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UNION ELECTRIC

CALLAWAY PLANT

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY — DECEMBER 1996

ANNUAL RADIOACTIVE EFFLUENT

RELEASE REPORT

CALLAWAY NUCLEAR PLANT

UNION ELECTRIC COMPANY

LICENSE NPF - 30

JANUARY - DECEMBER 1996

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1.0 INTRODUCTION

This Annual Radioactive Effluent Release Report is submitted in accordance with Section 6.9.1.7 of the Callaway Plant Technical Specifications.

The report presents a summary of radioactivity released in liquid and gaseous effluents, and solid waste shipped from the Callaway Plant during the period from January 1, 1996 to December 31, 1996. The information is presented in the format outlined in Appendix B of Regulatory Guide 1.21, Revision 1, June 1974.

All liquid and gaseous effluents discharged during this reporting period were in compliance with federal regulations and the limits in Union Electric Administrative Procedure APA-ZZ-01003, Offsite Dose Calculation Manual (ODCM).

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

Specified as follows are the Radiological Effluent Control (REC) limits applicable to the release of radioactive material in liquid and gaseous effluents.

2.1.1 Fission and Activation Gases (Noble Gases)

The dose rate due to radioactive noble gases released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin.

The air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the site boundary shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation and,

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

2.1.2 Radioiodine, Tritium, and Particulates

The dose rate due to Iodine-131 and 133, tritium and all radionuclides in particulate form with half-lives greater than eight (8) days released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to less than or equal to 1500 mrem/yr to any organ.

The dose to a member of the public from Iodine-131 and 133, tritium, and all radionuclides in particulate form with half-lives greater than eight (8) days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ and,

b. During any calendar year: Less than or equal to 15 mrem to any organ.

2.1.3 Liquid Effluents

The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to the concentrations specified in Appendix B, Table II, Column 2 to 10CFR20.001 to 20.601 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-04 microcuries/ml total activity.

The dose or dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total body and less than or equal to 5 mrem to any organ, and

b. During any calendar year to less than or equal to 3 mrem to the whole body and to less than or equal to 10 mrem to any organ.

2.1.4 Uranium Fuel Cycle Sources

The annual (calendar year) dose or dose commitment to any member of the public due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

2.2 Maximum Permissible Concentrations

2.2.1 The maximum permissible concentration values specified in Appendix B, Table II, Column 2 to 10CFR20.001 to 20.601 are used to calculate release rates and permissible concentrations of liquid radioactive effluents at the unrestricted area boundary. A value of 2.0E-4 microcuries/ml is used as the limiting concentration for dissolved and entrained noble gases in liquid effluents.

2.2.2 For gaseous effluents, maximum permissible concentrations are not utilized in release rate calculations since the applicable limits are based on dose rate at the site boundary. The "Percent of Tech Spec Limit" for Table 1A is therefore not applicable to the Callaway Plant.

2.3 Average Energy

This requirement is not applicable to the Callaway Plant radiological effluent monitoring program since the release rate limits for fission and activation gases in gaseous effluent are not based on the average energy of the radionuclide mixture.

2.4 Measurements and Approximations of Total Radioactivity

Radionuclide concentrations in liquid and gaseous effluents were obtained by effluent sampling and radiological analysis in accordance with the requirements of Table 9.3-A and Table 9.6-A of APA-ZZ-01003, Offsite Dose Calculation Manual.

Gamma spectroscopy was the primary analysis technique used to determine the radionuclide composition and concentration of liquid and gaseous effluents. Composite samples were analyzed for Sr-89, Sr-90, Fe-55, and transuranic nuclides by an independent laboratory. Tritium and gross alpha were measured for both liquid and gaseous

effluents using liquid scintillation counting and gas flow proportional counting techniques, respectively.

The total radioactivity in effluent releases was determined from the measured concentrations of each radionuclide present and the total volume of effluents discharged.

2.5 Batch Releases

Summary information relating to batch releases of gaseous and liquid effluents to the environment from the Callaway Plant during this year is presented below.

2.5.1 Liquid

	UNITS	PERIOD JAN - JUN	PERIOD JUL - DEC
Number of batch releases:		122	122
Total time period for batch releases:	Minutes	54702	58158
Maximum time period for batch releases:	Minutes	1643	1205
Average time period for batch releases:	Minutes	448	477
Minimum time period for batch releases:	Minutes	11	2
Average Missouri River flow during periods of effluent release to the river: [1]	Cubic feet per second	105613	125902

2.5.2 Gaseous

	UNITS	PERIOD JAN - JUN	PERIOD JUL - DEC
Number of batch releases:		41	32
Total time period for batch releases:	Minutes	3536	23872
Maximum time period for batch releases:	Minutes	445	8773
Average time period for batch releases:	Minutes	86	746
Minimum time period for batch releases:	Minutes	9	45

2.6 Unplanned Releases

2.6.1 Liquid

Number of releases: 0

Total Activity released: 0.00

[1] Letter, S. Ternes, United States Department of the Interior - Geological Survey - Water Resource Division to B. Holderness, Union Electric Company, dated January 17, 1996.

2.6.2 Gaseous

Number of releases: 1

Total Activity released: 1.19 E-03 Ci

3.0 SUMMARY OF GASEOUS RADIOACTIVE EFFLUENTS

3.1 The quantity of radioactive material released in gaseous effluents during the year is summarized in Tables 1A and 1B. During this year all gaseous effluents were considered as ground level releases.

4.0 SUMMARY OF LIQUID RADIOACTIVE EFFLUENTS

4.1 The quantity of radioactive material released in liquid effluents during the year is summarized in Tables 2A and 2B. During this year there was no continuous release of liquid effluent from the plant.

5.0 SOLID WASTES

5.1 The quantities of radioactive material released in shipments of solid waste for burial and irradiated fuel transported from the site during the year are summarized in Table 3. The total quantity and radioactivity reported in Table 3 for each waste type was for waste buried and includes wastes buried by waste reprocessors after volume reduction. The activity and fractional abundance of each nuclide was determined for each waste type based upon radiochemical analysis by an independent laboratory. The curie concentration of each nuclide listed in Table 3 was determined as the product of the fractional abundance and the total curies shipped. Those nuclides which comprise at least 1% of the total activity for a particular waste type are presented in Table 3.

6.0 RELATED INFORMATION

6.1 Unplanned Releases

Unplanned releases are: 1) Inadvertent or accidental releases of radioactive material; 2) Releases of radioactive material via normal pathways without a release permit, proper authorization, or proper sampling and analysis; and 3) Releases which are conducted in such a manner as to result in significant deviation from the requirements of the release permit.

There was one unplanned release during the reporting period.

During 1996 the auxiliary boiler was operated with existing low levels of radioactive contamination. The auxiliary boiler was initially contaminated on April 3, 1995, during Refuel 7 as reported in the 1995 Annual Radioactive Effluent Release Report. Routine isotopic analysis during 1996 occasionally identified low levels of Mn-54, Co-58, Co-60, and Sb-125 in the auxiliary boiler. This activity was determined to be from resuspension of radioactive material that had plated out in the system.

The auxiliary boiler blowdown and area drains are routed to the liquid radwaste system to insure processing of any radioactive liquid effluent before being discharged from the plant.

A 10CRF50.59 evaluation was initiated to address operation of the auxiliary boiler during 1996 with existing low levels of radioactive contamination. Dose calculations were performed based on isotopic analysis of auxiliary boiler contents and the estimated volume

released for normal monthly operation and Reuel 8 operation. The calculations were performed in accordance with the methodology in APA-ZZ-01003, "Offsite Dose Calculation Manual" using the computerized Effluent Management System.

The 10CFR50.59 evaluation concluded that resulting doses to a member of the public from releases of radioactive material to the environment would be a small fraction of the Radioactive Effluent Controls (REC) dose limits. Therefore, continued operation of the auxiliary boiler would not pose any significant safety or environmental concerns.

The end-of-year evaluation for operation of the auxiliary boiler showed that the following activity was released to the environment during 1996:

H-3	1.18E-03 Ci
Mn-54	7.97E-07 Ci
Co-58	2.65E-07 Ci
Co-60	5.98E-06 Ci
Sb-125	1.23E-06 Ci

The maximum organ dose to a member of the public from these releases was calculated to be 1.28E-05 mrem which is negligible when compared to the quarterly and annual effluent control limits. As a result, the release of radioactive material from operation of the auxiliary boiler did not endanger the health or safety of the public or the environment.

The activity released from the auxiliary boiler during 1996 is reported in Table 1A and 1B and is also included in the annual dose calculations (see Section 8.0).

A description of this event along with the completed safety evaluations were documented in Suggestion Occurrence Solution (SOS) 96-0090 and 96-1348.

6.2 Changes to the Process Control Program

There were no changes made to Administrative Procedure APA-ZZ-01011, "Process Control Program Manual", during this year.

6.3 Changes to the Offsite Dose Calculation Manual

Revision 6 of Administrative Procedure APA-ZZ-01003, Offsite Dose Calculation Manual (ODCM) was approved October 23, 1996.

The changes incorporated into revision 6 include the following:

1) Added liquid effluent dose factors for Ag-110m, Np-237, Pu-238, Pu-239/240, Pu-241, Am-241, Cm-242, and Cm-234/244 and Bioaccumulation Factors for Ag, Pu, Am, and Cm due to a change in the Liquid radwaste treatment process. Removed airborne meat pathway dose conversion factors for Y-91m and Tc-99m due to half-lives of less than eight days.

2) Revised the description and methodology for performing the 31 day dose projection for liquid and gaseous effluents.

3) Revised the maximum allowable background for liquid effluent monitor HB-RE-18.

4) Revised the definition of F_a in Section 3.2.1 and q_i in Section 3.3.2.1 to clarify their use in the dose calculations. Edited equations 3.13 and 3.14 and added equation 3.15 to clarify calculation of dose from radionuclides other than noble gas in gaseous effluents.

5) Added a description of the methodology for verifying the dose rate limit for gaseous effluents was not exceeded using unit vent and radwaste vent effluent samples.

6) Added a new table to describe the selection and use of atmospheric dispersion parameters during the preparation of the Annual Radioactive Effluent Release Report. Updated the Land Use Census reference to the current year for the unit vent and radwaste vent atmospheric dispersion parameter tables. There were no changes made to the receptor locations.

7) Eliminated REC 9.0.1 and REC 9.0.2 from the ODCM due to redundancy with Technical Specification 3.0.1 and 3.0.2.

8) Revised REC Table 9.3-A to incorporate sampling and analysis requirements for TRU nuclides in liquid effluent. Eliminated sampling of Fuel Building Exhaust from REC Table 9.6-A and the associated footnotes due to redundancy with unit vent sampling.

9) Revised the continuous sampling requirements for gaseous batch release points and changed the tritium analysis frequency for Purges from weekly to "prior to each purge" to be consistent with plant design.

10) Revised environmental airborne, milk and vegetable sample location criteria on REC Table 9.11-A and footnotes 1 and 6, and eliminated footnote 3 to be less generic and more descriptive of the parameters used in determining the station locations. Revised description to use baseline airborne samples to trigger gamma isotopic analysis in footnote 4 to REC Table 9.11-A.

11) Revised REC 9.10 surveillance requirement and bases to eliminate liquid effluents from this surveillance. Revised REC 9.5 and REC 9.9 to eliminate exceptions for partially tested effluents being released in excess of the respective limit.

A complete copy of Administrative Procedure APA-ZZ-01003, Revision 6 is included as Attachment 1.

6.4 Major Changes to Radwaste Treatment Systems

During this reporting period two changes were implemented to the radwaste treatment systems. These were 1) addition of filtration and demineralization as a method for processing liquid waste streams (ORC meeting 1423) and 2) removal of bladders from the recycle holdup tanks (ORC meeting 1415).

6.4.1 FSAR Change Notice 94-061, approved on July 3, 1996, allows the use of a demineralization and filtration process in lieu of evaporation to process some of the waste water generated in the plant. This change was implemented to simplify radioactive waste processing, reduce Low-Level Radioactive Waste burial volume and reduce worker radiation exposure.

Depending on analysis of the waste stream, the wastewater may be processed using liquid waste charcoal adsorber, the waste evaporator condensate demineralizer, the waste evaporator condensate filter, the waste monitoring demineralizer or the waste monitor tank filter in any combination prior to being eventually sent to the discharge monitor tanks. All the above equipment is existing within the plant. No new piping changes were required to provide the necessary flow paths for processing. The only change is the use of new hybrid ion-selective resins that are effective in eliminating specific target nuclides from the waste stream that are major contributors to dose to the public from liquid effluents. At Callaway Plant Cs-treat hybrid resin is being used to remove cesium nuclides from the waste streams.

The consequences or probability of an accident previously evaluated in the FSAR is not increased by this processing method since existing piping and equipment were used. Also, the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the FSAR is not created by this operational change of the liquid radwaste system. Per the FSAR, the liquid radwaste system is not safety related and its failure will not compromise any safety related equipment. As stated in the safety evaluation for the change notice, there are no unreviewed safety questions as a result of this processing method change.

While the estimated average activity released using this new process is greater than that estimated in NUREG 0813, the offsite doses are expected to remain below the calculated dose in NUREG 0813 due to the removal of major dose contributors.

The actual change in effluent concentrations will not be significant enough to cause dose estimates or effluent limits to be exceeded. While some radionuclides in the discharge have increased above the original estimate, all discharges continue to be at a small fraction of the regulatory limits.

This process change was implemented in August of 1996.

6.4.2 The second modification included removing the bladder from the inside of the Recycle Holdup Tanks, THE02A/B, and modifying the tank vent to accommodate a vacuum breaker. Due to a leak in the bladder that could not be found, water accumulated on the top of the bladder. This water has caused part of the bladder to sink. Which in turn, blocked the pump suction.

The safety evaluation for this modification determined there was no increase in the consequences of an accident evaluated in the FSAR. The modification did not affect the structural integrity of the tank, piping or other components that may lead to uncontrolled leakage. The equipment associated with this modification does not interface with equipment important to safety. Therefore, there was no unreviewed safety question associated with this modification.

Per the Environmental Evaluation, this modification did not result in the creation of a new release pathway, since the Radwaste Building HVAC exhaust is currently a monitored pathway to the environment. In addition, the modification did not create a new or different type of pollutant. The gaseous releases from the radwaste building are controlled by the Offsite Dose Calculation Manual to ensure releases are within regulatory limits.

The removal of the bladders allowed dissolved gases in the RCS blowdown to the RHUT to be vented directly to the radwaste building

The removal of the bladders allowed dissolved gases in the RCS letdown to the RHUT to be vented to the radwaste building ventilation system.

Two different source terms were evaluated assuming normal plant operations to determine the changes in noble gas activity released. The first case assumed a normal RCS activity with no fuel defects and the second case assumed RCS activity with failed fuel. While both cases resulted in an increased release of fission and activation gaseous activity over the year, the increase would be a small fraction of the total gaseous activity released during a year and will not be significant enough to cause effluent limits to be exceeded.

As a result of this change there was no significant change to plant personnel exposure.

The first RHUT bladder was removed in July, 1996 and the second RHUT bladder was removed in February, 1997.

6.5 Land Use Census Changes

The 1996 Land Use Census identified a change in the location of the nearest resident yielding the highest calculated dose commitment. The previously identified nearest resident moved and the house was demolished. The new nearest resident is located 1.9 miles NNW of the plant.

6.6 Inoperability of Effluent Monitoring Instrumentation

All effluent monitoring instrumentation was OPERABLE within the limits specified in FSAR Chapters 16.3.3.6 and 16.3.3.7B during the year.

6.7 Instances of Liquid Holdup Tanks or Waste Gas Decay Tanks Exceeding Technical Specification Limits

All liquid tanks and waste gas decay tanks were within limits specified in FSAR Chapters 16.11.1 and 16.11.3 during the reporting period.

7.0 METEOROLOGICAL DATA

The on-site meteorological data for this reporting period is presented in Table 4. The data is presented as Cumulative Joint Frequency Distributions of wind speed and wind direction by atmospheric stability class for the 10 and 60 meter tower elevations. Valid data recovery for 1996 was greater than 90% for all required parameters.

8.0 ASSESSMENT OF DOSES

Assessment of doses to the maximum exposed individual from gaseous and liquid effluents released was performed in accordance with Administrative Procedure APA-ZZ-01003 as described in the following sections. For all effluents released from the Callaway Plant during this year, the annual dose to the maximum exposed individual was less than 2% of the Radiological Effluent Control Limits presented in Section 2.1 of this report.

8.1 Dose at the Site Boundary from Gaseous Effluents

The dose at the Site Boundary was due to plume exposure from noble gases, ground plane exposure, and inhalation. It was conservatively assumed that a hypothetical maximum exposed individual was present at the Site Boundary location with the most limiting atmospheric dispersion (based on actual meteorological conditions for the year). Dose was conservatively calculated using a child as the critical age group.

The dose from gaseous effluent at the Site Boundary for 1996 is presented in Table 5.

8.2 Dose to the MEMBER OF THE PUBLIC

The MEMBER OF THE PUBLIC was considered to be a real individual, not occupationally associated with the plant, who uses portions of the plant site for recreational or other purposes not associated with plant operation. This individual's utilization of areas both inside and outside the Site Boundary was characterized for this calculation.

To evaluate total dose from the Uranium Fuel Cycle to any MEMBER OF THE PUBLIC, the critical MEMBER OF THE PUBLIC within the Site Boundary, and the Nearest Resident were each evaluated.

8.2.1 Dose at the Nearest Resident from Gaseous Effluent

The dose to the Nearest Resident was due to plume exposure from noble gases, ground plane exposure, and inhalation and ingestion. Dose was calculated at the nearest actual residence with the most limiting atmospheric dispersion (based on actual meteorological conditions for the year). It was conservatively assumed that each ingestion pathway (meat, milk, and vegetation) existed at this location. Dose was conservatively calculated assuming the child as the critical age group. Dose from activities within the Site Boundary was negligible and not included in this calculation.

The doses to the Nearest Resident for 1996 are presented in Table 5.

8.2.2 Dose to the MEMBER OF THE PUBLIC from Activities within the Site Boundary

Based on existing land use within the Site Boundary, the MEMBER OF THE PUBLIC with the highest dose was a farmer. Dose from farming activities within the Site Boundary was due to direct radiation exposure, plume exposure from noble gases, ground plane exposure and inhalation. The current tenant estimates spending 1100 hours per year working within the Site Boundary area. Dose was calculated using the adult farmer as the critical age group.

Dose to the MEMBER OF THE PUBLIC from activities within the Site Boundary is presented in Table 6.

8.3 Total Dose Due to the Uranium Fuel Cycle

Since there are no other Uranium Fuel Cycle facilities within 8 kilometers of the Callaway Plant, the total dose to the most likely exposed MEMBER OF THE PUBLIC resulted from direct radiation exposure and radioactive effluents from the Callaway Plant itself. Therefore, Dose from mining, fuel fabrication, and waste disposal were not included in this calculation.

Since dose via liquid releases was conservatively evaluated, reasonable assurance exists that no real individual received a significant dose from radioactive liquid release pathways. Therefore, only dose to individuals from airborne pathways and dose resulting from direct radiation were considered in this assessment.

The total dose to the MEMBER OF THE PUBLIC (Table 7) was the sum of the dose due to activities within the Site Boundary (Table 6) and the dose due to gaseous effluents at his residence. It was assumed that each food ingestion pathway exists at his residence. Dose was calculated using the adult farmer as the critical age group.

The total dose from the Uranium Fuel Cycle is presented in Table 7.

8.4 Dose Due to Liquid Effluents

Dose due to liquid effluents assumed contributions from the maximum exposed individual's consumption of fish and recreational activities. An adult was considered to be the maximum exposed individual in this assessment.

Since there are no potable water intakes within 50 river miles of the discharge point to the Missouri River, the potable water pathway was not included in the dose assessment. Therefore, dose contribution from fish consumption accounted for 95% of the total dose from liquid effluents discharged to the river. Dose from recreational activities contributed the additional 5%. It is conservatively assumed the hypothetical maximum exposed individual obtained his entire annual fish intake from near the plant discharge.

Total dose due to liquid effluents from Callaway Plant during the year is presented in Table 8.

TABLE 1A

SEMIANNUAL SUMMATION OF GASEOUS RELEASES
ALL AIRBORNE EFFLUENTS

QUARTERS 1 AND 2, 1996

TYPE OF EFFLUENT	UNITS	FIRST QUARTER	SECOND QUARTER	EST TOTAL ERROR % (a)
A. FISSION AND ACTIVATION GASES				
1. TOTAL RELEASE	CURIES	1.57E+01	2.56E+01	20
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	2.00E+00	3.25E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
B. RADIOIODINES				
1. TOTAL IODINE-131	CURIES	7.25E-05	0.00E+00	23
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	9.22E-06	0.00E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
C. PARTICULATES				
1. PARTICULATE (HALF-LIVES > 8 DAYS)	CURIES	0.00E+00	1.13E-07	30
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	0.00E+00	1.44E-08	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
4. GROSS ALPHA RADIOACTIVITY	CURIES	5.92E-07	1.98E-07	
D. TRITIUM				
1. TOTAL RELEASE	CURIES	3.34E+01	1.31E+01	14
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	4.25E+00	1.66E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	

(a) Safety Analysis Calculation 87-063-00, January 6, 1988

TABLE 1A (continued)

SEMIANNUAL SUMMATION OF GASEOUS RELEASES
ALL AIRBORNE EFFLUENTS

QUARTERS 3 AND 4, 1996

TYPE OF EFFLUENT	UNITS	THIRD QUARTER	FOURTH QUARTER	EST TOTAL ERROR % (a)
A. FISSION AND ACTIVATION GASES				
1. TOTAL RELEASE	CURIES	7.92E+00	9.57E+01	20
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	9.96E-01	1.20E+01	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
B. RADIOIODINES				
1. TOTAL IODINE-131	CURIES	0.00E+00	7.46E-06	23
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	0.00E+00	9.38E-07	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
C. PARTICULATES				
1. PARTICULATE (HALF-LIVES > 8 DAYS)	CURIES	1.71E-07	1.31E-05	30
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	2.15E-08	1.65E-06	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
4. GROSS ALPHA RADIOACTIVITY	CURIES	2.56E-07	1.07E-06	
D. TRITIUM				
1. TOTAL RELEASE	CURIES	1.12E+01	2.98E+01	14
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	1.41E+00	3.75E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	

(a) Safety Analysis Calculation 87-063-00, January 6, 1988

TABLE 2A

SEMIANNUAL SUMMATION OF LIQUID RELEASES
ALL LIQUID EFFLUENTS

QUARTERS 1 AND 2, 1996

TYPE OF EFFLUENT	UNITS	FIRST QUARTER	SECOND QUARTER	EST TOTAL ERROR % (a)
A. FISSION AND ACTIVATION PRODUCTS				
1. TOTAL RELEASE [NOT INCLUDING TRITIUM, GASES, ALPHA]	CURIES	7.93E-04	1.16E-03	20
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	2.07E-09	2.64E-09	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
B. TRITIUM				
1. TOTAL RELEASE	CURIES	3.07E+02	4.05E+02	14
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	8.02E-04	9.26E-04	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
C. DISSOLVED AND ENTRAINED GASES				
1. TOTAL RELEASE	CURIES	3.88E-03	6.91E-03	27
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	1.01E-08	1.58E-08	
D. GROSS ALPHA RADIOACTIVITY				
1. TOTAL RELEASE	CURIES	5.71E-04	1.26E-03	29
E. WASTE VOLUME RELEASED (PRE-DILUTION)	GAL	4.96E+06	6.12E+06	10
F. VOLUME OF DILUTION WATER USED	GAL	9.64E+07	1.09E+08	10

(a) Safety Analysis Calculation 87-063-00, January 6, 1988

TABLE 2A (continued)

SEMIANNUAL SUMMATION OF LIQUID RELEASES
ALL LIQUID EFFLUENTS

QUARTERS 3 AND 4, 1996

TYPE OF EFFLUENT	UNITS	THIRD QUARTER	FOURTH QUARTER	EST TOTAL ERROR % (a)
A. FISSION AND ACTIVATION PRODUCTS				
1. TOTAL RELEASE [NOT INCLUDING TRITIUM, GASES, ALPHA]	CURIES	3.80E-02	7.32E-01	20
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	7.25E-08	1.80E-06	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
B. TRITIUM				
1. TOTAL RELEASE	CURIES	3.42E+02	1.15E+02	14
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	6.53E-04	2.84E-04	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
C. DISSOLVED AND ENTRAINED GASES				
1. TOTAL RELEASE	CURIES	1.14E-02	1.33E-02	27
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	2.17E-08	3.27E-08	
D. GROSS ALPHA RADIOACTIVITY				
1. TOTAL RELEASE	CURIES	8.51E-03	1.41E-02	29
E. WASTE VOLUME RELEASED (PRE-DILUTION)	GAL	6.30E+06	4.93E+06	10
F. VOLUME OF DILUTION WATER USED	GAL	1.32E+08	1.02E+08	10

(a) Safety Analysis Calculation 87-063-00, January 6, 1988

TABLE 1B

SEMIANNUAL AIRBORNE CONTINUOUS AND BATCH RELEASES
GROUND LEVEL RELEASES
FISSION GASES, IODINES, AND PARTICULATES

QUARTERS 1 AND 2, 1996

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNITS	FIRST QUARTER	SECOND QUARTER	FIRST QUARTER	SECOND QUARTER
1. FISSION GASES					
AR-41	CURIES	0.00E+00	0.00E+00	1.49E-01	5.40E-02
XE-133	CURIES	1.47E+01	2.10E+01	6.67E-02	4.89E-02
XE-135	CURIES	5.88E-01	1.24E+00	1.08E-02	1.43E-03
XE-135M	CURIES	0.00E+00	0.00E+00	5.32E-02	1.13E-04
XE-131M	CURIES	0.00E+00	3.20E+00	1.15E-07	1.23E-03
KR-85	CURIES	0.00E+00	0.00E+00	1.20E-01	0.00E+00
KR-87	CURIES	0.00E+00	0.00E+00	0.00E+00	7.21E-05
XE-133M	CURIES	0.00E+00	0.00E+00	0.00E+00	2.60E-04
KR-85M	CURIES	0.00E+00	0.00E+00	0.00E+00	7.90E-06
KR-88	CURIES	0.00E+00	0.00E+00	0.00E+00	2.11E-05
TOTAL FOR PERIOD	CURIES	1.53E+01	2.55E+01	4.00E-01	1.06E-01
2. IODINES					
I-131	CURIES	0.00E+00	0.00E+00	7.25E-05	0.00E+00
I-132	CURIES	0.00E+00	0.00E+00	2.43E-07	0.00E+00
I-133	CURIES	0.00E+00	0.00E+00	1.38E-04	0.00E+00
I-134	CURIES	0.00E+00	0.00E+00	2.96E-08	0.00E+00
I-135	CURIES	0.00E+00	0.00E+00	9.56E-12	0.00E+00
TOTAL FOR PERIOD	CURIES	0.00E+00	0.00E+00	2.11E-04	0.00E+00
3. PARTICULATES					
CO-60	CURIES	0.00E+00	1.13E-07	0.00E+00	0.00E+00
ALPHA	CURIES	5.92E-07	1.98E-07	0.00E+00	0.00E+00
TOTAL FOR PERIOD	CURIES	5.92E-07	3.11E-07	0.00E+00	0.00E+00
4. TRITIUM					
H-3	CURIES	7.82E+00	1.27E+01	2.56E+01	3.24E-01

TABLE 1B (continued)

SEMIANNUAL AIRBORNE CONTINUOUS AND BATCH RELEASES
GROUND LEVEL RELEASES
FISSION GASES, IODINES, AND PARTICULATES

QUARTERS 3 AND 4, 1996

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNITS	THIRD QUARTER	FOURTH QUARTER	THIRD QUARTER	FOURTH QUARTER
1. FISSION GASES					
AR-41	CURIES	1.25E+00	5.43E-01	4.71E-01	5.26E-01
XE-133	CURIES	5.15E+00	2.20E+01	2.79E-01	6.36E+01
XE-135	CURIES	6.68E-01	2.03E+00	1.31E-02	9.47E-03
XE-135M	CURIES	0.00E+00	2.63E-02	2.02E-04	0.00E+00
XE-131M	CURIES	0.00E+00	0.00E+00	1.88E-03	3.48E-02
KR-85	CURIES	0.00E+00	0.00E+00	8.68E-02	6.08E-02
KR-87	CURIES	0.00E+00	2.63E-03	1.86E-05	0.00E+00
XE-133M	CURIES	0.00E+00	0.00E+00	4.27E-04	6.97E-01
KR-85M	CURIES	0.00E+00	3.64E-02	0.00E+00	0.00E+00
KR-88	CURIES	0.00E+00	3.50E-01	1.27E-03	0.00E+00
XE-138	CURIES	0.00E+00	0.00E+00	3.42E-04	2.96E-04
XE-137	CURIES	0.00E+00	5.83E+00	0.00E+00	0.00E+00
TOTAL FOR PERIOD	CURIES	7.07E+00	3.08E+01	8.54E-01	6.49E+01
2. IODINES					
I-131	CURIES	0.00E+00	7.46E-06	0.00E+00	0.00E+00
I-132	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	CURIES	0.00E+00	1.24E-05	0.00E+00	0.00E+00
I-134	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL FOR PERIOD	CURIES	0.00E+00	1.98E-05	0.00E+00	0.00E+00
3. PARTICULATES					
CO-60	CURIES	1.71E-07	5.98E-06	0.00E+00	0.00E+00
CE-141	CURIES	0.00E+00	7.37E-07	0.00E+00	0.00E+00
CO-58	CURIES	0.00E+00	3.45E-06	0.00E+00	0.00E+00
MN-54	CURIES	0.00E+00	7.97E-07	0.00E+00	0.00E+00
SB-125	CURIES	0.00E+00	1.23E-06	0.00E+00	0.00E+00
CE-144	CURIES	0.00E+00	9.53E-07	0.00E+00	0.00E+00
ALPHA	CURIES	2.56E-07	1.07E-06	0.00E+00	0.00E+00
TOTAL FOR PERIOD	CURIES	4.27E-07	1.42E-05	0.00E+00	0.00E+00
4. TRITIUM					
H-3	CURIES	1.03E+01	2.84E+01	9.36E-01	1.37E+00

TABLE 2B

SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
TOTALS FOR EACH NUCLIDE RELEASED

QUARTERS 1 AND 2, 1996

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNITS	FIRST QUARTER	SECOND QUARTER	FIRST QUARTER	SECOND QUARTER
1. ALL NUCLIDES					
ALPHA	CURIES	0.00E+00	0.00E+00	5.71E-04	1.26E-03
CO-60	CURIES	0.00E+00	0.00E+00	3.99E-04	6.77E-04
H-3	CURIES	0.00E+00	0.00E+00	3.07E+02	4.05E+02
CE-144	CURIES	0.00E+00	0.00E+00	3.81E-05	0.00E+00
PR-144	CURIES	0.00E+00	0.00E+00	3.81E-05	0.00E+00
CO-58	CURIES	0.00E+00	0.00E+00	2.64E-04	4.46E-05
CS-137	CURIES	0.00E+00	0.00E+00	4.09E-05	2.52E-06
MN-54	CURIES	0.00E+00	0.00E+00	5.82E-06	1.40E-05
XE-133	CURIES	0.00E+00	0.00E+00	3.75E-03	6.55E-03
XE-133M	CURIES	0.00E+00	0.00E+00	4.38E-05	0.00E+00
XE-135	CURIES	0.00E+00	0.00E+00	8.03E-05	5.83E-05
HF-181	CURIES	0.00E+00	0.00E+00	9.12E-07	0.00E+00
SB-125	CURIES	0.00E+00	0.00E+00	5.94E-06	7.37E-06
XE-131M	CURIES	0.00E+00	0.00E+00	0.00E+00	2.93E-04
CE-141	CURIES	0.00E+00	0.00E+00	0.00E+00	4.40E-06
CO-57	CURIES	0.00E+00	0.00E+00	0.00E+00	1.73E-06
KR-85M	CURIES	0.00E+00	0.00E+00	0.00E+00	4.43E-06
CR-51	CURIES	0.00E+00	0.00E+00	0.00E+00	1.39E-05
SR-89	CURIES	0.00E+00	0.00E+00	0.00E+00	3.91E-04
TOTALS FOR PERIOD	CURIES	0.00E+00	0.00E+00	3.07E+02	4.05E+02

TABLE 2B (continued)

SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
TOTALS FOR EACH NUCLIDE RELEASED

QUARTERS 3 AND 4, 1996

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNITS	THIRD QUARTER	FOURTH QUARTER	THIRD QUARTER	FOURTH QUARTER
1. ALL NUCLIDES					
ALPHA	CURIES	0.00E+00	0.00E+00	8.51E-03	1.41E-02
CO-60	CURIES	0.00E+00	0.00E+00	1.56E-02	2.29E-02
H-3	CURIES	0.00E+00	0.00E+00	3.42E+02	1.15E+02
CE-144	CURIES	0.00E+00	0.00E+00	1.05E-04	0.00E+00
PR-144	CURIES	0.00E+00	0.00E+00	1.05E-04	0.00E+00
CO-58	CURIES	0.00E+00	0.00E+00	5.18E-03	6.00E-01
CS-137	CURIES	0.00E+00	0.00E+00	4.86E-04	4.03E-04
MN-54	CURIES	0.00E+00	0.00E+00	2.09E-03	6.56E-03
XE-133	CURIES	0.00E+00	0.00E+00	1.09E-02	1.19E-02
XE-133M	CURIES	0.00E+00	0.00E+00	4.55E-05	4.65E-05
XE-135	CURIES	0.00E+00	0.00E+00	2.22E-04	1.49E-05
AR-41	CURIES	0.00E+00	0.00E+00	0.00E+00	3.35E-05
SB-125	CURIES	0.00E+00	0.00E+00	7.64E-03	1.85E-02
XE-131M	CURIES	0.00E+00	0.00E+00	1.56E-04	1.28E-03
CO-57	CURIES	0.00E+00	0.00E+00	1.17E-04	1.19E-03
KR-85M	CURIES	0.00E+00	0.00E+00	0.00E+00	9.43E-06
CR-51	CURIES	0.00E+00	0.00E+00	1.45E-04	4.40E-02
SR-89	CURIES	0.00E+00	0.00E+00	1.83E-03	0.00E+00
CS-134	CURIES	0.00E+00	0.00E+00	4.98E-05	2.71E-05
NB-95	CURIES	0.00E+00	0.00E+00	2.86E-06	8.03E-03
RU-106	CURIES	0.00E+00	0.00E+00	4.72E-04	9.96E-05
I-131	CURIES	0.00E+00	0.00E+00	3.59E-03	1.79E-02
I-133	CURIES	0.00E+00	0.00E+00	3.99E-04	1.01E-03
TC-99M	CURIES	0.00E+00	0.00E+00	5.66E-05	4.36E-04
AG-110M	CURIES	0.00E+00	0.00E+00	1.79E-05	7.77E-05
BE-7	CURIES	0.00E+00	0.00E+00	3.79E-07	0.00E+00
ZR-95	CURIES	0.00E+00	0.00E+00	3.10E-05	6.26E-03
AM-241	CURIES	0.00E+00	0.00E+00	4.98E-08	1.38E-06
CM-242	CURIES	0.00E+00	0.00E+00	3.91E-08	7.38E-07
CM-243	CURIES	0.00E+00	0.00E+00	9.25E-08	2.27E-06
FE-55	CURIES	0.00E+00	0.00E+00	1.46E-07	0.00E+00
PU-238	CURIES	0.00E+00	0.00E+00	1.85E-07	3.49E-06
PU-239	CURIES	0.00E+00	0.00E+00	2.85E-08	5.37E-07
PU-241	CURIES	0.00E+00	0.00E+00	5.69E-05	1.25E-03
SR-90	CURIES	0.00E+00	0.00E+00	2.49E-05	8.89E-05
LA-140	CURIES	0.00E+00	0.00E+00	0.00E+00	3.30E-04
MO-99	CURIES	0.00E+00	0.00E+00	0.00E+00	1.52E-04
SB-124	CURIES	0.00E+00	0.00E+00	0.00E+00	5.57E-04
I-132	CURIES	0.00E+00	0.00E+00	0.00E+00	1.21E-04
FE-59	CURIES	0.00E+00	0.00E+00	0.00E+00	1.38E-03
EU-154	CURIES	0.00E+00	0.00E+00	0.00E+00	1.75E-04
RU-103	CURIES	0.00E+00	0.00E+00	0.00E+00	2.09E-04
SN-113	CURIES	0.00E+00	0.00E+00	0.00E+00	2.44E-04
TOTALS FOR PERIOD	CURIES	0.00E+00	0.00E+00	3.42E+02	1.16E+02

TABLE 3
SOLID WASTE & IRRADIATED FUEL SHIPMENTS
1996

A. SOLID WASTE BURIED (DOES NOT INCLUDE IRRADIATED FUEL)

1. TYPE OF WASTE	UNITS	PERIOD JAN - JUN	PERIOD JUL - DEC	EST. TOTAL ERROR (%)
a. Spent resins, filter sludges evaporator bottoms, etc.	m^3	4.2	11.4	
	Ci	4.8E+01	3.1E+01	±25%
b. Dry compressible waste, contaminated equipment, etc.	m^3	7.3	35.5	
	Ci	2.6E-01	3.2E-01	±25%
c. Irradiated components, control rods, etc.	m^3	0.0	0.0	
	Ci	0.00E+00	0.00E+00	±25%
d. Other	m^3	0.0	0.0	
	Ci	0.00E+00	0.00E+00	±25%

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (by Type of Waste)

		PERIOD JAN - JUN		PERIOD JUL - DEC	
Nuclide		Percent Abundance	Curies	Percent Abundance	Curies
a.	Co-60	34.3%	1.6E+01	17.6%	5.4E+00
	Ni-63	31.3%	1.5E+01	16.7%	5.1E+00
	Cs-137	12.2%	5.3E+00		
	Cs-134	8.9%	4.2E+00		
	Fe-55	8.4%	4.0E+00	60.8%	1.9E+01
	Co-58	1.1%	5.2E-01		
	Mn-54			1.4%	4.4E-01
b.	Co-58	58.2%	1.5E-01	58.2%	1.9E-01
	Fe-55	16.5%	4.3E-02	16.5%	5.3E-02
	H-3	14.5%	3.8E-02	14.5%	4.6E-02
	Cs-137	5.2%	1.4E-02	5.2%	1.7E-02
	Co-60	3.0%	7.9E-03	3.0%	9.6E-03
	Pu-241	1.6%	4.2E-03	1.6%	5.1E-03
c.					
d.					

TABLE 3 (continued)
SOLID WASTE & IRRADIATED FUEL SHIPMENTS
1995

3. SOLID WASTE DISPOSITION:

Number of Shipments	Mode of Transportation	Destination	Class of Solid Waste Shipped	Type of Container
1	Cask	Barnwell, SC	B	LSA
1*	Cask	Scientific Ecology Group	C	LSA
5*	Cask	Scientific Ecology Group	A	LSA
32*	Truck	Scientific Ecology Group	A	LSA
1*	Truck	F. W. Hake	A	LSA
* Shipments sent to waste reprocessors for volume reduction before burial.				

4. SOLIDIFICATION AGENT:

None used.

B. IRRADIATED FUEL SHIPMENTS (DISPOSITION)

Number of Shipments	Mode of Transportation	Destination

TABLE 4

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:24.92

Meteorological Data
Averages Using Hourly Averaged Data

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

		UNITS	VALUES	% GOOD DATA
Stability Class		A - G	E	92%
10 Meter Level:	Wind Speed	Meter/Sec	3.41E+00	98%
	Wind Direction	Degrees	2.21E+02	97%
	Wind Direction Variability	Degrees	1.26E+01	97%
	Reference Temperature	Degrees C	1.14E+01	97%
	Dewpoint	Degrees C	5.07E+00	93%
60 Meter Level:	Wind Speed	Meter/Sec	5.33E+00	97%
	Wind Direction	Degrees	2.20E+02	96%
	Wind Direction Variability	Degrees	8.85E+00	97%
	Temperature Difference 60 - 10	Degrees C	1.16E-01	92%

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: A

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	4	0	0	0	0	4
NNE	0	4	0	0	0	0	4
NE	0	3	0	0	0	0	3
ENE	0	2	0	0	0	0	2
E	0	6	2	5	0	0	13
ESE	0	14	12	2	1	0	29
SE	1	21	26	2	0	0	50
SSE	3	13	11	7	2	0	36
S	2	23	21	7	1	0	54
SSW	1	17	31	5	0	0	54
SW	2	11	1	3	0	0	17
WSW	1	2	0	1	0	0	4
W	1	3	10	4	0	0	18
WNW	1	7	20	6	0	0	34
NW	1	3	9	5	0	0	18
NNW	2	9	4	0	0	0	15
TOT	15	142	147	47	4	0	355

Hours of Calm Data: 0
Hours of Invalid Data: 6

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: B

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	4	7	0	0	0	12
NNE	0	5	0	0	0	0	5
NE	0	2	1	0	0	0	3
ENE	0	2	5	0	0	0	7
E	1	5	6	2	1	0	15
ESE	1	10	5	1	0	0	17
SE	1	8	20	1	0	0	30
SSE	4	4	10	7	0	0	25
S	1	17	17	7	0	0	42
SSW	0	17	20	3	0	0	40
SW	2	11	1	2	0	0	16
WSW	2	7	1	1	0	0	11
W	0	14	14	3	1	0	32
WNW	1	18	19	10	1	0	49
NW	1	7	11	6	0	0	25
NNW	0	5	10	0	0	0	15
TOT	15	136	147	43	3	0	344

Hours of Calm Data: 0
Hours of Invalid Data: 4

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: C

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	2	3	14	2	0	0	21
NNE	1	7	3	0	0	0	11
NE	2	13	1	1	0	0	17
ENE	0	10	2	1	0	0	13
E	1	6	11	1	0	0	19
ESE	0	6	7	2	0	0	15
SE	2	10	19	3	0	0	34
SSE	2	7	19	4	0	0	32
S	4	19	33	11	0	0	67
SSW	0	19	24	5	2	0	50
SW	3	13	8	1	0	0	25
WSW	0	13	9	1	0	0	23
W	2	14	19	8	2	0	45
WNW	2	23	24	10	1	0	60
NW	0	20	16	6	4	0	46
NNW	2	12	23	2	0	0	39
TOT	23	195	232	58	9	0	517

Hours of Calm Data: 0
Hours of Invalid Data: 4

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: D

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	17	90	124	14	0	0	245
NNE	15	60	36	4	0	0	115
NE	20	77	30	1	0	0	128
ENE	8	68	47	4	0	0	127
E	4	46	55	5	2	0	112
ESE	8	40	42	8	1	0	99
SE	11	44	80	24	2	0	161
SSE	11	47	48	27	6	0	139
S	16	62	68	36	2	0	184
SSW	14	53	39	14	3	0	123
SW	14	42	23	9	4	0	92
WSW	20	37	27	13	14	1	112
W	17	54	70	50	8	0	199
WNW	17	85	160	81	4	1	348
NW	14	104	89	38	3	0	248
NNW	19	104	123	42	2	0	290
TOT	225	1013	1061	370	51	2	2722

Hours of Calm Data: 1
Hours of Invalid Data: 25

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: E

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	35	101	43	2	0	0	181
NNE	30	53	30	0	0	0	113
NE	38	64	19	0	0	0	121
ENE	20	43	31	3	0	0	97
E	14	58	20	6	0	1	109
ESE	19	101	55	6	0	0	181
SE	23	144	134	22	1	0	324
SSE	19	144	178	35	10	0	386
S	21	95	140	29	0	0	285
SSW	23	58	44	9	0	0	134
SW	16	42	20	7	5	0	90
WSW	20	44	34	10	2	0	110
W	24	91	33	11	2	0	161
WNW	30	109	70	24	1	0	234
NW	36	125	68	13	1	0	243
NNW	30	98	74	12	0	0	214
TOT	398	1380	993	189	22	1	2983

Hours of Calm Data: 11
Hours of Invalid Data: 13

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: F

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	18	29	1	0	0	0	48
NNE	31	13	1	0	0	0	45
NE	40	8	0	0	0	0	48
ENE	40	15	0	0	0	0	55
E	36	21	0	0	0	0	57
ESE	32	62	3	0	0	0	97
SE	25	132	41	0	0	0	198
SSE	16	104	21	0	0	0	141
S	15	41	13	0	0	0	69
SSW	28	36	9	0	0	0	73
SW	20	41	10	0	0	0	71
WSW	17	17	5	0	0	0	39
W	19	19	2	0	0	0	40
WNW	17	31	1	0	0	0	49
NW	20	40	6	1	0	0	67
NNW	13	25	0	0	0	0	38
TOT	387	634	113	1	0	0	1135

Hours of Calm Data: 14
Hours of Invalid Data: 12

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:33:46.52

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: G

	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	16	14	0	0	0	0	30
NNE	34	11	0	0	0	0	45
NE	23	2	0	0	0	0	25
ENE	16	0	0	0	0	0	16
E	11	3	0	0	0	0	14
ESE	7	12	0	0	0	0	19
SE	15	41	3	0	0	0	59
SSE	12	28	14	0	0	0	54
S	19	8	0	0	0	0	27
SSW	10	19	3	0	0	0	32
SW	8	16	4	0	0	0	28
WSW	2	2	0	0	0	0	4
W	10	1	1	0	0	0	12
WNW	7	14	0	0	0	0	21
NW	8	10	0	1	0	0	19
NNW	13	14	0	0	0	0	27
TOT	211	195	25	1	0	0	432

Hours of Calm Data: 5
Hours of Invalid Data: 26
Hours of Good Data: 8519 = 97.0% of Total Hours

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: A

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	3	1	0	0	0	4
NNE	0	2	1	0	0	0	3
NE	0	5	0	0	0	0	5
ENE	0	0	1	0	0	0	1
E	0	2	1	0	0	0	3
ESE	0	8	4	6	3	0	21
SE	1	9	20	8	1	0	39
SSE	0	13	20	5	1	1	40
S	1	15	19	4	7	1	47
SSW	1	8	31	14	4	4	62
SW	0	10	10	10	3	0	33
WSW	0	4	2	0	0	0	6
W	1	3	3	4	3	0	14
WNW	1	4	14	14	4	0	37
NW	0	2	9	5	5	1	22
NNW	0	1	9	0	0	0	10
TOT	5	89	145	70	31	7	347

Hours of Calm Data: 0
Hours of Invalid Data: 14

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: B

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	1	7	1	0	0	9
NNE	0	4	2	0	0	0	6
NE	0	1	4	0	0	0	5
ENE	0	2	1	1	0	0	4
E	0	2	7	0	0	0	9
ESE	0	4	6	3	1	0	14
SE	0	10	11	8	1	0	30
SSE	0	5	19	5	0	0	29
S	0	6	13	3	6	0	28
SSW	1	7	27	8	5	0	48
SW	1	4	12	4	4	0	25
WSW	0	4	8	4	0	0	16
W	1	6	5	9	1	0	22
WNW	0	8	23	12	4	3	50
NW	0	7	17	5	3	1	33
NNW	1	5	8	2	0	0	16
TOT	4	76	170	65	25	4	344

Hours of Calm Data: 0
Hours of Invalid Data: 4

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: C

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	4	8	4	0	0	16
NNE	0	3	11	0	0	0	14
NE	0	9	4	1	0	0	14
ENE	1	13	2	2	0	0	18
E	0	6	7	2	0	0	15
ESE	0	7	13	2	1	0	23
SE	0	5	17	7	2	0	31
SSE	2	3	18	6	1	0	30
S	0	9	25	11	1	0	46
SSW	1	8	30	20	7	4	70
SW	1	5	7	7	3	1	24
WSW	0	7	12	3	0	0	22
W	0	4	18	18	6	3	49
WNW	1	16	14	18	5	2	56
NW	2	10	19	8	4	4	47
NNW	1	10	26	3	2	0	42
TOT	9	119	231	112	32	14	517

Hours of Calm Data: 0
Hours of Invalid Data: 4

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: D

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	5	50	93	50	12	0	210
NNE	1	54	62	22	5	0	144
NE	6	54	55	3	1	0	119
ENE	4	44	78	13	2	0	141
E	6	25	69	17	2	0	119
ESE	3	29	45	19	6	1	103
SE	5	28	69	37	9	1	149
SSE	6	25	55	34	21	7	148
S	7	16	67	52	22	3	167
SSW	8	28	50	37	19	6	148
SW	6	23	31	17	8	3	88
WSW	5	13	33	27	12	14	104
W	10	26	54	98	49	16	253
WNW	5	40	87	94	43	5	274
NW	7	51	82	58	35	13	246
NNW	3	68	136	68	20	2	297
TOT	87	574	1066	646	266	71	2710

Hours of Calm Data: 0
Hours of Invalid Data: 38

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: E

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	24	63	40	0	0	131
NNE	5	26	73	23	1	0	128
NE	7	58	76	7	0	0	148
ENE	3	31	53	18	0	0	105
E	4	26	73	21	2	0	126
ESE	4	19	106	40	6	1	176
SE	1	19	119	108	14	0	261
SSE	3	11	110	187	29	14	354
S	1	17	85	164	36	1	304
SSW	1	18	49	107	19	5	199
SW	3	16	45	28	9	5	106
WSW	1	23	46	29	10	7	116
W	1	21	57	76	15	5	175
WNW	3	17	63	83	21	3	190
NW	5	28	102	79	7	1	222
NNW	2	37	106	79	16	0	240
TOT	48	391	1226	1089	185	42	2981

Hours of Calm Data: 0
Hours of Invalid Data: 26

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: F

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	5	17	5	0	0	27
NNE	0	11	14	12	0	0	37
NE	2	15	23	3	0	0	43
ENE	0	7	34	8	0	0	49
E	1	8	64	9	0	0	82
ESE	1	8	57	14	0	0	80
SE	0	10	53	39	1	0	103
SSE	3	13	82	69	1	0	168
S	1	10	69	38	1	0	119
SSW	2	8	50	31	3	0	94
SW	1	6	29	34	0	0	70
WSW	2	11	26	12	3	0	54
W	2	12	22	17	1	0	54
WNW	0	10	12	12	0	0	34
NW	2	3	18	23	1	0	47
NNW	0	16	24	16	0	0	56
TOT	17	153	594	342	11	0	1117

Hours of Calm Data: 0
Hours of Invalid Data: 44

Union Electric - Callaway Plant

Report Date/Time: 15-APR-1997 14:34:04.35

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-1996 00:00:00.00 to 31-DEC-1996 23:00:00.00

Stability Class: G

	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	9	5	4	0	0	18
NNE	0	8	15	8	0	0	31
NE	0	4	18	1	0	0	23
ENE	1	4	16	10	0	0	31
E	1	4	16	3	0	0	24
ESE	0	4	11	1	0	0	16
SE	1	2	13	5	0	0	21
SSE	0	8	20	14	2	0	44
S	0	11	23	17	6	0	57
SSW	0	5	20	7	0	0	32
SW	0	4	16	12	0	0	32
WSW	0	8	9	4	0	0	21
W	0	7	3	1	0	0	11
WNW	0	4	6	0	0	0	10
NW	0	0	4	4	1	0	9
NNW	0	2	8	6	0	0	16
TOT	3	84	203	97	9	0	396

Hours of Calm Data: 0
Hours of Invalid Data: 67
Hours of Good Data: 8412 = 95.8% of Total Hours

TABLE 5

DOSE AT THE SITE BOUNDARY AND TO THE NEAREST RESIDENT
FROM GASEOUS EFFLUENTS

		SITE BOUNDARY		NEAREST RESIDENT	
		LOCATION: 1.40 km SSW		LOCATION: 1.90 km WSW	
		AGE GROUP: CHILD		AGE GROUP: CHILD	
ORGAN	UNITS	DOSE	% LIMIT(a)	DOSE	% LIMIT(b)
1. GAMMA AIR DOSE *	MRAD	2.58E-03	0.03	1.51E-03	N/A
2. BETA AIR DOSE *	MRAD	6.26E-03	0.03	3.68E-03	N/A
3. WHOLE BODY ***	MREM	2.31E-03	N/A	1.36E-03	N/A
4. SKIN ***	MREM	6.32E-03	N/A	3.71E-03	N/A
5. BONE **	MREM	1.39E-05	N/A	2.55E-05	0.00
6. LIVER **	MREM	2.31E-03	N/A	1.20E-02	0.08
7. TOTAL BODY **	MREM	2.31E-03	N/A	1.20E-02	0.08
8. THYROID **	MREM	2.36E-03	N/A	1.73E-02	0.12
9. KIDNEY **	MREM	2.31E-03	N/A	1.20E-02	0.08
10. LUNG **	MREM	2.31E-03	N/A	1.20E-02	0.08
11. GI-LLI **	MREM	2.31E-03	N/A	1.20E-02	0.08

* Dose from Noble Gases only

** Dose from Tritium, Radioiodines, and Particulates only

*** Dose from Noble Gases plus Ground Plane dose

(a) Annual dose limits of Offsite Dose Calculation Manual (APA-ZZ-01003) of 10 mrad gamma air dose and 20 mrad beta air dose.

(b) Annual dose limits of Offsite Dose Calculation Manual (APA-ZZ-01003) of 15 mrem to any organ from I-131, I-133, H-3 and particulate radionuclides with halflives greater than 8 days.

TABLE 6

DOSE TO THE MEMBER OF THE PUBLIC FROM ACTIVITIES
WITHIN THE SITE BOUNDARY

ORGAN	UNITS	EFFLUENT DOSE WITHIN THE SITE BOUNDARY	DIRECT RADIATION FROM THE UNIT	DIRECT RADIATION FROM OUTSIDE TANKS	TOTAL DOSE FOR THE YEAR
1. SKIN	MREM	1.58E-03	N/A	N/A	1.58E-03
2. BONE	MREM	5.09E-06	8.79E-03	2.10E-03	1.09E-02
3. LIVER	MREM	7.39E-04	8.79E-03	2.10E-03	1.16E-02
4. TOTAL BODY	MREM	1.31E-03	8.79E-03	2.10E-03	1.22E-02
5. THYROID	MREM	7.48E-04	8.79E-03	2.10E-03	1.16E-02
6. KIDNEY	MREM	7.39E-04	8.79E-03	2.10E-03	1.16E-02
7. LUNG	MREM	7.39E-04	8.79E-03	2.10E-03	1.16E-02
8. GI-LLI	MREM	7.39E-04	8.79E-03	2.10E-03	1.16E-02

TABLE 7

TOTAL DOSE DUE TO THE URANIUM FUEL CYCLE
(MEMBER OF THE PUBLIC)

ORGAN	UNITS	DOSE AT THE RESIDENCE LOCATION	DOSE FROM ACTIVITIES WITHIN SITE BOUNDARY	TOTAL DOSE TO THE MEMBER OF THE PUBLIC	% LIMITS *
1. SKIN	MREM	1.86E-03	1.58E-03	3.44E-03	0.01
2. BONE	MREM	8.86E-06	1.09E-02	1.09E-02	0.04
3. LIVER	MREM	3.45E-03	1.16E-02	1.51E-02	0.06
4. TOTAL BODY	MREM	4.13E-03	1.22E-02	1.63E-02	0.07
5. THYROID	MREM	4.68E-03	1.16E-02	1.63E-02	0.02
6. KIDNEY	MREM	3.46E-03	1.16E-02	1.51E-02	0.06
7. LUNG	MREM	3.45E-03	1.16E-02	1.51E-02	0.06
8. GI-LLI	MREM	3.45E-03	1.16E-02	1.51E-02	0.06

* Annual dose limits from 40CFR190.10(a) of 25 mrem whole body, 75 mrem to the thyroid, and 25 mrem to any other organ.

TABLE 8

DOSE DUE TO LIQUID EFFLUENTS
(MEMBER OF THE PUBLIC)

1996

ORGAN	UNITS	DOSE	LIMIT *	% LIMIT
1. BONE	MREM	6.14E-03	10.00	6.14E-02
2. LIVER	MREM	1.10E-02	10.00	1.10E-01
3. TOTAL BODY	MREM	9.59E-03	3.00	3.20E-01
4. THYROID	MREM	2.14E-02	10.00	2.14E-01
5. KIDNEY	MREM	5.61E-03	10.00	5.61E-02
6. LUNG	MREM	3.91E-03	10.00	3.91E-02
7. GI-LLI	MREM	1.66E-01	10.00	1.66E+00

* Annual dose limits of APA-ZZ-01003, Section 9.4.1.1.

ATTACHMENT 1
APA-ZZ-01003, OFFSITE DOSE CALCULATION MANUAL, REVISION 6