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UNION ELECTRIC COMPANY
CALLAWAY PLANT
FACILITY OPERATING LICENSE NPF-30
1999 ANNUAL ENVIRONMENTAL OPERATING REPORT

Please find enclosed the 1999 Annual Environmental Operating Report for the Callaway Plant. This report is submitted in accordance with section 5.6.2 of the Technical Specification and Appendix B to the Callaway Plant Operating License.

Sincerely,

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CALLAWAY PLANT

1999

ANNUAL ENVIRONMENTAL OPERATING REPORT

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1.0 EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report describes the Union Electric Company, Callaway Plant Radiological Environmental Monitoring Program (REMP), and the program results for the calendar year 1999. It is submitted in accordance with section 5.6.2 of the Callaway Plant Technical Specifications.

Section 2.0 describes the Radiological Monitoring Program. Included is the identification of sampling locations, descriptions of sampling and analysis procedures, analysis results, data interpretations and program modifications. Quality assurance results, sampling deviations, unavailable samples and program changes are also discussed.

Section 3.0 describes the Non-Radiological Monitoring Program. Included are any unusual or important events, Environmental Protection Plan non-compliance, non-routine reports and plant design and operation environmental evaluations.

During 1999 the Callaway Plant operated in compliance with the Off Site Dose Calculation Manual requirements. Comparison of results for 1999 to pre-operational data and data from previous years show no significant differences.

Results from the REMP indicate the Callaway Plant has had no significant radiological impact on the health and safety of the public or on the environment.

2.0 RADIOLOGICAL MONITORING PROGRAM

2.1 INTRODUCTION

This report presents an analysis of the results of the REMP conducted during 1999 for Union Electric Company, Callaway Plant.

The radiological environmental monitoring program began in April, 1982.

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

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

2.2 PROGRAM DESIGN

The sample locations, frequency of sampling and sample analysis requirements originate from the Callaway Plant Off-Site Dose Calculation Manual, DNR Missouri State Operating Permit and continuation of the Callaway Plant Pre-Operational Environmental Monitoring Program.

Samples are collected from waterborne, airborne, ingestion and direct radiation pathways. The types of sample media collected are: milk, surface water, groundwater, shoreline sediment, bottom sediment, soil, wetlands, fish, vegetation, airborne particulate, airborne radioiodine and direct radiation (TLD). Indicator samples are collected from locations which could be influenced by plant effluents. Control samples are collected at locations that are not significantly affected by plant operation.

Samples are collected by Union Electric personnel or contractors to Union Electric and shipped to Teledyne Brown Engineering Environmental Services Midwest Laboratory (Teledyne) for analysis. The data is reported monthly and summarized in the annual report. TLD's are analyzed by Union Electric personnel.

2.3 PROGRAM DESCRIPTION

Sample locations for the REMP are shown in Figures 1, and 2. TLD location 4 is co-located with air station B-3. TLD locations 22a, 32a, and 39a were included and will be used during 2000. Table I identifies the location code, description and sample type. Table II specifies the collection frequency and required analysis.

FIGURE I

DISTANT COLLECTION LOCATIONS

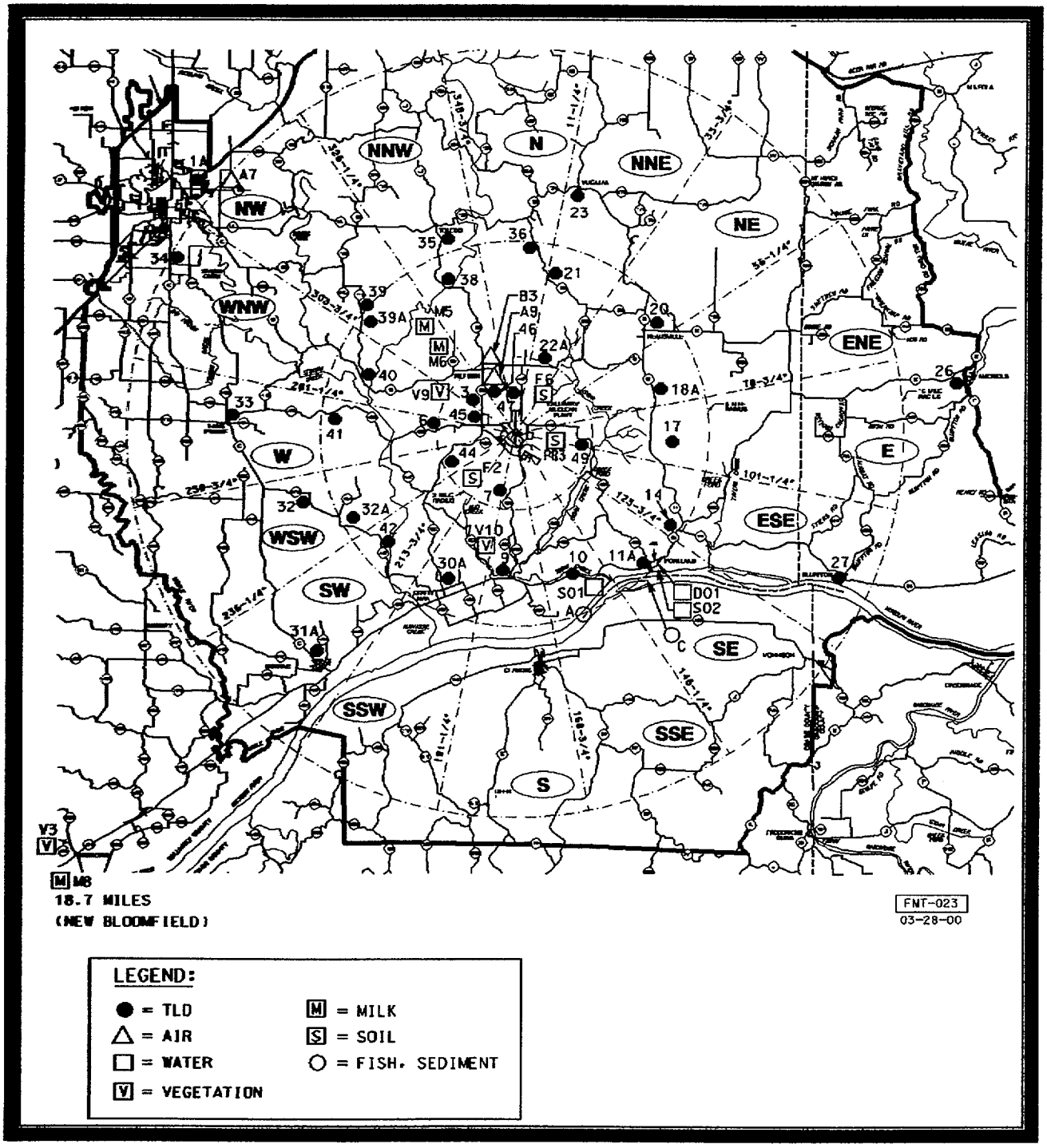

FIGURE II

NEAR SITE COLLECTION LOCATIONS

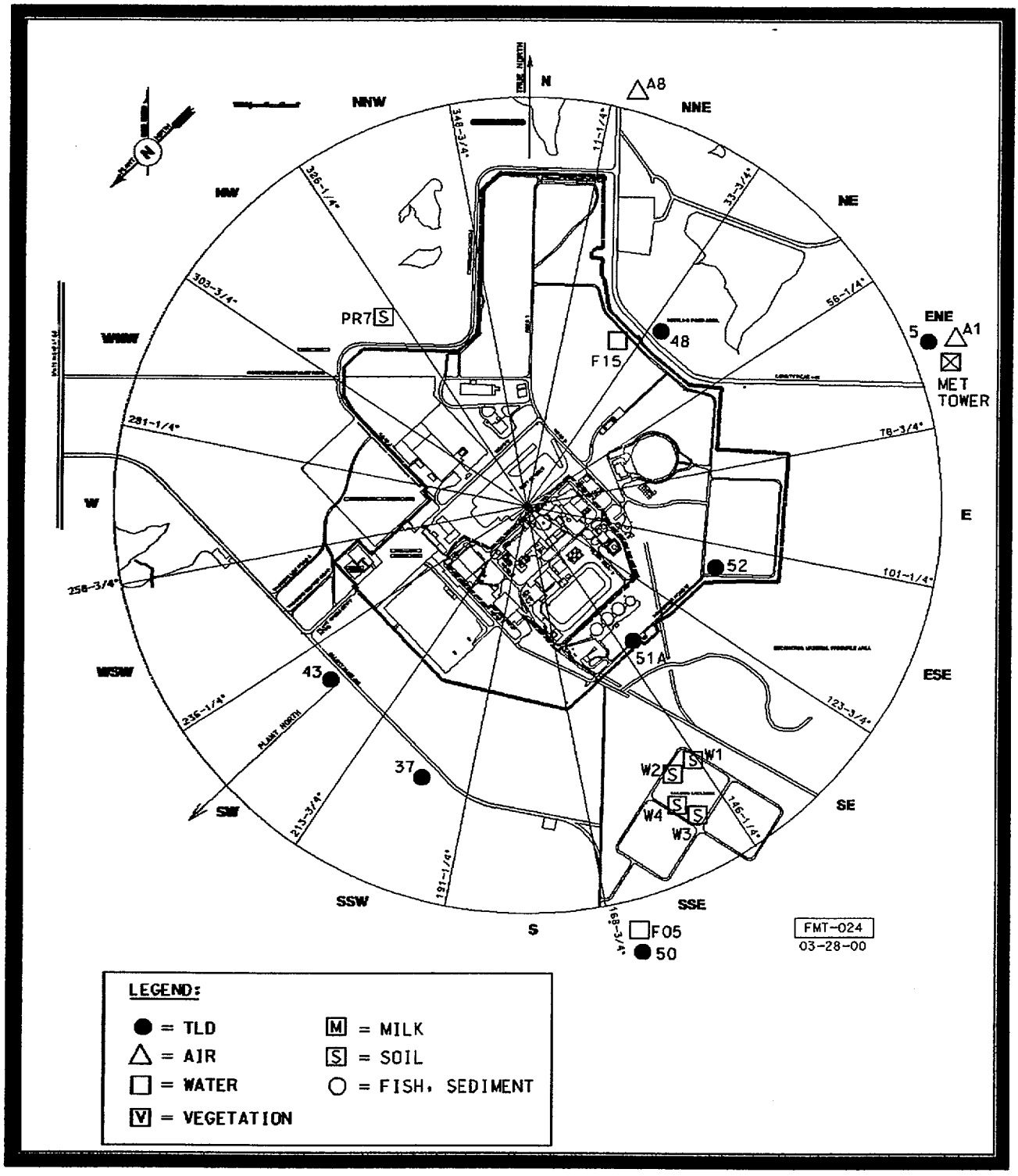

TABLE I

SAMPLING LOCATIONS

Location Code	Description[1]	Sample Types[2]
1a	10.8 mi. NW, City of Fulton on Hwy Z, 0.65 mi. East of Business 54, West of Campus Apartments	IDM
3	1.2 mi. NW; 0.1 mi. West of Hwy CC on Gravel Road, 0.8 mi. South Hwy 0, Callaway Electric Cooperative Utility Pole No. 18559.	IDM
4	1.9 mi N; 0.3 mi East of the O and CC Junction, Callaway Electric Cooperative Utility Pole No. 18892.	IDM
5	1.3 mi. ENE; Primary Meteorological Tower.	IDM
6	2.0 mi. W; County Road 428, 1.2 mi. West of Hwy CC, Callaway Electric Cooperative Utility Pole No. 18609.	IDM
7	1.4 mi. S; County Road 459, 2.6 mi. North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 35097	IDM
9	3.8 mi. S; NW Side of the County Road 459 and Hwy 94 Junction, Callaway Electric Cooperative Utility Pole No. 06754.	IDM
10	3.9 mi. SSE; Hwy 94, 1.8 mi. East of County Road 459, Callaway Electric Cooperative Utility Pole No. 12182.	IDM
11a	4.7 mi. SE; City of Portland, Callaway Electric Cooperative Utility Pole No. 12110.	IDM
14	4.9 mi. ESE; SE Side of Intersection D and 94, Callaway Electric Cooperative Utility Pole No. 11940.	IDM
17	3.8 mi. E; County Road 4053, 0.3 mi. East of Hwy 94, Kingdom Telephone Company Pole No. 3X12.	IDM
18a	3.7 mi. ENE; East side of Hwy D, 0.5 mi. South of 0, Callaway Electric Cooperative Utility Pole No. 38579.	IDM
20	4.7 mi. NE; City of Readsville, Callaway Electric Cooperative Utility Pole No. 12830.	IDM

TABLE I

SAMPLING LOCATIONS

Location Code	Description[1]	Sample Types[2]
21	3.8 mi. NNE; County Road 155, 1.9 mi. North of Hwy 0, Callaway Electric Cooperative Utility Pole No. 19100	IDM
23	6.6 mi. NNE; City of Yucatan, Callaway Electric Cooperative Utility Pole No. 12670	IDM
26[3]	11.7 mi. E; Town of Americus, Callaway Cooperative Utility Pole No. 11159.	IDM
27[3]	9.3 mi. ESE; Town of Bluffton, Callaway Electric Cooperative Utility Pole No. 11496.	IDM
30a	4.4 mi. SSW; City of Steedman, N side of Belgian Dr., 150 feet East of Hwy CC, Callaway Electric Cooperative Utility Pole No. 06557.	IDM
31a	7.8 mi. SW; City of Mokane, Junction Hwy C and County Road 400, 0.9 mi. North of Hwy 94, Callaway Electric Cooperative Utility Pole.	IDM
32	5.4 mi. WSW; Hwy VV, 0.6 mi. West of County Road 447, Callaway Electric Cooperative Utility Pole No. 27031.	IDM
33	7.4 mi. W; City of Hams Prairie, SE of Hwy C and AD Junction	IDM
34	9.5 mi. WNW; NE Side of Hwy C and County Road 408 Junction.	IDM
35	5.8 mi. NNW; City of Toledo, Callaway Electric Cooperative Utility Pole No. 17684.	IDM
36	4.9 mi. N; County Road 155, 0.8 mi. South of County Road 132, Callaway Electric Cooperative Utility Pole No. 19137.	IDM
37	0.5 mi. SSW; County Road 459, 0.9 mi. South of Hwy CC, Callaway Electric Cooperative Utility Pole No. 35077.	IDM

TABLE I

SAMPLING LOCATIONS

Location Code	Description[1]	Sample Types[2]
38	4.6 mi. NNW; County Road 133, 1.5 mi. South of Hwy UU, Callaway Electric Cooperative Utility Pole No. 34708.	IDM
39	5.4 mi. NW; County Road 111, Callaway Electric Cooperative Utility Pole No. 17516.	IDM
40	4.2 mi. WNW; NE Side of County Road 112 and Hwy 0, Callaway Electric Cooperative Utility Pole No. 06326.	IDM
41	4.9 mi. W; Hwy AD, 2.8 mi. East of Hwy C, Callaway Electric Cooperative Utility Pole No. 18239.	IDM
42	4.4 mi. SW; County Road 447, 2.6 mi. North of County Road 463, Callaway Electric Cooperative Utility Pole No. 06326.	IDM
43	0.5 mi. SW; County Road 459, 0.7 mi. South of Hwy CC, Callaway Electric Cooperative Utility Pole No. 35073.	IDM
44	1.6 mi. WSW; Hwy CC, 1.0 mi. South of County Road 459, Callaway Electric Cooperative Utility Pole No. 18769.	IDM
45	1.0 mi. WNW; County Road 428, 0.1 mi. West of Hwy CC, Callaway Electric Cooperative Utility Pole No. 18580.	IDM
46	1.5 mi. NNW; NE Side of Hwy CC and County Road 466 Intersection, Callaway Electric Cooperative Utility Pole No. 28242.	IDM
47	1.0 mi. N; County Road 448, 0.9 mi. South of Hwy 0, Callaway Electric Cooperative Utility Pole No. 28151.	IDM
48	0.4 mi. NE; County Road 448, 1.5 mi. South of Hwy 0, Plant Security Sign Post.	IDM
49	1.6 mi. E; County Road 448, Callaway Electric Cooperative Utility Pole No. 06959, Reform Wildlife Management Parking Area.	IDM

TABLE I

SAMPLING LOCATIONS

Location Code	Description[1]	Sample Types[2]
50	0.9 mi. SSE; County Road 459, 3.3 mi. North of Hwy 94, Callaway Electric Cooperative Utility Pole No. 35086.	IDM
51a	0.3 mi. SE; Owner Control Fence, SE of the Water Treatment Plant.	IDM
52	0.4 mi. ESE; Light Pole Near the East Plant Security Fence	IDM
A1	1.3 mi. ENE; Primary Meteorological Tower.	APT, AIO
A7	9.5 mi. NW; C. Bartley Farm.	APT, AIO
A8	0.9 mi. NNE; County Road 448, 0.9 miles South of Hwy 0.	APT, AIO
A9	1.9 mi. NNW; Community to Reform.	APT, AIO
B3	1.8 mi. NNW; 0.3 mi. East of the O and CC Junction, Callaway Electric Cooperative Utility Pole No. 18892.	APT, AIO
D01	5.0 mi. SE; Holzhouser Grocery Store/Tavern (Portland, MO).	WWA
F05	.9 mi. SSE; Onsite Groundwater Monitoring Well.	WWA
F15[3]	0.4 mi. NNE; Onsite Groundwater Monitoring Well.	WWA
M5	3.1 mi. NW, Schneider's Farm (Goat's Milk)	MLK
M6	2.7 mi. NW, Pierce's Farm (Cow's Milk)	MLK
M8[3]	18.7 mi. WSW, Kissock's Farm, South of New Bloomfield, MO (Cow's Milk).	MLK
V3[3]	15.0 mi. SW; Beazley Farm, West of Tebbetts, MO.	FPL, SOL
V9	2.0 mi. WNW; Meehan Farm	FPL
V10	3.4 mi. SSW; Brandt Farm	FPL

TABLE I

SAMPLING LOCATIONS

Location Code	Description[1]	Sample Types[2]
A[3,4]	4.9 mi. SSE; 0.6 River Miles Upstream of Discharge North Bank.	AQS, AQF
C[4]	4.9 mi. SE; 1.0 River Miles Downstream of Discharge North Bank.	AQS, AQF
S01[3]	4.7 mi. SSE; 105 feet Upstream of Discharge North Bank.	SWA
S02	4.9 mi. SE; 1.1 River Miles Downstream of Discharge North Bank.	SWA
F2	1.64 mi. SW; Callaway Plant Forest Ecology Plot F2.	SOL
F6	1.72 mi. NE; Callaway Plant Forest Ecology Plot F6.	SOL
PR3	1.02 mi. ESE; Callaway Plant Prairie Ecology Plot PR3.	SOL
PR7	0.45 mi. NNW; Callaway Plant Prairie Ecology Plant PR7.	SOL
W4	0.68 mi. SSE; Callaway Plant Wetlands, SW Bank	SOL
W2	0.60 mi. SSE; Callaway Plant Wetlands, Inlet Area	SOL
W1[3]	0.61 mi. SE; Callaway Plant Wetlands, High Ground	SOL
W3	0.72 mi. SSE; Callaway Plant Wetlands, Discharge Area	SOL

[1] All distance is measured from the centerline of the reactor.

[2] AIO = Air Iodine, APT = Air Particulate, AQF = Fish, AQS = Sediment, FPL = Leafy Green Vegetables, IDM = TLD, MLK = Milk, SOL = Soil, SWA = Surface Water, WWA = Ground Water.

[3] Control Locations.

[4] The fish collection area for location "A" is between 0.6 river miles and 3.0 river miles upstream of the plant discharge. Location "C" is between the plant discharge and 1.5 miles downstream.

TABLE II

REMP SAMPLE COLLECTION FREQUENCIES AND REQUIRED ANALYSIS[1]

Sample	Sample Type	Collection Frequency	Required Analysis
Airborne Iodine	AIO	Weekly	I-131 weekly
Air Particulate	APT	Weekly	Gross Beta weekly[2] and Gamma Isotopic of quarterly filter composite
Fish	AQF	Semiannually	Gamma Isotopic
Sediment	AQS	Semiannually	Gamma Isotopic
Leafy Green Vegetables	FPL	Monthly during the growing season	I-131, and Gamma Isotopic
TLD	IDM	Quarterly	Gamma Dose
Milk	MLK	Semimonthly when animals are on Pasture; monthly otherwise	I-131, and Gamma Isotopic
Surface Water	SWA	Monthly composite	H-3 and Gamma Isotopic
Ground Water	WWA	Quarterly Grab	H-3 and Gamma Isotopic (NPDES Requirement)

[1] Samples required by ODCM and NPDES permit. Additional sampling is performed as a continuation of the pre-operational monitoring program.

[2] If gross beta activity is greater than the established baseline activity level gamma isotopic analysis is performed on the individual sample.

2.4 SAMPLING PROGRAM EXECUTION AND RESULTS

2.4.1 Program Modifications and Exceptions

During 1999 no modifications were made to the Radiological Environmental Monitoring Program as described in the ODCM. Several changes were made to the Environmental Monitoring performed as a continuation of the pre-operational phase of the plant. These changes are documented in HPCI 99-01. HPCI 99-01, Surveillance Report No. SP99-051 and SOS 99-0294, 99-2030, 99-2033 and 99-2066 identified improvements to the location and description of REMP sampling locations.

The Radiological Environmental Monitoring Program was executed as described in the ODCM with any exceptions listed in this report.

2.4.2 Detection and Reporting Limits

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

The lower limit of detection (LLD) used in this report is described in NRC Regulatory Guide 4.1 Rev. 1, "Program for Monitoring Radioactivity in the Environs of Nuclear Power Plants" and the NRC Branch Technical Position, November 1979, "An Acceptable Radiological Environmental Monitoring Program".

Positive sample results are reported with a 2 sigma counting uncertainty (corresponding to the 95% confidence level). In cases where the activity is found to be below the sample analysis minimum detection level it is reported as Not Detected.

TABLE III

DETECTION CAPABILITIES FOR RADIOLOGICAL ENVIRONMENTAL SAMPLE ANALYSIS[1]

ANALYSIS	WATER (pCi/l)	AIRBORNE (pCi/m^3)	FISH (pCi/kg wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg wet)	SOIL AND SEDIMENT (pCi/kg dry)
Gross beta	4					
H-3	300					
Mn-54	15		130			
Fe-59	30		260			
Co-58, -60	15		130			
Zr-Nb-95[2]	15*					
I-131	1	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15[2]			15[2]		

[1] This list does not mean only these nuclides will be detected and reported. Other peaks which are measurable and identifiable will also be reported

[2] Total activity, parent plus daughter activity.

2.4.3 Quality Control Program

The contractor laboratory (Teledyne) maintains a quality control (QC) program in accordance with Regulatory Guide 4.15. The Program includes laboratory procedures designed to prevent cross-contamination and ensure accuracy and precision of analyses. QC checks include blind samples, duplicate samples, and spiked samples as necessary to verify laboratory analysis activities are being maintained at a high level of accuracy.

Teledyne participates in the Department of Energy's Environmental Laboratory Quality Assessment Program (EML) and Mixed Analyte Performance Evaluation Program (MAPEP). The results of these crosscheck programs are presented in Section 2.6.

The Callaway Plant Personnel Dosimetry program is certified by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The Environmental TLD Program has demonstrated compliance with the recommendations of Regulatory Guide 4.13. Quality control checks are performed including blanks, blind samples, daily performance checks and quarterly crosschecks.

2.4.4 Data Interpretations

Sample analysis results are evaluated to determine if the result was due to the operation of the Callaway Plant or due to other sources.

One method used is the indicator-control concept. Most sample types are collected at both indicator (areas potentially affected by plant operations) and control locations (areas not significantly affected by plant discharge). A possible plant effect would be indicated if the radiation level at an indicator location was statistically larger than at the control location.

Another method involves determining if the result originated from weapons testing. The sample can be compared to established environmental levels produced from weapons testing.

Current results can also be compared with pre-operational levels or samples collected in other parts of the country. Results can also be related to events known to have caused elevated levels of radiation in the environment.

2.4.5 Waterborne Pathway

Surface Water

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

The downstream water sampler (S02) was operational 74% of the time during 1999. Equipment malfunction, loss of power and river conditions were the main factors contributing to the down time. The sampler is checked daily and immediate action is taken to place the sampler back in service when a problem is identified. The following actions were taken to improve performance:

- Additional material was placed over the suction line for protection from the weather and passing objects.
- The suction line and guard pipe was extended farther into the river to improve suction during low river flow.
- An un-interruptible power supply and varistors were installed to improve operation of the sampler timer.
- Additional equipment was installed to improve monitoring of sample volume collection.
- Repairs were made to the samplers metering valve, pump, and timers to improve operation.

SOS's 99-0037, 99-0973, 99-1138, 99-3283 and 99-3695 document the operational problems and corrective actions taken.

The upstream water sampler (S01) was operational 98% of the time during 1999. The downtime was caused by a ground fault which occurred in March. After repairs were completed the sampler was operational 100% of the time for the remainder of 1999.

Daily grab samples were obtained during periods of Inoperability and included in the monthly composite sample, with the following exception. SO2 became inoperable on 10/28 and was not identified until 11/1 due to cognizant personnel error. This incident is documented in SOS 99-3283. All required monthly composite samples were collected during 1999.

Tritium was the only radionuclide detected in surface water samples collected during 1999. Five of twelve samples collected at indicator location S02 contained measurable levels of tritium with a mean concentration of 394 pCi/l. This is approximately 1% of the reporting limit for tritium in surface water.

The quantity of tritium measured at the indicator station is well within regulatory requirements. These results are inside the range of previous operational levels. There

was no significant radiological impact on the health and safety of the public or the environment.

The gamma analysis results for surface water samples were consistent with previously accumulated data and no plant operational effects were identified.

Ground Water

Ground water samples are collected quarterly from two sampling wells (F05 and F15) and one drinking water well (D01). The sample well samples are collected using a manual grab sampler which is lowered into the well. The drinking water sample is collected from a faucet after allowing the line to flush for two minutes. Ground water samples are analyzed for tritium and gamma emitting nuclides.

The ground water sample at D01 was not collected for the fourth quarter of 1999 due to a scheduling error. Administrative controls were improved and should prevent reoccurrence of this event. This sample is not required by REMP. It is a requirement of the Callaway Plant Missouri State Operating Permit. This incident is documented in SOS 00-0316.

The analysis results for all ground water samples were consistent with previously accumulated data and no plant operational effects were identified.

Water Analysis

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

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

Bottom Sediment

Bottom sediment samples are collected semi-annually from one indicator location (C) and one control location (A). The samples are taken from water at least 2 meters deep to prevent influence of bank erosion. A Ponar dredge is used to obtain the samples, consisting of the uppermost layer of sediment. Each sample is placed, without preservative, in a plastic bag and sealed. Bottom sediment samples are analyzed for gamma emitting isotopes.

The analysis results for bottom sediment samples were consistent with previously accumulated data and no plant operational effects were identified.

Shoreline Sediment

Shoreline sediment samples are collected semi-annually in the same area as bottom sediment. The samples are collected within two feet of the waters edge and consist of 2 six-inch diameter by two-inch deep sediment plugs. Each sample is placed in a plastic bag and sealed. Shoreline sediment samples are analyzed for gamma emitting isotopes. The analysis results for shoreline sediment samples were consistent with previously accumulated data and no plant operational effects were identified.

Sediment Analysis

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

Wetlands Soil

Wetlands Soil Samples are collected annually from 3 indicator locations (W2, W3, and W4) and one control location (W1). Two 6-inch square soil plugs consisting of the uppermost two-inch layer of soil are taken at each location. The samples are placed in plastic bags and sealed. Wetlands soil samples are analyzed for gamma emitting isotopes.

Cs-137 was detected in the wetlands samples. Control station W1 indicated 170 pCi/kg dry while the highest indicator station indicated 136 pCi/l.

The analysis results for wetlands soil samples were consistent with previously accumulated data and no plant operational effects were identified. The Cs-137 activity is due to worldwide fallout from atmospheric nuclear testing.

Soil Analysis

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

2.4.6 Airborne Pathway

Airborne

The air stations were 100% operational during 1999 with the exception of stations A-8 and B-3.

Station A-8 was operational 97% of the time due to loss of electricity during June (SOS 99-1142) and August (SOS 99-1876). The weekly sample collected on 6/17/99 did not collect enough sample to meet the required LLD. The Electric Cooperative was asked to investigate the electrical problems and no additional problems were experienced. The weekly sample collected on 7/29/99 did not collect enough sample to meet the required LLD due to improper operation of the air sample filter holder (SOS 99-1903).

Station B-3 was operational 98% of the time during 1999. The weekly sample collected on 7/29/99 did not collect enough sample to meet the required LLD due to improper operation of the air sample filter holder (SOS 99-1903).

All other required weekly samples were collected during 1999. All five sample locations are considered indicator locations (A1, A7, A8, A9, and B3). One indicator station (A9) is located at the community with the highest D/Q. Airborne samples are collected and analyzed weekly for I-131 and gross beta and a quarterly composite is analyzed for gamma isotopic.

Gross beta activity ranged from 0.008 to 0.048 pCi/m^3 in all samples. The average gross beta activity at all locations was 0.023 pCi/m^3. During 1999 there were 13 weekly samples with gross beta activities greater then the baseline action level of 0.037 pCi/m^3. Gamma spectral analysis was performed on these filters and no gamma emitting isotopes of plant origin was detected.

The analysis results for airborne samples were consistent with previously accumulated data and no plant operational effects were identified.

Airborne Analysis

Gross Beta: Airborne particulate samples are collected on a 47mm diameter glass fiber filter type A/E (99 percent removal efficiency at 1 micron particulate) at a volumetric rate of one and one-half cubic feet per minute at five locations. The particulate filters are collected weekly and shipped to Teledyne for analyses. The filters are analyzed approximately five days after collection to allow for decay of naturally occurring short-lived radionuclides. The glass fiber type filter is placed into a stainless steel planchet and counted for gross beta radioactivity using a proportional counter.

Iodine: Each airborne particulate air sampler is equipped with a charcoal cartridge in-line after the particulate filter holder. The charcoal cartridge at each location is

collected at the same time as the particulate filter and analyzed for Iodine-131 within eight days after collection. Each Charcoal cartridge is placed on the germanium detector and counted. A peak of 0.36 MeV is used to calculate the concentration at counting time. The equilibrium concentration at the end of collection is then calculated. Decay correction for the time interval between sample collection and counting is then made.

Gamma Spectrometry: Filters are composited according to location and counted using a germanium detector coupled to a computer based multi-channel analyzer. The resulting spectrum is analyzed by computer and specific nuclides, if present, identified and quantified.

2.4.7 Ingestion Pathway

Milk

When available, two-gallon milk samples are collected semi-monthly during the pasture season (April through September) and monthly during the winter from one goat and one cow milk location near the Plant (M5 and M6) and one cow milk location away from the Plant (M8). Milk samples are shipped in ice to be received and analyzed by Teledyne within eight days after collection. Analyses for Iodine-131, and gamma emitting nuclides are performed on all milk samples.

Milk samples were unavailable due to animals not producing milk during the following periods:

Location M5: January, February, and September through December. The farmer dropped out of the program beginning in September.

Location M8: Second half of September and October.

The analysis results for milk samples were consistent with previously accumulated data and no plant operational effects were identified.

Milk Analysis

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

Gamma Spectrometry: An aliquot of milk is placed in a standard counting container and specific nuclides are identified and quantified using a germanium detector coupled to a computer based, multi-channel analyzer.

Fish

The five most abundant recreational or commercial fish species are collected semi-annually from one indicator location (C) and one control location (A). Fish samples are filleted and are analyzed for gamma emitting isotopes.

The analysis results for fish samples were consistent with previously accumulated data and no plant operational effects were identified.

Fish Analysis

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

Vegetation

Monthly, during the growing season, green leafy vegetation is collected from two indicator locations (V9 and V10) and from one control location (V3). Vegetation samples consist of mustard greens, turnip greens, cabbage, lettuce, and spinach. The vegetation samples are analyzed for Iodine-131, and by gamma spectrometry.

Green leafy vegetation was unavailable due to lack of plant growth during the following periods:

Location V3: January through April and August through December
Location V9: January through March and September through October
Location V10: January through April, July through September and November

The analysis results for vegetation samples were consistent with previously accumulated data and no plant operational effects were identified.

Vegetation Analysis

Iodine-131: A suitable aliquot of wet (as received) sample is placed into a standard calibrated container and counted using a germanium detector coupled to a computer based, multi-channel analyzer. A peak of 0.36 MeV is used to calculate the concentration at counting time. The equilibrium concentration at the end of collection

is calculated by decay correcting for the time interval between sample collection and counting.

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

Direct Radiation

Thermoluminescent Dosimetry (TLD) is used to determine direct radiation levels in and around the Callaway site. Forty dosimeters are placed in 16 sectors around the plant as specified in the ODCM. The dosimeters are read once per quarter. Two locations are designated as controls (26 and 27).

Direct Radiation data was unavailable due to vandalism during the following periods:

Location 6: Second quarter
Location 36: Third quarter
Location 49: Fourth quarter.

The analysis results for TLD samples were consistent with previously accumulated data and no plant operational effects were identified.

TLD Analysis

The Union Electric program uses the Panasonic Model UD-814 TLD and Model UD-710A automatic dosimeter reader. Each dosimeter consists of three elements of $CaSO_4$:Tm. The dosimeters are sealed in a moisture resistant plastic bag and placed inside a polypropylene mesh cylindrical holder in the environment. After exposure in the environment the dosimeters are read and the exposure for the time period is determined.

Soil

Soil samples are collected annually from four indicator locations (F2, PR3, F6, and PR7) and one control location (V3). To ensure only the most recent deposition is sampled, the uppermost two-inch layer of soil is taken at each location. Samples consist of 2 six-inch square soil plugs. The litter at the surface and the root mat is considered part of the sample. The samples are placed in plastic bags and sealed. Each soil sample is analyzed for gamma emitting isotopes.

Cs-137 was detected in the soil samples. Control station V3 indicated 194 pCi/kg dry while the highest indicator station indicated 1,259 pCi/l.

The analysis results for soil samples were consistent with previously accumulated data and no plant operational effects were identified. The Cs-137 activity is due to worldwide fallout from atmospheric nuclear testing.

Soil Analysis

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

2.5 LAND USE CENSUS

The 1999 Land Use Census was performed as required by the ODCM. The census is performed annually during the growing season within a five mile radius of the Callaway Plant. The location of the nearest resident, milking animal and garden greater then 50 square meters is identified in each of the sixteen meteorological sectors. The results of the census are used to identify changes that would require modification to the existing monitoring programs conducted at the Callaway Plant.

The 1999 Land Use Census was conducted during November by the AmerenUE Real Estate Department. Information was collected by contacting residents by phone and conducting field surveys.

RESULTS

The results of the 1999 Land Use Census are presented in Table IV and discussed below. The table includes radial direction and distance from the Callaway Plant for each location. The radial direction is one of the 16 different compass points. The distance and direction from unit was determined using a combination of map position, aerial photography or Global Positioning System (GPS) receiver.

NEAREST RESIDENT

The distance of the nearest resident from the plant was updated using additional information obtained from aerial photographs and GPS. None of the changes required a change to the location of the nearest resident yielding the highest calculated dose commitment.

MILKING ANIMALS

There were no location changes resulting from the 1999 census.

VEGETABLE GARDENS

Additional volunteers with a higher average ground level D/Q then the current participants were identified. Contracts to collect samples from these new locations are currently being pursued.

TABLE IV

1999 LAND USE CENSUS RESULTS

Closest Receptor in Miles[1]

Sector	Residence	Garden	Cow Milk	Goat Milk
N	2.2	NI	NI	NI
NNE	2.2	1.9	NI	NI
NE	2.2	2.0	NI	NI
ENE	2.0	3.5	NI	NI
E	3.2	3.6	NI	NI
ESE	2.1	NI	NI	NI
SE	2.2	NI	NI	NI
SSE	2.9	2.9	2.9	2.9
S	2.7	NI	NI	NI
SSW	2.7	2.0	NI	NI
SW	2.7	2.1	2.5	NI
WSW	1.2	NI	NI	NI
W	1.5	3.5	4.1	NI
WNW	1.9	2.0	NI	NI
NW	2.1	3.2	2.6	NI
NNW	1.8	2.6	NI	NI

[1] NI = None Identified

2.6 CROSS-CHECK RESULTS

The cross check results performed by the vendor laboratory during 1999 are presented in Table V. The results indicate satisfactory performance. The U-238 analysis performed on soil in the Mixed Analyte Performance Evaluation Program failed low. The U-238 analysis performed on water in the Environmental Measurements Laboratory Quality Assessment Program failed high. The quality control program results for interlaboratory and intralaboratory results were reviewed. There was no indication of a problem in the analysis trend results. The out of tolerance results could be due to statistical variation and does not indicate a problem with the analysis program. The vendor laboratory indicated that the quantity of sample provided is below what is normally required for analysis. The lower quantity adversely effects the accuracy of low level samples.

TABLE V

1999 ENVIRONMENTAL MEASUREMENTS LABORATORY QUALITY ASSESSMENT PROGRAM RESULTS[1]

Date	Type	Nuclide	Reported Value[2]	Reference Value[3]	Control Limits[4]	Result
Mar-99	Air Filter	Alpha	1.24 ± 0.03	1.61 ± 0.10	0.60 - 1.64	PASS
Mar-99	Air Filter	Beta	1.98 ± 0.04	1.56 ± 0.16	0.06 - 1.64	PASS
Mar-99	Air Filter	Co-57	3.32 ± 0.06	3.01 ± 0.14	0.62 - 1.22	PASS
Mar-99	Air Filter	Co-60	5.28 ± 0.15	4.96 ± 0.28	0.62 - 1.42	PASS
Mar-99	Air Filter	Cs-137	6.96 ± 0.15	6.05 ± 0.30	0.72 - 1.32	PASS
Mar-99	Air Filter	Sb-125	4.35 ± 0.30	3.59 ± 0.31	0.62 - 1.39	PASS
Mar-99	Air Filter	U-233/4	0.07 ± 0.03	0.06 ± 0.00	0.78 - 3.00	PASS
Mar-99	Air Filter	U-238	0.07 ± 0.03	0.06 ± 0.00	0.78 - 3.00	PASS
Mar-99	Water	Co-60	54.40 ± 2.00	51.10 ± 3.00	0.92 - 1.18	PASS
Mar-99	Water	Cs-137	43.50 ± 2.00	39.38 ± 2.41	0.90 - 1.28	PASS
Mar-99	Water	Fe-55	81.50 ± 19.50	97.40 ± 1.65	0.31 - 1.54	PASS
Mar-99	Water	Alpha	1,1690 ± 37.00	1,090 ± 20.00	0.50 - 1.29	PASS
Mar-99	Water	Beta	1,274.60 ± 33.30	1,100.00 ± 40.00	0.50 - 1.29	PASS
Mar-99	Water	H-3	90.3 ± 24.80	121.08 ± 6.78	0.65 - 1.91	PASS
Mar-99	Water	Ni-63	125.80 ± 6.30	114.00 ± 10.00	0.50 - 1.50	PASS
Mar-99	Water	U-233/4	0.33 ± 0.08	0.27 ± 0.02	0.77 - 1.35	PASS
Mar-99	Water	U-238	0.33 ± 0.08	0.26 ± 0.02	0.77 - 1.35	PASS
Mar-99	Soil	Ac-228	45.10 ± 7.40	47.15 ± 2.99	0.50 - 1.50	PASS
Mar-99	Soil	Bi-214	67.30 ± 3.30	69.90 ± 5.66	0.50 - 1.50	PASS
Mar-99	Soil	Cs-137	620.50 ± 5.90	659.50 ± 24.95	0.80 - 1.34	PASS
Mar-99	Soil	K-40	355.70 ± 24.60	362.75 ± 20.16	0.73 - 1.67	PASS
Mar-99	Soil	Pb-212	47.90 ± 3.00	47.93 ± 2.57	0.50 - 1.50	PASS
Mar-99	Soil	Pb-214	70.10 ± 4.80	71.00 ± 7.04	0.50 - 1.50	PASS
Mar-99	Soil	Th-234	227.40 ± 35.20	138.00 ± 4.08	0.50 - 2.00	PASS
Mar-99	Soil	U-233/4	132.90 ± 6.90	140.67 ± 1.16	0.35 - 1.55	PASS
Mar-99	Soil	U-238	139.40 ± 7.00	145.00 ± 1.73	0.35 - 1.55	PASS
Mar-99	Vegetation	Co-60	21.00 ± 1.90	21.45 ± 1.00	0.62 - 1.42	PASS
Mar-99	Vegetation	Cs-137	453.90 ± 5.70	467.00 ± 20.00	0.81 - 1.45	PASS
Mar-99	Vegetation	K-40	667.60 ± 33.70	656.50 ± 20.00	0.79 - 1.50	PASS

[1] Results are reported as follows: Water Bq/L, Air Filters Bq/Filter, Soil and Vegetation Bq/Kg.
[2] Results are reported as the mean of three determinations +/- 1 standard deviation.
[3] Results are the mean of replicate determinations for each nuclide +/- the standard error of the mean.
[4] Control Limits are the ratio of Reported Value / Reference Value established using historic data.

TABLE V

1999 ENVIRONMENTAL MEASUREMENTS LABORATORY QUALITY ASSESSMENT PROGRAM RESULTS[1]

Date	Type	Nuclide	Reported Value[2]	Reference Value[3]	Control Limits[4]	Result
Sep-99	Air Filter	Co-57	8.10 ± 0.1	7.73 ± 0.03	0.65 - 1.39	**PASS**
Sep-99	Air Filter	Co-60	6.70 ± 0.1	6.35 ± 0.41	0.75 - 1.32	**PASS**
Sep-99	Air Filter	Cs-137	7.10 ± 0.20	6.43 ± 0.42	0.73 - 1.37	**PASS**
Sep-99	Air Filter	Mn-54	8.80 ± 0.20	7.91 ± 0.45	0.76 - 1.42	**PASS**
Sep-99	Air Filter	U-233/4	0.09 ± 0.03	0.07 ± 0.00	0.83 - 1.92	**PASS**
Sep-99	Air Filter	U-238	0.07 ± 0.03	0.07 ± 0.01	0.84 - 2.61	**PASS**
Sep-99	Air Filter	Alpha	3.18 ± 0.06	2.77 ± 0.26	0.50 - 1.55	**PASS**
Sep-99	Air Filter	Beta	3.65 ± 0.06	2.66 ± 0.26	0.72 - 1.67	**PASS**
Sep-99	Water	Co-60	54.10 ± 1.10	52.40 ± 2.20	0.80 - 1.20	**PASS**
Sep-99	Water	Cs-137	77.10 ± 1.40	76.00 ± 3.40	0.80 - 1.26	**PASS**
Sep-99	Water	Fe-55	48.60 ± 6.80	53.00 ± 2.00	0.44 - 1.53	**PASS**
Sep-99	Water	U-233/4	0.50 ± 0.09	0.37 ± 0.02	0.83 - 1.92	**PASS**
Sep-99	Water	U-238	0.46 ± 0.09	0.36 ± 0.02	0.80 - 1.26	**FAIL**
		Analysis reran with increased count time (0.42 ± 0.07)				
Sep-99	Water	Alpha	1,543.00 ± 44.00	1580.00 ± 20.00	0.61 - 1.32	**PASS**
Sep-99	Water	Beta	1,053.00 ± 31.00	740.00 ± 40.00	0.55 - 1.55	**PASS**
Sep-99	Water	H-3	136.00 ± 25.00	80.70 ± 3.70	0.71 - 1.79	**PASS**
Sep-99	Water	U-233/4	0.50 ± 0.09	0.37 ± 0.02	0.80 - 1.40	**PASS**
Sep-99	Water	U-238	0.46 ± 0.09	0.36 ± 0.02	0.80 - 1.26	**PASS**
Sep-99	Soil	Ac-228	127.30 ± 7.50	124.00 ± 4.80	0.79 - 1.75	**PASS**
Sep-99	Soil	Bi-212	107.40 ± 2.60	140.00 ± 14.00	0.42 - 1.22	**PASS**
Sep-99	Soil	Bi-214	90.10 ± 4.20	69.50 ± 1.80	0.74 - 1.42	**PASS**
Sep-99	Soil	Cs-137	195.90 ± 4.00	204.00 ± 5.00	0.83 - 1.32	**PASS**
Sep-99	Soil	K-40	744.70 ± 37.70	780.00 ± 27.00	0.78 - 1.53	**PASS**
Sep-99	Soil	Pb-212	123.40 ± 3.70	127.00 ± 4.80	0.74 - 1.33	**PASS**
Sep-99	Soil	Pb-214	96.50 ± 5.00	72.00 ± 0.42	0.65 - 1.45	**PASS**
Sep-99	Soil	Th-234	298.70 ± 24.60	198.00 ±5.60	0.59 - 1.85	**PASS**
Sep-99	Soil	U-233/4	184.40 ± 8.50	190.00 ± 5.20	0.47 - 1.30	**PASS**
Sep-99	Soil	U-238	184.80 ± 8.50	190.00 ± 5.20	0.47 - 1.30	**PASS**
Sep-99	Vegetation	Co-60	17.60 ± 1.90	17.60 ± 1.00	0.69 - 1.46	**PASS**
Sep-99	Vegetation	Cs-137	414.60 ± 5.70	440.00 ± 20.00	0.80 - 1.40	**PASS**
Sep-99	Vegetation	K-40	502.80 ± 34.70	513.00 ± 20.00	0.79 - 1.42	**PASS**

[1] Results are reported as follows: Water Bq/L, Air Filters Bq/Filter, Soil and Vegetation Bq/Kg.
[2] Results are reported as the mean of three determinations +/- 1 standard deviation.
[3] Results are the mean of replicate determinations for each nuclide +/- the standard error of the mean.
[4] Control Limits are the ratio of Reported Value / Reference Value established using historic data.

TABLE V

1999 MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM[1]

Date	Type	Nuclide	Reported Value[2]	Reference Value[3]	Control Limits[4]	Result
Jan-99	Water	Co-57	337.60 ± 33.76	358.00	250.60 – 465.40	PASS
Jan-99	Water	Cs-137	656.60 ± 65.66	637.00	445.90 – 828.10	PASS
Jan-99	Water	Fe-55	724.50 ± 72.45	664.00	464.80 – 863.20	PASS
Jan-99	Water	Mn-54	234.20 ± 23.42	229.00	160.30 – 297.70	PASS
Jan-99	Water	U-233/4	2.70 ± 0.27	2.67	1.87 – 3.47	PASS
Jan-99	Water	U-238	20.80 ± 2.08	21.2	14.84 – 27.56	PASS
Jan-99	Water	Zn-65	1,508.90 ± 150.90	1,560.00	1,092.00 – 2,028.00	PASS
Jan-99	Soil	Am-241	6.16 ± 0.70	6.55	4.59 – 8.52	PASS
Jan-99	Soil	Co-57	311.11 ± 3.60	360.00	252.00 – 468.00	PASS
Jan-99	Soil	Co-60	134.57 ± 2.15	131.00	91.70 – 170.30	PASS
Jan-99	Soil	Cs-134	682.35 ± 4.50	752.00	526.40 – 977.60	PASS
Jan-99	Soil	Cs-137	319.50 ± 3.60	331.00	231.70 – 430.30	PASS
Jan-99	Soil	K-40	667.04 ± 21.50	652.00	456.40 – 847.60	PASS
Jan-99	Soil	Mn-54	349.01 ± 7.00	345.00	241.50 – 448.50	PASS
Jan-99	Soil	U-233/4	139.56 ± 1.80	157.00	109.90 – 204.10	PASS
Jan-99	Soil	U-238	23.47 ± 0.75	40.70	28.49 – 52.91	FAIL
	No errors were found in the calculation or analytical process for U-238					
Jan-99	Soil	Zn-65	2,697.20 ± 25.00	2,840.00	1,988.00 – 3,692.00	PASS

[1] Results are reported as follows: Water Bq/L, Soil Bq/Kg.
[2] Results are reported as the mean of three determinations +/- 1 standard deviation.
[3] Results are presented as the known values and expected laboratory precision.
[4] Control Limits are defined by MAPEP.

2.7 DATA REPORTING CONVENTIONS

LOWER LIMIT OF DETECTION

The lower limit of detection (LLD) used in this report is per NRC Regulatory Guide 4.1, Rev. 1, "Program for Monitoring Radioactivity in the Environs of Nuclear Power Plants", and the NRC Branch Technical Position, November 1979, "An acceptable radiological Environmental Monitoring Program". The LLD is defined as the smallest concentration of radioactivity 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.

The maximum LLDs for radiological environmental sample analysis is presented in Table III.

DATA REPORTING

Positive sample results are reported with a 2 sigma counting uncertainty (corresponding to the 95% confidence level). In cases where the activity is found to be below the sample analysis minimum detection activity it is reported as Not Detected (ND).

2.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

The REMP Summary is presented in Table VI With the exception of a small indication of tritium in river water, there was no measurable impact on the environment due to plant operation.

TABLE VI

REMP SUMMARY

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analysis Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (f)[2] Range	Location With Highest Annual Mean Name / Distance and Direction	Mean (f)[2] Range	Control Location Mean (f)[2] Range	Number of Non-routine Reported Measurements
Waterborne Pathway								
Surface Water (pCi/l)	H-3	(24)	160	394 (5/12) (247 - 530)	S02 4.9 mi SE	394 (5/12) (247 - 530)	383 (3/12) (219 - 699)	0
	Gamma	(24)	--	-- (0/12)	NA	NA	-- (0/12)	0
Shoreline Sediment (pCi/kg)	Gamma	(4)	--	-- (0/2)	NA	NA	-- (0/2)	0
Airborne Pathway								
Airborne Particulate (pCi/m^3)	Gross Beta	(257)	--	0.023 (257/257) (0.008 - 0.048)	B-3 1.8 mi NNW	0.025 (51/51) (.010 - 0.048)	NA --	0
	Gamma	(20)	--	-- (0/20)	NA	NA	NA	0
	I-131	(257)	0.070	-- (0/257)	NA	NA	NA	0

TABLE VI

REMP SUMMARY

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analysis Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (f)[2] Range	Location With Highest Annual Mean Name / Distance and Direction	Mean (f)[2] / Range	Control Location Mean (f)[2] Range	Number of Non-routine Reported Measurements
Ingestion Pathway								
Milk	Gamma	(44)	--	(0/28)	NA	NA	-- (0/16)	0
(pCi/l)	(Cs-137)			NA	NA	NA		
	I-131	(44)	0.2	-- (0/28)	NA	NA	-- (0/16)	0
Fish	Gamma	(20)	--	-- (0/10)	NA	NA	-- (0/10)	0
(pCi/kg - wet)								
Vegetation	Gamma	(36)	--	-- (0/30	NA	NA	-- (0/6)	0
(pCi/kg - wet)								
	I-131	(36)	8.7 —	-- (0/30)	NA	NA	-- (0/6)	0

TABLE VI

REMP SUMMARY

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (f)[2] Range	Location With Highest Annual Mean Name / Distance and Direction	Location With Highest Annual Mean Mean (f)[2] / Range	Control Location Mean (f)[2] Range	Number of Non-routine Reported Measurements
Direct Radiation							
Quarterly TLDs (mRem/Standard Quarter)	Gamma (157) Dose	10	16.3 (149/149) (11 - 21)	8 2.9 mi S	18.5 (4/4) (17 - 21)	14 (8/8) (10 - 19)	0

Notes:

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

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

2.9 INDIVIDUAL SAMPLE RESULTS

The REMP Individual sample results are presented in Tables VII through XVI.

The following acronyms are used in these tables:

ND = Not Detected (Result below analysis detection limit)

NA = Not Available (Circumstances discussed in body of report)

TABLE VII

AIRBORNE[1]

GROSS BETA IN AIR PARTICULATE FILTERS (pCi/m^3)

	A-1	B-3	A-7	A-8	A-9		A-1	B-3	A-7	A-8	A-9
01/07/99	0.036	0.031	0.035	0.028	0.029	**07-08-99**	0.017	0.018	0.016	0.015	0.018
01/14/99	0.035	0.035	0.030	0.031	0.033	**07-15-99**	0.020	0.018	0.019	0.019	0.019
01/21/99	0.022	0.027	0.023	0.024	0.024	**07-22-99**	0.023	0.023	0.020	0.020	0.022
01/28/99	0.020	0.021	0.019	0.019	0.022	**07-29-99**	0.020	NA	0.018	NA	0.021
02-04-99	0.021	0.022	0.020	0.021	0.020	**08-05-99**	0.017	0.021	0.017	0.017	0.019
02-11-99	0.015	0.017	0.014	0.017	0.014	**08-12-99**	0.027	0.029	0.022	0.028	0.025
02-18-99	0.019	0.022	0.017	0.019	0.018	**08-19-99**	0.020	0.020	0.014	0.018	0.017
02-25-99	0.017	0.022	0.014	0.019	0.018	**08-26-99**	0.024	0.025	0.023	0.022	0.026
						09-02-99	0.032	0.033	0.021	0.030	0.033
03-04-99	0.018	0.020	0.017	0.017	0.016	**09-09-99**	0.027	0.026	0.024	0.025	0.026
03-11-99	0.016	0.018	0.015	0.017	0.016	**09-16-99**	0.023	0.024	0.016	0.021	0.025
03-18-99	0.020	0.023	0.021	0.024	0.022	**09-23-99**	0.023	0.023	0.027	0.023	0.024
03-25-99	0.023	0.024	0.017	0.023	0.022	**09-30-99**	0.023	0.027	0.026	0.022	0.022
04-01-99	0.022	0.022	0.019	0.022	0.021						
04-08-99	0.015	0.015	0.012	0.011	0.013	**10-07-99**	0.024	0.023	0.026	0.024	0.021
04-15-99	0.015	0.018	0.013	0.015	0.013	**10-14-99**	0.026	0.034	0.033	0.027	0.029
04-22-99	0.019	0.019	0.013	0.017	0.018	**10-21-99**	0.024	0.028	0.027	0.021	0.026
04-29-99	0.011	0.010	0.009	0.008	0.008	**10-28-99**	0.026	0.028	0.029	0.025	0.026
05-06-99	0.015	0.015	0.009	0.012	0.012	**11-04-99**	0.033	0.045	0.035	0.029	0.037
05-13-99	0.015	0.018	0.010	0.018	0.015	**11-11-99**	0.028	0.032	0.033	0.024	0.027
05-20-99	0.020	0.017	0.014	0.020	0.017	**11-18-99**	0.033	0.042	0.037	0.033	0.035
05-27-99	0.017	0.018	0.013	0.016	0.016	**11-24-99**	0.036	0.048	0.043	0.042	0.044
06-03-99	0.018	0.020	0.013	0.017	0.013	**12-02-99**	0.030	0.038	0.039	0.033	0.035
06-10-99	0.021	0.021	0.023	0.023	0.020	**12-08-99**	0.020	0.027	0.031	0.026	0.030
06-17-99	0.015	0.013	0.011	NA	0.012	**12-16-99**	0.030	0.040	0.038	0.040	0.040
06-24-99	0.021	0.023	0.020	0.019	0.023	**12-22-99**	0.026	0.028	0.032	0.031	0.029
07-01-99	0.010	0.013	0.010	0.012	0.013	**12-30-99**	0.029	0.037	0.038	0.034	0.036

[1] Iodine-131 concentrations <0.07 pCi/m^3 in all samples

TABLE VIII

AIRBORNE COMPOSITES (pCi/m^3)[1]

	A-1			
	QTR 1	**QTR 2**	**QTR 3**	**QTR 4**
Be-7	0.085	0.089	0.087	0.059

	A-7			
	QTR 1	**QTR 2**	**QTR 3**	**QTR 4**
Be-7	0.084	0.093	0.081	0.067

	A-8			
	QTR 1	**QTR 2**	**QTR 3**	**QTR 4**
Be-7	0.082	0.082	0.080	0.065

	A-9			
	QTR 1	**QTR 2**	**QTR 3**	**QTR 4**
Be-7	0.086	0.070	0.089	0.065

	B-3			
	QTR 1	**QTR 2**	**QTR 3**	**QTR 4**
Be-7	0.096	0.078	0.087	0.067

[1] Co-58, Co-60, Zr-95, Nb-95, Cs-134, Cs-137, Ba-140, La-140, Ce-144 Not Detectable

TABLE IX

SOIL (pCi/kg)[1]

	F2	F6	PR3	PR7	V3
	12/6/99	12/6/99	12/6/99	12/6/99	12/6/99
Gross Alpha	13,407	14,019	15,980	12,519	14,298
Gross Beta	22,727	24,300	22,495	19,802	27,148
K-40	11,724	10,936	10,226	10,992	13,836
Cs-137	519	1,259	647	367	194

	W1	W2	W3	W4
	12/6/99	12/6/99	12/6/99	12/6/99
Gross Alpha	15,142	21,398	14,963	12,009
Gross Beta	24,633	25,859	24,636	22,143
K-40	12,976	13,712	12,953	12,023
Cs-137	170	97	136	109

[1] Mn-54, Fe-59, Co-58, Co-60, Zr-95, Nb-95, Cs-134, Cs-137, Ba-140, La-140, Not Detectable

TABLE X

VEGETATION (pCi/kg wet)[1]

V3

	5/11/99 Greens	**6/8/99** Lettuce	**6/8/99** Spinach	**6/8/99** Turnip Greens	**7/12/99** Mustard Greens	**7/13/99** Turnip Greens
Gross Alpha	324	129	204	357	ND	173
Gross Beta	5,988	3,738	6,330	4,871	4,000	4,619
K-40	3,694	4,395	5,929	4,832	4,265	4,664

V10

	5/18/99 Turnip Greens	**5/18/99** Mustard Greens	**5/18/99** Spinach	**5/18/99** Lettuce	**6/8/99** Mustard Greens	**6/8/99** Lettuce
Gross Alpha	144	183	479	259	213	109
Gross Beta	3,817	3,737	8,080	3,999	5,586	2,790
K-40	3,665	3,949	7,872	3,441	3,719	3,853

V10

	6/8/99 Turnip Greens	**6/8/99** Spinach	**10/12/99** Turnip Greens	**10/12/99** Mustard Greens	**12/14/99** Mustard Greens	**12/14/99** Turnip Greens
Gross Alpha	328	241	162	189	103	129
Gross Beta	5,033	7,349	3,939	3,509	2,779	3,661
K-40	5,438	9,444	4,590	4,266	6,240	4,408

[1] Mn-54, Co-58, Co-60, I-131, Cs-134, Cs-137, Not Detectable

TABLE X

VEGETATION (pCi/kg wet)[1]

V9

	4/26/99 Lettuce	**5/25/99** Lettuce	**5/25/99** Turnip Greens	**6/8/99** Cabbage	**6/8/99** Turnip Greens	**6/8/99** Lettuce
Gross Alpha	243	355	241	113	263	371
Gross Beta	5,256	5,493	4,688	5,498	5,868	7,071
K-40	5,299	6,174	3,592	4,902	4,877	6,929

	7/12/99 Spinach	**7/12/99** Turnip Greens	**7/12/99** Lettuce	**7/12/99** Cabbage	**8/10/99** Cabbage	**8/10/99** Lettuce
Gross Alpha	406	285	330	85	67	ND
Gross Beta	10,210	5,329	7,983	3,094	2,580	8,827
K-40	8,471	4,923	6,810	2,205	3,634	10,546

	11/8/99 Turnip Greens	**11/8/99** Mustard Greens	**11/8/99** Cabbage	**12/13/99** Cabbage	**12/13/99** Mustard Greens	**12/13/99** Turnip Greens
Gross Alpha	ND	ND	ND	207	269	246
Gross Beta	5,074	4,854	3,105	4,214	4,858	3,203
K-40	4,609	5,178	3,540	2,777	3,558	3,190

[1] Mn-54, Co-58, Co-60, I-131, Cs-134, Cs-137, Not Detectable

TABLE XI

SURFACE WATER (pCi/l)[1]

SO1

	1/12/99	2/9/99	3/9/99	4/13/99	5/11/99	6/10/99
Gross alpha	ND	3.1	2.5	2.4	2.7	2.5
Gross beta	5.9	6.0	6.3	5.0	6.1	5.5
H-3	699	232	219	ND	ND	ND

	7/13/99	8/10/99	9/15/99	10/12/99	11/9/99	12/14/99
Gross alpha	3.9	2.7	3.7	2.0	2.5	ND
Gross beta	7.7	10.9	8.3	7.4	7.1	6.0
H-3	ND	ND	ND	ND	ND	ND

SO2

	1/12/99	2/9/99	3/9/99	4/13/99	5/11/99	6/10/99
Gross alpha	2.7	ND	3.9	3.1	1.9	2.2
Gross beta	5.4	6.2	6.0	5.6	5.3	6.3
H-3	530	247	ND	ND	ND	ND

	7/13/99	8/10/99	9/15/99	10/12/99	11/9/99	12/14/99
Gross alpha	3.9	3.2	4.9	3.0	ND	4.0
Gross beta	7.7	8.6	12.3	10.9	6.6	8.1
H-3	293	495	406	ND	ND	ND

[1] Mn-54, Fe-59, Co-58, Co-60, Zr-95, Nb-95, Cs-134, Cs-137, Ba-140, La-140, Not Detectable

TABLE XII

GROUND WATER[1]

D01

	QTR 1	QTR 2	QTR3	QTR 4
ALL	ND	ND	ND	NA

F05

	QTR 1	QTR 2	QTR3	QTR 4
ALL	ND	ND	ND	ND

F015

	QTR 1	QTR 2	QTR3	QTR 4
ALL	ND	ND	ND	ND

[1] H-3, Mn-54, Fe-59, Co-58, Co-60, Zr-95, Nb-95, Cs-134, Cs-137, Ba-140, La-140, Not Detectable

TABLE XIII

SEDIMENTS (pCi/kg dry)[1]

BOTTOM SEDIMENTS

	A			C	
	4/22/99	**10/19/99**		**4/22/99**	**10/19/99**
K-40	18,292	15,214	**K-40**	14,975	13,578
Cs-137	90.2	51.0	**Cs-137**	ND	ND

SHORELINE SEDIMENTS

	A			C	
	4/22/99	**10/19/99**		**4/22/99**	**10/19/99**
K-40	15,784	14,357	**K-40**	15,649	14,297
Cs-137	ND	69.5	**Cs-137**	ND	ND

[1] Mn-54, Fe-59, Co-58, Co-60, Zr-95, Nb-95, Cs-134, Ba-140, La-140, Not Detectable

TABLE XIV

FISH(pCi/kg wet)[1]

A

	4/22/99 Blue Catfish	4/22/99 Carp	4/22/99 River Carpsucker	4/22/99 Freshwater Drum	4/22/99 Bigmouth Buffalo
K-40	2,608	2,578	2,478	2,867	2,542

	10/19/99 Carp	10/19/99 Channel Catfish	10/19/99 Freshwater Drum	10/19/99 Smallmouth Buffalo	10/19/99 River Carpsucker
K-40	3,148	3,095	2,945	3,051	2,845

C

	4/22/99 Blue Catfish	4/22/99 Carp	4/22/99 River Carpsucker	4/22/99 Freshwater Drum	4/22/99 Bigmouth Buffalo
K-40	2,438	2,600	2,923	2,633	2,714

	10/19/99 Carp	10/19/99 Channel Catfish	10/19/99 Freshwater Drum	10/19/99 Smallmouth Buffalo	10/19/99 River Carpsucker
K-40	3,021	3,248	2,944	2,384	2,846

[1] Mn-54, Fe-59, Co-58, Co-60, I-131, Cs-134, Cs-137, Not Detectable

TABLE XV

MILK (pCi/l)[1]

M5

	1/11/99	2/9/99	3/8/99	4/13/99	4/26/99	5/10/99
K-40	NA	NA	1,539	1,674	1,826	1,750
	5/24/99	**6/7/99**	**6/21/99**	**7/12/99**	**7/27/99**	**8/10/99**
K-40	1,843	1,769	1,650	1,929	1,899	1,822
	8/24/99	**9/15/99**	**9/28/99**	**10/12/99**	**11/9/99**	**12/14/99**
K-40	NA	NA	NA	NA	NA	NA

M6

	1/12/99	2/9/99	3/9/99	4/13/99	4/27/99	5/11/99
K-40	1,170	1,182	1,229	1,185	1,190	1,127
	5/25/99	**6/8/99**	**6/22/99**	**7/12/99**	**7/27/99**	**8/10/99**
K-40	1,401	1,440	1,227	1,187	1,276	1,417
	8/24/99	**9/15/99**	**9/28/99**	**10/12/99**	**11/9/99**	**12/14/99**
K-40	1,268	1,189	1,332	1,243	1,229	1,375

M8

	1/11/99	2/9/99	3/9/99	4/13/99	4/26/99	5/11/99
K-40	1,276	1,167	1,203	1,069	946	1,068
	5/24/99	**6/7/99**	**6/21/99**	**7/12/99**	**7/27/99**	**8/10/99**
K-40	1,115	976	1,065	1,001	1,075	1,433
	8/22/99	**9/14/99**	**9/28/99**	**10/12/99**	**11/8/99**	**12/13/99**
K-40	1,377	1,432	NA	NA	1,336	1,474

[1] I-131, Zn-65, Cs-134, Cs-137, Ba-140, La-140, Not Detectable

TABLE XVI

DIRECT RADIATION (mrem)

	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
1a	15	14	15	20
3	17	15	18	19
4	15	13	15	16
5	15	12	14	16
6	17	NA	18	19
7	19	15	18	18
9	15	13	15	17
10	18	15	17	20
11a	17	18	18	21
14	17	15	17	17
17	16	15	16	19
18a	16	15	17	19
20	17	15	18	20
21	18	15	19	20
23	16	15	16	19
26	11	10	11	13
27	17	16	17	19
30a	16	14	16	17
31a	18	15	18	19
32	17	14	16	19

TABLE XVI

DIRECT RADIATION (mrem)

	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
33	16	15	16	18
34	15	14	16	19
35	14	13	15	16
36	16	14	NA	18
37	17	14	17	18
38	12	11	12	13
39	16	15	16	19
40	16	16	18	20
41	16	15	18	18
42	13	13	13	15
43	15	14	17	18
44	17	15	19	18
45	15	14	16	18
46	16	15	17	20
47	16	14	17	17
48	16	16	17	19
49	15	14	17	NA
50	17	17	17	19
51a	17	15	17	19
52	16	15	17	19

3.0 NON-RADIOLOGICAL MONITORING PROGRAM

3.1 INTRODUCTION

Union Electric Company, d.b.a. AmerenUE, in accordance with federal regulations and a desire to maintain the quality of the local environment around Callaway Plant has implemented an Environmental Protection Plan, (EPP) contained in Appendix B of the Callaway Plant Operating License.

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

This report describes the conduct of the EPP for the Callaway Plant during 1999.

3.2 UNUSUAL OR IMPORTANT EVENTS

No unusual or important events reportable under the EPP Section 4.1 were identified during 1999.

3.3 EPP NONCOMPLIANCES

During 1999 there were no noncompliances with the EPP.

3.4 NONROUTINE REPORTS

There were no nonroutine reports submitted in accordance with the EPP, Section 5.4.2 in 1999.

3.5 PLANT DESIGN AND OPERATION ENVIRONMENTAL EVALUATIONS.

This section lists all changes in the plant design, operation, tests or experiments completed during 1999, which could have involved a potentially significant unreviewed environmental question in accordance with section 3.1 of Appendix B.

During 1999, there were three plant design and operation changes that could have involved a potentially significant unreviewed environmental question. The interpretations and conclusions regarding these plant design and operation changes along with a description of the changes are presented below.

CALLAWAY MODIFICATION PACKAGE 97-1016, OL AMENDMENT #1196

Description of Change:

License amendment OL#1196 requested a change to the Operating License NPF-30 to increase the spent fuel storage capacity of the existing spent fuel pool. The increased capacity was accomplished by replacing the existing spent fuel pool racks with fuel racks that have a closer spacing and by adding racks to a portion of the cask loading area. The increased spent fuel capacity is designed to accommodate a complete core off load at the end of current licensed plant life, 2024.

Evaluation of Change:

This modification was confined to the spent fuel pool and cask loading area. No additional buildings or facilities were necessary. This modification could have resulted in a short duration increase in spent fuel pool temperature during fuel offload periods. The increased temperature could have resulted in higher spent fuel pool evaporation rate. However, new lower administrative limits have been set on the spent fuel temperature during this period, which will result in no substantial change in the spent fuel pool evaporation rate. The offsite doses due to increased number of spent fuel assemblies being stored in the spent fuel pool was also evaluated. The evaluation showed that the dose rates external to the building will meet the limits for the general public per 10 CFR 20.1301.a.2. This modification will not significantly affect the concentrations, frequencies or types of effluents being discharged from the plant, and does not affect the current plant power level. Therefore, this change did not constitute an unreviewed environmental question per Section 3.1 of appendix B to the Callaway Plant Operating License.

CALLAWAY REQUEST FOR RESOLUTION 19812 REVISION B

Description of Change:

This change allows the use of the Integrated Leak Test (IRLT) pressurization line to vent the containment air volume during the depressurization phase of IRLT. Request for resolution (RFR) 19812 rev. B changes the release point containment air volume for the IRLT depressurization, thus bypassing the normal filtration and radiation monitor for this flow path.

Evaluation of Change:

This change only is applicable during the depressurization phase of the IRLT. The release would be evaluated by sampling containment air prior to the pressurization phase. Ambient air was used to pressurize containment. The ambient air used for pressurization will mix with containment air that has previously been sampled. The Offsite Dose Calculation Manual, ODCM, assures regulatory compliance. This alternate release path will not affect concentrations, frequencies or types of effluents being discharged from the plant and does not affect plant power level. The use of this alternate release path for the IRLT will not significantly increase radioactive gaseous or particulate releases. Therefore, this change did not constitute an unreviewed environmental question per section 3.1 of Appendix B to the Callaway Plant Operating License.

CALLAWAY PROCEDURE ETP-BB-1336, OL AMENDMENT #132

Description of Change:

This procedure covers the steam generator electrosleeve project that was performed during refuel 10. The electrosleeve project generates several wastes, with some of them being a potentially mixed waste. The initial rinse or honing wastewater will not be hazardous and will be processed by Callaway's radwaste system. Other spent solutions will be treated as a potentially mixed waste. The generation and storage of waste from this process was evaluated to ensure that it would not significantly affect the environment and that these wastes were handled properly.

Evaluation of Change:

The evaluation of this change estimated that approximately 280 gallons of initial rinse water would be treated in the radwaste system and discharged from Outfall 001, Radwaste Treatment System. This amount of wastewater was not a significant change to the amount or quality of wastewater normally processed through this Outfall. The other wastewater generated by this process is a potentially mixed waste and could not be processed on site. The waste was stored in drums in a sealand container. The sealand container and will contain any leakage from the drums in the sealand. This potentially mixed waste has been shipped off site to a facility that is permitted to store this type of waste. The waste will be stored until it is treated by a permitted facility for final disposal. This change did not significantly affect any concentration, frequency or type of water discharged from the plant and does not change the current power level of the plant. Therefore, this change did not constitute an unreviewed environmental question per Section 3.1 of Appendix B to the Callaway Plant Operating License.

PACKAGE DIVIDER