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April 27, 2004

U. S. Nuclear Regulatory Commission
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Ladies and Gentlemen: ULNRC-04990

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
2003 ANNUAL ENVIRONMENTAL OPERATING REPORT

Please find enclosed the 2003 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.

Very truly yours,

Keith D. Young

Keith D. Young
Manager, Regulatory Affairs

DJW/jdg

Enclosure

IE25
IE48
A009

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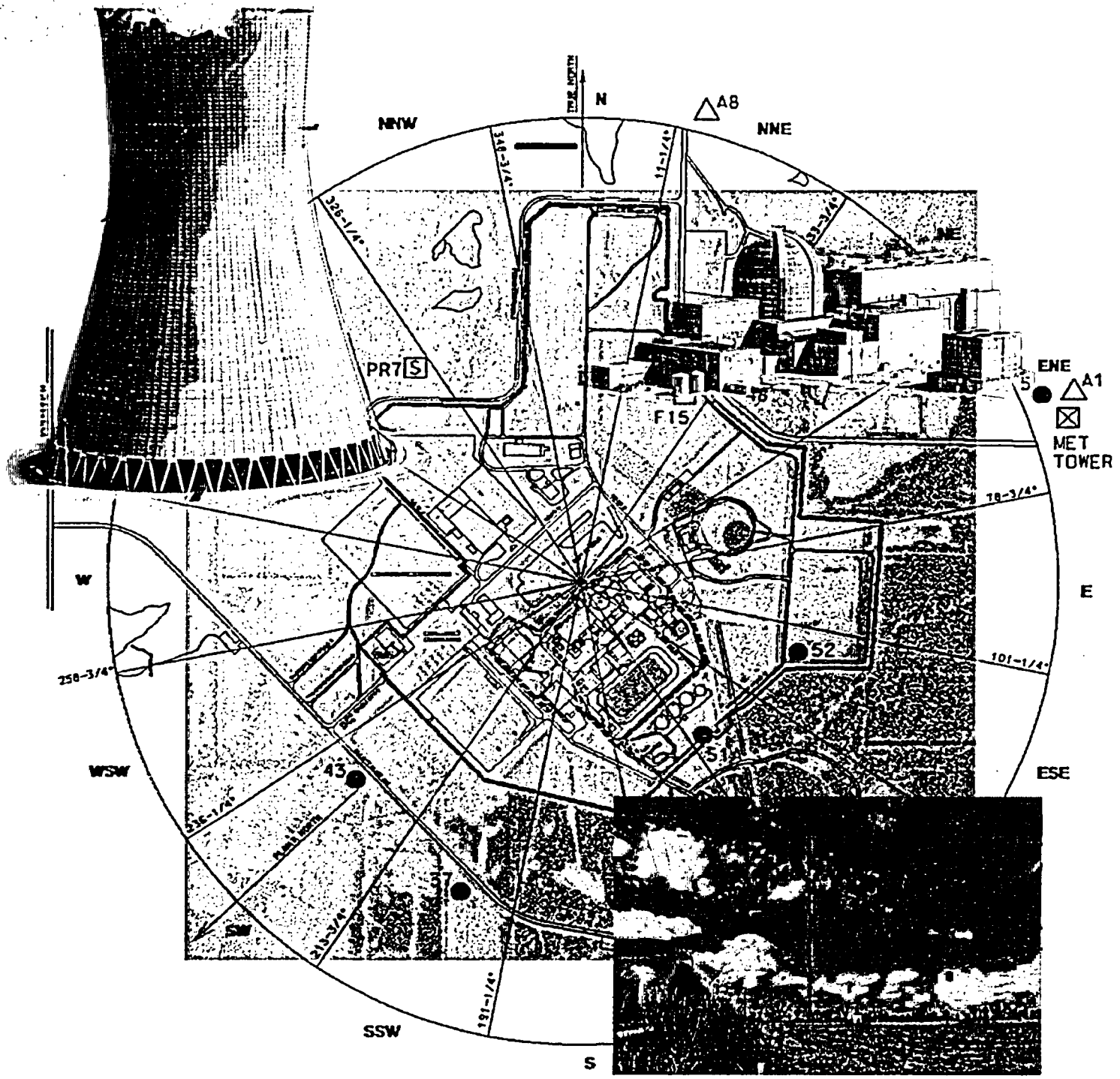
2003 Callaway Plant

Radioactive Effluent Release Report



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Docket no. 50-483

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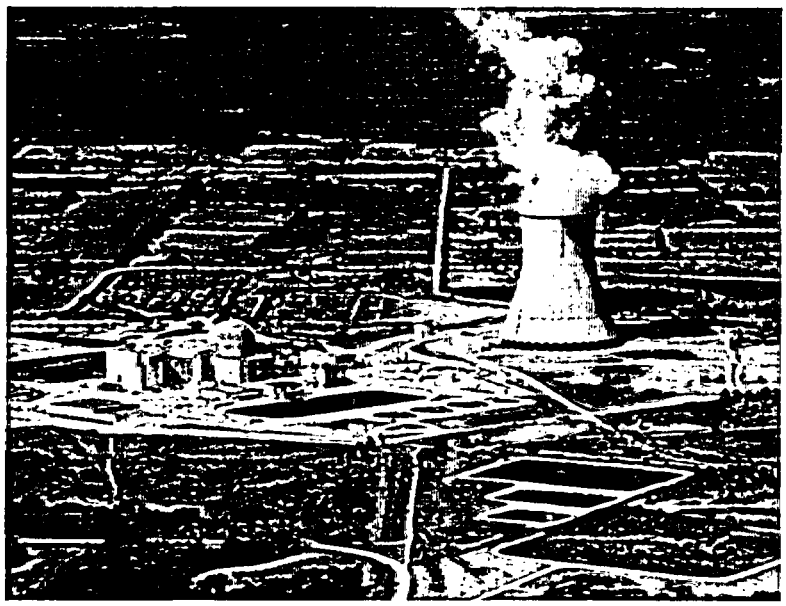
1.0 Introduction

This report describes the Union Electric Co. Callaway Plant radioactive effluent releases for 2003. It is submitted in accordance with Section 5.6.3 of the Callaway Plant Technical Specifications.

A summary of radioactivity released in liquid and gaseous effluents and solid waste shipped from the Callaway Plant during the period from January 1, 2003 to December 31, 2003 is presented.

All liquid and gaseous effluents discharged during this reporting period complied with federal regulations and the limits in the Offsite Dose Calculation Manual (ODCM). Any exceptions are noted in this report.



2.0 Supplemental Information

2.1 Regulatory Limits

The Radiological Effluent Control (REC) limits applicable to the release of radioactive material in liquid and gaseous effluents are provided below.

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.

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.

Liquid Effluent

The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to ten times the concentrations specified in Appendix B, Table 2, Column 2 of 10CFR20 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.

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 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.

2.3 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 Final Safety Analysis Report Table 16.11-1 and Table 16.11-4.

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 Environmental Inc. - Midwest 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.

2.4 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.

LIQUID

	UNITS	JAN-JUN	JUL-DEC
Number of batch releases:	——	76	68
Total time period for batch releases:	Minutes	34,684	32,336
Maximum time period for batch releases:	Minutes	624	1962
Average time period for batch releases:	Minutes	456	476
Minimum time period for batch releases:	Minutes	405	296
Average Missouri River flow during periods of effluent release to the river[1] :	ft^3/sec	47,970	45,571

GASEOUS

	UNITS	JAN - JUN	JUL - DEC
Number of batch releases:	——	30	29
Total time period for batch releases:	Minutes	19,288	6,826
Maximum time period for batch releases:	Minutes	7,243	3,737
Average time period for batch releases:	Minutes	643	235
Minimum time period for batch releases:	Minutes	22	35

[1] E-mail, S. Ternes, United States Department of the Interior - Geological Survey - Water Resources Division dated January 13, 2004

2.5 Abnormal Releases

LIQUID

Number of releases: 0

Total Activity released: 0

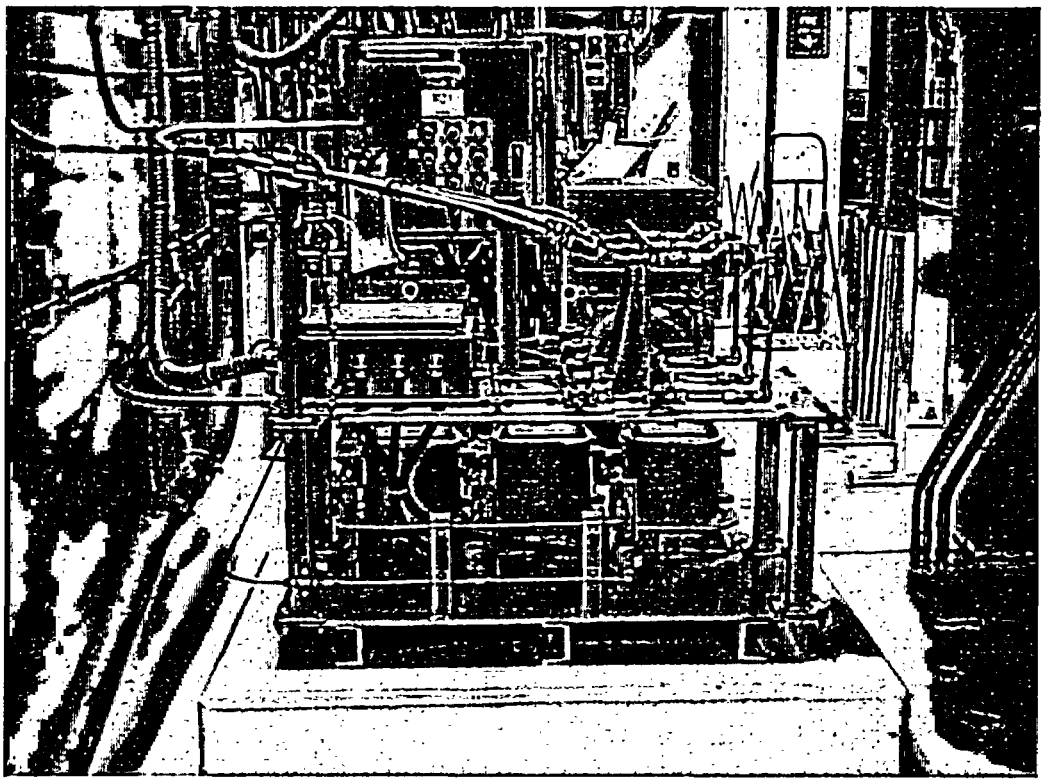
GASEOUS

Number of releases: 1

Total Activity released: 1.31e-02 Curies

3.0 Summary of Gaseous Radioactive Effluents

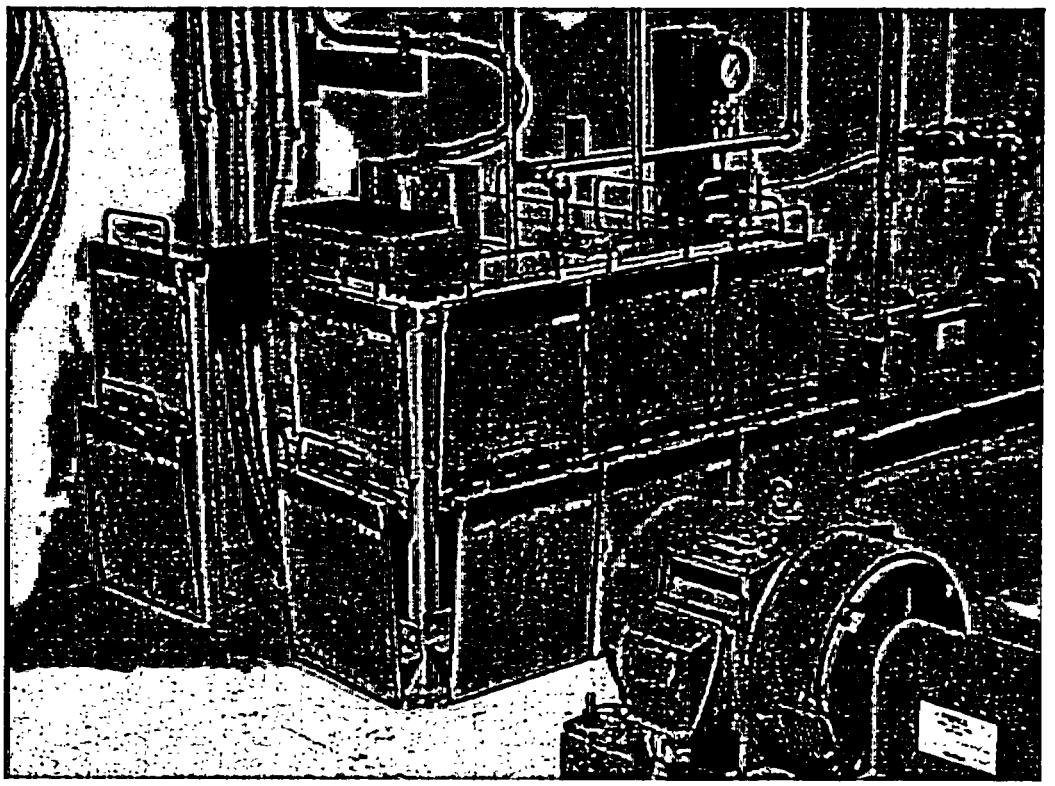
The quantity of radioactive material released in gaseous effluents during the year is summarized in Tables 1A and 1B. During 2003, all gaseous effluents were considered as ground level releases.



Gaseous effluents from the plant are continuously monitored. Instrumentation provides on-line and grab sampling for iodine, particulates and noble gas.

4.0 Summary of Liquid Radioactive Effluents

The quantity of radioactive material released in liquid effluents during the year is summarized in Tables 2A and 2B. During 2003, there was no continuous release of liquid effluent from the plant.



Liquid effluents from the plant are continuously monitored. Shown is a liquid radiation monitor shielded by lead to increase its sensitivity for sampling discharged water.

5.0 Solid Wastes

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 reprocesses 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.
3) Releases which are conducted in such a manner as to result in significant deviation from the requirements of the release permit.

Auxiliary Boiler Contamination

On April 10, 1998, during a refueling outage, radioactivity was detected in the Auxiliary Boiler feed water system. The boiler was flushed and cleaned several times in an attempt to decontaminate the unit. Small amounts of contamination remained in the sludge. During subsequent operation of the boiler small amounts of contamination leached from the sludge and were detected in the boiler water.

An investigation was performed to locate the source of the contamination. No mispositioned valves or leaks were identified. The results of sampling different system components were inconclusive, but may indicate a small leak in the SLWE heat exchanger. During refueling operations, the concentration of radioactive nuclides in the SLWE system can be a factor of 1000 times higher than normal operations. The size of the leak may be small enough to only be recognized when these high concentrations are present. Increased monitoring was initiated in an attempt to identify the source of the contamination. No additional contamination was identified.

A 10CFR50.59 evaluation concluded that the resulting dose to a Member of the Public from the release of radioactive material to the environment would be a small fraction of the regulatory dose limits. Therefore, continued operation of the Auxiliary Boiler would not pose any significant safety or environmental concern. The current safety evaluation for the Aux. Boiler was evaluated in early 2004. During the review, it was determined that several radionuclides were not included in the safety evaluation. A revision to the safety evaluation is being evaluated at this time (CAR 200400644). Despite having radionuclides present in the Auxiliary Boiler that were not listed in the current evaluation, it is still concluded that releases from the Auxiliary Boiler are well below regulatory limits.

The Auxiliary Boiler was operated intermittently during 2003. The maximum total body dose to a

Member of the Public from these releases was 3.72 E-05 mrem during 2003. This is negligible compared to the quarterly and annual effluent control limits. The activity released from the Auxiliary Boiler during 2003 is included in Tables 1A, 1B, 5, 6 and 7.

6.2 Changes to the Offsite Dose Calculation Manual

Changes were made to the Callaway Offsite Dose Calculation Manual (ODCM - Callaway plant procedure APA-ZZ-01003) and the Final Safety Analysis Report - Standard Plant (FSAR - SP) Chapter 16.11 (Offsite Dose Calculation Manual - Radiological Effluent Controls) in 2003. The ODCM was revised on June 17th to add a liquid Ingestion Dose Commitment factor for Pr-144 (CAR 200303251).

In addition, the Farmer's residence (Critical Receptor) was also updated to a location directly across the street from the Nearest Resident. For conservatism and ease in calculation, Table 6.1 and 6.2 were revised making the distances and dispersion parameters for the Critical Receptor and the Nearest Resident the same.

The ODCM was also revised by removing QA Dept. review requirements for all changes to the ODCM (CAR 200304509).

Callaway RFR 22046 Revision A allowed the addition of depleted or natural soluble zinc to the Callaway primary system to reduce radiation fields in out-of-core piping and components. As a result of zinc addition to the RCS, increased production of Zn -65 required revision of the Callaway REMP program (CAR 200303604). FSAR Change Notice 03 - 020 revised FSAR Tables 16.11-8/9 by adding lower limits of detection and reporting levels for Zn-65 as per the NRC Radiological Assessment Branch Technical Position, Rev 1, November 1979, "An Acceptable Radiological Environmental Monitoring Program".

FSAR - SP CN 03-045/046 revised the requirements listed in FSAR - SP Table 16.11-5 "Radioactive Gaseous Effluent Monitoring Instrumentation" by clarifying required actions when the Minimum Channels Operable requirement for Containment Purge System Noble Gas Activity Monitors are not met during CORE ALTERATIONS or movement of irradiated fuel within the containment (CAR 200305729).

FSAR - SP CN 03-050 revised section 16.11.1.3 and Tables 16.11-2 and 16.11-3 to allow either the cooling tower blowdown flow or bypass flow instrumentation to be used for dilution flow indication, instead of requiring that both instruments be operable for combined flow measurement (as long as dilution path used is for operable instrument).

This change was approved on 1/14/04 and in response to problems experienced in 2003 with the cooling tower blowdown flow transmitter FEDB1101 (CAR 200306808). The problems with Cooling Tower Blowdown flow transmitter FEDB1101 are described in section 6.5 of this report under Inoperablity of Effluent Monitor Instrumentation.

Major Changes to Radwaste Systems

During 2003, there were two major plant modifications to Radwaste systems:

1. Design Modification 01-1001 installed the Duratek - Advanced Liquid Processing System (ALPS) capable of processing fluid from floor drains, equipment drains, and RCS letdown. This modification replaces the temporary filtration skid, i.e. Nukem Skid, which utilized a modular design and included ultra-filtration membranes followed by demineralizers. Design Modification 01-1001 also removed a significant portion of Radwaste Volume Reduction (RVR) system to accomodate installation of the new ALPS system. The RVR system was used to process evaporator bottoms and is no longer needed due to the pending retirement of the evaporators. ALPS operation began on January 12, 2004.

2. Design Modification 98-1032 replaced antiquated H_2/O_2 analyzers with Orbisphere model 3636 analyzer systems. The previous H_2/O_2 analyzers were obsolete, thus spare parts were not readily available. The new Orbisphere analyzers will perform the same function as the existing analyzers.

The following minor modification was made to the gaseous radwaste system during 2003.

Modification Package 99 - 2003 removed the drum labeling and inspection station from service.

6.4 Land Use Census Changes

No changes were identified that required a change to the location of the nearest resident yielding the highest calculated dose commitment.

6.5 Inoperability of Effluent Monitoring Instrumentation

During 2003 all effluent monitoring instrumentation was OPERABLE within the limits specified in Radioactive Effluent Controls 16.11.1.3 and 16.11.2.4 with one exception being the Cooling Tower Blowdown flow transmitter FEDB1101.

CAR 200306808 was written on 8/23/03 by the Shift Engineer requesting a Operability Determination after FEDB1101 was declared inoperable. Radiological Effluent Controls 16.11.1.3 allows liquid effluent discharges to continue for up to 30 days provided that flow rates are estimated every 4 hours during discharge. Liquid effluent discharges continued based on the development of a graph which allowed operators to measure Cooling Tower Blowdown flow based on valve position.

An investigation of the blowdown flow transmitter condition indicated power supply failure, poor cable connections, transducer housing leakage in the pipe spool, as well as drastic corrosion. The cause was determined to be from age and environmental conditions. Part unavailability caused repairs to exceed 30 days. Additional maintenance, replacement of the spoolpiece and/or transducer, is scheduled during Refuel 13.

It is important to note that although Callaway Plant did not meet the full operability requirements of the FSAR for this equipment, dilution flow was always positively monitored with installed instrumentation (Bypass flow transmitter) during liquid effluent releases

As mentioned in Section 6.3, FSAR - SP CN 03 - 050 revised the liquid effluent dilution flow indication operability requirements.

6.6 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 Radioactive Effluent Controls 16.11.1 and 16.11.2 during the reporting period.

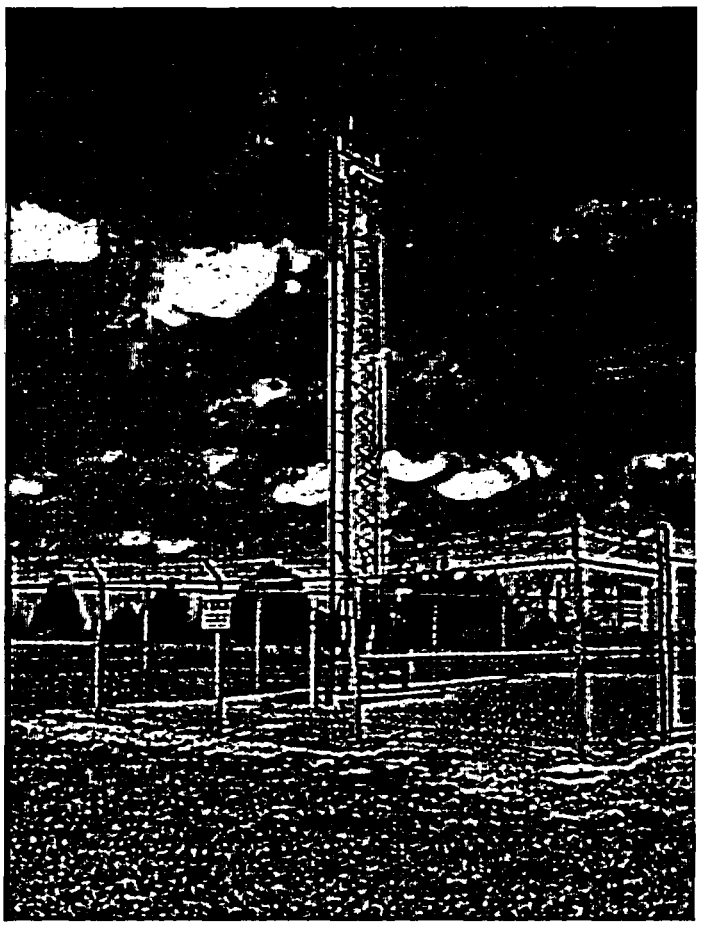
7.0 Meteorological Data

The on-site meteorological data for 2003 is presented in Table 4. All meteorological data was reviewed, analyzed, and validated by a boundary layer meteorologist.

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 2003 was 90% or greater for all required parameters. During January and February 2003, the Primary MET tower 10m wind direction data was offset when the crossarm adaptor collar for the anemometer was inadvertantly rotated on the crossarm following calibrations in late 2002. The problem was discovered when a distinct offset was observed in the data from the primary 10 m wind direction when compared to the other 3 directional channels (CAR 200300533). Discriminatory differential analysis, using all directional data obtained during well-mixed daytime periods of neutral stability, confirmed the offset to be a constant value of approximately 46 degrees. The primary 10m wind direction data was subsequently corrected before dispersion calculations were performed.

The precipitation gauge did not operate properly for several months during 2003. Auxiliary hourly precipitation data was acquired from the Prairie Fork Conservation area to aid in data assessments during these periods.

Other problems with the 2003 data were intermittent, of limited duration, or affected secondary 90 m data levels. These included a continued (but decreased) problem with upper level wind speed data, most likely affected by large birds perching on the anemometers (similar bird problems were encountered in 2001 and 2002 - CARs 200105528 and 200205532), precipitation events which affected the 60 m input data to the 60 - 10 m delta - temperature, as well as some drift observed in dew point data. All affected data was either invalidated or corrected at the 15 minute level before inclusion in the hourly averages for dispersion and dose modeling.



Pictured is the Secondary Meteological Tower. This station obtains measurements at a height of 10 meters, and provides backup data for the Primary Meteological Tower readings at 10, 60 and 90 meters.

8.0 Assessment of Doses

Assessment of doses to the maximum exposed individual from gaseous and liquid effluents released was performed in accordance with the ODCM as described in the following sections. For all airborne effluents released from the Callaway Plant during 2003, the annual dose to the maximum exposed individual was less than 1% of the Radiological Effluent Control Limits presented in Section 2.1 of this report.

For all liquid effluents, the annual dose to the maximum exposed individual was less than 2.5% of the Radiological Effluent Control Limits presented in Section 2.1 of this report. Liquid radwaste processing equipment performance problems and fuel defects contributed to increased cesium concentrations in liquid effluent and subsequent higher Total Body dose (CAR 200309297). CARs 200400200 and 200401501 were written in an effort to to reduce liquid effluent dose.

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 effluents at the Site Boundary for 2003 is presented in Table 5.

8.2 Dose to the Member of the Public

The Member of the Public is 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 and is described in the ODCM.

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.

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 2003 are presented in Table 5.

Dose To The Member Of The Public From Activities Within The Site Boundary

Based on the 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 farmer estimates spending 1100 hours per year working within the Site Boundary area. Dose was calculated using the adult 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.

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 conservatively assumed that each food ingestion pathway exists at his residence and that the adult is 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 includes contributions from the maximum exposed individual's consumption of fish and recreational activities. An adult was considered the maximum exposed individual in this assessment.

It is conservatively assumed that the hypothetical maximum exposed individual obtained his entire annual fish intake from near the plant discharge.

Table 1A Semiannual Summation of Gaseous Releases

All Airborne Effluents

TABLE 1A

SEMIANNUAL SUMMATION OF GASEOUS RELEASES
ALL AIRBORNE EFFLUENTS

QUARTERS 1 AND 2, 2003

TYPE OF EFFLUENT	UNITS	FIRST QUARTER	SECOND QUARTER	EST TOTAL ERROR % (a)
A. FISSION AND ACTIVATION GASES				
1. TOTAL RELEASE	CURIES	2.60E+01	1.13E+00	20
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	3.35E+00	1.44E-01	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
B. RADIOIODINES				
1. TOTAL IODINE-131	CURIES	1.63E-06	0.00E+00	23
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	2.10E-07	0.00E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
C. PARTICULATES				
1. PARTICULATE (HALF-LIVES > 8 DAYS)	CURIES	8.72E-05	2.22E-05	30
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	1.12E-05	2.82E-06	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
4. GROSS ALPHA RADIOACTIVITY	CURIES	1.83E-07	2.28E-07	
D. TRITIUM				
1. TOTAL RELEASE	CURIES	1.16E+01	1.44E+01	14
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	1.49E+00	1.84E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	

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

Page 1 of 1

TABLE 1A

SEMIANNUAL SUMMATION OF GASEOUS RELEASES
ALL AIRBORNE EFFLUENTS

QUARTERS 3 AND 4, 2003

TYPE OF EFFLUENT	UNITS	THIRD QUARTER	FOURTH QUARTER	EST TOTAL ERROR % (a)
A. FISSION AND ACTIVATION GASES				
1. TOTAL RELEASE	CURIES	5.08E+00	1.68E+01	20
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	6.39E-01	2.12E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
B. RADIOIODINES				
1. TOTAL IODINE-131	CURIES	0.00E+00	4.47E-07	23
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	0.00E+00	5.62E-08	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
C. PARTICULATES				
1. PARTICULATE (HALF-LIVES > 8 DAYS)	CURIES	5.13E-07	1.28E-05	30
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	6.45E-08	1.61E-06	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	
4. GROSS ALPHA RADIOACTIVITY	CURIES	7.89E-08	1.69E-07	
D. TRITIUM				
1. TOTAL RELEASE	CURIES	1.24E+01	1.08E+01	14
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/SEC	1.56E+00	1.36E+00	
3. PERCENT OF TECH SPEC LIMIT	%	N/A	N/A	

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

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Table 1B Semiannual Airborne Continuous and Batch Releases, Ground Level Releases

Fission Gases, Iodines, and Particulates

TABLE 1B

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

QUARTERS 1 AND 2, 2003

		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	2.11E-01	5.58E-02
XE-133	CURIES	1.04E+01	1.06E+00	1.41E+01	1.47E-02
XE-135	CURIES	3.03E-01	0.00E+00	2.55E-02	0.00E+00
XE-131M	CURIES	0.00E+00	0.00E+00	2.07E-01	0.00E+00
XE-133M	CURIES	4.01E-01	0.00E+00	1.15E-01	1.97E-09
XE-138	CURIES	1.59E-01	0.00E+00	1.44E-04	0.00E+00
XE-135M	CURIES	0.00E+00	0.00E+00	2.20E-04	0.00E+00
KR-85M	CURIES	0.00E+00	0.00E+00	9.53E-05	0.00E+00
KR-85	CURIES	0.00E+00	0.00E+00	1.15E-01	0.00E+00
TOTAL FOR PERIOD	CURIES	1.13E+01	1.06E+00	1.48E+01	7.05E-02
2. IODINES					
I-131	CURIES	6.26E-08	0.00E+00	1.57E-06	0.00E+00
TOTAL FOR PERIOD	CURIES	6.26E-08	0.00E+00	1.57E-06	0.00E+00
3. PARTICULATES					
SB-125	CURIES	3.90E-06	4.01E-06	0.00E+00	0.00E+00
CO-60	CURIES	3.30E-07	5.79E-07	8.08E-05	1.67E-05
CS-137	CURIES	7.95E-07	7.54E-07	3.70E-07	1.52E-07
CO-57	CURIES	5.12E-08	0.00E+00	0.00E+00	0.00E+00
CE-144	CURIES	0.00E+00	0.00E+00	1.44E-08	0.00E+00
NB-95	CURIES	0.00E+00	0.00E+00	5.34E-07	0.00E+00
ZR-95	CURIES	0.00E+00	0.00E+00	3.73E-07	0.00E+00
CO-58	CURIES	0.00E+00	0.00E+00	0.00E+00	2.02E-09
ALPHA	CURIES	1.83E-07	2.28E-07	0.00E+00	0.00E+00
TOTAL FOR PERIOD	CURIES	5.26E-06	5.57E-06	8.21E-05	1.69E-05
4. TRITIUM					
H-3	CURIES	1.09E+01	1.44E+01	6.63E-01	7.89E-02

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Table 1B Semiannual Airborne Continuous and Batch Releases, Ground Level Releases

Fission Gases, Iodines, and Particulates

TABLE 1B

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

QUARTERS 3 AND 4, 2003

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNITS	THIRD QUARTER	FOURTH QUARTER	THIRD QUARTER	FOURTH QUARTER
1. FISSION GASES					
AR-41	CURIES	0.00E+00	0.00E+00	3.94E-02	4.82E-01
XE-133	CURIES	1.78E-01	1.09E+01	1.19E-02	2.19E-01
XE-135	CURIES	0.00E+00	1.07E-01	0.00E+00	4.60E-03
XE-131M	CURIES	4.63E+00	4.97E+00	0.00E+00	1.76E-04
XE-133M	CURIES	0.00E+00	1.07E-02	0.00E+00	0.00E+00
XE-138	CURIES	0.00E+00	0.00E+00	2.82E-04	0.00E+00
XE-135M	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-85M	CURIES	0.00E+00	1.29E-03	0.00E+00	0.00E+00
KR-85	CURIES	0.00E+00	0.00E+00	2.28E-01	7.95E-02
KR-88	CURIES	0.00E+00	2.47E-02	0.00E+00	0.00E+00
KR-87	CURIES	0.00E+00	0.00E+00	0.00E+00	3.72E-05
TOTAL FOR PERIOD	CURIES	4.80E+00	1.60E+01	2.80E-01	7.85E-01
2. IODINES					
I-131	CURIES	0.00E+00	2.75E-07	0.00E+00	1.72E-07
I-133	CURIES	0.00E+00	0.00E+00	0.00E+00	6.59E-08
I-132	CURIES	0.00E+00	0.00E+00	0.00E+00	1.65E-08
TOTAL FOR PERIOD	CURIES	0.00E+00	2.75E-07	0.00E+00	2.55E-07
3. PARTICULATES					
SB-125	CURIES	4.90E-07	1.02E-06	0.00E+00	0.00E+00
CO-60	CURIES	0.00E+00	2.18E-07	2.23E-08	1.12E-05
CS-137	CURIES	0.00E+00	2.91E-07	0.00E+00	2.68E-08
CO-57	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-144	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-95	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR-95	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	CURIES	0.00E+00	0.00E+00	0.00E+00	1.39E-08
CS-136	CURIES	0.00E+00	0.00E+00	0.00E+00	4.47E-09
ALPHA	CURIES	7.89E-08	1.69E-07	0.00E+00	0.00E+00
TOTAL FOR PERIOD	CURIES	5.69E-07	1.70E-06	2.23E-08	1.13E-05
4. TRITIUM					
H-3	CURIES	1.23E+01	1.06E+01	3.91E-02	2.47E-01

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Table 2A Semiannual Summation of Liquid Releases

All Liquid Effluents

TABLE 2A

SEMIANNUAL SUMMATION OF LIQUID RELEASES
ALL LIQUID EFFLUENTS

QUARTERS 1 AND 2, 2003

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	2.36E-02	6.63E-02	20
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	5.43E-08	1.81E-07	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
B. TRITIUM				
1. TOTAL RELEASE	CURIES	1.91E+02	1.89E+02	14
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	4.42E-04	5.15E-04	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
C. DISSOLVED AND ENTRAINED GASES				
1. TOTAL RELEASE	CURIES	2.91E-01	8.29E-02	27
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	6.72E-07	2.26E-07	
D. GROSS ALPHA RADIOACTIVITY				
1. TOTAL RELEASE	CURIES	1.43E-03	0.00E+00	29
E. WASTE VOLUME RELEASED (PRE-DILUTION)	GAL	3.82E+06	3.25E+06	10
F. VOLUME OF DILUTION WATER USED	GAL	1.11E+08	9.37E+07	10

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

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Table 2A Semiannual Summation of Liquid Releases

All Liquid Effluents

TABLE 2A

SEMIANNUAL SUMMATION OF LIQUID RELEASES
ALL LIQUID EFFLUENTS

QUARTERS 3 AND 4, 2003

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	3.18E-02	2.18E-02	20
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	1.02E-07	5.28E-08	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
B. TRITIUM				
1. TOTAL RELEASE	CURIES	1.10E+02	4.46E+02	14
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	3.52E-04	1.08E-03	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
C. DISSOLVED AND ENTRAINED GASES				
1. TOTAL RELEASE	CURIES	2.23E-04	1.98E-01	27
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	uCi/ML	7.17E-10	4.79E-07	
D. GROSS ALPHA RADIOACTIVITY				
1. TOTAL RELEASE	CURIES	1.02E-03	1.93E-04	29
E. WASTE VOLUME RELEASED (PRE-DILUTION)	GAL	2.97E+06	3.36E+06	10
F. VOLUME OF DILUTION WATER USED	GAL	7.94E+07	1.06E+08	10

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

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Table 2B Semiannual Liquid Continuous & Batch Releases

Totals for Each Nuclide Released

TABLE 2B

SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
TOTALS FOR EACH NUCLIDE RELEASED

QUARTERS 1 AND 2, 2003

		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	1.43E-03	0.00E+00
CO-58	CURIES	0.00E+00	0.00E+00	6.97E-03	2.42E-02
CO-60	CURIES	0.00E+00	0.00E+00	8.17E-04	1.25E-03
CS-134	CURIES	0.00E+00	0.00E+00	1.99E-04	5.99E-04
CS-137	CURIES	0.00E+00	0.00E+00	6.90E-04	1.95E-03
H-3	CURIES	0.00E+00	0.00E+00	1.91E+02	1.89E+02
SB-125	CURIES	0.00E+00	0.00E+00	1.39E-02	3.39E-02
SB-124	CURIES	0.00E+00	0.00E+00	7.40E-05	1.95E-03
CR-51	CURIES	0.00E+00	0.00E+00	1.80E-04	1.30E-03
XE-133	CURIES	0.00E+00	0.00E+00	2.84E-01	8.19E-02
MN-54	CURIES	0.00E+00	0.00E+00	8.80E-06	0.00E+00
XE-135M	CURIES	0.00E+00	0.00E+00	3.20E-06	0.00E+00
NB-95	CURIES	0.00E+00	0.00E+00	1.03E-05	0.00E+00
XE-135	CURIES	0.00E+00	0.00E+00	1.24E-06	0.00E+00
KR-87	CURIES	0.00E+00	0.00E+00	3.52E-06	0.00E+00
I-131	CURIES	0.00E+00	0.00E+00	2.53E-04	3.53E-04
XE-131M	CURIES	0.00E+00	0.00E+00	6.21E-03	9.33E-04
CO-57	CURIES	0.00E+00	0.00E+00	1.89E-05	3.09E-05
XE-133M	CURIES	0.00E+00	0.00E+00	1.28E-03	1.18E-04
I-132	CURIES	0.00E+00	0.00E+00	2.27E-04	2.54E-04
TE-132	CURIES	0.00E+00	0.00E+00	2.25E-04	1.94E-04
ZR-95	CURIES	0.00E+00	0.00E+00	0.00E+00	1.52E-04
NA-24	CURIES	0.00E+00	0.00E+00	0.00E+00	3.04E-05
AG-110M	CURIES	0.00E+00	0.00E+00	0.00E+00	5.52E-05
TOTALS FOR PERIOD	CURIES	0.00E+00	0.00E+00	1.92E+02	1.89E+02

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Table 2B Semiannual Liquid Continuous & Batch Releases

Totals for Each Nuclide Released

TABLE 2B

SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
TOTALS FOR EACH NUCLIDE RELEASED

QUARTERS 3 AND 4, 2003

		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	1.02E-03	1.93E-04
CO-58	CURIES	0.00E+00	0.00E+00	5.48E-03	3.24E-04
CO-60	CURIES	0.00E+00	0.00E+00	2.36E-03	3.64E-03
CS-134	CURIES	0.00E+00	0.00E+00	5.30E-04	3.52E-03
CS-137	CURIES	0.00E+00	0.00E+00	1.89E-03	1.25E-02
H-3	CURIES	0.00E+00	0.00E+00	1.10E+02	4.46E+02
SB-125	CURIES	0.00E+00	0.00E+00	2.05E-02	1.52E-03
SB-124	CURIES	0.00E+00	0.00E+00	1.08E-04	0.00E+00
CR-51	CURIES	0.00E+00	0.00E+00	4.83E-04	0.00E+00
XE-133	CURIES	0.00E+00	0.00E+00	2.23E-04	1.88E-01
MN-54	CURIES	0.00E+00	0.00E+00	3.17E-05	2.44E-04
XE-135M	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-95	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-135	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-87	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	CURIES	0.00E+00	0.00E+00	1.47E-04	4.78E-05
XE-131M	CURIES	0.00E+00	0.00E+00	0.00E+00	6.93E-03
CO-57	CURIES	0.00E+00	0.00E+00	1.50E-04	7.04E-06
XE-133M	CURIES	0.00E+00	0.00E+00	0.00E+00	5.53E-04
I-132	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR-95	CURIES	0.00E+00	0.00E+00	1.82E-05	0.00E+00
NA-24	CURIES	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AG-110M	CURIES	0.00E+00	0.00E+00	8.75E-05	0.00E+00
NP-237	CURIES	0.00E+00	0.00E+00	1.80E-06	0.00E+00
SR-92	CURIES	0.00E+00	0.00E+00	5.05E-06	0.00E+00
ZN-65	CURIES	0.00E+00	0.00E+00	5.54E-06	0.00E+00
MO-99	CURIES	0.00E+00	0.00E+00	4.16E-06	3.86E-06
TC-99M	CURIES	0.00E+00	0.00E+00	4.16E-06	3.86E-06
BE-7	CURIES	0.00E+00	0.00E+00	0.00E+00	2.31E-05
KR-85	CURIES	0.00E+00	0.00E+00	0.00E+00	2.47E-03
ZR-97	CURIES	0.00E+00	0.00E+00	0.00E+00	2.06E-06
TOTALS FOR PERIOD	CURIES	0.00E+00	0.00E+00	1.10E+02	4.46E+02

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Table 3 Solid Waste & Irradiated Fuel Shipments 2003

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.	m³	0.0025	2.50	
	Ci	2.10E-6	64.20	±25%
b. Dry compressible waste, contaminated equipment, etc.	m³	11.02	5.19	
	Ci	0.37	2.16E-3	±25%
c. Irradiated components, control rods, etc.	m³	0	0	
	Ci	0	0	±25%
d. Other	m³	0	0	
	Ci	0	0	±25%

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

	PERIOD JAN - JUN		PERIOD JUL - DEC	
Nuclide	% Abundance	Curies	% Abundance	Curies
a. Ni-63	48.60	1.02E-06	48.60	31.20
Co-60	15.50	3.26E-07	15.50	9.95
Cs-137	11.79	2.48E-07	11.79	7.57
Fe-55	9.56	2.00E-07	9.56	6.14
Co-58	3.74	7.85E-08	3.74	2.40
Cs-134	3.19	6.70E-08	3.19	2.00
Sb-125	2.41	5.06E-08	2.41	1.55
Mn-54	2.05	4.31E-08	2.05	1.32
Ru-106	1.64	3.44E-08	1.64	1.05
b. Fe-55	30.03	0.11	30.03	6.48E-04
Cs-137	26.46	0.10	26.46	5.72E-04
Ni-63	18.86	0.07	18.86	4.07E-04
Cs-134	8.43	0.03	8.43	1.82E-04
Co-60	8.28	0.03	8.28	1.79E-04
Co-58	3.72	0.01	3.72	8.04E-05

Table 3 Solid Waste & Irradiated Fuel Shipments 2003

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

Nuclide	PERIOD JAN - JUN % Abundance	Curies	PERIOD JUL - DEC % Abundance	Curies

c. None

d. None

3. SOLID WASTE DISPOSITION:

Number of Shipments	Mode of Transport	Destination	Class of Solid Waste Shipped	Type of Container
3*	Cask	ALARON	A	LSA
2*	Cask	Studsvik	A	LSA
2*	Cask	Studsvik	B	LSA
10*	Truck	Duratek, Inc.	A	LSA
3*	Truck	Duratek, Inc. - Gallaher	A	LSA
5*	Truck	RACE, LLC	A	LSA

* Sent to waste processors for volume reduction before burial.

4. SOLIDIFICATION AGENT:
None used.

B. IRRADIATED FUEL SHIPMENTS (DISPOSITION)

Number of Shipments	Mode of Transportation	Destination
0		

Table 4 Meteorological Data

Averages Using Hourly Averaged Data

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:21.39

Meteorological Data
Averages Using Hourly Averaged Data

1-JAN-2003 00:00:00.00 to 31-DEC-2003 23:00:00.00

		UNITS	VALUES	% GOOD DATA
Stability Class		A - G	E	90%
Total Precipitation		CM.	8.08E+01	68%
10 Meter Level:	Wind Speed	Meter/Sec	2.90E+00	99%
	Wind Direction	Degrees	2.04E+02	97%
	Wind Direction Variability	Degrees	1.32E+01	99%
	Reference Temperature	Degrees C	1.26E+01	100%
	Dewpoint	Degrees C	6.34E+00	100%
60 Meter Level:	Wind Speed	Meter/Sec	5.09E+00	99%
	Wind Direction	Degrees	2.22E+02	99%
	Wind Direction Variability	Degrees	8.70E+00	99%
	Dewpoint	Degrees C	NONE	0%
	Temperature Difference 60 - 10	Degrees C	1.07E-01	90%

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	6	28	31	4	0	0	69
NNE	6	49	25	0	0	0	80
NE	3	30	3	0	0	0	36
ENE	5	25	2	0	0	0	32
E	7	23	4	0	0	0	34
ESE	8	24	6	2	0	0	40
SE	11	65	32	2	0	0	110
SSE	9	56	46	3	4	0	118
S	12	56	57	13	0	0	138
SSW	6	60	76	23	0	0	165
SW	4	49	41	12	0	0	106
WSW	6	21	23	3	0	0	53
W	6	25	23	3	0	0	57
WNW	2	34	37	7	0	0	80
NW	3	32	19	2	0	0	56
NNW	1	34	24	0	0	0	59
TOT	95	611	449	74	4	0	1233

Hours of Calm Data: 1
Hours of Invalid Data: 37

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	2	15	10	0	0	0	27
NNE	6	15	8	0	0	0	29
NE	2	18	4	0	0	0	24
ENE	1	14	2	0	0	0	17
E	4	8	3	0	0	0	15
ESE	0	7	4	1	0	0	12
SE	3	21	10	0	0	0	34
SSE	3	20	11	3	1	0	38
S	2	10	8	5	0	0	25
SSW	3	16	10	3	0	0	32
SW	5	10	18	2	0	0	35
WSW	6	10	10	1	0	0	27
W	4	7	6	3	0	0	20
WNW	5	15	7	2	0	0	29
NW	1	18	11	3	1	0	34
NNW	3	14	15	0	0	0	32
TOT	50	218	137	23	2	0	430

Hours of Calm Data: 0
Hours of Invalid Data: 10

Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	4	19	6	1	0	0	30
NNE	7	12	13	0	0	0	32
NE	1	28	2	0	0	0	31
ENE	3	11	7	0	0	0	21
E	2	7	4	0	0	0	13
ESE	7	9	3	0	0	0	19
SE	7	12	10	0	0	0	29
SSE	3	14	8	4	0	0	29
S	2	10	8	3	0	0	23
SSW	4	8	1	6	0	0	19
SW	1	13	12	1	1	0	28
WSW	0	7	6	2	0	0	15
W	4	7	10	3	0	0	24
WNW	1	14	17	5	0	0	37
NW	3	19	16	0	0	0	38
NNW	3	5	8	1	1	0	18
TOT	52	195	131	26	2	0	406

Hours of Calm Data: 0
Hours of Invalid Data: 12

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	13	76	119	18	1	0	227
NNE	15	95	65	4	0	0	179
NE	24	111	28	4	0	0	167
ENE	25	67	48	4	0	0	144
E	15	70	50	7	0	0	142
ESE	18	58	38	6	0	0	120
SE	12	66	50	8	2	0	138
SSE	13	70	66	13	0	0	162
S	8	48	42	17	0	0	115
SSW	9	50	33	1	0	0	93
SW	11	30	20	1	0	0	62
WSW	4	28	18	0	0	0	50
W	9	39	43	1	0	0	92
WNW	11	71	84	25	0	0	191
NW	17	78	72	12	0	0	179
NNW	12	75	127	32	0	0	246
TOT	216	1032	903	153	3	0	2307

Hours of Calm Data: 6
Hours of Invalid Data: 64

Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	31	59	27	5	0	0	122
NNE	44	72	13	1	0	0	130
NE	46	33	2	0	0	0	81
ENE	42	31	3	0	0	0	76
E	41	52	5	2	0	0	100
ESE	39	63	15	3	1	0	121
SE	28	117	46	0	0	0	191
SSE	20	139	89	0	0	0	248
S	19	124	97	12	0	0	252
SSW	20	99	50	3	0	0	172
SW	20	64	15	0	0	0	99
WSW	28	60	19	1	0	0	108
W	22	60	22	1	0	0	105
WNW	28	105	22	0	0	0	155
NW	39	82	42	2	0	0	165
NNW	14	50	31	4	0	0	99
TOT	481	1210	498	34	1	0	2224

Hours of Calm Data: 34
Hours of Invalid Data: 47

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	21	17	0	0	0	0	38
NNE	36	19	0	0	0	0	55
NE	41	3	0	0	0	0	44
ENE	32	6	0	0	0	0	38
E	25	7	0	0	0	0	32
ESE	45	10	0	0	0	0	55
SE	37	110	13	0	0	0	160
SSE	34	171	18	0	0	0	223
S	24	108	2	0	0	0	134
SSW	31	45	1	0	0	0	77
SW	34	54	0	0	0	0	88
WSW	29	20	0	0	0	0	49
W	27	30	0	0	0	0	57
WNW	38	22	0	0	0	0	60
NW	23	26	0	0	0	0	49
NNW	13	22	0	0	0	0	35
TOT	490	670	34	0	0	0	1194

Hours of Calm Data: 72
Hours of Invalid Data: 43

Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:23.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	32	9	0	0	0	0	41
NNE	27	3	0	0	0	0	30
NE	21	0	0	0	0	0	21
ENE	11	0	0	0	0	0	11
E	14	1	0	0	0	0	15
ESE	14	0	0	0	0	0	14
SE	18	12	0	0	0	0	30
SSE	33	46	5	0	0	0	84
S	26	20	0	0	0	0	46
SSW	22	4	0	0	0	0	26
SW	24	6	0	0	0	0	30
WSW	17	2	0	0	0	0	19
W	5	1	0	0	0	0	6
WNW	27	2	0	0	0	0	29
NW	31	14	0	0	0	0	45
NNW	38	10	0	0	0	0	48
TOT	360	130	5	0	0	0	495

Hours of Calm Data: 84
Hours of Invalid Data: 25
Hours of Good Data: 8486 = 96.9% of Total Hours

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	3	21	36	9	2	0	71
NNE	3	28	42	2	0	0	75
NE	3	19	14	0	0	0	36
ENE	2	17	9	0	0	0	28
E	2	20	11	0	0	0	33
ESE	4	26	8	7	0	0	45
SE	7	37	48	8	0	0	100
SSE	4	37	66	22	1	3	133
S	2	26	62	29	11	0	130
SSW	1	27	62	49	16	0	155
SW	4	22	49	38	8	6	127
WSW	1	6	21	20	4	0	52
W	4	17	23	14	2	2	62
WNW	0	15	27	31	14	4	91
NW	1	14	32	16	1	2	66
NNW	2	19	33	7	0	0	61
TOT	43	351	543	252	59	17	1265

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

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	2	9	13	3	0	0	27
NNE	3	14	9	5	0	0	31
NE	2	10	10	1	0	0	23
ENE	2	11	3	0	0	0	16
E	2	7	6	3	0	0	18
ESE	0	2	6	3	0	0	11
SE	0	9	16	5	0	0	30
SSE	1	12	18	6	2	1	40
S	2	6	9	6	5	0	28
SSW	2	5	11	6	3	0	27
SW	0	8	13	14	6	0	41
WSW	2	9	4	9	1	0	25
W	1	6	8	1	3	1	20
WNW	1	9	8	12	1	1	32
NW	1	7	24	7	3	1	43
NNW	0	7	13	7	0	0	27
TOT	21	131	171	88	24	4	439

Hours of Calm Data: 0
Hours of Invalid Data: 1

Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	3	10	13	2	0	0	28
NNE	1	9	15	3	0	0	28
NE	2	16	11	0	0	0	29
ENE	0	14	9	3	0	0	26
E	2	7	3	1	0	0	13
ESE	4	7	7	0	0	0	18
SE	4	4	12	2	0	0	22
SSE	1	15	11	4	3	0	34
S	3	3	10	6	3	0	25
SSW	0	4	6	3	4	1	18
SW	0	6	6	12	4	2	30
WSW	0	8	5	3	2	0	18
W	0	6	4	6	3	1	20
WNW	2	5	8	15	6	3	39
NW	2	11	18	13	3	1	48
NNW	1	2	11	3	0	1	18
TOT	25	127	149	76	28	9	414

Hours of Calm Data: 2
Hours of Invalid Data: 2

Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	6	33	135	62	8	1	245
NNE	5	33	97	31	2	0	168
NE	14	55	84	19	2	0	174
ENE	7	44	65	29	3	0	148
E	6	38	71	21	2	0	138
ESE	4	41	39	34	5	0	123
SE	1	26	61	32	8	3	131
SSE	6	9	79	47	17	0	158
S	4	12	56	40	17	1	130
SSW	3	11	49	29	6	0	98
SW	4	13	29	20	3	0	69
WSW	3	8	17	15	3	0	46
W	1	10	32	30	14	1	88
WNW	3	16	64	65	51	16	215
NW	2	24	77	66	34	4	207
NNW	5	24	86	100	22	0	237
TOT	74	397	1041	640	197	26	2375

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

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	2	12	42	33	1	0	90
NNE	4	22	71	18	0	0	115
NE	7	41	56	1	0	0	105
ENE	1	26	55	1	0	0	83
E	3	26	72	4	0	2	107
ESE	3	24	90	16	2	2	137
SE	3	18	94	67	2	0	184
SSE	1	16	75	110	5	0	207
S	1	11	91	120	27	0	250
SSW	1	14	66	118	12	0	211
SW	3	13	36	60	10	0	122
WSW	4	14	44	40	6	0	108
W	3	13	38	53	3	2	112
WNW	2	18	57	74	5	1	157
NW	4	17	77	71	12	1	182
NNW	5	18	55	43	4	0	125
TOT	47	303	1019	829	89	8	2295

Hours of Calm Data: 5
Hours of Invalid Data: 5

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	1	4	20	4	0	0	29
NNE	3	10	17	12	0	0	42
NE	5	16	34	3	0	0	58
ENE	2	7	40	2	0	0	51
E	2	10	29	1	0	0	42
ESE	4	15	55	12	0	0	86
SE	1	11	56	28	0	0	96
SSE	8	18	84	93	0	0	203
S	3	9	79	54	0	0	145
SSW	2	12	68	57	1	0	140
SW	4	10	37	39	4	0	94
WSW	3	12	32	17	0	0	64
W	2	11	30	30	0	0	73
WNW	1	15	27	25	0	0	68
NW	2	8	29	31	0	0	70
NNW	2	5	12	23	0	0	42
TOT	45	173	649	431	5	0	1303

Hours of Calm Data: 4
Hours of Invalid Data: 2

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Totals of Hours at Each Wind Speed & Direction

Union Electric - Callaway Plant

Report Date/Time: 23-APR-2004 14:35:25.50

Meteorological Data
Totals of Hours at Each Wind Speed & Direction

1-JAN-2003 00:00:00.00 to 31-DEC-2003 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	3	4	14	6	0	0	27
NNE	5	6	30	9	0	0	50
NE	3	14	27	3	0	0	47
ENE	2	12	19	3	0	0	36
E	4	8	24	2	0	0	38
ESE	3	11	10	1	0	0	25
SE	3	9	7	1	0	0	20
SSE	0	24	23	9	0	0	56
S	4	9	20	17	0	0	50
SSW	1	11	26	22	0	0	60
SW	5	8	12	3	0	0	28
WSW	3	11	25	6	0	0	45
W	4	7	17	1	0	0	29
WNW	0	13	5	10	0	0	28
NW	0	9	12	11	0	0	32
NNW	2	4	6	9	0	0	21
TOT	42	160	277	113	0	0	592

Hours of Calm Data: 5
Hours of Invalid Data: 7
Hours of Good Data: 8700 = 99.3% of Total Hours

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Table 5 Dose at the Site Boundry and to the Nearest Resident From Gaseous Effluents

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: 2.90 km NNW	
		AGE GROUP: CHILD		AGE GROUP: CHILD	
ORGAN	UNITS	DOSE	% LIMIT(a)	DOSE	% LIMIT(b)
1. GAMMA AIR DOSE *	MRAD	8.87E-04	0.01	4.77E-04	N/A
2. BETA AIR DOSE *	MRAD	2.00E-03	0.01	1.07E-03	N/A
3. WHOLE BODY ***	MREM	1.14E-03	N/A	6.10E-04	N/A
4. SKIN ***	MREM	2.09E-03	N/A	1.12E-03	N/A
5. BONE **	MREM	3.68E-04	N/A	2.28E-04	0.00
6. LIVER **	MREM	2.11E-03	N/A	8.27E-03	0.06
7. TOTAL BODY **	MREM	2.11E-03	N/A	8.25E-03	0.06
8. THYROID **	MREM	2.11E-03	N/A	8.40E-03	0.06
9. KIDNEY **	MREM	2.11E-03	N/A	8.24E-03	0.05
10. LUNG **	MREM	2.14E-03	N/A	8.25E-03	0.05
11. GI-LLI **	MREM	2.11E-03	N/A	8.26E-03	0.06

* 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.

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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	3.95E-04	N/A	N/A	3.95E-04
2. BONE	MREM	9.98E-05	8.79E-03	9.21E-04	9.81E-03
3. LIVER	MREM	5.72E-04	8.79E-03	9.21E-04	1.03E-02
4. TOTAL BODY	MREM	7.48E-04	8.79E-03	9.21E-04	1.05E-02
5. THYROID	MREM	5.72E-04	8.79E-03	9.21E-04	1.03E-02
6. KIDNEY	MREM	5.72E-04	8.79E-03	9.21E-04	1.03E-02
7. LUNG	MREM	5.77E-04	8.79E-03	9.21E-04	1.03E-02
8. GI-LLI	MREM	5.72E-04	8.79E-03	9.21E-04	1.03E-02

Table 7 Total Dose Due to the Uranium Fuel Cycle

(Member of the Public)

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	9.24E-04	3.95E-04	1.32E-03	0.01
2. BONE	MREM	2.05E-04	9.81E-03	1.00E-02	0.04
3. LIVER	MREM	5.10E-03	1.03E-02	1.54E-02	0.06
4. TOTAL BODY	MREM	5.51E-03	1.05E-02	1.60E-02	0.06
5. THYROID	MREM	5.15E-03	1.03E-02	1.54E-02	0.02
6. KIDNEY	MREM	5.09E-03	1.03E-02	1.54E-02	0.06
7. LUNG	MREM	5.10E-03	1.03E-02	1.54E-02	0.06
8. GI-LLI	MREM	5.13E-03	1.03E-02	1.54E-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.

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TABLE 8

DOSE DUE TO LIQUID EFFLUENTS
(MEMBER OF THE PUBLIC)

2003

ORGAN	UNITS	DOSE	LIMIT *	% LIMIT
1. BONE	MREM	6.48E-02	10.00	6.48E-01
2. LIVER	MREM	1.02E-01	10.00	1.02E+00
3. TOTAL BODY	MREM	7.22E-02	3.00	2.41E+00
4. THYROID	MREM	2.19E-03	10.00	2.19E-02
5. KIDNEY	MREM	3.54E-02	10.00	3.54E-01
6. LUNG	MREM	1.29E-02	10.00	1.29E-01
7. GI-LLI	MREM	4.93E-03	10.00	4.93E-02

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

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