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April 28, 1988

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DOCKET NUMBER 50-483
CALLAWAY PLANT
FACILITY OPERATING LICENSE NPF-30
1987 ANNUAL ENVIRONMENTAL OPERATING REPORT

Please find enclosed the 1987 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,

Robert J. Schukai

Donald F. Schnell

BFH/mlg

Enclosure

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CALLAWAY PLANT

ANNUAL ENVIRONMENTAL OPERATING REPORT

1987

DOCKET NO. 50-483

Union Electric

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 1987 and the environmental evaluations for plant modifications completed during 1987.

The first section of this report summarizes and interprets the results of the radiological environmental monitoring program conducted in accordance with Technical Specification Section 3/4.12. Section 2 describes the non-radiological environmental program and its results conducted in accordance with Section 2.2 of Appendix B to the Callaway Plant Operating License. The third section of this report describes changes in plant design or operation, test, 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 Specification and Appendix B to the Callaway Plant Operating License.

CONCLUSION

The first section of this report contains all the radiological environmental monitoring conducted in the vicinity of the Callaway Plant during 1987. The comparison of the results for the radiological environmental monitoring conducted during 1987 to the preoperational data showed no unexpected or adverse effects from the operation of the Callaway Plant on the environment.

The non-radiological monitoring conducted in the vicinity of the Callaway Plant during 1987 is contained in Section 2 of this report. The monitoring conducted during 1987 showed no evidence of effects of drift from the cooling tower. The foliar disease found in the vegetation during 1987 could be directly attributed to natural causes.

There were no plant modifications completed during 1987 with an unreviewed environmental question as shown in Section 3 of this report.

TABLE OF CONTENTS

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT UNIT 1

OPERATIONAL RADIOLOGICAL MONITORING PROGRAM

1987 SUMMARY REPORT

SUBMITTED BY:

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

1925 ROSINA STREET

SANTA FE, NEW MEXICO

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Prepared By: Bob Bates
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Approved By:
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CONTENTS

TABLES

FIGURES

FIGURES

Abstract

The Radiological Environmental Monitoring Program is an ongoing study conducted by Controls for Environmental Pollution, Inc. (CEP) for Union Electric Company (UEC), Callaway Plant, Unit 1. This report is a summary of al data obtained from samples collected by UEC personnel during 1987.

The monitoring program provides a comprehensive environmental analysis of radiological activity in the area surrounding the Callaway Plant Site. CEP analyzed the following types of samples: air particulate and radioiodine, ground water, surface water, milk, washload sediment, bedload sediment, bottom sediment, shoreline sediment, fish, vegetation, soil and direct radiation (TLD).

A statistical analysis and graphic presentation for all analytical results for samples collected during 1987 are included in this summary report. Possible trends and anomalous results, as interpreted by CEP are also discussed.

1.0 Introduction

This report presents an analysis of the results of the Radiological Environmental Monitoring Program (REMP) conducted during 1987 for Union Electric Company, Callaway Plant, Unit 1.

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 radiological environmental monitoring program are as follows: 1) to establish baseline radiation levels in the environs prior to reactor operations; 2) to monitor potential critical pathways of radioeffluent to man; 3) to determine radiological impact on the environment caused by the operation of the Callaway Plant.

A number of techniques are being used to distinguish Callaway Plant effects from other sources during the operational phase, including application of established background levels. Operational radiation levels measured in the vicinity of the Callaway Plant will be compared with the pre-operational measurements at each of the sampling locations. In addition, results of the monitoring program will help to evaluate sources of elevated levels of radiation during reactor operation in the environment, e.g., atmospheric fallout or abnormal plant releases.

The Callaway Plant is located on a plateau approximately five miles north of the Missouri River in Callaway County, Missouri. The plant consists of a 1150 MWE pressurized water reactor, which achieved initial criticality on October 2, 1984.

2.0 Description of the Monitoring Program

Union Electric Company has contracted with Controls for Environmental Pollution, Inc. starting May, 1983, to determine the radiation levels existing in and around the Callaway Plant area. Prior to this time, all analyses were performed by Radiation Management Company.

UEC personnel collected the samples and shipped them to CEP for analysis. The type of samples collected were: milk, surface water, groundwater, shoreline sediment, bottom sediment, bedload sediment, washload sediment, soil, fish, vegetation, airborne particulates, airborne radioiodine and direct radiation (TLD).

Information regarding sample preparation and analytical methods, instrumentation, detection limits, etc. used by CEP may be found in the First Quarterly Report for 1987.

3.0 Data Interpretations and Conclusions

This section addresses interpretations and conclusions regarding all types of samples analyzed during this report period.

A variety of radionuclides, both naturally occuring and man-made, were detected in the environment around the Callaway Plant. The man-made radionuclides found were the fission products typically found in nuclear test fallout. The levels and fluctuations of radioactivity detected in the samples collected around the Callaway Plant were consistent with previously accumulated environmental data.

For this reporting period there was no reportable levels of radioactivity as a result of plant effluents, or analysis in which the detection limit was not achievable.

3.1 Airborne Particulates and Radioiodine

Airborne particulate samples were collected from five monitoring stations. All of the air particulate samples were analyzed for Gross Beta activity. Gamma Spectrometry, Strontium-89 and Strontium-90 analyses were performed on quarterly composites from each station. The airborne particulate stations were also sites for airborne radioiodine.

The range and 1987 annual mean Gross Beta activity at each of the sampling locations follows. Measurements are in pCi/m^3.

Collection Location	Minimum	Maximum	1987 Annual Mean
A1	0.010±0.001	0.038±0.002	0.021±0.007
A7	0.010±0.001	0.048±0.002	0.023±0.009
A8	0.007±0.002	0.039±0.003	0.020±0.006
A9	0.009±0.002	0.037±0.002	0.020±0.005
B3	0.005±0.001	0.044±0.003	0.019±0.009

Gross Beta levels at all monitoring stations during 1987 are consistent with the control station and do not indicate any anomolous data. Graphic presentations of the Weekly Gross Beta activities for each collection location are presented in Figures 1 through 5. Invalid samples are those with anomolous Gross Beta activity due to air sampler malfunction (i.e. hour meter malfunction, sampler malfunction, etc.) or other circumstances which may have compromised the sample integrity.

Figure 6 presents the Mean Weekly Gross Beta activity for all collection locations. The lowest Mean Weekly Gross Beta activity (0.009±0.003 pCi/m^3) was observed from 05/21/87-05/28/87 while the weeks exhibiting the highest activity were 07/30/87-08/06/87 (0.035±0.005 pCi/m^3) and 10/29/87-11/05/87 (0.035±0.006 pCi/m^3).

Mean Quarterly Gross Beta activities were as follows:

	pCi/m^3
January - March 1987	0.020 ± 0.006
April - June 1987	0.016 ± 0.006
July - September 1987	0.023 ± 0.009
October - December 1987	0.023 ± 0.006

Strontium-90 was detected in one of the quarterly composite samples during 1987. The first quarter composite for Site A8 indicated Strontium-90 activity of 0.003 ± 0.001 pCi/m^3.

Gamma-emitting nuclides of interest detected in quarterly air particulate composites were limited to Berylliu. -7. (See individual quarterly reports).

Airborne radioiodine was detected in two samples during the first quarter of 1987.

During the fourth quarter 1987, the air monitoring stations were taken out-of-service for a short period of time to allow replacement of sampling station enclosure and sampling equipment. This replacement was required to improve station reliability and personnel safety.

Figure 1
GROSS BETA IN AIR PARTICULATE
WEEKLY ACTIVITY - 1987
STATION A1

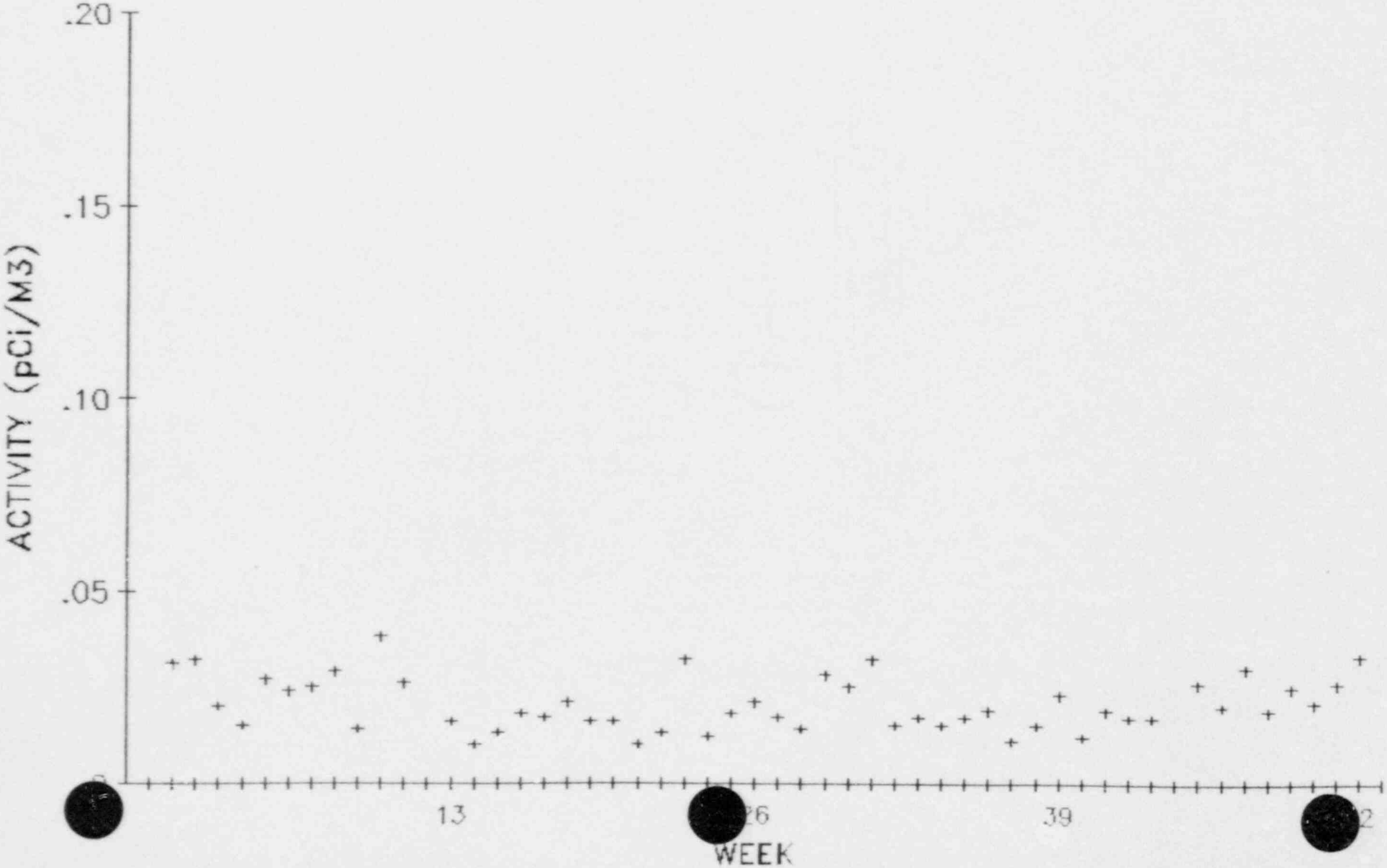


Figure 2
GROSS BETA IN AIR PARTICULATE
WEEKLY ACTIVITY - 1987
STATION A7

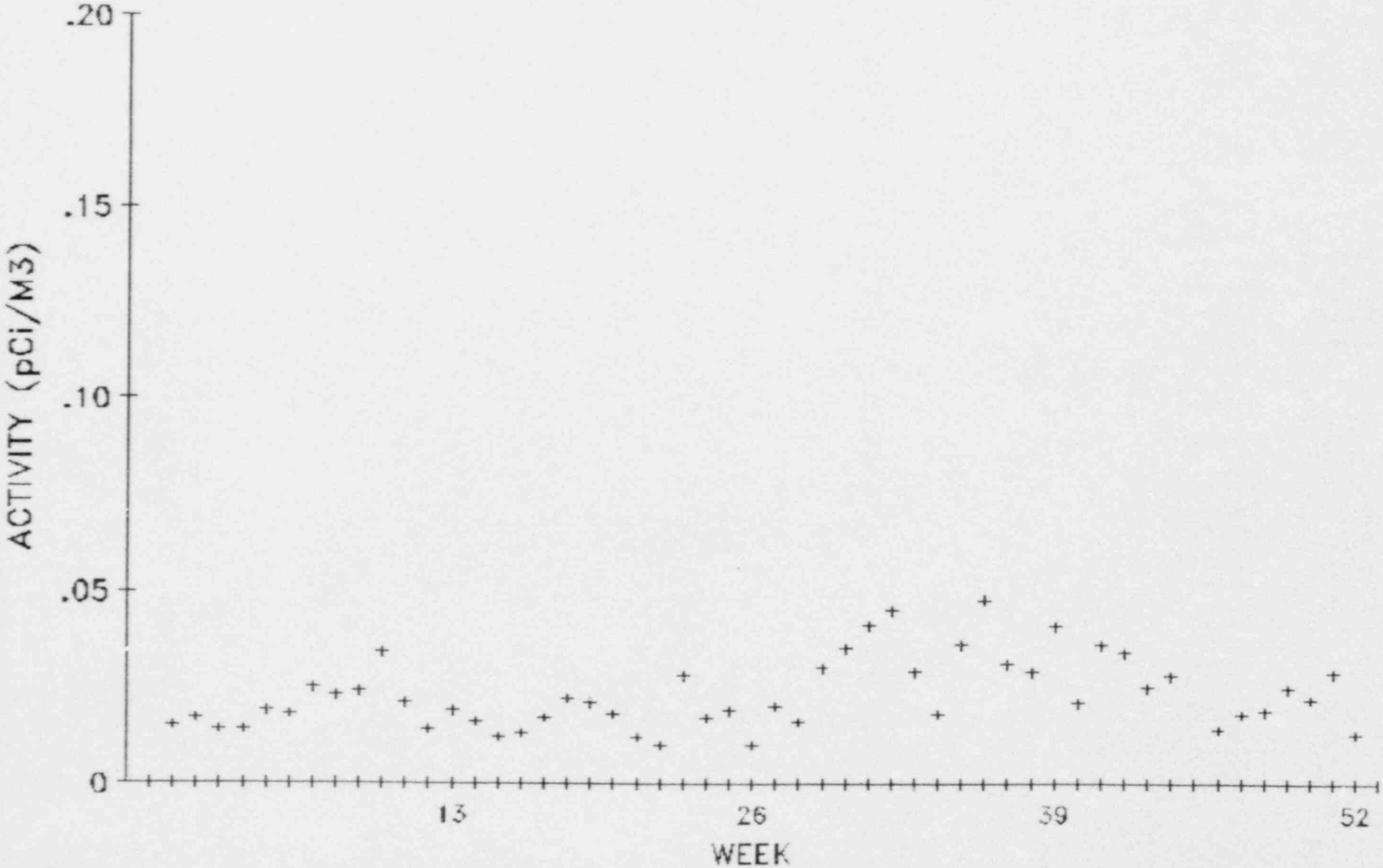


Figure 3
GROSS BETA IN AIR PARTICULATE
WEEKLY ACTIVITY - 1987
STATION A8

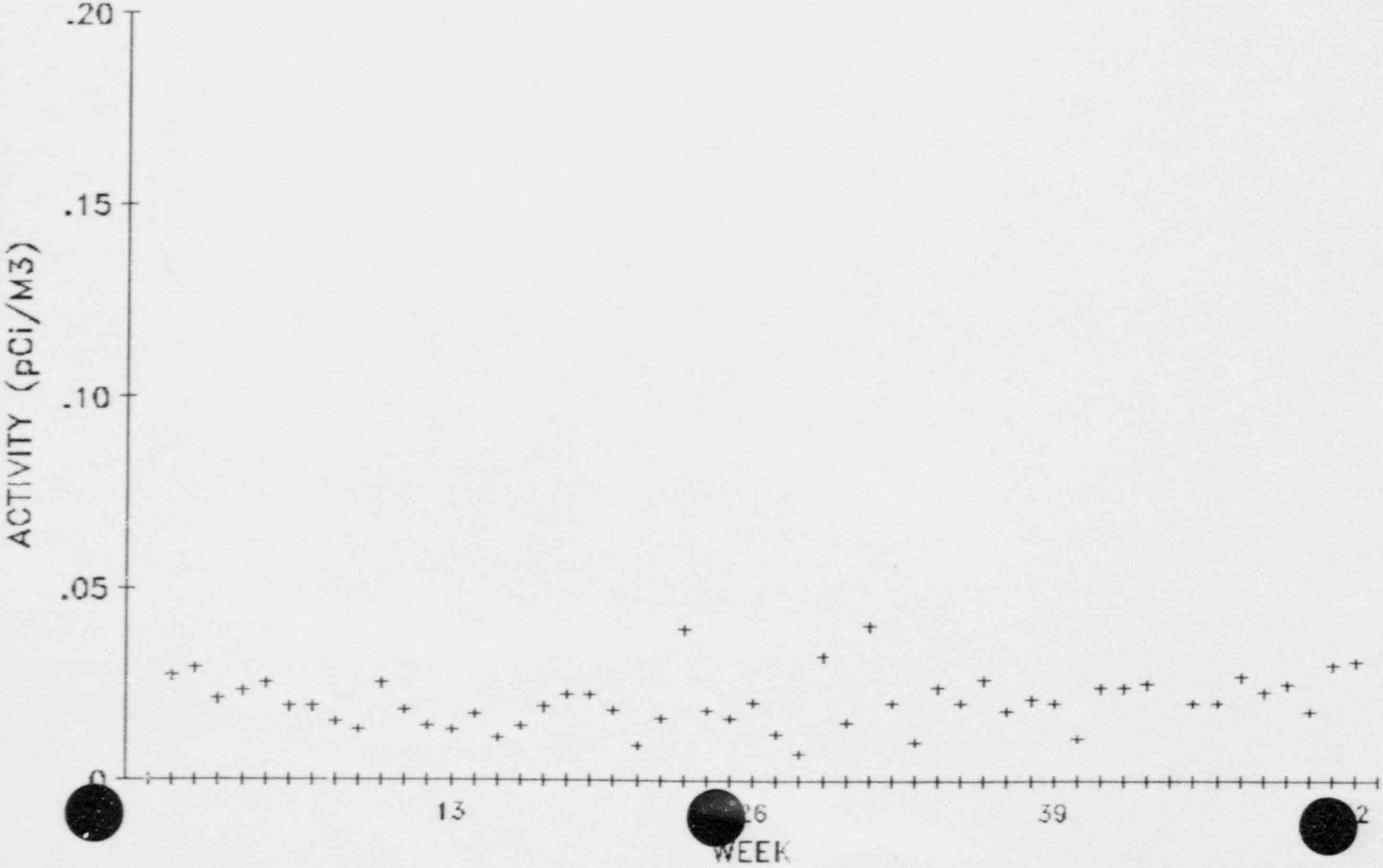


Figure 4
GROSS BETA IN AIR PARTICULATE
WEEKLY ACTIVITY - 1987
STATION A9

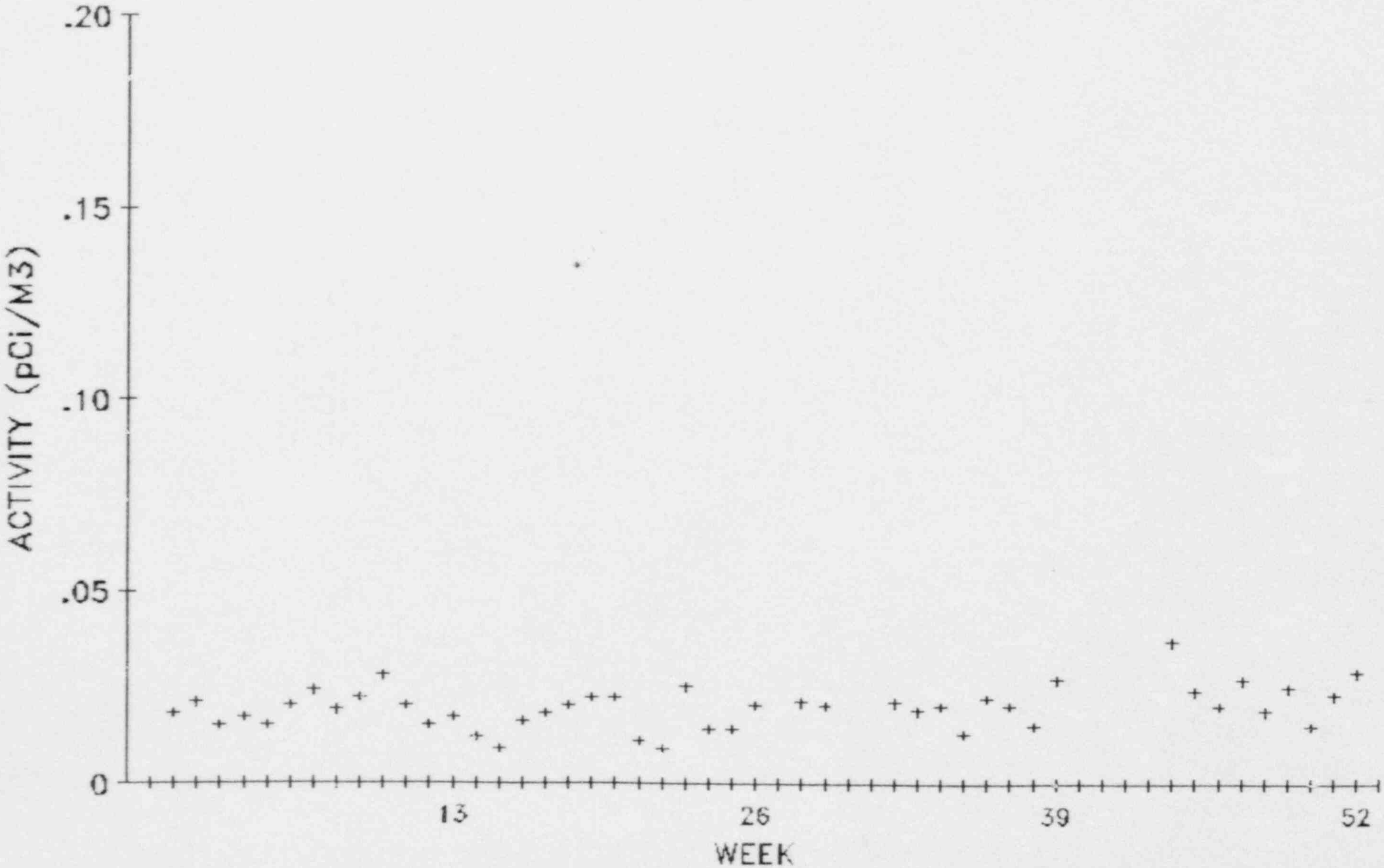


Figure 5
GROSS BETA IN AIR PARTICULATE
WEEKLY ACTIVITY - 1987
STATION B3

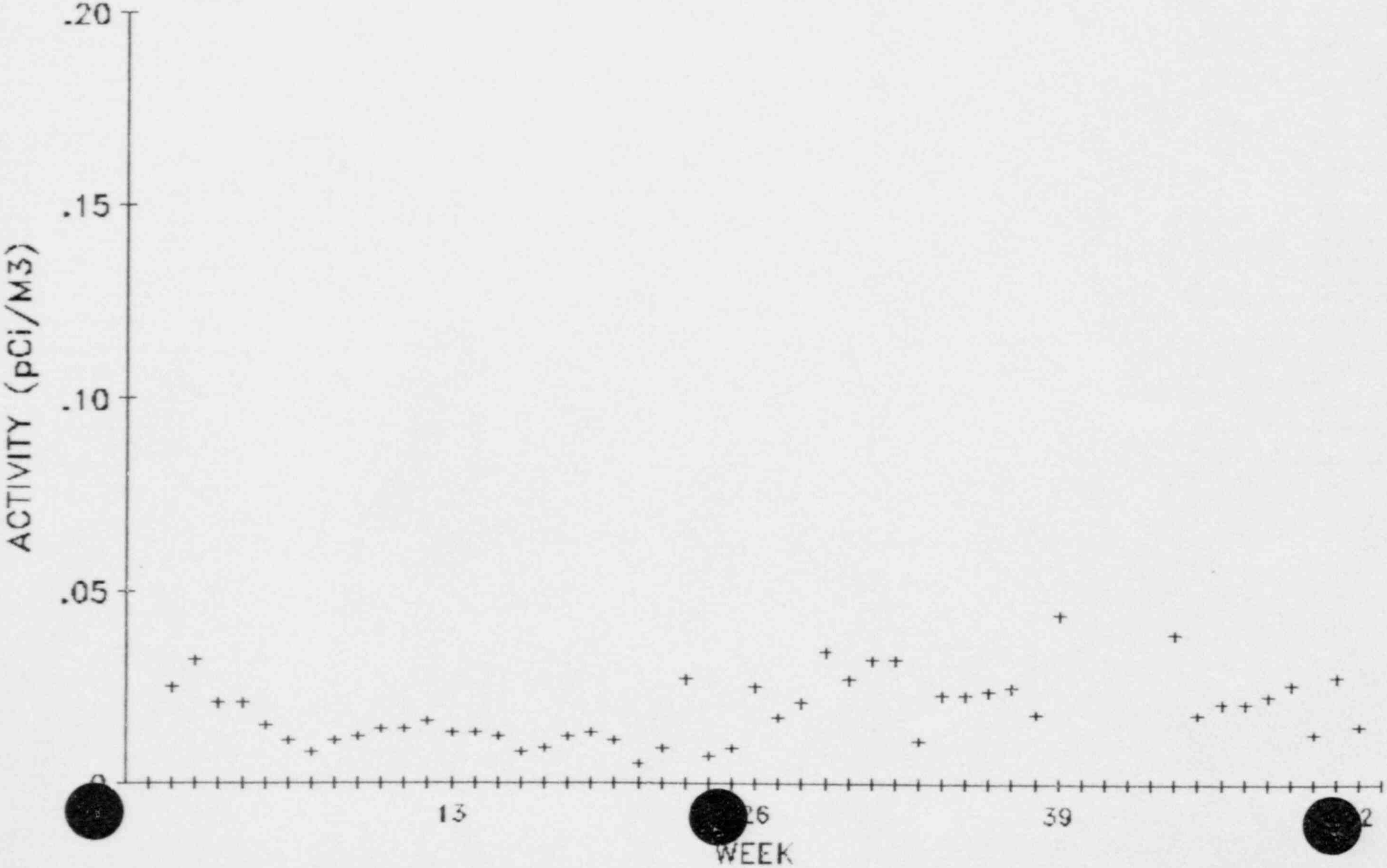
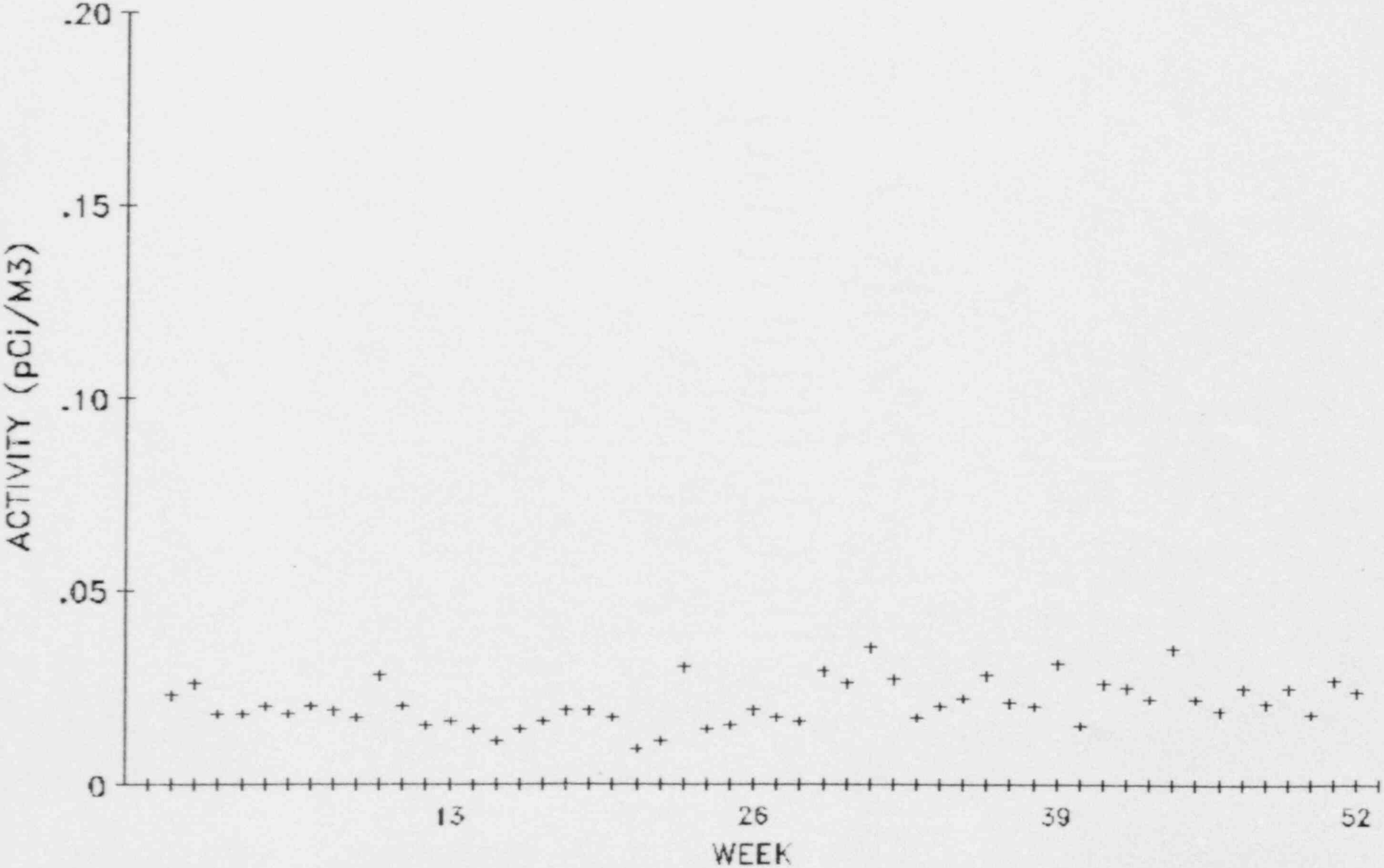


Figure 6
GROSS BETA IN AIR PARTICULATE
MEAN WEEKLY ACTIVITY
1987



3.2 Thermoluminescent Dosimetry

Thermoluminescent Dosimetry (TLD) was employed to determine direct radiation levels in and around the Callaway Site. Calcium Sulfate: Dy phosphor TLD chips in black polyethylene pouches were placed in plastic holders containing copper backing to shield out low energy radiation. The TLD's were placed at 52 locations and exchanged monthly through June. Then beginning with the third quarter the TLD's were exchanged quarterly.

Listed below are the mean readings in uR/hr for January through June and mRem/Std. Qtr for the Third and Fourth Quarter, for all TLD's placed around the Callaway Site.

January	10.7 $\pm$ 1.0 uR/hr $\pm$ 2 σ
February	11.0 $\pm$ 1.1 uR/hr $\pm$ 2 σ
March	10.5 $\pm$ 0.9 uR/hr $\pm$ 2 σ
April	13.2 $\pm$ 0.8 uR/hr $\pm$ 2 σ
May	9.1 $\pm$ 0.9 uR/hr $\pm$ 2 σ
June	15.5 $\pm$ 5.3 uR/hr $\pm$ 2 σ
Third Quarter	13.1 $\pm$ 1.7 mRem/Std. Qtr $\pm$ 2σ
Fourth Quarter	17.7 $\pm$ 2.7 mRem/Std. Qtr $\pm$ 2σ

Annual TLD's were placed in the field on December 31, 1986 and were collected on December 30, 1987. Data appearing in Table I is the result of reading and averaging the four quadrants of each TLD chip. Transit control dosimeters were used to determine the dosage received during shipment and were substracted from the gross readings obtained for each monitoring site.

TABLE I

THERMOLUMINESCENT DOSIMETRY

1987 ANNUAL

12/31/86 - 12/30/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	69.8 ± 3.2	17.3 ± 0.8
CA-IDM-02	6.6 mi NW, Smola Farm	65.6 ± 2.2	16.2 ± 0.5
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	69.8 ± 2.8	17.3 ± 0.7
CA-IDM-04	1.9 mi N, 0.6 miles East of the O and CC Junction	67.3 ± 1.7	16.6 ± 0.4
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	67.7 ± 1.1	16.7 ± 0.3
CA-IDM-06	1.8 mi W, Akers Farm	72.9 ± 3.8	18.0 ± 0.9
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	72.9 ± 2.6	18.0 ± 0.6
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	76.5 ± 4.1	18.9 ± 1.0
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	75.9 ± 4.2	18.8 ± 1.0
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	70.3 ± 3.7	17.4 ± 0.9
CA-IDM-11	5.0 mi SE, City of Portland	78.1 ± 4.2	19.3 ± 1.0
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	75.8 ± 3.9	18.7 ± 1.0
CA-IDM-13	5.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	80.1 ± 13.9	19.8 ± 3.4
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	72.0 ± 4.8	17.8 ± 1.2
CA-IDM-15	4.2 mi ESE, Lamb Farm	77.4 ± 1.9	19.1 ± 0.5
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	69.6 ± 5.8	17.2 ± 1.4

TABLE I (Cont.)

THERMOLUMINESCENT DOSIMETRY

1987 ANNUAL

12/31/86 - 12/30/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	76.4 ± 3.3	18.9 ± 0.8
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	76.7 ± 4.1	19.0 ± 1.0
CA-IDM-19	4.2 mi NE, R[illegible] Farm	72.8 ± 5.7	18.0 ± 1.4
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	62.7 ± 3.6	15.5 ± 0.9
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	64.3 ± 4.3	15.9 ± 1.1
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	77.3 ± 3.3	19.1 ± 0.8
CA-IDM-23	6.7 mi NNE, City of Yucatan	Missing	
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	51.6 ± 1.8	12.8 ± 0.4
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	76.8 ± 4.5	19.0 ± 1.1
CA-IDM-26	12.1 mi E, Town of Americus	54.0 ± 4.9	13.4 ± 1.2
CA-IDM-27	9.5 mi ESE, Town of Bluffton	Missing	
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	75.3 ± 4.9	18.6 ± 1.2
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	65.5 ± 3.3	16.2 ± 0.8
CA-IDM-30	4.5 mi SSW, City of Steedman	66.7 ± 1.7	16.5 ± 0.4
CA-IDM-31	7.6 mi SW, City of Mokane	75.6 ± 0.6	18.7 ± 0.1
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	77.4 ± 3.1	19.1 ± 0.8
CA-IDM-33	7.3 mi W, City of Hams Prairie	74.3 ± 2.8	18.4 ± 0.7

TABLE I (Cont.)

THERMOLUMINESCENT DOSIMETRY

1987 ANNUAL

12/31/86 - 12/30/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	64.5 ± 3.9	15.9 ± 1.0
CA-IDM-35	5.8 mi NNW, City of Toledo	65.3 ± 1.9	16.1 ± 0.5
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	72.3 ± 2.1	17.9 ± 0.5
CA-IDM-37	0.5 mi SSW, Piezometer M8 and M6	72.5 ± 7.8	17.9 ± 1.9
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	56.6 ± 4.5	14.0 ± 1.1
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	71.2 ± 1.7	17.6 ± 0.4
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	76.4 ± 3.2	18.9 ± 0.8
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	Missing	
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	65.0 ± 3.6	16.1 ± 0.9
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	64.6 ± 4.2	16.0 ± 1.0
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	66.4 ± 4.4	16.4 ± 1.1
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	76.0 ± 3.5	18.8 ± 0.9
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	40.0 ± 5.7	9.9 ± 1.4
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile South of Hwy O	68.2 ± 3.4	16.9 ± 0.8

TABLE I (Cont.)

THERMOLUMINESCENT DOSIMETRY

1987 ANNUAL

12/31/86 - 12/30/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 448)	73.8 ± 5.1	18.2 ± 1.3
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	59.6 ± 2.2	14.7 ± 0.5
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	73.1 ± 2.3	18.1 ± 0.6
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	70.0 ± 2.1	17.3 ± 0.5
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	70.9 ± 2.1	17.5 ± 0.5

3.3 Well Water

Well water samples were collected monthly from three locations and analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-89, Strontium-90 and Gamma-emitting nuclides. A summary of the Mean Gross Alpha and Gross Beta activities for Well Water samples may be found in Table II.

Collection location DO1 (4.0 mi SE, Holzhouser Grocery Store/Tavern) had Gross Alpha activities ranging from less than 2.0 pCi/l to 4.0±1.5 pCi/l (collected 08/11/87) with an annual mean Gross Alpha activity of 3.3±0.8 pCi/l. Gross Beta activities from this collection location ranged from less than 3.0 pCi/l to 5.2±0.6 pCi/l (collected 08/11/87) with a 1987 mean Gross Beta activity of 3.8±1.2 pCi/l. A graphic presentation of the monthly Gross Alpha and Gross Beta results for Well Water samples obtained from collection location DO1 may be found in Figure 7. No detectable levels of Tritium, Strontium-90 or Strontium-89 were observed in any of the Well Water samples collected at Site DO1 during 1987.

Gross Alpha activities at collection location FO5 (1.0 mi SSE, Onsite Groundwater Monitoring Well) ranged from less than 2.0 pCi/l to 4.4±1.6 pCi/l (collected 04/14/87). The 1987 mean Gross Alpha activity for Site FO5 was 2.7±1.0 pCi/l. Gross Beta activities at collection location FO5 ranged from 3.3±0.6 pCi/l to 14.7±0.8 pCi/l (collected 02/10/87) with a mean annual Gross Beta activity of 9.3±3.7 pCi/l. Figure 8 graphically presents the monthly Gross Alpha and Gross Beta activities for collection location FO5. All Well Water samples from collection location FO5 were less than 500 pCi/l for Tritium activity and less than 1.5 pCi/l for Strontium-89 activity and less than 1.0 pCi/l for Strontium-90 activity.

Figure 9 illustrates the monthly Gross Alpha and Gross Beta activities for all Well Water samples collected from site F15 (0.55 mi NE, Onsite Groundwater Monitoring Well) during 1987. Gross Alpha activities ranged from less than 2.0 pCi/l to 5.6±1.6 pCi/l (collected 06/09/87) with a mean annual Gross Alpha activity of 3.3±1.0 pCi/l. Gross Beta activities ranged from 4.4±1.0 pCi/l to 8.8±1.0 pCi/l (collected 04/14/87). The mean annual Gross Beta activity for F15 was 6.9±1.4 pCi/l. All Well Water samples collected at Site F15 were less than the detection limits for Tritium, Strontium-89 and Strontium-90 (500 pCi/l 1.5 pCi/l, and 1.0 pCi/l respectively).

Overall, the 1987 mean annual Gross Alpha activity for all Well Water samples was 3.1±1.0 pCi/l. A 1987 mean Gross Beta activity for all Well Water samples was calculated to be 7.6±3.2 pCi/l. No gamma-emitting nuclides of interest were detected in any of the Well Water samples collected during 1987.

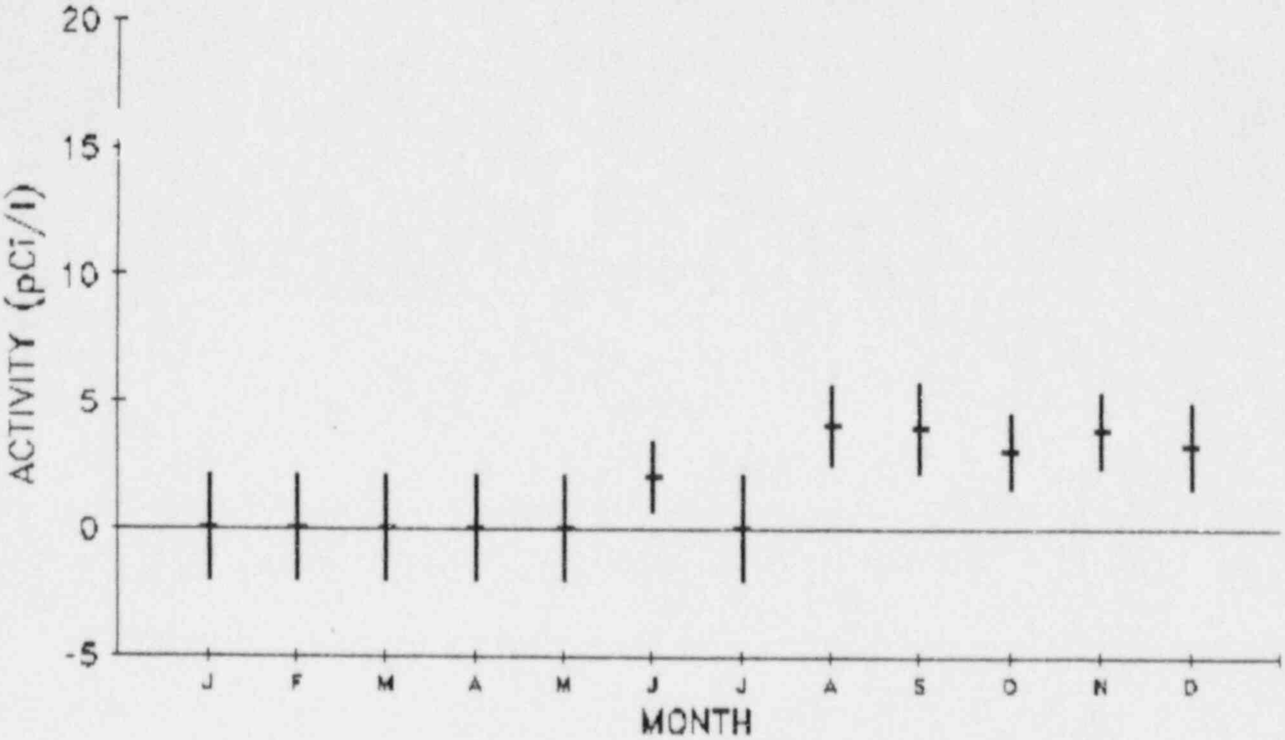
Table II

1987 Mean Gross Alpha and Gross Beta Activities in Well Water

(pCi/l)

	Gross Alpha	Gross Beta
CA-WWA-DO1	3.3 ± 0.8	3.8 ± 1.2
CA-WWA-FO5	2.7 ± 1.0	9.3 ± 3.7
CA-WWA-F15	3.3 ± 1.1	6.9 ± 1.4
All Locations	3.1 ± 1.0	7.6 ± 3.2

Figure 7
MONTHLY GROSS ALPHA ACTIVITY
WELL WATER - STATION D01
1987



MONTHLY GROSS BETA ACTIVITY
WELL WATER - STATION D01
1987

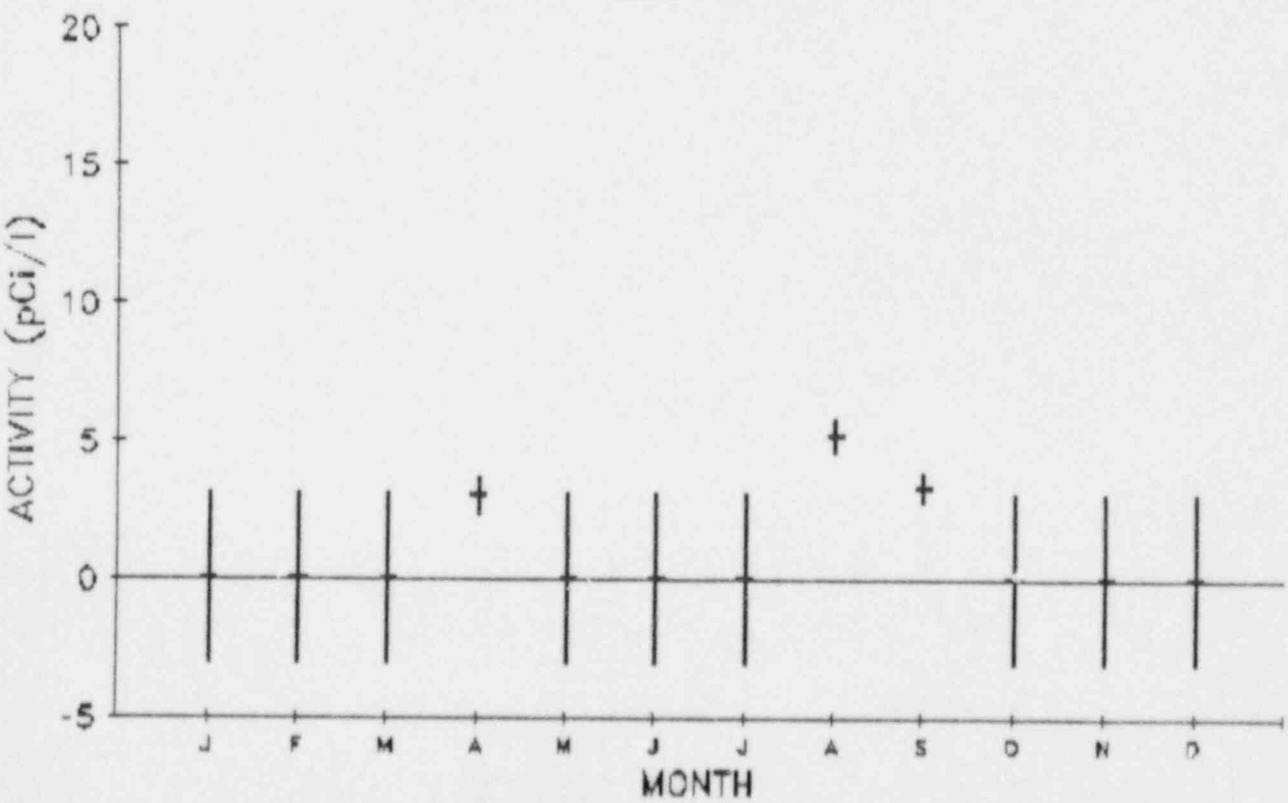
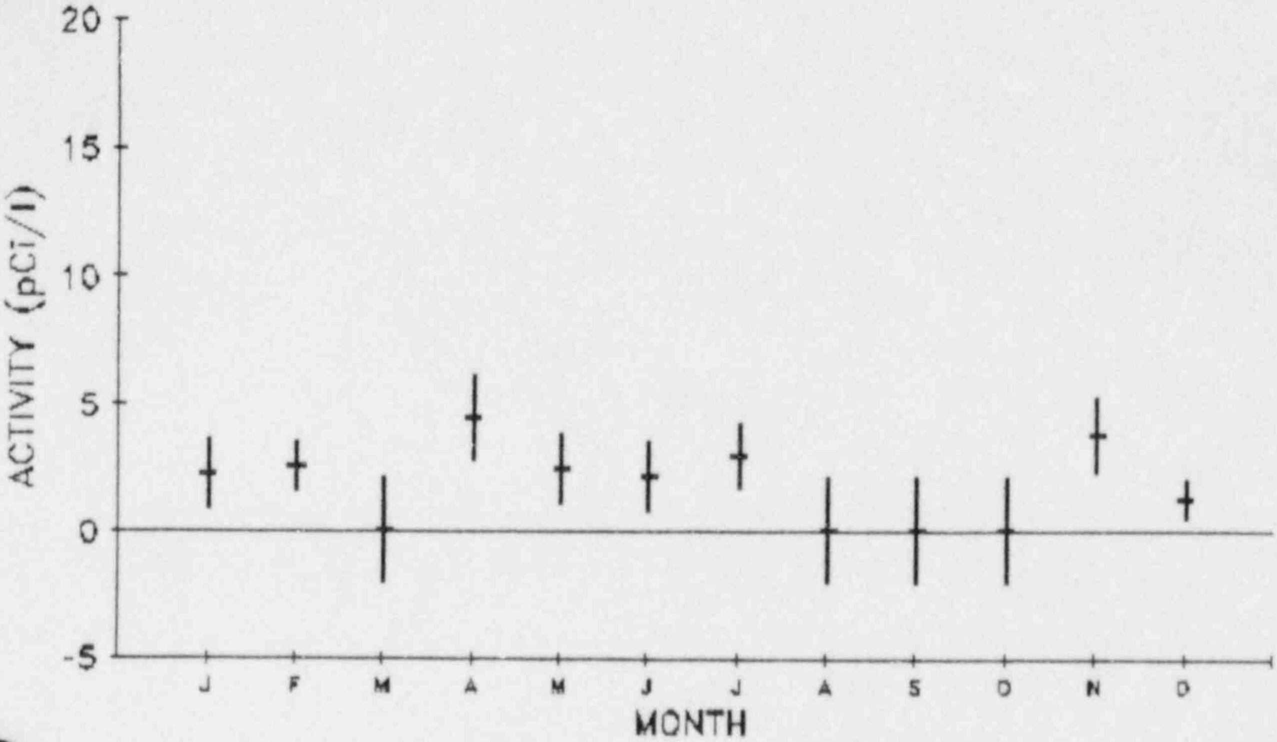


Figure 8
MONTHLY GROSS ALPHA ACTIVITY
WELL WATER - STATION F05
1987



MONTHLY GROSS BETA ACTIVITY
WELL WATER - STATION F05
1987

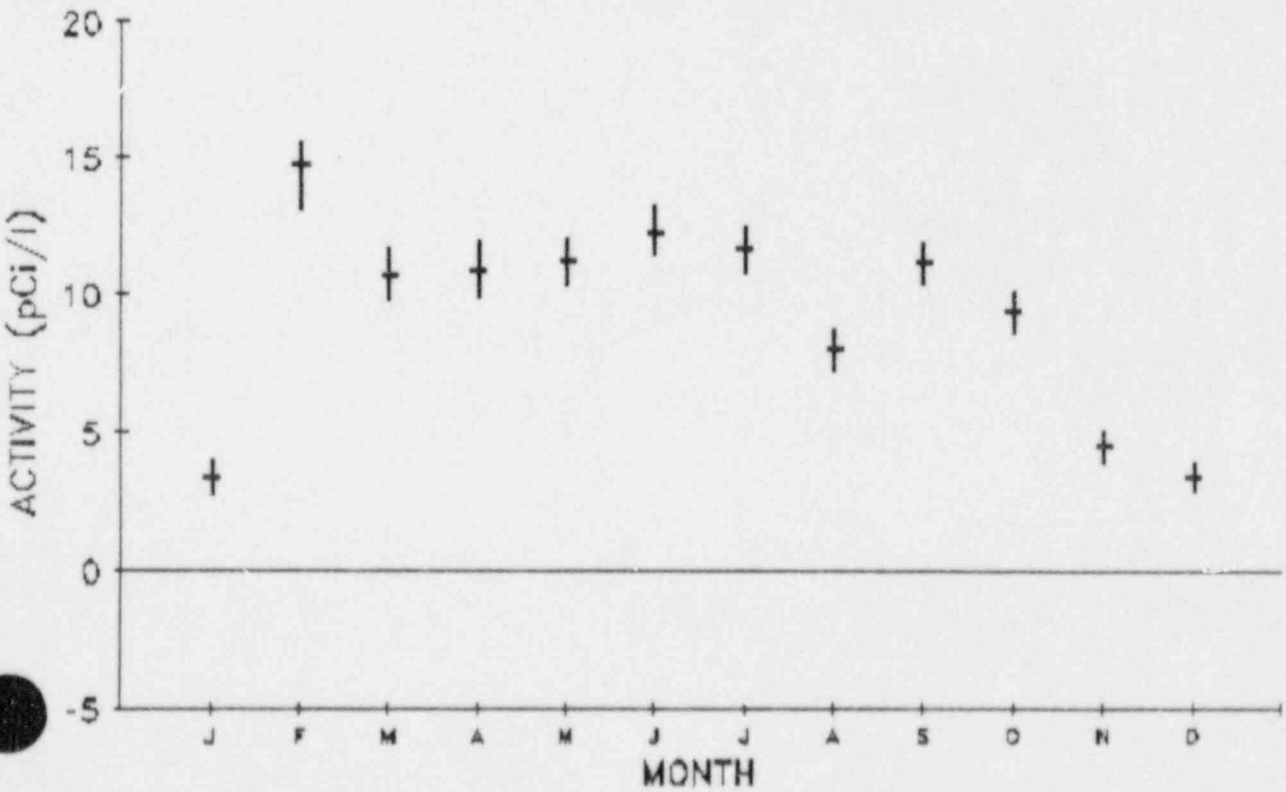
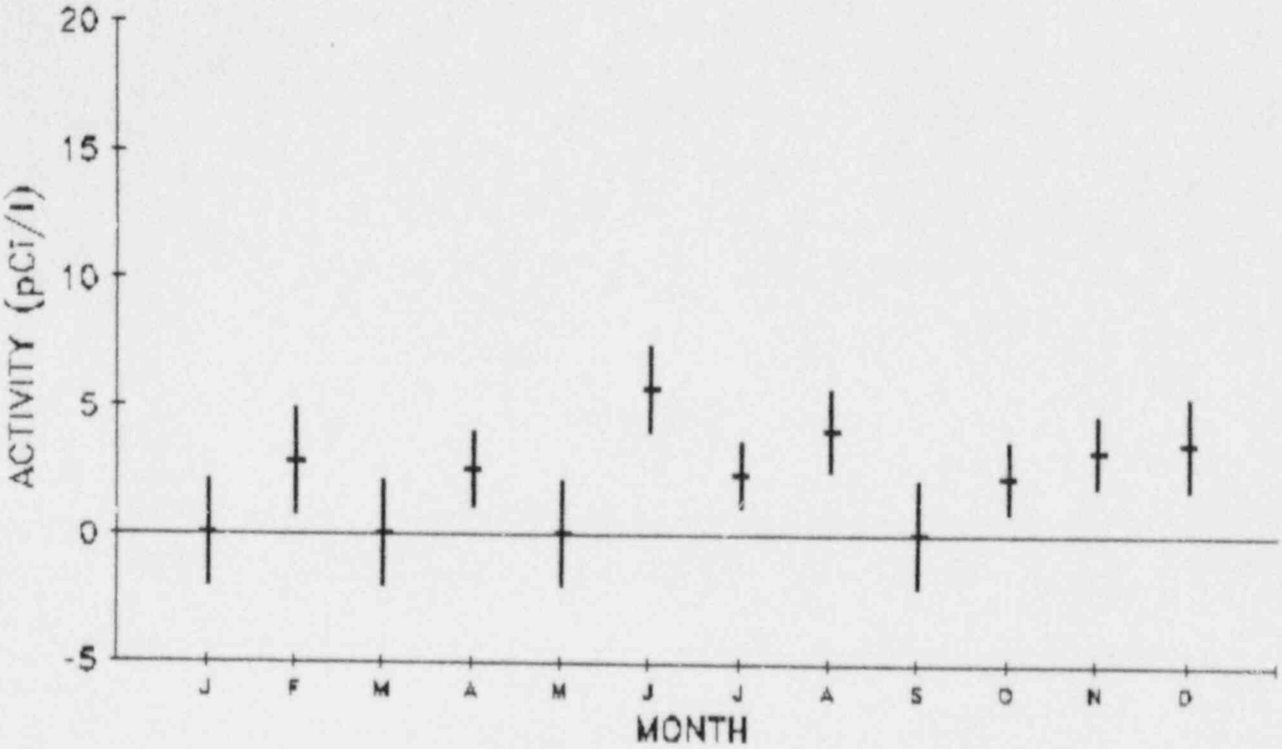
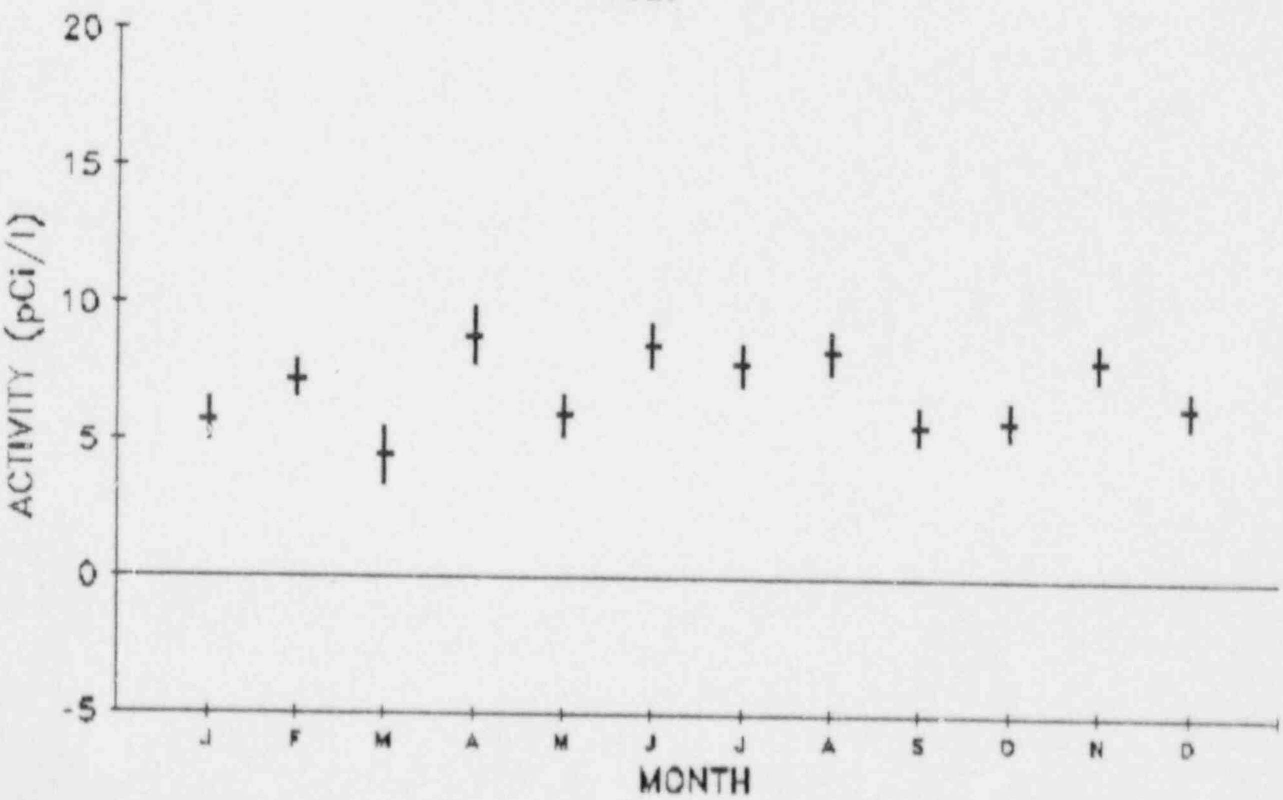


Figure 9
MONTHLY GROSS ALPHA ACTIVITY
WELL WATER - STATION F15
1987



MONTHLY GROSS BETA ACTIVITY
WELL WATER - STATION F15
1987



3.4 Surface Water

Surface Water samples were collected from three locations on a monthly basis. Samples were analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-89, Strontium-90 and for Gamma-emitting nuclides. A summary of the Mean Gross Alpha and Gross Beta activities for Surface Water samples may be found in Table III.

Samples obtained from collection location SO1 (4.8 mi SE, 84 feet upstream of discharge, North Bank) yielded a 1987 mean Gross Alpha activity of 3.5±0.9 pCi/l with a range from less than 2.0 pCi/l to 4.8±1.5 (collected 06/09/87). The mean annual Gross Beta activity for SO1 was calculated to be 7.9±3.5 pCi/l with a range of Gross Beta activity from less than 3.0 pCi/l to 16.2±0.9 pCi/l (collected 08/11/87). The monthly Gross Alpha and Gross Beta results are shown in Figure 10. No Strontium-89 or Tritium activity was observed above detection limit in any of the Surface Water samples collected from location S01 during 1987. One sample collected on 01/13/87 indicated a Strontium-90 activity of 2.4±0.9 pCi/l.

Collection location SO2 (5.2 mi SE, 1.1 River miles downstream of discharge, North Bank) had a range of Gross Alpha activity from less than 2.0 pCi/l to 4.7±1.5 pCi/l (collected 11/10/87). The 1987 mean Gross Alpha activity from this location was 3.9±0.7 pCi/l. An annual mean Gross Beta activity of 7.3±3.7 pCi/l was observed while the range of Gross Beta activity for this site was from less than 3.0 pCi/l to 16.0±1.0 pCi/l (collected 10/13/87). Figure 11 shows the monthly Gross Alpha and Gross Beta results graphically. All Surface Water samples collected from location SO2 during 1987 were less than the detection limits for Tritium, Strontium-90 and Strontium-89 (500 pCi/l, 1.0 pCi/l and 1.5 pCi/l, respectively).

Figure 12 presents the monthly Gross Alpha and Gross Beta results for samples collected during 1987 from collection location SO3 (68 mi E, City of St. Louis Water Intake). A range of Gross Alpha activity from less than 2.0 pCi/l to 7.2$\pm$1.6 pCi/l (collected 08/21/87) was observed in the samples collected from location SO3. The 1987 mean Gross Alpha activity for samples from this location was 3.5$\pm$1.8 pCi/l. Results of Gross Beta analyses for Surface Water samples from Location SO3 ranged from 3.0$\pm$0.6 pCi/l to 18.9$\pm$0.9 pCi/l collected 07/07/87. A 1987 mean Gross Beta activity of 7.9$\pm$4.3 pCi/l was observed for this site. No Strontium-90, Strontium-89 or Tritium were detected in any of the Surface Water samples collected from this location during 1987.

The 1987 mean Gross Alpha and Gross Beta activities for all Surface Water samples were 3.6$\pm$1.2 pCi/l and 7.7$\pm$3.8 pCi/l. No gamma-emitting nuclides of interest were detected in the 1987 Surface Water samples.

During 1987, the upstream surface water samples from January to September were daily grab samples composited over the month. This was due to continuous maintenance problems with the upstream sampler. To reduce the out-of-service time for the upstream sampler, a redesign of the sampler was installed during September 1987.

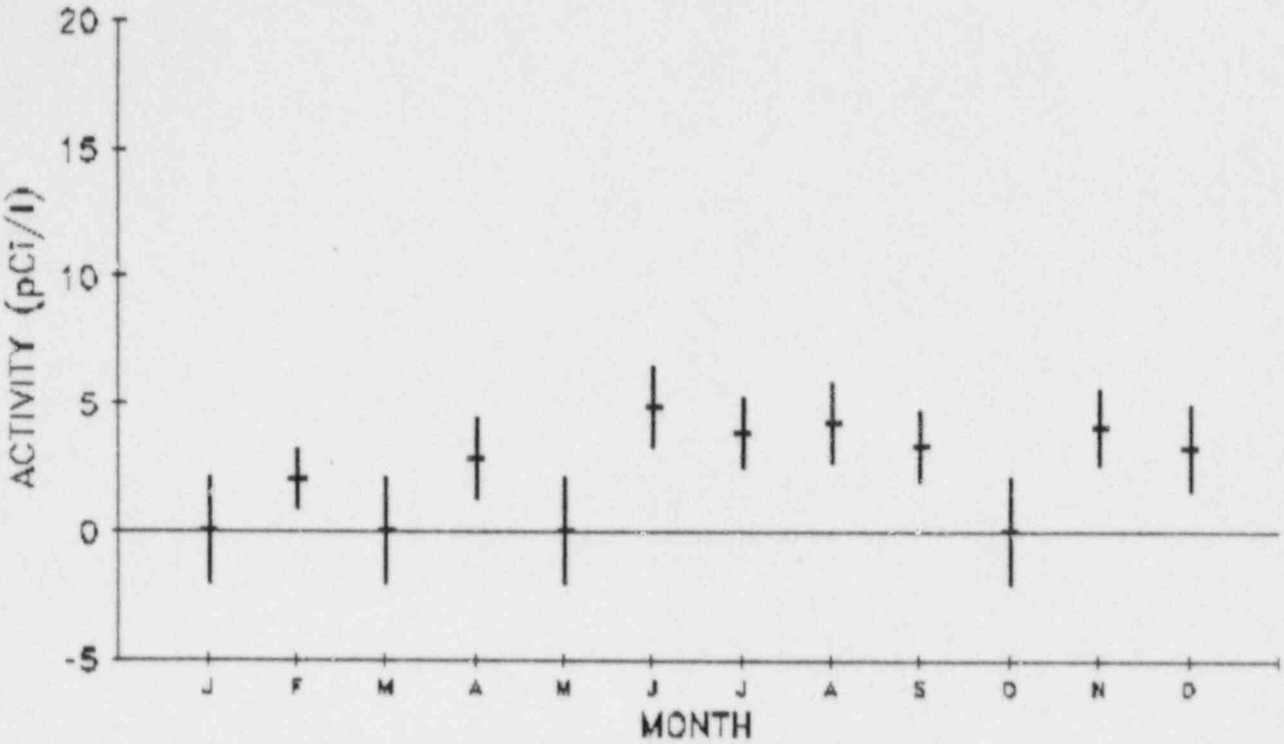
Table III

1987 Mean Gross Alpha and Gross Beta Activities in Surface Water

(pCi/l)

	Gross Alpha	Gross Beta
CA-SWA-SO1	3.5 ± 0.9	7.9 ± 3.5
CA-SWA-SO2	3.9 ± 0.7	7.3 ± 3.7
CA-SWA-SO3	3.5 ± 1.8	7.9 ± 4.3
All Locations	3.6 ± 1.2	7.7 ± 3.8

Figure 10
MONTHLY GROSS ALPHA ACTIVITY
SURFACE WATER - STATION S01
1987



MONTHLY GROSS BETA ACTIVITY
SURFACE WATER - STATION S01
1987

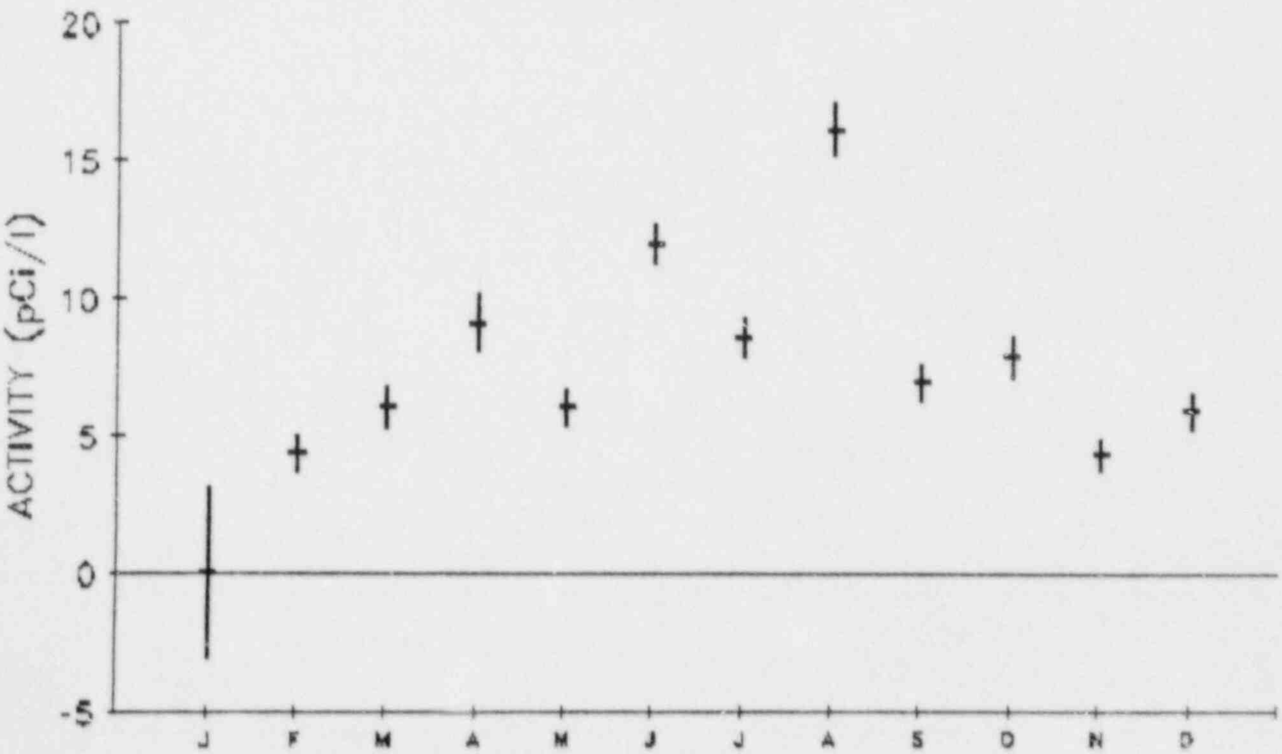
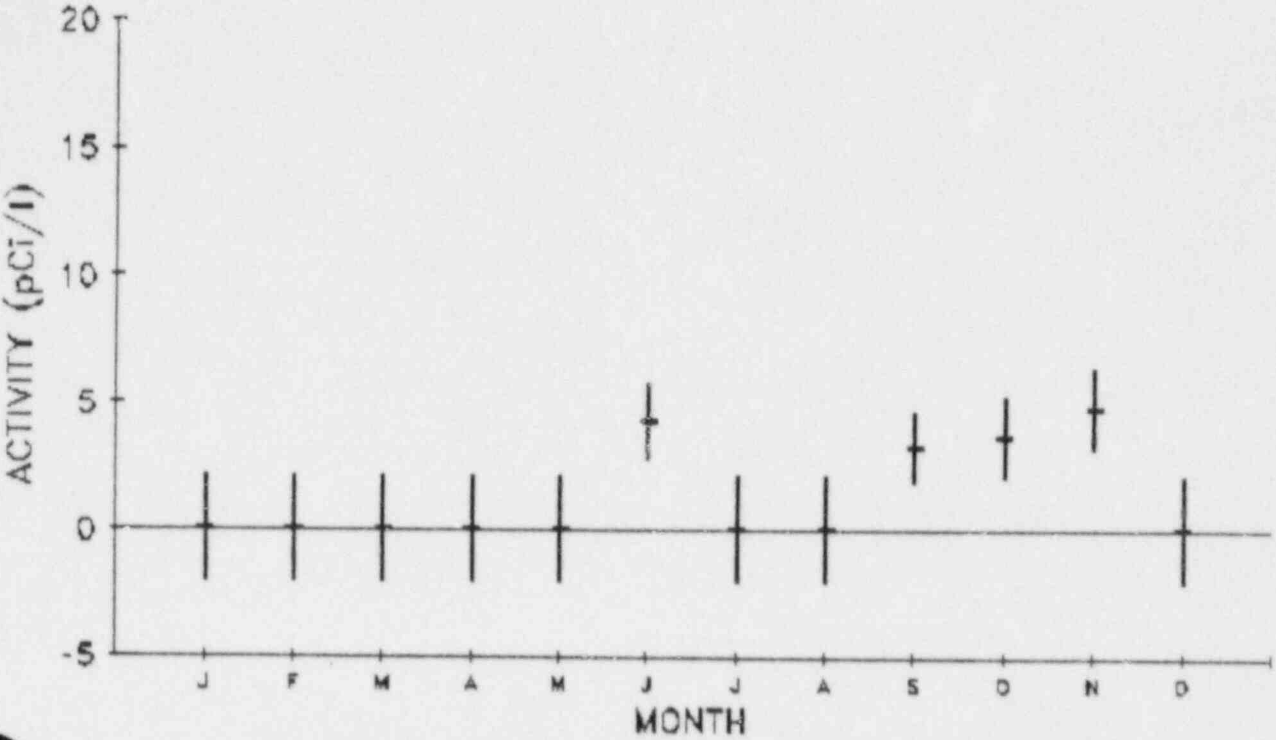


Figure 11
MONTHLY GROSS ALPHA ACTIVITY
SURFACE WATER - STATION S02
1987



MONTHLY GROSS BETA ACTIVITY
SURFACE WATER - STATION S02
1987

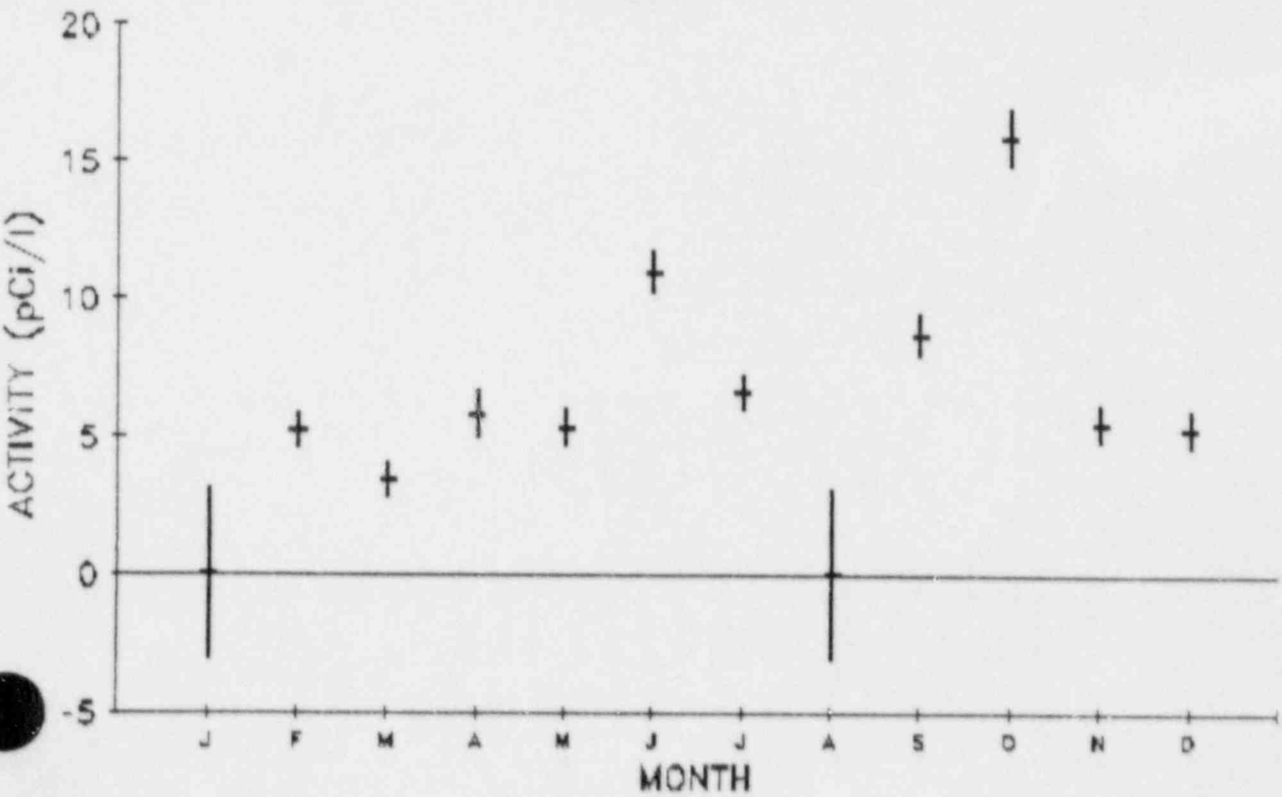
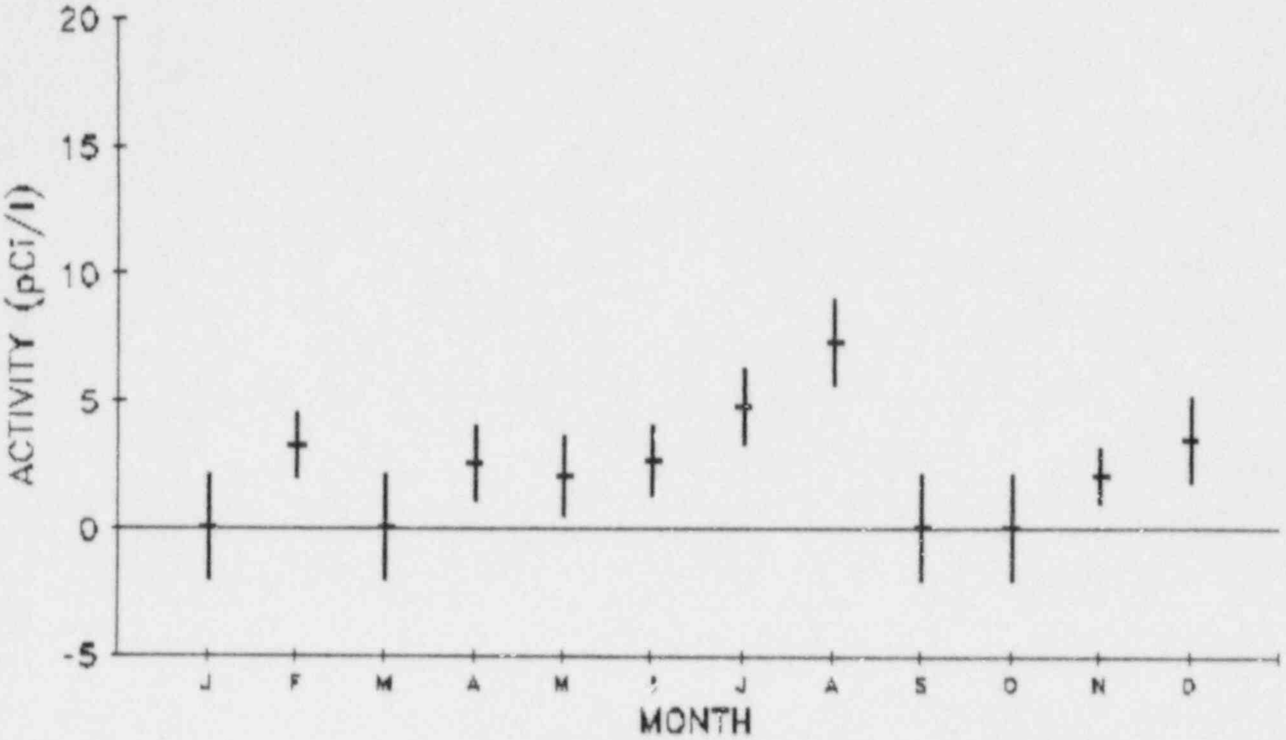
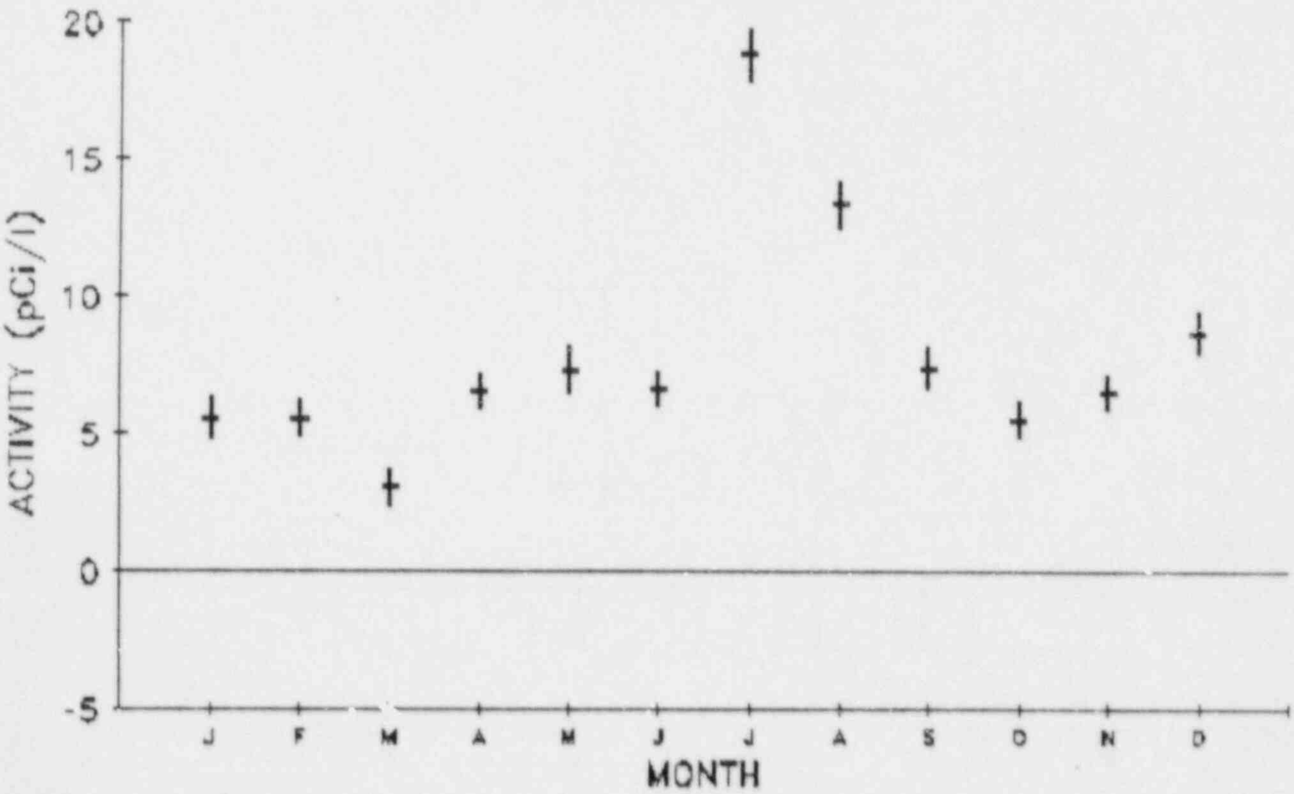


Figure 12

MONTHLY GROSS ALPHA ACTIVITY
SURFACE WATER - STATION S03
1987



MONTHLY GROSS BETA ACTIVITY
SURFACE WATER - STATION S03
1987



3.5 Sediment

Washload, Bedload and Bottom sediment samples were collected quarterly from three locations along the Missouri River. Samples were analyzed for Gross Alpha, Gross Beta, Strontium-89, Strontium-90 and by Gamma Spectrometry. A summary of mean Gross Alpha and Gross Beta activities for all sediment samples collected during 1987 is presented in Table IV.

Washload sediment samples collected from Location A (4.9 mi SSE, 0.6 river mile upstream of discharge, North Bank) had a range of Gross Alpha activity from less than 0.3 pCi/g to 2.2±0.3 pCi/g collected 05/27/87. The mean Gross Alpha activity for 1987 was 1.4±0.8 pCi/g for Washload sediment samples collected from Location A. The 1987 mean Gross Beta activity for Washload sediments collected at Location A was calculated to be 4.0±3.2 pCi/g. A chronological presentation of all Gross Alpha and Gross Beta results for Washload sediment samples from this site may be found in Figure 13. Strontium-90 was not detected in Washload sediment samples collected during 1987. No Strontium-89 was detected in any of the Location A Washload samples. No gamma-emitting nuclides of interest were detected in any of the Washload sediment samples collected from Location A during 1987.

Figure 14 presents the quarterly Gross Alpha and Gross Beta results for Washload sediment collected from Location C (3.1 mi SE, 1.0 river mile downstream of discharge, North Bank). Gross Alpha activity for Washload sediment samples from Collection Location C ranged from less than 0.3 pCi/g to 3.1±1.4 pCi/g (collected 03/09/87). Gross Beta activity in the samples from this site ranged from less than 0.2 pCi/g to 8.0±0.7 pCi/g (collected 03/09/87). The 1987 mean Gross Alpha and Gross Beta levels for Washload sediments collected at Location

C were 1.5±1.4 pCi/g and 4.2±3.8 pCi/g, respectively. Strontium-90 was not detected in Washload sediment samples collected from Location C during 1987. No Strontium-89 was detected in the Washload samples collected from this location. No gamma-emitting nuclides of interest were observed in any of the 1987 Washload sediment samples collected from Location C.

The monthly Gross Alpha and Gross Beta results for the Washload sediment samples collected from Location D (53.0 mi ESE, 59.5 river miles downstream of discharge, South Bank) are graphically presented in Figure 15. Gross Alpha activity in these samples ranged from 1.2±0.4 pCi/g to 3.3±0.9 pCi/g (collected 03/06/87) with a 1987 mean of 2.2±1.2 pCi/g. The annual mean Gross Beta activity for Washload samples collected at Location D was 7.5±5.0 pCi/g with a range of activity from 0.6±0.1 pCi/g to 12.4±0.8 pCi/g (collected 11/03/87). Strontium-90 was not observed in Washload sediment samples from Collection Location D. Strontium-89 was not detected in any samples from this location. No gamma-emitting nuclides of interest were detected in any of the Washload sediments collected from Location D during 1987.

Bedload sediment samples collected from Location A (4.9 mi SSE, 0.6 river mile upstream of discharge, North Bank) yielded a range of Gross Alpha activity from less than 0.3 pCi/g to 1.2±0.3 pCi/g (collected 03/09/87). The Gross Beta activity for these samples ranged from less than 0.2 pCi/g to 3.3±0.2 pCi/g. The 1987 mean Gross Alpha and Gross Beta activities for Bedload samples from Collection Location A were 0.9±0.3 pCi/g and 2.3±1.7 pCi/g, respectively (See Figure 16). No Strontium-90 activity was observed in any of the Bedload samples collected from Location A during 1987. In addition, no Strontium-89 activity was detected in any of the 1987 Location A Bedload sediment samples. No gamma emitting nuclides of interest were detected in any of the Bedload sediment samples collected from Location A during 1987.

Location C (5.1 mi SE, 1.0 river mile downstream of discharge, North Bank) Bedload sediment samples ranged from less than 0.3 pCi/g to 2.2±0.3 (collected 08/19/87) for Gross Alpha activity while the 1987 mean Gross Alpha activity was calculated to be 1.7±0.7 pCi/g. A mean annual Gross Beta activity of 2.2±1.6 pCi/g was observed in Bedload samples from Location C. The range of Gross Beta activity was from 0.5±0.3 pCi/g to 4.2±0.6 pCi/g (collected 03/09/87) (See Figure 17). No Strontium-90 was detected in any Location C Bedload samples during 1987. No Strontium-89 was observed in any of the Bedload samples from Collection Location C. Cesium-137 was detected in the sample collected 08/19/87 (0.12±0.02 pCi/g). No other gamma-emitting nuclides of interest were detected in the Bedload samples collected from Location C during 1987.

A chronological presentation of the Gross Alpha and Gross Beta activities for Bedload sediment samples from Location D (53.0 mi ESE, 59.5 river miles downstream of discharge, South Bank) may be found in Figure 18. The Gross Alpha activity ranged from less than 0.3 pCi/g to 1.5±0.3 pCi/g (collected 08/20/87) for these samples. Gross Beta levels ranged from less than 0.2 pCi/g to 4.0±0.2 pCi/g (collected 03/06/87). The Bedload sediment samples from Location D had a mean annual Gross Alpha activity of 1.2±0.4 pCi/g and a mean annual Gross Beta activity of 2.4±1.5 pCi/g. No Strontium-90 was observed in any of the 1987 Location D Bedload samples. No Strontium-89 was observed in any of the Location D Bedload sediment samples. Cesium-137 was detected in two of the Location D Bedload samples, collected 05/22/87 (0.43±0.11 pCi/g) and

08/20/87 (0.09±0.03 pCi/g). No other gamma emitting nuclides of interest were detected.

Bottom sediment samples collected from Location A (4.9 mi SSE, 0.6 river mile upstream of discharge, North Bank) had a mean annual Gross Alpha activity of 1.8±0.3 pCi/g and a mean annual Gross Beta activity of 1.6±0.5 pCi/g. Figure 19 exhibits the quarterly Gross Alpha and Gross Beta results for these samples. The quarterly Gross Alpha results ranged from 1.6±0.2 pCi/g to 2.3±0.3 pCi/g (collected 08/19/87) while the range of Gross Beta results was from 1.2±0.1 pCi/g to 2.4±0.1 pCi/g (collected 03/09/87). All Bottom sediment samples collected from Location A during 1987 were below the detection limits of 0.30 pCi/g and 0.20 pCi/g for Strontium-89 and Strontium-90, respectively. Cesium-137, was detected in two Bottom sediment samples collected from Location A during 1987 (0.03±0.01 pCi/g on 05/27/87 and 0.06±0.01 pCi/g on 08/19/87).

Location C (5.1 mi SE, 1.0 river mile downstream of discharge, North Bank) had a range of Gross Alpha activity from 1.2±0.2 pCi/g to 2.3±0.3 pCi/g (collected 11/12/87) and a Gross Beta activity range from 1.0±0.1 pCi/g to [illegible].6±0.1 pCi/g (collected 03/09/87) for Bottom sediment samples. All Gross Alpha and Beta results from 1987 are graphed in Figure 20. The 1987 mean Gross Alpha and Gross Beta activities for Location C Bottom sediment samples were 1.7±0.5 pCi/g and 1.6±0.7 pCi/g, respectively. Strontium-90 was detected in none of the Bottom sediment samples collected from this site. No Strontium-89 was detected in any of these samples. Cesium-137 was detected in three Bottom Sediment samples collected from Location C during 1987 (0.13±0.01 pCi/g on 05/27/87, 0.12±0.01 pCi/g on 08/19/87 and 0.5±0.1 pCi/g on 11/12/87). Cobalt-58 was detected in the sample collected on 11/12/87 (0.25±0.07 pCi/g).

Figure 21 graphically presents the quarterly Gross Alpha and Gross Beta results for Bottom sediment samples collected during 1987 from Location D (53.0 mi ESE, 59.5 river miles downstream of discharge, South Bank). The range of Gross Alpha activity for these samples was from 1.0±0.2 pCi/g to 4.0±0.6 pCi/g (collected 11/03/87), while Gross Beta activity ranged from 0.9±0.1 pCi/g to 3.0±0.2 pCi/g (collected 11/03/87). The 1987 mean Gross Alpha and Gross Beta activities for Bottom sediment samples from Location D were 2.0±1.4 pCi/g and 1.7±0.9 pCi/g, respectively. No Strontium-90 was detected in any of the four Location D Bottom sediments. No Strontium-89 was observed in any of the Bottom sediment samples collected from Location D during 1987. Cesium-137 was detected in two of the 1987 Bottom Sediment samples collected from Location D (0.09±0.01 pCi/g on 05/22/87 and 0.15±0.06 pCi/g on 11/03/87).

Two Shoreline sediment samples were collected from Location C during 1987. The Shoreline sediment collected 05/26/87 exhibited a Cesium-137 activity of 0.11±0.01 pCi/g and the sample collected 11/09/87 exhibited Cesium-137 activity of 0.07±0.01 pCi/g. No other gamma-emitting nuclides of interest and no Strontium-89/90 activity was detected in the Shoreline sediments collected during 1987.

Table IV

1987 Mean Annual Gross Alpha Activities in Sediments

(pCi/g-dry)

	Washload	Bedload	Bottom
Location A	1.4 ± 0.8	0.9 ± 0.3	1.8 ± 0.3
Location C	1.5 ± 1.4	1.7 ± 0.7	1.7 ± 0.5
Location D	2.2 ± 1.2	1.2 ± 0.4	2.0 ± 1.4
All Locations	1.8 ± 1.1	1.3 ± 0.6	1.8 ± 0.8

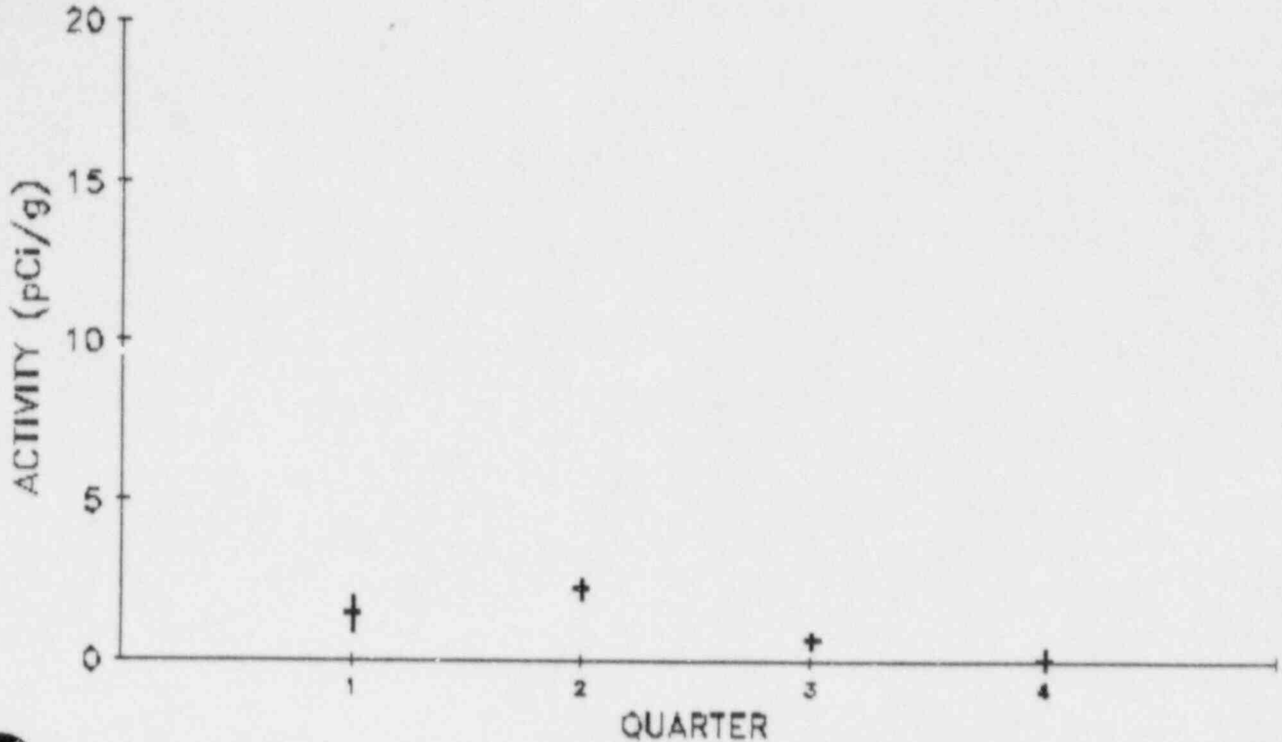
1987 Mean Annual Gross Beta Activities in Sediments

(pCi/g-dry)

	Washload	Bedload	Bottom
Location A	4.0 ± 3.2	2.3 ± 1.7	1.6 ± 0.5
Location C	4.2 ± 3.8	2.2 ± 1.6	1.6 ± 0.7
Location D	7.5 ± 5.0	2.4 ± 1.5	1.7 ± 0.9
All Locations	5.4 ± 4.1	2.3 ± 1.4	1.6 ± 0.7

Figure 13

QUARTERLY GROSS ALPHA ACTIVITY
WASHLOAD SEDIMENT - LOCATION A
1987



QUARTERLY GROSS BETA ACTIVITY
WASHLOAD SEDIMENT - LOCATION A
1987

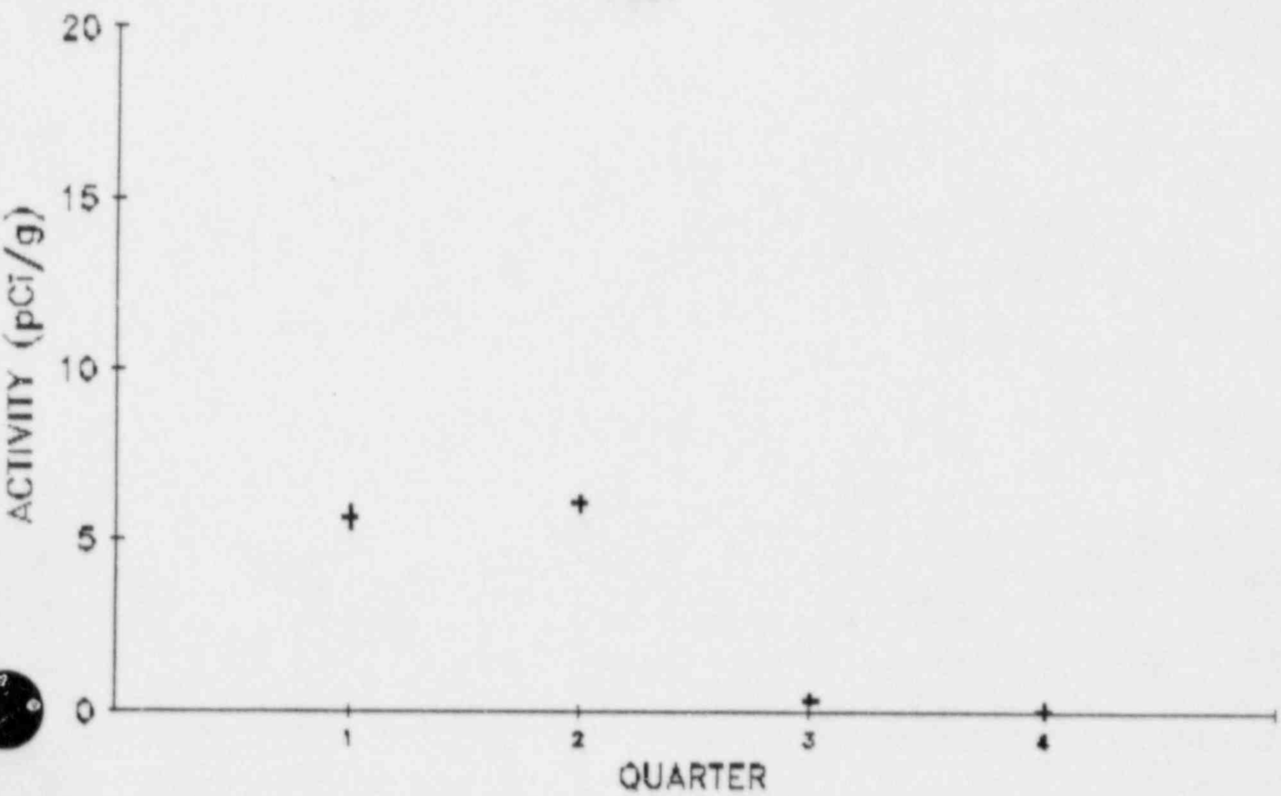
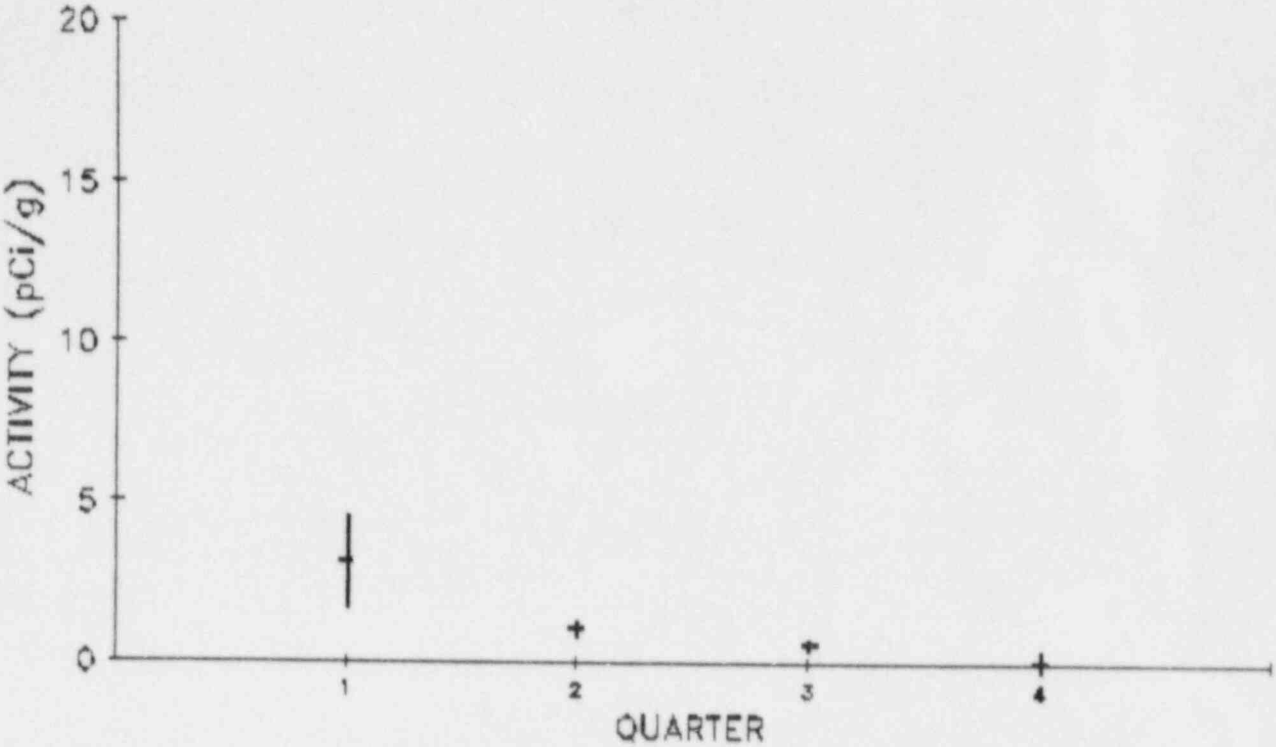


Figure 14

QUARTERLY GROSS ALPHA ACTIVITY
WASHLOAD SEDIMENT - LOCATION C
1987



QUARTERLY GROSS BETA ACTIVITY
WASHLOAD SEDIMENT - LOCATION C
1987

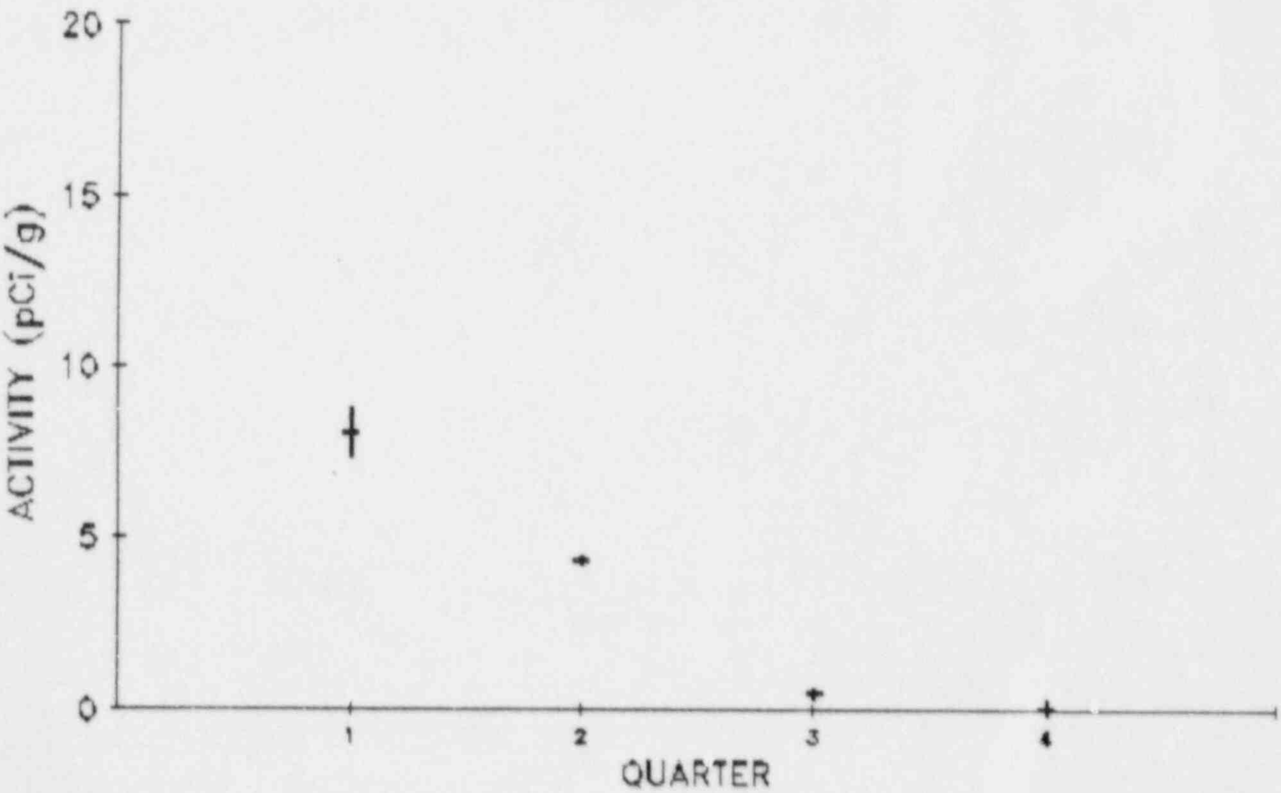
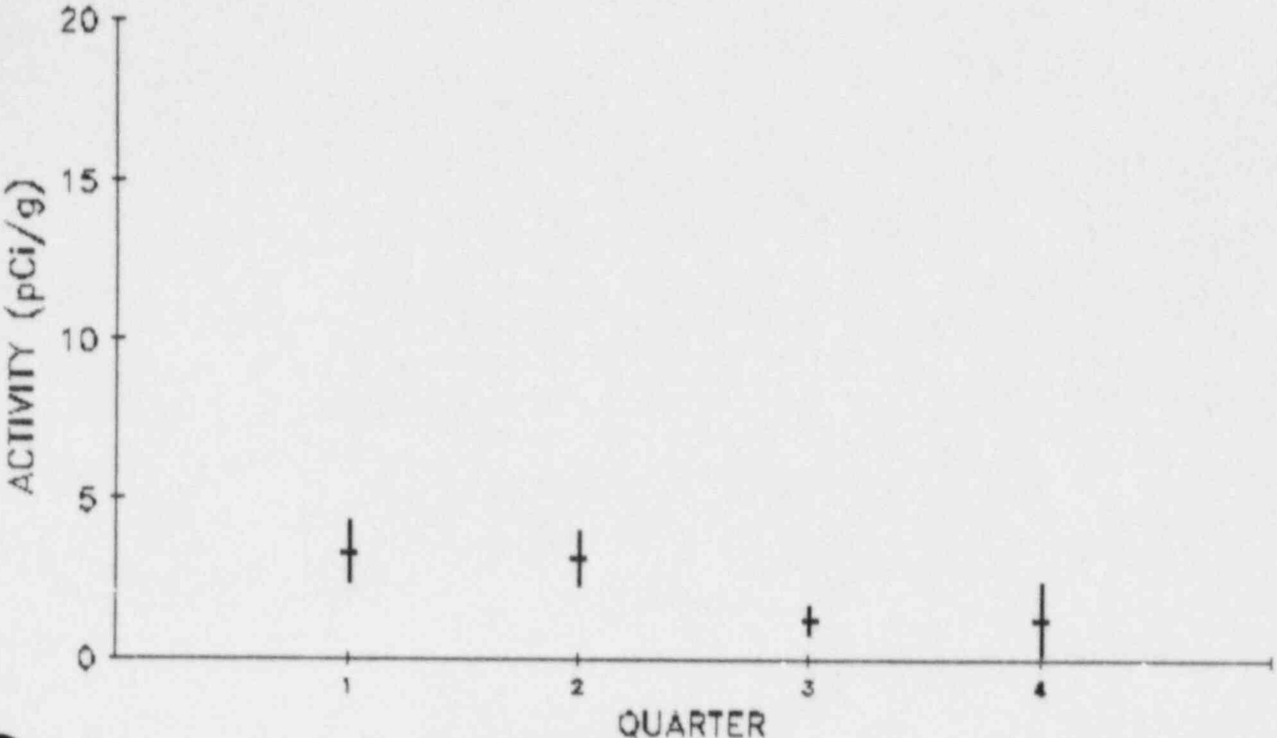


Figure 15
QUARTERLY GROSS ALPHA ACTIVITY
WASHLOAD SEDIMENT - LOCATION D
1987



QUARTERLY GROSS BETA ACTIVITY
WASHLOAD SEDIMENT - LOCATION D
1987

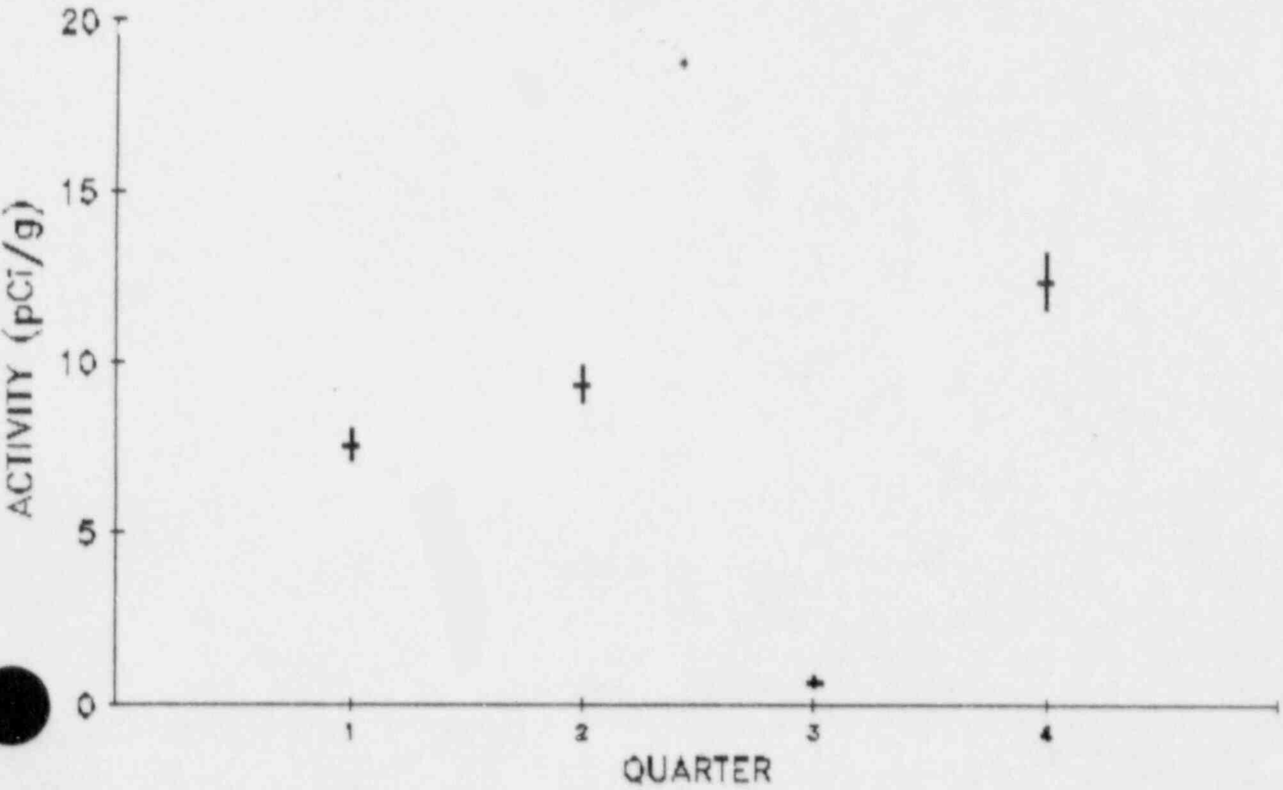
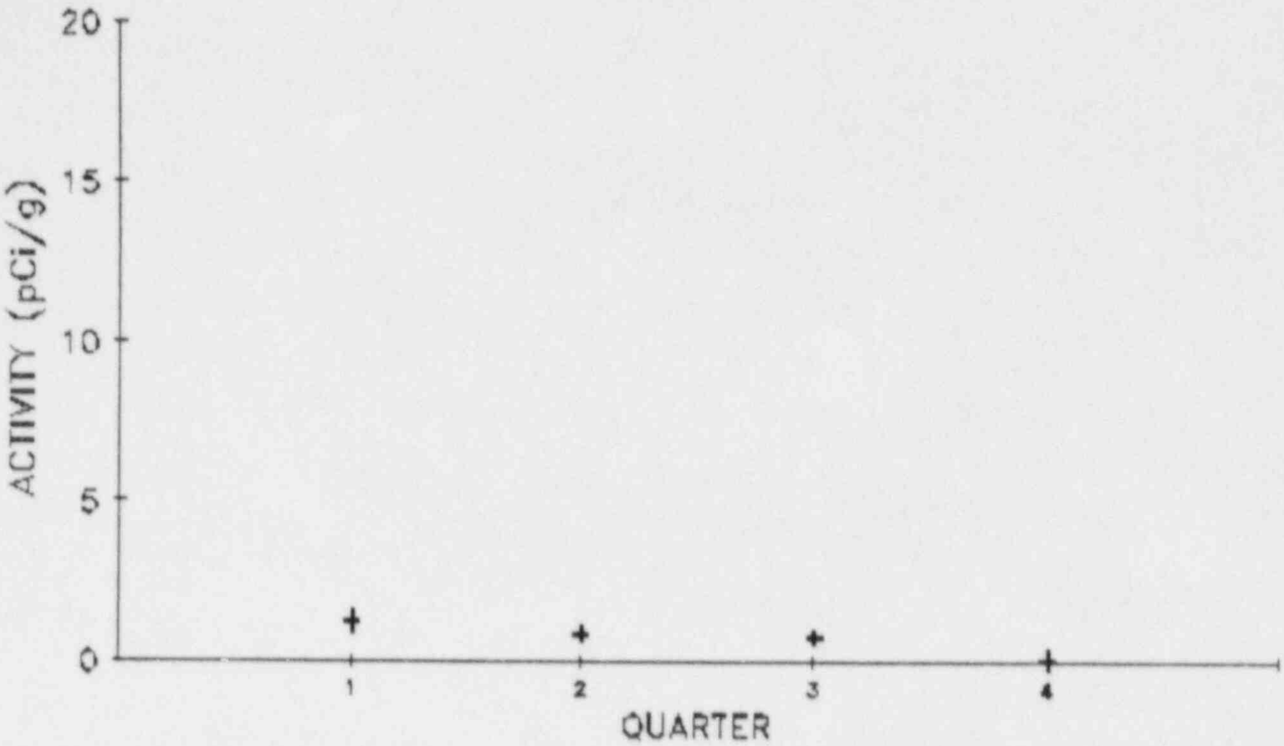


Figure 16
QUARTERLY GROSS ALPHA ACTIVITY
BEDLOAD SEDIMENT - LOCATION A
1987



QUARTERLY GROSS BETA ACTIVITY
BEDLOAD SEDIMENT - LOCATION A
1987

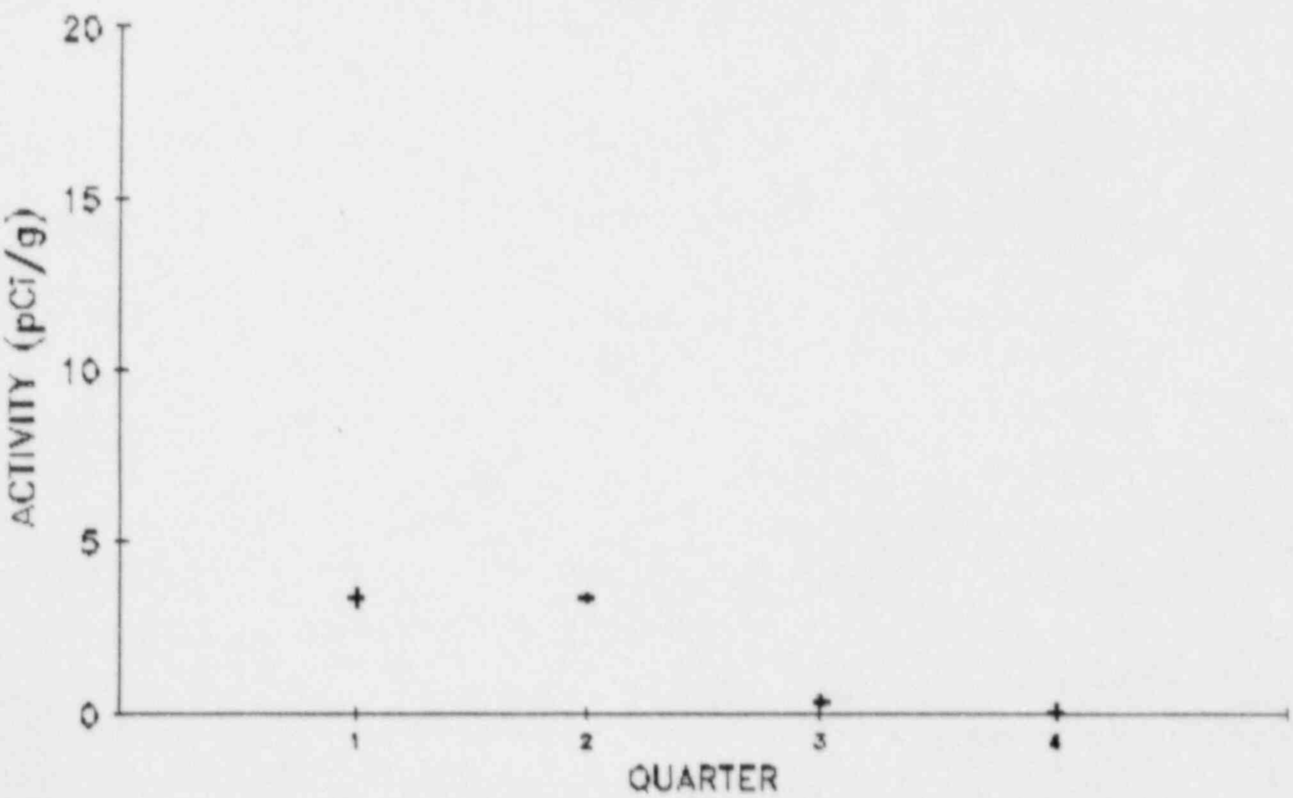
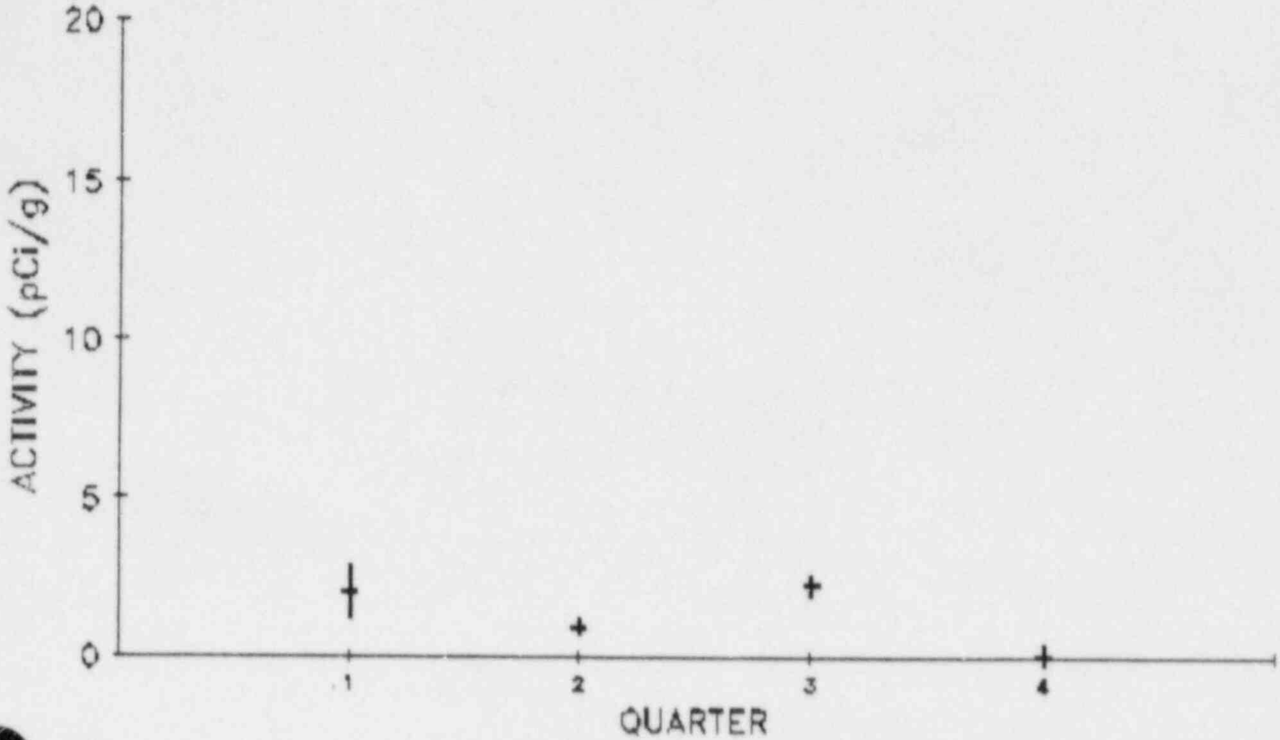


Figure 17
QUARTERLY GROSS ALPHA ACTIVITY
BEDLOAD SEDIMENT - LOCATION C
1987



QUARTERLY GROSS BETA ACTIVITY
BEDLOAD SEDIMENT - LOCATION C
1987

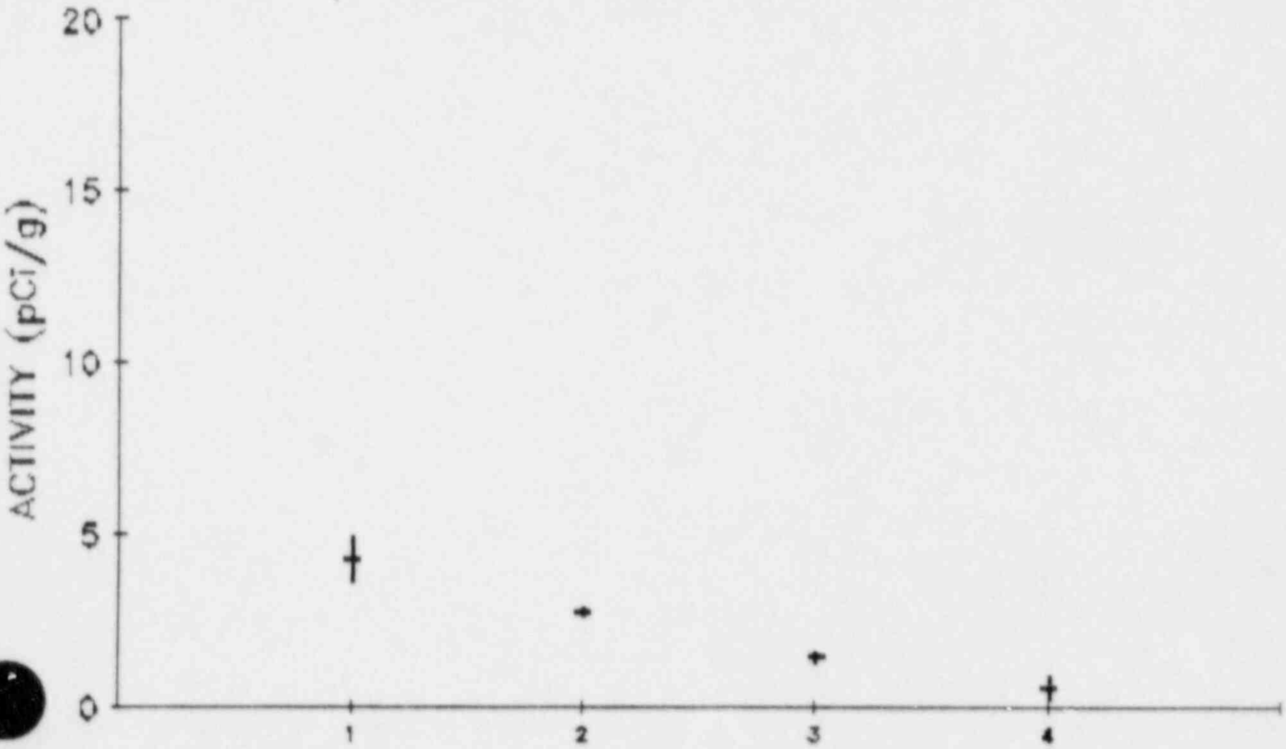
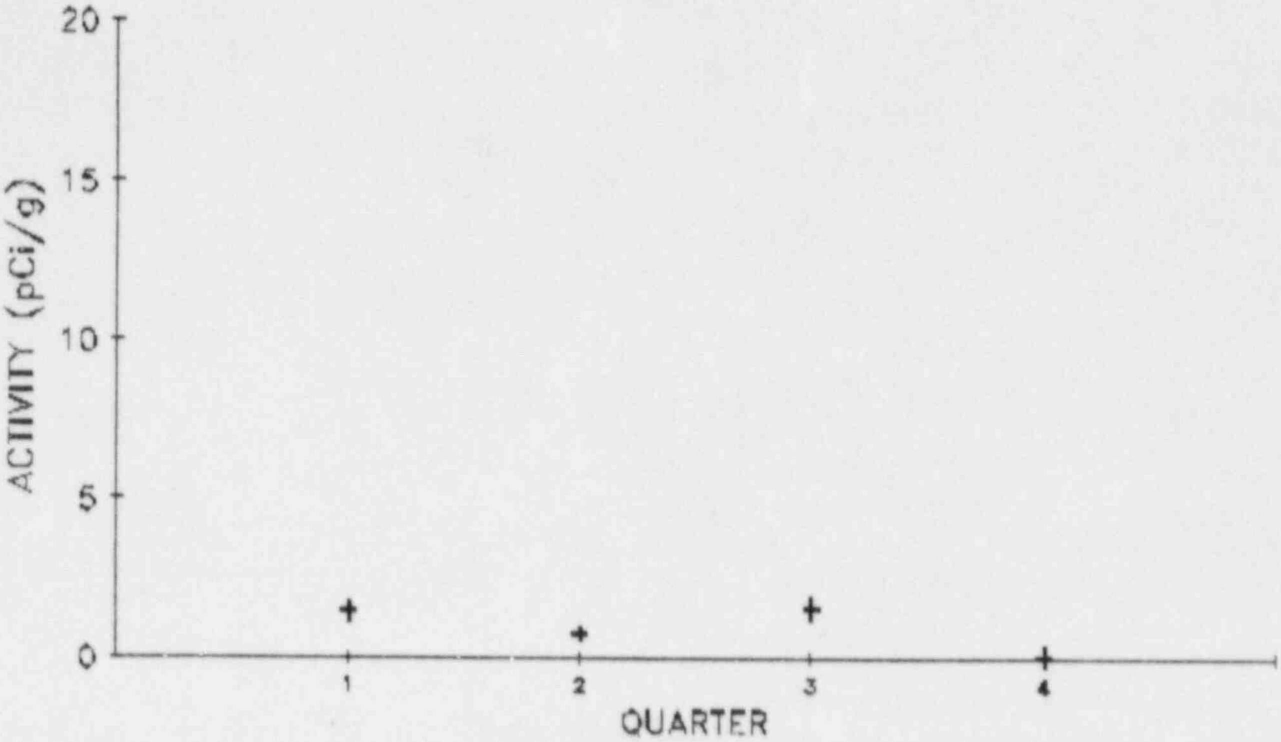


Figure 18
QUARTERLY GROSS ALPHA ACTIVITY
BEDLOAD SEDIMENT - LOCATION D
1987



QUARTERLY GROSS BETA ACTIVITY
BEDLOAD SEDIMENT - LOCATION D
1987

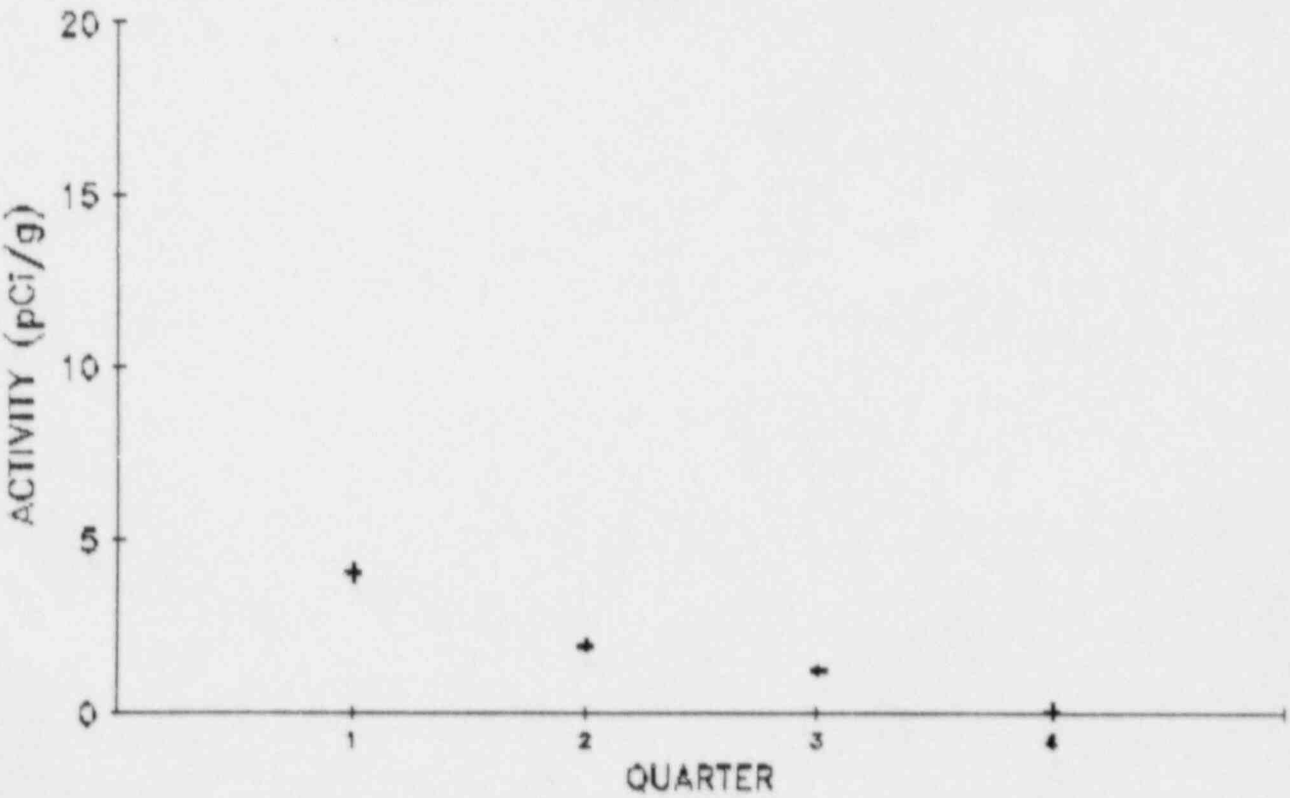
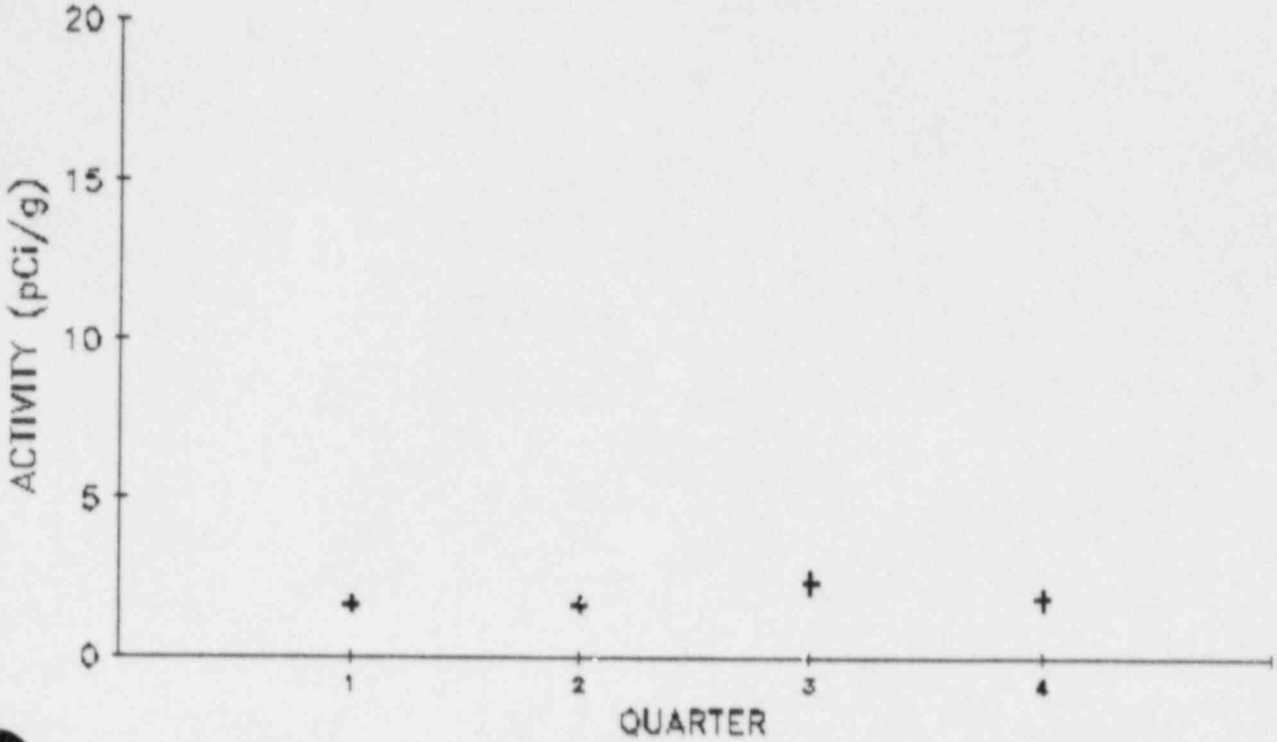


Figure 19
QUARTERLY GROSS ALPHA ACTIVITY
BOTTOM SEDIMENT - LOCATION A
1987



QUARTERLY GROSS BETA ACTIVITY
BOTTOM SEDIMENT - LOCATION A
1987

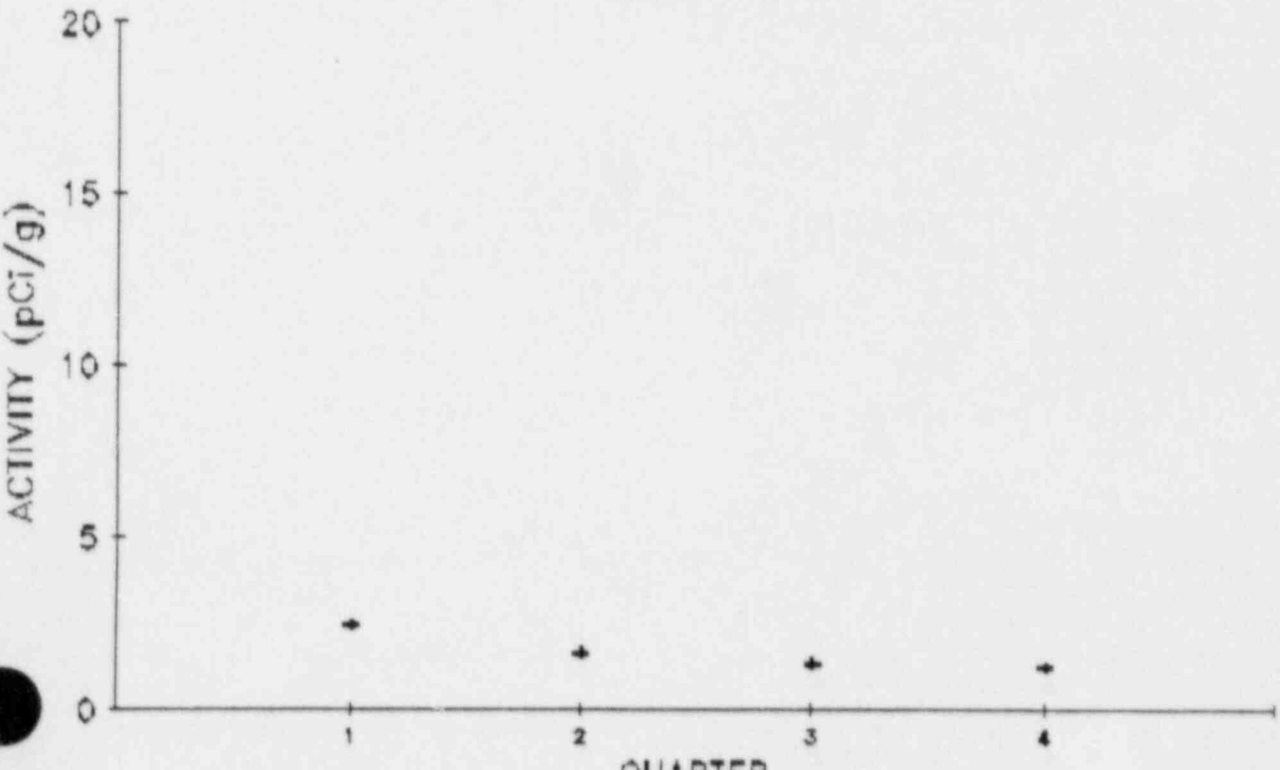
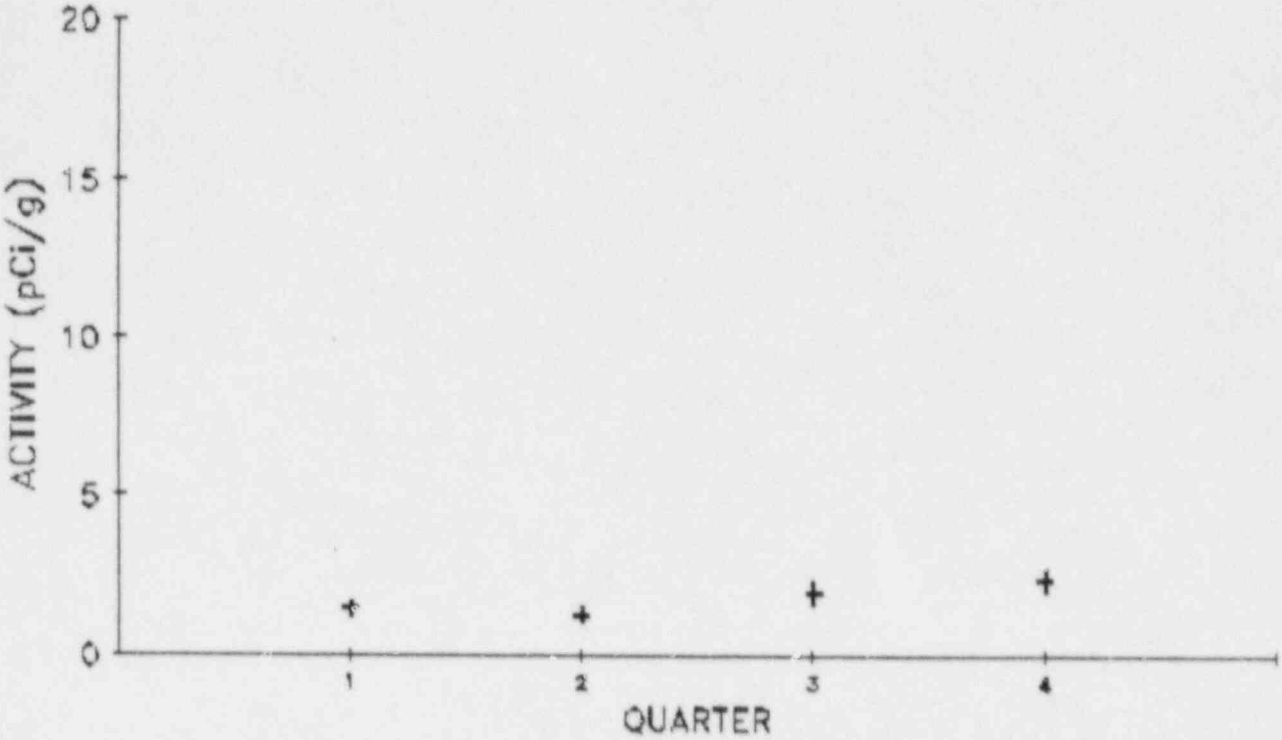


Figure 20
QUARTERLY GROSS ALPHA ACTIVITY
BOTTOM SEDIMENT - LOCATION C
1987



QUARTERLY GROSS BETA ACTIVITY
BOTTOM SEDIMENT - LOCATION C
1987

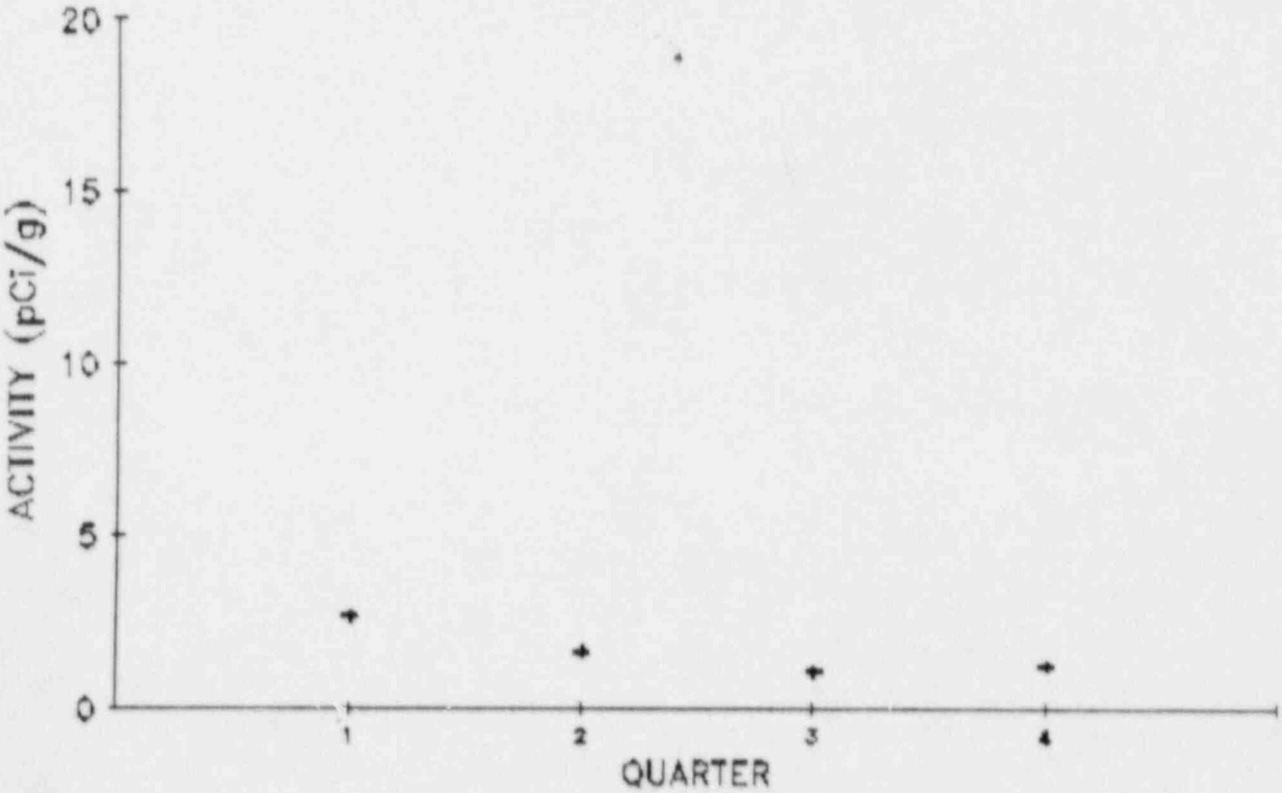
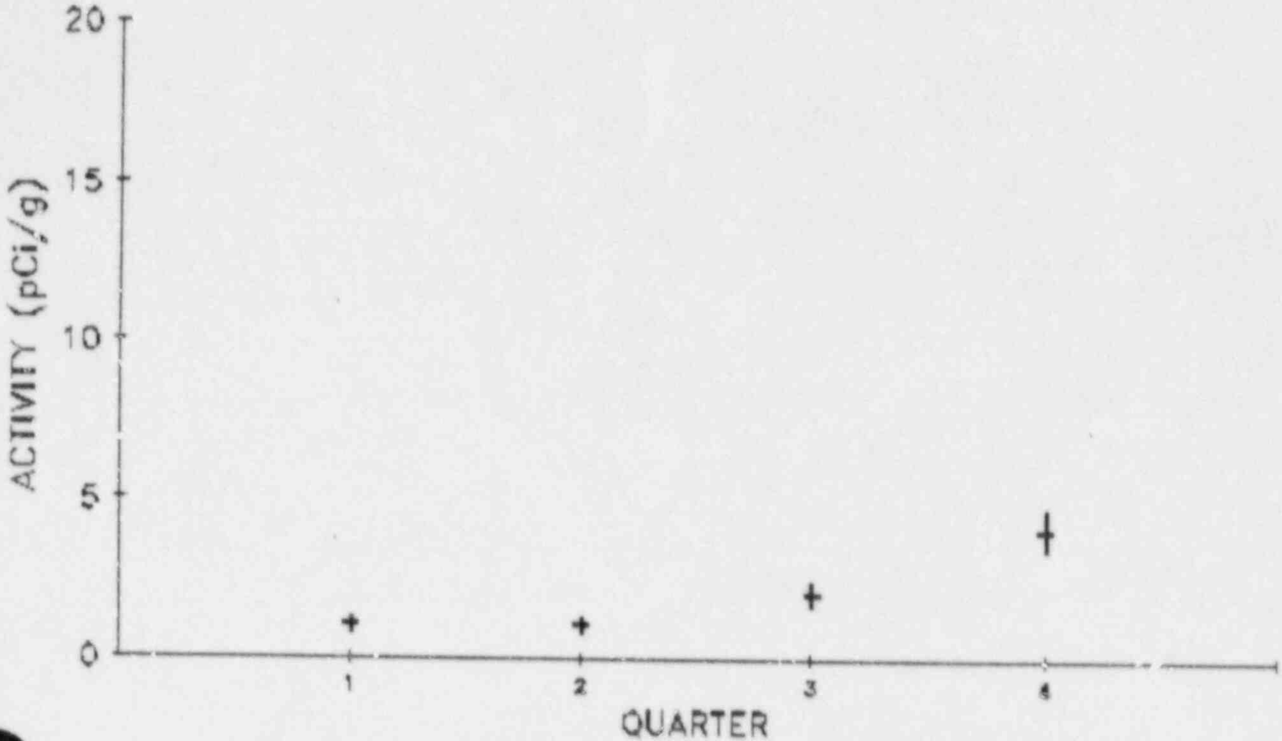
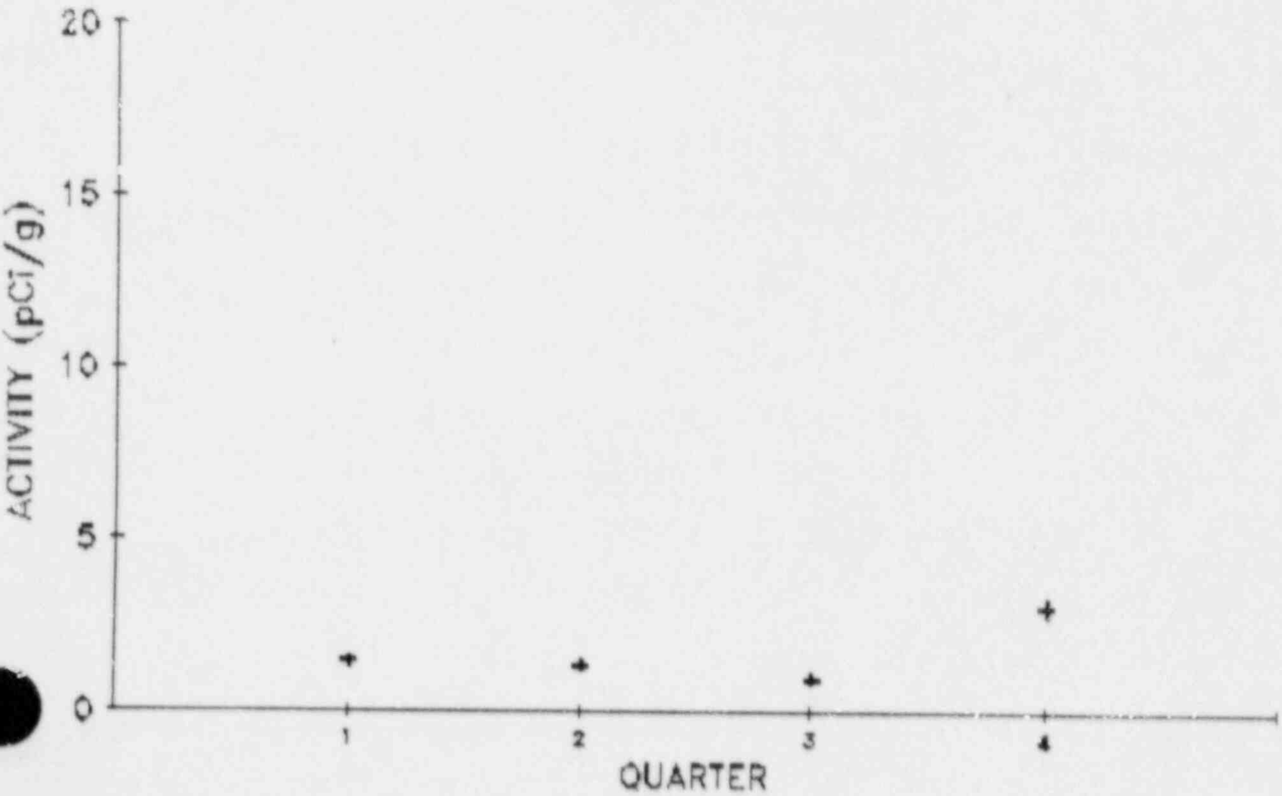


Figure 21

QUARTERLY GROSS ALPHA ACTIVITY
BOTTOM SEDIMENT - LOCATION D
1987



QUARTERLY GROSS BETA ACTIVITY
BOTTOM SEDIMENT - LOCATION D
1987



3.6 Fish

Five species of fish were collected on a monthly basis from the same locations on the Missouri River as the sediment samples. Fish samples were not collected from location A and C during January due to adverse weather conditions and paucity of fish. Species of fish collected during 1987 include freshwater drum, bigmouth buffalo, smallmouth buffalo, carp, goldeye, river carpsucker, shorthead redhorse, shortnose gar, longnose gar, gizzard shad, blue catfish, channel catfish, northern pike, flathead catfish, blue sucker and white crappie. Gross Alpha, Gross Beta, Strontium-89, Strontium-90 and Gamma Spectralanalyses were performed on all fish samples. All results are in terms of pCi/g (dry). The 1987 mean Gross Alpha and Gross Beta activities for each sampling location are summarized in Table V.

The monthly Gross Alpha activities in fish samples collected from Location A (4.9 mi SSE, 0.6 river mile upstream of discharge, North Bank) ranged from less than 0.3 pCi/g to 1.2$\pm$0.2 pCi/g (Bigmouth Buffalo collected 07/09/87) with a 1987 mean Gross Alpha activity of 0.6$\pm$0.3 pCi/g. Gross Beta activities in these samples ranged from 1.8$\pm$0.1 pCi/g to 8.4$\pm$0.2 pCi/g (Freshwater Drum collected 08/19/87). The mean Gross Beta activity for 1987 Fish samples collected at Location A was 6.0$\pm$1.4 pCi/g. Figure 22 is a chronological presentation of all Gross Alpha and Gross Beta activities for 1987. Strontium-90 and Strontium-89 were not detected in fish samples collected in 1987 from Location A. Cesium-137 was detected in one fish sample, Longnose Gar collected 06/25/87 indicated activity of 0.17$\pm$0.04 pCi/g. No other Gamma emitting nuclides were detected in the fish samples collected from Location A.

Fish samples collected from Location C (5.1 mi SE, 1.0 river mile downstream of discharge, North Bank) had mean annual Gross Alpha and Gross Beta activities of 0.4±0.2 pCi/g and 6.0±1.6 pCi/g, respectively. Figure 23 illustrates the monthly Gross Alpha and Gross Beta activities for fish collected from Location C. Gross Alpha levels in these samples ranged from less than 0.3 pCi/g to 0.8±0.2 pCi/g, while Gross Beta levels ranged from 2.2±0.1 pCi/g to 8.6±0.2 pCi/g (Gizzard Shad collected 06/25/87 and Freshwater Drum collected 12/03/87). No Strontium-89 or Strontium-90 was detected in any of the Fish from Collection Location C. Cesium-137 was detected in the Gizzard Shad collected 06/25/87 (0.30±0.15 pCi/g). No other gamma emitting nuclides of interest were detected in 1987 Location C Fish.

Figure 24 graphically presents the monthly Gross Alpha and Gross Beta results for Fish samples collected from Location D. Gross Alpha activities ranged from less than 0.3 pCi/g to 0.8±0.2 pCi/g (River Carpsucker collected 02/04/87) with a mean Gross Alpha activity of 0.4±0.2 pCi/g for all fish collected from Location D during 1987. Gross Beta ranged from 2.5±0.1 pCi/g to 8.5±0.2 pCi/g (Carp collected 07/07/87) with a 1987 mean of 5.8±1.4 pCi/g. No Strontium-89 or Strontium-90 activity was observed in any of the fish collected from this location. No gamma emitting isotopes of interest were detected in any of the 1987 Location D Fish samples.

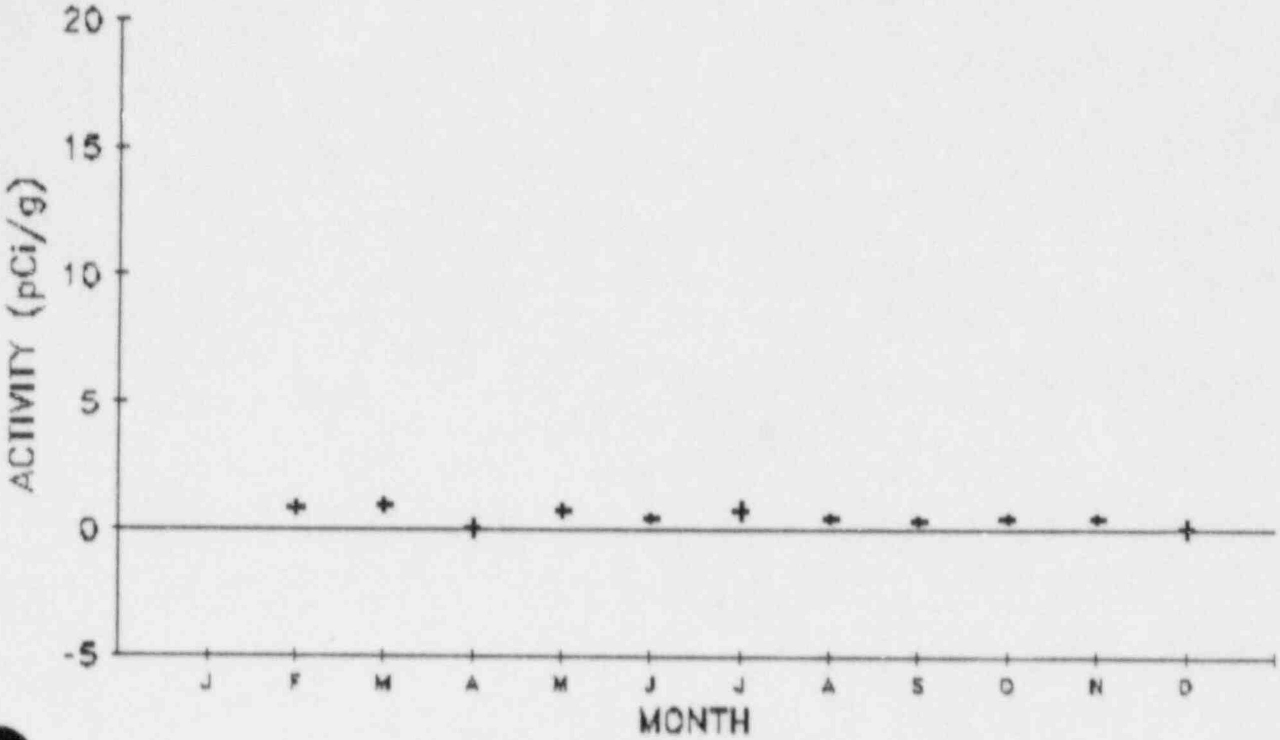
Table V

1987 Mean Annual Gross Alpha and Gross Beta Activities in Fish

(pCi/g-dry)

	Gross Alpha	Gross Beta
Location A	0.6 ± 0.4	6.0 ± 1.4
Location C	0.4 ± 0.2	6.0 ± 1.6
Location D	0.4 ± 0.2	5.8 ± 1.4
All Locations	0.5 ± 0.2	5.9 ± 1.5

Figure 22
MONTHLY GROSS ALPHA ACTIVITY
FISH - LOCATION A
1987



MONTHLY GROSS BETA ACTIVITY
FISH - LOCATION A
1987

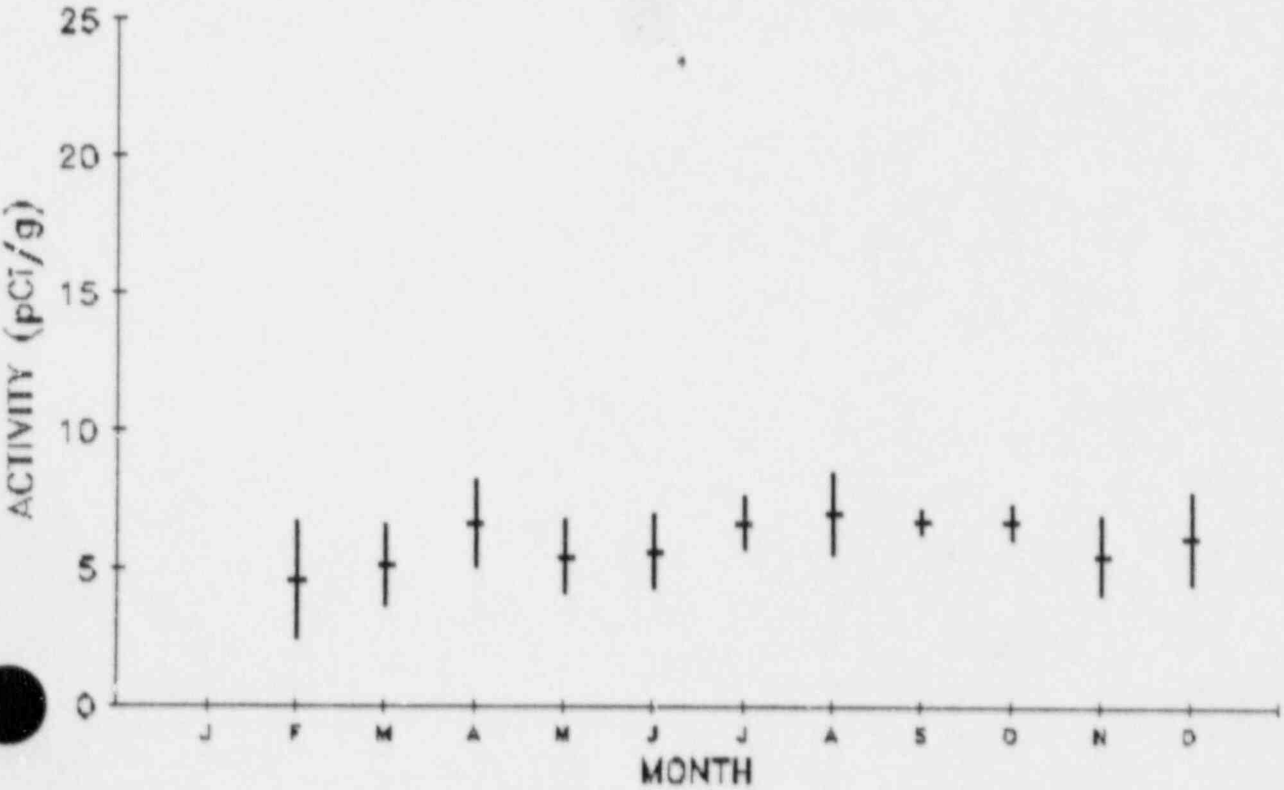
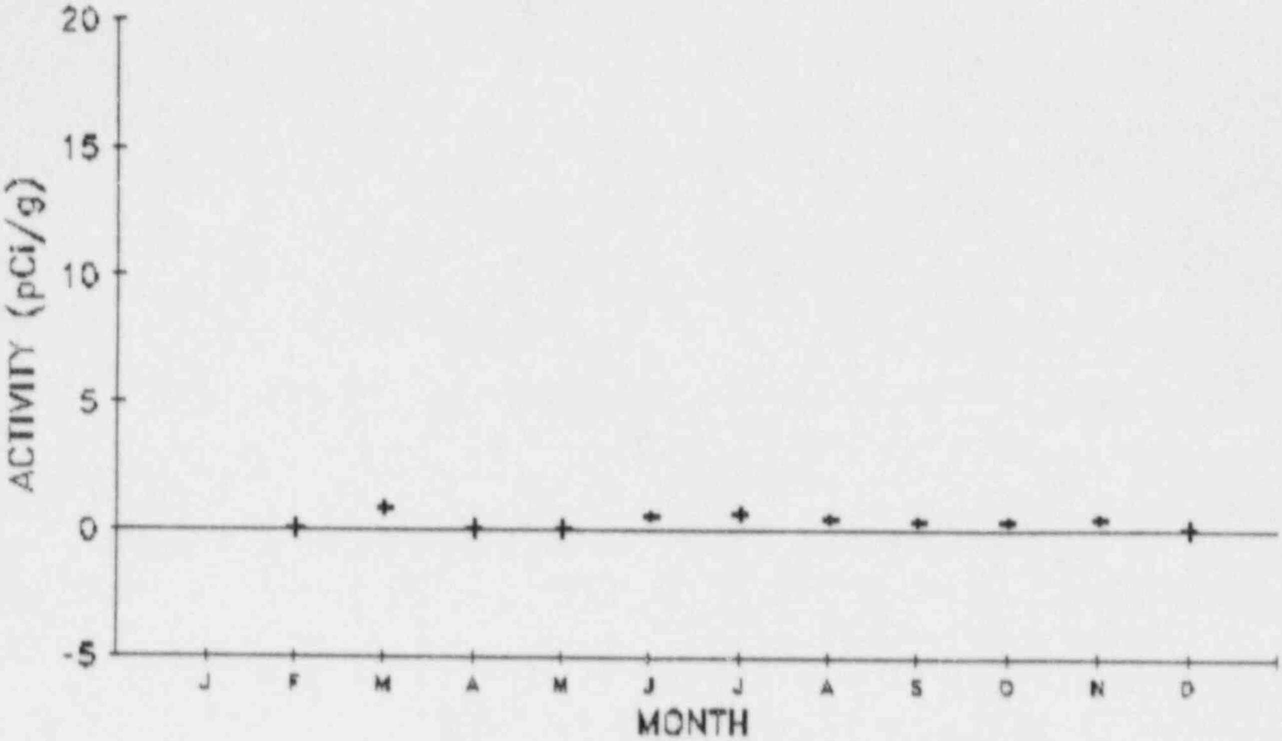


Figure 23
MONTHLY GROSS ALPHA ACTIVITY
FISH - LOCATION C
1987



MONTHLY GROSS BETA ACTIVITY
FISH - LOCATION C
1987

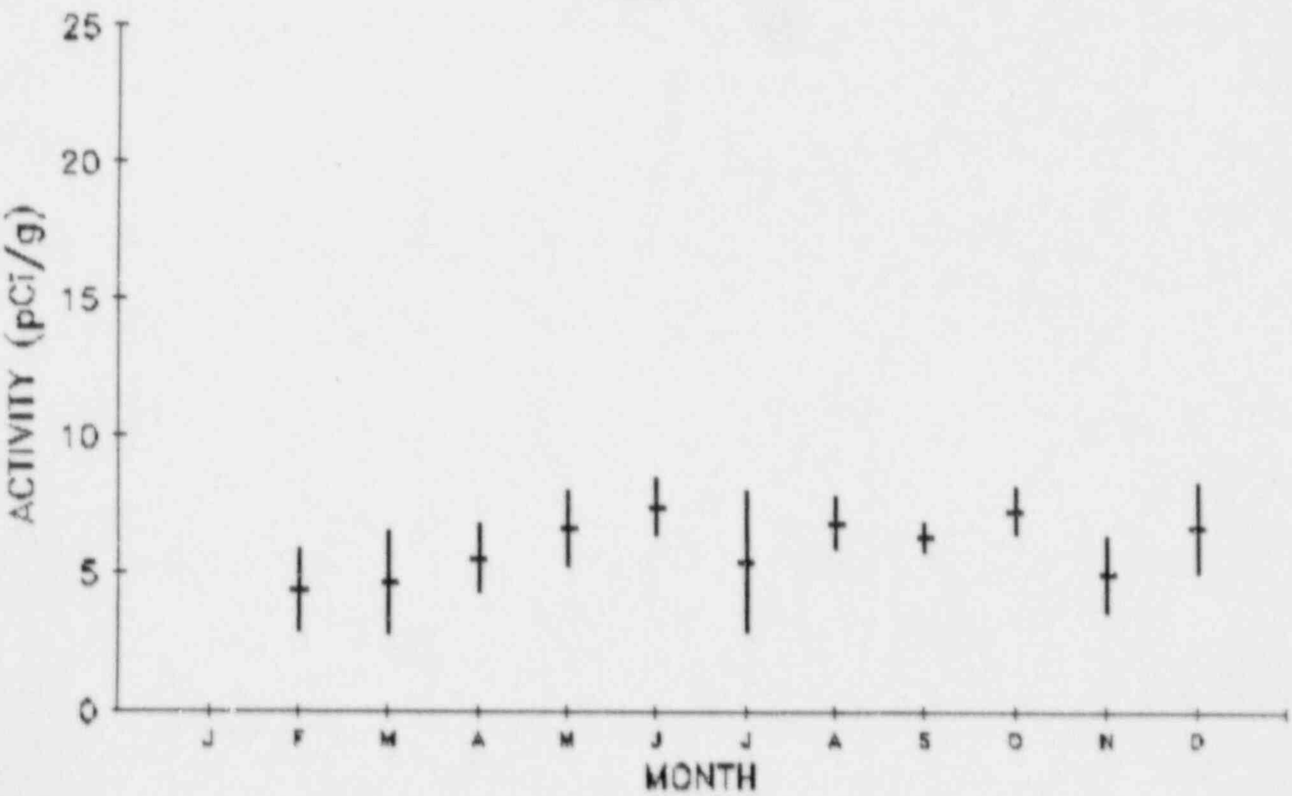
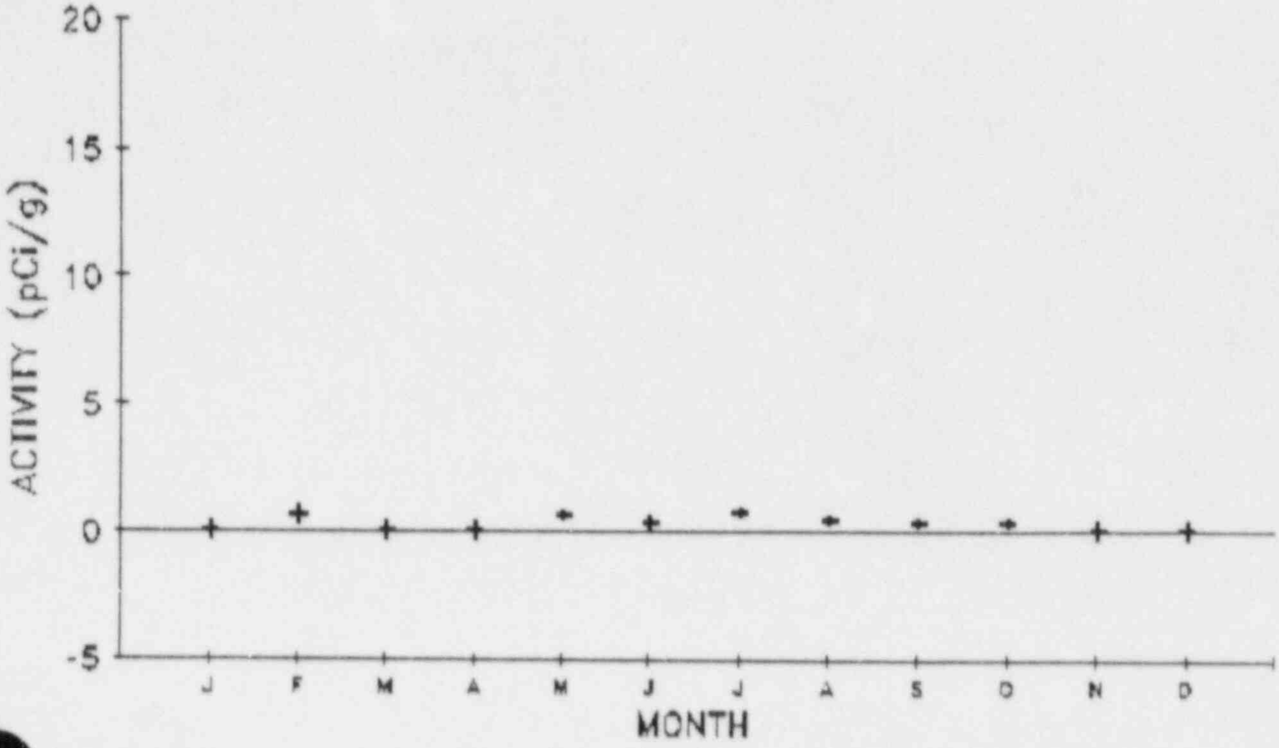
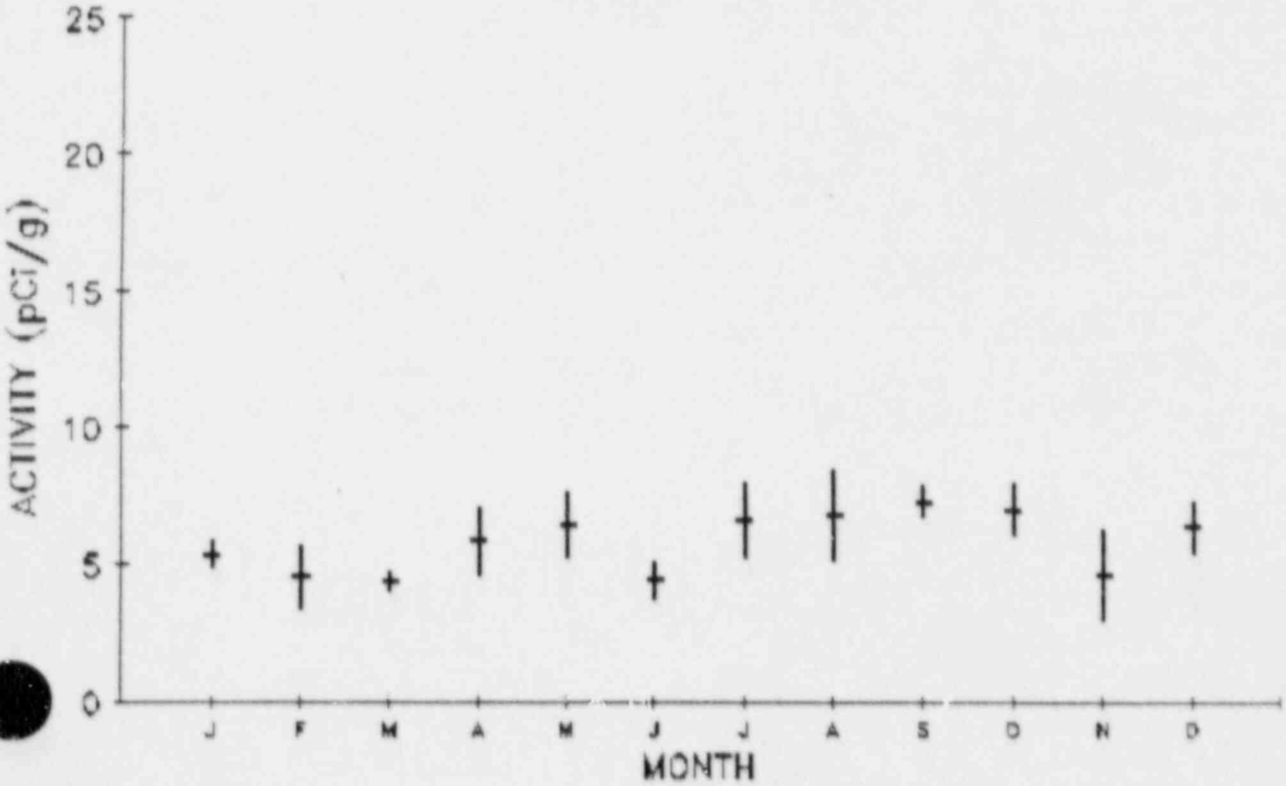


Figure 24
MONTHLY GROSS ALPHA ACTIVITY
FISH - LOCATION D
1987



MONTHLY GROSS BETA ACTIVITY
FISH - LOCATION D
1987



3.7 Milk

During 1987, Milk samples were collected from two locations, the Green Farm (M-1), and the Schneider Farm. The Schneider Farm provided cow milk (M-5A) and goat milk (M-5B). Analyses for Iodine-131, elemental Calcium, Strontium-89, Strontium-90 and Gamma emitting nuclides were performed on all milk samples. No cow milk samples were collected from the Schneider Farm during January and no goat milk samples were collected from this farm during January, February, November and December, because the cows and goats were dry.

Iodine-131 was detected in one milk sample collected during 1987. Activity of 1.0 ± 0.5 pCi/l (collected 05/28/87) was detected at the Green Farm.

Strontium-90 was detected in three milk samples during 1987. The Schneider cow milk of 03/08/87 indicated 2.4 ± 0.7 pCi/l and the sample of 10/11/87 indicated 4.2 ± 0.5 pCi/l. One goat milk from the Schneider farm indicated 3.2 ± 0.9 pCi/l (10/12/87). No Strontium-89 was detected in the milk samples.

Elemental Calcium ranged from 740 mg/l to 1720 mg/l.

No gamma emitting nuclides of interest were detected in any of the milk samples collected during 1987.

3.8 Vegetation

Vegetation samples were collected during the second, third and fourth quarters of 1987 from three locations. Samples were analyzed for Gross Alpha, Gross Beta, Iodine-131 and Gamma-emitting nuclides.

Gross Alpha activity was detected in twenty-one of the vegetation samples. Levels of Gross Alpha activity ranged from less than 0.3 pCi/g to 2.6±0.3 pCi/g (Lettuce collected from Becker Farm 06/15/87). The 1987 mean Gross Alpha activity was 1.1±0.7 pCi/g. Gross Beta activity ranged from 1.1±0.1 to 27.4±0.3 pCi/g (Lettuce collected from Becker Farm 06/15/87). The mean Gross Beta activity of the vegetation samples collected during 1987 was 14.1±5.7 pCi/g.

Iodine-131 was not detected in any vegetation samples collected during 1987.

No gamma emitting nuclides of interest were observed in the vegetation samples collected during 1987.

3.9 Soil

Soil samples were collected on 11/09/87 from eleven locations. Soil was analyzed for Gross Alpha, Gross Beta and Gamma emitting nuclides of interest.

Gross Alpha activity in the soil samples ranged from 2.6±0.3 pCi/g to 5.9±0.5 pCi/g with a 1987 mean of 3.8±0.9 pCi/g. Gross Beta activity ranged from 2.0±0.1 pCi/g to 3.5±0.5 pCi/g with a 1987 Mean Gross Beta activity of 2.7±0.5 pCi/g.

Cesium-137 was observed in all the 1987 soil samples. The range of Cesium-137 was from 0.71±0.19 pCi/g to 3.29±0.05 pCi/g. Manganese-54 was detected in two soil samples, CA-SOL-F6 (0.07±0.02 pCi/g) and CA-SOL-F8 (0.05±0.02 pCi/g). No other gamma emitting nuclides of interest were detected in the soil samples collected during 1987.

4.0 Annual Summary

Table VI, Environmental Radiological Monitoring Program Annual Summary, contains a condensed summary of all data for 1987.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri **Reporting Period:** 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean Name Distance Direction	Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Air Particulates (pCi/m^3)	Gross Beta (250)	0.003	0.021(199/199) 0.005-0.044	Primary Met. Tower 1.3 miles 78°	0.021(50/50) 0.010-0.038	0.023(51/51) 0.010-0.048	0
	Gamma Spec (20) Beryllium-7	0.01	0.045(16/16) 0.009-0.230	O & CC Junction 1.9 mile 349°	0.071(4/4) 0.009-0.230	0.045(4/4) 0.013-0.098	0
	Strontium-90 (20)	0.002	0.003(1/16) 0.003	County Road 448 0.9 miles 24°	0.003(1/4) 0.003	<LLD	0
	Strontium-89 (20)	0.002	<LLD	----	----	<LLD	0
Airborne Radioiodine (pCi/m^3)	Iodine-131 (250)	0.006	0.010(2/199) 0.009-0.010	Reform 1.7 miles 338°	0.010(1/49) 0.010	<LLD	0

*LLD - See Section 6.0 First Quarter Report.

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

TAB[illegible] (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri **Reporting Period:** 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean Name Distance Direction	Location with Highest Annual Mean Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Well Water (pCi/l)	Gross Alpha (36)	2.0	3.1(22/36) 2.0-5.6	Holzhouser Store 5.1 miles 135°	3.3(6/12) 2.0-4.0	N/A	0
	Gross Beta (36)	3.0 *	7.6(27/36) 3.0-14.7	Onsite Well 1.0 miles 158°	9.3(12/12) 3.3-14.7	N/A	0
	Tritium (36)	500	< LLD	----	----	N/A	0
	Strontium-89 (36)	1.5	< LLD	----	----	N/A	0
	Strontium-90 (36)	1.0	< LLD	----	----	N/A	0
	Gamma Spec (36)	*	< LLD	----	----	N/A	0

*LLD - See Section 6.0 First Quarter Report.

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

TABLE VI (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri **Reporting Period:** 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean Name Distance Direction	Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Surface Water (pCi/l)	Gross Alpha (36)	2.0	3.6(12/24) 2.0-7.2	Downstream 5.2 miles 133°	3.9(4/12) 3.2-4.7	3.5(8/12) 2.0-4.8	0
	Gross Beta (36)	3.0	7.6(22/24) 3.0-18.9	St. Louis Intake 68 miles 90°	7.9(12/12) 3.0-18.9	7.9(11/12) 4.3-16.2	0
	Tritium (36)	500	< LLD	----	----	< LLD	0
	Strontium-89 (36)	1.5	< LLD	----	----	< LLD	0
	Strontium-90 (36)	1.0	< LLD	----	----	2.4(1/12) 2.4	0
	Gamma Spec (36)	*	< LLD	----	----	< LLD	0

*LLD - See Section 6.0 First Quarter Report.

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

TAB[illegible] (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri **Reporting Period:** 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean Name Distance Direction	Location with Highest Annual Mean Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Sediment[a] (pCi/g)	Gross Alpha (36)	0.3	1.8(21/24) 0.5-4.0	Downstream 53.0 miles 112°	1.9(11/12) 0.7-4.0	1.4(10/12) 0.6-2.3	0
	Gross Beta (36)	0.2	3.2(22/24) 0.4-12.4	Downstream 53.0 miles 112°	4.0(11/12) 0.6-12.4	2.5(10/12) 0.3-6.0	0
	Strontium-89 (36)	0.30	< LLD	----	----	< LLD	0
	Strontium-90 (36)	0.20	< LLD	----	----	< LLD	0
	Gamma Spec (36) Cesium-137	0.04	0.15(8/24) 0.05-0.43	Downstream 53.0 miles 112°	0.19(4/12) 0.09-0.43	0.05(2/12) 0.03-0.06	0
	Cobalt-58	0.02	0.25(1/24) 0.25	Downstream 5.1 miles 68°	0.25(1/12) 0.25	< LLD	0

[a]Includes Washload, Bedload and Bottom Sediments.

*LLD - See Section 6.0 First Quarter Report.

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri **Reporting Period:** 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean Name Distance Direction	Location with Highest Annual Mean Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Fish (pCi/g)	Gross Alpha (170)	0.3	0.4(43/115) 0.3-0.8	Downstream 5.1 miles 135°	0.4(24/55) 0.3-0.8	0.6(30/55) 0.3-1.2	0
	Gross Beta (170)	0.2	5.9(115/115) 2.2-8.6	Downstream 5.1 miles 135°	6.0(55/55) 2.2-8.6	6.0(55/55) 1.8-8.4	0
	Strontium-89 (170)	0.30	< LLD	----	----	< LLD	0
	Strontium-90 (170)	0.20	< LLD	----	----	< LLD	0
	Gamma Spec (170) Cesium-137	0.04	0.30(1/115) 0.30	Downstream 5.1 miles 135°	0.30(1/55) 0.30	0.17(1/55) 0.17	0

*LLD - See Section 6.0 First Quarter Report.

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

TAB[illegible] (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri **Reporting Period:** 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean Name Distance Direction	Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Milk (pCi/l)	Iodine-131 (49)	0.5	<LLD	----	----	1.0(1/18) 1.0	0
	Strontium-89 (49)	2.0	<LLD	----	----	<LLD	0
	Strontium-90 (49)	1.0	3.3(3/31) 2.4-4.2	Schneider Farm 3.1 miles 315°	3.3(3/31) 2.4-4.2	<LLD	0
	Gamma Spec (49)	*	<LLD	----	----	<LLD	0
Vegetation (pCi/g)	Gross Alpha (53)	0.3	1.1(15/40) 0.3-2.6	Becker Farm 1.8 miles 344°	1.4(5/15) 0.6-2.6	1.1(6/13) 0.4-2.0	0
	Gross Beta (53)	0.2	14.3(40/40) 1.1-27.4	Meehan Farm 1.8 miles 356°	14.6(25/25) 1.1-24.0	13.3(12/13) 5.7-24.3	0
	Gamma Spec (53) Iodine-131	0.03	<LLD	----	----	<LLD	0

***LLD - See Section 6.0 First Quarter Report.**

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

TABLE VI (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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

Location of Facility: Callaway County, Missouri   Reporting Period: 1987

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean: Name Distance Direction	Location with Highest Annual Mean: Mean (f) Range	Control Locations Mean (f) Range	Number of Nonroutine Reported Measurements
Soil (pCi/g)	Gross Alpha (11)	0.3	3.8(10/10) 2.6-5.9	Callaway Plant Forest - F9 1.45 miles 338°	5.9(1/1) 5.9	3.7(1/1) 3.7	0
	Gross Beta (11)	0.2	2.6(10/10) 2.0-3.5	Callaway Plant Forest - F2 1.64 miles 225°	3.5(1/1) 3.5	3.2(1/1) 3.2	0
	Gamma Spec (11) Cesium-137	0.04	1.7(10/10) 0.71-3.29	Callaway Plant Forest - F9 1.45 miles 338°	3.29(1/1) 3.29	0.97(1/1) 0.97	0
	Manganese-54	0.02	0.06(2/10) 0.05-0.07	Callaway Plant Forest - F6 1.72 miles 45°	0.07(1/1) 0.07	< LLD	0

*LLD - See Section 6.0 First Quarter Report.

Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parenthesis (f).

APPENDIX A

UNION ELECTRIC COMPANY

CALLAWAY PLANT

1987 LAND USE CENSUS

APPENDIX A

UNION ELECTRIC COMPANY

CALLAWAY PLANT

1987 LAND USE CENSUS

Prepared by Brian F. Wilkerson

Approved by Neil Slater

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 August, 1987 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 1986 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 1987 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 no changes in the nearest resident noted in the 1987 census.

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. Several changes were noted in the garden locations during the 1987 census. However, none of the changes noted resulted in changes to the current vegetable sampling locations.

TABLE 1

NEAREST MILKING ANIMALS WITHIN FIVE MILES OF THE CALLAWAY PLANT

1987

Meteorological Sector	Radial Mileage	Number of Cows	Number of Goats
NE	2.37	1	NONE
ENE	3.80	NONE	50*
ESE	2.28	19*	NONE
S	2.90	6*	NONE
SSW	2.60	12*	NONE
WSW	1.35	17*	NONE
WNW	2.60	6*	NONE
NW	2.43	12*	NONE

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

TABLE 2

NEAREST RESIDENCE WITHIN FIVE MILES OF THE CALLAWAY PLANT

1987

Meteorological Sector	Radial Mileage
N	1.76
NNE	2.00
NE	2.00
ENE	3.80
E	3.37
ESE	2.28
SE	2.38
SSE	2.58
S	2.64
SSW	2.60
SW	2.57
WSW	1.35
W	1.60
WNW	2.60
NW	2.13
NNW	1.78

TABLE 3

NEAREST GARDEN WITHIN FIVE MILES OF THE CALLAWAY PLANT

1987

Meteorological Sector	Radial Mileage
N	1.76
NNE	2.00
NE	2.00
ENE	3.80
E	3.80
ESE	2.28
SE	2.80
SSE	2.58
S	2.90
SSW	2.60
SW	2.57
WSW	1.35
W	1.60
WNW	2.60
NW	2.13
NNW	1.78

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT UNIT 1

RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM

QUARTERLY REPORT FOR

JANUARY, FEBRUARY AND MARCH 1987

SUBMITTED BY:

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

1925 ROSINA STREET

SANTA FE, NEW MEXICO

Copy No. 11

Prepared By: Bob Bates

Bob Bates, Contract Manager

Approved By:

James J. Mueller, President

CONTENTS

TABLES

FIGURES

Abstract

Controls for Environmental Pollution, Inc (CEP) has conducted a radiological environmental monitoring program (REMP) for Union Electric Company (UEC), Callaway Plant, Unit 1, since May 5, 1983. This quarterly report presents data for the months of January, February and March 1987.

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

Analytical results are presented and discussed along with other pertinent information. Possible trends and anomalous results, as interpreted by Controls for Environmental Pollution, Inc., are discussed.

1.0 Introduction

This report presents an analysis of the results of the Radiological Environmental Monitoring Program (REMP) conducted during the first quarter of 1987 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 radiological environmental monitoring program are as follows: 1) to establish baseline radiation levels in the environs prior to reactor operations; 2) to monitor potential critical pathways of radioeffluent to man; 3) to determine radiological impact on the environment caused by the operation of the Callaway Plant.

A number of techniques are being used to distinguish Callaway Plant effects from other sources during the operational phase, including application of established background levels. Operational radiation levels measured in the vicinity of the Callaway Plant are compared with the pre-operational measurements at each of the sampling locations. In addition, results of the monitoring program help to evaluate sources of elevated levels of radiation during reactor operation in the environment, e.g., atmospheric fallout or abnormal plant releases.

The Callaway Plant is located on a plateau approximately five miles north of the Missouri River in Callaway County, Missouri. The plant consists of one 1150 MWE pressurized water reactor, which achieved initial criticality on October 2, 1984.

2.0 Description of the Monitoring Program

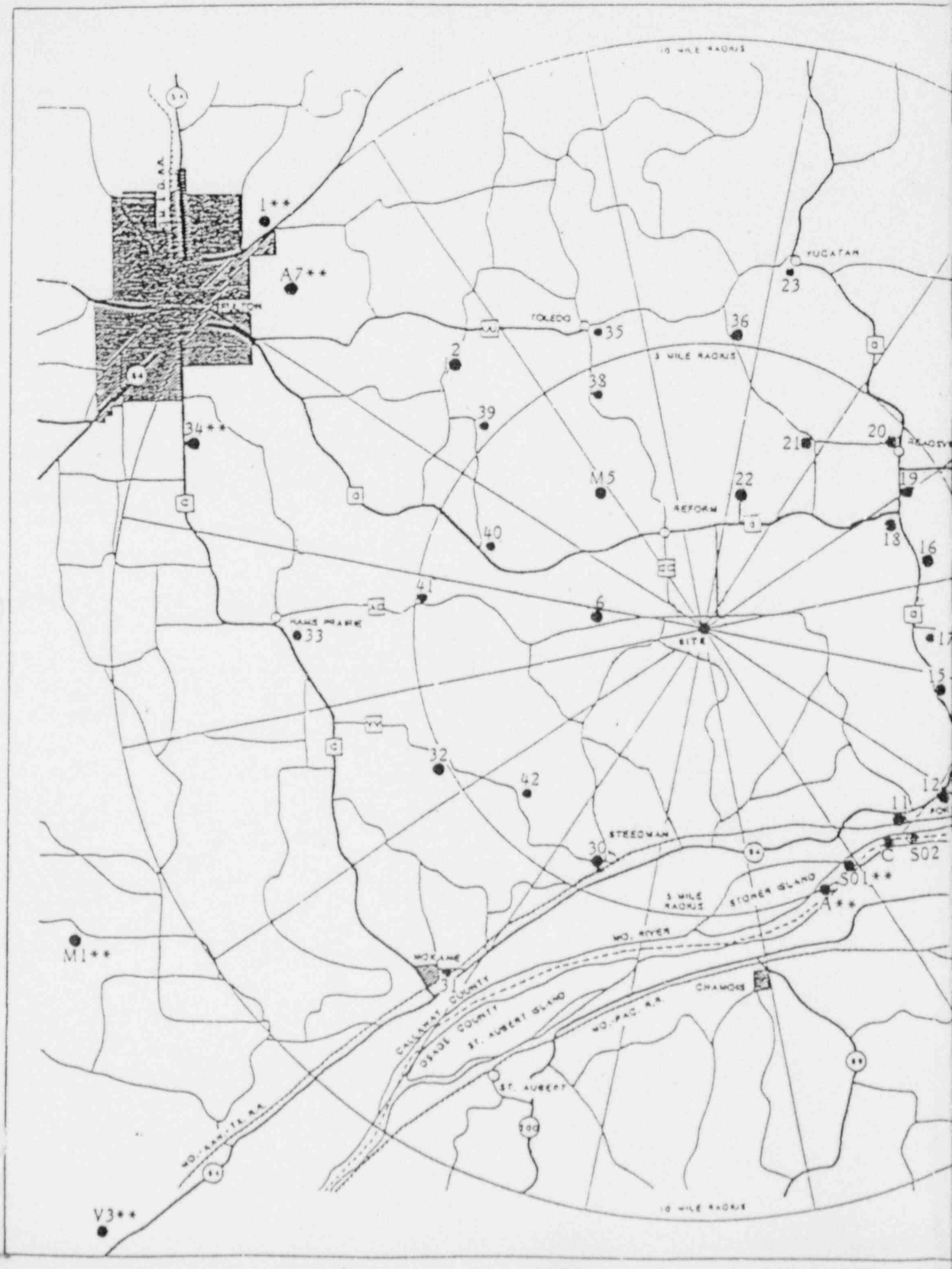
Union Electric Company has contracted with Controls for Environmental Pollution, Inc. starting May 1983, to determine the radiation levels existing in and around the Callaway Plant area.

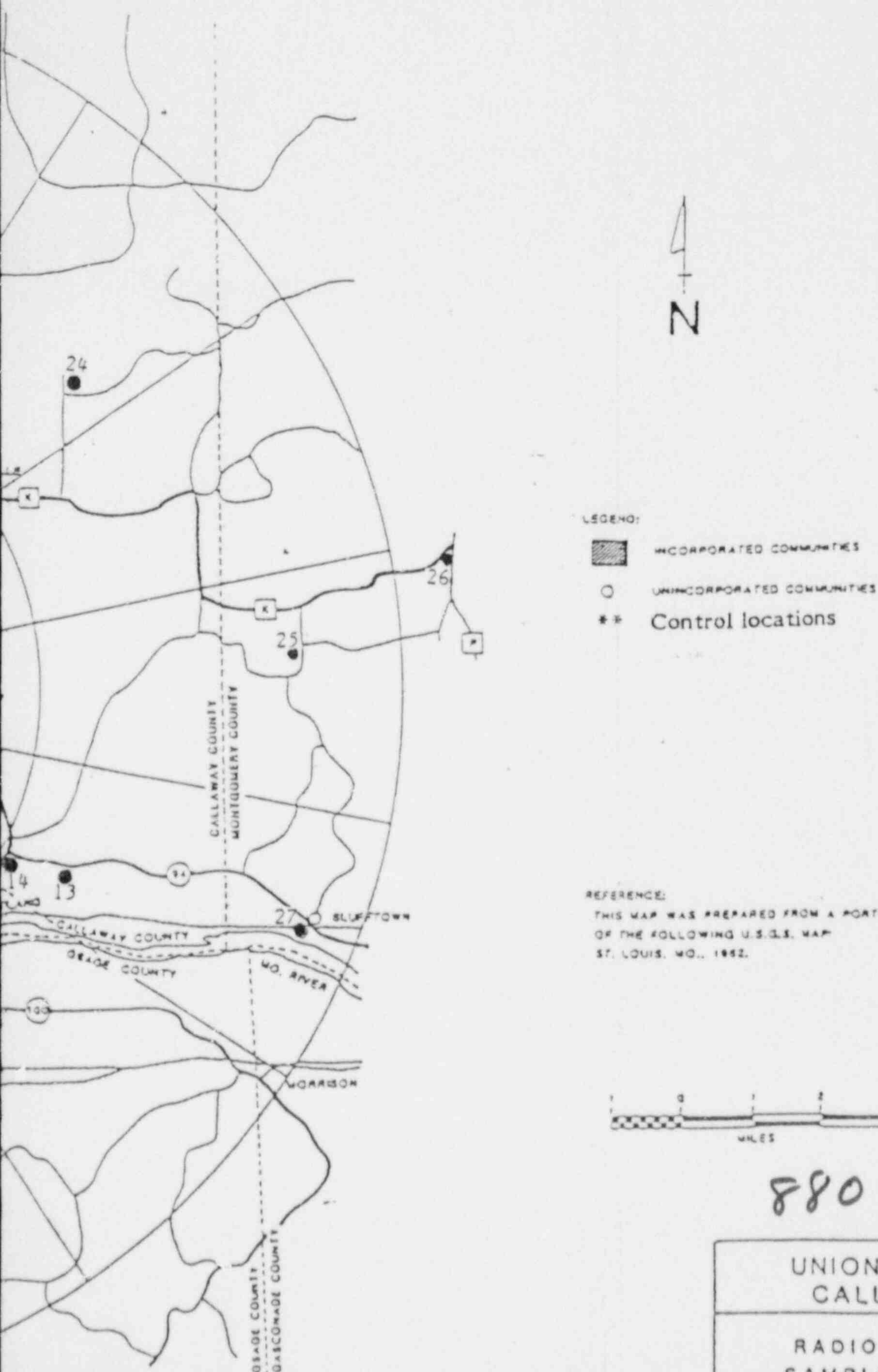
UEC personnel collected the samples and shipped them to CEP for analysis. The type of samples collected this quarter were: milk, surface water, well water, bottom sediment, bedload sediment, washload sediment, fish, airborne particulates, airborne radioiodine and direct radiation (TLD).

Locations of the monitoring sites are shown in Figures 1 and 2. Table I presents the monitoring sites and the respective samples collected. Sample collection frequency for each of the monitoring locations is depicted in Table II.

Meanings 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	Well Water


10 MILE RADIUS
1**
A7**
FULTON
TOLEDO
35
36
23
YUCATAN
2
3 MILE RADIUS
38
39
34**
20
21
M5
22
19
REFORM
40
18
16
41
6
HAMS PRAIRIE
33
SITE
17
15
32
42
12
11
STEEDMAN
30
C
S02
S01**
A**
5 MILE RADIUS
STONER ISLAND
M1**
MO. RIVER
MOKANE
31
CHAMOIS
CALLAWAY COUNTY
OSAGE COUNTY
ST. AUBERT ISLAND
MO. PAC. R.R.
ST. AUBERT
MO.-KAN.-TX. R.R.
V3**
10 MILE RADIUS



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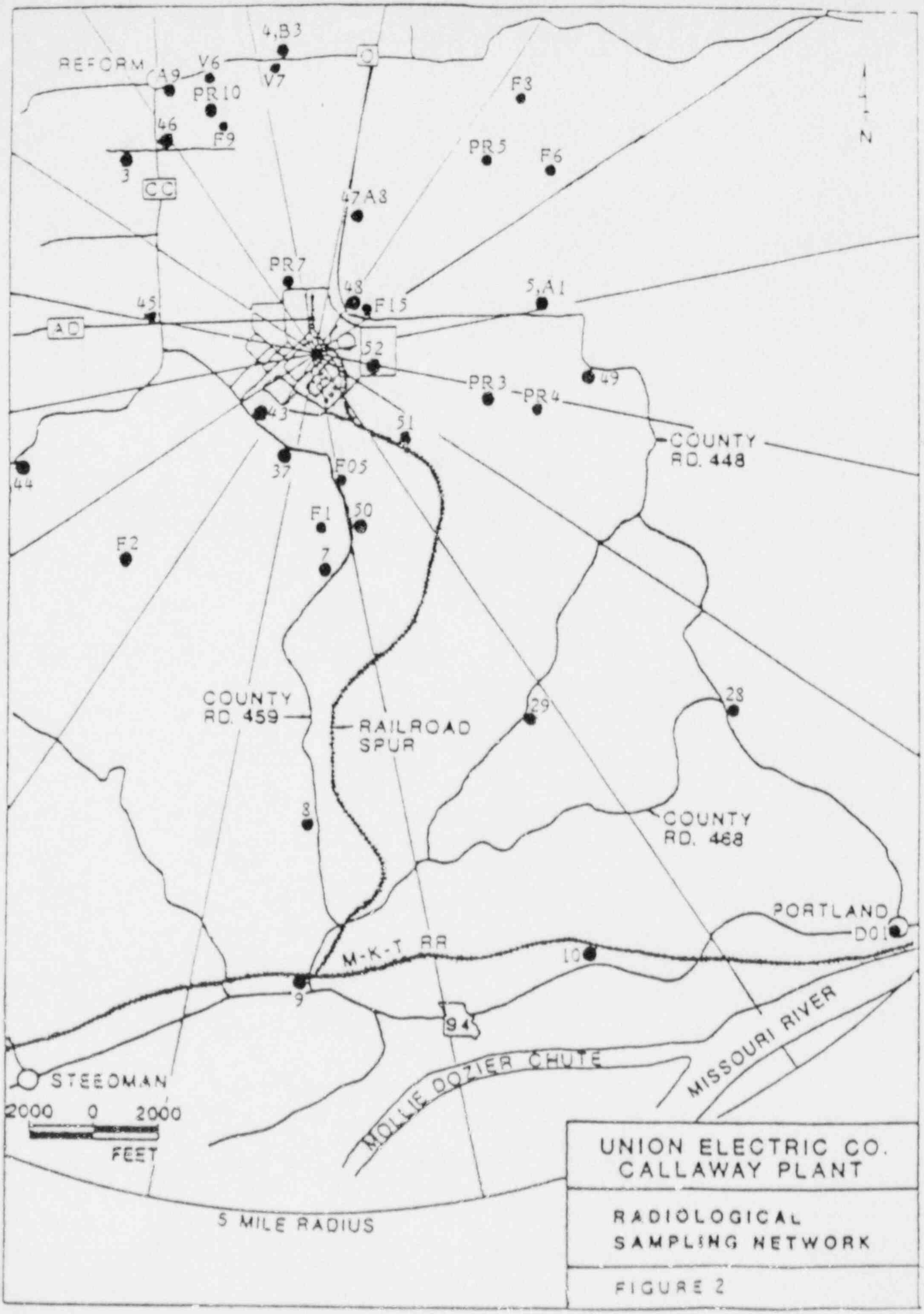
UNION ELECTRIC CO.
CALLAWAY PLANT

RADIOLOGICAL
SAMPLING NETWORK

FIGURE 1



UNION ELECTRIC CO.
CALLAWAY PLANT

RADIOLOGICAL SAMPLING NETWORK

FIGURE 2

TABLE I

SAMPLING LOCATIONS

Location Code	Description*	Sample Types
1**	10.6 mi NW, City Limits of Fulton on Hwy Z	IDM
2	6.6 mi NW, Smola Farm	IDM
3	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	IDM
4,B3	1.9 mi N, 0.6 miles East of the O and CC Junction	IDM,APT,AIO
5,A1	1.3 mi ENE, Primary Meteorological Tower	IDM,APT,AIO
6	1.8 mi W, Akers Farm	IDM
7	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	IDM
8	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	IDM
9	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	IDM
10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	IDM
11	5.0 mi SE, City of Portland	IDM
12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	IDM
13	5.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	IDM
14	5.2 mi ESE, SE Side of Intersection D and 94	IDM
15	4.2 mi ESE, Lamb Farm	IDM
16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	IDM
17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	IDM
18	3.8 mi ENE, 0.4 miles South of the D and O Junction	IDM

TABLE I (Cont.)
SAMPLING LOCATIONS

Location Code	Description*	Sample Types
19	4.2 mi NE, Rivera Farm	IDM
20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630 (city of Readsville)	IDM
21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	IDM
22	2.5 mi NNE, Lost Canyon Lakes	IDM
23	6.7 mi NNE, City of Yucatan	IDM
24	7.0 mi NE, Bahr Bros. Farm	IDM
25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	IDM
26	12.1 mi E, Town of Americus	IDM
27	9.5 mi ESE, Town of Bluffton	IDM
28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	IDM
29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	IDM
30	4.5 mi SSW, City of Steedman	IDM
31	7.6 mi SW, City of Mokane	IDM
32	5.1 mi WSW, D. Bartley Farm	IDM
33	7.3 mi W, City of Hams Prairie	IDM
34**	9.5 mi WNW, 2.5 miles South of O and C Junction	IDM
35	5.8 mi NNW, City of Toledo	IDM
36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	IDM
37	0.5 mi SSW, Piezometer M8 and M6	IDM

TABLE I (Cont.)

SAMPLING LOCATIONS

Location Code	Description*	Sample Types
38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	IDM
39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	IDM
40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	IDM
41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	IDM
42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	IDM
43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	IDM
44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	IDM
45	0.9 mi WNW, NW Side of Intersection CC and AD	IDM
46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	IDM
47	0.9 mi NNE, County Road 448, 0.9 mile south of Hwy O	IDM
48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 448)	IDM
49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	IDM
50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	IDM
51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	IDM
52	0.3 mi ESE, Light Pole near the East Plant Security Fence	IDM

TABLE I (Cont.)

SAMPLING LOCATIONS

Location Code	Description*	Sample Types
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	1.7 mi NNW, Community of Reform	APT,AIO
D01	5.1 mi SE, Holzhouser Grocery Store/Tavern (Portland, MO)	WWA
F05	1.0 mi SSE, Onsite Groundwater Monitoring Well	WWA
F15	5.5 mi NE, Onsite Groundwater Monitoring Well	WWA
M1**	12.3 mi WSW, Green's Farm	MLK
M5	3.1 mi NW, Schnider Farm	MLK
V3**	15.0 mi SW, Beazley Farm	FPL,SOL
V6	1.8 mi NNW, Becker Farm	FPL
V7	1.8 mi N, Meehan	FPL
A**	4.9 mi SSE, 0.6 River Miles Upstream of Discharge North Bank	AQS,AQF
C	5.1 mi SE, 1.0 River Miles Downstream of Discharge North Bank	AQS,AQF
D	53.0 mi ESE, 59.5 River Miles Downstream of Discharge South Bank	AQS,AQF
S01**	4.8 mi SE, 84 feet Upstream of Discharge North Bank	SWA
S02	5.2 mi SE, 1.1 River Miles Downstream of Discharge North Bank	SWA
S03	68 mi E, City of St. Louis Water Intake	SWA

TABLE I (Cont.)
SAMPLING LOCATIONS

Location Code	Description*	Sample Types
F1	0.98 mi S, Callaway Plant Forest Ecology Plot F1	SOL
F2	1.64 mi SW, Callaway Plant Forest Ecology Plot F2	SOL
F6	1.72 mi NE, Callaway Plant Forest Ecology Plot F6	SOL
F8	1.50 mi NE, Callaway Plant Forest Ecology Plot F8	SOL
F9	1.45 mi NNW, Callaway Plant Forest Ecology Plot F9	SOL
PR3	1.02 mi ESE, Callaway Plant Prairie Ecology Plot PR3	SOL
PR4	1.34 mi ESE, Callaway Plant Prairie Ecology Plot PR4	SOL
PR5	1.89 mi NE, Callaway Plant Prairie Ecology Plot PR5	SOL
PR7	0.45 mi NNW, Callaway Plant Prairie Ecology Plot PR7	SOL
PR10	1.55 mi NNW, Callaway Plant Prairie Ecology Plot PR10	SOL

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

TABLE II

COLLECTION SCHEDULE

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

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

TABLE II (Cont.)

COLLECTION SCHEDULE

Collection Site	Air Particulates	Air Radioiodine	Well Water	Surface Water	Sediment	Fish	Miik	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					Q	M			
C, 1.0 River miles Downstream of Discharge North Bank					Q	M			
D, 59.5 River miles Downstream of Discharge South Bank					Q	M			
S01, 84 feet Upstream of Discharge North Bank				M					
S02, 1.1 River miles Downstream of Discharge North Bank				M					
S03, City of St. Louis Water Intake (grab)				M					
F1, Callaway Plant Forest Ecology Plot F1									A
F2, Callaway Plant Forest Ecology Plot F2									A

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

TABLE II (Cont.)

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 Plot 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

3.0 Analytical Procedures

The analytical procedures described below are those routinely used by CEP to analyze samples.

3.1 Airborne

3.1.1 Gross Alpha and Gross Beta

The glass-fiber filter, type A/E (99 percent removal efficiency at 1 micron particulate), is placed into a two-inch stainless steel planchet and counted for Gross Alpha and Gross Beta radioactivity using an internal gas flow, ten channel low-level planchet counting system (Berthold LB770).

3.1.2 Gamma Spectrometry

The filters are composited according to station and sealed in a small, plastic Marinelli beaker. The filters are then counted using either a Ge(Li) or intrinsic germanium detector which is coupled to a computer based, multi-channel analyzer (Nuclear Data). The resulting spectrum is then analyzed by the computer and specific nuclides, if present, identified and quantized.

3.1.3 Strontium-89 and Strontium-90

The composited filters are dissolved in acid and brought to a known volume. Strontium carrier is added and the solution is evaporated to dryness. The resulting residue is taken up in dilute acid. Yttrium carrier is added and placed into ingrowth for 14 days. After the ingrowth period has been established it is back extracted into an aqueous phase, precipitated as the oxalate, counted in a low background proportional counter (Berthold LB770), and calculated as Strontium-90 activity. The aqueous phase is evaporated to a low volume, precipitated with fuming nitric acid, redissolved in water, made basic with dilute ammonium hydroxide and precipitated as the oxalate. The dried precipitate is counted in a low background proportional counter (Berthold LB770) and the Strontium-89 activity is determined by subtracting the previously measured Strontium-90 activity and its corresponding Yttrium-90 ingrowth from the measured gross Strontium activity.

3.1.4 Iodine-131

3.1.4.1 Alkaline Leach Method

The radioiodine is stripped off activated charcoal by reduction using concentrated ammonium hydroxide (NH_4OH) and hydrogen peroxide (H_2O_2). The charcoal is then filtered and the remaining solution is acidified with nitric acid (HNO_3) and extracted with carbon tetrachloride (CCl_4) to remove the Iodine. It is then back extracted using 0.2% hydrazine solution, which supplies further purification and an aqueous media for precipitation. It is then precipitated with silver nitrate ($AgNO_3$) and filtered on a tared glass-fiber filter as silver iodide (AgI). The dried precipitate is weighed for recovery and counted for Iodine-131 in a thin window gas flow proportional counter (Berthold LB770) having a forty-one percent efficiency for Iodine-131 precipitated as silver iodide (AgI).

3.1.4.2 Gamma Spectrometry Method

The charcoal canister is placed directly on an intrinsic germanium detector and Iodine-131 activity determined using Method 3.1.2.

3.1.5 Direct Radiation

Direct radiation measurements were taken using Thermoluminescent

Dosimeters (TLD's). Each dosimeter consists of a Teflon wafer impregnated with twenty-five percent $CaSO_4$:Dy phosphor. Dosimeters are annealed in an oven prior to use and are inserted into black polyethylene pouches. The $CaSO_4$:Dy phosphor pouches are placed in rectangular holders which contain copper shielding to filter out low energy radiation. After exposure in the environment, the dosimeters are read in a Teledyne Isotopes model 8300 TLD reader.

3.2 Vegetation

3.2.1 Iodine-131

A suitable aliquot of wet (as received) sample is placed into a small, plastic Marinelli beaker and Iodine-131 activity determined using Method 3.1.2.

3.2.2 Gross Alpha and Gross Beta

A suitable aliquot of prepared sample is muffled, dissolved in dilute acid and transferred to a tared two-inch stainless steel planchet. The planchet is counted for Gross Alpha and Gross Beta activity using Method 3.1.1.

3.2.3 Gamma Spectrometry

A suitable aliquot of prepared sample is placed into a small, plastic Marinelli beaker and specific nuclides, if present, identified and quantized using Method 3.1.2.

3.3 Milk

3.3.1 Iodine-131

Two liters of milk containing standardized Iodine carrier are stirred with Amberlite IRA-400 anion exchange resin for one hour. The Iodine is stripped from the resin with sodium perchlorate ($NaClO_4$) acidified with nitric acid, precipitated with silver nitrate ($AgNO_3$) and filtered on a tared glass-fiber filter. The dried precipitate is weighed for percent recovery and counted for Iodine-131 in a thin window, gas flow, proportional counter ((Berthold LB770).

3.3.2 Strontium-89 and Strontium-90

Two liters of milk containing Strontium carrier is stirred with Dowex 50WX8 cation exchange resin at a pH of 6 for thirty minutes. All nuclides are stripped from the resin with strong acid. Method 3.1.3 is then followed beginning at the ingrowth period.

3.3.3 Gamma Spectrometry

A one liter aliquot of milk is placed in a plastic Marinelli beaker and specific nuclides identified and quantized using Method 3.1.2.

3.3.4 Elemental Calcium

One milliliter of milk is diluted to 100 milliliters and acidified with nitric acid. The diluted sample is analyzed for Calcium using Instruments S.A. Jy-38 Sequential Plasma Spectrometer.

3.4 Surface and Well Water

3.4.1 Gross Alpha and Gross Beta

A suitable aliquot of water is evaporated to dryness and transferred to a tared two-inch stainless steel planchet. The planchet is counted for Gross Alpha and Gross Beta activity as in Method 3.1.1.

3.4.2 Tritium

Three milliliters of water sample are mixed with liquid scintillation cocktail. This gives a mixture of twenty-three percent sample in a clear gel type cocktail. The mixture gives a Tritium counting efficiency of approximately thirty percent. The counting system used is a Beckman LS 5801 Liquid Scintillation System.

3.4.3 Strontium-89 and Strontium-90

A one liter aliquot of water, containing Strontium carrier, is evaporated to dryness and the residue taken up in dilute acid. Method 3.1.3 is then followed beginning at the ingrowth period.

3.4.4 Gamma Spectrometry

A one liter aliquot of the water sample is placed in a plastic Marinelli beaker and specific nuclides identified and quantized using Method 3.1.2.

3.5 Fish

3.5.1 Gross Alpha and Gross Beta

Refer to Method 3.2.2.

3.5.2 Strontium-89 and Strontium-90

A suitable aliquot of prepared sample is muffled, dissolved in acid, transferred to a 100 ml beaker and Strontium-Yttrium carriers added. The sample is then wet ashed with nitric acid and hydrogen peroxide, taken to dryness and up to volume in dilute acid. Method 3.1.3 is then followed beginning at the ingrowth period.

3.5.3 Gamma Spectrometry

A suitable aliquot of prepared sample is placed in a plastic Marinelli beaker and specific nuclides identified and quantized using Method 3.1.2.

3.6 Bottom, Bedload and Washload Sediment

3.6.1 Gross Alpha and Gross Beta

A suitable aliquot of prepared sample is muffled, dissolved in acid, nitrated, evaporated and transferred to a tared two-inch stainless steel planchet. The planchet is counted for Gross Alpha and Gross Beta activity as in Method 3.1.1.

3.6.2 Strontium-89 and Strontium-90

Refer to Method 3.5.2.

3.6.3 Gamma Spectrometry

Refer to Method 3.5.3.

4.0 Sample Preparation Methods

4.1 Vegetation

1. Sample wet weight is recorded.
2. A known wet weight is placed in a plastic Marinelli beaker for Gamma Spectrometry.
3. Remaining sample is transferred to a drying pan and placed in an oven at 110°C.
4. The dry sample is weighed, ground to a fine powder and homogenized.
5. Specific aliquots of the sample are then taken for further analysis.

4.2 Bottom Sediment

1. Sample is transferred to a drying pan and placed in an oven at 110°C.
2. The dry sample is weighed, ground to a fine powder and homogenized.
3. Specific aliquots of the sample are then taken for analysis.

4.3 Bedload and Washload Sediment

1. Sample containers are allowed to stand undisturbed to allow suspended solids to settle.
2. Liquid portion of the samples is then decanted and saved.
3. Remaining residue is then transferred to a beaker and placed on a hot plate (low heat) to drive off remaining liquid.
4. The dry weight of the sediment is recorded.
5. Sediment is then placed in a plastic Marinelli beaker for Gamma Spectrometry.
6. After gamma counting, sample is ground to a fine powder and homogenized.
7. Specific aliquots of the sample are then taken for further analysis.

4.4 Fish

1. Each specimen is dissected and filleted and a wet weight recorded.
2. Filleted portions are transferred into drying pans according to species and placed in an oven at 110°C.
3. The dry sample is weighed, ground, blended and placed in a plastic container.
4. Specific aliquots of the sample are then taken for analysis.

5.0 Major Instrumentation

5.1 Nuclear Data Computer Based Gamma Spectrometer

The Gamma Spectrometer consists of a Nuclear Data Multichannel Analyzer equipped with two solid state Ge(Li) detectors and three intrinsic detectors having 2.8 KeV, 3.0 KeV, 2.07 KeV, 2.20 KeV and 1.85 KeV resolutions and respective efficiencies of 16.1%, 8.9%, 22.6%, 30.6% and 25.1%.

The Computer Based Nuclear Data Gamma Spectrometry System is used for all gamma analysis. The system uses Nuclear Data developed software (automatic isotope analysis) to search and identify, as well as quantize the peaks of interest.

5.2 Beckman Liquid Scintillation Counting Systems

A Beckman LS-5801 Liquid Scintillation Counter will be used for all Tritium determinations. The system background averages approximately 30 cpm with a counting efficiency of approximately sixty percent with an unquenched standard.

5.3 Sequential Plasma Spectroanalyzer

The JY-38P (Instruments SA) Sequential Plasma Spectroanalyzer is an emission spectrometer system designed for rapid, automatic sequential elemental analyses. It is comprised of three main sub-systems:

- The Inductively Coupled Plasma (ICP) Source
- The Scanning Monochromator
- The Data Acquistion and Control Package

5.4 Berthold-10-Channel Low-Level Planchet Counting System

The Berthold LB770 is capable of simultaneously counting 10 planchets for Gross Alpha and Gross Beta activities alternately with proportional gas flow detectors. The system has an average background count rate of less than 1 count per minute for Beta and less than 0.05 count per minute for Alpha. The instrument has an

Alpha efficiency of thirty-three percent for Plutonium-239 and Beta efficiencies of forty-five percent for Strontium-Yttrium-90, and forty-three percent for Cesium-137. Data from the system is input into to a computer to calculate activity as pCi/unit volume.

6.0 Isotopic Detection Limits and Activity Determinations

A discussion of the calculations used in determining detection limits and activity by Controls for Environmental Pollution, Inc., is found in Appendix B.

Table III gives the detection limits for radiochemical and chemical analytical methods. For each sample type, the table lists the detection level for each isotope analyzed.

Table IV gives the detection limits for Gamma Spectrometry. The table lists isotopes and respective detection levels for air particulate, vegetation, milk, water, sediment and fish.

The sample counting times and the aliquot size used for detection limit calculations and actual analyses are shown in Tables V and VI, respectively.

TABLE III

DETECTION LIMITS FOR RADIOCHEMICAL AND CHEMICAL PARAMETERS

Sample Type	Gross Alpha	Gross Beta	Strontium-89	Strontium-90	Tritium	Iodine-131	Calcium
Airborne Particulates		0.003 pCi/m^3	0.002 pCi/m^3	0.002 pCi/m^3			
Airborne Radioiodine						0.006 pCi/m^3*	
Vegetation	0.3 pCi/gm**	0.2 pCi/gm**				0.03 pCi/gm***	
Milk			2.0 pCi/l	1.0 pCi/l		0.5 pCi/l	0.1 mg/l
Surface and Well Water	2.0 pCi/l	3.0 pCi/l	1.5 pCi/l	1.0 pCi/l	500 pCi/l		
Bottom, Bedload, Washload Sediment and Soil	0.3 pCi/gm**	0.2 pCi/gm**	0.30 pCi/gm**	0.20 pCi/gm**			
Fish	0.3 pCi/gm**	0.2 pCi/gm**	0.30 pCi/gm**	0.20 pCi/gm**			

***Alkaline Leach Method**

****Dry Weight**

*****Wet Weight**

TABLE IV

DETECTION LIMITS BY GAMMA SPECTROMETRY

Energy meV	Isotope	Milk and Water pCi/liter	Fish, Vegetation and Sediments pCi/gm	Airborne Particulate pCi/m^3
0.122	Cobalt-57	1	0.002	0.001
0.134	Cerium-144	18	0.02	0.005
0.320	Chromium-51	18	0.004	0.010
0.364	Iodine-131	1	0.03	0.02
0.477	Beryllium-7	40	0.75	0.01
0.537	Ba/La-140	4	0.01	0.03
0.605	Cesium-134	10	0.03	0.010
0.622	Ru,Rh-106	10	0.04	0.001
0.662	Cesium-137	2	0.04	0.001
0.765	Zr, Nb-95	8	0.08	0.026
0.810	Cobalt-58	3	0.02	0.001
0.835	Manganese-54	2	0.02	0.001
1.095	Iron-59	3	0.02	0.006
1.115	Zinc-65	16	0.05	0.045
1.173	Cobalt-60	5	0.02	0.014

TABLE V

SAMPLE COUNTING TIMES

Sample Type	Gross Alpha	Gross Beta	Strontium-89	Strontium-90	Tritium	Iodine-131	Gamma Spec.
Airborne Particulate		100 min.	100 min.	100 min.			8 hours
Airborne Radioiodine						8 hours*	
Vegetation	100 min.	100 min.				8 hours	8 hours
Milk			100 min.	100 min.		100 min.	8 hours
Surface and Well Water	100 min.	100 min.	100 min.	100 min.	150 min.		8 hours
Bottom, Bedload, Washload Sediment and Soil	100 min.	100 min.	100 min.	100 min.			8 hours
Fish	100 min.	100 min.	100 min.	100 min.			8 hours

***Alkaline Leach Method counted for 100 minutes.**

TABLE VI

ALIQUOT USED FOR DETECTION LIMIT CALCULATIONS AND ACTUAL ANALYSIS

Sample Type	Gross Alpha and Beta	Strontium-89, Strontium-90	Tritium	Iodine-131	Calcium	Gamma Spec.
Airborne Particulate	265 m^3	265 m^3				265 m^3
Airborne Radioiodine				265 m^3		
Vegetation	10 g	10 g				200 g
Milk		2.0 l		2.0 l	1 ml	1.0 l
Water	1.0 l	1.0 l	3 ml			1.0 l
Sediment and Soil	10 g	10 g				200 g
Fish	10 g	10 g				200 g

7.0 Quality Control Program

CEP employs a multi-faceted Quality Control Program designed to maintain high performance of its laboratory. The overall objectives of the program are to:

1.) Verify that work procedures are adequate to meet specifications of UEC.

2.) Coordinate an in-house quality control program independent of external programs, to assure that CEP is operating at maximum efficiency.

Objectives are met by a variety of procedures that oversee areas of sample receipt and handling, analysis and data review. These procedures include standard operating procedures, internal lab spike analysis, blank analysis, reagent, carrier and nuclide standardization as well as participation in the U.S. Environmental Protection Agency's Interlaboratory Cross-check Program (See Appendix A for EPA Cross-check Results).

CEP's Quality Assurance Program is reviewed and revised (when necessary) on a regularly scheduled basis. This review assures that the program meets all current regulatory guidelines as well as maintaining the highest standards of quality assurance practices.

8.0 Data Interpretations and Conclusions

This section addresses interpretations and conclusions regarding all types of samples analyzed during this report period.

Analysis and review of data incorporates various techniques from historical comparison to statisical evaluation. Results which do not compare with the historical range are recalculated for verification. If the recalculation verifies the original result, the sample is reanalyzed if possible (i.e. sufficient sample volume or isotope half life). Results which are outliers with respect to historical comparison of previous data are considered out of baseline range or anomolous and will be so noted in the report.

8.1 Airborne Particulates and Radioiodine

Airborne particulate samples were collected from five (5) monitoring stations on a weekly basis from January 2, 1987 through April 2, 1987. The five airborne particulate stations were also collection sites for airborne radioiodine (see Table VIII).

All of the air particulate samples were analyzed for Gross Beta activity. Gamma Spectrometry, Strontium-90 and Strontium-89 analyses were performed on quarterly composites from each station.

The range of Gross Beta activity at each of the sampling locations follows.

Collection Location	Minimum (pCi/m^3)	Maximum (pCi/m^3)
Site A1	0.014 ± 0.002	0.038 ± 0.002
Site A7	0.014 ± 0.002	0.034 ± 0.002
Site A8	0.013 ± 0.002	0.029 ± 0.002
Site A9	0.015 ± 0.002	0.028 ± 0.002
Site B3	0.008 ± 0.001	0.032 ± 0.002

Table VII, Gross Beta in Airborne Particulates, shows that the Gross Beta activity ranged from a minimum at Site B3 of 0.008 ± 0.001 pCi/m^3, collected 02/12/87-02/19/87 to a maximum of 0.038 ± 0.002 pCi/m^3 at Site A1 during the collection period of 03/05/87-03/12/87.

The highest mean Gross Beta activity during the report period was observed at Site A1 with a mean activity of 0.025 ± 0.007 pCi/m^3.

Mean weekly Gross Beta activities ranged from a low of 0.015±0.001 pCi/m^3 during the collection period of 03/19/87-03/26/87 to a high of 0.028±0.009 pCi/m^3 during the collection period of 03/05/87-03/12/87.

Strontium-90 was detected in one airborne particulate coposite; Site A8 indicated Strontium-90 activity of 0.003±0.001 pCi/m3. All of the other airborne particulate composite analyses for Strontium-89 and Strontium-90 were less than the lower limit of detection (0.002 pCi/m^3).

Gamma spectralanalysis of the site composites indicated the following activities:

Collection Location	Isotope Identified	pCi/m^3
Site A1	Beryllium-7	0.016±0.003
Site A7	Beryllium-7	0.013±0.003
Site A8	Beryllium-7	0.023±0.002
Site A9	Beryllium-7	0.013±0.002
Site B3	Beryllium-7	0.009±0.002

No other gamma emitting isotopes of interest were detected in the quarterly site composites.

Results of the airborne radioiodine analyses may be found in Table VIII. Two samples exhibited levels of Iodine-131 greater than the detection limit of 0.006 pCi/m^3. Site B3, collected 01/30/87 (0.009±0.003 pCi/m^3) and Site A9 (0.010±0.004) collected 03/12/87.

Levels and fluctuations of activity in the air particulate and radiodine samples are consistent with the previously accumulated preoperational data.

TABLE VII

GROSS BETA IN AIRBORNE PARTICULATES (pCi/m^3)

FIRST QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3	Weekly Mean Gross Beta Activity ± Standard Deviation of the Mean
01/02/87 - 01/08/87	0.031±0.002	0.015±0.002	0.027±0.002	0.018±0.002	0.025±0.002	0.023±0.007
01/08/87 - 01/15/87	0.032±0.002	0.017±0.002	0.029±0.002	0.021±0.002	0.032±0.002	0.026±0.007
01/15/87 - 01/22/87	0.020±0.002	0.014±0.002	0.021±0.002	0.015±0.002	0.021±0.002	0.018±0.003
01/22/87 - 01/30/87	0.015±0.001	0.014±0.001	0.023±0.002	0.017±0.001	0.021±0.002	0.018±0.004
01/30/87 - 02/05/87	0.027±0.002	0.019±0.002	0.025±0.002	0.015±0.002	0.015±0.002	0.020±0.006
02/05/87 - 02/12/87	0.024±0.002	0.018±0.002	0.019±0.002	0.020±0.002	0.011±0.002	0.018±0.005
02/12/87 - 02/19/87	0.025±0.002	0.025±0.002	0.019±0.002	0.024±0.002	0.008±0.001	0.020±0.007
02/19/87 - 02/26/87	0.029±0.002	0.023±0.002	0.015±0.002	0.019±0.002	0.011±0.001	0.019±0.007
02/26/87 - 03/05/87	0.014±0.002	0.024±0.002	0.013±0.002	0.022±0.002	0.012±0.002	0.017±0.006
03/05/87 - 03/12/87	0.038±0.002	0.034±0.002	0.025±0.002	0.028±0.002	0.014±0.002	0.028±0.009
03/12/87 - 03/19/87	0.026±0.003	0.021±0.002	0.018±0.002	0.020±0.002	0.014±0.001	0.020±0.004
03/19/87 - 03/26/87	a	0.014±0.002	0.014±0.002	0.015±0.002	0.016±0.002	0.015±0.001
03/26/87 - 04/02/87	0.016±0.002	0.019±0.002	0.013±0.002	0.017±0.002	0.013±0.002	0.016±0.003
Mean Gross Beta Activity ± Standard Deviation of the Mean	0.025±0.007	0.020±0.006	0.020±0.005	0.019±0.004	0.016±0.007	

[a]Sampler malfunction.

TABLE VIII

AIRBORNE RADIOIODINE (pCi/l^{3})

FIRST QUARTER

1987

Collection Peroid	Site A1	Site A7	Site A8	Site A9	Site B3
01/02/87 - 01/08/87	*	*	*	*	*
01/08/87 - 01/15/87	*	*	*	*	*
01/15/87 - 01/22/87	*	*	*	*	*
01/22/87 - 01/30/87	*	*	*	*	0.009 ± 0.003**
01/30/87 - 02/05/87	*	*	*	*	*
02/05/87 - 02/12/87	*	*	*	*	*
02/12/87 - 02/19/87	*	*	*	*	*
02/19/87 - 02/26/87	*	*	*	*	*
02/26/87 - 03/05/87	*	*	*	*	*
03/05/87 - 03/12/87	*	*	*	0.010 ± 0.004**	*
03/12/87 - 03/19/87	*	*	*	*	*
03/19/87 - 03/26/87	a	*	*	*	*
03/26/87 - 04/02/87	*	*	*	*	*

*No Iodine-131 detected above 0.006 pCi/m^{3}

**Verified by t½ decay.

[a]Sampler malfunction.

8.2 <u>Thermoluminescent Dosimetry</u>

Thermoluminscent Dosimetry (TLD) was employed to determine direct radiation levels in and around the Callaway Site. Calcium Sulfate:Dy phosphor TLD chips in black polyethylene pouches were placed in plastic holders with areas 1 and 2 containing 0.022 inch copper shielding and areas 3 and 4 containing 0.093 inch copper shielding. The TLD's were placed at 52 locations and exchanged monthly.

Data appearing in Tables IX thru XI are the result of reading and averaging the four quadrants of each TLD chip. Transit control dosimeters were used to determine dosage received during shipment and were subtracted from the gross readings obtained for each monitoring site.

Exposure levels for all monitoring locations during January, February, and March are consistent with background levels detected during the preoperational monitoring program.

TABLE IX

THERMOLUMINESCENT DOSIMETRY

JANUARY 1987

12/30/86 - 01/28/87

Station Identification	Collection Location	Total Exposure (mRem $\pm$ 2σ)	Exposure Rate* (ur/hr)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	7.8 ± 0.4	11.2
CA-IDM-02	6.6 mi NW, Smola Farm	8.3 ± 0.2	11.9
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	8.1 ± 0.4	11.6
CA-IDM-04	1.9 mi N, 0.6 miles East of the O and CC Junction	7.3 ± 0.4	10.5
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	7.4 ± 0.4	10.6
CA-IDM-06	1.8 mi W, Akers Farm	8.2 ± 0.7	11.8
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	7.5 ± 0.4	10.8
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	8.3 ± 0.2	11.9
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	8.4 ± 0.4	12.1
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	6.8 ± 2.1	9.8
CA-IDM-11	5.0 mi SE, City of Portland	8.1 ± 0.5	11.6
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	8.0 ± 0.5	11.5
CA-IDM-13	5.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	7.3 ± 0.5	10.5
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	7.6 ± 0.5	10.9
CA-IDM-15	4.2 mi ESE, Lamb Farm	7.4 ± 0.5	10.6
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	7.0 ± 0.4	10.1

***Calculated from Total Exposure Result.**

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

JANUARY 1987

12/30/86 - 01/28/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	7.1 ± 0.5	10.2
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	7.6 ± 0.4	10.9
CA-IDM-19	4.2 mi NE, Rivera Farm	7.0 ± 0.6	10.1
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	7.9 ± 0.7	11.4
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	8.4 ± 0.3	12.1
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	8.3 ± 0.5	11.9
CA-IDM-23	6.7 mi NNE, City of Yucation	7.8 ± 0.4	11.2
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	6.5 ± 0.4	9.3
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	7.1 ± 0.5	10.2
CA-IDM-26	12.1 mi E, Town of Americus	5.8 ± 0.3	8.3
CA-iDM-27	9.5 mi ESE, Town of Bluffton	7.5 ± 0.3	10.8
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	7.0 ± 0.4	10.1
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	6.5 ± 0.4	9.3
CA-IDM-30	4.5 mi SSW, City of Steedman	6.7 ± 0.3	9.6
CA-IDM-31	7.6 mi SW, City of Mokane	5.9 ± 0.5	8.5
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	7.0 ± 0.4	10.1
CA-IDM-33	7.3 mi W, City of Hams Prairie	9.1 ± 1.2	13.1

*Calculated from Total Exposure Result.

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

JANUARY 1987

12/30/86 - 01/28/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	7.4 ± 0.4	10.6
CA-IDM-35	5.8 mi NNW, City of Toledo	7.4 ± 0.5	10.6
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	7.6 ± 0.3	10.9
CA-IDM-37	0.5 mi SSW, Piezometer M8 and M6	7.4 ± 0.4	10.6
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	6.4 ± 0.4	9.2
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	8.1 ± 0.4	11.6
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	8.4 ± 0.4	12.1
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	7.4 ± 0.3	10.6
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	6.5 ± 0.3	9.3
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	7.0 ± 0.3	10.1
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	7.5 ± 0.7	10.8
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	7.5 ± 0.4	10.8
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	7.1 ± 0.5	10.2
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile South of Hwy O	7.3 ± 0.4	10.5

***Calculated from Total Exposure Result.**

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

JANUARY 1987

12/30/86 - 01/28/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 335)	8.3 ± 0.6	11.9
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	6.9 ± 0.5	9.9
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	7.2 ± 0.8	10.3
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	7.0 ± 0.4	10.1
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	6.8 ± 0.5	9.8

*Calculated from Total Exposure Result.

TABLE X

THERMOLUMINESCENT DOSIMETRY

FEBRUARY 1987

01/27/87 - 02/25/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	7.9 ± 0.8	11.4
CA-IDM-02	6.6 mi NW, Smola Farm	7.5 ± 0.5	10.8
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	7.8 ± 0.6	11.2
CA-IDM-04	1.9 mi N, 0.6 miles East of the O and CC Junction	6.0 ± 0.7	8.6
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	7.6 ± 0.8	10.9
CA-IDM-06	1.8 mi W, Akers Farm	7.4 ± 0.4	10.6
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	8.8 ± 0.6	12.6
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	7.6 ± 0.6	10.9
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	7.6 ± 0.8	10.9
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	7.7 ± 0.7	11.1
CA-IDM-11	5.0 mi SE, City of Portland	7.7 ± 0.3	11.1
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	7.1 ± 0.6	10.2
CA-IDM-13	6.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	7.4 ± 0.3	10.6
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	7.2 ± 0.5	10.3
CA-IDM-15	4.2 mi ESE, Lamb Farm	7.4 ± 0.8	10.6
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	7.3 ± 0.5	10.5

*Calculated from Total Exposure Result.

TABLE X (Cont.)

THERMOLUMINESCENT DOSIMETRY

FEBRUARY 1987

01/27/87 - 02/25/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	6.6 ± 0.4	9.5
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	7.5 ± 0.6	10.8
CA-IDM-19	4.2 mi NE, Rivera Farm	7.8 ± 0.7	11.2
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	7.3 ± 0.5	10.5
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	7.7 ± 0.7	11.1
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	8.4 ± 0.4	12.1
CA-IDM-23	6.7 mi NNE, City of Yucation	7.6 ± 0.7	10.9
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	7.6 ± 0.6	10.9
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	9.0 ± 0.4	12.9
CA-IDM-26	12.1 mi E, Town of Americus	6.8 ± 0.3	9.8
CA-IDM-27	9.5 mi ESE, Town of Bluffton	8.6 ± 0.7	12.4
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	9.6 ± 0.6	13.8
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	7.5 ± 0.5	10.8
CA-IDM-30	4.5 mi SSW, City of Steedman	7.1 ± 0.6	10.2
CA-IDM-31	7.6 mi SW, City of Mokane	8.8 ± 0.7	12.6
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	8.0 ± 0.4	11.5
CA-IDM-33	7.3 mi W, City of Hams Prairie	6.3 ± 0.7	9.1

***Calculated from Total Exposure Result.**

TABLE X (Cont.)
THERMOLUMINESCENT DOSIMETRY
FEBRUARY 1987
01/27/87 - 02/25/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	7.1 ± 0.4	10.2
CA-IDM-35	5.8 mi NNW, City of Toledo	7.4 ± 0.3	10.6
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	8.7 ± 0.8	12.5
CA-IDM-37	0.5 mi SSW, Piezometer M8 and M6	8.1 ± 0.8	11.6
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	6.5 ± 0.7	9.3
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	9.3 ± 0.7	13.4
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	9.4 ± 1.9	13.5
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	7.8 ± 0.7	11.2
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	7.0 ± 0.4	10.1
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	8.1 ± 0.7	11.6
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	7.6 ± 0.5	10.9
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	7.8 ± 1.5	11.2
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	7.7 ± 1.0	11.1
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile south of Hwy O	6.6 ± 0.2	9.5

***Calculated from Total Exposure Result.**

TABLE X (Cont.)

THERMOLUMINESCENT DOSIMETRY

FEBRUARY 1987

01/27/87 - 02/25/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 448)	7.8 ± 0.3	11.2
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	7.2 ± 0.5	10.3
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	7.5 ± 0.7	10.8
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	7.0 ± 0.7	10.1
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	8.2 ± 0.6	11.8

*Calculated from Total Exposure Result.

TABLE XI

THERMOLUMINESCENT DOSIMETRY

MARCH 1987

02/24/87 - 04/02/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	8.5 ± 0.8	9.6
CA-IDM-02	6.6 mi NW, Smola Farm	9.9 ± 0.9	11.1
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	9.4 ± 0.8	10.6
CA-IDM-04	1.9 mi N, 0.6 miles East of the O and CC Junction	8.6 ± 0.8	9.7
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	8.4 ± 0.6	9.5
CA-IDM-06	1.8 mi W, Akers Farm	9.0 ± 0.6	10.1
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	8.9 ± 0.6	10.0
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	9.1 ± 0.7	10.2
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	9.6 ± 0.7	10.8
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	8.9 ± 0.6	10.0
CA-IDM-11	5.0 mi SE, City of Portland	9.5 ± 0.4	10.7
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	9.2 ± 0.5	10.4
CA-IDM-13	5.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	9.1 ± 0.8	10.2
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	9.3 ± 0.8	10.5
CA-IDM-15	4.2 mi ESE, Lamb Farm	9.5 ± 0.5	10.7
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	8.4 ± 1.3	9.5

***Calculated from Total Exposure Result.**

TABLE XI (Cont.)

THERMOLUMINESCENT DOSIMETRY

MARCH 1987

02/24/87 - 04/02/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	8.7 ± 0.5	9.8
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	9.6 ± 0.5	10.8
CA-IDM-19	4.2 mi NE, Rivera Farm	9.7 ± 0.7	10.9
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	10.2 ± 0.7	11.5
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	9.4 ± 0.7	10.6
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	9.2 ± 0.7	10.4
CA-IDM-23	6.7 mi NNE, City of Yucation	8.3 ± 0.6	9.3
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	11.6 ± 1.0	13.1
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	12.6 ± 1.9	14.2
CA-IDM-26	12.1 mi E, Town of Americus	10.1 ± 0.4	11.4
CA-IDM-27	9.5 mi ESE, Town of Bluffton	9.6 ± 0.7	10.8
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	8.9 ± 0.8	10.0
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	8.5 ± 0.6	9.6
CA-IDM-30	4.5 mi SSW, City of Steedman	9.0 ± 0.7	10.1
CA-IDM-31	7.6 mi SW, City of Mokane	9.0 ± 0.7	10.1
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	9.6 ± 0.5	10.8
CA-IDM-33	7.3 mi W, City of Hams Prairie	9.1 ± 0.5	10.2

*Calculated from Total Exposure Result.

TABLE XI (Cont.)

THERMOLUMINESCENT DOSIMETRY

MARCH 1987

02/24/87 - 04/02/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	8.8 ± 0.7	9.9
CA-IDM-35	5.8 mi NNW, City of Toledo	8.5 ± 0.5	9.6
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	10.2 ± 0.5	11.5
CA-IDM-37	0.5 mi SSW, Piezometer M8 and M6	9.9 ± 0.7	11.1
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	8.1 ± 0.4	9.1
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	9.7 ± 0.2	10.9
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	11.3 ± 1.2	12.7
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	9.1 ± 0.8	10.2
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	8.3 ± 0.3	9.3
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	9.0 ± 0.2	10.1
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	9.0 ± 1.2	10.1
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	9.1 ± 0.4	10.2
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	9.2 ± 0.4	10.4
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile south of Hwy O	8.7 ± 0.6	9.8

*Calculated from Total Exposure Result.

TABLE XI (Cont.)

THERMOLUMINESCENT DOSIMETRY

MARCH 1987

02/24/87 - 04/02/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 448)	9.3 ± 0.7	10.5
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	9.0 ± 0.5	10.1
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	9.3 ± 0.5	10.5
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	9.2 ± 0.6	10.4
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	9.3 ± 0.4	10.5

*Calculated from Total Exposure Result.

8.3 Well Water

Well water samples were collected monthly from three locations and analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-89, Strontium-90, and gamma-emitting nuclides.

Table XII presents the results of the radiochemical analyses. Gross Alpha activity ranged from less than 2.0 pCi/l to 2.8$\pm$2.0 pCi/l. Gross Beta levels varied from less than 3.0 pCi/l to 14.7$\pm$0.8 pCi/l. The Gross Alpha and Gross Beta levels were consistent with the preoperational data.

Results for Tritium analysis were below the lower limit of detection (500 pCi/l) for all samples.

All sample results for Strontium 89 and Strontium 90 analysis were below the lower limits of detection (1.5 pCi/l and 1.0 pCi/l respectively).

Gamma spectrometry showed no detectable levels of isotopes of interest. Results are summarized in Table XIII.

TABLE XII

WELL WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l)				
		Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-WWA-D01	01/13/87	< 2.0	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-D01	02/10/87	< 2.0	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-D01	03/10/87	< 2.0	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-F05	01/13/87	2.2 ± 1.3	3.3 ± 0.6	< 500	< 1.0	< 1.5
CA-WWA-F05	02/10/87	2.5 ± 0.9	14.7 ± 0.8*	< 500	< 1.0	< 1.5
CA-WWA-F05	03/10/87	< 2.0	10.7 ± 0.9*	< 500	< 1.0	< 1.5
CA-WWA-F15	01/13/87	< 2.0	5.7 ± 0.7	< 500	< 1.0	< 1.5
CA-WWA-F15	02/10/87	2.8 ± 2.0	7.2 ± 0.6*	< 500	< 1.0	< 1.5
CA-WWA-F15	03/10/87	< 2.0	4.4 ± 1.0	< 500	< 1.0	< 1.5

*Verified by reanalysis

TABLE XIII

WELL WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-WWA-D01	01/13/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	02/10/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	03/10/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	01/13/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	02/10/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	03/10/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	01/13/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	02/10/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	03/10/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.4 Surface Water

Surface water samples were collected from three locations on a monthly basis. During the first quarter, the upstream composite water sampler was inoperable due to equipment failures. Therefore, daily grab samples were taken and composited over the month. Samples were analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XIV and XV.

Gross Alpha and Gross Beta analyses of surface water samples showed a range of activities from less than 2.0 pCi/l to 3.2 ± 1.2 pCi/l and less than 3.0 pCi/l to 6.0 ± 0.7 pCi/l, respectively. The positive Gross Alpha and Gross Beta activities can be attributed to naturally occurring isotopes, such as Potassium-40, and are consistent with the preoperational data.

All Tritium data from surface water samples were below the lower limit of detection (500 pCi/l).

Strontium-90 was detected in one sample, CA-SWA-SO1 collected 01/13/87 with an activity of 2.4 ± 0.9 pCi/l. No other Strontium-89 or Strontium 90 was detected in any of the surface water samples collected this quarter.

Gamma Spectralanalysis of surface water samples showed no detectable activity from isotopes of interest.

TABLE XIV

SURFACE WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l) Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-SWA-S01	01/13/87	< 2.0	< 3.0	< 500	2.4 ± 0.9*	< 1.5
CA-SWA-S01	02/10/87	2.0 ± 1.1	4.3 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S01	03/10/87	< 2.0	6.0 ± 0.7	< 500	< 1.0	< 1.5
CA-SWA-S02	01/13/87	< 2.0	< 3.0	< 500	< 1.0	< 1.5
CA-SWA-S02	02/10/87	< 2.0	5.2 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S02	03/10/87	< 2.0	3.4 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S03	01/27/87	< 2.0	5.5 ± 0.7	< 500	< 1.0	< 1.5
CA-SWA-S03	02/17/87	3.2 ± 1.2	5.5 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S03	03/06/87	< 2.0	3.0 ± 0.6	< 500	< 1.0	< 1.5

*Verified by reanalysis

TABLE XV

SURFACE WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-SWA-S01	01/13/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	02/10/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	03/10/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	01/13/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	02/10/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	03/10/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	01/27/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	02/17/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	03/06/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.5 Sediment

Washload, Bedload and Bottom Sediment samples were collected in March from three locations along the Missouri River. Samples were analyzed for Gross Alpha, Gross Beta, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XVI thru XXI.

The following ranges of Gross Alpha and Gross Beta activities were observed in the washload, bedload and bottom sediments.

Sample Type	Gross Alpha Range pCi/g	Gross Beta Range pCi/g
Washload	1.4±0.5 - 3.3±0.9	5.6±0.3 - 8.0±0.7
Bedload	1.2±0.3 - 2.0±0.8	3.3±0.2 - 4.2±0.6
Bottom	1.0±0.2 - 1.6±0.2	1.4±0.1 - 2.6±0.1

The highest activity of Gross Alpha (3.3±0.9 pCi/g) was seen in the Washload sediment at sample location D (59.5 river miles downstream of discharge south bank). The highest activity of Gross Beta (8.0±0.7 pCi/g) was seen in the Washload sediment at sample location C (1.0 river miles downstream of discharge north bank).

No Strontium-89 or Strontium-90 was detected in the washload, bedload, or bottom sediments collected during the first quarter 1987.

Gamma Spectral analysis of the sediment samples collected during this report period are detailed in Tables XVII, XIX and XXI.

TABLE XVI

WASHLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	03/09/87	1.4 ± 0.5	5.6 ± 0.3	< 0.20	< 0.30
CA-AQS-C	03/09/87	3.1 ± 1.4	8.0 ± 0.7	< 0.20	< 0.30
CA-AQS-D	03/06/87	3.3 ± 0.9	7.5 ± 0.4	< 0.20	< 0.30

TABLE XVII

WASHLOAD SEDIMENT

GAMMA SPECTROMETRY

		pCi/g (dry)									
Sample Identification	Date Collected	Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	03/09/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	03/09/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	03/06/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XVIII
BEDLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	03/09/87	1.2 ± 0.3	3.3 ± 0.2	<0.20	<0.30
CA-AQS-C	03/09/87	2.0 ± 0.8	4.2 ± 0.6	<0.20	<0.30
CA-AQS-D	03/06/87	1.4 ± 0.3	4.0 ± 0.2	< 0.20	< 0.30

TABLE XIX

BEDLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	03/09/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	03/09/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	03/06/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XX
BOTTOM SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	03/09/87	1.6 ± 0.2	2.4 ± 0.1	< 0.20	< 0.30
CA-AQS-C	03/09/87	1.4 ± 0.2	2.6 ± 0.1	< 0.20	< 0.30
CA-AQS-D	03/06/87	1.0 ± 0.2	1.4 ± 0.1	< 0.20	< 0.30

TABLE XXI

BOTTOM SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	03/09/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	03/09/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	03/06/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.6 Fish

Due to adverse river conditions no fish samples were collected from locations A and C during January. Five (5) species of fish were collected at location D during January and from each of the three collection locations during the remainder of the quarter. Types of fish collected during this quarter were: goldeye, freshwater drum, blue catfish, flathead catfish, black buffalo, carp, river carpsucker, channel catfish, shorthead redhorse, smallmouth buffalo, and gizzard shad. Gross Alpha, Gross Beta, Strontium-90, Strontium-89 and Gamma Spectralanalysis were performed on all fish collected each month. Results are presented in Tables XXII thru XXVII. The activity levels are consistent with the preoperational data.

Gross Alpha activity was detected in eight samples during this quarter. Gross Beta activities ranged from a low of 1.8 ± 0.1 pCi/g (sample CA-AQF-A, River Carpsucker, collected 02/05/87) to a high of 7.3 ± 0.2 pCi/g (sample CA-AQF-C, Grass Carp, collected 03/09/87). Gross Alpha and Gross Beta activities seen in fish samples can be attributed to naturally occurring isotopes (e.g. Potassium-40).

All fish data for Strontium-90 and Strontium-89 were below the lower limits of detection of 0.20 pCi/g and 0.30 pCi/g, respectively.

Results of Gamma Spectralanalysis may be found in Tables XXIII, XXV, and XXVII.

TABLE XXII

FISH - CA-AQF-A

Sample Identification	Collection Date	Grams: Wet Weight	Grams: Dry Weight	Radiochemical Analysis pCi/g (dry): Gross Alpha	Gross Beta	Strontium-90	Strontium-89
River Carpsucker	02/05/87	1411	415	< 0.3	1.8 ± 0.1	< 0.20	< 0.30
Carp	02/05/87	927	266	< 0.3	2.9 ± 0.1	< 0.20	< 0.30
Shorthead Redhorse	02/05/87	1683	457	< 0.3	6.7 ± 0.2	< 0.20	< 0.30
Goldeye	02/05/87	654	197	0.8 ± 0.2	6.4 ± 0.2	< 0.20	< 0.30
Gizzard Shad	02/05/87	564	147	< 0.3	4.9 ± 0.1	< 0.20	< 0.30
Goldeye	03/09/87	1192	366	< 0.3	3.8 ± 0.1	< 0.20	< 0.30
Freshwater Drum	03/09/87	1183	312	0.7 ± 0.1*	6.7 ± 0.2	< 0.20	< 0.30
Gizzard Shad	03/09/87	1203	304	0.9 ± 0.2*	5.0 ± 0.1	< 0.20	< 0.30
Smallmouth Buffalo	03/09/87	1224	337	0.8 ± 0.2*	3.7 ± 0.1	< 0.20	< 0.30
Carp	03/09/87	591	117	1.1 ± 0.2*	6.2 ± 0.2	< 0.20	< 0.30

*Verified by reanalysis

TABLE XXIII

FISH - CA-AQF-A

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
River Carpsucker	02/05/87	**	**	**	**	**	**	**	**	**	**
Carp	02/05/87	**	**	**	**	**	**	**	**	**	**
Shorthead Redhorse	02/05/87	**	**	**	**	**	**	**	**	**	**
Goldeye	02/05/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	02/05/87	**	**	**	**	**	**	**	**	**	**
Goldeye	03/09/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	03/09/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	03/09/87	**	**	**	**	**	**	**	**	**	**
Smallmouth Buffalo	03/09/87	**	**	**	**	**	**	**	**	**	**
Carp	03/09/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXIV

FISH - CA-AQF-C

Sample Identification	Collection Date	Grams		Radiochemical Analysis pCi/g (dry)			
		Wet Weight	Dry Weight	Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Carp	02/05/87	1349	418	<0.3	4.3 ± 0.1	< 0.20	< 0.30
Goldeye	02/05/87	942	334	<0.3	2.2 ± 0.1	< 0.20	< 0.30
Black Buffalo	02/05/87	668	160	<0.3	4.3 ± 0.1	< 0.20	< 0.30
Gizzard Shad	02/05/87	1370	347	<0.3	5.8 ± 0.1	< 0.20	< 0.30
Shorthead Redhorse	02/05/87	902	244	<0.3	5.1 ± 0.1	< 0.20	< 0.30
Grass Carp	03/09/87	748	189	0.8 ± 0.2*	7.3 ± 0.2	< 0.20	< 0.30
Carp	03/09/87	785	201	<0.3	3.9 ± 0.1	< 0.20	< 0.30
Freshwater Drum	03/09/87	1005	253	<0.3	2.4 ± 0.1	< 0.20	< 0.30
Gizzard Shad	03/09/87	1169	292	<0.3	5.1 ± 0.1	< 0.20	< 0.30
River Carpsucker	03/09/87	1304	334	<0.3	4.5 ± 0.1	< 0.20	< 0.30

*Verified by reanalysis

TABLE XXV

FISH - CA-AQF-C

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Carp	02/05/87	**	**	**	**	**	**	**	**	**	**
Goldeye	02/05/87	**	**	**	**	**	**	**	**	**	**
Black Buffalo	02/05/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	02/05/87	**	**	**	**	**	**	**	**	**	**
Shorthead Redhorse	02/05/87	**	**	**	**	**	**	**	**	**	**
Grass Carp	03/09/87	**	**	**	**	**	**	**	**	**	**
Carp	03/09/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	03/09/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	03/09/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	03/09/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXVI

FISH - CA-AQF-D

Sample Identification	Collection Date	Grams		Radiochemical Analysis pCi/g (dry)			
		Wet Weight	Dry Weight	Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Smallmouth Buffalo	01/29/87	388	182	< 0.3	5.0 ± 0.1	< 0.20	< 0.30
Channel Catfish	01/29/87	1278	487	< 0.3	5.6 ± 0.1	< 0.20	< 0.30
Freshwater Drum	01/29/87	1921	561	< 0.3	5.2 ± 0.1	< 0.20	< 0.30
River Carpsucker	01/29/87	1810	599	< 0.3	4.9 ± 0.1	< 0.20	< 0.30
Carp	01/29/87	786	177	< 0.3	5.7 ± 0.1	< 0.20	< 0.30
Goldeye	02/04/87	1125	389	< 0.3	3.2 ± 0.1	< 0.20	< 0.30
Carp	02/04/87	938	212	< 0.3	4.8 ± 0.1	< 0.20	< 0.30
Channel Catfish	02/04/87	1503	399	0.4 ± 0.1	3.7 ± 0.1	< 0.20	< 0.30
Blue Catfish	02/04/87	1372	421	< 0.3	5.0 ± 0.1	< 0.20	< 0.30
River Carpsucker	02/04/87	2392	834	0.8 ± 0.2	5.9 ± 0.2	< 0.20	< 0.30
Freshwater Drum	03/06/87	1488	464	< 0.3	4.1 ± 0.1	< 0.20	< 0.30
River Carpsucker	03/06/87	1939	571	< 0.3	4.6 ± 0.1	< 0.20	< 0.30
Carp	03/06/87	798	245	< 0.3	4.2 ± 0.1	< 0.20	< 0.30
Flathead Catfish	03/06/87	1673	469	< 0.3	4.1 ± 0.1	< 0.20	< 0.30
Channel Catfish	03/06/87	2135	602	< 0.3	4.7 ± 0.1	< 0.20	< 0.30

TABLE XXVII

FISH - CA-AQF-D

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Smallmouth Buffalo	01/29/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	01/29/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	01/29/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	01/29/87	**	**	**	**	**	**	**	**	**	**
Carp	01/29/87	**	**	**	**	**	**	**	**	**	**
Goldeye	02/04/87	**	**	**	**	**	**	**	**	**	**
Carp	02/04/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	02/04/87	**	**	**	**	**	**	**	**	**	**
Blue Catfish	02/04/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	02/04/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	03/06/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	03/06/87	**	**	**	**	**	**	**	**	**	**
Carp	03/06/87	**	**	**	**	**	**	**	**	**	**
Flathead Catfish	03/06/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	03/06/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.7 Milk

Milk samples were collected from two locations, the Green Farm and the Schneider Farm. No samples were collected from Schneider Farm during January; the cows and goats were dry, and no goat milk sample was collected during February for the same reason. The Green Farm supplies cow's milk while the Schneider Farm provides both cow's milk and goat's milk. Analyses for Iodine-131, Elemental Calcium, Strontium-90, Strontium-89 and Gamma-emitting isotopes were performed on all milk samples. Tables XXVIII and XXIX present results of these analyses.

No Iodine-131 was detected in the milk samples during this period.

One milk sample from Schneider Farm (M5A) collected 03/08/87, indicated Strontium-90 activity of 2.4 $\pm$ 0.7 pCi/l. No Strontium-89 was detected in this sample. All of the other milk samples collected during the first quarter were below the lower limit of detection of 2.0 pCi/l for Strontium-89 and 1.0 pCi/l for Strontium-90.

No gamma-emitting isotopes of interest were detected in any of the milk samples.

TABLE XXVIII
FRESH MILK

Collection Date	Radiochemical Iodine-131 pCi/l	Radiochemical Calcium mg/l	Radiochemical Strontium-90 pCi/l	Strontium-89 pCi/l
Green Farm (M-1)				
01/13/87	<0.5	860	< 1.0	< 2.0
02/10/87	<0.5	1270	< 1.0	< 2.0
03/10/87	<0.5	1690	< 1.0	< 2.0
Schneider Farm (M5A)				
02/10/87	<0.5	1500	< 1.0	< 2.0
03/08/87	<0.5	1540	2.4 ± 0.7*	< 2.0
Schneider Farm (M5B)				
03/09/87	<0.5	1630	< 1.0	< 2.0

*Verified by reanalysis

TABLE XXIX

MILK

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l									
		Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
Green Farm	01/13/87	**	**	**	**	**	**	**	**	**	**
	02/10/87	**	**	**	**	**	**	**	**	**	**
	03/10/87	**	**	**	**	**	**	**	**	**	**
Schneider Cow Milk	02/10/87	**	**	**	**	**	**	**	**	**	**
	03/08/87	**	**	**	**	**	**	**	**	**	**
Schneider Goat Milk	03/09/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.8 Vegetation

No vegetation samples were available for collection during the first quarter of 1987.

APPENDIX A

Results of the EPA Cross-Check Program

1987

EPA CROSS-CHECK PROGRAM

1987

Gross Alpha and Gross Beta in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
1/87	Gross Alpha	11 ± 5	12 ± 2 12 ± 2 12 ± 2
	Gross Beta	10 ± 5	22 ± 6 25 ± 6 27 ± 7
3/87	Gross Alpha	3 ± 5	4 ± 2 4 ± 2 4 ± 2
	Gross Beta	13 ± 5	12 ± 4 9 ± 4 8 ± 4

EPA CROSS-CHECK PROGRAM

1987

Gamma in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Cobalt-60	50.0 ± 5.0	55.0 ± 5.0 55.0 ± 5.0 56.0 ± 5.0
	Zinc-65	91.0 ± 5.0	102.0 ± 7.0 114.0 ± 6.0 108.0 ± 6.0
	Ruthenium-106	100.0 ± 5.0	93.0 ± 5.0 105.0 ± 5.0 108.0 ± 5.0
	Cesium-134	59.0 ± 5.0	61.0 ± 3.0 57.0 ± 2.0 60.0 ± 3.0
	Cesium-137	87.0 ± 5.0	109.0 ± 6.0 98.0 ± 6.0 102.0 ± 5.0

EPA CROSS-CHECK PROGRAM

1987

Tritium in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Tritium	4209 ± 421	4600 ± 500 4510 ± 500 4330 ± 500

EPA CROSS-CHECK PROGRAM

1987

Strontium In Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Strontium-89	25 ± 5	15 ± 5 17 ± 6 20 ± 5
	Strontium-90	25 ± 1.5	22 ± 5 24 ± 6 24 ± 5

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 In Milk

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Low Level	9.0 ± 0.9	9.0 ± 1.0 8.0 ± 0.5 8.0 ± 0.5

APPENDIX B

Isotopic Detection Limits

And

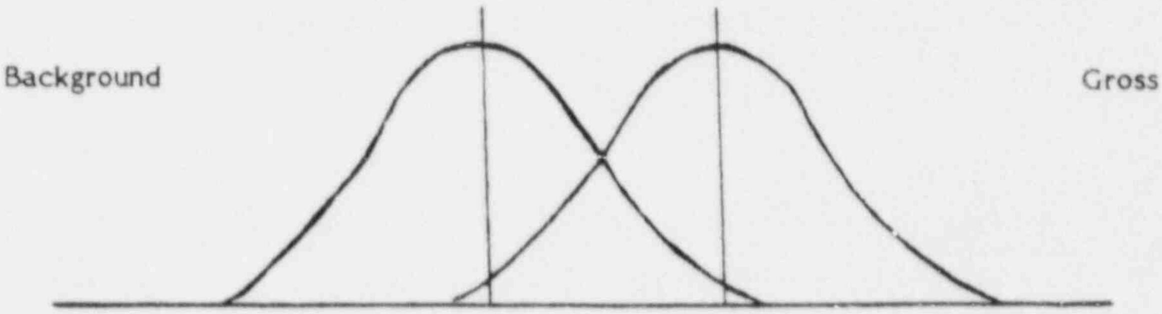
Activity Determinations

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 normal Gaussian distribution. 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. In routine analysis such replication is not carried out, and it is not possible to report a Gaussian standard deviation $\pm$ one or two Poisson standard deviations. The reported values are then considered to give some indication of the range in which the true value might be expected to occur.

The simplest possible case to consider would be one where the background is negligible and the sample activity is zero. It is sometimes not realized that if a series of counts is taken on such a system, half of the net values should be less than zero. Negative counts are not possible, of course. But when there is an appreciable background, the entire scale is raised. The resulting situation: half of the sample counts on a zero activity sample would be less than background. This negative net count occurs frequently in low-level measurements, causing considerable concern. Actually, such results are to be expected.

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. The 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 activities per unit sample mass or volume are determined using the following formula:

$$A = \frac{C-B}{(2.22)(V)(T)(R)(E)(e^{-\lambda t})} \pm \frac{1.96\left[\frac{C+B}{T^2}\right]^{1/2}}{(2.22)(V)(R)(E)(e^{-\lambda t})}$$

WHERE:

- A = Activity as pCi per unit sample mass or volume.
- C = Sample counts.
- B = Background counts.
- V = Sample volume or mass analyzed.
- E = Counter efficiency in cpm/dpm.
- 2.22 = Numerical constant to convert disintegrations per minute to picocuries.
- $(e^{-\lambda t})$ = Decay factor to correct the activity to time of collection.
- T = Counting time in minutes for sample and background.
- 1.96 = Statistical constant for the 95% confidence level.
- R = Chemical recovery or photon yield.

CEP uses the following method to determine lower limit of detection (LLD) as per NRC Regulatory Guide 4.1, Rev. 1, "Programs 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):

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

WHERE:

LLD = "A priori" 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.

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT UNIT 1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

QUARTERLY REPORT FOR

APRIL, MAY AND JUNE 1987

SUBMITTED BY:

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

1925 ROSINA STREET

SANTA FE, NEW MEXICO

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Approved By: [signature]
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CONTENTS

TABLES

Abstract

Controls for Environmental Pollution, Inc (CEP) has conducted a radiological environmental monitoring program (REMP) for Union Electric Company (UEC), Callaway Plant, Unit 1, since May 5, 1983. This quarterly report presents data for the months of April, May and June 1987.

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

Analytical results are presented and discussed along with other pertinent information. Possible trends and anomalous results, as interpreted by Controls for Environmental Pollution, Inc., are discussed.

1.0 Introduction

This report presents an analysis of the results of the Radiological Environmental Monitoring Program (REMP) conducted during the second quarter of 1987 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 radiological environmental monitoring program are as follows: 1) to establish baseline radiation levels in the environs prior to reactor operations; 2) to monitor potential critical pathways of radioeffluent to man; 3) to determine radiological impact on the environment caused by the operation of the Callaway Plant.

A number of techniques are being used to distinguish Callaway Plant effects from other sources during the operational phase, including application of established background levels. Operational radiation levels measured in the vicinity of the Callaway Plant are compared with the pre-operational measurements at each of the sampling locations. In addition, results of the monitoring program help to evaluate sources of elevated levels of radiation during reactor operation in the environment, e.g., atmospheric fallout or abnormal plant releases.

The Callaway Plant is located on a plateau approximately five miles north of the Missouri River in Callaway County, Missouri. The plant consists of one 1150 MWE pressurized water reactor, which achieved initial criticality on October 2, 1984.

2.0 Description of the Monitoring Program

Union Electric Company has contracted with Controls for Environmental Pollution, Inc. starting May 1983, to determine the radiation levels existing in and around the Callaway Plant area.

A summary of the Callaway Plant Monitoring Program is contained in the first quarter report 1987 (page 3). No changes in the monitoring program occured during the second quarter, 1987.

3.0 Analytical Procedures

The analytical procedures routinely used by CEP to analyze samples are discussed in the First Quarter 1987 Report (pages 14 to 18). No new analytical methods were used this quarter.

4.0 Sample Preparation Methods

Sample preparation methods used by CEP are discussed in the First Quarter 1987 Report (page 19). No new sample preparation methods were used this quarter.

5.0 Major Instrumentation

Major analytical instrumentation used by CEP are discussed in the First Quarter 1987 Report (pages 20 to 21). No new instrumentation was used for sample analysis this quarter.

6.0 Isotopic Lower Limits of Detection and Activity Determinations

A discussion of the calculations used in determining lower limits of detection and activity by Controls for Environmental Pollution, Inc., is found in Appendix B, First Quarter 1987 Report.

Table III in the first quarter 1987 report gives the lower limits of detection for radiochemical and chemical analytical methods.

Table IV in the first quarter 1987 report gives the lower limits of detection for Gamma Spectrometry.

The sample counting times and the aliquot size used for lower limit of detection calculations and actual analyses are shown in Tables V and VI, in the first quarter 1987 report, respectively.

7.0 Quality Control Program

A summary of CEP's Quality Control Program is contained in the First Quarter 1987 Report (page 26). No changes in the Quality Control Program occured this quarter.

8.0 Data Interpretations and Conclusions

This section addresses interpretations and conclusions regarding all types of samples analyzed during this report period.

Analysis and review of data incorporates various techniques from historical comparison to statisical evaluation. Results which do not compare with the historical range are recalculated for verification. If the recalculation verifies the original result, the sample is reanalyzed if possible (i.e. sufficient sample volume or isotope half life). Once it is determined that the results obtained are accurate, a statistical analysis is made. Results which are outliers with respect to historical comparison of previous data are considered out of baseline range or anomolous and will be so noted in the report.

8.1 Airborne Particulates and Radioiodine

Airborne particulate samples were collected at five (5) monitoring stations on a weekly basis from April 2, 1987 through July 2, 1987. The five airborne particulate stations were also collection sites for airborne radioiodine (see Table VIII).

All of the air particulate samples were analyzed for Gross Beta activity. Gamma Spectrometry, Strontium-90 and Strontium-89 analyses were performed on quarterly composites from each station.

The range of Gross Beta activity at each of the sampling locations follows.

Collection Location	Minimum (pCi/m^3)	Maximum (pCi/m^3)
Site A1	0.010$\pm$0.001	0.032$\pm$0.003
Site A7	0.010$\pm$0.002	0.028$\pm$0.003
Site A8	0.009$\pm$0.001	0.039$\pm$0.003
Site A9	0.009$\pm$0.002	0.025$\pm$0.003
Site B3	0.005$\pm$0.001	0.025$\pm$0.002

Table VII, Gross Beta in Airborne Particulates, shows that the Gross Beta activity ranged from a minimum at Site B3 of 0.005$\pm$0.001 pCi/m^3, collected 05/21/87-05/28/87 to a maximum of 0.039$\pm$0.003 pCi/m^3 at Site A8 during the collection period of 06/04/87-06/11/87.

The highest mean Gross Beta activity during the report period was observed at Site A8 with a mean activity of 0.019$\pm$0.007 pCi/m^3.

Mean weekly Gross Beta activities ranged from a low of 0.009±0.003 pCi/m^3 during the collection period of 05/21/87-05/28/87 to a high of 0.030±0.006 pCi/m^3 during the collection period of 06/04/87-06/11/87.

All of the airborne particulate composite analyses for Strontium-89 and Strontium-90 were less than the lower limit of detection (0.002 pCi/m^3).

Gamma spectralanalysis of the site composites indicated the following activities:

Collection Location	Isotope Identified	pCi/m^3
Site A1	Beryllium-7	0.038±0.004
Site A7	Beryllium-7	0.041±0.003
Site A8	Beryllium-7	0.011±0.002
Site A9	Beryllium-7	0.016±0.003
Site B3	Beryllium-7	0.015±0.002

No other gamma emitting isotopes of interest were detected in the quarterly site composites.

Results of the airborne radioiodine analyses may be found in Table VIII. No Iodine-131 activity above the lower limit of detection (0.006 pCi/m^3) was detected this quarter.

Levels and fluctuations of activity in the air particulate and radioiodine samples are consistent with the previously accumulated preoperational data.

TABLE VII

GROSS BETA IN AIRBORNE PARTICULATES (pCi/m^3)

SECOND QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3	Weekly Mean Gross Beta Activity ± Standard Deviation of the Mean
04/02/87 - 04/09/87	0.010±0.001	0.016±0.002	0.017±0.002	0.012±0.001	0.013±0.001	0.014±0.003
04/09/87 - 04/16/87	0.013±0.002	0.012±0.002	0.011±0.002	0.009±0.001	0.012±0.002	0.011±0.002
04/16/87 - 04/23/87	0.018±0.002	0.013±0.001	0.014±0.002	0.016±0.002	0.008±0.001	0.014±0.004
04/23/87 - 04/30/87	0.017±0.002	0.017±0.002	0.019±0.002	0.018±0.002	0.009±0.001	0.016±0.004
04/30/87 - 05/07/87	0.021±0.002	0.022±0.002	0.022±0.002	0.020±0.002	0.012±0.001	0.019±0.004
05/07/87 - 05/14/87	0.016±0.002	0.021±0.002	0.022±0.002	0.022±0.002	0.013±0.002	0.019±0.004
05/14/87 - 05/21/87	0.016±0.002	0.018±0.002	0.018±0.002	0.022±0.002	0.011±0.001	0.017±0.004
05/21/87 - 05/28/87	0.010±0.001	0.012±0.001	0.009±0.001	0.011±0.001	0.005±0.001	0.009±0.003
05/28/87 - 06/04/87	0.013±0.002	0.010±0.002	0.016±0.002	0.009±0.002	0.009±0.002	0.011±0.003
06/04/87 - 06/11/87	0.032±0.003	0.028±0.003	0.039±0.003	0.025±0.003	0.027±0.003	0.030±0.006
06/11/87 - 06/18/87	0.012±0.001	0.017±0.003	0.018±0.002	0.014±0.001	0.007±0.001	0.014±0.004
06/18/87 - 06/25/87	0.018±0.002	0.019±0.002	0.016±0.002	0.014±0.002	0.009±0.002	0.015±0.004
06/25/87 - 07/02/87	0.021±0.002	0.010±0.001	0.020±0.005	0.020±0.009	0.025±0.002	0.019±0.006
Mean Gross Beta Activity ± Standard Deviation of the Mean	0.017±0.006	0.017±0.005	0.019±0.007	0.016±0.005	0.012±0.007	

TABLE VIII

AIRBORNE RADIOIODINE (pCi/l^3)

SECOND QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3
04/02/87 - 04/09/87	*	*	*	*	*
04/09/87 - 04/16/87	*	*	*	*	*
04/16/87 - 04/23/87	*	*	*	*	*
04/23/87 - 04/30/87	*	*	*	*	*
04/30/87 - 05/07/87	*	*	*	*	*
05/07/87 - 05/14/87	*	*	*	*	*
05/14/87 - 05/21/87	*	*	*	*	*
05/21/87 - 05/28/87	*	*	*	*	*
05/28/87 - 06/04/87	*	*	*	*	*
06/04/87 - 06/11/87	*	*	*	*	*
06/11/87 - 06/18/87	*	*	*	*	*
06/18/87 - 06/25/87	*	*	*	*	*
06/25/87 - 07/02/87	*	*	*	*	*

*No Iodine-131 detected above 0.006 pCi/m^3.

8.2 Thermoluminescent Dosimetry

Thermoluminscent Dosimetry (TLD) was employed to determine direct radiation levels in and around the Callaway Site. Calcium Sulfate:Dy phosphor TLD chips in black polyethylene pouches were placed in plastic holders with areas 1 and 2 containing 0.022 inch copper shielding and areas 3 and 4 containing 0.093 inch copper shielding. The TLD's were placed at 52 locations and exchanged monthly.

Data appearing in Tables IX thru XI are the result of reading and averaging the four quadrants of each TLD chip. Transit control dosimeters were used to determine dosage received during shipment and were subtracted from the gross readings obtained for each monitoring site.

Exposure levels for all monitoring locations during April and May are consistent with background levels detected during the preoperational monitoring program and with levels seen during previous quarters.

Half of the June TLD's and the transit control TLD had slightly higher than normal exposure levels. We have concluded that this excess exposure resulted from an unidentified radiation source during transit. Evidence to support this conclusion includes the fact that a review of the site TLD locations showed the exposed TLD's were located randomly around the plant site which would not be indicative of a plant related exposure. In addition, the Union Electric Company comparison TLD's that were placed in the field with the CEP TLD's did not show an increase in radiation exposure for the same time period.

TABLE IX

THERMOLUMINESCENT DOSIMETRY

APRIL 1987

04/02/87 - 04/29/87

Station Identification	Collection Location	Total Exposure (mRem ± 2 σ)	Exposure Rate* (ur/hr)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	8.5 ± 0.4	13.1
CA-IDM-02	6.6 mi NW, Smola Farm	9.3 ± 0.3	14.4
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	9.2 ± 0.3	14.2
CA-IDM-04	1.9 mi N, 0.6 miles East of the O and CC Junction	9.1 ± 0.3	14.0
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	8.2 ± 0.4	12.7
CA-IDM-06	1.8 mi W, Akers Farm	9.6 ± 0.4	14.8
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	7.7 ± 0.5	11.9
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	9.2 ± 0.6	14.2
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	9.3 ± 0.3	14.4
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	9.0 ± 0.7	13.9
CA-IDM-11	5.0 mi SE, City of Portland	9.6 ± 0.5	14.8
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	8.4 ± 0.4	13.0
CA-IDM-13	5.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	8.8 ± 0.3	13.6
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	8.6 ± 0.5	13.3
CA-IDM-15	4.2 mi ESE, Lamb Farm	7.9 ± 0.7	12.2
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	7.9 ± 0.2	12.2

*Calculated from Total Exposure Result.

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

APRIL 1987

04/02/87 - 04/29/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	8.1 ± 0.4	12.5
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	8.1 ± 0.5	12.5
CA-IDM-19	4.2 mi NE, Rivera Farm	8.9 ± 0.6	13.7
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	9.0 ± 0.8	13.9
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	8.6 ± 0.5	13.3
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	8.6 ± 0.5	13.3
CA-IDM-23	6.7 mi NNE, City of Yucation	8.4 ± 0.4	13.0
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	8.2 ± 0.7	12.7
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	9.7 ± 0.6	15.0
CA-IDM-26	12.1 mi E, Town of Americus	7.2 ± 0.4	11.1
CA-IDM-27	9.5 mi ESE, Town of Bluffton	7.1 ± 0.5	11.0
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	8.3 ± 0.4	12.8
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	8.4 ± 0.5	13.0
CA-IDM-30	4.5 mi SSW, City of Steedman	8.4 ± 0.8	13.0
CA-IDM-31	7.6 mi SW, City of Mokane	8.6 ± 0.6	13.3
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	8.7 ± 0.6	13.4
CA-IDM-33	7.3 mi W, City of Hams Prairie	8.6 ± 0.7	13.3

*Calculated from Total Exposure Result.

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

APRIL 1987

04/02/87 - 04/29/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	8.3 ± 0.3	12.8
CA-IDM-35	5.8 mi NNW, City of Toledo	8.2 ± 0.6	12.7
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	9.0 ± 0.4	13.9
CA-IDM-37	0.5 mi SSW, Piezometer M8 and M6	8.6 ± 0.4	13.3
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	7.7 ± 0.5	11.9
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	8.7 ± 1.4	13.4
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	8.6 ± 0.6	13.3
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	8.5 ± 0.5	13.1
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	8.3 ± 0.3	12.8
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	8.5 ± 0.6	13.1
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	8.4 ± 0.6	13.0
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	8.8 ± 0.4	13.6
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	8.6 ± 0.3	13.3
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile South of Hwy O	8.2 ± 0.5	12.7

*Calculated from Total Exposure Result.

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

APRIL 1987

04/02/87 - 04/29/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 335)	8.7 ± 0.4	13.4
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06939	8.3 ± 0.5	12.8
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	8.3 ± 0.4	12.8
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	9.0 ± 0.7	13.9
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	8.3 ± 0.5	12.8

*Calculated from Total Exposure Result.

TABLE X

THERMOLUMINESCENT DOSIMETRY

MAY 1987

04/29/87 - 05/27/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	5.9 ± 0.9	8.5
CA-IDM-02	6.6 mi NW, Smola Farm	6.7 ± 1.0	9.6
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	6.2 ± 0.4	8.9
CA-IDM-04	1.9 mi N, 0.5 miles East of the O and CC Junction	6.5 ± 0.7	9.3
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	5.1 ± 0.3	7.3
CA-IDM-06	1.8 mi W, Akers Farm	6.5 ± 0.6	9.3
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	6.2 ± 0.8	8.9
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	6.3 ± 0.3	9.1
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	6.4 ± 0.8	9.2
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	5.9 ± 0.4	8.5
CA-IDM-11	5.0 mi SE, City of Portland	6.1 ± 0.5	8.8
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	7.2 ± 0.4	10.3
CA-IDM-13	6.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	6.5 ± 0.6	9.3
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	6.4 ± 0.3	9.2
CA-IDM-15	4.2 mi ESE, Lamb Farm	6.8 ± 0.5	9.8
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	5.4 ± 0.2	7.8

***Calculated from Total Exposure Result.**

TABLE X (Cont.)

THERMOLUMINESCENT DOSIMETRY

MAY 1987

04/29/87 - 05/27/87

Station Identification	Collection Location	Total Exposure (mRem ± 2 σ)	Exposure Rate* (ur/hr)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	6.0 ± 0.5	8.6
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	6.4 ± 0.6	9.2
CA-IDM-19	4.2 mi NE, Rivera Farm	6.7 ± 0.7	9.6
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	4.9 ± 0.4	7.0
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	6.3 ± 0.5	9.1
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	5.7 ± 0.5	8.2
CA-IDM-23	6.7 mi NNE, City of Yucation	5.8 ± 0.9	8.3
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	6.1 ± 0.7	8.8
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	7.7 ± 0.6	11.1
CA-IDM-26	12.1 mi E, Town of Americus	4.5 ± 0.4	6.5
CA-IDM-27	9.5 mi ESE, Town of Bluffton	7.1 ± 0.7	10.2
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	6.3 ± 0.8	9.1
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	6.3 ± 0.3	9.1
CA-IDM-30	4.5 mi SSW, City of Steedman	6.0 ± 0.5	8.6
CA-IDM-31	7.6 mi SW, City of Mokane	6.9 ± 0.5	9.9
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	5.0 ± 0.5	7.2
CA-IDM-33	7.3 mi W, City of Hams Prairie	6.5 ± 0.7	9.3

*Calculated from Total Exposure Result.

TABLE X (Cont.)

THERMOLUMINESCENT DOSIMETRY

MAY 1987

04/29/87 - 05/27/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	6.3 ± 0.4	9.1
CA-IDM-35	5.8 mi NNW, City of Toledo	6.1 ± 0.5	8.8
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	5.9 ± 0.5	8.5
CA-IDM-37	0.5 mi SSW, Piezometer M8 and M6	6.6 ± 0.3	9.5
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	6.0 ± 0.6	8.6
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	6.2 ± 0.3	8.9
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	7.7 ± 0.5	11.1
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	6.7 ± 0.7	9.6
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	5.7 ± 0.7	8.2
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	6.1 ± 0.7	8.8
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	6.7 ± 0.6	9.6
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	5.7 ± 0.6	8.2
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	7.1 ± 0.3	10.2
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile south of Hwy O	6.0 ± 0.6	8.6

***Calculated from Total Exposure Result.**

TABLE X (Cont.)

THERMOLUMINESCENT DOSIMETRY

MAY 1987

04/29/87 - 05/27/87

Station Identification	Collection Location	Total Exposure (mRem ± 2 σ)	Exposure Rate* (ur/hr)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 448)	7.3 ± 0.6	10.5
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	6.4 ± 0.6	9.2
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	6.8 ± 0.8	9.8
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	6.8 ± 0.9	9.8
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	7.2 ± 0.8	10.3

*Calculated from Total Exposure Result.

TABLE XI

THERMOLUMINESCENT DOSIMETRY

JUNE 1987

05/27/87 - 06/26/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-01	10.6 mi NW, City Limits of Fulton on Hwy Z	14.0 ± 5.9	19.4
CA-IDM-02	6.6 mi NW, Smola Farm	16.8 ± 7.0	23.3
CA-IDM-03	1.6 mi NW, Callaway Electric Cooperative Utility Pole No. 18450	16.6 ± 6.4	23.1
CA-IDM-04	1.9 mi N, 0.6 miles East of the O and CC Junction	15.1 ± 5.6	21.0
CA-IDM-05	1.3 mi ENE, Primary Meteorological Tower	15.6 ± 5.7	21.7
CA-IDM-06	1.8 mi W, Akers Farm	16.6 ± 5.4	23.1
CA-IDM-07	1.3 mi S, Callaway Electric Cooperative Utility Pole No. 18715	14.7 ± 5.6	20.4
CA-IDM-08	2.9 mi S, Callaway Electric Cooperative Utility Pole No. 06823	17.1 ± 6.0	23.8
CA-IDM-09	3.7 mi S, NW Side of the Heavy Haul Road and 94 Junction	15.7 ± 5.2	21.8
CA-IDM-10	4.0 mi SE, Callaway Electric Cooperative Utility Pole No. 12179	14.9 ± 4.9	20.7
CA-IDM-11	5.0 mi SE, City of Portland	16.1 ± 5.7	22.4
CA-IDM-12	5.3 mi SE, 0.6 miles South of the 94 and D Junction	16.6 ± 5.5	23.1
CA-IDM-13	5.6 mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	14.7 ± 4.8	20.4
CA-IDM-14	5.2 mi ESE, SE Side of Intersection D and 94	14.4 ± 3.8	20.0
CA-IDM-15	4.2 mi ESE, Lamb Farm	17.7 ± 2.1	24.6
CA-IDM-16	4.1 mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	8.1 ± 2.3	11.3

*Calculated from Total Exposure Result.

TABLE XI (Cont.)

THERMOLUMINESCENT DOSIMETRY

JUNE 1987

05/27/87 - 06/26/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-17	4.0 mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	8.4 ± 2.1	11.7
CA-IDM-18	3.8 mi ENE, 0.4 miles South of the D and O Junction	10.2 ± 2.2	14.2
CA-IDM-19	4.2 mi NE, Rivera Farm	9.7 ± 2.1	13.5
CA-IDM-20	4.8 mi NE, Callaway Electric Cooperative Utility Pole No. 12630	9.4 ± 2.6	13.1
CA-IDM-21	3.8 mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	11.0 ± 1.3	15.3
CA-IDM-22	2.5 mi NNE, Lost Canyon Lakes	11.4 ± 2.1	15.8
CA-IDM-23	6.7 mi NNE, City of Yucation	11.4 ± 2.0	15.8
CA-IDM-24	7.0 mi NE, Bahr Bros. Farm	9.3 ± 2.6	12.9
CA-IDM-25	8.7 mi E, Callaway Electric Cooperative Utility Pole No. 11295	9.5 ± 2.2	13.2
CA-IDM-26	12.1 mi E, Town of Americus	14.1 ± 5.8	19.6
CA-IDM-27	9.5 mi ESE, Town of Bluffton	17.8 ± 9.3	24.7
CA-IDM-28	3.3 mi SE, Callaway Electric Cooperative Utility Pole No. 06896	15.7 ± 0.9	21.8
CA-IDM-29	2.7 mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	6.9 ± 1.8	9.6
CA-IDM-30	4.5 mi SSW, City of Steedman	12.5 ± 2.2	17.4
CA-IDM-31	7.6 mi SW, City of Mokane	12.3 ± 2.3	17.1
CA-IDM-32	5.1 mi WSW, D. Bartley Farm	11.0 ± 2.4	15.3
CA-IDM-33	7.3 mi W, City of Hams Prairie	8.1 ± 2.0	11.3

***Calculated from Total Exposure Result.**

TABLE XI (Cont.)

THERMOLUMINESCENT DOSIMETRY

JUNE 1987

05/27/87 - 06/26/87

Station Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (μr/hr)
CA-IDM-34	9.5 mi WNW, 2.5 miles South of O and C Junction	8.2 ± 2.6	11.4
CA-IDM-35	5.8 mi NNW, City of Toledo	7.6 ± 1.7	10.6
CA-IDM-36	4.9 mi N, Callaway Electric Cooperative Utility Pole No. 19137	7.0 ± 1.9	9.7
CA-IDM-37	0.5 mi SSW, Plezometer M8 and M6	9.5 ± 2.0	13.2
CA-IDM-38	4.5 mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	6.6 ± 1.8	9.2
CA-IDM-39	5.4 mi NW, Callaway Electric Cooperative Utility Pole No. 17516	7.2 ± 2.2	10.0
CA-IDM-40	4.2 mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	7.8 ± 1.4	10.8
CA-IDM-41	4.8 mi W, Callaway Electric Cooperative Utility Pole No. 18239	7.1 ± 1.8	9.9
CA-IDM-42	4.4 mi SW, Callaway Electric Cooperative Utility Pole No. 06326	6.9 ± 2.2	9.6
CA-IDM-43	0.5 mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	7.2 ± 1.3	10.0
CA-IDM-44	1.7 mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	7.3 ± 1.7	10.1
CA-IDM-45	0.9 mi WNW, NW Side of Intersection CC and AD	6.7 ± 3.3	9.3
CA-IDM-46	1.5 mi NNW, 0.3 mile South of the CC and O Junction	10.0 ± 1.7	13.9
CA-IDM-47	0.9 mi NNE, County Road 448, 0.9 mile south of Hwy O	9.8 ± 1.8	13.6

*Calculated from Total Exposure Result.

TABLE XI (Cont.)

THERMOLUMINESCENT DOSIMETRY

JUNE 1987

05/27/87 - 06/26/87

Location Identification	Collection Location	Total Exposure (mRem ± 2σ)	Exposure Rate* (ur/hr)
CA-IDM-48	0.5 mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 448)	13.2 ± 1.4	18.3
CA-IDM-49	1.7 mi E, Callaway Electric Cooperative Utility Pole No. 06959	7.7 ± 1.8	10.7
CA-IDM-50	1.1 mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	5.1 ± 2.4	7.1
CA-IDM-51	0.7 mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	5.7 ± 2.3	7.9
CA-IDM-52	0.3 mi ESE, Light Pole near the East Plant Security Fence	7.7 ± 1.8	10.7

*Calculated from Total Exposure Result.

8.3 Well Water

Well water samples were collected monthly from three locations and analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-89, Strontium-90, and gamma-emitting nuclides.

Table XII presents the results of the radiochemical analyses. Gross Alpha activity ranged from less than 2.0 pCi/l to 5.6±1.6 pCi/l. Gross Beta levels varied from less than 3.0 pCi/l to 12.3±0.8 pCi/l. The Gross Alpha and Gross Beta levels were consistent with the preoperational data.

Results for Tritium analysis were below the lower limit of detection (500 pCi/l) for all samples.

All sample results for Strontium 89 and Strontium 90 analysis were below the lower limits of detection (1.5 pCi/l and 1.0 pCi/l respectively).

Gamma spectrometry showed no detectable levels of isotopes of interest. Results are summarized in Table XIII.

TABLE XII

WELL WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l)				
		Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-WWA-D01	04/14/87	< 2.0	3.0 ± 0.6	< 500	< 1.0	< 1.5
CA-WWA-D01	05/12/87	< 2.0	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-D01	06/09/87	2.0 ± 1.3	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-F05	04/14/87	4.4 ± 1.6	10.9 ± 1.0	< 500	< 1.0	< 1.5
CA-WWA-F05	05/12/87	2.4 ± 1.3	11.2 ± 0.8	< 500	< 1.0	< 1.5
CA-WWA-F05	06/09/87	2.1 ± 1.3	12.3 ± 0.8*	< 500	< 1.0	< 1.5
CA-WWA-F15	04/14/87	2.5 ± 1.4	8.8 ± 1.0	< 500	< 1.0	< 1.5
CA-WWA-F15	05/12/87	< 2.0	5.9 ± 0.7	< 500	< 1.0	< 1.5
CA-WWA-F15	06/09/87	5.6 ± 1.6*	8.5 ± 0.8	< 500	< 1.0	< 1.5

*Verified by reanalysis.

TABLE XIII

WELL WATER

GAMMA SPECTROMETRY

		pCi/l									
Sample Identification	Date Collected	Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-WWA-D01	04/14/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	05/12/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	06/09/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	04/14/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	05/12/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	06/09/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	04/14/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	05/12/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	06/09/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.4 Surface Water

Surface water samples were collected from three locations on a monthly basis. During the second quarter, the upstream composite water sampler was inoperable due to equipment failures. Therefore, daily grab samples were taken and composited over the month. Samples were analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XIV and XV.

Gross Alpha and Gross Beta analyses of surface water samples showed a range of activities from less than 2.0 pCi/l to 4.8±1.4 pCi/l and 5.3±0.6 pCi/l to 12.0±0.7 pCi/l, respectively. The positive Gross Alpha and Gross Beta activities can be attributed to naturally occurring isotopes, such as Potassium-40, and are consistent with the preoperational data.

All Tritium data from surface water samples were below the lower limit of detection (500 pCi/l).

No Strontium-89 or Strontium-90 was detected in any of the surface water samples collected this quarter.

Gamma Spectralanalysis of surface water samples showed no detectable activity from isotopes of interest.

TABLE XIV

SURFACE WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l) Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-SWA-S01	04/08/87	2.8 ± 1.5	9.1 ± 1.0	< 500	< 1.0	< 1.5
CA-SWA-S01	05/12/87	< 2.0	6.0 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S01	06/09/87	4.8 ± 1.5	12.0 ± 0.7	< 500	< 1.0	< 1.5
CA-SWA-S02	04/14/87	< 2.0	5.8 ± 0.8	< 500	< 1.0	< 1.5
CA-SWA-S02	05/12/87	< 2.0	5.3 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S02	06/09/87	4.2 ± 1.4	11.0 ± 0.7	< 500	< 1.0	< 1.5
CA-SWA-S03	04/16/87	2.5 ± 1.4	6.5 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S03	05/22/87	2.0 ± 1.5	7.3 ± 0.8	< 500	< 1.0	< 1.5
CA-SWA-S03	06/26/87	2.6 ± 1.3	5.6 ± 0.6	< 500	< 1.0	< 1.5

TABLE XV

SURFACE WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-SWA-S01	04/08/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	05/12/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	06/09/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	04/14/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	05/12/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	06/09/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	04/16/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	05/22/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	06/26/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.5 Sediment

Washload, Bedload and Bottom Sediment samples were collected in May from three locations along the Missouri River. Samples were analyzed for Gross Alpha, Gross Beta, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XVI thru XXI.

The following ranges of Gross Alpha and Gross Beta activities were observed in the washload, bedload and bottom sediments.

Sample Type	Gross Alpha Range pCi/g	Gross Beta Range pCi/g
Washload	1.0±0.2 - 3.1±0.8	4.3±0.1 - 9.3±0.5
Bedload	0.7±0.2 - 0.9±0.2	1.9±0.1 - 3.3±0.1
Bottom	1.0±0.2 - 1.6±0.2	1.3±0.1 - 1.6±0.1

The highest activity of Gross Alpha (3.1±0.8 pCi/g) was seen in the Washload sediment at sample location D (59.5 river miles downstream of discharge south bank). The highest activity of Gross Beta (9.3±0.5 pCi/g) was seen in the Washload sediment at sample location D (59.5 river miles downstream of discharge south bank).

No Strontium-89 or Strontium-90 was detected in the washload, bedload, or bottom sediments collected during the second quarter of 1987.

Gamma Spectralanalysis of the sediment samples collected during this report period are detailed in Tables XVII, XIX and XXI, and are consistent with previous data.

One Shoreline Sediment sample was collected on 05/26/87 and exhibited a Gross Alpha acitivity of 1.0±0.2 pCi/g, and a Gross Beta activity of 1.5±0.1 pCi/g. Gamma Spectralanalysis indicated a Cesium-137 activity of 0.11±0.01 pCi/g. No Strontium-89 or Strontium-90 activity was detected.

TABLE XVI

WASHLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	05/27/87	2.2 ± 0.3	6.0 ± 0.2	< 0.20	< 0.30
CA-AQS-C	05/27/87	1.0 ± 0.2	4.3 ± 0.1	< 0.20	< 0.30
CA-AQS-D	05/22/87	3.1 ± 0.8	9.3 ± 0.5	< 0.20	< 0.30

TABLE XVII

WASHLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	05/27/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	05/27/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	05/22/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XVIII

BEDLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	05/27/87	0.8 ± 0.2	3.3 ± 0.1	< 0.20	< 0.30
CA-AQS-C	05/27/87	0.9 ± 0.2	2.7 ± 0.1	< 0.20	< 0.30
CA-AQS-D	05/22/87	0.7 ± 0.2	1.9 ± 0.1	< 0.20	< 0.30

TABLE XIX

BEDLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	05/27/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	05/27/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	05/22/87	**	**	0.43 ± 0.11	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XX

BOTTOM SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	05/27/87	1.6 ± 0.2	1.6 ± 0.1	< 0.20	< 0.30
CA-AQS-C	05/27/87	1.2 ± 0.2	1.6 ± 0.1	< 0.20	< 0.30
CA-AQS-D	05/22/87	1.0 ± 0.2	1.3 ± 0.1	< 0.20	< 0.30

TABLE XXI

BOTTOM SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	05/27/87	**	**	0.03±0.01	**	**	**	**	**	**	**
CA-AQS-C	05/27/87	**	**	0.13±0.01	**	**	**	**	**	**	**
CA-AQS-D	05/22/87	**	**	0.09±0.01	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.6 Fish

Fish were collected during the quarter from three collection locations. Types of fish collected during this quarter were: goldeye, freshwater drum, blue sucker, flathead catfish, shortnose gar, carp, longnose gar, northern pike, bigmouth buffalo, river carpsucker, channel catfish, shorthead redhorse, smallmouth buffalo, and gizzard shad. Gross Alpha, Gross Beta, Strontium-90, Strontium-89 and Gamma Spectralanalysis were performed on all fish collected each month. Results are presented in Tables XXII thru XXVII. The activity levels are consistent with the preoperational data.

Gross Alpha activity was detected in seventeen samples during this quarter and ranged from less than 0.3 pCi/g to 0.8 ± 0.2 pCi/g. Gross Beta activities ranged from a low of 3.7 ± 0.1 pCi/g (sample CA-AQF-D, flathead catfish collected 06/19/87) to a high of 8.6 ± 0.2 pCi/g (sample CA-AQF-C, gizzard shad, collected 06/25/87). Gross Alpha and Gross Beta activities seen in fish samples can be attributed to naturally occurring isotopes (e.g. Potassium-40).

All fish data for Strontium-90 and Strontium-89 were below the lower limits of detection of 0.20 pCi/g and 0.30 pCi/g, respectively.

Results of Gamma Spectralanalysis may be found in Tables XXIII, XXV, and XXVII.

TABLE XXII

FISH - CA-AQF-A

Sample Identification	Collection Date	Grams: Wet Weight	Grams: Dry Weight	Radiochemical Analysis pCi/g (dry): Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Goldeye	04/29/87	1150	375	<0.3	6.1 ± 0.2	< 0.20	<0.30
Blue Sucker	04/29/87	572	177	<0.3	5.8 ± 0.1	< 0.20	<0.30
Carp	04/29/87	751	195	<0.3	4.8 ± 0.1	< 0.20	<0.30
Gizzard Shad	04/29/87	1105	460	<0.3	8.3 ± 0.2	< 0.20	<0.30
Shortnose Gar	04/29/87	1262	427	<0.3	7.8 ± 0.2	< 0.20	<0.30
Carp	05/27/87	497	101	0.9 ± 0.2	7.3 ± 0.2	< 0.20	<0.30
Freshwater Drum	05/27/87	849	234	0.6 ± 0.1	5.8 ± 0.2	< 0.20	<0.30
Goldeye	05/27/87	808	216	0.8 ± 0.2	5.5 ± 0.2	< 0.20	<0.30
Shortnose Gar	05/27/87	1345	563	0.5 ± 0.1	3.9 ± 0.1	< 0.20	<0.30
Longnose Gar	05/27/87	1814	635	0.7 ± 0.1	4.3 ± 0.1	< 0.20	<0.30
Flathead Catfish	06/25/87	1468	637	0.3 ± 0.1	5.5 ±0.2	< 0.20	<0.30
Freshwater Drum	06/25/87	990	280	<0.3	7.8 ± 0.2	< 0.20	<0.30
Carp	06/25/87	1079	290	0.4 ± 0.1	5.2 ± 0.1	< 0.20	<0.30
Shortnose Gar	06/25/87	1475	625	0.3 ± 0.1	5.1 ± 0.1	< 0.20	<0.30
Longnose Gar	06/25/87	1644	622	0.4 ± 0.1	4.6 ± 0.1	< 0.20	<0.30

TABLE XXIII

FISH - CA-AQF-A

GAMMA SPECTROMETRY

Sample Identification	Date Collected	Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
		pCi/g (dry)									
Goldeye	04/29/87	**	**	**	**	**	**	**	**	**	**
Blue Sucker	04/29/87	**	**	**	**	**	**	**	**	**	**
Carp	04/29/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	04/29/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	04/29/87	**	**	**	**	**	**	**	**	**	**
Carp	05/27/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	05/27/87	**	**	**	**	**	**	**	**	**	**
Goldeye	05/27/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	05/27/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	05/27/87	**	**	**	**	**	**	**	**	**	**
Flathead Catfish	06/25/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	06/25/87	**	**	**	**	**	**	**	**	**	**
Carp	06/25/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	06/25/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	06/25/87	**	**	0.17 ± 0.04	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXIV

FISH - CA-AQF-C

Sample Identification	Collection Date	Grams Wet Weight	Grams Dry Weight	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Carp	04/29/87	522	127	< 0.3	4.4 ± 0.1	< 0.20	< 0.30
Channel Catfish	04/29/87	1701	544	< 0.3	5.2 ± 0.1	< 0.20	< 0.30
River Carpsucker	04/29/87	1543	471	< 0.3	5.3 ± 0.1	< 0.20	< 0.30
Freshwater Drum	04/29/87	1040	274	< 0.3	5.2 ± 0.1	< 0.20	< 0.30
Northern Pike	04/29/87	1107	272	< 0.3	7.6 ± 0.2	< 0.20	< 0.30
Carp	05/27/87	455	104	< 0.3	6.4 ± 0.2	< 0.20	< 0.30
Channel Catfish	05/27/87	894	278	< 0.3	6.0 ± 0.2	< 0.20	< 0.30
River Carpsucker	05/27/87	529	126	< 0.3	7.2 ± 0.2	< 0.20	< 0.30
Gizzard Shad	05/27/87	1142	271	< 0.3	8.5 ± 0.2	< 0.20	< 0.30
Shortnose Gar	05/27/87	1285	479	< 0.3	5.1 ± 0.1	< 0.20	< 0.30
Flathead Catfish	06/25/87	839	190	0.5 ± 0.2	8.0 ± 0.2	< 0.20	< 0.30
Channel Catfish	06/25/87	1347	460	0.5 ± 0.2	6.0 ± 0.2	< 0.20	< 0.30
Carp	06/25/87	712	154	0.5 ± 0.2	7.4 ± 0.2	< 0.20	< 0.30
Gizzard Shad	06/25/87	865	213	0.5 ± 0.2	8.6 ± 0.2	< 0.20	< 0.30
Shortnose Gar	06/25/87	1524	547	0.5 ± 0.2	6.8 ± 0.2	< 0.20	< 0.30

TABLE XXV

FISH - CA-AQF-C

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Carp	04/29/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	04/29/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	04/29/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	04/29/87	**	**	**	**	**	**	**	**	**	**
Northern Pike	04/29/87	**	**	**	**	**	**	**	**	**	**
Carp	05/27/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	05/27/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	05/27/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	05/27/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	05/27/87	**	**	**	**	**	**	**	**	**	**
Flathead Catfish	06/25/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	06/25/87	**	**	**	**	**	**	**	**	**	**
Carp	06/25/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	06/25/87	**	**	0.30 ± 0.15	**	**	**	**	**	**	**
Shortnose Gar	06/25/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXVI

FISH - CA-AQF-D

Sample Identification	Collection Date	Grams: Wet Weight	Grams: Dry Weight	Radiochemical Analysis pCi/g (dry): Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Blue Sucker	04/16/87	2548	1221	<0.3	4.1 ± 0.1	<0.20	<0.30
Carp	04/16/87	743	171	<0.3	5.3 ± 0.1	<0.20	<0.30
River Carpsucker	04/16/87	1787	591	<0.3	6.1 ± 0.2	<0.20	<0.30
Smallmouth Buffalo	04/16/87	1353	529	<0.3	7.5 ± 0.2	<0.20	<0.30
Bigmouth Buffalo	04/16/87	719	155	<0.3	6.0 ± 0.2	<0.20	<0.30
Carp	05/22/87	702	150	<0.3	6.8 ± 0.2	<0.20	<0.30
River Carpsucker	05/22/87	1589	480	<0.3	7.4 ± 0.2	<0.20	<0.30
Bigmouth Buffalo	05/22/87	847	220	0.5 ± 0.1	4.8 ± 0.1	<0.20	<0.30
Channel Catfish	05/22/87	1181	455	<0.3	5.7 ± 0.1	<0.20	<0.30
Shorthead Redhorse	05/22/87	813	218	0.6 ± 0.1	7.3 ± 0.2	<0.20	<0.30
Channel Catfish	06/19/87	949	289	<0.3	4.1 ± 0.1	<0.20	<0.30
Flathead Catfish	06/19/87	755	190	<0.3	3.7 ± 0.1	<0.20	<0.30
Carp	06/19/87	738	207	<0.3	4.2 ± 0.1	<0.20	<0.30
Shortnose Gar	06/19/87	1505	544	<0.3	5.0 ± 0.2	<0.20	<0.30
Longnose Gar	06/19/87	1302	466	0.3 ± 0.2	4.9 ± 0.2	<0.20	<0.30

TABLE XXVII

FISH - CA-AQF-D

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Blue Sucker	04/16/87	**	**	**	**	**	**	**	**	**	**
Carp	04/16/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	04/16/87	**	**	**	**	**	**	**	**	**	**
Smallmouth Buffalo	04/16/87	**	**	**	**	**	**	**	**	**	**
Bigmouth Buffalo	04/16/87	**	**	**	**	**	**	**	**	**	**
Carp	05/22/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	05/22/87	**	**	**	**	**	**	**	**	**	**
Bigmouth Buffalo	05/22/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	05/22/87	**	**	**	**	**	**	**	**	**	**
Shorthead Redhorse	05/22/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	06/19/87	**	**	**	**	**	**	**	**	**	**
Flathead Catfish	06/19/87	**	**	**	**	**	**	**	**	**	**
Carp	06/19/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	06/19/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	06/19/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.7 Milk

Milk samples were collected from two locations, the Green Farm and the Schneider Farm. The Green Farm supplies cow's milk while the Schneider Farm provides both cow's milk and goat's milk. Analyses for Iodine-131, elemental Calcium, Strontium-90, Strontium-89 and Gamma-emitting isotopes were performed on all milk samples. Tables XXVIII and XXIX present results of these analyses.

Iodine-131 was detected in one milk sample (1.0±0.5 pCi/l) from the Green Farm (M-1) collected 05/28/87. No Iodine-131 was detected in the other milk samples during this period.

All of the milk samples collected during the second quarter were below the lower limit of detection of 2.0 pCi/l for Strontium-89 and 1.0 pCi/l for Strontium-90.

No ga nma-emitting isotopes of interest were detected in any of the milk samples.

TABLE XXVIII

FRESH MILK

Collection Date	Radiochemical Iodine-131 pCi/l	Calcium mg/l	Strontium-90 pCi/l	Strontium-89 pCi/l
Green Farm (M-1)				
04/14/87	<0.5	1460	<1.0	< 2.0
04/28/87	<0.5	1240	<1.0	< 2.0
05/12/87	<0.5	1070	<1.0	< 2.0
05/28/87	1.0 ± 0.5	1070	<1.0	< 2.0
06/09/87	<0.5	1030	<1.0	< 2.0
06/23/87	<0.5	974	<1.0	< 2.0
Schneider Farm (M5A)				
04/12/87	<0.5	1110	<1.0	< 2.0
04/26/87	<0.5	1040	<1.0	< 2.0
05/10/87	<0.5	1150	<1.0	< 2.0
05/28/87	<0.5	1120	<1.0	< 2.0
06/09/87	<0.5	1090	<1.0	< 2.0
06/23/87	<0.5	804	<1.0	< 2.0
Schneider Farm (M5B)				
04/12/87	<0.5	1660	<1.0	< 2.0
04/26/87	<0.5	1720	<1.0	< 2.0
05/10/87	<0.5	1510	<1.0	< 2.0
05/23/87	<0.5	1030	<1.0	< 2.0
06/09/87	<0.5	1240	<1.0	< 2.0
06/23/87	<0.5	1200	<1.0	< 2.0

TABLE XXIX

MILK

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l									
		Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
Green Farm	04/14/87	**	**	**	**	**	**	**	**	**	**
	04/28/87	**	**	**	**	**	**	**	**	**	**
	05/12/87	**	**	**	**	**	**	**	**	**	**
	05/28/87	**	**	**	**	**	**	**	**	**	**
	06/09/87	**	**	**	**	**	**	**	**	**	**
	06/23/87	**	**	**	**	**	**	**	**	**	**
Schneider Cow Milk	04/12/87	**	**	**	**	**	**	**	**	**	**
	04/26/87	**	**	**	**	**	**	**	**	**	**
	05/10/87	**	**	**	**	**	**	**	**	**	**
	05/24/87	**	**	**	**	**	**	**	**	**	**
	06/09/87	**	**	**	**	**	**	**	**	**	**
	06/23/87	**	**	**	**	**	**	**	**	**	**
Schneider Goat Milk	04/12/87	**	**	**	**	**	**	**	**	**	**
	04/26/87	**	**	**	**	**	**	**	**	**	**
	05/10/87	**	**	**	**	**	**	**	**	**	**
	05/23/87	**	**	**	**	**	**	**	**	**	**
	06/09/87	**	**	**	**	**	**	**	**	**	**
	06/23/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.8 Vegetation

Vegetation samples were collected from three (3) sampling locations during the second quarter of 1987. Vegetation samples consisted of spinach, lettuce, mustard greens, turnip greens and cabbage collected from the Beazley, Becker and Meehan Farms. All vegetation samples were analyzed for Gross Alpha, Gross Beta, Iodine-131 and by Gamma Spectrometry. Results are presented in Tables XXX and XXXI.

Gross Alpha activity ranged from less than lower limit of detection (0.3 pCi/g) to a high of 2.6$\pm$0.3 pCi/g at the Becker Farm (CA-FPL-V6, Lettuce) collected on 06/15/87. These Gross Alpha activities are consistent with the levels found during monitoring in previous years.

Gross Beta activity observed in the vegetation samples ranged from 7.4$\pm$0.2 pCi/g to 27.4$\pm$0.3 pCi/g.

No gamma emitting nuclides of interest were detected in the vegetation samples collected during the second quarter of 1987.

TABLE XXX

VEGETATION

Sample Identification; Date Collected	Sample Location	Radiochemical Analysis (pCi/g)		
		Gross Alpha	Gross Beta	Iodine-131
CA-FPL-V3 Spinach 05/26/87	Beazley Farm	< 0.3	11.5 ± 0.2	< 0.03
CA-FPL-V3 Lettuce 05/26/87	Beazley Farm	< 0.3	16.8 ± 0.3	< 0.03
CA-FPL-V3 Lettuce 06/15/87	Beazley Farm	2.0 ± 0.2*	24.3 ± 0.3	< 0.03
CA-FPL-V3 Spinach 06/15/87	Beazley Farm	1.6 ± 0.2*	20.4 ± 0.3	< 0.03
CA-FPL-V3 Mustard Greens 06/15/87	Beazley Farm	< 0.3	13.4 ± 0.2	< 0.03
CA-FPL-V3 Turnip Greens 06/15/87	Beazley Farm	(a)	(a)	< 0.03
CA-FPL-V3 Cabbage 06/15/87	Beazley Farm	0.9 ± 0.2*	13.5 ± 0.2	< 0.03
CA-FPL-V6 Cabbage 05/26/87	Becker Farm	<0.3	9.0 ± 0.2	< 0.03
CA-FPL-V6 Lettuce 05/26/87	Becker Farm	<0.3	13.8 ± 0.2	< 0.03
CA-FPL-V6 Turnip Greens 05/26/87	Becker Farm	<0.3	13.3 ± 0.3	< 0.03
CA-FPL-V6 Mustard Greens 05/26/87	Becker Farm	<0.3	13.3 ± 0.2	< 0.03

Verified by reanalysis.

) Insufficient sample for Gross Alpha/Beta analyses.

TABLE XXX (Cont.)

VEGETATION

Sample Identification; Date Collected	Sample Location	Radiochemical Analysis (pCi/g)		
		Gross Alpha	Gross Beta	Iodine-131
CA-FPL-V6 Lettuce 06/15/87	Becker Farm	2.6 ± 0.3*	27.4 ± 0.3	< 0.03
CA-FPL-V6 Mustard Greens 06/15/87	Becker Farm	2.0 ± 0.2*	23.1 ± 0.3	< 0.03
CA-FPL-V6 Cabbage 06/15/87	Becker Farm	0.7 ± 0.2*	7.4 ± 0.2	< 0.03
CA-FPL-V6 Turnip Greens 06/15/87	Becker Farm	1.3 ± 0.2*	12.2 ± 0.2	< 0.03
CA-FPL-V7 Lettuce 05/26/87	Meehan Farm	< 0.3	10.2 ± 0.2	< 0.03
CA-FPL-V7 Mustard Greens 05/26/87	Meehan Farm	< 0.3	10.0 ± 0.2	< 0.03
CA-FPL-V7 Turnip Greens 05/26/87	Meehan Farm	< 0.3	11.2 ± 0.2	< 0.03
CA-FPL-V7 Spinach 05/26/87	Meehan Farm	< 0.3	13.3 ± 0.2	< 0.03
CA-FPL-V7 Lettuce 06/15/87	Meehan Farm	1.9 ± 0.2*	23.7 ± 0.3	< 0.03
CA-FPL-V7 Mustard Greens 06/15/87	Meehan Farm	1.4 ± 0.2*	16.2 ± 0.3	< 0.03
CA-FPL-V7 Cabbage 06/15/87	Meehan Farm	1.7 ± 0.2*	18.7 ± 0.3	< 0.03
CA-FPL-V7 Turnip Greens 06/15/87	Meehan Farm	1.5 ± 0.2*	17.8 ± 0.3	< 0.03

*Verified by reanalysis.

TABLE XXXI

VEGETATION

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g Cr-51 0.004*	Cs-134 0.029*	Cs-137 0.040*	Co-58 0.020*	Mn-54 0.021*	Fe-59 0.021*	Zn-65 0.060*	Co-60 0.063*	Ba,La-140 0.075*	Zr,Nb-95 0.066*
Beazley Farm											
Spinach	05/26/87	**	**	**	**	**	**	**	**	**	**
Lettuce	05/26/87	**	**	**	**	**	**	**	**	**	**
Lettuce	06/15/87	**	**	**	**	**	**	**	**	**	**
Spinach	06/15/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	06/15/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	06/15/87	**	**	**	**	**	**	**	**	**	**
Cabbage	06/15/87	**	**	**	**	**	**	**	**	**	**
Becker Farm											
Cabbage	05/26/87	**	**	**	**	**	**	**	**	**	**
Lettuce	05/26/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	05/26/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	05/26/87	**	**	**	**	**	**	**	**	**	**
Lettuce	06/15/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	06/15/87	**	**	**	**	**	**	**	**	**	**
Cabbage	06/15/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	06/15/87	**	**	**	**	**	**	**	**	**	**
Meehan Farm											
Lettuce	05/26/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	05/26/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	05/26/87	**	**	**	**	**	**	**	**	**	**
Spinach	05/26/87	**	**	**	**	**	**	**	**	**	**
Lettuce	06/15/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	06/15/87	**	**	**	**	**	**	**	**	**	**
Cabbage	06/15/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	06/15/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection (LLD)

**Less than lower limit of detection

APPENDIX A

Results of the EPA Cross-Check Program

1987

EPA CROSS-CHECK PROGRAM

1987

Gross Alpha and Gross Beta in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
1/87	Gross Alpha	11 ± 5	12 ± 2 12 ± 2 12 ± 2
	Gross Beta	10 ± 5	22 ± 6 25 ± 6 27 ± 7
3/87	Gross Alpha	3 ± 5	4 ± 2 4 ± 2 4 ± 2
	Gross Beta	13 ± 5	12 ± 4 9 ± 4 8 ± 4

EPA CROSS-CHECK PROGRAM

1987

Gamma in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Cobalt-60	50.0 ± 5.0	55.0 ± 5.0 55.0 ± 5.0 56.0 ± 5.0
	Zinc-65	91.0 ± 5.0	102.0 ± 7.0 114.0 ± 6.0 108.0 ± 6.0
	Ruthenium-106	100.0 ± 5.0	93.0 ± 5.0 105.0 ± 5.0 108.0 ± 5.0
	Cesium-134	59.0 ± 5.0	61.0 ± 3.0 57.0 ± 2.0 60.0 ± 3.0
	Cesium-137	87.0 ± 5.0	109.0 ± 6.0 98.0 ± 6.0 102.0 ± 5.0

EPA CROSS-CHECK PROGRAM

1987

Tritium in Water

Date	Parameter	EPA Known Value pCi/l ± 1σ	CEP Reported Value pCi/l ± 2σ
2/87	Tritium	4209 ± 421	4600 ± 500 4510 ± 500 4330 ± 500
6/87	Tritium	2895 ± 357	2866 ± 285 2831 ± 288 2792 ± 288

EPA CROSS-CHECK PROGRAM

1987

Strontium In Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Strontium-89	25 ± 5	15 ± 5 17 ± 6 20 ± 5
	Strontium-90	25 ± 1.5	22 ± 5 24 ± 6 24 ± 5

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 In Milk

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Low Level	9.0 ± 0.9	9.0 ± 1.0 8.0 ± 0.5 8.0 ± 0.5

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT UNIT 1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

QUARTERLY REPORT FOR JULY, AUGUST AND SEPTEMBER 1987

COPY NO. 11

Prepared By: Bob Bates
Bob Bates, Contract Manager

Approved By:
James J. Mueller, President

CONTENTS

TABLES

Abstract

Controls for Environmental Pollution, Inc (CEP) has conducted a radiological environmental monitoring program (REMP) for Union Electric Company (UEC), Callaway Plant, Unit 1, since May 5, 1983. This quarterly report presents data for the months of July, August and September 1987.

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

Analytical results are presented and discussed along with other pertinent information. Possible trends and anomalous results, as interpreted by Controls for Environmental Pollution, Inc., are discussed.

1.0 Introduction

This report presents an analysis of the results of the Radiological Environmental Monitoring Program (REMP) conducted during the third quarter of 1987 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 radiological environmental monitoring program are as follows: 1) to establish baseline radiation levels in the environs prior to reactor operations; 2) to monitor potential critical pathways of radioeffluent to man; 3) to determine radiological impact on the environment caused by the operation of the Callaway Plant.

A number of techniques are being used to distinguish Callaway Plant effects from other sources during the operational phase, including application of established background levels. Operational radiation levels measured in the vicinity of the Callaway Plant are compared with the pre-operational measurements at each of the sampling locations. In addition, results of the monitoring program help to evaluate sources of elevated levels of radiation during reactor operation in the environment, e.g., atmospheric fallout or abnormal plant releases.

The Callaway Plant is located on a plateau approximately five miles north of the Missouri River in Callaway County, Missouri. The plant consists of one 1150 MWE pressurized water reactor, which achieved initial criticality on October 2, 1984.

2.0 Description of the Monitoring Program

Union Electric Company has contracted with Controls for Environmental Pollution, Inc., starting May, 1983, to determine the radiation levels existing in and around the Callaway Plant area.

A summary of the Callaway Plant Monitoring Program is contained in the first quarter report, 1987 (page 3). No changes in the monitoring program occurred during the third quarter, 1987.

3.0 Analytical Procedures

The analytical procedures routinely used by CEP to analyze samples are discussed in the First Quarter 1987 Report (pages 14 to 18). No new analytical methods were used this quarter.

4.0 Sample Preparation Methods

Sample preparation methods used by CEP are discussed in the First Quarter 1987 Report (page 19). No new sample preparation methods were used this quarter.

5.0 Major Instrumentation

Major analytical instrumentation used by CEP are discussed in the First Quarter 1987 Report (pages 20 to 21). No new instrumentation was used for sample analysis this quarter.

6.0 Isotopic Lower Limits of Detection and Activity Determinations

A discussion of the calculations used in determining lower limits of detection and activity by Controls for Environmental Pollution, Inc., is found in Appendix B, First Quarter 1987 Report.

Table III in the first quarter 1987 report gives the lower limits of detection for radiochemical and chemical analytical methods.

Table IV in the first quarter 1987 report gives the lower limits of detection for Gamma Spectrometry.

The sample counting times and the aliquot size used for lower limit of detection calculations and actual analyses are shown in Tables V and VI, in the first quarter 1987 report, respectively.

7.0 Quality Control Program

A summary of CEP's Quality Control Program is contained in the First Quarter 1987 Report (page 26). No changes in the Quality Control Program occurred this quarter.

8.0 Data Interpretations and Conclusions

This section addresses interpretations and conclusions regarding all types of samples analyzed during this report period.

Analysis and review of data incorporates various techniques from historical comparison to statistical evaluation. Results which do not compare with the historical range are recalculated for verification. If the recalculation verifies the original result, the sample is reanalyzed if possible (i.e. sufficient sample volume or isotope half life). Once it is determined that the results obtained are accurate, a statistical analysis is made. Results which are outliers with respect to historical comparison of previous data are considered out of baseline range or anomolous and will be so noted in the report.

8.1 Airborne Particulates and Radioiodine

Airborne particulate samples were collected at five (5) monitoring stations on a weekly basis from July 2, 1987, through October 1, 1987. The five airborne particulate stations were also collection sites for airborne radioiodine (see Table VIII).

All of the air particulate samples were analyzed for Gross Beta activity. Gamma Spectrometry, Strontium-90 and Strontium-89 analyses were performed on quarterly composites from each station.

The range of Gross Beta activity at each of the sampling locations follows.

Collection Location	Minimum (pCi/m^3)	Maximum (pCi/m^3)
Site A1	0.011 ± 0.002	0.032 ± 0.002
Site A7	0.016 ± 0.002	0.048 ± 0.002
Site A8	0.007 ± 0.002	0.032 ± 0.002
Site A9	0.013 ± 0.002	0.027 ± 0.003
Site B3	0.011 ± 0.002	0.044 ± 0.003

Table VII, Gross Beta in Airborne Particulates, shows that the Gross Beta activity ranged from a minimum at Site A8 of 0.007 ± 0.002 pCi/m^3, collected 07/09/87-07/16/87 to a maximum of 0.048 ± 0.002 pCi/m^3 at Site A7 during the collection period of 09/03/87-09/10/87.

The highest mean Gross Beta activity during the report period was observed at Site A7 with a mean activity of 0.032 ± 0.010 pCi/m^3.

Mean weekly Gross Beta activities ranged from a low of 0.016±0.006 pCi/m^3 during the collection period of 07/09/87-07/16/87 to a high of 0.035±0.005 pCi/m^3 during the collection period of 07/30/87-08/06/87.

All of the airborne particulate composite analyses for Strontium-89 and Strontium-90 were less than the lower limit of detection (0.002 pCi/m^3).

Gamma spectralanalysis of the site composites indicated the following activities:

Collection Location	Isotope Identified	pCi/m^3
Site A1	Beryllium-7	0.018±0.002
Site A7	Beryllium-7	0.028±0.003
Site A8	Beryllium-7	0.066±0.008
Site A9	Beryllium-7	0.043±0.011
Site B3	Beryllium-7	0.030±0.003

No other gamma emitting isotopes of interest were detected in the quarterly site composites.

Results of the airborne radioiodine analyses may be found in Table VIII. No Iodine-131 activity above the lower limit of detection (0.006 pCi/m^3) was detected this quarter.

Levels and fluctuations of activity in the air particulate and radioiodine samples are consistent with the previously accumulated preoperational data.

TABLE VII

GROSS BETA IN AIRBORNE PARTICULATES (pCi/m^3)

THIRD QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3	Weekly Mean Gross Beta Activity ± Standard Deviation of the Mean
07/02/87 - 07/09/87	0.017±0.002	0.020±0.002	0.012±0.002	0.737±0.224*	0.017±0.002	0.017±0.003
07/09/87 - 07/16/87	0.014±0.002	0.016±0.002	0.007±0.002	0.021±0.002	0.021±0.002	0.016±0.006
07/16/87 - 07/23/87	0.028±0.002	0.030±0.002	0.032±0.002	0.020±0.002	0.034±0.002	0.029±0.005
07/23/87 - 07/30/87	0.025±0.002	0.035±0.003	0.015±0.002	*	0.027±0.002	0.026±0.008
07/30/87 - 08/06/87	0.032±0.002	0.041±0.002	0.040±0.056*	0.019±0.037*	0.032±0.002	0.035±0.005
08/06/87 - 08/13/87	0.015±0.002	0.045±0.002	0.020±0.002	0.021±0.002	0.032±0.002	0.027±0.012
08/13/87 - 08/20/87	0.017±0.002	0.029±0.002	0.010±0.002	0.019±0.002	0.011±0.002	0.017±0.008
08/20/87 - 08/27/87	0.015±0.002	0.018±0.002	0.024±0.002	0.020±0.002	0.023±0.002	0.020±0.004
08/27/87 - 09/03/87	0.017±0.002	0.036±0.002	0.020±0.002	0.013±0.002	0.023±0.002	0.022±0.009
09/03/87 - 09/10/87	0.019±0.002	0.048±0.002**	0.026±0.002	0.022±0.002	0.024±0.002	0.028±0.012
09/10/87 - 09/17/87	0.011±0.002	0.031±0.002	0.018±0.002	0.020±0.002	0.025±0.002	0.021±0.008
09/17/87 - 09/24/87	0.015±0.002	0.029±0.002	0.021±0.002	0.015±0.002	0.018±0.002	0.020±0.006
09/24/87 - 10/01/87	0.023±0.002	0.041±0.002	0.020±0.002	0.027±0.003[a]	0.044±0.003[a]	0.031±0.011
Mean Gross Beta Activity ± Standard Deviation of the Mean	0.019±0.006	0.032±0.010	0.019±0.007	0.020±0.004	0.025±0.009	

* Invalid sample - equipment malfunction (not included in mean)

** Verified by reanalysis.

[a] Samples collected 09/28/87 for equipment maintenance purposes.

TABLE VIII

AIRBORNE RADIOIODINE (pCi/m^3)

THIRD QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3
07/02/87 - 07/09/87	*	*	*	a	*
07/09/87 - 07/16/87	*	*	*	*	*
07/16/87 - 07/23/87	*	*	*	*	*
07/23/37 - 07/30/87	*	*	*	a	*
07/30/87 - 08/06/87	*	*	a	a	*
08/06/87 - 08/13/87	*	*	*	*	*
08/13/87 - 08/20/87	*	*	*	*	*
08/20/87 - 08/27/87	*	*	*	*	*
08/27/87 - 09/03/87	*	*	*	*	*
09/03/87 - 09/10/87	*	*	*	*	*
09/10/87 - 09/17/87	*	*	*	*	*
09/17/87 - 09/24/87	*	*	*	*	*
09/24/87 - 10/01/87	*	*	*	*	*

*No Iodine-131 detected above 0.006 pCi/m^3.

[a] Invalid sample - equipment malfunction.

8.2 Thermoluminescent Dosimetry

Thermoluminescent Dosimetry (TLD) was employed to determine direct radiation levels in and around the Callaway Site. Calcium Sulfate:Dy phosphor TLD chips in black polyethylene pouches were placed in plastic holders with areas 1 and 2 containing 0.022 inch copper shielding and areas 3 and 4 containing 0.093 inch copper shielding. The TLD's were placed at 52 locations and exchanged quarterly. (Beginning with the third quarter, 1987, the TLD's are being exchanged quarterly instead of monthly as they have been in the past.)

Data appearing in Table IX is the result of reading and averaging the four quadrants of each TLD chip. Transit control dosimeters were used to determine dosage received during shipment and were subtracted from the gross readings obtained for each monitoring site. Net exposures were obtained by normalizing the total exposures to a 90-day quarter (standard quarter).

Exposure levels for all monitoring locations during the third quarter, 1987, are consistent with background levels detected during the preoperational monitoring program and with levels seen during previous quarters.

TABLE IX

THERMOLUMINESCENT DOSIMETRY

THIRD QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-1	10.6 Mi NW, City Limits of Fulton on Hwy Z	96.19	13.6 ± 1.2	12.7 ± 1.1
CA-IDM-2	6.6 Mi NW, Smola Farm	95.98	11.7 ± 0.8	11.0 ± 0.8
CA-IDM-3	1.6 Mi NW, Callaway Electric Cooperative Utility Pole No. 18450	98.24	16.1 ± 0.9	14.7 ± 0.8
CA-IDM-4	1.9 Mi N, 0.6 miles East of the O and CC Junction	97.11	13.9 ± 1.2	12.9 ± 1.1
CA-IDM-5	1.3 Mi ENE, Primary Meteorological Tower	97.08	12.3 ± 0.8	11.4 ± 0.7
CA-IDM-6	1.8 Mi W, Akers Farm	95.94	10.0 ± 0.6	9.4 ± 0.6
CA-IDM-7	1.3 Mi S, Callaway Electric Cooperative Utility Pole No. 18715	97.16	11.9 ± 0.9	11.0 ± [illegible]
CA-IDM-8	2.9 Mi S, Callaway Electric Cooperative Utility Pole No. 06823	97.16	16.9 ± 1.1	15.7 ± 1.0
CA-IDM-9	3.7 Mi S, NW Side of the Heavy Haul Road and 94 Junction	97.03	14.3 ± 0.6	13.3 ± 0.6
CA-IDM-10	4.0 Mi SE, Callaway Electric Cooperative Utility Pole No. 12179	97.03	14.2 ± 1.3	13.2 ± 1.2
CA-IDM-11	5.0 Mi SE, City of Portland	97.94	14.0 ± 0.8	12.9 ± 0.7
CA-IDM-12	5.3 Mi SE, 0.6 miles South of the 94 and Junction	97.94	12.3 ± 1.2	11.3 ± 1.1
CA-IDM-13	5.6 Mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	97.09	15.0 ± 1.4	13.9 ± 1.3
CA-IDM-14	5.2 Mi ESE, SE Side of Intersection D and 94	97.09	13.6 ± 1.1	12.6 ± 1.0
CA-IDM-15	4.2 Mi ESE, Lamb Farm	97.09	14.1 ± 0.9	13.1 ± 0.8
CA-IDM-16	4.1 Mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	97.08	12.8 ± 1.0	11.9 ± 0.9

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

THIRD QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-17	4.0 Mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	97.09	14.4 ± 1.3	13.3 ± 1.2
CA-IDM-18	3.8 Mi ENE, 0.4 miles South of the D and O Junction	97.09	15.4 ± 1.4	14.3 ± 1.3
CA-IDM-19	4.2 Mi NE, Rivera Farm	97.09	4.9 ± 1.2	13.8 ± 1.1
CA-IDM-20	4.8 Mi NE, Callaway Electric Cooperative Utility Pole No. 12630	97.10	15.9 ± 1.0	14.7 ± 0.9
CA-IDM-21	3.8 Mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	97.10	17.0 ± 1.0	15.8 ± 0.9
CA-IDM-22	2.5 Mi NNE, Lost Canyon Lakes	97.10	15.8 ± 0.6	14.6 ± 0.6
CA-IDM-23	6.7 Mi NNE, City of Yucation	97.10	Missing	Missing
CA-IDM-24	7.0 Mi NE, Bahr Bros. Farm	97.05	10.1 ± 0.3	9.4 ± 0.3
CA-IDM-25	8.7 Mi E, Callaway Electric Cooperative Utility Pole No. 11295	97.09	16.5 ± 1.4	15.3 ± 1.3
CA-IDM-26	12.1 Mi E, Town of Americus	97.09	9.7 ± 0.9	9.0 ± 0.8
CA-IDM-27	9.5 Mi ESE, Town of Bluffton	97.08	15.5 ± 1.3	14.4 ± 1.2
CA-IDM-28	3.3 Mi SE, Callaway Electric Cooperative Utility Pole No. 06896	97.16	15.8 ± 1.2	14.6 ± 1.1
CA-IDM-29	2.7 Mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	96.03	14.3 ± 1.2	13.4 ± 1.1
CA-IDM-30	4.5 Mi SSW, City of Steedman	97.07	14.5 ± 1.0	13.4 ± 0.9
CA-IDM-31	7.6 Mi SW, City of Mokane	97.08	13.6 ± 1.0	12.6 ± 0.9
CA-IDM-32	5.1 Mi WSW, D. Bartley Farm	96.17	16.0 ± 1.1	15.0 ± 1.0
CA-IDM-33	7.3 Mi W, City of Hams Prairie	96.18	14.0 ± 1.3	13.1 ± 1.2
CA-IDM-34	9.5 Mi WNW, 2.5 miles South of O and C Junction	96.17	13.6 ± 1.2	12.7 ± 1.1

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

THIRD QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-35	5.8 Mi NNW, City of Toledo	96.18	13.7 ± 1.2	12.8 ± 1.1
CA-IDM-36	4.9 Mi N, Callaway Electric Cooperative Utility Pole No. 19137	97.10	14.7 ± 1.3	13.6 ± 1.2
CA-IDM-37	0.5 Mi SSW, Piezometer M8 and M6	96.07	15.0 ± 1.0	14.1 ± 0.9
CA-IDM-38	4.5 Mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	96.18	10.2 ± 0.6	9.5 ± 0.6
CA-IDM-39	5.4 Mi NW, Callaway Electric Cooperative Utility Pole No. 17516	96.17	14.3 ± 1.1	13.4 ± 1.0
CA-IDM-40	4.2 Mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	96.17	14.1 ± 1.0	13.2 ± [illegible]
CA-IDM-41	4.8 Mi W, Callaway Electric Cooperative Utility Pole No. 18239	97.16	12.5 ± 2.0	11.6 ± 1.9
CA-IDM-42	4.4 Mi SW, Callaway Electric Cooperative Utility Pole No. 06326	96.17	11.3 ± 0.4	10.6 ± 0.4
CA-IDM-43	0.5 Mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	96.07	13.0 ± 0.8	12.2 ± 0.7
CA-IDM-44	1.7 Mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	97.08	16.8 ± 1.1	15.6 ± 1.0
CA-IDM-45	0.9 Mi WNW, NW Side of Intersection CC and AD	96.16	14.2 ± 0.7	13.3 ± 0.7
CA-IDM-46	1.5 Mi NNW, 0.3 miles South of the CC and O Junction	98.24	15.6 ± 1.2	14.3 ± 1.1
CA-IDM-47	0.9 Mi NNE, County Road 448, 0.9 miles South of Hwy O	97.08	15.5 ± 1.0	14.4 ± 0.9
CA-IDM-48	0.5 Mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 335)	97.08	14.0 ± 0.6	13.0 ± [illegible]

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

THIRD QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem $\pm$ 2σ)	Net Exposure (mRem/Std Qtr $\pm$ 2σ)
CA-IDM-49	1.7 Mi E, Callaway Electric Cooperative Utility Pole No. 06959	97.03	14.9 $\pm$ 0.6	13.8 $\pm$ 0.6
CA-IDM-50	1.1 Mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	97.15	16.0 $\pm$ 0.5	14.8 $\pm$ 0.5
CA-IDM-51	0.7 Mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	97.13	16.8 $\pm$ 1.2	15.6 $\pm$ 1.1
CA-IDM-52	0.3 Mi ESE, Light Pole near the East Plant Security Fence	98.32	14.2 $\pm$ 1.1	13.0 $\pm$ 1.0

8.3 Well Water

Well water samples were collected monthly from three locations and analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-89, Strontium-90, and gamma-emitting nuclides.

Table X presents the results of the radiochemical analyses. Gross Alpha activity ranged from less than 2.0 pCi/l to 4.0±1.5 pCi/l. Gross Beta levels varied from less than 3.0 pCi/l to 11.7±0.8 pCi/l. The Gross Alpha and Gross Beta levels were consistent with the preoperational data.

Results for Tritium analysis were below the lower limit of detection (500 pCi/l) for all samples.

All sample resu. for Strontium 89 and Strontium 90 analysis were below the lower limits of detection (1.5 pCi/l and 1.0 pCi/l respectively).

Gamma spectrometry showed no detectable levels of isotopes of interest. Results are summarized in Table XI.

TABLE X

WELL WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l)				
		Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-WWA-D01	07/14/87	< 2.0	< 3.0	<500	<1.0	<1.5
CA-WWA-D01	08/11/87	4.0 ± 1.5	5.2 ± 0.6	<500	<1.0	<1.5
CA-WWA-D01	09/08/87	3.9 ± 1.7	3.3 ± 0.5	<500	<1.0	<1.5
CA-WWA-F05	07/14/87	2.9 ± 1.2	11.7 ± 0.8	<500	<1.0	<1.5
CA-WWA-F05	08/11/87	< 2.0	8.0 ± 0.7	<500	<1.0	<1.5
CA-WWA-F05	09/08/87	< 2.0	11.2 ± 0.7	<500	<1.0	<1.5
CA-WWA-F15	07/14/87	2.3 ± 1.2	7.8 ± 0.7	<500	<1.0	<1.5
CA-WWA-F15	08/11/87	4.0 ± 1.5	8.3 ± 0.7	<500	<1.0	<1.5
CA-WWA-F15	09/08/87	< 2.0	5.6 ± 0.6	<500	<1.0	<1.5

TABLE XI

WELL WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-WWA-D01	07/14/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	08/11/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	09/08/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	07/14/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	08/11/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	09/08/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	07/14/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	08/11/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	09/08/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.4 Surface Water

Surface water samples were collected from three locations on a monthly basis. During the third quarter, the upstream composite water sampler was inoperable at various times due to equipment failures. Therefore, daily grab samples were taken and composited over the month. Samples were analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XII and XIII.

Gross Alpha and Gross Beta analyses of surface water samples showed a range of activities from less than 2.0 pCi/l to 4.7±1.4 pCi/l and less than 3.0 pCi/l to 18.9±0.9 pCi/l, respectively. The positive Gross Alpha and Gross Beta activities can be attributed to naturally occurring isotopes, such as Potassium-40, and are consistent with the preoperational data.

All Tritium data from surface water samples were below the lower limit of detection (500 pCi/l).

No Strontium-89 or Strontium-90 was detected in any of the surface water samples collected this quarter.

Gamma Spectralanalysis of surface water samples showed no detectable activity from isotopes of interest.

TABLE XII

SURFACE WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l)				
		Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-SWA-S01	07/14/87	3.8 ± 1.3	8.6 ± 0.7	<500	<1.0	<1.5
CA-SWA-S01	08/11/87	4.2 ± 1.5	16.2 ± 0.9	<500	<1.0	<1.5
CA-SWA-S01	09/07/87	3.3 ± 1.3	7.0 ± 0.6	<500	<1.0	<1.5
CA-SWA-S02	07/14/87	<2.0	6.6 ± 0.6	<500	<1.0	<1.5
CA-SWA-S02	08/11/87	<2.0	< 3.0	<500	<1.0	<1.5
CA-SWA-S02	09/09/87	3.2 ± 1.3	8.7 ± 0.7	<500	<1.0	<1.5
CA-SWA-S03	07/07/87	4.7 ± 1.4	18.9 ± 0.9	<500	<1.0	<1.5
CA-SWA-S03	08/21/87	7.2 ± 1.6*	13.4 ± 0.8	<500	<1.0	<1.5
CA-SWA-S03	09/11/87	<2.0	7.4 ± 0.7	<500	<1.0	<1.5

* Verified by reanalysis.

TABLE XIII

SURFACE WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
		pCi/l									
CA-SWA-S01	07/14/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	08/11/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	09/07/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	07/14/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	08/11/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	09/09/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	07/07/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	08/21/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	09/11/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.5 Sediment

Washload, Bedload and Bottom Sediment samples were collected in August from three locations along the Missouri River. Samples were analyzed for Gross Alpha, Gross Beta, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XIV thru XIX.

The following ranges of Gross Alpha and Gross Beta activities were observed in the washload, bedload and bottom sediments.

Sample Type	Gross Alpha Range pCi/g	Gross Beta Range pCi/g
Washload	0.5±0.1 - 1.2±0.4	0.3±0.1 - 0.6±0.1
Bedload	0.7±0.2 - 2.2±0.3	0.3±0.1 - 1.4±0.1
Bottom	1.9±0.3 - 2.3±0.3	0.9±0.1 - 1.3±0.1

The highest activity of Gross Alpha (2.3±0.3 pCi/g) was seen in the Bottom sediment at sample location A (0.6 river miles upstream of discharge north bank). The highest activity of Gross Beta (1.4±0.1 pCi/g) was seen in the Bedload sediment at sample location C (1.0 river miles downstream of discharge north bank).

No Strontium-89 or Strontium-90 was detected in the washload, bedload, or bottom sediments collected during the third quarter of 1987.

Gamma Spectralanalysis of the sediment samples collected during this report period are detailed in Tables XV, XVII and XIX, and are consistent with previous data.

TABLE XIV

WASHLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	08/19/87	0.6±0.2	0.3±0.1	<0.20	<0.30
CA-AQS-C	08/19/87	0.5±0.1	0.4±0.1	<0.20	<0.30
CA-AQS-D	08/20/87	1.2±0.4	0.6±0.1	<0.20	<0.30

TABLE XV

WASHLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	08/19/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	08/19/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	08/20/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XVI

BEDLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	08/19/87	0.7±0.2	0.3±0.1	<0.20	< 0.30
CA-AQS-C	08/19/87	2.2±0.3	1.4±0.1	<0.20	< 0.30
CA-AQS-D	08/20/87	1.5±0.3	1.2±0.1	<0.20	< 0.30

TABLE XVII

BEDLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	08/19/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	08/19/87	**	**	0.12±0.02	**	**	**	**	**	**	**
CA-AQS-D	08/20/87	**	**	0.09±0.03	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XVIII

BOTTOM SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	08/19/87	2.3±0.3	1.3±0.1	<0.20	<0.30
CA-AQS-C	08/19/87	1.9±0.3	1.0±0.1	<0.20	<0.30
CA-AQS-D	08/20/87	2.0±0.3	0.9±0.1	<0.20	<0.30

TABLE XIX

BOTTOM SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	08/19/87	**	**	0.06±0.01	**	**	**	**	**	**	**
CA-AQS-C	08/19/87	**	**	0.12±0.01	**	**	**	**	**	**	**
CA-AQS-D	08/20/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.6 Fish

Fish were collected during the quarter from three collection locations. Types of fish collected during this quarter were: freshwater drum, blue sucker, flathead catfish, shortnose gar, carp, longnose gar, bigmouth buffalo, river carpsucker, channel catfish, blue catfish, smallmouth buffalo, and gizzard shad. Gross Alpha, Gross Beta, Strontium-90, Strontium-89 and Gamma Spectralanalysis were performed on all fish collected each month. Results are presented in Tables XX thru XXV. The activity levels are consistent with the preoperational data.

Gross Alpha activity during this quarter ranged from less than 0.3 pCi/g to 1.2$\pm$0.2 pCi/g. Gross Beta activities ranged from a low of 2.3$\pm$0.1 pCi/g (sample CA-AQF-C, shortnose gar collected 07/09/87) to a high of 8.5$\pm$0.2 pCi/g (sample CA-AQF-D, carp, collected 07/07/87). Gross Alpha and Gross Beta activities seen in fish samples can be attributed to naturally occurring isotopes (e.g. Potassium-40).

All fish data for Strontium-90 and Strontium-89 were below the lower limits of detection of 0.20 pCi/g and 0.30 pCi/g, respectively.

Results of Gamma Spectralanalysis may be found in Tables XXI, XXIII, and XXV.

TABLE XX

FISH - CA-AQF-A

Sample Identification	Collection Date	Grams: Wet Weight	Grams: Dry Weight	Radiochemical Analysis pCi/g (dry): Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Carp	07/09/87	945	243	0.6 ± 0.1	6.2 ± 0.2	<0.20	<0.30
River Carpsucker	07/09/87	889	271	0.8 ± 0.2	6.9 ± 0.2	<0.20	<0.30
Shortnose Gar	07/09/87	1298	459	0.5 ± 0.1	5.4 ± 0.2	<0.20	<0.30
Longnose Gar	07/09/87	1557	571	0.6 ± 0.1	6.4 ± 0.2	<0.20	<0.30
Bigmouth Buffalo	07/09/87	418	105	1.2 ± 0.2	7.9 ± 0.2	<0.20	<0.30
Longnose Gar	08/19/87	1241	430	0.3 ± 0.1	6.4 ± 0.2	<0.20	<0.30
Shortnose Gar	08/19/87	1688	566	< 0.3	4.9 ± 0.1	<0.20	<0.30
Carp	08/19/87	1375	472	0.4 ± 0.1	8.1 ± 0.2	<0.20	<0.30
Freshwater Drum	08/19/87	1141	308	0.3 ± 0.1	8.4 ± 0.2	<0.20	<0.30
Smallmouth Buffalo	08/19/87	828	197	0.5 ± 0.1	7.1 ± 0.2	<0.20	<0.30
Gizzard Shad	09/09/87	460	111	< 0.3	6.9 ± 0.2	<0.20	<0.30
Carp	09/09/87	347	78	< 0.3	6.8 ± 0.2	<0.20	<0.30
Blue Catfish	09/09/87	1106	274	0.3 ± 0.1	6.0 ± 0.2	<0.20	<0.30
Channel Catfish	09/09/87	736	210	< 0.3	6.8 ± 0.2	<0.20	<0.30
Longnose Gar	09/09/87	1468	560	< 0.3	6.9 ± 0.2	<0.20	<0.30

TABLE XXI

FISH - CA-AQF-A

GAMMA SPECTROMETRY

Sample Identification	Date Collected	Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
		pCi/g (dry)									
Carp	07/09/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	07/09/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	07/09/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	07/09/87	**	**	**	**	**	**	**	**	**	**
Bigmouth Buffalo	07/09/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	08/19/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	08/19/87	**	**	**	**	**	**	**	**	**	**
Carp	08/19/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	08/19/87	**	**	**	**	**	**	**	**	**	**
Smallmouth Buffalo	08/19/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	09/09/87	**	**	**	**	**	**	**	**	**	**
Carp	09/09/87	**	**	**	**	**	**	**	**	**	**
Blue Catfish	09/09/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	09/09/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	09/09/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXII

FISH - CA-AQF-C

Sample Identification	Collection Date	Grams Wet Weight	Grams Dry Weight	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Carp	07/09/87	1016	247	< 0.3	3.6 ± 0.1	< 0.20	< 0.30
Bigmouth Buffalo	07/09/87	1135	273	0.8 ± 0.2	8.0 ± 0.2	< 0.20	< 0.30
River Carpsucker	07/09/87	418	100	0.7 ± 0.2	7.6 ± 0.2	< 0.20	< 0.30
Shortnose Gar	07/09/87	1384	529	0.3 ± 0.1	2.3 ± 0.1	< 0.20	< 0.30
Longnose Gar	07/09/87	1289	459	0.4 ± 0.1	5.6 ± 0.2	< 0.20	< 0.30
Carp	08/19/87	941	205	0.4 ± 0.1	7.4 ± 0.2	< 0.20	< 0.30
Longnose Gar	08/19/87	1572	549	< 0.3	6.1 ± 0.2	< 0.20	< 0.30
Shortnose Gar	08/19/87	1816	635	0.3 ± 0.1	5.8 ± 0.1	< 0.20	< 0.30
River Carpsucker	08/19/87	636	140	0.4 ± 0.2	6.8 ± 0.2	< 0.20	< 0.30
Gizzard Shad	08/19/87	879	241	0.5 ± 0.2	8.0 ± 0.2	< 0.20	< 0.30
Carp	09/09/87	842	224	< 0.3	6.6 ± 0.2	< 0.20	< 0.30
Blue Catfish	09/09/87	1689	444	< 0.3	7.1 ± 0.2	< 0.20	< 0.30
Freshwater Drum	09/09/87	845	246	0.3 ± 0.1	5.8 ± 0.2	< 0.20	< 0.30
Flathead Catfish	09/09/87	1233	281	< 0.3	6.2 ± 0.2	< 0.20	< 0.30
Gizzard Shad	09/09/87	1006	319	0.3 ± 0.1	5.9 ± 0.2	< 0.20	< 0.30

TABLE XXIII

FISH - CA-AQF-C

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Carp	07/09/87	**	**	**	**	**	**	**	**	**	**
Bigmouth Buffalo	07/09/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	07/09/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	07/09/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	07/09/87	**	**	**	**	**	**	**	**	**	**
Carp	08/19/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	08/19/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	08/19/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	08/19/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	08/19/87	**	**	**	**	**	**	**	**	**	**
Carp	09/09/87	**	**	**	**	**	**	**	**	**	**
Blue Catfish	09/09/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	09/09/87	**	**	**	**	**	**	**	**	**	**
Flathead Catfish	09/09/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	09/09/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXIV

FISH - CA-AQF-D

Sample Identification	Collection Date	Grams Wet Weight	Grams Dry Weight	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Channel Catfish	07/07/87	1046	334	0.7 ± 0.2	7.1 ± 0.2	< 0.20	< 0.30
Carp	07/07/87	588	134	0.6 ± 0.1	8.5 ± 0.2	< 0.20	< 0.30
Shortnose Gar	07/07/87	1231	451	0.7 ± 0.2	6.4 ± 0.2	< 0.20	< 0.30
Longnose Gar	07/07/87	1449	601	0.6 ± 0.1	5.4 ± 0.2	< 0.20	< 0.30
Blue Sucker	07/07/87	809	304	< 0.3	5.6 ± 0.2	< 0.20	< 0.30
Shortnose Gar	08/20/87	653	446	0.3 ± 0.1	7.3 ± 0.2	< 0.20	< 0.30
River Carpsucker	08/20/87	576	127	0.5 ± 0.2	8.2 ± 0.2	< 0.20	< 0.30
Gizzard Shad	08/20/87	1001	298	< 0.3	4.1 ± 0.1	< 0.20	< 0.30
Carp	08/20/87	520	105	< 0.3	7.0 ± 0.2	< 0.20	< 0.30
Freshwater Drum	08/20/87	789	202	0.4 ± 0.2	7.5 ± 0.2	< 0.20	< 0.30
Channel Catfish	09/11/87	2125	483	< 0.3	7.8 ± 0.2	< 0.20	< 0.30
Freshwater Drum	09/11/87	1164	296	0.3 ± 0.1	6.8 ± 0.2	< 0.20	< 0.30
Carp	09/11/87	749	171	0.3 ± 0.1	6.8 ± 0.2	< 0.20	< 0.30
River Carpsucker	09/11/87	396	85	0.3 ± 0.1	7.9 ± 0.2	< 0.20	< 0.30
Gizzard Shad	09/11/87	725	229	< 0.3	7.2 ± 0.2	< 0.20	< 0.30

TABLE XXV

FISH - CA-AQF-D

GAMMA SPECTROMETRY

Sample Identification	Date Collected	Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
		pCi/g (dry)									
Channel Catfish	07/07/87	**	**	**	**	**	**	**	**	**	**
Carp	07/07/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	07/07/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	07/07/87	**	**	**	**	**	**	**	**	**	**
Blue Sucker	07/07/87	**	**	**	**	**	**	**	**	**	**
Shortnose Gar	08/20/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	08/20/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	08/20/87	**	**	**	**	**	**	**	**	**	**
Carp	08/20/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	08/20/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	09/11/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	09/11/87	**	**	**	**	**	**	**	**	**	**
Carp	09/11/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	09/11/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	09/11/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.7 Milk

Milk samples were collected from two locations, the Green Farm and the Schneider Farm. The Green Farm supplies cow's milk while the Schneider Farm provides both cow's milk and goat's milk. Analyses for Iodine-131, elemental Calcium, Strontium-90, Strontium-89 and Gamma-emitting isotopes were performed on all milk samples. Tables XXVI and XXVII present results of these analyses.

No Iodine-131 above the lower limit of detection (0.5 pCi/l) was detected in the milk samples during this period.

All of the milk samples collected during the third quarter were below the lower limit of detection of 2.0 pCi/l for Strontium-89 and 1.0 pCi/l for Strontium-90.

No gamma-emitting isotopes of interest were detected in any of the milk samples.

TABLE XXVI

FRESH MILK

Collection Date	Radiochemical Iodine-131 pCi/l	Calcium mg/l	Strontium-90 pCi/l	Strontium-89 pCi/l
Green Farm (M-1)				
07/14/87	< 0.5	1100	< 1.0	< 2.0
07/28/87	< 0.5	1500	< 1.0	< 2.0
08/11/87	< 0.5	860	< 1.0	< 2.0
08/25/87	< 0.5	1260	< 1.0	< 2.0
09/08/87	< 0.5	760	< 1.0	< 2.0
09/22/87	< 0.5	1000	< 1.0	< 2.0
Schneider Farm (M5A)				
07/12/87	< 0.5	1000	< 1.0	< 2.0
07/25/87	< 0.5	1400	< 1.0	< 2.0
08/11/87	< 0.5	840	< 1.0	< 2.0
08/23/87	< 0.5	1220	< 1.0	< 2.0
09/08/87	< 0.5	740	< 1.0	< 2.0
09/21/87	< 0.5	1190	< 1.0	< 2.0
Schneider Farm (M5B)				
07/12/87	< 0.5	1100	< 1.0	< 2.0
07/25/87	< 0.5	1400	< 1.0	< 2.0
08/11/87	< 0.5	1100	< 1.0	< 2.0
08/24/87	< 0.5	1600	< 1.0	< 2.0
09/08/87	< 0.5	1170	< 1.0	< 2.0
09/21/87	< 0.5	1450	< 1.0	< 2.0

TABLE XXVII

MILK

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l									
		Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
Green Farm	07/14/87	**	**	**	**	**	**	**	**	**	**
	07/28/87	**	**	**	**	**	**	**	**	**	**
	08/11/87	**	**	**	**	**	**	**	**	**	**
	08/25/87	**	**	**	**	**	**	**	**	**	**
	09/08/87	**	**	**	**	**	**	**	**	**	**
	09/22/87	**	**	**	**	**	**	**	**	**	**
Schneider Cow Milk	07/12/87	**	**	**	**	**	**	**	**	**	**
	07/25/87	**	**	**	**	**	**	**	**	**	**
	08/11/87	**	**	**	**	**	**	**	**	**	**
	08/23/87	**	**	**	**	**	**	**	**	**	**
	09/08/87	**	**	**	**	**	**	**	**	**	**
	09/21/87	**	**	**	**	**	**	**	**	**	**
Schneider Goat Milk	07/13/87	**	**	**	**	**	**	**	**	**	**
	07/25/87	**	**	**	**	**	**	**	**	**	**
	08/11/87	**	**	**	**	**	**	**	**	**	**
	08/24/87	**	**	**	**	**	**	**	**	**	**
	09/08/87	**	**	**	**	**	**	**	**	**	**
	09/21/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.8 Vegetation

Vegetation samples were collected from three (3) sampling locations during the third quarter of 1987. Vegetation samples consisted of lettuce, mustard greens, turnip greens and cabbage collected from the Beazley, Becker and Meehan Farms. All vegetation samples were analyzed for Gross Alpha, Gross Beta, Iodine-131 and by Gamma Spectrometry. Results are presented in Tables XXVIII and XXIX.

Gross Alpha activity ranged from less than lower limit of detection (0.3 pCi/g) to a high of 0.8 ± 0.2 pCi/g at the Beazley Farm (CA-FPL-V3, Mustard Greens) collected on 07/21/87. These Gross Alpha activities are consistent with the levels found during monitoring in previous years.

Gross Beta activity observed in the vegetation samples ranged from 1.1 ± 0.1 pCi/g to 22.2 ± 0.3 pCi/g.

No gamma emitting nuclides of interest were detected in the vegetation samples collected during the third quarter of 1987.

TABLE XXVIII

VEGETATION

Sample Identification; Date Collected	Sample Location	Radiochemical Analysis (pCi/g)		
		Gross Alpha	Gross Beta	Iodine-131
CA-FPL-V3 Lettuce 07/21/87	Beazley Farm	< 0.3	8.5 ± 0.2	< 0.03
CA-FPL-V3 Turnip Greens 07/21/87	Beazley Farm	0.6 ± 0.1	5.7 ± 0.2	< 0.03
CA-FPL-V3 Cabbage 07/21/87	Beazley Farm	< 0.3	5.9 ± 0.2	< 0.03
CA-FPL-V3 Mustard Greens 07/21/87	Beazley Farm	0.8 ± 0.2	17.1 ± 0.3	< 0.03
CA-FPL-V3 Turnip Greens 08/24/87	Beazley Farm	< 0.3	6.0 ± 0.2	< 0.03
CA-FPL-V3 Lettuce 08/24/87	Beazley Farm	0.4 ± 0.1	16.1 ± 0.3	< 0.03
CA-FPL-V6 Lettuce 07/21/87	Becker Farm	< 0.3	15.7 ± 0.2	< 0.03
CA-FPL-V6 Turnip Greens 07/21/87	Becker Farm	< 0.3	9.4 ± 0.2	< 0.03
CA-FPL-V6 Cabbage 07/21/87	Becker Farm	< 0.3	12.6 ± 0.2	< 0.03
CA-FPL-V6 Mustard Greens 07/21/87	Becker Farm	< 0.3	9.6 ± 0.2	< 0.03

TABLE XXVIII (Cont.)

VEGETATION

Sample Identification; Date Collected	Sample Location	Radiochemical Analysis (pCi/g)		
		Gross Alpha	Gross Beta	Iodine-131
CA-FPL-V6 Cabbage 08/24/87	Becker Farm	0.6 ± 0.2	12.5 ± 0.2	< 0.03
CA-FPL-V6 Cabbage 09/18/87	Becker Farm	<0.3	16.5 ± 0.2	< 0.03
CA-FPL-V7 Lettuce 07/21/87	Meehan Farm	< 0.3	22.2 ± 0.3	< 0.03
CA-FPL-V7 Turnip Greens 07/21/87	Meehan Farm	0.6 ± 0.2	7.1 ± 0.2	< 0.03
CA-FPL-V7 Cabbage 07/21/87	Meehan Farm	< 0.3	1.1 ± 0.1	< 0.03
CA-FPL-V7 Mustard Greens 07/21/87	Meehan Farm	0.3 ± 0.2	10.3 ± 0.2	< 0.03
CA-FPL-V7 Turnip Greens 08/24/87	Meehan Farm	0.6 ± 0.2	14.7 ± 0.2	< 0.03
CA-FPL-V7 Mustard Greens 08/24/87	Meehan Farm	0.4 ± 0.1	11.9 ± 0.2	< 0.03
CA-FPL-V7 Cabbage 09/18/87	Meehan Farm	< 0.3	18.7 ± 0.3	< 0.03

TABLE XXIX

VEGETATION

GAMMA SPECTROMETRY

Sample Identification	Date Collected	Cr-51 0.004*	Cs-134 0.029*	Cs-137 0.040*	Co-58 0.020*	Mn-54 0.021*	Fe-59 0.0[illegible]1*	Zn-65 0.060*	Co-60 0.063*	Ba,La-140 0.075*	Zr,Nb-95 0.066*
		pCi/g									
Beazley Farm											
Lettuce	07/21/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	07/21/87	**	**	**	**	**	**	**	**	**	**
Cabbage	07/21/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	07/21/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	08/24/87	**	**	**	**	**	**	**	**	**	**
Lettuce	08/24/87	**	**	**	**	**	**	**	**	**	**
Becker Farm											
Lettuce	07/21/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	07/21/87	**	**	**	**	**	**	**	**	**	**
Cabbage	07/21/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	07/21/87	**	**	**	**	**	**	**	**	**	**
Cabbage	08/24/87	**	**	**	**	**	**	**	**	**	**
Cabbage	09/18/87	**	**	**	**	**	**	**	**	**	**
Meehan Farm											
Lettuce	07/21/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	07/21/87	**	**	**	**	**	**	**	**	**	**
Cabbage	07/21/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	07/21/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	08/24/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	08/24/87	**	**	**	**	**	**	**	**	**	**
Cabbage	09/18/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection (LLD)

**Less than lower limit of detection

APPENDIX A

Results of the EPA Cross-Check Program

1987

EPA CROSS-CHECK PROGRAM

1987

Gross Alpha and Gross Beta in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
1/87	Gross Alpha	11 ± 5	12 ± 2 12 ± 2 12 ± 2
	Gross Beta	10 ± 5	22 ± 6 25 ± 6 27 ± 7
3/87	Gross Alpha	3 ± 5	4 ± 2 4 ± 2 4 ± 2
	Gross Beta	13 ± 5	12 ± 4 9 ± 4 8 ± 4
5/87	Gross Alpha	11 ± 5	11 ± 2 11 ± 2 12 ± 2
	Gross Beta	7 ± 5	17 ± 6 18 ± 6 19 ± 6
7/87	Gross Alpha	5 ± 5	4 ± 2 5 ± 2 6 ± 2
	Gross Beta	5 ± 5	6 ± 3 7 ± 3 9 ± 3

EPA CROSS-CHECK PROGRAM

1987

Gamma in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Cobalt-60	50.0 ± 5.0	55.0 ± 5.0 55.0 ± 5.0 56.0 ± 5.0
	Zinc-65	91.0 ± 5.0	102.0 ± 7.0 114.0 ± 6.0 108.0 ± 6.0
	Ruthenium-106	100.0 ± 5.0	93.0 ± 5.0 105.0 ± 5.0 108.0 ± 5.0
	Cesium-134	59.0 ± 5.0	61.0 ± 3.0 57.0 ± 2.0 60.0 ± 3.0
	Cesium-137	87.0 ± 5.0	109.0 ± 6.0 98.0 ± 6.0 102.0 ± 5.0
6/87	Cobalt-60	64 ± 5	69 ± 5 69 ± 5 71 ± 5
	Zinc-65	10 ± 5	12 ± 3 14 ± 3 16 ± 3
	Ruthenium-106	75 ± 5	80 ± 5 75 ± 5 71 ± 5
	Cesium-134	40 ± 5	40 ± 3 39 ± 3 38 ± 3
	Cesium-137	80 ± 5	82 ± 5 84 ± 5 85 ± 5
	Chromium-51	41 ± 5	46 ± 3 44 ± 3 40 ± 3

EPA CROSS-CHECK PROGRAM

1987

Tritium in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Tritium	4209 ± 421	4600 ± 500 4510 ± 500 4330 ± 500
6/87	Tritium	2895 ± 357	2866 ± 285 2831 ± 288 2792 ± 288

EPA CROSS-CHECK PROGRAM

1987

Strontium In Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Strontium-89	25 ± 5	15 ± 5 17 ± 6 20 ± 5
	Strontium-90	25 ± 1.5	22 ± 5 24 ± 6 24 ± 5

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
8/87	High Level	48 ± 6	43 ± 5 41 ± 4 39 ± 3

EPA CROSS-CHECK PROGRAM

1987

Radionuclides in Milk

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
6/87	Strontium-90	35 ± 1.5	29 ± 3 28 ± 3 32 ± 3
	Cesium-137	74 ± 5	75 ± 2 77 ± 2 70 ± 2

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 In Milk

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Low Level	9.0 ± 0.9	9.0 ± 1.0 8.0 ± 0.5 8.0 ± 0.5
6/87	High Level	59 ± 6	64 ± 2 64 ± 2 63 ± 2

UNION ELECTRIC COMPANY

ST. LOUIS, MISSOURI

CALLAWAY PLANT UNIT 1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

QUARTERLY REPORT FOR OCTOBER, NOVEMBER AND DECEMBER 1987

COPY NO. 11

Prepared By: Bob Bates
Bob Bates, Contract Manager

Approved By: [signature]
James J. Mueller, President

CONTENTS

TABLES

Abstract

Controls for Environmental Pollution, Inc (CEP) has conducted a radiological environmental monitoring program (REMP) for Union Electric Company (UEC), Callaway Plant, Unit 1, since May 5, 1983. This quarterly report presents data for the months of October, November and December 1987.

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

Analytical results are presented and discussed along with other pertinent information. Possible trends and anomalous results, as interpreted by Controls for Environmental Pollution, Inc., are discussed.

1.0 Introduction

This report presents an analysis of the results of the Radiological Environmental Monitoring Program (REMP) conducted during the fourth quarter of 1987 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 radiological environmental monitoring program are as follows: 1) to establish baseline radiation levels in the environs prior to reactor operations; 2) to monitor potential critical pathways of radioeffluent to man; 3) to determine radiological impact on the environment caused by the operation of the Callaway Plant.

A number of techniques are being used to distinguish Callaway Plant effects from other sources during the operational phase, including application of established background levels. Operational radiation levels measured in the vicinity of the Callaway Plant are compared with the pre-operational measurements at each of the sampling locations. In addition, results of the monitoring program help to evaluate sources of elevated levels of radiation during reactor operation in the environment, e.g., atmospheric fallout or abnormal plant releases.

The Callaway Plant is located on a plateau approximately five miles north of the Missouri River in Callaway County, Missouri. The plant consists of one 1150 MWE pressurized water reactor, which achieved initial criticality on October 2, 1984.

2.0 Description of the Monitoring Program

Union Electric Company has contracted with Controls for Environmental Pollution, Inc., starting May, 1983, to determine the radiation levels existing in and around the Callaway Plant area.

A summary of the Callaway Plant Monitoring Program is contained in the first quarter report, 1987 (page 3). No changes in the monitoring program occurred during the third quarter, 1987.

3.0 Analytical Procedures

The analytical procedures routinely used by CEP to analyze samples are discussed in the First Quarter 1987 Report (pages 14 to 18). No new analytical methods were used this quarter.

4.0 Sample Preparation Methods

Sample preparation methods used by CEP are discussed in the First Quarter 1987 Report (page 19). No new sample preparation methods were used this quarter.

5.0 Major Instrumentation

Major analytical instrumentation used by CEP are discussed in the First Quarter 1987 Report (pages 20 to 21). No new instrumentation was used for sample analysis this quarter.

6.0 Isotopic Lower Limits of Detection and Activity Determinations

A discussion of the calculations used in determining lower limits of detection and activity by Controls for Environmental Pollution, Inc., is found in Appendix B, First Quarter 1987 Report.

Table III in the first quarter 1987 report gives the lower limits of detection for radiochemical and chemical analytical methods.

Table IV in the first quarter 1987 report gives the lower limits of detection for Gamma Spectrometry.

The sample counting times and the aliquot size used for lower limit of detection calculations and actual analyses are shown in Tables V and VI, in the first quarter 1987 report, respectively.

7.0 Quality Control Program

A summary of CEP's Quality Control Program is contained in the First Quarter 1987 Report (page 26). No changes in the Quality Control Program occurred this quarter.

8.0 Data Interpretations and Conclusions

This section addresses interpretations and conclusions regarding all types of samples analyzed during this report period.

Analysis and review of data incorporates various techniques from historical comparison to statistical evaluation. Results which do not compare with the historical range are recalculated for verification. If the recalculation verifies the original result, the sample is reanalyzed if possible (i.e. sufficient sample volume or isotope half life). Once it is determined that the results obtained are accurate, a statistical analysis is made. Results which are outliers with respect to historical comparison of previous data are considered out of baseline range or anomolous and will be so noted in the report.

8.1 Airborne Particulates and Radioiodine

Airborne particulate samples were collected at five (5) monitoring stations on a weekly basis from October 1, 1987, through December 30, 1987. The five airborne particulate stations were also collection sites for airborne radioiodine (see Table VIII).

All of the air particulate samples were analyzed for Gross Beta activity. Gamma Spectrometry, Strontium-90 and Strontium-89 analyses were performed on quarterly composites from each station.

The range of Gross Beta activity at each of the sampling locations follows.

Collection Location	Minimum (pCi/m^3)	Maximum (pCi/m^3)
Site A1	0.012 ± 0.001	0.033 ± 0.002
Site A7	0.013 ± 0.002	0.036 ± 0.002
Site A8	0.011 ± 0.001	0.031 ± 0.002
Site A9	0.015 ± 0.002	0.037 ± 0.002
Site B3	0.013 ± 0.002	0.039 ± 0.002

Table VII, Gross Beta in Airborne Particulates, shows that the Gross Beta activity ranged from a minimum at Site A8 of 0.011 ± 0.001 pCi/m^3, collected 10/01/87-10/08/87 to a maximum of 0.039 ± 0.002 pCi/m^3 at Site B3 during the collection period of 10/29/87-11/05/87.

The highest mean Gross Beta activity during the report period was observed at Sites A7 and A9 with mean activities of 0.024 ± 0.007 pCi/m^3 and 0.024 ± 0.006 pCi/m^3, respectively.

Mean weekly Gross Beta activities ranged from a low of 0.015±0.006 pCi/m^3 during the collection period of 10/01/87-10/08/37 to a high of 0.035±0.006 pCi/m^3 during the collection period of 10/29/87-11/05/87.

All of the airborne particulate composite analyses for Strontium-89 and Strontium-90 were less than the lower limit of detection (0.002 pCi/m^3).

Gamma spectralanalysis of the site composites indicated the following activities:

Collection Location	Isotope Identified	pCi/m^3
Site A1	Beryllium-7	0.073±0.029
Site A7	Beryllium-7	0.098±0.031
Site A8	Beryllium-7	0.062±0.025
Site A9	Beryllium-7	0.062±0.039
Site B3	Beryllium-7	0.230±0.120

No other gamma emitting isotopes of interest were detected in the quarterly site composites.

Results of the airborne radioiodine analyses may be found in Table VIII. No Iodine-131 activity above the lower limit of detection (0.006 pCi/m^3) was detected this quarter.

Levels and fluctuations of activity in the air particulate and radioiodine samples are consistent with the previously accumulated preoperational data.

TABLE VII

GROSS BETA IN AIRBORNE PARTICULATES (pCi/m^3)

FOURTH QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3	Weekly Mean Gross Beta Activity ± Standard Deviation of the Mean
10/01/87 - 10/08/87	0.012±0.001	0.021±0.002	0.011±0.001	**	**	0.015±0.006
10/08/87 - 10/15/87	0.019±0.002	0.036±0.002	0.024±0.002	**	**	0.026±0.009
10/15/87 - 10/22/87	0.017±0.002	0.034±0.002	0.024±0.002	**	**	0.025±0.009
10/22/87 - 10/29/87	0.017±0.002	0.025±0.002	0.025±0.002	0.103±0.014*	0.009±0.011*	0.022±0.005
10/29/87 - 11/05/87	**	0.028±0.002	0.040±0.007[a]	0.037±0.002	0.039±0.002	0.035±0.006
11/05/87 - 11/12/87	0.026±0.002	**	0.020±0.002	0.024±0.002	0.018±0.002	0.022±0.004
11/12/87 - 11/18/87	0.022±0.002	0.014±0.002	0.020±0.002	0.020±0.002	0.021±0.002	0.019±0.003
11/18/87 - 11/27/87	0.030±0.002	0.018±0.002	0.027±0.002	0.027±0.002	0.021±0.002	0.025±0.005
11/27/87 - 12/03/87	0.019±0.002	0.019±0.002	0.023±0.002	0.019±0.002	0.023±0.002	0.021±0.002
12/03/87 - 12/10/87	0.025±0.002	0.025±0.002	0.025±0.002	0.025±0.002	0.026±0.002	0.025±0.001
12/10/87 - 12/17/87	0.021±0.002	0.022±0.002	0.018±0.002	0.015±0.002	0.013±0.002	0.018±0.004
12/17/87 - 12/23/87	0.026±0.002	0.029±0.002	0.030±0.002	0.023±0.002	0.028±0.002	0.027±0.003
12/23/87 - 12/30/87	0.033±0.002	0.013±0.002	0.031±0.002	0.029±0.002	0.015±0.002	0.024±0.009
Mean Gross Beta Activity ± Standard Deviation of the Mean	0.022±0.006	0.024±0.007	0.023±0.005	0.024±0.006	0.023±0.008	

*Invalid sample, one day sample (48.1 m^3) - not included in mean

**No sample from station

[a]Invalid sample, one day sampling (69.2 m^3) - not included in mean

TABLE VIII

AIRBORNE RADIOIODINE (pCi/m^3)

FOURTH QUARTER

1987

Collection Period	Site A1	Site A7	Site A8	Site A9	Site B3
10/01/87 - 10/08/87	*	*	*	a	a
10/08/87 - 10/15/87	*	*	*	a	a
10/15/87 - 10/22/87	*	*	*	a	a
10/22/87 - 10/29/87	*	*	*	b	b
10/29/87 - 11/05/87	a	*	b	*	*
11/05/87 - 11/12/87	*	a	*	*	*
11/12/87 - 11/18/87	*	*	*	*	*
11/18/87 - 11/27/87	*	*	*	*	*
11/27/87 - 12/03/87	*	*	*	*	*
12/03/87 - 12/10/87	*	*	*	*	*
12/10/87 - 12/17/87	*	*	*	*	*
12/17/87 - 12/23/87	*	*	*	*	*
12/23/87 - 12/30/87	*	*	*	*	*

*No Iodine-131 detected above 0.006 pCi/m^3

[a]No sample collected from station

[b]Invalid sample

8.2 Thermoluminescent Dosimetry

Thermoluminescent Dosimetry (TLD) was employed to determine direct radiation levels in and around the Callaway Site. Calcium Sulfate:Dy phosphor TLD chips in black polyethylene pouches were placed in plastic holders with areas 1 and 2 containing 0.022 inch copper shielding and areas 3 and 4 containing 0.093 inch copper shielding. The TLD's were placed at 52 locations and exchanged quarterly. (Beginning with the third quarter, 1987, the TLD's are being exchanged quarterly instead of monthly as they have been in the past.)

Data appearing in Table IX is the result of reading and averaging the four quadrants of each TLD chip. Transit control dosimeters were used to determine dosage received during shipment and were subtracted from the gross readings obtained for each monitoring site. Net exposures were obtained by normalizing the total exposures to a 90-day quarter (standard quarter).

Exposure levels for all monitoring locations during the fourth quarter, 1987, are consistent with background levels detected during the preoperational monitoring program and with levels seen during previous quarters.

TABLE IX

THERMOLUMINESCENT DOSIMETRY

FOURTH QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-1	10.6 Mi NW, City Limits of Fulton on Hwy Z	90.83	19.5 ± 1.4	19.3 ± 1.4
CA-IDM-2	6.6 Mi NW, Smola Farm	91.04	18.6 ± 2.6	18.4 ± 2.6
CA-IDM-3	1.6 Mi NW, Callaway Electric Cooperative Utility Pole No. 18450	88.80	19.0 ± 1.8	19.0 ± 1.8
CA-IDM-4	1.9 Mi N, 0.6 miles East of the O and CC Junction	89.91	13.6 ± 2.9	13.6 ± 2.9
CA-IDM-5	1.3 Mi ENE, Primary Meteorological Tower	89.94	16.0 ± 1.9	16.0 ± 1.9
CA-IDM-6	1.8 Mi W, Akers Farm	91.06	16.6 ± 1.6	16.4 ± 1.6
CA-IDM-7	1.3 Mi S, Callaway Electric Cooperative Utility Pole No. 18715	89.01	15.0 ± 1.7	15.2 ± [illegible]
CA-IDM-8	2.9 Mi S, Callaway Electric Cooperative Utility Pole No. 06823	89.01	19.5 ± 1.5	19.5 ± 1.5
CA-IDM-9	3.7 Mi S, NW Side of the Heavy Haul Road and 94 Junction	89.95	18.0 ± 1.6	18.0 ± 1.6
CA-IDM-10	4.0 Mi SE, Callaway Electric Cooperative Utility Pole No. 12179	89.95	16.6 ± 0.9	16.6 ± 0.9
CA-IDM-11	5.0 Mi SE, City of Portland	89.02	21.3 ± 1.0	21.5 ± 1.0
CA-IDM-12	5.3 Mi SE, 0.6 miles South of the 94 and Junction	89.02	19.7 ± 2.5	19.9 ± 2.5
CA-IDM-13	5.6 Mi ESE, 1 mile South of 94, 0.75 miles East of the D and 94 Junction	89.94	17.1 ± 1.5	17.1 ± 1.5
CA-IDM-14	5.2 Mi ESE, SE Side of Intersection D and 94	89.94	17.3 ± 2.1	17.3 ± 2.1
CA-IDM-15	4.2 Mi ESE, Lamb Farm	89.94	17.2 ± 2.2	17.2 ± 2.2
CA-IDM-16	4.1 Mi ENE, Callaway Electric Cooperative Utility Pole No. 12976	89.94	16.4 ± 1.6	16.4 ± [illegible]

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

FOURTH QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-17	4.0 Mi E, 0.5 miles East of D, 1.5 miles South of D and O Junction	89.94	18.2 ± 1.8	18.2 ± 1.8
CA-IDM-18	3.8 Mi ENE, 0.4 miles South of the D and O Junction	89.94	17.6 ± 1.3	17.6 ± 1.3
CA-IDM-19	4.2 Mi NE, Rivera Farm	89.94	20.8 ± 2.4	20.8 ± 2.4
CA-IDM-20	4.8 Mi NE, Callaway Electric Cooperative Utility Pole No. 12630	89.92	16.8 ± 1.7	16.8 ± 1.7
CA-IDM-21	3.8 Mi NNE, Callaway Electric Cooperative Utility Pole No. 19100	89.91	19.2 ± 1.7	19.2 ± 1.7
CA-IDM-22	2.5 Mi NNE, Lost Canyon Lakes	89.91	19.1 ± 1.0	19.1 ± 1.0
CA-IDM-23	6.7 Mi NNE, City of Yucation	89.92	17.1 ± 1.3	17.1 ± 1.3
CA-IDM-24	7.0 Mi NE, Bahr Bros. Farm	89.97	6.2 ± 1.0	6.2 ± 1.0
CA-IDM-25	8.7 Mi E, Callaway Electric Cooperative Utility Pole No. 11295	89.94	15.5 ± 2.0	15.5 ± 2.0
CA-IDM-26	12.1 Mi E, Town of Americus	89.93	12.3 ± 1.2	12.3 ± 1.2
CA-IDM-27	9.5 Mi ESE, Town of Bluffton	89.94	Missing	
CA-IDM-28	3.3 Mi SE, Callaway Electric Cooperative Utility Pole No. 06896	89.01	18.9 ± 1.1	19.1 ± 1.1
CA-IDM-29	2.7 Mi SSW, Callaway Electric Cooperative Utility Pole No. 06851	89.95	16.4 ± 1.5	16.4 ± 1.5
CA-IDM-30	4.5 Mi SSW, City of Steedman	89.10	16.6 ± 2.1	16.8 ± 2.1
CA-IDM-31	7.6 Mi SW, City of Mokane	89.09	17.8 ± 1.6	18.0 ± 1.6
CA-IDM-32	5.1 Mi WSW, D. Bartley Farm	90.82	17.1 ± 1.8	16.9 ± 1.8
CA-IDM-33	7.3 Mi W, City of Hams Prairie	90.81	17.8 ± 1.4	17.6 ± 1.4
CA-IDM-34	9.5 Mi WNW, 2.5 miles South of O and C Junction	90.82	17.9 ± 1.3	17.7 ± 1.3

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

FOURTH QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-35	5.8 Mi NNW, City of Toledo	90.83	17.5 ± 2.0	17.3 ± 2.0
CA-IDM-36	4.9 Mi N, Callaway Electric Cooperative Utility Pole No. 19137	89.91	23.1 ± 1.9	23.1 ± 1.9
CA-IDM-37	0.5 Mi SSW, Piezometer M8 and M6	90.10	19.3 ± 2.0	19.3 ± 2.0
CA-IDM-38	4.5 Mi NNW, Callaway Electric Cooperative Utility Pole No. 34708	90.83	16.5 ± 2.3	16.3 ± 2.3
CA-IDM-39	5.4 Mi NW, Callaway Electric Cooperative Utility Pole No. 17516	90.84	19.7 ± 2.6	19.5 ± 2.6
CA-IDM-40	4.2 Mi WNW, Callaway Electric Cooperative Utility Pole No. 18145	90.84	19.2 ± 2.1	19.0 ± [illegible]
CA-IDM-41	4.8 Mi W, Callaway Electric Cooperative Utility Pole No. 18239	89.83	19.1 ± 2.6	19.1 ± 2.6
CA-IDM-42	4.4 Mi SW, Callaway Electric Cooperative Utility Pole No. 06326	90.82	13.7 ± 2.8	13.6 ± 2.8
CA-IDM-43	0.5 Mi SW, Plant Security and Wildlife Management Area Sign Post (Heavy Haul Road)	90.11	18.8 ± 1.9	18.8 ± 1.9
CA-IDM-44	1.7 Mi WSW, Callaway Electric Cooperative Utility Pole No. 18769	89.10	19.2 ± 2.0	19.4 ± 2.0
CA-IDM-45	0.9 Mi WNW, NW Side of Intersection CC and AD	90.84	20.3 ± 2.2	20.1 ± 2.2
CA-IDM-46	1.5 Mi NNW, 0.3 miles South of the CC and O Junction	88.80	18.5 ± 3.0	18.8 ± 3.0
CA-IDM-47	0.9 Mi NNE, County Road 448, 0.9 miles South of Hwy O	89.94	19.2 ± 1.7	19.2 ± 1.7
CA-IDM-48	0.5 Mi NE, Plant Security and Wildlife Management Area Sign Post (County Road 335)	89.94	20.7 ± 3.0	20.7 ± [illegible]

TABLE IX (Cont.)

THERMOLUMINESCENT DOSIMETRY

FOURTH QUARTER 1987

Station Identification	Collection Location	Field Time (Days)	Total Exposure (mRem ± 2σ)	Net Exposure (mRem/Std Qtr ± 2σ)
CA-IDM-49	1.7 Mi E, Callaway Electric Cooperative Utility Pole No. 06959	89.95	20.6 ± 2.2	20.6 ± 2.2
CA-IDM-50	1.1 Mi SSE, Heavy Haul Road, Intake/Discharge Pipeline Marker	89.01	21.3 ± 2.2	21.5 ± 2.2
CA-IDM-51	0.7 Mi SE, Located in the "Y" of the Railroad Spur, NW of Sludge Lagoon	89.87	21.2 ± 1.8	21.2 ± 1.8
CA-IDM-52	0.3 Mi ESE, Light Pole near the East Plant Security Fence	88.69	17.7 ± 4.6	18.0 ± 4.7

8.3 Well Water

Well water samples were collected monthly from three locations and analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-89, Strontium-90, and gamma-emitting nuclides.

Table X presents the results of the radiochemical analyses. Gross Alpha activity ranged from less than 2.0 pCi/l to 3.8±1.4 pCi/l. Gross Beta levels varied from less than 3.0 pCi/l to 9.4±0.7 pCi/l. The Gross Alpha and Gross Beta levels were consistent with the preoperational data.

Results for Tritium analysis were below the lower limit of detection (500 pCi/l) for all samples.

All sample results for Strontium 89 and Strontium 90 analysis were below the lower limits of detection (1.5 pCi/l and 1.0 pCi/l respectively).

Gamma spectrometry showed no detectable levels of isotopes of interest. Results are summarized in Table XI.

TABLE X

WELL WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l)				
		Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-WWA-D01	10/13/87	3.0 ± 1.4	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-D01	11/20/87	3.8 ± 1.4	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-D01	12/07/87	3.2 ± 1.6	< 3.0	< 500	< 1.0	< 1.5
CA-WWA-F05	10/13/87	< 2.0	9.4 ± 0.7	< 500	< 1.0	< 1.5
CA-WWA-F05	11/05/87	3.7 ± 1.4	4.5 ± 0.5	< 500	< 1.0	< 1.5
CA-WWA-F05	12/07/87	1.2 ± 0.7	3.4 ± 0.5	< 500	< 1.0	< 1.5
CA-WWA-F15	10/13/87	2.2 ± 1.3	5.8 ± 0.6	< 500	< 1.0	< 1.5
CA-WWA-F15	11/05/87	3.2 ± 1.3	8.0 ± 0.6	< 500	< 1.0	< 1.5
CA-WWA-F15	12/07/87	3.5 ± 1.7	6.3 ± 0.6	< 500	< 1.0	< 1.5

TABLE XI

WELL WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-WWA-D01	10/13/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	11/20/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-D01	12/07/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	10/13/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	11/05/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F05	12/07/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	10/13/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	11/05/87	**	**	**	**	**	**	**	**	**	**
CA-WWA-F15	12/07/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.4 Surface Water

Surface water samples were collected from three locations on a monthly basis. Samples were analyzed for Gross Alpha, Gross Beta, Tritium, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XII and XIII.

Gross Alpha and Gross Beta analyses of surface water samples showed a range of activities from less than 2.0 pCi/l to 4.7$\pm$1.5 pCi/l and 4.3$\pm$0.5 pCi/l to 16.0$\pm$1.0 pCi/l, respectively. The positive Gross Alpha and Gross Beta activities can be attributed to naturally occurring isotopes, such as Potassium-40, and are consistent with the preoperational data.

All Tritium data from surface water samples were below the lower limit of detection (500 pCi/l).

No Strontium-89 or Strontium-90 was detected in any of the surface water samples collected this quarter.

Gamma Spectralanalysis of surface water samples showed no detectable activity from isotopes of interest.

TABLE XII

SURFACE WATER

Sample Identification	Collection Date	Radiochemical Analysis (pCi/l) Gross Alpha	Gross Beta	Tritium	Strontium-90	Strontium-89
CA-SWA-S01	10/13/87	< 2.0	7.9 ± 0.7	< 500	< 1.0	< 1.5
CA-SWA-S01	11/10/87	4.0 ± 1.4	4.3 ± 0.5	< 500	< 1.0	< 1.5
CA-SWA-S01	12/07/87	3.2 ± 1.6	5.9 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S02	10/13/87	3.6 ± 1.5	16.0 ± 1.0*	< 500	< 1.0	< 1.5
CA-SWA-S02	11/10/87	4.7 ± 1.5	5.5 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S02	12/07/87	< 2.0	5.3 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S03	10/13/87	< 2.0	5.5 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S03	11/04/87	2.0 ± 1.0	6.5 ± 0.6	< 500	< 1.0	< 1.5
CA-SWA-S03	12/04/87	3.4 ± 1.6	8.7 ± 0.7	< 500	< 1.0	< 1.5

*Verified by reanalysis

TABLE XIII

SURFACE WATER

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/l Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
CA-SWA-S01	10/13/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	11/10/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S01	12/07/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	10/13/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	11/10/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S02	12/07/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	10/13/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	11/04/87	**	**	**	**	**	**	**	**	**	**
CA-SWA-S03	12/04/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.5 Sediment

Washload, Bedload and Bottom Sediment samples were collected in November from three locations along the Missouri River. Samples were analyzed for Gross Alpha, Gross Beta, Strontium-90, Strontium-89, and by Gamma Spectrometry. Results are summarized in Tables XIV thru XIX.

The following ranges of Gross Alpha and Gross Beta activities were observed in the washload, bedload and bottom sediments.

Sample Type	Gross Alpha Range pCi/g	Gross Beta Range pCi/g
Washload	<0.3 - 1.2±1.1	<0.2 - 12.4±0.8
Bedload	<0.3	<0.2 - 0.5±0.3
Bottom	1.8±0.3 - 4.0±0.6	1.2±0.1 - 3.0±0.2

The highest activity of Gross Alpha (4.0±0.6 pCi/g) was seen in the Bottom sediment at sample location D (59.5 river miles downstream of discharge south bank). The highest activity of Gross Beta (12.4±0.8 pCi/g) was seen in the Washload sediment at sample location D (59.5 river miles downstream of discharge south bank).

No Strontium-89 or Strontium-90 was detected in the washload, bedload, or bottom sediments collected during the fourth quarter of 1987.

Gamma Spectralanalysis of the sediment samples collected during this report period are detailed in Tables XV, XVII and XIX, and are consistent with previous data.

One Shoreline sediment sample was collected on 11/09/87 and exhibited a Gross Alpha activity of 3.4$\pm$0.4 pCi/g, and a Gross Beta activity of 2.1$\pm$0.1 pCi/g. Gamma Spectranalysis indicated a Cesium-137 activity of 0.07$\pm$0.01 pCi/g. No Strontium-89 or Strontium-90 activity was detected.

TABLE XIV

WASHLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	11/12/87	< 0.3	< 0.2	< 0.20	< 0.30
CA-AQS-C	11/12/87	< 0.3	< 0.2	< 0.20	< 0.30
CA-AQS-D	11/03/87	1.2±1.1	12.4±0.8	< 0.20	< 0.30

TABLE XV

WASHLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	11/12/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	11/12/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	11/03/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XVI

BEDLOAD SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	11/12/87	< 0.3	< 0.2	< 0.20	< 0.30
CA-AQS-C	11/12/87	< 0.3	0.5±0.3	< 0.20	< 0.30
CA-AQS-D	11/03/87	< 0.3	< 0.2	< 0.20	< 0.30

TABLE XVII

BEDLOAD SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	11/12/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	11/12/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-D	11/03/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XVIII

BOTTOM SEDIMENT

Sample Identification	Collection Date	Radiochemical Analysis pCi/g (dry)			
		Gross Alpha	Gross Beta	Strontium-90	Strontium-89
CA-AQS-A	11/12/87	1.8±0.3	1.2±0.1	< 0.20	< 0.30
CA-AQS-C	11/12/87	2.3±0.3	1.2±0.1	< 0.20	< 0.30
CA-AQS-D	11/03/87	4.0±0.6	3.0±0.2	< 0.20	< 0.30

TABLE XIX

BOTTOM SEDIMENT

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry)									
		Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
CA-AQS-A	11/12/87	**	**	**	**	**	**	**	**	**	**
CA-AQS-C	11/12/87	**	**	0.05±0.01	0.25±0.07	**	**	**	**	**	**
CA-AQS-D	11/03/87	**	**	0.15±0.06	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.6 <u>Fish</u>

Fish were collected during the quarter from three locations. Types of fish collected during this quarter were: freshwater drum, blue sucker, carp, longnose gar, bigmouth buffalo, river carpsucker, goldeye, shorthead redhorse, channel catfish, blue catfish and gizzard shad. Gross Alpha, Gross Beta, Strontium-90, Strontium-89 and Gamma Spectralanalysis were performed on all fish collected each month. Results are presented in Tables XX thru XXV. The activity levels are consistent with the preoperational data.

Gross Alpha activity during this quarter ranged from less than 0.3 pCi/g to 0.4$\pm$0.1 pCi/g. Gross Beta activities ranged from a low of 2.5$\pm$0.1 pCi/g (sample CA-AQF-D, channel catfish collected 11/03/87) to a high of 8.6$\pm$0.2 pCi/g (sample CA-AQF-C, freshwater drum collected 12/03/87). Gross Alpha and Gross Beta activities seen in fish samples can be attributed to naturally occurring isotopes (e.g. Potassium-40).

All fish data for Strontium-90 and Strontium-89 were below the lower limits of detection of 0.20 pCi/g and 0.30 pCi/g, respectively.

Results of Gamma Spectralanalysis may be found in Tables XXI, XXIII, and XXV.

TABLE XX

FISH - CA-AQF-A

Sample Identification	Collection Date	Grams Wet Weight	Grams Dry Weight	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Freshwater Drum	10/15/87	721	217	0.3 ± 1	6.2 ± 0.2	< 0.20	< 0.30
Longnose Gar	10/15/87	1542	545	< 0.3	7.0 ± 0.2	< 0.20	< 0.30
Gizzard Shad	10/15/87	1023	339	< 0.3	6.3 ± 0.2	< 0.20	< 0.30
Carp	10/15/87	991	260	< 0.3	6.3 ± 0.2	< 0.20	< 0.30
Blue Sucker	10/15/87	408	104	0.4 ± 0.1	7.5 ± 0.2	< 0.20	< 0.30
Gizzard Shad	11/12/87	496	97	< 0.3	6.3 ± 0.2	< 0.20	< 0.30
Freshwater Drum	11/12/87	268	55	0.3 ± 0.1	4.2 ± 0.1	< 0.20	< 0.30
Carp	11/12/87	561	98	0.4 ± 0.1	4.8 ± 0.1	< 0.20	< 0.30
River Carpsucker	11/12/87	485	97	0.3 ± 0.1	7.5 ± 0.2	< 0.20	< 0.30
Blue Catfish	11/12/87	421	90	0.4 ± 0.1	4.8 ± 0.1	< 0.20	< 0.30
Goldeye	12/03/87	1821	632	< 0.3	4.3 ± 0.1	< 0.20	< 0.30
River Carpsucker	12/03/87	201	54	< 0.3	7.0 ± 0.2	< 0.20	< 0.30
Freshwater Drum	12/03/87	8030	7699	< 0.3	4.4 ± 0.1	< 0.20	< 0.30
Gizzard Shad	12/03/87	1660	505	< 0.3	6.9 ± 0.2	< 0.20	< 0.30
Shorthead Redhorse	12/03/87	687	156	< 0.3	7.8 ± 0.2	< 0.20	< 0.30

TABLE XXI

FISH - CA-AQF-A

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Freshwater Drum	10/15/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	10/15/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	10/15/87	**	**	**	**	**	**	**	**	**	**
Carp	10/15/87	**	**	**	**	**	**	**	**	**	**
Blue Sucker	10/15/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	11/12/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	11/12/87	**	**	**	**	**	**	**	**	**	**
Carp	11/12/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	11/12/87	**	**	**	**	**	**	**	**	**	**
Blue Catfish	11/12/87	**	**	**	**	**	**	**	**	**	**
Goldeye	12/03/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	12/03/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	12/03/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	12/03/87	**	**	**	**	**	**	**	**	**	**
Shorthead Redhorse	12/03/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXII

FISH - CA-AQF-C

Sample Identification	Collection Date	Grams Wet Weight	Grams Dry Weight	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Gizzard Shad	10/15/87	821	238	0.3 ± 0.1	7.8 ± 0.2	< 0.20	< 0.30
Carp	10/15/87	627	120	0.3 ± 0.1	7.3 ± 0.2	< 0.20	< 0.30
Blue Sucker	10/15/87	350	94	0.3 ± 0.1	7.2 ± 0.2	< 0.20	< 0.30
Longnose Gar	10/15/87	1127	382	0.3 ± 0.1	6.2 ± 0.2	< 0.20	< 0.30
Freshwater Drum	10/15/87	792	229	0.3 ± 0.1	8.2 ± 0.2	< 0.20	< 0.30
Gizzard Shad	11/12/87	402	97	0.4 ± 0.1	5.7 ± 0.2	< 0.20	< 0.30
River Carpsucker	11/12/87	453	100	< 0.3	4.1 ± 0.1	< 0.20	< 0.30
Freshwater Drum	11/12/87	349	75	0.4 ± 0.1	4.8 ± 0.1	< 0.20	< 0.30
Channel Catfish	11/12/87	139	51	< 0.3	6.9 ± 0.2	< 0.20	< 0.30
Carp	11/12/87	469	102	0.3 ± 0.1	3.6 ± 0.1	< 0.20	< 0.30
Freshwater Drum	12/03/87	751	174	< 0.3	8.6 ± 0.2	< 0.20	< 0.30
Goldeye	12/03/87	560	177	< 0.3	6.6 ± 0.2	< 0.20	< 0.30
River Carpsucker	12/03/87	1376	84	< 0.3	7.2 ± 0.2	< 0.20	< 0.30
Gizzard Shad	12/03/87	1481	459	< 0.3	7.2 ± 0.2	< 0.20	< 0.30
Carp	12/03/87	147	25	< 0.3	4.1 ± 0.1	< 0.20	< 0.30

TABLE XXIII

FISH - CA-AQF-C

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.0[illegible]*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Gizzard Shad	10/15/87	**	**	**	**	**	**	**	**	**	**
Carp	10/15/87	**	**	**	**	**	**	**	**	**	**
Blue Sucker	10/15/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	10/15/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	10/15/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	11/12/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	11/12/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	11/12/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	11/12/87	**	**	**	**	**	**	**	**	**	**
Carp	11/12/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	12/03/87	**	**	**	**	**	**	**	**	**	**
Goldeye	12/03/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	12/03/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	12/03/87	**	**	**	**	**	**	**	**	**	**
Carp	12/03/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

TABLE XXIV

FISH - CA-AQF-D

Sample Identification	Collection Date	Grams Wet Weight	Grams Dry Weight	Radiochemical Analysis pCi/g (dry) Gross Alpha	Gross Beta	Strontium-90	Strontium-89
Blue Catfish	10/13/87	920	207	< 0.3	8.2 ± 0.2	< 0.20	< 0.30
Blue Sucker	10/13/87	644	184	0.3 ± 0.1	5.8 ± 0.2	< 0.20	< 0.30
Freshwater Drum	10/13/87	608	131	0.3 ± 0.1	7.4 ± 0.2	< 0.20	< 0.30
River Carpsucker	10/13/87	421	106	0.3 ± 0.1	6.9 ± 0.2	< 0.20	< 0.30
River Carp	10/13/87	661	153	0.3 ± 0.1	6.9 ± 0.2	< 0.20	< 0.30
Carp	11/03/87	937	275	< 0.3	4.1 ± 0.1	< 0.20	< 0.30
River Carpsucker	11/03/87	641	150	< 0.3	6.8 ± 0.2	< 0.20	< 0.30
Freshwater Drum	11/03/87	606	177	< 0.3	4.0 ± 0.1	< 0.20	< 0.30
Bigmouth Buffalo	11/03/87	1091	252	< 0.3	5.4 ± 0.2	< 0.20	< 0.30
Channel Catfish	11/03/87	613	147	< 0.3	2.5 ± 0.1	< 0.20	< 0.30
Carp	12/04/87	829	195	< 0.3	7.1 ± 0.2	< 0.20	< 0.30
River Carpsucker	12/04/87	483	131	< 0.3	5.8 ± 0.2	< 0.20	< 0.30
Channel Catfish	12/04/87	716	146	< 0.3	7.2 ± 0.2	< 0.20	< 0.30
Gizzard Shad	12/04/87	1004	177	< 0.3	6.9 ± 0.2	< 0.20	< 0.30
Longnose Gar	12/04/87	2307	1812	< 0.3	5.1 ± 0.1	< 0.20	< 0.30

TABLE XXV

FISH - CA-AQF-D

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.03*	Cs-137 0.04*	Co-58 0.02*	Mn-54 0.02*	Fe-59 0.02*	Zn-65 0.05*	Co-60 0.02*	Ba,La-140 0.01*	Zr,Nb-95 0.08*
Blue Catfish	10/13/87	**	**	**	**	**	**	**	**	**	**
Blue Sucker	10/13/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	10/13/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	10/13/87	**	**	**	**	**	**	**	**	**	**
River Carp	10/13/87	**	**	**	**	**	**	**	**	**	**
Carp	11/03/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	11/03/87	**	**	**	**	**	**	**	**	**	**
Freshwater Drum	11/03/87	**	**	**	**	**	**	**	**	**	**
Bigmouth Buffalo	11/03/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	11/03/87	**	**	**	**	**	**	**	**	**	**
Carp	12/04/87	**	**	**	**	**	**	**	**	**	**
River Carpsucker	12/04/87	**	**	**	**	**	**	**	**	**	**
Channel Catfish	12/04/87	**	**	**	**	**	**	**	**	**	**
Gizzard Shad	12/04/87	**	**	**	**	**	**	**	**	**	**
Longnose Gar	12/04/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.7 Milk

Milk samples were collected from two locations, the Green Farm and the Schneider Farm. The Green Farm supplies cow's milk while the Schneider Farm provides both cow's milk and goat's milk. Analyses for Iodine-131, elemental Calcium, Strontium-90, Strontium-89 and Gamma-emitting isotopes were performed on all milk samples. Tables XXVI and XXVII present results of these analyses.

No Iodine-131 above the lower limit of detection (0.5 pCi/l) was detected in the milk samples during this period.

Two milk samples indicated the presence of Strontium-90. The cow's milk and goat's milk collected on 10/11/87 from the Schneider Farm had activity of 4.2 ± 0.5 pCi/l and 3.2 ± 0.9 pCi/l, respectively.

All of the other milk samples collected during the fourth quarter were below the lower limit of detection of 2.0 pCi/l for Strontium-89 and 1.0 pCi/l for Strontium-90.

No gamma-emitting isotopes of interest were detected in any of the milk samples.

TABLE XXVI

FRESH MILK

Collection Date	Iodine-131 pCi/l	Calcium mg/l	Strontium-90 pCi/l	Strontium-89 pCi/l
	Radiochemical			
Green Farm (M-1)				
10/13/87	< 0.5	1140	< 1.0	< 2.0
11/08/87	< 0.5	850	< 1.0	< 2.0
12/07/87	< 0.5	1270	< 1.0	< 2.0
Schneider Farm (M5A)				
10/11/87	< 0.5	930	4.2 ± 0.5*	< 2.0
11/08/87	< 0.5	900	< 1.0	< 2.0
12/07/87	< 0.5	1110	< 1.0	< 2.0
Schneider Farm (M5B)				
10/12/87	< 0.5	1150	3.2 ± 0.9*	< 2.0

*Verified by reanalysis.

TABLE XXVII

MILK

GAMMA SPECTROMETRY

Sample Identification	Date Collected	Cr-51 18*	Cs-134 10*	Cs-137 2*	Co-58 3*	Mn-54 2*	Fe-59 3*	Zn-65 16*	Co-60 5*	Ba,La-140 4*	Zr,Nb-95 8*
		pCi/l									
Green Farm	10/13/87	**	**	**	**	**	**	**	**	**	**
	11/08/87	**	**	**	**	**	**	**	**	**	**
	12/07/87	**	**	**	**	**	**	**	**	**	**
Schneider Cow Milk	10/11/87	**	**	**	**	**	**	**	**	**	**
	11/08/87	**	**	**	**	**	**	**	**	**	**
	12/07/87	**	**	**	**	**	**	**	**	**	**
Schneider Goat Milk	10/12/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.8 Vegetation

Vegetation samples were collected from two (2) sampling locations during the fourth quarter of 1987. Vegetation samples consisted of lettuce, mustard greens, spinach, turnip greens and cabbage collected from the Becker and Meehan Farms. All vegetation samples were analyzed for Gross Alpha, Gross Beta, Iodine-131 and by Gamma Spectrometry. Results are presented in Tables XXVIII and XXIX.

Gross Alpha activity ranged from less than lower limit of detection (0.3 pCi/g) to a high of 0.3 ± 0.2 pCi/g at the Meehan Farm (lettuce and turnip greens) collected on 10/21/87. These Gross Alpha activities are consistent with the levels found during monitoring in previous years.

Gross Beta activity observed in the vegetation samples ranged from 5.0 ± 0.1 pCi/g to 24.0 ± 0.3 pCi/g.

No gamma emitting nuclides of interest were detected in the vegetation samples collected during the fourth quarter of 1987.

TABLE XXVIII

VEGETATION

Sample Identification; Date Collected	Sample Location	Radiochemical Analysis (pCi/g)		
		Gross Alpha	Gross Beta	Iodine-131
CA-FPL-V6 Cabbage 10/21/87	Becker Farm	< 0.3	10.8 ± 0.2	< 0.03
CA-FPL-V7 Cabbage 10/21/87	Meehan Farm	< 0.3	14.6 ± 0.2	< 0.03
CA-FPL-V7 Lettuce 10/21/87	Meehan Farm	0.3 ± 0.2	24.0 ± 0.3	< 0.03
CA-FPL-V7 Spinach 10/21/87	Meehan Farm	< 0.3	21.7 ± 0.3	< 0.03
CA-FPL-V7 Turnip Greens 10/21/87	Meehan Farm	0.3 ± 0.2	13.7 ± 0.2	< 0.03
CA-FPL-V7 Mustard Greens 10/21/87	Meehan Farm	< 0.3	12.2 ± 0.2	< 0.03
CA-FPL-V7 Cabbage 11/24/87	Meehan Farm	< 0.3	5.0 ± 0.1	< 0.03
CA-FPL-V7 Lettuce 11/24/87	Meehan Farm	< 0.3	14.0 ± 0.2	< 0.03
CA-FPL-V7 Spinach 11/24/87	Meehan Farm	< 0.3	23.3 ± 0.3	< 0.03
CA-FPL-V7 Mustard Greens 11/24/87	Meehan Farm	< 0.3	17.0 ± 0.2	< 0.03
CA-FPL-V7 Turnip Greens 11/24/87	Meehan Farm	< 0.3	12.2 ± 0.2	< 0.03

TABLE XXIX

VEGETATION

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g Cr-51 0.004*	Cs-134 0.029*	Cs-137 0.040*	Co-58 0.020*	Mn-54 0.021*	Fe-59 0.021*	Zn-65 0.060*	Co-60 0.063*	Ba,La-140 0.075*	Zr,Nb-95 0.066*
Becker Farm											
Cabbage	10/21/87	**	**	**	**	**	**	**	**	**	**
Meehan Farm											
Cabbage	10/21/87	**	**	**	**	**	**	**	**	**	**
Lettuce	10/21/87	**	**	**	**	**	**	**	**	**	**
Spinach	10/21/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	10/21/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	10/21/87	**	**	**	**	**	**	**	**	**	**
Cabbage	11/24/87	**	**	**	**	**	**	**	**	**	**
Lettuce	11/24/87	**	**	**	**	**	**	**	**	**	**
Spinach	11/24/87	**	**	**	**	**	**	**	**	**	**
Turnip Greens	11/24/87	**	**	**	**	**	**	**	**	**	**
Mustard Greens	11/24/87	**	**	**	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

8.9 Soil

Soil samples were collected from eleven locations during the fourth quarter of 1987. Soil was analyzed for Gross Alpha activity, Gross Beta activity and by Gamma Spectralanalysis. Results of these analyses are found in Table XXX and XXXI.

Gross Alpha activity in the soil samples ranged from a low of 2.6±0.3 pCi/g at Callaway Plant Forest, Ecology Plot F1; to a high of 5.9±0.5 pCi/g at Callaway Plant Forest, Ecology Plot F9.

Gross Beta activity ranged from 2.0±0.1 pCi/g at Callaway Plant Forest, Ecology Plot F1 to a high of 3.5±0.1 pCi/g at Callaway Plant Forest, Ecology Plot F2 and Ecology Plot F9.

Cesium-137 was detected in all soil samples collected during the fourth quarter of 1987. Cesium-137 activity ranged from 0.71±0.19 pCi/g to 3.29±0.05 pCi/g. Manganese-54 was detected in two soil samples, Callaway Plant Forest, CA-SOL-F6 and CA-SOL-F8. No other isotopes of interest were detected in the soil samples.

explanation?

TABLE XXX

SOIL

Sample Identification; Date Collected	Sample Location	Radiochemical Analysis (pCi/g) Gross Alpha	Gross Beta
CA-SOL-F1	Callaway Plant Forest	2.6 ± 0.3*	2.0 ± 0.1
CA-SOL-F2	Callaway Plant Forest	2.7 ± 0.2*	3.5 ± 0.5
CA-SOL-F6	Callaway Plant Forest	4.2 ± 0.8*	2.4 ± 0.1
CA-SOL-F8	Callaway Plant Forest	4.7 ± 0.4*	2.7 ± 0.1
CA-SOL-F9	Callaway Plant Forest	5.9 ± 0.5*	3.5 ± 0.1
CA-SOL-PR3	Callaway Plant Prairie	3.2 ± 0.4*	2.3 ± 0.1
CA-SOL-PR4	Callaway Plant Prairie	3.7 ± 0.4*	2.5 ± 0.1
CA-SOL-PR5	Callaway Plant Prairie	3.5 ± 0.3*	2.4 ± 0.1
CA-SOL-PR7	Callaway Plant Prairie	4.2 ± 0.4*	2.5 ± 0.1
CA-SOL-PR10	Callaway Plant Prairie	3.3 ± 0.7*	2.4 ± 0.1
CA-SOL-V3	Beazley Farm	3.7 ± 0.4*	3.2 ± 0.1

*Verified by reanalysis.

TABLE XXXI

SOIL

GAMMA SPECTROMETRY

Sample Identification	Date Collected	pCi/g (dry) Cr-51 0.004*	Cs-134 0.029*	Cs-137 0.040*	Co-58 0.020*	Mn-54 0.021*	Fe-59 0.021*	Zn-65 0.060*	Co-60 0.063*	Ba,La-140 0.075*	Zr,Nb-95 0.066*
CA-SOL-F1	11/09/87	**	**	1.62±0.04	**	**	**	**	**	**	**
CA-SOL-F2	11/09/87	**	**	2.49±0.04	**	**	**	**	**	**	**
CA-SOL-F6	11/09/87	**	**	0.71±0.19	**	0.07±0.02	**	**	**	**	**
CA-SOL-F8	11/09/87	**	**	2.03±0.04	**	0.05±0.02	**	**	**	**	**
CA-SOL-F9	11/09/87	**	**	3.29±0.05	**	**	**	**	**	**	**
CA-SOL-PR3	11/09/87	**	**	1.51±0.04	**	**	**	**	**	**	**
CA-SOL-PR4	11/09/87	**	**	1.30±0.04	**	**	**	**	**	**	**
CA-SOL-PR5	11/09/87	**	**	2.09±0.07	**	**	**	**	**	**	**
CA-SOL-PR7	11/09/87	**	**	0.77±0.02	**	**	**	**	**	**	**
CA-SOL-PR10	11/09/87	**	**	1.55±0.04	**	**	**	**	**	**	**
CA-SOL-V3	11/09/87	**	**	0.97±0.04	**	**	**	**	**	**	**

*Lower limit of detection

**Less than lower limit of detection

APPENDIX A

EPA CROSS-CHECK RESULTS

1987

EPA CROSS-CHECK PROGRAM

1987

Radionuclides in Air Filters

Date	Parameter	EPA Known Value pCi/filter ± 1 σ	CEP Reported Value pCi/filter ± 2 σ
4/87	Gross Alpha	14 ± 5	20 ± 1 18 ± 1 17 ± 1
	Gross Beta	43 ± 5	63 ± 2 64 ± 2 66 ± 2
	Strontium-90	17 ± 1.5	19 ± 10 23 ± 10 24 ± 10
	Cesium-137	8 ± 5	17 ± 5 19 ± 5 20 ± 5
8/87	Gross Alpha	10 ± 5	10 ± 1 12 ± 1 13 ± 1
	Gross Beta	30 ± 5	29 ± 2 31 ± 2 33 ± 2
	Strontium-90	10 ± 1.5	8 ± 1 9 ± 1 9 ± 1
	Cesium-137	10 ± 5	8 ± 5 10 ± 5 10 ± 5

EPA CROSS-CHECK PROGRAM

1987

Gross Alpha and Gross Beta in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
1/87	Gross Alpha	11 ± 5	12 ± 2 12 ± 2 12 ± 2
	Gross Beta	10 ± 5	22 ± 6 25 ± 6 27 ± 7
3/87	Gross Alpha	3 ± 5	4 ± 2 4 ± 2 4 ± 2
	Gross Beta	13 ± 5	12 ± 4 9 ± 4 8 ± 4
5/87	Gross Alpha	11 ± 5	11 ± 2 11 ± 2 12 ± 2
	Gross Beta	7 ± 5	17 ± 6 18 ± 6 19 ± 6
7/87	Gross Alpha	5 ± 5	4 ± 2 5 ± 2 6 ± 2
	Gross Beta	5 ± 5	6 ± 3 7 ± 3 9 ± 3
9/87	Gross Alpha	4 ± 5	3 ± 1 3 ± 1 3 ± 1
	Gross Beta	12 ± 5	13 ± 1 13 ± 1 15 ± 1

EPA CROSS-CHECK PROGRAM

1987

Gross Alpha and Gross Beta in Water (Cont.)

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
11/87	Gross Alpha	7 ± 5	6 ± 2 7 ± 2 8 ± 2
	Gross Beta	19 ± 5	16 ± 3 18 ± 3 20 ± 3

EPA CROSS-CHECK PROGRAM

1987

Gamma in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Cobalt-60	50 ± 5	55 ± 5 55 ± 5 56 ± 5
	Zinc-65	91 ± 5	102 ± 7 114 ± 6 108 ± 6
	Ruthenium-106	100 ± 5	93 ± 5 105 ± 5 108 ± 5
	Cesium-134	59 ± 5	61 ± 3 57 ± 2 60 ± 3
	Cesium-137	87 ± 5	109 ± 6 98 ± 6 102 ± 5
6/87	Cobalt-60	64 ± 5	69 ± 5 69 ± 5 71 ± 5
	Zinc-65	10 ± 5	12 ± 3 14 ± 3 16 ± 3
	Ruthenium-106	75 ± 5	80 ± 5 75 ± 5 71 ± 5
	Cesium-134	40 ± 5	40 ± 3 39 ± 3 38 ± 3
	Cesium-137	80 ± 5	82 ± 5 84 ± 5 85 ± 5
	Chromium-51	41 ± 5	46 ± 3 44 ± 3 40 ± 3

EPA CROSS-CHECK PROGRAM

1987

Gamma in Water (Cont.)

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
10/87	Chromium-51	70 ± 5	66 ± 8 67 ± 8 73 ± 8
	Cobalt-60	15 ± 5	17 ± 2 18 ± 2 19 ± 2
	Zinc-65	46 ± 5	55 ± 15 57 ± 15 61 ± 15
	Ruthenium-106	61 ± 5	71 ± 10 75 ± 10 79 ± 10
	Cesium-134	25 ± 5	26 ± 3 26 ± 3 27 ± 3
	Cesium-137	51 ± 5	56 ± 5 56 ± 5 58 ± 5

EPA CROSS-CHECK PROGRAM

1987

Tritium in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Tritium	4209 ± 421	4600 ± 500 4510 ± 500 4330 ± 500
6/87	Tritium	2895 ± 357	2866 ± 285 2831 ± 288 2792 ± 288
10/87	Tritium	4492 ± 449	3867 ± 300 3925 ± 300 4211 ± 300

EPA CROSS-CHECK PROGRAM

1987

Strontium In Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
1/87	Strontium-89	25 ± 5	15 ± 5 17 ± 6 20 ± 5
	Strontium-90	25 ± 1.5	22 ± 5 24 ± 6 24 ± 5
5/87	Strontium-89	41 ± 5	26 ± 5 34 ± 5 34 ± 5
	Strontium-90	20 ± 1.5	14 ± 3 15 ± 3 17 ± 3

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 in Water

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
3/87	Low Level *	7.0 ± 0.7	2 ± 4 2 ± 4 2 ± 4
8/87	High Level	48 ± 6	43 ± 5 41 ± 4 39 ± 3
10/87	Mid Level	26 ± 6	19 ± 4 20 ± 4 22 ± 4

*Unable to reanalyze due to half-life decay.

EPA CROSS-CHECK PROGRAM

1987

Radionuclides in Milk

Date	Parameter	EPA Known Value pCi/l ± 1σ	CEP Reported Value pCi/l ± 2σ
6/87	Strontium-90	35 ± 1.5	29 ± 3 28 ± 3 32 ± 3
	Cesium-137	74 ± 5	75 ± 2 77 ± 2 70 ± 2
	Strontium-89	69 ± 5	5 ± 2 5 ± 2 4 ± 2
	Iodine-131	59 ± 6	63 ± 2 64 ± 2 64 ± 2
	Potassium	1525 ± 76 mg/l	1617 ± 150 mg/l 1648 ± 150 mg/l 1648 ± 150 mg/l
10/87	EPA cancelled Milk Study due to EPA facility being reroofed.		

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 In Milk

Date	Parameter	EPA Known Value pCi/l ± 1 σ	CEP Reported Value pCi/l ± 2 σ
2/87	Low Level	9.0 ± 0.9	9.0 ± 1.0 8.0 ± 0.5 8.0 ± 0.5

AERIAL PHOTOGRAPHIC MONITORING AND INTERPRETATION OF VEGETATION AT CALLAWAY

AUGUST 1987

AB-593

AERIAL PHOTOGRAPHIC MONITORING AND INTERPRETATION OF VEGETATION AT CALLAWAY

AUGUST 1987

OCTOBER 1987

Prepared for

UNION ELECTRIC COMPANY
St. Louis, Missouri

Prepared by

APPLIED BIOLOGY, INC.
Decatur, Georgia

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Environmental information on the condition of vegetation at the Callaway site during the third year of plant operation was developed through infrared aerial photography, photointerpretation and ground truthing of stressed vegetation, vegetation mapping and phytopathological diagnosis of stressed vegetation during August, 1987.

Ten terrestrial study plots were photographed with infrared film at a scale of 1" = 250'. Residual lands were photographed at a scale of 1" = 1000'. Photointerpretation was performed based upon the differential infrared reflectance characteristics of healthy versus stressed tree cover. The infrared photographic record was then verified with a ground truthing field inspection. On-site and laboratory phytopathological diagnoses were made for stressed vegetation identified from aerial photography. A vegetation map was produced to show the location of stressed vegetation.

No evidence of the effects of drift from the cooling tower was found. Vegetation stress in the vicinity of the plant site was found to be caused by natural factors such as oak wilt, Dutch elm disease, root and butt rot and dieback due to unfavorable edaphic and meteorological conditions. No distributional pattern of these diseases was identified during the study. Therefore, the foliar disease found in the Callaway vegetation during 1987 can be directly attributed to natural causes and not to operation of the Callaway cooling tower.

1.0 INTRODUCTION

1.1 Purpose

Union Electric Company (UE), in response to Nuclear Regulatory Commission (NRC) mandate, has undertaken a program to monitor the potential impacts of cooling tower drift on the local flora surrounding the UE Callaway Plant in Callaway County, Missouri. The goals of the program are to establish a record of baseline and operational phase vegetation conditions at the Callaway Plant site using color infrared aerial photography, to document any naturally occurring vegetation stress, and to determine if any vegetation damage can be attributed to operation of the cooling tower. Interpretation of aerial photographs was used to prepare this information. This was supplemented by ground truthing to assure accurate interpretation of photographs and field phytopathological assessment to identify the causes of any vegetation stress encountered.

Using these investigative methods, preoperational baseline environmental information on the condition of vegetation at the Callaway Plant site was developed during July and August, 1984. Observations during the first and second years of plant operation were made during August, 1985 and July and August, 1986. During August, 1987 monitoring was performed to assess the condition of vegetation during the third year of plant operation. The results of these four years of monitoring complement other vegetation monitoring undertaken at the study site. Prior to the present program of infrared aerial photographic monitoring, classical field botany techniques were used to describe the species composition of the vegetation community at the Callaway Plant. This work was performed in 1973-1975, 1981, and 1983-1984, and concentrated on a set of permanent terrestrial study plots.

2.0 STUDY METHODS

Applied Biology, Inc. (ABI) acted as coordinator for the infrared aerial photography, photointerpretation and ground truthing of stressed vegetation, vegetation mapping and phytopathological assessment of stressed vegetation conducted at the Callaway Plant site in 1987.

2.1 Aerial Photography

Aerial photography for this project was flown from 0936 to 1016 hours on 5 August 1987 by Walker and Associates, Inc. of Fenton, Missouri. No cloud cover was present. Atmospheric conditions were haze- and dust-free. Color infrared film was exposed in a Wild RC-8 precision aerial mapping camera with 6 inch focal length lens. Ten one-hectare terrestrial study plots were photographed with 60 percent forward overlap at a scale of 1" = 250'. The residual lands of the plant site were photographed with 60 percent forward overlap and 30 percent side overlap at a scale of 1" = 1000'. Overlapping of photo frames is used to assure adequate coverage that avoids any visual distortion or loss of infrared photograph brightness that may occur along the edges of an aerial photographic exposure. Duplicate sets of positive film transparencies and positive prints were produced in 9" by 9" format.

2.2 Photointerpretation

Analysis of color infrared aerial photographs for the presence of vegetation stress is based upon the changes in infrared foliage reflectance that occur as a result of plant stress. A number of technical sources describe the theory and application of color infrared vegetation analysis and were used as a guide for the photointerpretation in this study. Plants under stress due to insect attack, disease or environmental conditions such as drought exhibit discoloration of their foliage on color infrared film because of loss of reflectance. This decrease of infrared reflectance occurs when normally highly reflective spongy leaf mesophyll cells collapse because of plant stress (Colwell, 1956). Vegetation color differences can be used to make inferences about plant vigor (Murtha, 1982; Barrett and Curtis, 1976). Healthy deciduous trees are highly reflective of infrared vegetation and appear as red and magenta in color infrared photographs. Evergreen pines and cedars at the site appear in shades of reddish gray. Stressed vegetation, with leaf yellowing apparent in normal spectral color photography, appears in shades of mauve, blue-grey, yellow and white in color infrared photography. When vegetation is dead and dry, it appears as yellow and tan on color infrared photography.

Using these differential reflectances as signature guides, examination of photographs was performed with simple magnification. Trees that were possibly in stressed condition were marked on photographic prints for subsequent ground truthing.

2.3 Ground Truthing

Ground truthing of stressed vegetation was the process used to locate (with the aid of aerial photographs and topographical maps) potentially stressed trees recorded on aerial photograph prints. The condition of these trees and the assessment made during phytopathological investigations were then correlated with the infrared photographic signature in order to identify stressed trees. Ground truthing took place on 29 and 30 August 1987.

2.4 Vegetation Mapping

After photointerpretation and ground truthing, the locations of stressed or dying trees were plotted on a map of the Callaway Plant site at a scale of 1" = 2,000' (Figure 1). Individual stressed or dying trees were represented by an asterisk (*) on the vegetation map. A considerable number of the trees that were plotted on the site vegetation map were inspected for photointerpretation ground truth correlation and phytopathological appraisal.

2.5 Phytopathological Investigations

Individual trees that were located at the Callaway site from aerial photograph plotting were appraised by plant pathologist Barbara S. Lucas of Columbia, Missouri. The purpose of this appraisal was to provide diagnoses of the causes of vegetative stress found on specimens at the study site. The causes of plant stresses were categorized as environmental, disease, or insect. Plant species vary in their tolerance of, or

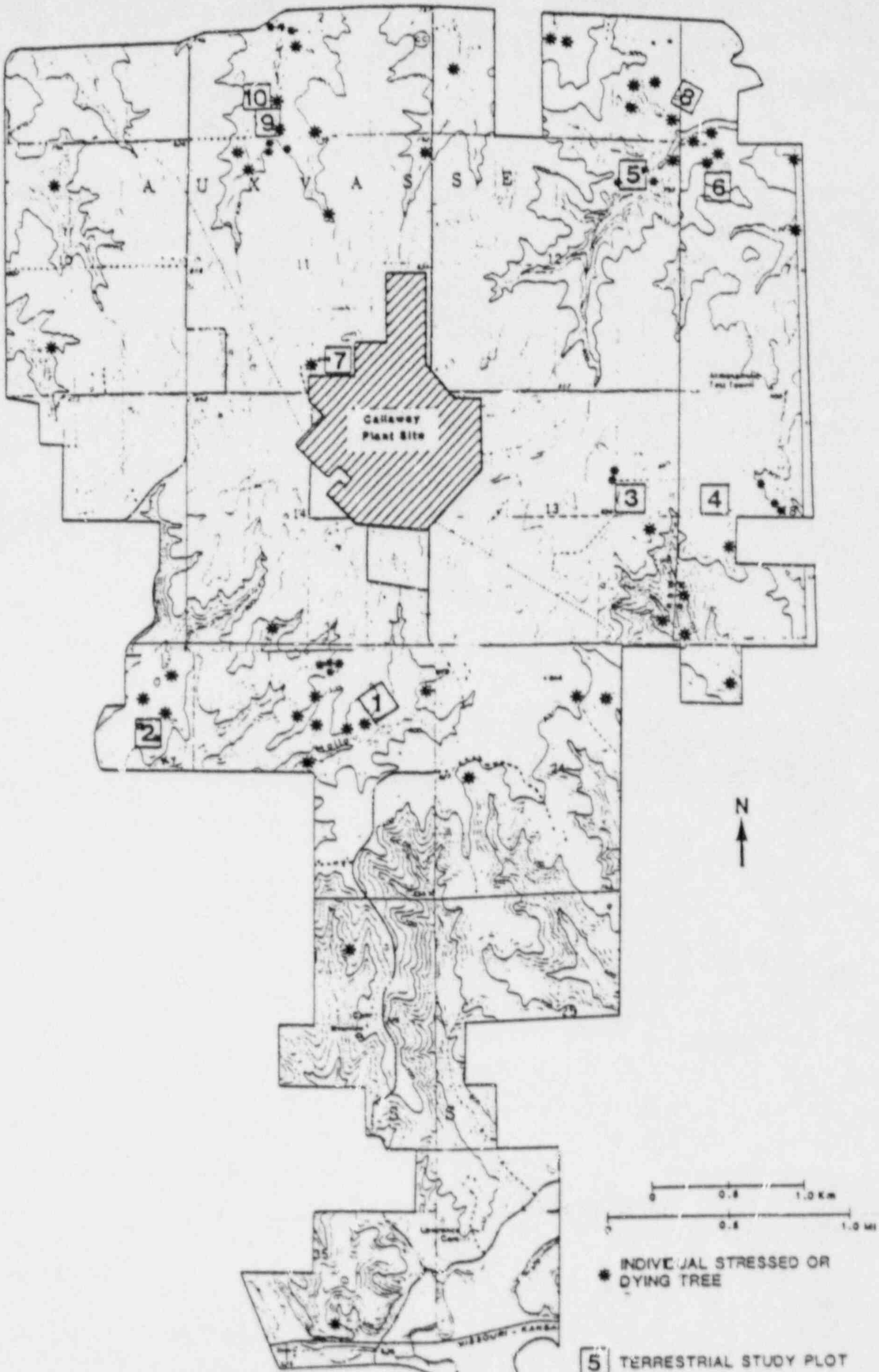

Figure 1: Location of stressed and dying trees, Callaway Plant, August 1987

sensitivity to, adverse conditions brought about by any of the above categories. It is pertinent to note that stress symptoms in plants, especially trees, can be very similar among the categories of causes mentioned above.

Freezing and thawing, drought, flooding, lightning damage, chemical injury, mechanical injury, or high winds are all examples of environmental conditions that can result in stressed plants. These conditions may cause outright death of plants or may stress them to a point where they are unable to withstand invasion by secondary disease organisms or insect pests.

Disease is a condition in plants brought about as a result of invasion of plant tissues by other living microorganisms. Primary diseases, such as oak wilt and Dutch elm disease (DED), are caused by microorganisms that can invade healthy plant tisues. These organisms consume plant-supplied water and nutrient reserves for their own growth, therby creating a stress on the plant. Secondary diseases, such as maple decline, are caused by "disease complexes" that usually occur on plants that have already been stressed from other causes. Disease complexes are generally caused by microorganisms that by themselves cannot invade tissues of healthy plants. When plants are stressed, however, their normal resistance to invasion by insect and disease organisms is lowered. The disease-complex organisms then are able to invade plant tissues, causing further stress and/or death of the plant.

Insects may cause direct or indirect damage to plants that may result in stress. Direct damage usually is a result of feeding on plant parts such as leaves, bark (cambial layers), wood, or roots. Oviposition (egg-laying) is another type of direct damage that can restrict the flow of water or nutrients in the plant. Insects may also cause indirect damage by serving as vectors of disease-causing organisms; insects feeding on diseased plants inadvertently carry spores of disease organisms to healthy plants.

The elements that were analyzed during diagnosis of stressed tree specimens were: history of forest management practices or herbicide application, site edaphic conditions, condition of surrounding vegetation, recent meteorological record, and inspection of tree leaves, branches, bark and roots. In addition to field observations, standard culturing procedures using twigs and small branches were carried out in the laboratory in an attempt to recover the causal fungus in cases of suspected fungal infestation. Samples were plated on two culture media: 1) oak wilt agar (Nutrimigen base) and 2) acid potato-dextrose agar. These laboratory procedures were inconclusive in 1984 and were not repeated in 1985 or in 1986. In 1987, twig samples from two oak specimens were again cultured in an attempt to isolate the causal fungus.

3.0 RESULTS AND DISCUSSION

3.1 Photointerpretation and Ground Truthing

Analysis of color infrared aerial photographs indicated that the vast majority of deciduous trees at the Callaway Plant site were in good health as indicated by their intense magenta reflectance. Certain deciduous trees observed across the study site displayed somewhat lighter magenta or pink coloration or a light fringed appearance on infrared aerial photographs. Ground truthing revealed these trees to be species such as red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), persimmon (*Diospyros virginiana*), cottonwood (*Populus deltoides*) and mulberry (*Morus rubra*) that were in good health. Such trees possess a somewhat different infrared color signature than the deep magenta of the oaks and hickories that are dominant at the Callaway site. Deciduous trees that showed signs of stress reflected in shades of light pinkish mauve, grey and tan on infrared photography. These deciduous trees were plotted as individual stressed or dying trees on the site vegetation map (Figure 1). The distribution of these trees showed no apparent pattern. Ground truthing and phytopathological examination revealed that a variety of stress factors (dêtailed in Section 3.2) were affecting these trees. During previous years of vegetation monitoring, areas with relatively high densities of stressed, dying or dead deciduous trees were observed on the aerial photographs. These areas were recorded in past years as tree damage zones on the site vegetation map. Field inspection revealed that these zones were subject to forest management practices carried out by the Missouri Department of Conservation in which less robust tree specimens or undesired species were girdled by chain saw cutting. The culled dead and dying trees appeared as stressed aggregations on infrared aerial photography. In an area to the west of Vegetation Ecology Site 2, numerous trees appear as whitish, barren trunks on infrared aerial photography. These dead trees have been left standing on this site for some time and have been noted in the three previous annual reports on aerial photographic vegetation monitoring at the Callaway site. This area is not mapped as a tree damage zone in this 1987 report since the observed trees at this location have been dead for several years and the area is now in a process of regrowth/recovery. No other tree damage zones were noted over the entire Callaway study site in 1987 vegetation monitoring.

Healthy eastern redcedar (Juniperus virginiana) and plantation grown white pine (Pinus strobus), both evergreen species, displayed reddish gray coloration in infrared photography. The only stressed white pine that was apparent on aerial photographs was a single specimen located in a cultivated stand just northwest of the complex of power plant buildings. This stressed pine displayed tan infrared reflectance. As a whole, the stand of white pine was in fairly good condition but with some lower branch dieback, perhaps due to crowding and sunlight shading. Eastern redcedars were in good condition across the study site in general.

3.2 Phytopathological Investigations

Oak wilt (OW), a vascular disease caused by the fungus Ceratocystis fagacearum, was diagnosed as the cause of stress in a number of oak spe-

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

cimens. These trees were either black oak (Quercus velutina), red oak (Quercus rubra), or shingle oak (Quercus umbricaria). Diagnoses were based on symptom expression in the field. Symptom development begins in the upper crown of infected trees. Leaves exhibit marginal scorching, a moisture stress symptom, and often fall from the tree. Leaf scorch symptoms develop because the fungus multiplies in the vascular system, effectively blocking the uptake of water. The disease develops rapidly in the red oak group (which includes black oak and shingle oak), spreading throughout the entire tree. Infected trees in this group are often killed in a single season. Disease development in white oaks is much slower. Symptom expression is usually confined to a few branches each year. White oaks decline over a period of several years.

Once a tree dies, the fungus produces mycelial mats underneath the outer bark. The mycelial mats, o ressure pads", often split the bark, exposing the pad surface upon which spores are produced. The spores have a fruity odor that is attractive to the sap- and bark-feeding beetles that vector the fungus to healthy trees. Pressure pads are formed in the late summer of death if adequate moisture is available. If moisture is limiting, pads may not form until early spring if at all (Boyce, 1957; Tainter and Gubler, 1973). Invasion of the oak-wilted trees by secondary disease organisms inhibits pad formation (Shigo, 1985; Tainter and Gubler, 1973).

Oak wilt symptoms were observed at Sites 1, 5, 6 and 7. The disease was confirmed in the laboratory for the first time on samples collected from Site 1. Oak wilt appears to be the major cause of oak mortality.

Dutch elm disease (DED), caused by the fungus _Ceratocystis_ _ulmi_, was identified as the stress factor on American elm (_Ulmus_ _americana_) trees. Diagnoses were based on visual symptoms: wilting, dieback of branches, and discoloration of the vascular system. DED is a vascular disease similar to oak wilt. It has been devastating on American elm (_Ulmus_ _americana_) and other native species because it is caused by an "introduced" pathogen against which native American elms have not developed genetic resistance. DED was encountered at Sites 8 and 9.

A third disease that was encountered was root and butt rot. Root and butt rot was observed on plantation grown white pine (_Pinus_ _strobus_) at Site 7. Root and butt rots are caused by a variety of fungi capable of attacking healthy trees and killing the roots and the living bark of the lower trunk. Many of the root and butt rot fungi survive as saprophytes in cut stumps. They utilize the stump as an energy source for growth through the soil until a healthy root is encountered. These rots are therefore common in logged areas. Above-ground symptoms of root and butt rot are expressed as branch die-back and sparse, off-color foliage. Fruiting bodies (basidiocaps) of the causal fungi, when they occur, are usually formed in the fall. Decay and discoloration and fungal mats can be observed at the base of the trunk and on large roots just under the soil surface.

A number of tree species, including black c. ry (_Pinus_ _serotina_), hickory (_Carya_ _ovata_), red, black, white and shingle oaks (_Quercus_ _rubra_, _Q._ _velutina_, _Q._ _alba_ and _Q._ _imbricaria_) and red maple (_Acer_ _rubrum_), exhibited symptoms of dieback and decline. The dieback and decline symptoms varied with the species but in general were thinning crowns, small pale foliage and branch dieback. While it is impossible to determine the exact cause of the decline, such symptoms are often indicative of a root problem. When the root system is not functioning sufficiently to meet the needs of the above-ground parts, decline begins. Branch dieback is often the tree's attempt to reestablish the balance between roots and shoots. Some of the root problems that can lead to decline are: reduced oxygen in compacted soil, destruction of fine roots from extended drought, root rots, or site disturbances that physically damage roots.

The stressed condition of a number of oak trees was attributed to locally unfavorable edaphic conditions. These trees were found growing on slopes or ridges with shallow gravelly soil. On these sites, tree and shrub growth was thin and less vigorous than generally observed; ground cover was sparse. This habitat appears to be marginally suited for good vegetation growth. The occurrence of very hot, dry summers and severe cold winters over the past several years could cause trees growing in such a habitat to eventually exhibit decline and dieback symptoms.

Edaphic factors also combine with site temperature and rainfall characteristics to affect vegetation health. The US Department of Agriculture Soil Conservation Service classifies the three most commonly observed soil types of the study site as Calwoods, Gorin or Mexico silt loam. The subsoil of each type is a relatively deep (9 to 70 inches) silty clay or clay overlain by a shallow (3 to 7 inches) topsoil of silty loam or silty clay loam. Permeability to water and available water capacity of these soils are the primary characteristics that affect plant growth. Each soil has a large water holding capacity but also a low permeability to water and low available water capacity. With ample precipitation these soils absorb large quantities of water and because of their low permeability rates can become waterlogged. Waterlogged soils are poorly aerated; that is, they have low oxygen concentration. Low oxygen concentration has adverse effects on root growth by inhibiting the uptake of water and nutrients and may produce stresses similar to drought or physical damage, resulting in wilting or chlorosis. Additionally, restricted root growth can result in an accumulation of toxic metabolites that interfere with defense reactions of the host plant (Schoeneweiss, 1975).

Alternately, during the hot, dry summers, such as occurred in several recent years, these soils began drying. Because these soils are composed of a high percentage of clay particles that tenaciously bond to water molecules, water is much less available to plants. In periods of high transpiration, plants growing in these types of soils generally cannot absorb and translocate sufficient amounts of water to continue normal, or in some cases even sustainable, growth rates. Thus they may become dehydrated, wilt and possibly die.

A summary of site observations is presented below:

Site 1

Twig samples were collected from a black oak exhibiting a thinning crown, defoliation and leaf scorch (slide 17). Ceratocystis fagacearum, the causal organism of oak wilt (OW), was isolated from a twig that showed the vascular discoloration symptomatic of the disease. Although oak wilt symptoms have been observed in past years, this is the first laboratory confirmation of the disease. Three additional black oak specimens (represented by slides 15 and 20) also exhibited characteristic OW symptoms. Basidiocarps (fungal fruiting structures, slide 18) of a wood-rotting fungus were observed on dead oaks in the general area. The oaks were probably killed by OW, with wood rot occurring secondarily. One shagbark hickory (slide 16) had two large, dead trunks that forked from the same base. One fork had been dead for some time while the other died recently. Both trunks were infested with wood-boring insects (slide 19). Another dead hickory within 50 meters was also infested with borers. Two stressed maples were observed at this site: one was damaged by wind and the other was in a general state of decline.

Site 2

This site is located in a timber management area and is characterized by the shallower soils usually found in the heavily timbered areas of the region. Four individual stressed oak specimens and several stressed understory oaks were observed on this site. One oak was stressed from a fungal disease caused by a Fomes sp. (slide 13), and many of the understory shrubs were infected with a fungal canker disease. Two of the other oaks (represented in slide 12) were stressed from wind/storm damage, and the remaining oak specimen (slide 11) was in a state of natural decline.

Site 3

The infrared analysis of this site was similar to that of previous years; therefore, no on-site inspection was made.

Site 4

One white oak and many understory hickories at this site were identified as being stressed. The white oak (slide 26) exhibited dieback and decline symptoms that have been occurring for several years. The leaves of many hickory saplings were infected with a fungal leaf spot disease (slide 25).

Site 5

This site generally contains hilltops shallowly sloping into watersheds with red oak, hickory and hop-hornbeam in greatest abundance. One northern red oak exhibited a streaked vascular system symptomatic of OW. Twig samples from this specimen were cultured for OW but the causal fungus was not isolated. Two buckeyes (*Aesculus sp.*) were prematurely defoliated by a fungal leaf disease.

Site 6

There appeared to be a greater number of red maples located at this site; many were reseeding. Quite a few large, mature oaks were present and among them were several standing, dead trees. Two red oaks and two buckeyes were stressed from disease. One red oak had a lower trunk rot caused by a fungus. Another red oak had symptoms of and was considered to be stressed from OW. The two buckeyes (slide 21) had the same fungal leaf disease as observed at Site 5. A white oak had been declining for several years and had a couple of large scaffold branches gone.

Site 7

This entire site is located on fairly level, upland soil. The land has been divided into various use categories including cropping, water storage, grass waterways, roads, timber and buildings. At this site, one shingle oak (slide 1) was completely killed by lightning strike. A second shingle oak exhibited symptoms of decline and was considered to be stressed by OW. A single white pine, located in a pine plantation (slide 2), was dead from a probable root and butt fungal rot disease. This disease has been observed in the pine plantation in every year of the study.

Site 8

This site is located off a main power line right-of-way having very steep, rocky slopes and very shallow soils covered with moss and lichens. A large black oak approximately 14 inches in diameter was almost completely dead at this site. This year's leaves were still attached, indicating relatively recent decline. The suspected cause of stress that has probably contributed greatly to the decline of this specimen is the site condition alone. Of other similar-sized black oaks in the immediate vicinity, none were living. Dutch Elm disease is the probable cause of death of two elm trees at this site (slide 27).

Site 9

This site was generally characterized as a low, swampy area with heavy undergrowth of such species as wild grapes, impatiens and gooseberry. The entire stand was full of dead and dying trees. Dutch Elm disease was considered the cause of death of one elm tree (slide 9). A natural, progressive decline of a shingle oak (slide 8), a large hickory (slide 10) and a red maple (slides 29 and 30), from a combination of environmental and biotic factors, have resulted in stress. All understory hickories had the same fungal leaf spot disease observed on the hickories at Site 4. A basswood tree exhibited yellowing leaves and a severely defloiated canopy. This stressed condition was most probably caused by a fungal leaf disease.

Site 10

This site was located in the generally rolling hills and watersheds of the region. A large white oak (slides 3 and 4) was completely killed this year by a lightning strike. Another stressed basswood tree (slide 6) was observed with a defoliated canopy, again due to a fungal leaf disease. A grouping of seven black cherry sproutlings (slide 7), derived from the loss/removal of the main trunk, had very thin, pale-green canopies. Cause of the stress is most likely a result of an imbalance between the large amount of vegetative mass above ground (trunks, branches, etc.) to the root mass below ground, i.e., environmental conditions.

4.0 CONCLUSIONS

In 1987, the number of oaks with oak wilt symptoms was approximately the same as in 1984 and 1985. Most of the oaks showing stress symptoms in the infrared photos were trees that had died recently. The dead leaves remained attached as opposed to oak wilt, with which defoliation of the upper crown begins in early summer. The exact cause of death of these trees cannot be determined, but is likely due to the combined effects of poor site conditions and environmental stress.

Common foliar diseases were found on oak, hickory, buckeye and basswood, and were generally more common in 1987 than in 1986, but approximately the same as in 1985. Other diseases noted were Dutch elm disease and root and butt rot of white pine.

No directional patterns of stressed vegetation were noted, and no stress symptoms were found to be due to the effects of drift from the cooling tower. Overall, there was no discernable increase in the number of stressed trees in 1987 as compared to previous years.

Most of the deciduous tree cover at the Callaway site is healthy and reflects intense magenta on infrared aerial photography. Those specimens that are stressed or dying are recognizable on color infrared photography because of their mauvish pink, grey or tan reflectance. Tree damage zones, locations of a forest management program carried out by the Missouri Department of Conservation (in which the less robust tree specimens were chain saw girdled for the purpose of selective stand thinning) were not observed at the Callaway site in 1987. Essentially all of the evergreen species at the study site (white pine and eastern redcedar) are in good condition and are recognizable by their reddish grey infrared reflectance. Stressed evergreens are apparent because of their tan infrared reflectance.

5.0 LITERATURE CITED

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UNION ELECTRIC COMPANY

CALLAWAY PLANT

PLANT MODIFICATION

ENVIRONMENTAL EVALUATION

1987

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.

This report covers all plant modifications that were completed from January 1, 1987, through December 31, 1987

During 1987 there were two plant modifications that involved a potentially significant unreviewed environmental question. The interpretations and conclusions regarding these plant modification along with a description of the changes are presented below.

2.0 ENVIRONMENTAL EVALUATIONS

2.1 Callaway Modification Package 86-0070

2.1.1 Description of Change

This change involved the installation of underground piping from the oily waste building to the equalization basin and the installation of a weir at Lagoon number 1. This change provides an alternate discharge path for the waste water from the oily waste separator.

2.1.2 Evaluation of Change

The installation of the underground piping and the weir did not result in a significant increase in any adverse environmental impact, since all measurable non-radiological environmental effects were confined to the area previously disturbed during site preparation and plant construction. There was no increase in effluent released, since this change provided a discharge path for oily waste water to Lagoon No. 1, from which no discharge is allowed. Therefore, this change did not constitute an unreviewed environmental question per section 7.1 of Appendix B to the Callaway Plant Operating License.

2.2 Callaway Modification Package 86-0111

2.2.1 Description of Change

This change involved removal and restoration of nine environmental air sampling locations and modifications to five environmental air sampling stations and two ground water sampling wells. This change reduced the number of air sampling stations to the number required in the Callaway Plant Technical Specifications. The environmental air sampling stations and ground water stations were modified to improve reliability and personnel safety.

2.2.2 Evaluation of Change

There were 14 existing environmental air sampling stations. Five of these were refurbished resulting in a minor amount of additional earth work. This relatively insignificant impact was more than offset by the restoration of the other nine sites. Therefore, there was no significant increase in any adverse environmental impact previously evaluated by NRC and no unreviewed environmental question.