ± 0.4	82.8	18.1 ± 0.5	19.7 ± 0.5	99.1	19.0 ± 0.6	17.3 ± 0.5	104	20.7 ± 0.9	17.9 ± 0.8	375	71.5 ± 3.8	17.2 ± 0.9
CA-IDM-38	89.2	13.3 ± 0.4	13.5 ± 0.4	82.7	13.8 ± 0.5	15.0 ± 0.5	99.1	14.4 ± 0.5	13.1 ± 0.5	104	15.3 ± 0.5	13.2 ± 0.4	375	55.2 ± 2.2	13.2 ± 0.5
CA-IDM-39	89.1	18.4 ± 0.6	18.5 ± 0.6	82.7	18.5 ± 0.4	20.1 ± 0.4	99.1	19.9 ± 0.7	18.1 ± 0.6	104	21.4 ± 0.4	18.5 ± 0.3	375	77.4 ± 5.3	18.6 ± 1.3
CA-IDM-40	89.1	18.7 ± 0.4	18.9 ± 0.4	82.7	19.5 ± 0.5	21.3 ± 0.6	99.1	20.5 ± 1.1	18.6 ± 1.0	104	22.9 ± 1.6	19.8 ± 1.4	375	77.3 ± 4.6	18.6 ± 1.1
CA-IDM-41	89.1	17.3 ± 0.5	17.4 ± 0.5	82.9	17.6 ± 0.4	19.1 ± 0.5	99.0	20.5 ± 4.0	18.6 ± 3.6	104	20.4 ± 0.3	17.7 ± 0.3	375	72.3 ± 1.2	17.4 ± 0.3
CA-IDM-42	89.1	31.0 ± 0.7	31.3 ± 0.7	82.9	15.8 ± 0.5	17.1 ± 0.5	99.0	16.2 ± 0.4	14.7 ± 0.4	104	18.9 ± 0.1	16.4 ± 0.1	375	62.7 ± 1.5	15.0 ± 0.3
CA-IDM-43	89.1	17.4 ± 0.6	17.5 ± 0.6	82.8	18.8 ± 0.5	20.4 ± 0.5	99.1	19.2 ± 0.6	17.5 ± 0.5	104	21.2 ± 0.8	18.3 ± 0.7	375	72.4 ± 1.9	17.4 ± 0.4
CA-IDM-44	89.1	18.5 ± 0.5	18.7 ± 0.5	82.8	19.0 ± 0.6	20.7 ± 0.6	98.6	ND	ND	104	21.7 ± 0.9	18.7 ± 0.8	375	ND	ND
CA-IDM-45	89.2	17.9 ± 0.7	18.1 ± 0.7	82.9	18.6 ± 0.4	20.2 ± 0.4	99.0	18.9 ± 0.8	17.2 ± 0.7	104	21.0 ± 0.7	18.1 ± 0.6	375	71.3 ± 3.8	17.1 ± 0.9
CA-IDM-46	89.2	18.7 ± 0.3	18.9 ± 0.3	82.9	19.5 ± 0.5	21.2 ± 0.5	98.9	19.4 ± 0.8	17.6 ± 0.7	104	21.8 ± 0.7	18.8 ± 0.6	375	76.3 ± 1.3	18.3 ± 0.3
CA-IDM-47	89.2	17.2 ± 0.3	17.4 ± 0.3	82.9	18.0 ± 0.5	19.6 ± 0.5	99.0	18.6 ± 0.5	17.0 ± 0.5	104	20.5 ± 0.7	17.7 ± 0.6	375	72.7 ± 4.4	17.4 ± 1.1
CA-IDM-48	89.2	18.3 ± 0.5	18.4 ± 0.5	82.9	18.8 ± 0.5	20.4 ± 0.6	99.0	19.9 ± 0.6	18.1 ± 0.5	104	22.3 ± 0.5	19.3 ± 0.5	375	76.3 ± 3.3	18.3 ± 0.8
CA-IDM-49	89.2	17.4 ± 0.8	17.6 ± 0.8	82.9	19.1 ± 0.3	20.7 ± 0.3	99.0	19.4 ± 1.1	17.7 ± 1.0	104	21.1 ± 0.7	18.3 ± 0.6	375	72.3 ± 1.2	17.3 ± 0.3
CA-IDM-50	89.1	18.3 ± 0.6	18.5 ± 0.6	82.8	18.8 ± 0.4	20.5 ± 0.5	99.1	19.9 ± 0.3	18.0 ± 0.3	104	22.4 ± 0.8	19.4 ± 0.7	375	75.5 ± 2.6	18.1 ± 0.6
CA-IDM-51	88.9	17.4 ± 0.5	17.7 ± 0.5	82.9	18.6 ± 0.6	20.2 ± 0.6	99.0	19.7 ± 0.5	18.0 ± 0.5	104	21.8 ± 0.6	18.9 ± 0.6	375	77.0 ± 3.3	18.5 ± 0.8
CA-IDM-52	89.2	18.9 ± 0.6	19.1 ± 0.6	82.9	1.1 ± 0.2	1.2 ± 0.2	99.0	35.3 ± 1.7	32.1 ± 1.5	104	22.2 ± 0.5	19.2 ± 0.5	375	92.4 ± 3.0	22.2 ± 0.7

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

SECTION 4.0

NONRADIOLOGICAL ENVIRONMENTAL MONITORING

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT

SECTION 4.0

NONRADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

ANNUAL REPORT

1992

CONTENTS

1.0 INTRODUCTION

Union Electric Company (UEC) in compliance with federal regulations and its concern to maintain the quality of the local environment around the Callaway Plant has implemented an Environmental Protection Plan (EPP) contained in Appendix B of the Callaway Plant Operating License.

The objective of the EPP is to provide for protection of nonradiological environmental values during the operation of the Callaway Plant.

This report describes the conduct of the EPP for the Callaway Plant during 1992.

2.0 ENVIRONMENTAL MONITORING

During 1992 there was no nonradiological environmental monitoring conducted in the vicinity of the Callaway Plant. This is in agreement with Section 4.2 of EPP. 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 1991, and will be conducted during 1993 to satisfy the last requirement.

3.0 CULTURAL RESOURCES

In accordance with Sections 4.3 and 5.4 of EPP a description of the implementation of Cultural Resources requirements follows.

Union Electric has submitted an amendment request dated 2/21/92 (ULNRC-2566) which proposes to revise the Callaway Facility Operating License NPF-30, Appendix B, Environmental Protection Plan (non-radiological), by removing Sections 2.3 and 4.3, "Cultural Resources." Union Electric has developed and maintains a management plan for the protection of cultural resources on the Callaway Plant site including those within the area of potential effects. This management plan was revised and forwarded to NRC by letter dated 4/16/92 (ULNRC-2620). The amendment request provides the status and disposition of each portion of the present Appendix B which addresses cultural resources.

4.0 UNUSUAL OR IMPORTANT EVENTS

No unusual or important events reportable under EPP Section 4.1 were identified during 1992.

5.0 EPP NONCOMPLIANCES

During 1992 there were no noncompliances with the EPP.

6.0 NONROUTINE REPORTS

There were no nonroutine reports submitted in accordance with EPP, Section 5.4.2 in 1992.

SECTION 5.0

PLANT MODIFICATION
ENVIRONMENTAL EVALUATION

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT

SECTION 5.0

PLANT MODIFICATIONS

ENVIRONMENTAL EVALUATIONS

1992

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, 1992, through December 31, 1992.

During 1992 there were eleven 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 87-1039

2.1.1 Description of Change

This change involves the installation of eight additional anode ground beds at a depth of twelve feet which will upgrade the current plant cathodic protection system for underground piping and tanks. These anodes will specifically provide protection for the Technical Support center and security diesel generator fuel oil tanks.

2.1.2 Evaluation of Change

The installation of the additional anode ground beds 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. Since the anode ground beds will be placed at a depth of twelve feet below the surface, there is no concern with ground water contamination. Therefore, this change does not constitute an unreviewed environmental question per section 3.1 of the Appendix B to the Callaway Plant Operating License.

2.2 Callaway Modification Package 88-3005

2.2.1 Description of Change

This modification replaces the temporary potable water and fire water mains to warehouse number 2 with permanent water lines.

2.2.2 Evaluation of Change

The installation of the permanent water lines 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.

2.3 Callaway Modification Package 89-3020

2.3.1 Description of Change

This change installed a flashing light to the supernatant sump to indicate a high sump level and an inflatable stopper plug in the piping between the sump and the sludge lagoon to isolate the sump from the sludge lagoon on high sump level. This modification is being installed in an effort to eliminate violations of the NPDES permit from overflows of untreated water.

2.3.2 Evaluation of Change

The installation of high sump level flashing light and inflatable stopper plug 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.

2.4 Callaway Modification Package 90-1042

2.4.1 Description of Change

This change involved the construction of a concrete laydown area to the plant east of the Fuel Building and the installation of a sump to collect near surface ground water. The sump is for collecting near surface ground water before it leaks into the Auxiliary Building and pump it to storm water system.

2.4.2 Evaluation of Change

The construction of the concrete laydown area and sump 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. The discharge of the ground water from the sump to the storm water system has been approved by the Missouri Department of Natural Resources. Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating License.

2.5 Callaway Modification Package 91-3016

2.5.1 Description of Change

This modification involves the installation of sump pumps and level alarms in three manholes and associated piping from the sump pumps to the site storm water system. This change is required to prevent the potential flooding of the main access facility basement with ground water via the cable ducts from these manholes to the main access facility.

2.5.2 Evaluation of Change

The installation of the level alarms, sump pumps, and associated piping did not result 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. In addition, the small amount of water that the sump pumps will automatically discharge at intermittent intervals will not cause a significant increase in any adverse environmental impact from the site storm water system. The installation and use of these sump pumps has been approved by the Missouri DNR. Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating license.

2.6 Callaway Modification Package 92-9050

2.6.1 Description of Change

This change incorporated sludge lagoon #1 into a polishing wetlands treatment system for the plant's sewage treatment plant. The change involved the installation of a pump station near the sewage

treatment plant and associated piping to sludge lagoon #1. In addition, a wetlands discharge pipe was installed from sludge lagoon #1 to the plant discharge line.

2.6.2 Evaluation of Change

The installation of the pump station and piping associated with converting sludge lagoon #1 to a wetlands treatment system did not result in any adverse environmental impact, since all non-radiological environmental effects were confined to the areas previously disturbed during site preparation and plant construction. There will be no new pollutants or increase in frequency of pollutants in that the wetlands act as a tertiary treat process to further clean up the sewage treatment plant (STP) Effluent. The STP will be operated as it has in the past with its effluent being further polished to a higher quality level.

This change is considered a "Pilot Project" by the Missouri Department of Natural Resources and as such does not require our NPDES permit to be changed at this time. Water quality is checked at both the STP and the discharge point of the wetlands for compliance with our NPDES Permit limits.

Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating license.

2.7 Request for Resolution 09442

2.7.1 Description of Change

This change involved the removal of an underground gasoline storage tank and associated equipment located plant west of the stores building that failed a leak tightness test. In addition, an above ground gasoline storage tank and berm were installed plant west of the stores building to replace the underground tank.

2.7.2 Evaluation of Change

The removal of the underground gasoline storage tank and the installation of the above ground gasoline storage tank did not result 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. Removal of the underground storage tank was performed in accordance with the Missouri Underground Storage Tank closure guidelines

including soil sampling and removal of contaminated soil.

The above ground gasoline storage tank is enclosed within a berm which will contain 100% of the tank volume plus the largest anticipated rainfall in a 24-hour period.

Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating License.

2.8 Plant Procedure CTP-ZZ-04640, Rev. 0

2.8.1 Description of Change

This procedure will allow the use of ferric sulfate to eliminate the hydrogen sulfate odor present in the Auxiliary Building from ground water leakage into the building. This procedure will be utilized until approval is given from the Missouri Department of Natural Resources to allow the sump, which collects the water, to be pumped to storm water system.

2.8.2 Evaluation of Change

Ferric sulfate will be added to the ground water leak emanating from the wall and mixed in a drum prior to directing this water to the nearby sump. Ferric sulfide will be produced from this reaction as a precipitate. The waste water is routed through the secondary liquid waste system to the discharge monitoring tanks. The waste water is then discharged by batch release via outfall 001.

In our last NPDES Permit Renewal Application, we informed the Missouri Department of Natural Resources that the average concentration of iron in Outfall 001 is 0.33 ppm. Approval from the Department of Natural Resources is not required as long as the concentration in a waste stream does not increase above a factor of five times the concentration provided in the application.

Although additional iron is being added to this waste stream, it is likely that all or most of the ferric sulfide will be removed by filtration or by settling. The auxiliary building leak has been measured at less than 3 gpm which amounts to approximately 4300 gallons per day. The average discharge rate via Outfall 001 is near 80,000 gallons per day. Therefore, the small amount of additional iron entering the DMT should not significantly change the iron concentration in this Outfall.

Therefore this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating License.

2.9 Plant Procedure CTP-DF-05111, Rev. 2

2.9.1 Description of Change

The procedure was revised to allow the use of BULAB 5091 to help reduce solids during low turbidity and cold water river conditions. It is believed that the aluminum hydroxychloride will provide better solids removal during periods of low river turbidity than the ferric sulfate currently being used.

2.9.2 Evaluation of Change

BULAB 5091 is a coagulant consisting of a cationic polymer combined with aluminum hydroxychloride. This product will be added to the river water at the water treatment plant. During coagulation, the aluminum component will attach to the floc and be routed to the sludge pond where it will settle with the removed solids. Therefore, little if any product will be released to the Missouri River effecting the quality of our discharges.

BULAB 5090 was not previously identified in the Callaway Plant NPDES Permit. However, the Missouri Department of Natural Resources was notified of our intent to use this product and did not have any objections. Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B of the Callaway Plant Operating License.

2.10 Plant Procedure CTP-ZZ-04650, Rev. 12

2.10.1 Description of Change

The procedure was revised to allow the use of sodium bromide (a biocide) in the circulating and service water systems and BULAB 8006 (a dispersant/penetrant) in the service water system. Sodium bromide and BULAB 8006 are being added as part of a three month test program to better aid in eliminating under deposit microbiological corrosion (MIC) present in the service water system.

2.10.2 Evaluation of Change

During the test period sodium bromide was stored in a 300-gallon metal porta feed located inside the circulating water pumphouse within the diked area for zinc storage. Sodium bromide was added to both the service water and circulating water system twice a day for approximately 30 minutes each while sodium hypochlorite is being injected. Sodium bromide may be added to those systems for a total period not to exceed two hours per day or a total volume of 41 gallons per day.

BULAB 8006 is to be added to the service water system once per week for approximately one hour prior to adding bromine/chlorine. This product was added directly to the service water pump bay via a 55 gallon drum.

Throughout this test, administrative controls were in place to prevent any overfeed of these chemicals or spills to the environment.

While it is known that hypobromous acid (the active bromide generated) is toxic to aquatic life, the free available oxident concentration discharged will be limited to 0.2 ppm which is our current NPDES Permit limit for chlorine. The actual concentration in the cooling tower blowdown should be much less than this. BULAB 8006 is expected to be absorbed by the deposits in the service water system and therefore should be negligible in the discharge. To help assure that there is little affect on the environment, our annual whole effluent toxicity test will be conducted during the early part of this test on a day when both sodium bromine and BULAB 8006 are added to the system.

Although the use of these products will result in a new or different pollutant being discharged, they have been approved by the Missouri Department of Natural Resources for the three month test period.

Therefore, this change does not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating License.

2.11 Plant Procedure CTP-ZZ-04650, Rev. 15

2.11.1 Description of Change

The procedure was revised to allow the use of sodium bromide in the circulating and service water systems and BULAB 8006 in the service water system on a permanent basis.

2.11.2 Evaluation of Change

This change was evaluated in revision 12 to the procedure which is discussed above in Section 2.11. There were no modifications to revision 12 which affected the previous evaluation.