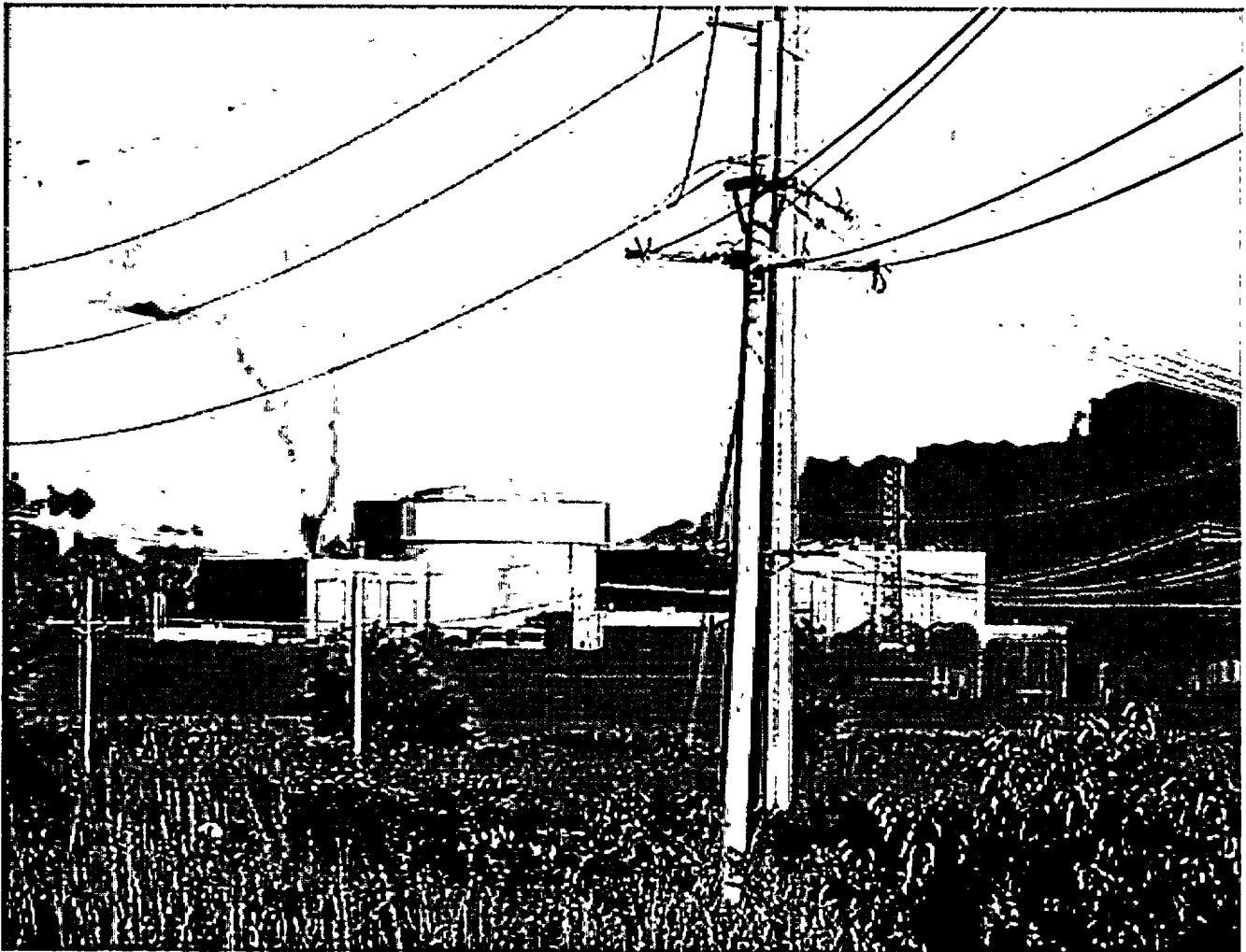


Omaha Public Power District Fort Calhoun Station Unit No. 1

Annual Report For Technical Specification Section 5.9.4.a

January 1, 2002 to December 31, 2002



**Omaha Public Power District
Fort Calhoun Station Unit No. 1**

Annual Report
For
Technical Specifications,
Section 5.9.4.A

January 1, 2002 to December 31, 2002

DOCKET NO. 50-285

OPERATING LICENSE DPR-40

Annual Radiological Effluent Release Report

This report is submitted in accordance with Section 5.9.4.a of the Technical Specifications of Fort Calhoun Station Unit No. 1, Facility Operating License DPR-40 for the period January 1, 2002 through December 31, 2002. The Effluent Report is presented in the format outlined in Regulatory Guide 1.21, Revision 1.

In addition, this report provides the results of quarterly dose calculations performed in accordance with the Offsite Dose Calculation Manual. Results are presented by quarter for the period January 1, 2002 through December 31, 2002.

Further description of any changes made during the preceding twelve months to the Offsite Dose Calculation Manual and/or the Process Control Program for the Fort Calhoun Station are presented.

**PRC RECOMMENDS
APPROVAL**

MAR 26 2003

PRC MTG. MINUTES

David Banitt
Manager-Fort Calhoun Station

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1.0 INTRODUCTION

This Annual Radiological Effluent Release Report, for Fort Calhoun Station Unit No. 1, is submitted as required by Technical Specification 5.9.4.a for the period January 1, 2002 through December 31, 2002.

1.1 Executive Summary

The Radioactive Effluent Monitoring program for the year 2002 was conducted as described in the following report. Major efforts were made to maintain the release of radioactive effluents to the environment as low as reasonably achievable. Activity released was significantly reduced due to the replacement of defective fuel in the spring of 2002.

The total gaseous activity released for 2002 was 2259.8 Curies. This was 32.14% less than the 3330 Curies released in 2001.

Dose contributions from gaseous effluents at the unrestricted area boundary were 2.20E-01 millirad maximum gamma air dose, and 7.12E-01 millirad maximum beta air dose. This was a decrease from the 2001 values of 3.24E-01 millirad and 1.19E+00 millirad respectively.

Total activity (excluding tritium, dissolved gases and alpha) released in 2002 in liquid effluents was 4.20E-01 Curies. This was lower than the 2001 value of 5.60E-01 Curies.

The total tritium activity released in 2002 in liquid effluents was 293 Curies. This was an increase from the 2001 value of 175.4 Curies. This was due to an increase in liquid effluent releases during the 1st and 2nd quarters of 2002 when reactor coolant system tritium levels were higher.

The calculated whole body dose due to liquid effluents at the site discharge from all sources in 2002 was 1.69E-01 mRem. This was a decrease from the 2001 dose of 4.41E-01 mRem.

The calculated critical organ dose due to liquid effluents at the site discharge from all sources in 2002 was 2.22E-01 mRem. This was a decrease from the 2001 dose of 5.94E-01 mRem.

The Fort Calhoun Station meteorological system achieved a cumulative availability rate of 94.41% for the joint frequency parameters required by Regulatory Guide 1.23 of wind speed, wind direction and delta temperature.

There were no abnormal releases during 2002.

During 2002 there was one change to the Offsite Dose Calculations Manual (ODCM) and no changes to the Process Control Program (PCP).

For 2002, the total volume of buried solid radwaste was 23.30 cubic meters, essentially unchanged from the 21.8 cubic meters of solid waste buried in 2001. The total buried activity for 2002 was 952.76 Curies, 952 of which came from spent resin. This was an increase from the 2001 value of 175.4 Curies.

Overall, the radioactive effluent monitoring program was conducted in a manner to ensure the activity released and associated dose to the public were maintained as low as reasonably achievable.

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

The ODCM Radiological Effluent Control Specifications applicable to the release of radioactive material in liquid and gaseous effluents are described in the following sections.

2.1.1 Fission and Activation Gases (Noble Gases)

The release rate of radioactive material in airborne effluents shall be controlled such that the instantaneous concentrations of radionuclides do not exceed the values specified in 10 CFR 20 for airborne effluents at the unrestricted area boundary. To support plant operations, Supervisor - System Chemistry may increase this limit up to the limits specified in Technical Specification 5.16.1.g.

Technical Specification 5.16.1.g establishes the administrative control limit on the concentration resulting from radioactive material, other than noble gases, released in gaseous effluents to unrestricted areas conforming to ten times 10 CFR 20.1001-20.2401, Appendix B, Table 2,

Column 1. For noble gases, the concentration shall be limited to five times 10 CFR 20.1001-20.2401, Appendix B, Table 2, Column 1.

The air dose due to noble gases released in gaseous effluents to areas at or beyond the unrestricted area 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 Dose - Iodine-131, Radioactive Material in Particulate Form with Half Lives Greater than 8 Days (Other than Noble Gases) and Tritium

- a. The dose to an individual or dose commitment to any organ of an individual in unrestricted areas due to the release of I-131, radioactive material in particulate form with half-lives greater than eight days (other than noble gases), and tritium in airborne effluents shall not exceed 7.5 millirem from all exposure pathways during any calendar quarter.
- b. The dose to an individual or dose commitment to any organ of an individual in unrestricted areas due to the release of I-131, radioactive materials in particulate form with half-lives greater than eight days (other than noble gases), and tritium in airborne effluents shall not exceed 15 millirem from all exposure pathways during any calendar year.

2.1.3 Liquid Effluents

The release rate of radioactive material in liquid effluents shall be controlled such that the instantaneous concentrations for radionuclides, other than dissolved or entrained noble gases, do not exceed the values specified in 10 CFR 20 for liquid

effluents at site discharge. To support plant operations, Supervisor - System Chemistry may increase this limit up to the limit specified in Technical Specifications 5.16.1.b.

Technical Specification 5.16.1.b establishes the administrative control limit on concentration of radioactive material, other than dissolved or entrained noble gases, released in liquid effluents to unrestricted areas conforming to ten times 10 CFR 20.1001-20.2401, Appendix B, Table 2, Column 2. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-04 $\mu\text{Ci/ml}$ total activity.

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to unrestricted areas shall be limited to:

- a. During any calendar quarter: Less than or equal to 1.5 mRem to the whole body and less than or equal to 5 mRem to any organ, and
- b. During any calendar year: Less than or equal to 3 mRem to the whole body and less than or equal to 10 mRem to any organ.

2.1.4 Total Dose-Uranium Fuel Cycle

The dose to any real individual from uranium fuel cycle sources shall be limited to ≤ 25 mRem to the total body or any organ (except the thyroid, which shall be limited to ≤ 75 mRem) during each calendar year.

2.2 Effluent Concentration Limits (ECL)

2.2.1 Liquid Effluents

The values specified in 10 CFR Part 20, Appendix B, Column 2 are used as the ECL for liquid radioactive effluents released to unrestricted areas. A value of 2.0E-04 $\mu\text{Ci/ml}$ is used as the ECL for dissolved and entrained noble gases in liquid effluents.

2.2.2 Gaseous Effluents

The values specified in 10 CFR Part 20, Appendix B, Column 1 are used as the ECL for gaseous radioactive effluents released to unrestricted areas.

2.3 Measurements and Approximations of Total Radioactivity

Measurements of total radioactivity in liquid and gaseous radioactive effluents were accomplished in accordance with the sampling and analysis requirements of Tables 3.1 and 3.2 of Part I of the ODCM.

2.3.1 Liquid Radioactive Effluents

Each batch was sampled and analyzed for gamma emitting radionuclides using gamma spectroscopy, prior to release. Composite samples were analyzed monthly and quarterly for the Monitor and Hotel Waste Tanks. Composite samples were analyzed monthly in the onsite laboratory for tritium and gross alpha radioactivity using liquid scintillation and proportional counting techniques respectively. Composite samples were analyzed quarterly for Sr-89, Sr-90 and Fe-55 by a contract laboratory (Teledyne Brown Engineering). A software program was used to project the total body and critical organ dose contribution at the unrestricted area boundary for each release and the percent contribution to the annual objective dose.

For continuous releases from the Steam Generator blowdown, daily grab samples were obtained for weekly, monthly and quarterly composites, in proportion to the rate of blowdown. Samples were analyzed using gamma spectroscopy techniques weekly. Composites were also analyzed monthly in the onsite laboratory for tritium and gross alpha radioactivity using liquid scintillation and proportional counting techniques, respectively. Composite samples were analyzed quarterly for Sr-89, Sr-90, and Fe-55 by a contract laboratory (Teledyne Brown Engineering).

2.3.2 Gaseous Radioactive Effluents

Each gaseous batch release was sampled and analyzed for radioactivity prior to release. For release of Waste Gas Decay Tanks, noble gas grab samples were analyzed for gamma emitting radionuclides using gamma spectroscopy. For releases from the Containment Building, samples were taken using charcoal and particulate filters, in addition to noble gas and tritium grab samples, and analyzed for gamma emitting radionuclides prior to each release. The results of the analysis and the total volume of effluent released were used to determine the total amount of radioactivity released in the batch mode. A software program was developed and installed that can project the total body and critical organ dose contribution at the unrestricted area boundary for each release and the percent contribution to the annual objective dose. This program also adds the projected dose to the current actual dose totals in a temporary file, until it is updated with actual release data at the completion of a purge.

Continuous release effluent pathways were continuously sampled using charcoal and particulate filters and analyzed weekly for gamma emitting radionuclides using gamma spectroscopy. Weekly particulate filters were analyzed for gross alpha radioactivity in the onsite laboratory using proportional counting techniques. Quarterly composites of particulate filters were analyzed for Sr-89 and Sr-90 by an offsite laboratory (Teledyne Brown Engineering).

2.4 Estimation of Total Percent Error

The estimated total percent error is calculated as follows:

$$\text{Total Percent Error} = (E_1^2 + E_2^2 + E_3^2 + \dots + E_n^2)^{1/2}$$

Where E_n = Percent Error Associated with each contributing parameter.

Sample counting error is estimated by the Canberra Genie System Software for samples analyzed by gamma spectroscopy. This calculation can include the error

associated with peak area determination, gamma ray abundance, efficiency and half-life. Systematic error is estimated for gaseous and liquid effluent analyses and dilution and wastewater volume.

2.5 Batch Releases

A summary of information for liquid and gaseous batch releases is included in Table III-1.

2.6 Abnormal Releases

Abnormal Releases are defined as unplanned and unmonitored releases of radioactive material from the site.

A summary of information for liquid and gaseous abnormal releases is included in Table III-2.

3.0 GASEOUS EFFLUENTS

The quantities of radioactive material released in gaseous effluents are summarized in Tables III-3, III-4 and III-5. All radioactive material released in gaseous form is considered to be ground level releases.

4.0 LIQUID EFFLUENTS

The quantities of radioactive material released in liquid effluents are summarized in Tables III-6, III-7 and III-8.

5.0 SOLID WASTES

The quantities of radioactive material released as solid effluents are summarized in Section VI.

6.0 RELATED INFORMATION

6.1 Operability of Liquid and Gaseous Monitoring Instrumentation

During the reporting period no instruments used to monitor radioactive effluent releases were in violation of the reportable instrument operability requirements listed in the ODCM.

6.2 Changes to the Offsite Dose Calculation Manual (ODCM) or Process Control Program (PCP)

During 2002 there was one change made to the ODCM and no changes made to the PCP.

6.3 New Locations or Modifications for Dose Calculations or Environmental Monitoring

New receptor locations were identified in the 2002 Land Use Survey which resulted in changes to our environmental monitoring sample locations. These changes are reflected in the attached revision to the Offsite Dose Calculation Manual (ODCM).

6.4 Noncompliance with Radiological Effluent Control Requirements

This section provides a list of any event that did not comply with the applicable requirements of the Radiological Effluent Controls given in the Offsite Dose Calculation Manual (ODCM). Detailed documentation concerning the evaluations and corrective actions is maintained onsite.

6.4.1 Abnormal Gaseous and Liquid Releases

No abnormal releases were made during the calendar year of 2002.

6.4.2 Failure to Meet Specified Sampling Requirements

During 2002 there were no instances in which specified sampling requirements were not met.

6.5 Modifications to Liquid and Gaseous Waste Treatment and Ventilation Exhaust Systems

During the reporting period no design modifications were approved nor implemented involving major changes to the Liquid and Gaseous Waste Treatment Systems.

6.6 Meteorological Monitoring Program

A summary of hourly meteorological data, collected during 2002, is retained onsite. This data is available for review by the Nuclear Regulatory Commission upon request. Joint Frequency tables are included in Section VII, Attachment 2.

Real time hourly meteorological data is used to calculate the annual air effluent dose to individuals. For quarterly estimates during the year an annual average X/Q is used which is an average of the highest X/Qs calculated for each of the previous two years.

6.7 Assessment of Doses

6.7.1 Doses Due to Liquid Effluents

Total body, skin, and organ dose for liquid releases were calculated in mRem for all significant liquid pathways using the annual configuration of the LADTAP II program. The site discharge location was chosen to present a most conservative estimate of dose for an average adult, teenager, child and infant. A conservative approach is also presented by the assumption that Omaha and Council Bluffs receive all drinking water from the Missouri River.

The LADTAP II program in its annual configuration was also used to calculate the total body and organ doses for the population of 853,274 within a 50-mile radius of the plant (based on the 2000 census). The results of the calculations are listed in Section V.

The dose due to liquid effluents for total body and critical organ are also calculated quarterly using the methods in the ODCM. The results are listed in Section II.

6.7.2 Doses Due to Gaseous Effluents

Total body, skin and organ doses from ground releases were calculated in mRem to an average adult, teenager, child, and infant in each receptor using the annual configuration of the GASPAR II program. Also, the doses to the same groups, in units of mrad, due to gamma and beta radiation carried by air, were computed using GASPAR II.

The GASPAR II program in its annual configuration was also used to calculate the ALARA integrated population dose summary for the total body, skin and organ doses in person-rem for all individuals within a 50-mile radius. The results of the calculations are shown in Section IV.

The dose due to gaseous effluents for total body gamma and beta noble gas air dose are calculated quarterly using the methods in the ODCM with an annual average X/Q. The results are listed in Section II.

6.7.3 Doses Due to I-131, Tritium and Particulates with Half Lives Greater than 8 days.

The doses due to I-131, Tritium and Particulates with half lives greater than 8 days for total body and critical organ dose are calculated quarterly using the highest of infant or child dose factors and an annual average X/Q. The results are listed in Section II for inhalation, ground and food.

6.7.4 Direct Radiation Dose to Individuals and Populations

Direct radiation doses attributed to the gamma radiation emitted from the containment structure were not observed above local background at any TLD sample locations for this annual period.

6.7.5 40 CFR 190 Dose Evaluation

ODCM Radiological Effluent Controls require dose evaluations to demonstrate compliance with 40 CFR Part 190 only if calculated yearly doses exceed two times the annual design objectives for liquid and/or gaseous effluents. At no time during 2002 were any of these limits exceeded, therefore, no evaluations were required.

SECTION II
QUARTERLY DOSES FROM EFFLUENTS

Offsite Dose Calculation Manual

January 1, 2002 - December 31, 2002

Quarterly Dose Calculation Results

January 1, 2002 through December 31, 2002


With the implementation of the Fort Calhoun Station Radiological Effluent Technical Specifications (RETS) on October 1, 1985, radiation doses in the unrestricted area from liquid and gaseous effluents must be calculated on a quarterly basis in accordance with the Offsite Dose Calculation Manual (ODCM). These calculations are performed to ensure the annual dose limits delineated in Appendix I of 10 CFR 50 and implemented by RETS are not exceeded. If the results of the quarterly calculations exceed fifty percent (50%) of the annual limits of Appendix I, actions are taken to reduce effluents so that the resultant doses do not exceed the annual limits during the remainder of the year and a special report is submitted to the Nuclear Regulatory Commission.

This section presents the results of the quarterly dose calculations performed during the period January 1, 2002 through December 31, 2002. Details are shown as to the types, sources and resultant doses from the effluents, the annual limits and a comparison to the annual limits.

QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
 FORT CALHOUN FIRST QUARTER 2002 DOSE PROJECTIONS

I. Liquid Effluents: -----	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Batch:	2.67E-02	3.40E-02
Continuous:	0.00E+00	0.00E+00
-----	-----	-----
Totals:	2.67E-02	3.40E-02
ODCM Quarterly Objective:	1.50E+00	5.00E+00
-----	-----	-----
Percent of Quarterly Obj:	1.78 %	0.68 %
ODCM Annual Objective:	3.00E+00	1.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	0.89 %	0.34 %


II. Gaseous Effluents: -----	Total Body Gamma Dose (mrad) -----	Total Body Beta Dose (mrad) -----
A. Noble Gas Air Dose:	3.23E-02	1.04E-01
ODCM Quarterly Objective:	5.00E+00	1.00E+01
-----	-----	-----
Percent of Quarterly Obj:	0.65 %	1.04 %
ODCM Annual Objective:	1.00E+01	2.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	0.32 %	0.52 %
B. I-131, H-3, and Particulates with Half-lives > 8 Days:	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Inhalation:	2.46E-05	3.02E-03
Ground and Food:	1.38E-04	2.98E-02
-----	-----	-----
Totals:	1.63E-04	3.28E-02
ODCM Quarterly Objective:	7.50E+00	7.50E+00
-----	-----	-----
Percent of Quarterly Obj:	0.00 %	0.44 %
ODCM Annual Objective:	1.50E+01	1.50E+01
-----	-----	-----
YTD Percent of Annual Obj:	0.00 %	0.22 %

Reviewed by: 

QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
 FORT CALHOUN SECOND QUARTER 2002 DOSE PROJECTIONS

I. Liquid Effluents: -----	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Batch:	9.95E-02	1.33E-01
Continuous:	2.06E-08	4.68E-08
-----	-----	-----
Totals:	9.95E-02	1.33E-01
ODCM Quarterly Objective:	1.50E+00	5.00E+00
-----	-----	-----
Percent of Quarterly Obj:	6.63 %	2.66 %
ODCM Annual Objective:	3.00E+00	1.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	4.20 %	1.66 %

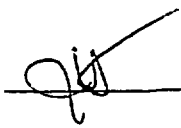
II. Gaseous Effluents: -----	Total Body Gamma Dose (mrad) -----	Total Body Beta Dose (mrad) -----
A. Noble Gas Air Dose:	2.44E-01	7.91E-01
ODCM Quarterly Objective:	5.00E+00	1.00E+01
-----	-----	-----
Percent of Quarterly Obj:	4.88 %	7.91 %
ODCM Annual Objective:	1.00E+01	2.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	2.76 %	4.47 %
B. I-131, H-3, and Particulates with Half-lives > 8 Days:	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Inhalation:	5.65E-04	5.06E-02
Ground and Food:	3.42E-03	7.30E-01
-----	-----	-----
Totals:	3.98E-03	7.81E-01
ODCM Quarterly Objective:	7.50E+00	7.50E+00
-----	-----	-----
Percent of Quarterly Obj:	0.05 %	10.41 %
ODCM Annual Objective:	1.50E+01	1.50E+01
-----	-----	-----
YTD Percent of Annual Obj:	0.03 %	5.42 %

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QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
 FORT CALHOUN THIRD QUARTER 2002 DOSE PROJECTIONS

I. Liquid Effluents: -----	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Batch:	3.18E-02	4.36E-02
Continuous:	0.00E+00	0.00E+00
-----	-----	-----
Totals:	3.18E-02	4.36E-02
ODCM Quarterly Objective:	1.50E+00	5.00E+00
-----	-----	-----
Percent of Quarterly Obj:	2.12 %	0.87 %
ODCM Annual Objective:	3.00E+00	1.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	5.27 %	2.10 %

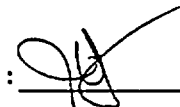
II. Gaseous Effluents: -----	Total Body Gamma Dose (mrad) -----	Total Body Beta Dose (mrad) -----
A. Noble Gas Air Dose:	1.26E-03	5.48E-03
ODCM Quarterly Objective:	5.00E+00	1.00E+01
-----	-----	-----
Percent of Quarterly Obj:	0.03 %	0.05 %
ODCM Annual Objective:	1.00E+01	2.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	2.78 %	4.50 %
B. I-131, H-3, and Particulates with Half-lives > 8 Days:	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Inhalation:	2.24E-05	1.28E-03
Ground and Food:	1.24E-04	1.84E-02
-----	-----	-----
Totals:	1.46E-04	1.97E-02
ODCM Quarterly Objective:	7.50E+00	7.50E+00
-----	-----	-----
Percent of Quarterly Obj:	0.00 %	0.26 %
ODCM Annual Objective:	1.50E+01	1.50E+01
-----	-----	-----
YTD Percent of Annual Obj:	0.03 %	5.55 %

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QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
 FORT CALHOUN FOURTH QUARTER 2002 DOSE PROJECTIONS

I. Liquid Effluents: -----	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Batch:	9.55E-03	1.22E-02
Continuous:	0.00E+00	0.00E+00
-----	-----	-----
Totals:	9.55E-03	1.22E-02
ODCM Quarterly Objective:	1.50E+00	5.00E+00
-----	-----	-----
Percent of Quarterly Obj:	0.64 %	0.24 %
ODCM Annual Objective:	3.00E+00	1.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	5.60 %	2.21 %

II. Gaseous Effluents: -----	Total Body Gamma Dose (mrad) -----	Total Body Beta Dose (mrad) -----
A. Noble Gas Air Dose:	2.20E-01	7.12E-01
ODCM Quarterly Objective:	5.00E+00	1.00E+01
-----	-----	-----
Percent of Quarterly Obj:	4.40 %	7.12 %
ODCM Annual Objective:	1.00E+01	2.00E+01
-----	-----	-----
YTD Percent of Annual Obj:	2.79 %	4.51 %
B. I-131, H-3, and Particulates with Half-lives > 8 Days:	Total Body Dose (mrem) -----	Critical Organ Dose (mrem) -----
Inhalation:	4.91E-04	4.21E-02
Ground and Food:	6.61E-03	2.87E+00
-----	-----	-----
Totals:	7.11E-03	2.91E+00
ODCM Quarterly Objective:	7.50E+00	7.50E+00
-----	-----	-----
Percent of Quarterly Obj:	0.09 %	38.83 %
ODCM Annual Objective:	1.50E+01	1.50E+01
-----	-----	-----
YTD Percent of Annual Obj:	0.03 %	5.56 %

Reviewed by: 

SECTION III
RADIOLOGICAL EFFLUENT RELEASES
Technical Specification (5.9.4a)

Table III-1	Batch Liquid and Gas Release Summary
Table III-2	Abnormal Batch Liquid and Gaseous Release Summary
Table III-3	Gaseous Effluents - Summation of all Releases
Table III-4	Gaseous Effluent Releases - Batch Mode
Table III-5	Gaseous Effluent Releases - Continuous Mode
Table III-6	Liquid Effluents - Summation of all Releases
Table III-7	Liquid Effluent Releases - Batch Mode
Table III-8	Liquid Effluent Releases - Continuous Mode

January 1, 2002 - December 31, 2002

TABLE III.1
 BATCH LIQUID AND GASEOUS RELEASE SUMMARY
 JANUARY THROUGH DECEMBER 2002

	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
<u>A. Liquid Releases All Sources</u>				
1. Number of Batch Releases:	23	100	30	24
2. Total Time Period for Batch Releases (min):	2,913	17,883	13,844	2,772
3. Maximum Time Period for Batch Releases (min):	235	565	9,353	128
4. Average Time Period for Batch Releases (min):	127	179	461	116
5. Minimum Time Period for Batch Releases (min):	91	9	103	106
6. Average Dilution Stream Flow During Periods Of Release into the Missouri River (mls/min):	1.343E+09	8.519E+08	1.284E+09	1.325E+09
<u>B. Gaseous Releases All Sources</u>				
1. Number of Batch Releases:	16	70	18	18
2. Total Time Period for Batch Releases (min):	63,978	81,315	67,535	69,932
3. Maximum Time Period for Batch Releases (min):	5,547	6,967	5,369	7,505
4. Average Time Period for Batch Releases (min):	3,999	1,162	3,752	3,885
5. Minimum Time Period for Batch Releases (min):	342	56	352	150

TABLE III.2

ABNORMAL BATCH LIQUID AND GASEOUS RELEASE SUMMARY

JANUARY THROUGH DECEMBER 2002

	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
<u>A. Liquid Releases All Sources</u>				
Number of Releases:	0	0	0	0
Total Activity Releases(Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<u>B. Gaseous Releases All Sources</u>				
Number of Releases:	0	0	0	0
Total Activity Releases (Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE III.3
 GASEOUS EFFLUENTS--SUMMATION OF ALL RELEASES
 JANUARY THROUGH DECEMBER 2002

	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
A. Fission & Activation Gases				
Total Release (Ci):	2.57E+02	1.99E+03	8.51E+00	4.29E+00
Avg. Release Rate for period (uCi/sec):	3.35E+01	2.56E+02	1.08E+00	5.46E-01
Total Error(%): <u>33.98</u>				
B. Iodines				
Total Release (Ci):	1.44E-03	9.18E-03	2.28E-04	4.41E-05
Avg. Release Rate for period (uCi/sec):	1.87E-04	1.18E-03	2.90E-05	5.61E-06
Total Error(%): <u>37.38</u>				
C. Particulates				
Total Release (Ci):	0.00E+00	6.96E-06	0.00E+00	0.00E+00
Avg. Release Rate for period (uCi/sec):	0.00E+00	8.95E-07	0.00E+00	0.00E+00
Total Error(%): <u>49.17</u>				
Gross Alpha	1.06E-05	8.97E-06	6.33E-06	1.03E-05
Total Error(%): <u>20.62</u>				
D. Tritium				
Total Release (Ci):	7.40E-02	1.84E+00	7.78E-02	4.92E-02
Avg. Release Rate for period (uCi/sec):	9.63E-03	2.37E-01	9.89E-03	6.25E-03
Total Error(%): <u>25.08</u>				

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.4
 GASEOUS EFFLUENTS--GROUND LEVEL RELEASES
 JANUARY THROUGH DECEMBER 2002
 Batch Mode

<u>Nuclides (Ci)</u>	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Fission & Activation Gases				
AR-41	2.36E-01	1.60E-01	2.47E-01	2.40E-01
KR-85	1.49E+01	8.97E+01	5.99E+00	1.52E+00
KR-85M	4.45E-02	4.15E-02	2.04E-03	2.75E-03
KR-87	0.00E+00	1.61E-03	0.00E+00	1.73E-04
KR-88	3.67E-02	2.41E-02	1.02E-03	1.68E-03
XE-131M	4.11E+00	3.93E+01	8.42E-02	1.12E-02
XE-133	2.18E+02	1.76E+03	1.96E+00	2.34E+00
XE-133M	1.65E+00	1.84E+01	2.64E-02	3.36E-02
XE-135	7.57E-01	6.79E+00	6.19E-02	8.77E-02
XE-135M	0.00E+00	3.98E-03	0.00E+00	0.00E+00
Totals for Period:	2.40E+02	1.91E+03	8.38E+00	4.24E+00
Iodines				
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pariculates				
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium and Gross Alpha				
ALPHA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	7.40E-02	1.84E+00	7.78E-02	4.92E-02

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.5
 GASEOUS EFFLUENTS--GROUND LEVEL RELEASES
 JANUARY THROUGH DECEMBER 2002
 Continuous Mode

<u>Nuclides(Ci)</u>	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Fission & Activation Gases				
AR-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-85M	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-131M	0.00E+00	3.16E+00	0.00E+00	0.00E+00
XE-133	1.69E+01	7.03E+01	0.00E+00	0.00E+00
XE-133M	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-135	3.76E-01	1.47E-01	1.29E-01	5.15E-02
XE-135M	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period:	1.73E+01	7.36E+01	1.29E-01	5.15E-02
Iodines				
I-131	3.37E-04	8.41E-03	2.12E-04	9.74E-06
I-132	8.80E-05	1.99E-04	0.00E+00	0.00E+00
I-133	6.59E-04	5.74E-04	1.63E-05	3.44E-05
I-135	3.56E-04	0.00E+00	0.00E+00	0.00E+00
Totals for Period:	1.44E-03	9.18E-03	2.28E-04	4.41E-05
Particulates				
CO-58	0.00E+00	6.96E-06	0.00E+00	0.00E+00
Totals for Period:	0.00E+00	6.96E-06	0.00E+00	0.00E+00
Tritium and Gross Alpha				
ALPHA	1.06E-05	8.97E-06	6.22E-06	1.00E-05
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.6
LIQUID EFFLUENTS--SUMMATION OF ALL RELEASES
JANUARY THROUGH DECEMBER 2002

	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
A. Fission & Activation Products				
Total Release				
(No Tritium, Gas, Alpha) (Ci):	1.27E-02	2.86E-01	8.58E-02	3.54E-02
Avg Diluted Concentration				
(uCi/ml):	3.72E-11	1.13E-09	2.40E-10	1.04E-10
10 CFR 20, App. B Limit				
1.00E-06 uCi/ml				
Percent of Limit (%):	3.72E-03	1.13E-01	2.40E-02	1.04E-02
Total Error (%): <u>25.29</u>				
B. Tritium				
Total Release (Ci):	8.19E+01	1.42E+02	1.92E+01	4.99E+01
Avg Diluted Concentration				
(uCi/ml):	2.40E-07	5.60E-07	5.37E-08	1.47E-07
10 CFR 20, App. B Limit				
1.00E-03 uCi/ml				
Percent of Limit (%):	2.40E-02	5.60E-02	5.37E-03	1.47E-02
Total Error (%): <u>25.08</u>				
C. Dissolved & Entrained Gases				
Total Release (Ci):	3.20E-02	6.37E-02	2.68E-05	1.96E-04
Avg Diluted Concentration				
(uCi/ml):	9.37E-11	2.51E-10	7.50E-14	5.76E-13
ODCM Limit				
2.00E-04 uCi/ml				
Percent of Limit (%):	4.69E-05	1.26E-04	3.75E-08	2.88E-07
Total Error (%): <u>28.50</u>				
D. Gross Alpha Radioactivity				
Total Release (Ci):	3.10E-03	3.22E-03	3.48E-03	7.75E-04
Total Error (%): <u>25.08</u>				
E. Volume of Waste Released				
Prior to Dilution (Liters):	4.91E+07	3.81E+07	4.97E+07	4.69E+07
F. Volume of Dilution Water				
This Period (Liters):	3.42E+11	2.53E+11	3.57E+11	3.39E+11

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.7
LIQUID EFFLUENTS

JANUARY THROUGH DECEMBER 2002

Batch Mode

<u>Nuclides(Ci)</u>	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Fission & Activation Gases				
AG-110M	1.42E-04	5.82E-03	7.18E-03	3.45E-03
AM-241	0.00E+00	1.89E-05	0.00E+00	0.00E+00
AS-76	0.00E+00	3.41E-05	0.00E+00	0.00E+00
BA-139	0.00E+00	3.12E-05	0.00E+00	0.00E+00
BA-140	0.00E+00	2.27E-04	0.00E+00	0.00E+00
BE-7	0.00E+00	4.06E-05	0.00E+00	0.00E+00
BR-76	0.00E+00	1.72E-05	0.00E+00	0.00E+00
CD-109	0.00E+00	2.37E-04	0.00E+00	0.00E+00
CE-139	0.00E+00	5.47E-06	0.00E+00	0.00E+00
CE-141	0.00E+00	2.62E-04	5.02E-05	0.00E+00
CE-144	0.00E+00	6.61E-04	1.24E-03	2.98E-04
CO-57	0.00E+00	2.02E-05	1.31E-04	1.19E-04
CO-58	6.81E-05	2.06E-02	2.83E-02	1.66E-02
CO-60	8.62E-05	3.54E-03	5.97E-03	3.13E-03
CR-51	2.12E-04	1.55E-02	5.58E-03	5.02E-04
CS-134	1.38E-03	6.00E-03	2.04E-03	3.55E-04
CS-136	9.87E-07	5.96E-05	0.00E+00	0.00E+00
CS-137	1.82E-03	7.44E-03	2.59E-03	5.46E-04
FE-55	1.41E-03	1.41E-02	0.00E+00	9.19E-04
FE-59	0.00E+00	3.84E-04	2.00E-04	2.85E-06
HF-181	0.00E+00	4.35E-05	1.51E-04	2.96E-06
I-131	4.19E-04	5.05E-02	4.11E-04	2.27E-05
I-132	0.00E+00	2.98E-03	0.00E+00	0.00E+00
I-133	1.02E-05	3.88E-04	0.00E+00	0.00E+00
LA-140	0.00E+00	1.24E-03	8.42E-05	3.25E-05
LA-141	0.00E+00	3.14E-04	0.00E+00	0.00E+00
MN-54	2.15E-06	5.97E-04	9.68E-04	2.74E-04
MO-99	0.00E+00	3.19E-04	0.00E+00	0.00E+00
NB-95	2.20E-05	4.15E-03	9.34E-03	3.05E-03
NP-239	0.00E+00	1.09E-04	0.00E+00	0.00E+00
PR-144	0.00E+00	6.61E-04	1.24E-03	2.98E-04
RB-88	0.00E+00	9.19E-05	0.00E+00	0.00E+00
RH-103M	0.00E+00	1.16E-04	0.00E+00	0.00E+00
RH-105	0.00E+00	4.53E-06	0.00E+00	0.00E+00
RU-103	0.00E+00	4.67E-04	2.54E-04	2.72E-05
SB-122	0.00E+00	7.11E-05	0.00E+00	0.00E+00
SB-124	1.53E-05	7.98E-03	5.37E-04	6.70E-05
SB-125	7.13E-03	1.01E-01	1.48E-02	4.37E-03
SB-126	0.00E+00	1.18E-03	0.00E+00	0.00E+00
SE-75	6.57E-06	0.00E+00	4.11E-05	2.35E-05
SN-113	0.00E+00	8.59E-05	1.78E-04	4.44E-05
SN-117M	0.00E+00	1.01E-04	0.00E+00	0.00E+00
SR-90	5.86E-06	5.63E-05	0.00E+00	0.00E+00
TA-182	6.57E-07	2.74E-06	9.06E-06	0.00E+00
TC-99M	0.00E+00	3.19E-04	0.00E+00	0.00E+00
TE-129	0.00E+00	6.09E-03	0.00E+00	0.00E+00
TE-129M	0.00E+00	2.73E-02	0.00E+00	0.00E+00
TE-132	0.00E+00	2.95E-03	0.00E+00	0.00E+00
Y-90	5.86E-06	5.63E-05	0.00E+00	0.00E+00
ZR-95	0.00E+00	1.90E-03	4.60E-03	1.20E-03
Totals for Period:	1.27E-02	2.86E-01	8.58E-02	3.54E-02
Dissolved & Entrained Gases				
AR-41	0.00E+00	5.23E-06	0.00E+00	0.00E+00
KR-85	1.11E-03	0.00E+00	0.00E+00	0.00E+00
XE-131M	4.88E-04	1.76E-03	0.00E+00	0.00E+00
XE-133	3.03E-02	6.10E-02	2.68E-05	1.96E-04
XE-133M	9.67E-05	5.37E-04	0.00E+00	0.00E+00
XE-135	8.21E-06	3.96E-04	0.00E+00	0.00E+00
Totals for Period:	3.20E-02	6.37E-02	2.68E-05	1.96E-04
Tritium and Gross Alpha				
ALPHA	1.39E-04	2.49E-03	5.51E-04	1.19E-04
H-3	8.19E+01	1.42E+02	1.92E+01	4.99E+01

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD) values.

TABLE III.8
LIQUID EFFLUENTS
JANUARY THROUGH DECEMBER 2002
Continuous Mode

<u>Nuclides (Ci)</u>	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Fission & Activation Products				
I-131	0.00E+00	2.15E-06	0.00E+00	0.00E+00
Totals for Period:	0.00E+00	2.15E-06	0.00E+00	0.00E+00
Dissolved & Entrained Gases				
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium and Gross Alpha				
ALPHA	2.96E-03	7.31E-04	2.93E-03	6.56E-04
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

SECTION IV
DOSE FROM GASEOUS EFFLUENTS

Technical Specification 5.9.4a

GASPAR II OUTPUT

January 1, 2002 - December 31, 2002

Radioactive Effluent Releases - First, Second, Third and Fourth Quarters 2002

GASEOUS EFFLUENTS

Radioactive gaseous releases for the reporting period totaled $2.26\text{E}+03$ Curies of inert gas. The gross gaseous activity release rates were $3.35\text{E}+02$ $\mu\text{Ci}/\text{sec}$ for the first quarter, $2.56\text{E}+02$ $\mu\text{Ci}/\text{sec}$ for the second quarter, $1.08\text{E}+00$ $\mu\text{Ci}/\text{sec}$ for the third quarter, and $5.46\text{E}-01$ $\mu\text{Ci}/\text{sec}$ for the fourth quarter.

Radioactive halogens and Particulates with half-lives greater than eight days released during the reporting period totaled $1.09\text{E}-02$ Curies. The halogen release rates were $1.87\text{E}-04$ $\mu\text{Ci}/\text{sec}$ for the first quarter, $1.18\text{E}-03$ $\mu\text{Ci}/\text{sec}$ for the second quarter, $2.90\text{E}-05$ $\mu\text{Ci}/\text{sec}$ for the third quarter, and $5.61\text{E}-06$ $\mu\text{Ci}/\text{sec}$ for the fourth quarter. The release rates for Particulates with half-lives greater than eight days were $0.00\text{E}+00$ $\mu\text{Ci}/\text{sec}$ for the first quarter, $8.95\text{E}-07$ $\mu\text{Ci}/\text{sec}$ for the second quarter, $0.00\text{E}+00$ $\mu\text{Ci}/\text{sec}$ for the third quarter and $0.00\text{E}+00$ $\mu\text{Ci}/\text{sec}$ for the fourth quarter.

Radioactive tritium released during the reporting period totaled $2.04\text{E}+00$ Curies. Gross alpha radioactivity released during the reporting period totaled $3.62\text{E}-05$ Curies.

POTENTIAL DOSES TO INDIVIDUALS AND POPULATIONS

A. Potential Annual Doses to Individuals from Gaseous Releases

Total body, skin, and organ doses from ground releases were calculated in mRem to an average adult, teenager, child, and infant using the annual configuration of the GASPARD II program. Results to each receptor are shown in Tables IV-A-1 through IV-A-40. Also, the doses to the same groups, Table IV-B-1, in units of mrad, due to gamma and beta radiation carried by air, were computed using GASPARD II. In its annual configuration, GASPARD II assumes that all release rates are entered in curies per year (Ci/yr).

The inputs to GASPARD II for the annual period from January 1, 2002 through December 31, 2002 were as follows:

- (1) All gaseous effluents
- (2) Entrained gases (Ar-41, Xe-131M, Xe-133M, Xe-133, Xe-135M, Xe-135, Kr-85M, Kr-87, and Kr-88) from liquid effluents.
- (3) Annual X/Qs at the actual receptor locations, which are corrected for open terrain and plume depletion, are calculated according to Regulatory Guideline 1.111. Also included are annual deposition rates corrected for the open terrain factor.
- (4) The production, intake and grazing fractions were as follows: 1.0 for leafy vegetables grown in garden of interest, 0.76 for produce grown in garden of interest, 0.5 for the pasture grazing season of the milk animal, 1.0 for pasture grazing season of the meat animal, and 8 g/m^3 for the air water (humidity) concentrations.
- (5) All dose factors, transport times from receptor to individual, and usage factors are defined by Regulatory Guide 1.109 and NUREG-0172.
- (6) Site specific information, within a five-mile radius of the plant, on types of receptors located in each sector was used. That is, if a cow was not present in a sector, then the milk pathway for that sector was not considered. If it was present, then the actual sector distance was used.

These inputs introduce a most conservative approach for the following reasons:

- (1) The open terrain and deposition corrections increase annual X/Qs by a factor ranging between 1.0 and 4.0
- (2) The production, intake, and grazing fractions, as defined in the input definition statement, represent the environment in an extremely conservative manner.

B. Potential Semiannual Doses to Population from Gaseous Releases

The GASPAR II program in its annual configuration was also used to calculate the ALARA integrated population dose summary for the total body, skin, and organ doses in man-rem for all individuals within a 50-mile radius. The population-integrated dose is the summation of the dose received by all individuals and has units of man-thyroid-rem when applied to the summation of thyroid doses. The same inputs were used as in the individual case with the addition of the following:

- (1) A total population of 853,274 (based on the 2000 census) was used to define the sector segments within a 50-mile radius of the plant.
- (2) Production of milk, meat, and vegetation is based on 1973 annual data for Nebraska as recommended by the Nuclear Regulatory Commission for use in GASPAR II.

TABLE IV-A- 1

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 1 RES
 AT 4.57 MILES N

ANNUAL_BETA_AIR_DOSE = 8.35E-03 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.53E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.56E-03	: 4.78E-03
GROUND	: 7.39E-07	: 7.39E-07	: 7.39E-07	: 7.39E-07	: 7.39E-07	: 7.39E-07	: 7.39E-07	: 8.95E-07
INHAL	:	:	:	:	:	:	:	:
ADULT	: 5.71E-06	: 5.33E-06	: 7.38E-07	: 6.18E-06	: 6.94E-06	: 3.48E-04	: 5.14E-06	: 5.12E-06
TEEN	: 5.93E-06	: 5.39E-06	: 1.04E-06	: 6.62E-06	: 7.66E-06	: 4.27E-04	: 5.19E-06	: 5.17E-06
CHILD	: 5.36E-06	: 4.67E-06	: 1.41E-06	: 5.99E-06	: 6.90E-06	: 4.74E-04	: 4.58E-06	: 4.56E-06
INFANT	: 3.20E-06	: 2.66E-06	: 1.11E-06	: 3.94E-06	: 4.16E-06	: 4.32E-04	: 2.64E-06	: 2.63E-06



TABLE IV-A- 2

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 2 RES
 AT 1.93 MILES NNE

ANNUAL_BETA_AIR_DOSE = 4.39E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.35E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 7.87E-03	: 7.87E-03	: 7.87E-03	: 7.87E-03	: 7.87E-03	: 7.87E-03	: 8.31E-03	: 2.53E-02
GROUND	: 4.43E-06	: 4.43E-06	: 4.43E-06	: 4.43E-06	: 4.43E-06	: 4.43E-06	: 4.43E-06	: 5.37E-06
INHAL	:	:	:	:	:	:	:	:
ADULT	: 2.93E-05	: 2.72E-05	: 3.98E-06	: 3.18E-05	: 3.59E-05	: 1.86E-03	: 2.62E-05	: 2.61E-05
TEEN	: 3.04E-05	: 2.75E-05	: 5.59E-06	: 3.42E-05	: 3.98E-05	: 2.29E-03	: 2.64E-05	: 2.63E-05
CHILD	: 2.75E-05	: 2.38E-05	: 7.59E-06	: 3.09E-05	: 3.58E-05	: 2.54E-03	: 2.34E-05	: 2.32E-05
INFANT	: 1.64E-05	: 1.36E-05	: 5.99E-06	: 2.05E-05	: 2.17E-05	: 2.32E-03	: 1.34E-05	: 1.34E-05

TABLE IV-A- 3

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 3 RES
 AT 1.52 MILES NE

ANNUAL_BETA_AIR_DOSE = 4.99E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.53E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 8.91E-03	: 8.91E-03	: 8.91E-03	: 8.91E-03	: 8.91E-03	: 8.91E-03	: 9.40E-03	: 2.87E-02
GROUND	: 4.41E-06	: 4.41E-06	: 4.41E-06	: 4.41E-06	: 4.41E-06	: 4.41E-06	: 4.41E-06	: 5.34E-06
INHAL	:	:	:	:	:	:	:	:
ADULT	: 3.35E-05	: 3.11E-05	: 4.56E-06	: 3.63E-05	: 4.10E-05	: 2.13E-03	: 2.99E-05	: 2.98E-05
TEEN	: 3.48E-05	: 3.15E-05	: 6.41E-06	: 3.91E-05	: 4.55E-05	: 2.62E-03	: 3.02E-05	: 3.01E-05
CHILD	: 3.15E-05	: 2.72E-05	: 8.70E-06	: 3.54E-05	: 4.10E-05	: 2.92E-03	: 2.67E-05	: 2.66E-05
INFANT	: 1.88E-05	: 1.55E-05	: 6.86E-06	: 2.34E-05	: 2.48E-05	: 2.66E-03	: 1.54E-05	: 1.53E-05



TABLE IV-A- 4

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 4 RES
 AT 4.79 MILES ENE

ANNUAL BETA AIR DOSE = 3.77E-03 MILLRADS
 ANNUAL GAMMA AIR DOSE = 1.15E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 6.68E-04	: 6.68E-04	: 6.68E-04	: 6.68E-04	: 6.68E-04	: 6.68E-04	: 7.06E-04	: 2.16E-03
GROUND	: 1.87E-07	: 1.87E-07	: 1.87E-07	: 1.87E-07	: 1.87E-07	: 1.87E-07	: 1.87E-07	: 2.26E-07
INHAL	:	:	:	:	:	:	:	:
ADULT	: 2.55E-06	: 2.38E-06	: 3.33E-07	: 2.76E-06	: 3.10E-06	: 1.57E-04	: 2.29E-06	: 2.28E-06
TEEN	: 2.65E-06	: 2.40E-06	: 4.68E-07	: 2.96E-06	: 3.43E-06	: 1.92E-04	: 2.31E-06	: 2.30E-06
CHILD	: 2.39E-06	: 2.08E-06	: 6.36E-07	: 2.68E-06	: 3.09E-06	: 2.14E-04	: 2.04E-06	: 2.03E-06
INFANT	: 1.43E-06	: 1.19E-06	: 5.02E-07	: 1.76E-06	: 1.86E-06	: 1.95E-04	: 1.18E-06	: 1.17E-06

TABLE IV-A- 5

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 5 RES
 AT 4.67 MILES E

ANNUAL_BETA_AIR_DOSE = 5.68E-03 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.73E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.01E-03	: 1.01E-03	: 1.01E-03	: 1.01E-03	: 1.01E-03	: 1.01E-03	: 1.06E-03	: 3.25E-03
GROUND	: 2.33E-07	: 2.33E-07	: 2.33E-07	: 2.33E-07	: 2.33E-07	: 2.33E-07	: 2.33E-07	: 2.82E-07
INHAL	:	:	:	:	:	:	:	:
ADULT	: 3.85E-06	: 3.59E-06	: 5.01E-07	: 4.16E-06	: 4.68E-06	: 2.36E-04	: 3.46E-06	: 3.45E-06
TEEN	: 4.00E-06	: 3.63E-06	: 7.05E-07	: 4.46E-06	: 5.17E-06	: 2.89E-04	: 3.49E-06	: 3.48E-06
CHILD	: 3.61E-06	: 3.14E-06	: 9.57E-07	: 4.04E-06	: 4.66E-06	: 3.22E-04	: 3.08E-06	: 3.07E-06
INFANT	: 2.15E-06	: 1.79E-06	: 7.55E-07	: 2.66E-06	: 2.81E-06	: 2.93E-04	: 1.78E-06	: 1.77E-06



TABLE IV-A- 6

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 6 RES
 AT 4.22 MILES ESE

ANNUAL BETA AIR DOSE = 9.14E-03 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.77E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.61E-03	: 1.61E-03	: 1.61E-03	: 1.61E-03	: 1.61E-03	: 1.61E-03	: 1.71E-03	: 5.23E-03
GROUND	: 4.48E-07	: 4.48E-07	: 4.48E-07	: 4.48E-07	: 4.48E-07	: 4.48E-07	: 4.48E-07	: 5.42E-07
INHAL	:	:	:	:	:	:	:	:
ADULT	: 6.24E-06	: 5.82E-06	: 8.16E-07	: 6.76E-06	: 7.59E-06	: 3.84E-04	: 5.61E-06	: 5.59E-06
TEEN	: 6.48E-06	: 5.88E-06	: 1.15E-06	: 7.24E-06	: 8.39E-06	: 4.71E-04	: 5.67E-06	: 5.64E-06
CHILD	: 5.86E-06	: 5.09E-06	: 1.56E-06	: 6.55E-06	: 7.56E-06	: 5.24E-04	: 5.00E-06	: 4.98E-06
INFANT	: 3.50E-06	: 2.91E-06	: 1.23E-06	: 4.32E-06	: 4.56E-06	: 4.77E-04	: 2.88E-06	: 2.86E-06

TABLE IV-A- 7

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 7 RES
 AT 1.67 MILES SE

ANNUAL_BETA_AIR_DOSE = 7.37E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.26E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.32E-02	: 1.32E-02	: 1.32E-02	: 1.32E-02	: 1.32E-02	: 1.32E-02	: 1.39E-02	: 4.24E-02
GROUND	: 8.05E-06	: 8.05E-06	: 8.05E-06	: 8.05E-06	: 8.05E-06	: 8.05E-06	: 8.05E-06	: 9.76E-06
INHAL	:	:	:	:	:	:	:	:
ADULT	: 4.91E-05	: 4.57E-05	: 6.69E-06	: 5.34E-05	: 6.03E-05	: 3.13E-03	: 4.39E-05	: 4.38E-05
TEEN	: 5.11E-05	: 4.62E-05	: 9.40E-06	: 5.74E-05	: 6.68E-05	: 3.85E-03	: 4.44E-05	: 4.42E-05
CHILD	: 4.62E-05	: 4.00E-05	: 1.28E-05	: 5.19E-05	: 6.02E-05	: 4.28E-03	: 3.92E-05	: 3.90E-05
INFANT	: 2.76E-05	: 2.28E-05	: 1.01E-05	: 3.44E-05	: 3.64E-05	: 3.90E-03	: 2.26E-05	: 2.24E-05



TABLE IV-A- 8

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS

SPECIAL LOCATION NO. 8 RES
AT 0.94 MILES SSE

ANNUAL_BETA_AIR_DOSE = 2.61E-01 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 8.07E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.97E-02	: 1.51E-01
GROUND	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 4.63E-05
INHAL	:	:	:	:	:	:	:	:
ADULT	: 1.73E-04	: 1.61E-04	: 2.40E-05	: 1.88E-04	: 2.13E-04	: 1.12E-02	: 1.54E-04	: 1.54E-04
TEEN	: 1.80E-04	: 1.63E-04	: 3.38E-05	: 2.03E-04	: 2.36E-04	: 1.38E-02	: 1.56E-04	: 1.55E-04
CHILD	: 1.63E-04	: 1.40E-04	: 4.59E-05	: 1.83E-04	: 2.13E-04	: 1.53E-02	: 1.38E-04	: 1.37E-04
INFANT	: 9.73E-05	: 8.01E-05	: 3.62E-05	: 1.22E-04	: 1.29E-04	: 1.40E-02	: 7.93E-05	: 7.88E-05

TABLE IV-A- 9

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 9 RES
 AT 0.74 MILES S

ANNUAL_BETA_AIR_DOSE = 3.24E-01 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.00E-01 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 5.85E-02	: 5.85E-02	: 5.85E-02	: 5.85E-02	: 5.85E-02	: 5.85E-02	: 6.18E-02	: 1.88E-01
GROUND	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 4.63E-05
INHAL	:	:	:	:	:	:	:	:
ADULT	: 2.15E-04	: 2.00E-04	: 3.01E-05	: 2.34E-04	: 2.65E-04	: 1.40E-02	: 1.92E-04	: 1.91E-04
TEEN	: 2.24E-04	: 2.02E-04	: 4.23E-05	: 2.52E-04	: 2.94E-04	: 1.73E-02	: 1.94E-04	: 1.93E-04
CHILD	: 2.02E-04	: 1.75E-04	: 5.74E-05	: 2.28E-04	: 2.66E-04	: 1.92E-02	: 1.71E-04	: 1.70E-04
INFANT	: 1.21E-04	: 9.96E-05	: 4.53E-05	: 1.52E-04	: 1.61E-04	: 1.75E-02	: 9.85E-05	: 9.79E-05



TABLE IV-A-10

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 10 RES
 AT 0.60 MILES SSW

ANNUAL BETA AIR DOSE = 3.64E-01 MILLIRADS
 ANNUAL GAMMA AIR DOSE = 1.13E-01 MILLIRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.93E-02	2.10E-01
GROUND	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	3.47E-05
INHAL								
ADULT	2.41E-04	2.24E-04	3.38E-05	2.63E-04	2.98E-04	1.58E-02	2.15E-04	2.14E-04
TEEN	2.51E-04	2.27E-04	4.76E-05	2.83E-04	3.31E-04	1.94E-02	2.17E-04	2.16E-04
CHILD	2.27E-04	1.96E-04	6.46E-05	2.56E-04	2.98E-04	2.16E-02	1.92E-04	1.91E-04
INFANT	1.36E-04	1.12E-04	5.10E-05	1.70E-04	1.80E-04	1.97E-02	1.11E-04	1.10E-04

TABLE IV-A-11

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS

SPECIAL LOCATION NO. 11 RES
AT 0.73 MILES SW

ANNUAL_BETA_AIR_DOSE = 2.22E-01 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 6.85E-02 MILLRADS

PATHWAY	T BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.22E-02	1.28E-01
GROUND	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.74E-05
INHAL	:	:	:	:	:	:	:	:
ADULT	1.47E-04	1.36E-04	2.05E-05	1.60E-04	1.81E-04	9.57E-03	1.31E-04	1.30E-04
TEEN	1.53E-04	1.38E-04	2.88E-05	1.72E-04	2.01E-04	1.18E-02	1.32E-04	1.32E-04
CHILD	1.38E-04	1.19E-04	3.91E-05	1.56E-04	1.81E-04	1.31E-02	1.17E-04	1.16E-04
INFANT	8.27E-05	6.80E-05	3.08E-05	1.03E-04	1.10E-04	1.19E-02	6.73E-05	6.68E-05



TABLE IV-A-12

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 12 RES
 AT 1.06 MILES WSW

ANNUAL BETA AIR DOSE = 8.71E-02 MILLRADS
 ANNUAL GAMMA AIR DOSE = 2.69E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.57E-02	1.57E-02	1.57E-02	1.57E-02	1.57E-02	1.57E-02	1.66E-02	5.03E-02
GROUND	6.05E-06	6.05E-06	6.05E-06	6.05E-06	6.05E-06	6.05E-06	6.05E-06	7.33E-06
INHAL								
ADULT	5.76E-05	5.36E-05	7.92E-06	6.26E-05	7.08E-05	3.70E-03	5.14E-05	5.12E-05
TEEN	5.99E-05	5.42E-05	1.11E-05	6.74E-05	7.85E-05	4.55E-03	5.20E-05	5.17E-05
CHILD	5.42E-05	4.68E-05	1.51E-05	6.10E-05	7.08E-05	5.06E-03	4.59E-05	4.56E-05
INFANT	3.24E-05	2.67E-05	1.19E-05	4.04E-05	4.28E-05	4.61E-03	2.64E-05	2.63E-05

TABLE IV-A-13

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 13 RES
 AT 1.20 MILES W

ANNUAL BETA AIR DOSE = 7.05E-02 MILLRADS
 ANNUAL GAMMA AIR DOSE = 2.16E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.33E-02	: 4.06E-02
GROUND	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 5.55E-06
INHAL	:	:	:	:	:	:	:	:
ADULT	: 4.71E-05	: 4.38E-05	: 6.45E-06	: 5.12E-05	: 5.78E-05	: 3.02E-03	: 4.21E-05	: 4.19E-05
TEEN	: 4.90E-05	: 4.43E-05	: 9.07E-06	: 5.50E-05	: 6.41E-05	: 3.71E-03	: 4.25E-05	: 4.23E-05
CHILD	: 4.43E-05	: 3.83E-05	: 1.23E-05	: 4.98E-05	: 5.78E-05	: 4.13E-03	: 3.75E-05	: 3.73E-05
INFANT	: 2.65E-05	: 2.18E-05	: 9.72E-06	: 3.30E-05	: 3.49E-05	: 3.76E-03	: 2.16E-05	: 2.15E-05



TABLE IV-A-14

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 14 RES
 AT 2.26 MILES WNW

ANNUAL BETA AIR DOSE = 3.68E-02 MILLRADS
 ANNUAL GAMMA AIR DOSE = 1.13E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.59E-03	6.59E-03	6.59E-03	6.59E-03	6.59E-03	6.59E-03	6.96E-03	2.12E-02
GROUND	1.90E-06	1.90E-06	1.90E-06	1.90E-06	1.90E-06	1.90E-06	1.90E-06	2.30E-06
INHAL								
ADULT	2.45E-05	2.29E-05	3.32E-06	2.67E-05	3.01E-05	1.55E-03	2.20E-05	2.19E-05
TEEN	2.55E-05	2.31E-05	4.67E-06	2.86E-05	3.33E-05	1.91E-03	2.22E-05	2.21E-05
CHILD	2.31E-05	2.00E-05	6.34E-06	2.59E-05	3.00E-05	2.12E-03	1.96E-05	1.95E-05
INFANT	1.38E-05	1.14E-05	5.00E-06	1.71E-05	1.81E-05	1.94E-03	1.13E-05	1.12E-05

TABLE IV-A-15

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 15 RES
 AT 2.40 MILES NW

ANNUAL_BETA_AIR_DOSE = 3.45E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.06E-02 MILLRADS

PATHWAY	T BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 6.16E-03	: 6.16E-03	: 6.16E-03	: 6.16E-03	: 6.16E-03	: 6.16E-03	: 6.51E-03	: 1.98E-02
GROUND	: 2.37E-06	: 2.37E-06	: 2.37E-06	: 2.37E-06	: 2.37E-06	: 2.37E-06	: 2.37E-06	: 2.87E-06
INHAL	:	:	:	:	:	:	:	:
ADULT	: 2.30E-05	: 2.14E-05	: 3.12E-06	: 2.50E-05	: 2.82E-05	: 1.46E-03	: 2.06E-05	: 2.05E-05
TEEN	: 2.39E-05	: 2.16E-05	: 4.38E-06	: 2.68E-05	: 3.12E-05	: 1.79E-03	: 2.08E-05	: 2.07E-05
CHILD	: 2.16E-05	: 1.87E-05	: 5.95E-06	: 2.43E-05	: 2.81E-05	: 1.99E-03	: 1.83E-05	: 1.83E-05
INFANT	: 1.29E-05	: 1.07E-05	: 4.69E-06	: 1.61E-05	: 1.70E-05	: 1.82E-03	: 1.06E-05	: 1.05E-05



TABLE IV-A-16

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 16 RES
 AT 2.08 MILES NNW

ANNUAL_BETA_AIR_DOSE = 4.12E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.26E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 7.34E-03	: 7.34E-03	: 7.34E-03	: 7.34E-03	: 7.34E-03	: 7.34E-03	: 7.75E-03	: 2.37E-02
GROUND	: 4.55E-06	: 4.55E-06	: 4.55E-06	: 4.55E-06	: 4.55E-06	: 4.55E-06	: 4.55E-06	: 5.52E-06
INHAL	:	:	:	:	:	:	:	:
ADULT	: 2.77E-05	: 2.58E-05	: 3.73E-06	: 3.00E-05	: 3.39E-05	: 1.75E-03	: 2.48E-05	: 2.47E-05
TEEN	: 2.88E-05	: 2.60E-05	: 5.24E-06	: 3.23E-05	: 3.75E-05	: 2.15E-03	: 2.50E-05	: 2.49E-05
CHILD	: 2.60E-05	: 2.25E-05	: 7.11E-06	: 2.92E-05	: 3.38E-05	: 2.39E-03	: 2.21E-05	: 2.20E-05
INFANT	: 1.55E-05	: 1.29E-05	: 5.61E-06	: 1.93E-05	: 2.04E-05	: 2.17E-03	: 1.27E-05	: 1.27E-05

TABLE IV-A-18

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 18 VEG
 AT 4.67 MILES E

ANNUAL_BETA_AIR_DOSE = 5.68E-03 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.73E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.06E-03	3.25E-03
GROUND	2.33E-07	2.33E-07	2.33E-07	2.33E-07	2.33E-07	2.33E-07	2.33E-07	2.82E-07
VEGET								
ADULT	8.66E-06	7.39E-06	2.94E-06	1.05E-05	1.35E-05	1.38E-03	6.24E-06	6.24E-06
TEEN	1.03E-05	8.35E-06	4.24E-06	1.31E-05	1.74E-05	1.74E-03	7.14E-06	7.14E-06
CHILD	1.67E-05	1.20E-05	9.75E-06	2.09E-05	2.72E-05	3.25E-03	1.11E-05	1.11E-05

TABLE IV-A-19

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 19 VEG
 AT 1.74 MILES SE

ANNUAL_BETA_AIR_DOSE = 6.89E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.11E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.23E-02	: 1.23E-02	: 1.23E-02	: 1.23E-02	: 1.23E-02	: 1.23E-02	: 1.30E-02	: 3.97E-02
GROUND	: 7.42E-06	: 7.42E-06	: 7.42E-06	: 7.42E-06	: 7.42E-06	: 7.42E-06	: 7.42E-06	: 8.99E-06
VEGET	:	:	:	:	:	:	:	:
ADULT	: 1.51E-04	: 1.11E-04	: 9.33E-05	: 2.08E-04	: 3.03E-04	: 4.38E-02	: 7.42E-05	: 7.42E-05
TEEN	: 1.86E-04	: 1.23E-04	: 1.35E-04	: 2.74E-04	: 4.10E-04	: 5.51E-02	: 8.49E-05	: 8.49E-05
CHILD	: 3.09E-04	: 1.60E-04	: 3.10E-04	: 4.43E-04	: 6.43E-04	: 1.03E-01	: 1.32E-04	: 1.32E-04



TABLE IV-A-20

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 20 VEG
 AT 0.94 MILES SSE

ANNUAL_BETA_AIR_DOSE = 2.61E-01 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 8.07E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.71E-02	: 4.97E-02	: 1.51E-01
GROUND	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 3.82E-05	: 4.63E-05
VEGET	:	:	:	:	:	:	:	:
ADULT	: 6.72E-04	: 4.65E-04	: 4.80E-04	: 9.65E-04	: 1.46E-03	: 2.25E-01	: 2.78E-04	: 2.78E-04
TEEN	: 8.40E-04	: 5.15E-04	: 6.93E-04	: 1.29E-03	: 1.99E-03	: 2.83E-01	: 3.18E-04	: 3.18E-04
CHILD	: 1.41E-03	: 6.40E-04	: 1.59E-03	: 2.10E-03	: 3.12E-03	: 5.30E-01	: 4.95E-04	: 4.95E-04

TABLE IV-A-22

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 22 VEG
 AT 0.60 MILES SSW

ANNUAL_BETA_AIR_DOSE = 3.64E-01 MILLIRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.13E-01 MILLIRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.93E-02	2.10E-01
GROUND	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	3.47E-05
VEGET	:	:	:	:	:	:	:	:
ADULT	6.83E-04	5.28E-04	3.60E-04	9.03E-04	1.27E-03	1.69E-01	3.88E-04	3.88E-04
TEEN	8.35E-04	5.92E-04	5.20E-04	1.17E-03	1.70E-03	2.13E-01	4.44E-04	4.44E-04
CHILD	1.37E-03	7.99E-04	1.19E-03	1.89E-03	2.66E-03	3.98E-01	6.89E-04	6.89E-04

TABLE IV-A-24

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 24 VEG
 AT 1.21 MILES WSW

ANNUAL BETA AIR DOSE = 5.74E-02 MILLRADS
 ANNUAL GAMMA AIR DOSE = 1.77E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.03E-02	1.03E-02	1.03E-02	1.03E-02	1.03E-02	1.03E-02	1.09E-02	3.31E-02
GROUND	4.12E-06	4.12E-06	4.12E-06	4.12E-06	4.12E-06	4.12E-06	4.12E-06	4.99E-06
VEGET	:	:	:	:	:	:	:	:
ADULT	1.04E-04	8.17E-05	5.18E-05	1.36E-04	1.89E-04	2.43E-02	6.16E-05	6.16E-05
TEEN	1.27E-04	9.17E-05	7.47E-05	1.75E-04	2.51E-04	3.06E-02	7.04E-05	7.04E-05
CHILD	2.08E-04	1.25E-04	1.72E-04	2.82E-04	3.93E-04	5.72E-02	1.09E-04	1.09E-04

TABLE IV-A-25

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 25 VEG
 AT 1.20 MILES W

ANNUAL_BETA_AIR_DOSE = 7.05E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.16E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.26E-02	: 1.33E-02	: 4.06E-02
GROUND	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 4.58E-06	: 5.55E-06
VEGET	:	:	:	:	:	:	:	:
ADULT	: 1.23E-04	: 9.83E-05	: 5.76E-05	: 1.58E-04	: 2.17E-04	: 2.71E-02	: 7.59E-05	: 7.59E-05
TEEN	: 1.49E-04	: 1.10E-04	: 8.32E-05	: 2.03E-04	: 2.87E-04	: 3.41E-02	: 8.68E-05	: 8.68E-05
CHILD	: 2.44E-04	: 1.52E-04	: 1.91E-04	: 3.27E-04	: 4.50E-04	: 6.37E-02	: 1.35E-04	: 1.35E-04



TABLE IV-A-26

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 26 VEG
 AT 2.97 MILES WNW

ANNUAL_BETA_AIR_DOSE = 1.78E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 5.45E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 3.17E-03	: 3.17E-03	: 3.17E-03	: 3.17E-03	: 3.17E-03	: 3.17E-03	: 3.35E-03	: 1.02E-02
GROUND	: 8.46E-07	: 8.46E-07	: 8.46E-07	: 8.46E-07	: 8.46E-07	: 8.46E-07	: 8.46E-07	: 1.02E-06
VEGET	:	:	:	:	:	:	:	:
ADULT	: 2.82E-05	: 2.35E-05	: 1.07E-05	: 3.47E-05	: 4.55E-05	: 5.01E-03	: 1.94E-05	: 1.94E-05
TEEN	: 3.38E-05	: 2.66E-05	: 1.54E-05	: 4.38E-05	: 5.93E-05	: 6.31E-03	: 2.22E-05	: 2.22E-05
CHILD	: 5.47E-05	: 3.77E-05	: 3.54E-05	: 7.01E-05	: 9.29E-05	: 1.18E-02	: 3.45E-05	: 3.45E-05

TABLE IV-A-27

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 27 VEG
 AT 2.40 MILES NW

ANNUAL_BETA_AIR_DOSE = 3.45E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.06E-02 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.16E-03	6.16E-03	6.16E-03	6.16E-03	6.16E-03	6.16E-03	6.51E-03	1.98E-02
GROUND	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.87E-06
VEGET	:	:	:	:	:	:	:	:
ADULT	6.16E-05	4.87E-05	2.98E-05	7.98E-05	1.10E-04	1.40E-02	3.71E-05	3.71E-05
TEEN	7.48E-05	5.47E-05	4.30E-05	1.03E-04	1.46E-04	1.76E-02	4.25E-05	4.25E-05
CHILD	1.23E-04	7.50E-05	9.88E-05	1.65E-04	2.29E-04	3.29E-02	6.59E-05	6.59E-05



TABLE IV-A-28

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 28 VEG
 AT 4.01 MILES NNW

ANNUAL BETA AIR DOSE = 9.93E-03 MILLRADS
 ANNUAL GAMMA AIR DOSE = 3.02E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.76E-03	1.76E-03	1.76E-03	1.76E-03	1.76E-03	1.76E-03	1.85E-03	5.69E-03
GROUND	8.97E-07	8.97E-07	8.97E-07	8.97E-07	8.97E-07	8.97E-07	8.97E-07	1.09E-06
VEGET								
ADULT	2.03E-05	1.54E-05	1.13E-05	2.72E-05	3.88E-05	5.32E-03	1.10E-05	1.10E-05
TEEN	2.49E-05	1.72E-05	1.64E-05	3.55E-05	5.20E-05	6.70E-03	1.25E-05	1.25E-05
CHILD	4.10E-05	2.29E-05	3.76E-05	5.73E-05	8.16E-05	1.25E-02	1.95E-05	1.95E-05

TABLE IV-A-29

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 29 BEEF
 AT 4.72 MILES NNE

ANNUAL_BETA_AIR_DOSE = 6.86E-03 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.09E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.22E-03	: 1.22E-03	: 1.22E-03	: 1.22E-03	: 1.22E-03	: 1.22E-03	: 1.29E-03	: 3.94E-03
GROUND	: 5.14E-07	: 5.14E-07	: 5.14E-07	: 5.14E-07	: 5.14E-07	: 5.14E-07	: 5.14E-07	: 6.23E-07
MEAT	:	:	:	:	:	:	:	:
ADULT	: 1.32E-06	: 1.21E-06	: 2.92E-07	: 1.50E-06	: 1.80E-06	: 1.38E-04	: 1.08E-06	: 1.08E-06
TEEN	: 8.28E-07	: 7.22E-07	: 2.43E-07	: 9.84E-07	: 1.23E-06	: 9.98E-05	: 6.43E-07	: 6.43E-07
CHILD	: 1.04E-06	: 8.25E-07	: 4.50E-07	: 1.23E-06	: 1.52E-06	: 1.50E-04	: 7.79E-07	: 7.79E-07



TABLE IV-A-30

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 30 BEEF
 AT 4.91 MILES E

ANNUAL BETA AIR DOSE = 5.28E-03 MILLRADS
 ANNUAL GAMMA AIR DOSE = 1.60E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 9.35E-04	: 9.35E-04	: 9.35E-04	: 9.35E-04	: 9.35E-04	: 9.35E-04	: 9.87E-04	: 3.03E-03
GROUND	: 2.17E-07	: 2.17E-07	: 2.17E-07	: 2.17E-07	: 2.17E-07	: 2.17E-07	: 2.17E-07	: 2.63E-07
MEAT	:	:	:	:	:	:	:	:
ADULT	: 9.39E-07	: 8.93E-07	: 1.23E-07	: 1.01E-06	: 1.14E-06	: 5.86E-05	: 8.37E-07	: 8.37E-07
TEEN	: 5.76E-07	: 5.32E-07	: 1.02E-07	: 6.42E-07	: 7.46E-07	: 4.24E-05	: 4.99E-07	: 4.99E-07
CHILD	: 7.14E-07	: 6.23E-07	: 1.90E-07	: 7.96E-07	: 9.18E-07	: 6.38E-05	: 6.04E-07	: 6.04E-07

TABLE IV-A-31

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 31 BEEF
 AT 4.59 MILES SE

ANNUAL_BETA_AIR_DOSE = 8.35E-03 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 2.53E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.47E-03	: 1.56E-03	: 4.78E-03
GROUND	: 6.47E-07	: 6.47E-07	: 6.47E-07	: 6.47E-07	: 6.47E-07	: 6.47E-07	: 6.47E-07	: 7.83E-07
MEAT	:	:	:	:	:	:	:	:
ADULT	: 1.64E-06	: 1.50E-06	: 3.68E-07	: 1.86E-06	: 2.24E-06	: 1.74E-04	: 1.33E-06	: 1.33E-06
TEEN	: 1.03E-06	: 8.94E-07	: 3.06E-07	: 1.22E-06	: 1.53E-06	: 1.26E-04	: 7.95E-07	: 7.95E-07
CHILD	: 1.29E-06	: 1.02E-06	: 5.67E-07	: 1.53E-06	: 1.90E-06	: 1.89E-04	: 9.63E-07	: 9.63E-07



TABLE IV-A-32

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 32 BEEF
 AT 1.82 MILES SSE

ANNUAL_BETA_AIR_DOSE = 5.50E-02 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.69E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 9.87E-03	: 9.87E-03	: 9.87E-03	: 9.87E-03	: 9.87E-03	: 9.87E-03	: 1.04E-02	: 3.17E-02
GROUND	: 7.60E-06	: 7.60E-06	: 7.60E-06	: 7.60E-06	: 7.60E-06	: 7.60E-06	: 7.60E-06	: 9.21E-06
MEAT	:	:	:	:	:	:	:	:
ADULT	: 1.21E-05	: 1.04E-05	: 4.30E-06	: 1.47E-05	: 1.90E-05	: 2.02E-03	: 8.49E-06	: 8.49E-06
TEEN	: 7.77E-06	: 6.22E-06	: 3.57E-06	: 1.01E-05	: 1.37E-05	: 1.47E-03	: 5.06E-06	: 5.06E-06
CHILD	: 9.96E-06	: 6.81E-06	: 6.63E-06	: 1.28E-05	: 1.71E-05	: 2.21E-03	: 6.13E-06	: 6.13E-06

TABLE IV-A-33

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 33 BEEF
 AT 2.60 MILES S

ANNUAL BETA AIR DOSE = 1.42E-02 MILLRADS
 ANNUAL GAMMA AIR DOSE = 4.40E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 2.57E-03	: 2.57E-03	: 2.57E-03	: 2.57E-03	: 2.57E-03	: 2.57E-03	: 2.71E-03	: 8.24E-03
GROUND	: 1.45E-06	: 1.45E-06	: 1.45E-06	: 1.45E-06	: 1.45E-06	: 1.45E-06	: 1.45E-06	: 1.76E-06
MEAT	:	:	:	:	:	:	:	:
ADULT	: 2.86E-06	: 2.55E-06	: 8.19E-07	: 3.36E-06	: 4.19E-06	: 3.86E-04	: 2.18E-06	: 2.18E-06
TEEN	: 1.82E-06	: 1.52E-06	: 6.80E-07	: 2.26E-06	: 2.94E-06	: 2.79E-04	: 1.30E-06	: 1.30E-06
CHILD	: 2.31E-06	: 1.70E-06	: 1.26E-06	: 2.85E-06	: 3.66E-06	: 4.21E-04	: 1.58E-06	: 1.58E-06



TABLE IV-A-34

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 34 BEEF
 AT 0.60 MILES SSW

ANNUAL BETA AIR DOSE = 3.64E-01 MILLIRADS
 ANNUAL GAMMA AIR DOSE = 1.13E-01 MILLIRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.57E-02	6.93E-02	2.10E-01
GROUND	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	2.87E-05	3.47E-05
MEAT								
ADULT	6.92E-05	6.31E-05	1.62E-05	7.90E-05	9.55E-05	7.65E-03	5.58E-05	5.58E-05
TEEN	4.35E-05	3.76E-05	1.35E-05	5.21E-05	6.57E-05	5.53E-03	3.32E-05	3.32E-05
CHILD	5.47E-05	4.28E-05	2.50E-05	6.54E-05	8.15E-05	8.34E-03	4.03E-05	4.03E-05

TABLE IV-A-35

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 35 BEEF
 AT 0.73 MILES SW

ANNUAL_BETA_AIR_DOSE = 2.22E-01 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 6.85E-02 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.22E-02	1.28E-01
GROUND	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.43E-05	1.74E-05
MEAT	:	:	:	:	:	:	:	:
ADULT	4.07E-05	3.76E-05	8.10E-06	4.56E-05	5.38E-05	3.83E-03	3.40E-05	3.40E-05
TEEN	2.53E-05	2.24E-05	6.73E-06	2.97E-05	3.64E-05	2.77E-03	2.02E-05	2.02E-05
CHILD	3.17E-05	2.58E-05	1.25E-05	3.71E-05	4.51E-05	4.17E-03	2.45E-05	2.45E-05



TABLE IV-A-36

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 36 BEEF
 AT 2.42 MILES WSW

ANNUAL BETA AIR DOSE = 1.07E-02 MILLRADS
 ANNUAL GAMMA AIR DOSE = 3.26E-03 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.90E-03	: 1.90E-03	: 1.90E-03	: 1.90E-03	: 1.90E-03	: 1.90E-03	: 2.00E-03	: 6.15E-03
GROUND	: 6.67E-07	: 6.67E-07	: 6.67E-07	: 6.67E-07	: 6.67E-07	: 6.67E-07	: 6.67E-07	: 8.08E-07
MEAT	:	:	:	:	:	:	:	:
ADULT	: 2.01E-06	: 1.87E-06	: 3.79E-07	: 2.24E-06	: 2.63E-06	: 1.79E-04	: 1.70E-06	: 1.70E-06
TEEN	: 1.25E-06	: 1.11E-06	: 3.15E-07	: 1.45E-06	: 1.77E-06	: 1.30E-04	: 1.01E-06	: 1.01E-06
CHILD	: 1.56E-06	: 1.29E-06	: 5.84E-07	: 1.81E-06	: 2.19E-06	: 1.95E-04	: 1.23E-06	: 1.23E-06

TABLE IV-A-37

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 37 BEEF
 AT 3.25 MILES W

ANNUAL_BETA_AIR_DOSE = 6.50E-03 MILLIRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.98E-03 MILLIRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.16E-03	: 1.16E-03	: 1.16E-03	: 1.16E-03	: 1.16E-03	: 1.16E-03	: 1.22E-03	: 3.73E-03
GROUND	: 3.44E-07	: 3.44E-07	: 3.44E-07	: 3.44E-07	: 3.44E-07	: 3.44E-07	: 3.44E-07	: 4.17E-07
MEAT	:	:	:	:	:	:	:	:
ADULT	: 1.18E-06	: 1.11E-06	: 1.95E-07	: 1.30E-06	: 1.50E-06	: 9.25E-05	: 1.02E-06	: 1.02E-06
TEEN	: 7.30E-07	: 6.60E-07	: 1.62E-07	: 8.35E-07	: 9.98E-07	: 6.69E-05	: 6.07E-07	: 6.07E-07
CHILD	: 9.09E-07	: 7.66E-07	: 3.01E-07	: 1.04E-06	: 1.23E-06	: 1.01E-04	: 7.35E-07	: 7.35E-07



TABLE IV-A-38

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 38 BEEF
 AT 2.74 MILES WNW

ANNUAL BETA AIR DOSE = 2.18E-02 MILLIRADS
 ANNUAL GAMMA AIR DOSE = 6.66E-03 MILLIRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.88E-03	3.88E-03	3.88E-03	3.88E-03	3.88E-03	3.88E-03	4.10E-03	1.25E-02
GROUND	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.29E-06
MEAT								
ADULT	3.90E-06	3.67E-06	6.06E-07	4.26E-06	4.88E-06	2.87E-04	3.40E-06	3.40E-06
TEEN	2.41E-06	2.19E-06	5.03E-07	2.73E-06	3.24E-06	2.08E-04	2.02E-06	2.02E-06
CHILD	2.99E-06	2.55E-06	9.33E-07	3.39E-06	3.99E-06	3.13E-04	2.45E-06	2.45E-06

TABLE IV-A-39

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 SPECIAL LOCATION NO. 39 GOAT
 AT 0.60 MILES SSW

ANNUAL_BETA_AIR_DOSE = 3.64E-01 MILLRADS
 ANNUAL_GAMMA_AIR_DOSE = 1.13E-01 MILLRADS

PATHWAY	T. BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 6.57E-02	: 6.57E-02	: 6.57E-02	: 6.57E-02	: 6.57E-02	: 6.57E-02	: 6.93E-02	: 2.10E-01
GROUND	: 2.87E-05	: 2.87E-05	: 2.87E-05	: 2.87E-05	: 2.87E-05	: 2.87E-05	: 2.87E-05	: 3.47E-05
GOATMILK	:	:	:	:	:	:	:	:
ADULT	: 7.07E-04	: 4.71E-04	: 5.37E-04	: 1.04E-03	: 1.58E-03	: 2.52E-01	: 2.67E-04	: 2.67E-04
TEEN	: 1.08E-03	: 6.19E-04	: 9.74E-04	: 1.71E-03	: 2.70E-03	: 3.98E-01	: 3.48E-04	: 3.48E-04
CHILD	: 1.90E-03	: 7.64E-04	: 2.36E-03	: 2.93E-03	: 4.46E-03	: 7.86E-01	: 5.51E-04	: 5.51E-04
INFANT	: 3.39E-03	: 1.05E-03	: 4.93E-03	: 6.65E-03	: 7.63E-03	: 1.91E+00	: 8.36E-04	: 8.36E-04



TABLE IV-B-1

FORT CALHOUN 1
DOSE CONTRIBUTIONS FROM GASEOUS EFFLUENTS
UNRESTRICTED AREA BOUNDARY
REQUIRED BY TECHNICAL SPECIFICATION 5.9.4.a.

ANNUAL FOR JANUARY 1, 2002 TO DECEMBER 31, 2002

MAXIMUM SITE BOUNDARY GAMMA AIR DOSE -	2.20E-01	MILLRADS
MAXIMUM SITE BOUNDARY BETA AIR DOSE -	7.12E-01	MILLRADS

TABLE IV-C-1

FORT CALHOUN ANNUAL 2002, DOSE PROJECTIONS
 ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.08E-01 : 98.60%	1.08E-01 : 98.77%	1.08E-01 : 99.59%	1.08E-01 : 98.40%	1.08E-01 : 98.09%	1.08E-01 : 39.72%	1.16E-01 : 98.94%	4.33E-01 : 99.71%
GROUND	3.41E-05 : 0.03%	3.41E-05 : 0.03%	3.41E-05 : 0.03%	3.41E-05 : 0.03%	3.41E-05 : 0.03%	3.41E-05 : 0.01%	3.41E-05 : 0.03%	4.13E-05 : 0.01%
INHAL	5.97E-04 : 0.55%	5.51E-04 : 0.51%	8.87E-05 : 0.08%	6.48E-04 : 0.59%	7.29E-04 : 0.66%	3.78E-02 : 13.95%	5.34E-04 : 0.45%	5.33E-04 : 0.12%
VEGET	4.72E-04 : 0.43%	4.71E-04 : 0.43%	5.84E-06 : 0.01%	4.75E-04 : 0.43%	4.80E-04 : 0.44%	2.80E-03 : 1.03%	4.68E-04 : 0.40%	4.68E-04 : 0.11%
COW MILK	3.00E-04 : 0.27%	1.65E-04 : 0.15%	2.89E-04 : 0.27%	4.51E-04 : 0.41%	6.87E-04 : 0.63%	1.12E-01 : 41.43%	1.04E-04 : 0.09%	1.04E-04 : 0.02%
MEAT	1.24E-04 : 0.11%	1.14E-04 : 0.10%	2.42E-05 : 0.02%	1.37E-04 : 0.13%	1.60E-04 : 0.15%	1.04E-02 : 3.85%	1.06E-04 : 0.09%	1.06E-04 : 0.02%
TOTAL	1.09E-01	1.09E-01	1.08E-01	1.09E-01	1.10E-01	2.71E-01	1.17E-01	4.35E-01

SECTION V

DOSE FROM LIQUID EFFLUENTS

LADTAP II OUTPUT

Technical Specification 5.9.4a

January 1, 2002 - December 31, 2002

Radioactive Effluent Releases - First, Second, Third, and Fourth Quarters 2002

LIQUID EFFLUENTS

During the reporting period, a total of 4.20E-01 Curies of radioactive liquid materials less tritium, dissolved noble gases, and alpha was released to the Missouri River at an average concentration of 3.78E-10 $\mu\text{Ci/mL}$. This represents 1.51E-01% of the limits specified in Appendix B to 10 CFR 20 (1.0E-06 $\mu\text{Ci/mL}$ for unrestricted areas), 293 Curies of tritium were discharged at an average diluted concentration of 2.50E-07 $\mu\text{Ci/mL}$ or 1.00E-01% of ECL (1.0E-03 $\mu\text{Ci/mL}$). Gross alpha radioactivity released during the reporting period total 1.06E-02 Curies.

Dilution water during the period amounted to 1.29E+12 liters, while radioactive liquid waste volume was 1.84E+08 liters.

A. Potential Annual Doses to Individuals from Liquid Releases

Total body, skin, and organ mRem for liquid releases were calculated for all significant liquid pathways using the annual configuration of the LADTAP II program.

The inputs to LADTAP II for the annual period from January 1, 2002 through December 31, 2002 were as follows:

- (1) All liquid effluents were as described in Section IV except for entrained noble gases (Ar-41, Xe-131M, Xe-133M, Xe-133, Xe-135M, Xe-135, Kr-85M, Kr-87, and Kr-88)
- (2) An average plant discharge rate of 733.0 cubic feet per second (CFS) was utilized for 2002. The average discharge rate during releases was 678.0 cubic feet per second (CFS).
- (3) Dilution factors (inverse of the mixing ratios) were computed based on Regulatory Guide 1.113 (equation 7 in Section 2.a.1 of Appendix A) for a one dimensional transport model.
- (4) Drinking water transport times of 6.6 hours to the Omaha intake and 7.0 hours to the Council Bluffs intake for the ALARA doses were used. A transport time of 0.0 was used from the plant to the discharge site.
- (5) A shorewidth factor of 0.2 was used.
- (6) All dose factors, transport times from receptor to individual, and usage factors are defined by Regulatory Guide 1.109 and NUREG-0172.

The discharge site was chosen to present the most conservative estimate of mRem dose for an average adult, teenager, child, and infant. A conservative approach is also presented by the assumption that Omaha and Council Bluffs receive all drinking water from the Missouri River.

B. Potential Annual Doses to Population from Liquid Releases

The LADTAP II program in its annual configuration was also used to calculate to total body and organ doses for the population of 853,274 within a 50-mile radius of the plant (based on the 2000 census). The same input was used as in the individual cases with the addition of the following:

- (1) Dilution factors and transport times for the pathways of sport fish, commercial fish, recreation and biota were calculated based on a distance of two miles downstream as approximately the distance to the nearest recreation facility - DeSoto National Wildlife Preserve.
- (2) The total fish harvest for both sport and commercial purposes was calculated using an average commercial fish catch for Nebraska.

PATHWAY	ADULT DOSES							DOSE (MREM PER YEAR INTAKE)								
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		1.58E-02	2.68E-02	1.97E-02	6.79E-03	1.14E-02	2.99E-03	5.26E-02								
DRINKING		1.16E-04	8.12E-04	7.81E-04	4.33E-03	7.90E-04	7.02E-04	1.03E-03								
SHORELINE	7.53E-05	6.51E-05	6.51E-05	6.51E-05	6.51E-05	6.51E-05	6.51E-05	6.51E-05								
SWIMMING		1.46E-06	1.46E-06	1.46E-06	1.46E-06	1.46E-06	1.46E-06	1.46E-06								
BOATING		7.29E-07	7.29E-07	7.29E-07	7.29E-07	7.29E-07	7.29E-07	7.29E-07								
TOTAL	7.53E-05	1.60E-02	2.77E-02	2.06E-02	1.12E-02	1.22E-02	3.76E-03	5.37E-02								

SHOREWIDTH FACTOR=0.2

PATHWAY	USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)
FISH	21.0	7.3	24.00
DRINKING	730.0	30.8	18.60
SHORELINE	12.0	7.3	0.00
SWIMMING	12.0	7.3	0.00
BOATING	12.0	7.3	0.00

PATHWAY	TEENAGER DOSES							DOSE (MREM PER YEAR INTAKE)								
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		1.67E-02	2.75E-02	1.13E-02	6.35E-03	1.17E-02	3.50E-03	3.75E-02								
DRINKING		1.09E-04	6.03E-04	5.39E-04	3.61E-03	5.85E-04	5.03E-04	7.14E-04								
SHORELINE	4.21E-04	3.63E-04	3.63E-04	3.63E-04	3.63E-04	3.63E-04	3.63E-04	3.63E-04								
SWIMMING		8.14E-06	8.14E-06	8.14E-06	8.14E-06	8.14E-06	8.14E-06	8.14E-06								
BOATING		4.07E-06	4.07E-06	4.07E-06	4.07E-06	4.07E-06	4.07E-06	4.07E-06								
TOTAL	4.21E-04	1.71E-02	2.85E-02	1.22E-02	1.03E-02	1.27E-02	4.38E-03	3.86E-02								

SHOREWIDTH FACTOR=0.2

PATHWAY	USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)
FISH	16.0	7.3	24.00
DRINKING	510.0	30.8	18.60
SHORELINE	67.0	7.3	0.00
SWIMMING	67.0	7.3	0.00
BOATING	67.0	7.3	0.00

C H I L D D O S E S

PATHWAY	DOSE (MREM PER YEAR INTAKE)									
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI		
FISH		2.07E-02	2.40E-02	4.49E-03	6.60E-03	1.01E-02	2.76E-03	1.36E-02		
DRINKING		3.09E-04	1.17E-03	1.00E-03	8.41E-03	1.13E-03	9.63E-04	1.13E-03		
SHORELINE	8.79E-05	7.59E-05	7.59E-05	7.59E-05	7.59E-05	7.59E-05	7.59E-05	7.59E-05		
SWIMMING		1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06		
BOATING		8.51E-07	8.51E-07	8.51E-07	8.51E-07	8.51E-07	8.51E-07	8.51E-07		
TOTAL	8.79E-05	2.11E-02	2.53E-02	5.57E-03	1.51E-02	1.13E-02	3.80E-03	1.48E-02		

USAGE (KG/YR,HR/YR) DILUTION TIME(HR) SHOREWIDTH FACTOR=0.2

FISH	6.9	7.3	24.00
DRINKING	510.0	30.8	18.60
SHORELINE	14.0	7.3	0.00
SWIMMING	14.0	7.3	0.00
BOATING	14.0	7.3	0.00

I N F A N T D O S E S

PATHWAY	DOSE (MREM PER YEAR INTAKE)									
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI		
FISH		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		
DRINKING		3.25E-04	1.22E-03	9.76E-04	1.27E-02	1.14E-03	9.53E-04	1.03E-03		
SHORELINE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		
TOTAL	0.00E+00	3.25E-04	1.22E-03	9.76E-04	1.27E-02	1.14E-03	9.53E-04	1.03E-03		

USAGE (KG/YR,HR/YR) DILUTION TIME(HR) SHOREWIDTH FACTOR=0.2

FISH	0.0	7.3	24.00
DRINKING	330.0	30.8	18.60

LOCATION IS SITE DISCHG.

A D U L T D O S E S

PATHWAY	SKIN	DOSE (MREM PER YEAR INTAKE)						GI-LLI
		BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	
FISH		1.15E-01	1.95E-01	1.44E-01	4.96E-02	8.30E-02	2.18E-02	3.84E-01
DRINKING		3.58E-03	2.50E-02	2.41E-02	1.36E-01	2.44E-02	2.16E-02	3.16E-02
SHORELINE	5.50E-04	4.75E-04	4.75E-04	4.75E-04	4.75E-04	4.75E-04	4.75E-04	4.75E-04
SWIMMING		1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05
BOATING		5.32E-06	5.32E-06	5.32E-06	5.32E-06	5.32E-06	5.32E-06	5.32E-06
TOTAL	5.50E-04	1.20E-01	2.21E-01	1.69E-01	1.86E-01	1.08E-01	4.39E-02	4.16E-01

SHOREWIDTH FACTOR=0.2

USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)
FISH	1.0	24.00
DRINKING	1.0	12.00
SHORELINE	1.0	0.00
SWIMMING	1.0	0.00
BOATING	1.0	0.00

T E E N A G E R D O S E S

PATHWAY	SKIN	DOSE (MREM PER YEAR INTAKE)						GI-LLI
		BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	
FISH		1.22E-01	2.01E-01	8.23E-02	4.63E-02	8.56E-02	2.56E-02	2.74E-01
DRINKING		3.37E-03	1.86E-02	1.66E-02	1.13E-01	1.80E-02	1.55E-02	2.20E-02
SHORELINE	3.07E-03	2.65E-03	2.65E-03	2.65E-03	2.65E-03	2.65E-03	2.65E-03	2.65E-03
SWIMMING		5.94E-05	5.94E-05	5.94E-05	5.94E-05	5.94E-05	5.94E-05	5.94E-05
BOATING		2.97E-05	2.97E-05	2.97E-05	2.97E-05	2.97E-05	2.97E-05	2.97E-05
TOTAL	3.07E-03	1.28E-01	2.22E-01	1.02E-01	1.63E-01	1.06E-01	4.38E-02	2.99E-01

SHOREWIDTH FACTOR=0.2

USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)
FISH	1.0	24.00
DRINKING	1.0	12.00
SHORELINE	1.0	0.00
SWIMMING	1.0	0.00
BOATING	1.0	0.00

LOCATION IS SITE DISCHG.

C H I L D D O S E S

PATHWAY	DOSE (MREM PER YEAR INTAKE)							
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		1.51E-01	1.75E-01	3.28E-02	4.81E-02	7.34E-02	2.02E-02	9.93E-02
DRINKING		9.54E-03	3.61E-02	3.09E-02	2.65E-01	3.50E-02	2.97E-02	3.48E-02
SHORELINE	6.41E-04	5.54E-04	5.54E-04	5.54E-04	5.54E-04	5.54E-04	5.54E-04	5.54E-04
SWIMMING		1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05
BOATING		6.21E-06	6.21E-06	6.21E-06	6.21E-06	6.21E-06	6.21E-06	6.21E-06
TOTAL	6.41E-04	1.61E-01	2.12E-01	6.42E-02	3.13E-01	1.09E-01	5.04E-02	1.35E-01

SHOREWIDTH FACTOR=0.2

PATHWAY	USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)
FISH	6.9	1.0	24.00
DRINKING	510.0	1.0	12.00
SHORELINE	14.0	1.0	0.00
SWIMMING	14.0	1.0	0.00
BOATING	14.0	1.0	0.00

I N F A N T D O S E S

PATHWAY	DOSE (MREM PER YEAR INTAKE)							
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
DRINKING		1.00E-02	3.77E-02	3.01E-02	3.99E-01	3.51E-02	2.93E-02	3.18E-02
SHORELINE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	1.00E-02	3.77E-02	3.01E-02	3.99E-01	3.51E-02	2.93E-02	3.18E-02

SHOREWIDTH FACTOR=0.2

PATHWAY	USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)
FISH	0.0	1.0	24.00
DRINKING	330.0	1.0	12.00

* * * FISH CONSUMPTION POPULATION DOSES * * *
PERSON-REM

SPORT HARVEST

PATHWAY	AGE GROUP	USAGE	-----DOSE (PERSON-REM)-----						
			BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	6.10E+04	4.55E-02	7.74E-02	5.71E-02	1.20E-02	3.19E-02	8.65E-03	1.35E-01
FISH	TEENAGER	7.12E+03	7.35E-03	1.22E-02	4.99E-03	1.71E-03	5.04E-03	1.55E-03	1.48E-02
FISH	CHILD	4.93E+03	1.46E-02	1.71E-02	3.17E-03	2.86E-03	6.92E-03	1.97E-03	8.61E-03
FISH	TOTAL	7.30E+04	6.75E-02	1.07E-01	6.52E-02	1.65E-02	4.39E-02	1.22E-02	1.59E-01

LOCATION DILUTION CATCH TIME (HR) - INCLUDES FOOD PROCESSING TIME OF 1.68E+02 HR POPULATION=1.24E+04
7.30E+00 7.30E+04 1.69E+02

AVERAGE INDIVIDUAL CONSUMPTION (KG/YR) ADULT=6.90E+00 TEEN=5.20E+00 CHILD=2.20E+00

COMMERCIAL HARVEST

PATHWAY	AGE GROUP	USAGE	-----DOSE (PERSON-REM)-----						
			BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	4.18E+06	5.16E-03	8.78E-03	6.48E-03	1.07E-03	3.58E-03	9.82E-04	1.45E-02
FISH	TEENAGER	4.88E+05	8.34E-04	1.38E-03	5.66E-04	1.53E-04	5.65E-04	1.77E-04	1.59E-03
FISH	CHILD	3.38E+05	1.66E-03	1.94E-03	3.60E-04	2.56E-04	7.75E-04	2.23E-04	9.24E-04
FISH	TOTAL	5.01E+06	7.66E-03	1.21E-02	7.40E-03	1.47E-03	4.92E-03	1.38E-03	1.70E-02

LOCATION DILUTION CATCH TIME (HR) - INCLUDES FOOD PROCESSING TIME OF 2.40E+02 HR POPULATION=8.53E+05
7.30E+00 7.30E+04 2.41E+02

AVERAGE INDIVIDUAL CONSUMPTION (KG/YR) ADULT=6.90E+00 TEEN=5.20E+00 CHILD=2.20E+00

* * * POPULATION WATER CONSUMPTION DOSES * * *

SUPPLIER-OMAHA

		-----DOSE (PERSON-REM)-----								
PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	
DRINKING	ADULT	1.39E+08	2.20E-02	1.54E-01	1.49E-01	7.95E-01	1.50E-01	1.34E-01	1.95E-01	
DRINKING	TEENAGER	1.51E+07	3.22E-03	1.79E-02	1.60E-02	1.03E-01	1.73E-02	1.49E-02	2.11E-02	
DRINKING	CHILD	2.48E+07	1.49E-02	5.69E-02	4.86E-02	3.93E-01	5.49E-02	4.68E-02	5.46E-02	
DRINKING	TOTAL	1.79E+08	4.01E-02	2.29E-01	2.13E-01	1.29E+00	2.22E-01	1.95E-01	2.70E-01	
POPULATION=5.29E+05		DILUTION=3.08E+01	TRANSIT TIME=3.06E+01 HR (INCLUDING 24 HR FOR TREATMENT FACILITY)							

AVERAGE INDIVIDUAL CONSUMPTION (L/YR) ADULT=3.70E+02 TEEN=2.60E+02 CHILD=2.60E+02

SUPPLIER-COUNCIL BLUFFS

		-----DOSE (PERSON-REM)-----								
PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	
DRINKING	ADULT	2.29E+07	3.55E-03	2.50E-02	2.40E-02	1.29E-01	2.43E-02	2.16E-02	3.15E-02	
DRINKING	TEENAGER	2.49E+06	5.21E-04	2.89E-03	2.59E-03	1.67E-02	2.80E-03	2.41E-03	3.42E-03	
DRINKING	CHILD	4.07E+06	2.41E-03	9.20E-03	7.87E-03	6.35E-02	8.89E-03	7.57E-03	8.84E-03	
DRINKING	TOTAL	2.94E+07	6.49E-03	3.71E-02	3.45E-02	2.09E-01	3.60E-02	3.16E-02	4.38E-02	
POPULATION=8.70E+04		DILUTION=3.13E+01	TRANSIT TIME=3.10E+01 HR (INCLUDING 24 HR FOR TREATMENT FACILITY)							

AVERAGE INDIVIDUAL CONSUMPTION (L/YR) ADULT=3.70E+02 TEEN=2.60E+02 CHILD=2.60E+02

-----CUMULATIVE TOTAL-----

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	CUMUL TOTAL	2.08E+08	4.66E-02	2.66E-01	2.48E-01	1.50E+00	2.58E-01	2.27E-01	3.14E-01

NEPA DOSES

NOTE--TOTAL NEPA DOSE INCLUDES SPORT CATCH

		-----DOSE (PERSON-REM)-----							
PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	1.22E+05	9.09E-02	1.55E-01	1.14E-01	2.13E-02	6.33E-02	1.73E-02	2.63E-01
FISH	TEENAGER	1.42E+04	1.47E-02	2.43E-02	9.97E-03	3.06E-03	1.00E-02	3.10E-03	2.87E-02
FISH	CHILD	9.85E+03	2.92E-02	3.41E-02	6.33E-03	5.11E-03	1.37E-02	3.93E-03	1.67E-02
FISH	TOTAL	1.46E+05	1.35E-01	2.13E-01	1.30E-01	2.95E-02	8.71E-02	2.43E-02	3.08E-01

HYDROSPHERE TRITIUM DOSE

AVERAGE INDIVIDUAL WATER CONSUMPTION = 3.0 L/DAY

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
WATER	TOTAL	2.86E+11	0.00E+00	2.23E-03	2.23E-03	2.23E-03	2.23E-03	2.23E-03	2.23E-03

* * * RECREATION POPULATION DOSES * * *

LOCATION- DOWN STREAM SWIMMING

DILUTION= 7.30E+00 TRANSIT TIME= 6.70E-01 HR SWF= 0.2

PATHWAY	AGE GROUP	USAGE	DOSE (PERSON-REM)	
			TOTAL BODY	THYROID
SHORELINE	TOTAL POPUL	4.10E+07	2.57E-01	2.22E-01

LOCATION- DOWN STREAM SWIMMING

DILUTION= 7.30E+00 TRANSIT TIME= 6.70E-01 HR

PATHWAY	AGE GROUP	USAGE	DOSE (PERSON-REM)	
			TOTAL BODY	THYROID
SWIMMING	TOTAL POPUL	4.10E+07	4.95E-03	4.95E-03

LOCATION- DOWN STREAM BOATING

DILUTION= 7.30E+00 TRANSIT TIME= 6.70E-01 HR

PATHWAY	AGE GROUP	USAGE	DOSE (PERSON-REM)	
			TOTAL BODY	THYROID
BOATING	TOTAL POPUL	4.10E+07	2.48E-03	2.48E-03

* * * DOSE TO BIOTA * * *
MRADS PER YEAR

BIOTA	DILUTION= 1.00E+00		TRANSIT TIME= 0.00E+00 HR	
	INTERNAL	EXTERNAL	TOTAL	
FISH	2.07E+00	1.74E+00	3.81E+00	
INVERTEBRATE	4.94E+00	3.48E+00	8.41E+00	
ALGAE	2.42E+00	7.77E-03	2.43E+00	
MUSKRAT	2.60E+00	1.16E+00	3.76E+00	
RACCOON	1.14E+00	8.67E-01	2.01E+00	
HERON	1.35E+01	1.16E+00	1.46E+01	
DUCK	2.28E+00	1.74E+00	4.02E+00	

SECTION VI

RADIOACTIVE EFFLUENT RELEASES - SOLID RADIOACTIVE WASTE
Technical Specifications 5.9.4a, 5.17d and 5.18d

January 1, 2002 - December 31, 2002

III. RADIOACTIVE EFFLUENT RELEASES-SOLID RADIOACTIVE
WASTE EFFLUENT AND WASTE DISPOSAL REPORT

January 1, 2002 through December 31, 2002

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (NOT IRRADIATED)

1. Type of Waste	Month Shipped	Number of Shipments	Volume Cu.Meter	Curie Content	Est.Total % Error
a. Spent resins, filter sludges, evaporator bottoms, etc.	January	0	0.00E+00	0.00E+00	N/A
	February	0	0.00E+00	0.00E+00	N/A
	March	0	0.00E+00	0.00E+00	N/A
	April	1	3.40E+00	4.72E+02	20
	May	0	0.00E+00	0.00E+00	N/A
	June	0	0.00E+00	0.00E+00	N/A
	July	0	0.00E+00	0.00E+00	N/A
	August	1	3.86E+00	5.09E+01	20
	September	0	0.00E+00	0.00E+00	N/A
	October	1	3.40E+00	4.29E+02	20
	November	0	0.00E+00	0.00E+00	N/A
	December	0	0.00E+00	0.00E+00	N/A
Total	(Type a)	3	1.07E+01	9.52E+02	20
b. Dry compressable, contaminated equipment, etc.	January	0	0.00E+00	0.00E+00	N/A
	February	1	8.00E-02	1.10E-02	20
	March	1	2.50E-01	2.18E-03	20
	April	1	1.40E-01	8.58E-02	20
	May	3	1.50E-01	8.16E-02	20
	June	7	3.02E+00	1.13E-01	20
	July	5	1.65E+00	1.31E-01	20
	August	7	4.29E+00	3.31E-02	20
	September	6	1.68E+00	2.67E-01	20
	October	0	0.00E+00	0.00E+00	N/A
	November	0	0.00E+00	0.00E+00	N/A
	December	3	1.33E+00	3.58E-02	20
Total	(Type b)	34	1.26E+01	7.60E-01	20

c. Irradiated components and other categories	January	0	0	0	N/A
	February	0	0	0	N/A
	March	0	0	0	N/A
	April	0	0	0	N/A
	May	0	0	0	N/A
	June	0	0	0	N/A
	July	0	0	0	N/A
	August	0	0	0	N/A
	September	0	0	0	N/A
	October	0	0	0	N/A
	November	0	0	0	N/A
	December	0	0	0	N/A
Total	(Type c)	0	0	0	N/A
d. Other	January	0	0	0	N/A
	February	0	0	0	N/A
	March	0	0	0	N/A
	April	0	0	0	N/A
	May	0	0	0	N/A
	June	0	0	0	N/A
	July	0	0	0	N/A
	August	0	0	0	N/A
	September	0	0	0	N/A
	October	0	0	0	N/A
	November	0	0	0	N/A
	December	0	0	0	N/A
Total	(Type d)	0	0	0	N/A

B. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (By Type of Waste)

1. Percentage of Curies from Represented Isotopes

	Isotope	Percent	Curies	
a.	Cs-134	46.5%	4.43E + 02	All other nuclides constitute less than 1%
	Cs-137	46.1%	4.39E + 02	
	H-3	2.0%	1.94E + 01	
	Ni-63	1.9%	1.82E + 01	
	Sb-125	1.7%	1.61E + 01	
b.	Cs-137	20.2%	1.53E-01	All other nuclides constitute less than 1%
	Nb-95	19.8%	1.50E-01	
	Cr-51	9.7%	7.37E-02	
	Cs-134	9.5%	7.24E-02	
	Co-58	7.7%	5.82E-02	
	Zr-95	6.8%	5.20E-02	
	RU-106	6.6%	5.01E-02	
	Co-60	6.2%	4.72E-02	
	Ni-63	3.2%	2.45E-02	
	Fe-55	2.9%	2.22E-02	
	I-131	2.6%	1.96E-02	
	Ce-144	1.2%	9.36E-03	
c.	N/A	N/A	N/A	
d.	N/A	N/A	N/A	

C. SOLID WASTE (DISPOSITION)

Number of Shipments	Transportation Mode	Destination
4	Closed Sole Use Vehicle	Barnwell,S.C.
33	Closed Sole Use Vehicle	Clive Utah.

D. IRRADIATED FUEL SHIPMENTS (DISPOSITION)

Number of Shipments	Transportation Mode	Destination
N/A	N/A	N/A

SECTION VII

ATTACHMENT 1

ODCM and PCP revisions for the period January 1, 2002 through December 31, 2002 in accordance with Technical Specification 5.17d and 5.18d, the radioactive effluent release report shall include any revisions to the Offsite Dose Calculation Manual (ODCM) and the Process Control Program (PCP).

 1 revision(s) made to the Offsite Dose Calculation Manual (ODCM).

 0 revision(s) made to the Process Control Program (PCP).

January 1, 2002 - December 31, 2002

WP8

Fort Calhoun Station
Unit No. 1

CH-ODCM-0001

OFF-SITE DOSE CALCULATION MANUAL

Title: OFF-SITE DOSE CALCULATION MANUAL (ODCM)

FC-68 Number: EC 29304

Reason for Change: Correct errors, update to reflect land use survey.

Requestor: J. Shipman

Preparer: J. Shipman

Correction (a): Page 18 (09-05-02)

ISSUED: 09-03-02 3:00 pm

R12

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OFF-SITE DOSE CALCULATION MANUAL (ODCM)

1. DEFINITIONS

Effluent Concentration Limit(ECL)

Radionuclide limits listed in 10 CFR Part 20, Appendix B, Table 2, Column 1.

Channel Check

A qualitative determination of acceptable operability by observation of channel behavior during normal plant operation. This determination shall, where feasible, include comparison of the channel with other independent channels measuring the same variable.

Channel Function Test

Injection of a simulated signal into the channel to verify that it is operable, including any alarm and/or trip initiating action.

Member(s) of the Public

Member(s) of the Public means any individual except when that individual is receiving occupational dose.

Operable - Operability

A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s). Implicit in this definition shall be the assumption that all necessary attendant instrumentation, controls, normal and emergency electrical power sources, cooling or seal water, lubrication, or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).

Purge-Purging

A means for the removal and replacement of gases within the containment building.

Source Check

Verification of channel response when the channel sensor is exposed to a radioactive source.

1. DEFINITIONS (continued)

Venting

A means for the reduction of pressure greater than atmospheric within the containment structure.

Unrestricted Area

Means an area, access to which is neither limited or controlled by licensee.

Water Effluent Concentration (WEC)

Radionuclide limits listed in 10 CFR Part 20, Appendix B, Table 2, Column 2.

Table 1.2 - Frequency Notation

The surveillance intervals are defined as follows:

NOTATION	TITLE	FREQUENCY
S	Shift	At least once per shift
D	Daily	At least once per 24 hours
W	Weekly	At least once per 7 days
BW	Biweekly	At least once per 14 days
M	Monthly	At least once per 31 days
Q	Quarterly	At least once per 92 days
SA	Semiannual	At least once per 184 days
A	Annually	At least once per 366 days
R	Refueling	At least once per 18 months
P	Prior to	Prior to each release

Table 1.3 - Radiological Effluent Controls Program Technical Specification Implementation

Technical Specification	ODCM Implementing Step
5.16.1.a	2.1.1, 2.2.1
5.16.1.b	3.1.1
5.16.1.c	Table 3.1, Table 3.2
5.16.1.d	3.1.2
5.16.1.e	3.1.2.B.1, 3.2.2.B.1
5.16.1.f	3.1.3.1, 3.2.4.1
5.16.1.g	3.2.1
5.16.1.h	3.2.2
5.16.1.i	3.2.3
5.16.1.j	3.3.1
5.16.2.a	4.1.1
5.16.2.b	4.2.1
5.16.2.c	4.3.1
5.17	5.3, 5.2.1.d
5.18	5.2.1.d

2. INSTRUMENTATION

2.1 Radioactive Liquid Effluent Instrumentation

2.1.1 Limiting Condition for Operation

- A. The radioactive liquid effluent monitoring instrumentation channels shown in Table 2.1.1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.1.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with Section II of the Off-site Dose Calculation Manual.

APPLICABILITY: At all times

ACTION:

- 1) With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, immediately suspend the releases of radioactive liquid effluents monitored by the affected channel or declare the channel inoperable.
- 2) With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels operable, take the action shown in Table 2.1.1. Restore inoperable effluent monitoring instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Radiological Effluent Release Report why this inoperability was not corrected in a timely manner. The reporting requirement is limited to the following instrumentation that monitors effluent streams: RM-055, RM-054A, and RM-054B.

2.1.2 Surveillance Requirements

- A. Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CALIBRATION, and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 2.1.2.

Table 2.1.1 - Radioactive Liquid Effluent Monitoring Instrumentation

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>ACTION</u>
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release.		
a. Liquid Radwaste Effluent Line (RM-055)	1	1, 5
b. Steam Generator Blowdown Effluent Line (RM-054 A and B)	1 ¹	2, 5
2. Flow Rate Measurement Devices		
a. Liquid Radwaste Effluent Line	1	3
b. Steam Generator Blowdown Effluent Line	1	3
3. Radioactivity Recorders		
a. Liquid Radwaste Effluent Line	1	4
b. Steam Generator Blowdown Effluent Line	1	4
1 If one of the two radiation monitors is inoperable, the activity of both blowdown lines shall be monitored by the operable monitor within 2 hours of the declaration of inoperability by the Shift Manager, or the action steps of ACTION 2, Table 2.1.1 should be performed on the Steam Generator that is not being monitored.		

Table 2.1.1 (continued)

Table Notation

- ACTION 1** With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided that prior to initiating a release:
1. At least two independent samples are analyzed in accordance with applicable chemistry procedures.
 2. At least two qualified individuals independently verify the release rate calculations.
- ACTION 2** With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided that grab samples are analyzed for principal gamma emitters at a sensitivity of 5.0E-07 $\mu\text{Ci}/\text{gram}$:
1. At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 $\mu\text{Ci}/\text{gram}$ dose equivalent I-131.
 2. At least daily when the specific activity of the secondary coolant is less than or equal to 0.01 $\mu\text{Ci}/\text{gram}$ equivalent I-131. Otherwise, suspend release of radioactive effluents via this pathway.
- ACTION 3** With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided the flow rate is determined at least once per four hours during the actual release.
- ACTION 4** With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided the radioactivity is recorded manually at least once per four hours during the actual release.
- ACTION 5** During the performance of source checks the effluent radiation monitor is unable to respond, hence is considered inoperable. Effluent releases may continue uninterrupted during the performance of source checks provided the operator is stationed at the monitor during the check. If the effluent radiation monitor fails the source check, carryout the action(s) of the ODCM for the inoperable monitor or terminate the effluent release.

Table 2.1.2 - Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements

INSTRUMENT	CHANNEL CHECK	CHANNEL		SOURCE CHECK ² PRIOR TO RELEASE
		CALIBRATION	FUNCTION TEST	
1. Radioactivity Monitors Providing Alarm and Automatic Isolation				
a. RM-054A/054B	D ¹	R	Q	----
b. RM-055	----	R	Q	P
2. Flowrate Monitors				
a. Steam Generator Blowdown	D	R	----	----

1 Visual Flowcheck Daily
2 A Source Check must be completed within 24 hrs prior to release.

2.2 Radioactive Gaseous Effluent Instrumentation

2.2.1 Limiting Condition for Operation

- A. The radioactive gaseous effluent monitoring instrumentation channels shown in Table 2.2.1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.2.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with Section II of the Off-site Dose Calculation Manual.

APPLICABILITY: At all times

ACTION:

- 1) With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, immediately suspend the releases of radioactive gaseous effluents monitored by the affected channel or declare the channel inoperable.
- 2) With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels operable, take the action shown in Table 2.2.1. Restore inoperable effluent monitoring instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Radiological Effluent Release Report why this inoperability was not corrected in a timely manner. The reporting requirement is limited to the following instrumentation that monitors effluent streams: RM-057, RM-043, RM-062, RM-063, and RM-052.

2.2.2 Surveillance Requirements

- A. Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CALIBRATION, and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 2.2.2.

Table 2.2.1 - Radioactive Gaseous Effluent Monitoring Instrumentation

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>ACTION</u>
1. Auxiliary Bldg. Exhaust Stack (RM-052, RM-062)		
a. Noble Gas	1	1, 9, 11
b. Iodine and Particulate	1	2, 9, 11
2. Laboratory and Radwaste Processing Building Stack (RM-043)		
a. Noble Gas	1	3, 9
b. Iodine and Particulate	1	4, 9
3. Condenser Off Gas (RM-057)		
a. Noble Gas	1	5, 9
4. Containment Purge Line (RM-050/51)		
a. Noble Gas	1	1, 6, 9, 11, 12
b. Iodine and Particulate	1	2, 9, 11, 12
5. Containment Pressure Relief Line (RM-050/51)		
a. Noble Gas	1	1, 9, 11
b. Iodine and Particulate	1	2, 9, 11
6. Containment Penetrations M72 and M74 (Integrated Leak Rate Test Depressurization Vent Path)	N/A	10

Table 2.2.1 (continued)

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>ACTION</u>
7. Flow Rate Measurement Devices		
a. Waste Gas Discharge Header	1	7
b. Auxiliary Building Stack	1	7
c. Laboratory and Radwaste Processing Building Stack	1	7
d. Containment Purge Line	1	7
e. Containment Pressure Relief Line Annubar D/P	1	7
8. Radioactivity Chart Recorders		
a. Auxiliary Building Exhaust Stack	1	8

Table 2.2.1 (continued)

TABLE NOTATION

- ACTION 1** If the Auxiliary Building Exhaust Stack Noble Gas Monitor is inoperable, releases from the containment pressure relief line and the containment purge line are to be secured in the most expeditious manner. Ventilation of the auxiliary building via the Auxiliary Building Exhaust Stack may continue provided grab samples are taken once per 8 hours (+25% maximum extension) and analyzed for principal gamma emitters. (See Table 3.2)
- ACTION 2** If the Auxiliary Building Exhaust Stack Iodine and Particulate Sampler is inoperable, ventilation of the Auxiliary Building and releases from the gaseous waste discharge header, containment pressure relief line or the containment purge line may continue through the Auxiliary Building Exhaust Stack provided sample collection in accordance with Table 3.2 using auxiliary sample collection equipment is initiated within 2 hours of the declaration of inoperability by the Shift Manager. |
- ACTION 3** If the Noble Gas Monitor is inoperable, ventilation of the LRWPB may continue via the LRWPB stack provided grab samples will be taken once per 24 hours (+ 25% maximum extension) and analyzed for principal gamma emitters. (See Table 3.2)
- ACTION 4** If the Iodine and Particulate Sampler is inoperable, ventilation of the LRWPB may continue via the LRWPB Stack provided sample collection using auxiliary sample collection equipment is initiated within 2 hours of the declaration of inoperability, by the Shift Manager, in accordance with Table 3.2. |
- ACTION 5** During power operation, when the condenser air ejector is in service, the condenser off gas discharge shall be monitored for gross radioactivity. If this monitor is inoperable, grab samples shall be taken once per 24 hours (+25% maximum extension) and analyzed for principal gamma emitters. (See Table 3.2)
- ACTION 6** The release of airborne effluents from the Containment purge line will be secured if a noble gas monitor is unavailable to monitor the containment building atmosphere.
- ACTION 7** With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided the flowrate is estimated or recorded manually at least once per four hours during the actual release.

Table 2.2.1 (continued)

TABLE NOTATION

- ACTION 8** With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided the radioactivity level is recorded manually at least once per four hours during the actual release.
- ACTION 9** During the performance of source checks the effluent radiation monitor is unable to respond, hence is considered inoperable. Effluent releases may continue uninterrupted during the performance of source checks provided the operator is stationed at the monitor during the check. If the effluent radiation monitor fails the source check, carryout the Action(s) of the ODCM for the inoperable monitor or terminate the effluent release.
- ACTION 10** Automatic release termination capability is not required provided manual isolation can be accomplished in accordance with the requirements of SS-ST-ILRT-0001.
- ACTION 11** During the ventilation of airborne effluents from the Auxiliary Building Stack at least one Auxiliary Building Exhaust fan shall be in operation.
- ACTION 12** IF containment purges are made without processing through at least one of the Containment Air Cooling and Filtering Units, and it is confirmed that one half of the annual dose objective listed in Section 3.2.2 will be exceeded during the calender quarter, a special report shall be submitted to the NRC as defined in Section 3.2.4

Table 2.2.2 - Radioactive Gaseous Effluent Monitoring Instrumentation
 Surveillance Requirements

INSTRUMENT	CHANNEL CHECK	CALIBRATION	CHANNEL FUNCTION TEST	SOURCE CHECK ² PRIOR TO RELEASE
1. Radioactivity Monitors Providing Alarm and Automatic Isolation				
a. RM-043	D	R	Q	---
b. RM-057	D	R	Q	---
c. RM-062	D	R	Q	P
d. RM-052 ¹	D	R	Q	P
2. Flowrate Monitors				
a. RM-043 Sampler	D	R	---	---
b. RM-062 Sampler	D	R	---	---
c. RM-052 Sampler	D	R	---	---
d. Auxiliary Bldg Exhaust Stack	D	R	---	---
e. Laboratory and Radwaste Process Bldg Exhaust Stack	D	R	---	---
	Operations Check		Air Flow Calibration	
3. Environmental Monitors				
a. RM-035		M		A
b. RM-036		M		A
c. RM-037		M		A
d. RM-038		M		A
e. RM-040		M		A
f. RM-025		M		A
g. RM-026		M		A
h. RM-027		M		A

1 Required when RM-052 is sampling the Auxiliary Building Exhaust Stack.
 2 A Source Check must be completed within 24 hrs prior to release.

3. RADIOACTIVE EFFLUENTS

3.1 Radioactive Liquid Effluents

3.1.1 Concentration

A. Limiting Condition for Operation

- 1) The release rate of radioactive material in liquid effluents shall be controlled such that the instantaneous concentrations for radionuclides, other than dissolved or entrained noble gases, do not exceed the values specified in 10 CFR Part 20 for liquid effluents at site discharge. To support plant operations, Supervisor-System Chemistry may increase this limit up to the limit specified in Technical Specifications 5.16.1.b. For dissolved or entrained noble gases, the concentration shall be limited to $2.0E-04$ $\mu\text{Ci/ml}$, total activity.
- 2) Technical Specification 5.16.1.b establishes the administrative control limit on concentration of radioactive material, other than dissolved or entrained noble gases, released in liquid effluents to unrestricted areas conforming to ten times 10 CFR Part 20.1001-20.2401, Appendix B, Table 2, Column 2. For dissolved or entrained noble gases, the concentration shall be limited to $2.0E-04$ $\mu\text{Ci/ml}$ total activity.

APPLICABILITY: At all times

ACTION:

- a) When the concentration of radioactive material released at site discharge exceeds the above limits, appropriate corrective actions shall be taken immediately to restore concentrations within the above limits.

B. Surveillance Requirements

- 1) Radioactive liquid waste shall be sampled and analyzed according to the sampling and analysis program in Table 3.1.
- 2) The results of the radioactivity analysis shall be used with the calculational methods in Part II of the ODCM to assure that the concentration at the point of release is maintained within the limits of Technical Specification 5.16.1.b.
- 3) Records shall be maintained of the radioactive concentrations and volume before dilution of each batch of liquid effluent released and of the average dilution flow and length of time over which each discharge occurred. Analytical results shall be submitted to the Commission in accordance with Part I, Section 5.

Table 3.1 - Radioactive Liquid Effluent Sampling And Analysis

A. Monitor & Hotel Waste Tanks Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu\text{Ci/ml}$) ¹
Each Batch	Principal Gamma Emitters ²	5.0E-07
Each Batch	I-131	1.0E-06
Monthly from One Batch	Dissolved Noble Gases (Gamma Emitters)	1.0E-05
Monthly Composite ⁴	H-3	1.0E-05
Monthly Composite ⁴	Gross Alpha	1.0E-07
Quarterly Composite ⁴	Sr-89, Sr-90	5.0E-08
Quarterly Composite ⁴	Fe-55	1.0E-06

B. Steam Generator Blowdown

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu\text{Ci/ml}$) ¹
Weekly Composite ⁴	Principal Gamma Emitters ²	5.0E-07
Weekly Composite ⁴	I-131 ³	1.0E-06
Monthly	Dissolved Noble Gases (Gamma Emitters)	1.0E-05
Monthly Composite ⁴	H-3	1.0E-05
Monthly Composite ⁴	Gross Alpha	1.0E-07
Quarterly Composite ⁴	Sr-89, Sr-90	5.0E-08
Quarterly Composite ⁴	Fe-55	1.0E-06

NOTES:

- 1 LLD is defined in Part II of the ODCM.
- 2 The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with a LLD of 5.0E-06.
- 3 A weekly grab sample and analyses program including gamma isotopic identification will be initiated for the turbine building sump effluent when the steam generator blowdown water composite analysis indicates the I-131 concentration is greater than 1.0E-06 $\mu\text{Ci/ml}$.
- 4 To be representative of the average quantities and concentrations of radioactive materials in liquid effluents, samples should be collected in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite should be mixed in order for the composite sample to be representative of the average effluent release.

3.1.2 Dose from Radioactive Liquid Effluents

A. Limiting Condition for Operation

- 1) The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed 3 millirems to the total body and 10 millirems to any organ.
- 2) The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar quarter shall not exceed 1.5 millirems to the total body and 5 millirems to any organ.

APPLICABILITY: At all times

ACTION:

- a) The radiation dose contributions from radioactive materials in liquid effluents released at site discharge shall be determined, in accordance with the methodology and parameters in Part II of the ODCM, on a quarterly basis. If the dose contribution, due to the cumulative release of liquid effluents averaged over a calendar quarter, exceeds one-half of the annual design objectives, the following course of actions shall be taken:
 - 1) Make an investigation to identify the causes for such releases.
 - 2) Define and initiate a program of action to reduce such releases to the design levels.
 - 3) Submit a special report, pursuant to Technical Specification 5.16, within 30 days from the end of the quarter during which the release(s) occurred, identifying the causes and describing the proposed program of action to reduce such releases to the design levels.

B. Surveillance Requirements

- 1) Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in Part II of the ODCM at least once per quarter.

3.1.3 Liquid Radwaste Treatment

A. Limiting Condition for Operation

- 1) The Liquid Radwaste Treatment System shall be OPERABLE, and appropriate portions of these systems shall be used to reduce the radioactive material in liquid wastes so that one half of the annual dose objective listed in ODCM Specification 3.1.2.A will not be exceeded in a calender quarter.

APPLICABILITY: At all times

ACTION:

- a) Every effort will be made to process all liquid waste, except from the hotel waste tanks, through the Filtration/Ion Exchange (FIX) system before entering the monitor tanks. If the radioactive liquid waste is discharged without processing and it is confirmed that one half of the annual dose objective will be exceeded during the calender quarter, a special report pursuant to Technical Specification 5.16, shall be prepared and submitted to the Nuclear Regulatory Commission within 30 days of the end of the quarter during which the equipment or subsystem(s) were inoperable. This report shall include the following information:
 - 1) Identification of equipment or subsystem(s) not operable and reasons for inoperability.
 - 2) Action(s) taken to restore the inoperable equipment to operable status.
 - 3) Summary description of action(s) taken to prevent a recurrence.

B. Surveillance Requirements

- 1) Dose due to liquid releases shall be projected frequently and at least once per quarter, in accordance with the methodology and parameters in Part II of the ODCM , when Liquid Radwaste Treatment Systems are not fully OPERABLE.

3.1.3B 2) OPERABLE is defined as follows:

A filtration/ion exchange (FIX) system will be utilized for processing liquid radwaste. The system consists of a booster pump, charcoal pretreatment filter, and pressure vessels containing organic/inorganic resins, which can be configured for optimum performance. The effluent from the FIX system is directed to the monitor tanks for release.

Waste filters (WD-17A and WD-17B) are used only on those occasions when considered necessary, otherwise the flows from the low activity fluids may bypass the filters. No credit for decontamination factors (iodines, Cs, Rb, others) was taken for these filters during the 10 CFR Part 50 Appendix I dose design objective evaluation; therefore, the inoperability of these filters does not affect the dose contributions to any individual in the unrestricted areas via liquid pathways. The inoperability of waste filters will not be considered a reportable event in accordance with the Action listed above.

3.1.4 Liquid Holdup Tanks

Tanks included in this Specification are those outdoor tanks that are not surrounded by liners, dikes, or walls capable of holding the tanks contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system.

A. Limiting Condition for Operation

- 1) The quantity of radioactive material contained in each unprotected outdoor liquid holdup tank shall not exceed 10 curies, excluding tritium and dissolved or entrained noble gases.

APPLICABILITY: At all times

ACTION:

- a) When the quantity of radioactive material in any unprotected outdoor liquid holdup tank exceeds 10 curies, excluding tritium and dissolved or entrained noble gasses, immediately suspend all additions of radioactive material to the tank and within 48 hours reduce the tank contents to within the limit.

3.1.4 B. Surveillance Requirements

- 1) The quantity of radioactive material contained in each outdoor liquid holdup tank shall be determined to be within the above limit by analyzing a representative sample of the tank's contents at least once per 7 days when radioactive material is being added to the tank.

3.2 Radioactive Gaseous Effluents

3.2.1 Concentration

A. Limiting Condition for Operation

- 1) The release rate of radioactive material in airborne effluents shall be controlled such that the instantaneous concentrations of radionuclides does not exceed the values specified in 10 CFR Part 20 for airborne effluents at the unrestricted area boundary. To support plant operations, Supervisor-System Chemistry may increase this limit up to the limits specified in Technical Specification 5.16.1.g.
- 2) Technical Specification 5.16.1.g establishes the administrative control limit on the concentration resulting from radioactive material, other than noble gases, released in gaseous effluents to unrestricted areas conforming to ten times 10 CFR Part 20.1001-20.2401, Appendix B, Table 2, Column 1. For noble gases, the concentration shall be limited to five times 10 CFR Part 20.1001-20.2401, Appendix B, Table 2, Column 1.

APPLICABILITY: At all times

ACTION:

- a) When the concentration of radioactive material released to unrestricted areas exceeds the above limits, appropriate corrective actions shall be taken immediately to restore concentrations within the above limits.

B. Surveillance Requirements

- 1) Radioactive gaseous wastes shall be sampled and analyzed according to the sampling and analysis program of Table 3.2. The results of the radioactivity analysis shall be used to assure the limits in 3.2.1.A are not exceeded.

Table 3.2 - Radioactive Airborne Effluent Sampling And Analysis

A. Gas Decay Tank Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu\text{Ci/ml}$) ¹
Prior to each release	Principal Gamma Emitters ²	1.0E-04

B. Containment Purge Releases or Containment Pressure Relief Line Releases⁵

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu\text{Ci/ml}$) ¹
Prior to each release	Principal Gamma Emitters ²	1.0E-04
Prior to each release	H-3	1.0E-06

C. Condenser Off Gas Releases⁵

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu\text{Ci/ml}$) ¹
Monthly ³	Tritium (H-3)	1.0E-06
Monthly	Principal Gamma Emitters ²	1.0E-04

D. Auxiliary Building Exhaust Stack and Laboratory and Radwaste Building Exhaust Stack⁵

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu\text{Ci/ml}$) ¹
Weekly (Charcoal Sample)	I-131	1.0E-12
Weekly (Particulates)	Principal Gamma Emitters ² , I-131, and Particulates with half-lives > eight (8) days.	1.0E-11
Weekly (Noble Gases)	Principal Gamma Emitters ²	1.0E-4
Monthly Composite ⁴	Gross Alpha	1.0E-11
Quarterly Composite (Particulates)	Sr-89, Sr-90	1.0E-11

Table 3.2 (continued)

NOTES:

- 1 LLD is defined in Part II of the ODCM
- 2 The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 for particulate emissions.
- 3 Required only when steam generator blowdown radioactivity for tritium (Table 3.1, Item B) exceeds 3.0E-03 $\mu\text{Ci}/\text{milliliter}$.
- 4 Frequency requirement may be satisfied using weekly gross alpha results from particulate sampling media.
- 5 Particulate and Iodine samples shall be corrected for sampler deposition/transportation efficiency by using the approved software programs or by multiplying the activity obtained by the associated sampler multiplication factor (See Table 3.3).

Table 3.3 - Sampler Deposition/transportation Correction Factors

SAMPLER	SAMPLE	PARTICULATE		IODINE	
		DF	ACTMULT ¹	DF	ACTMULT ¹
RM-062	AB	0.411	2.433	0.669	1.495
RM-052 ²	AB	0.638	1.567	0.653	1.531
RM-052 ²	CONT	0.525	1.905	0.688	1.453
RM-051	CONT	0.624	1.603	0.714	1.401
RM-043	LRWPB	0.809	1.236	0.873	1.236
PORTABLE	CONT	1.000	1.000	0.950	1.053

ACRONYM DEFINITIONS:

AB - Auxiliary Building Exhaust Stack

CONT - Containment Building

LRWPB - Laboratory and Rad Waste Processing Building

DF - Deposition Factor

ACTMULT - Activity multiplication factor to correct for sample loss.

- 1 ACTMULT factors are automatically determined using the appropriate analysis sequence file for the sample type.
- 2 Sampler can be used to monitor either the Containment or Auxiliary Building.

3.2.2 Dose - Noble Gases

A. Limiting Condition for Operation

- 1) During any calendar year: Less than or equal to 10 mrads for gamma radiation and less than or equal to 20 mrads for beta radiation.
- 2) During any calendar quarter: Less than or equal to 5 mrads for gamma radiation and less than or equal to 10 mrads for beta radiation.

APPLICABILITY: At all times

ACTION:

- a) If the dose contribution, due to the cumulative release of noble gases in airborne effluents averaged over a calendar quarter exceeds one-half of the annual design objectives, the following course of actions shall be taken:
 - 1) Make an investigation to identify the cause for such release rates.
 - 2) Define and initiate a program of action to reduce such releases to design levels.
 - 3) Submit a special report, pursuant to Technical Specification 5.16, within 30 days from the end of the quarter during which the release(s) occurred, identifying the causes and describing the proposed program of action to reduce dose contributions.

B. Surveillance Requirements

- 1) The radiation dose contributions from radioactive noble gases in airborne effluents shall be determined, in accordance with the methodologies and parameters of Part II of the ODCM, on a quarterly basis.

3.2.3 Dose - Iodine-131, Radioactive Material in Particulate Form with Half-Lives Greater than 8 Days (Other than Noble Gases) and Tritium

A. Limiting Condition for Operation

- 1) The dose to an individual or dose commitment to any organ of an individual in unrestricted areas due to the release of I-131, Tritium, and radioactive materials in particulate form with half-lives greater than eight days (excluding noble gases) in airborne effluents shall not exceed 7.5 millirems in any calendar quarter and 15 millirems from all exposure pathways during any calendar year.

APPLICABILITY: At all times

ACTION:

- a) If the dose contribution, due to the cumulative release of I-131, Tritium, and radioactive materials in particulate form with half-lives greater than eight days (excluding noble gases) in airborne effluents averaged over a calendar quarter exceeds one-half of the annual design objectives, the following course of actions shall be taken:
 - 1) Make an investigation to identify the cause for such release rates.
 - 2) Define and initiate a program of action to reduce such releases to design levels.
 - 3) Submit a special report, pursuant to Technical Specification 5.16, within 30 days from the end of the quarter during which the release(s) occurred, identifying the causes and describing the proposed program of action to reduce dose contributions.

B. Surveillance Requirements

- 1) The radiation dose contributions from I-131, Tritium, and radioactive materials in particulate form with half-lives greater than eight days (excluding noble gases) in airborne effluents shall be determined, in accordance with the methodologies and parameters of Part II of the ODCM, on a quarterly basis.

3.2.4 Gaseous Radwaste Treatment

A. Limiting Condition for Operation

- 1) In accordance with Technical specification 5.16.1.f, the Waste Gas System and the Ventilation Exhaust Systems shall be OPERABLE, and appropriate portions of these systems shall be used to reduce the radioactive material in gaseous wastes so that one half of the annual dose objectives listed in ODCM Specifications 3.2.2.A and 3.2.3A will not be exceeded.

APPLICABILITY: At all times

ACTION:

- a) If radioactive gaseous waste is discharged without treatment and it is confirmed that one half of the annual dose objective will be exceeded during the calendar quarter, a special report pursuant to Technical Specification 5.16, shall be prepared and submitted to the Nuclear Regulatory Commission within 30 days of the end of the quarter during which the equipment or subsystem(s) were inoperable. This report shall include the following information:
 - 1) Identification of equipment or subsystem(s) not operable and reasons for inoperability.
 - 2) Action(s) taken to restore the inoperable equipment to operable status.
 - 3) Summary description of action(s) taken to prevent a recurrence.

B. Surveillance Requirements

- 1) Dose due to gaseous releases shall be projected frequently and at least once per quarter, in accordance with the methodology and parameters in Part II of the ODCM, when Waste Gas Systems and Ventilation Exhaust Systems are not fully OPERABLE.

3.2.4B 2) OPERABLE is defined as follows:

a) Waste Gas System

The waste airborne radioactive material at Fort Calhoun Station is collected in the vent header where the gas compressors take suction, compress the gas and deliver it to one of the four gas decay tanks. The waste airborne radioactive material is treated in these gas decay tanks by holding for radioactive decay prior to final controlled release to the environs. In order to provide conformance with the dose design objectives, gas decay tanks are normally stored for approximately 30 days, with earlier release allowed to support plant operation only, and thus achieve decay of short half-life radioactive materials, e.g., I-131, Xe-133. If the radioactive airborne wastes from the gas decay tanks are discharged without processing in accordance with the above conditions, and it is confirmed that one half of the annual dose objective will be exceeded during the calendar quarter, a special report shall be submitted to the Commission pursuant to Section 3.2.4A.

b) Ventilation Exhaust Systems

The radioactive effluents from the controlled access area of the auxiliary building are filtered by the HEPA filters in the auxiliary building ventilation system. If the radioactive effluents are discharged without the HEPA filters, a special report shall be submitted to the NRC as defined in Action a) above.

The discharge from the gas decay tanks is routed through charcoal and HEPA filter unit VA-82. No credit was taken for the operation of hydrogen purge filters during the 10 CFR Part 50, Appendix I dose design evaluation and doses through the airborne effluent pathways were well below the design objectives. The unavailability of hydrogen purge filters will not be considered a reportable event.

The containment air is processed through at least one of the redundant containment HEPA and charcoal filters in the Containment Air Cooling and Filtering Units prior to purging. If the containment purges are made without processing through one of the Containment Air Cooling and Filtering Units, and it is confirmed that one half of the annual dose objective will be exceeded during the calendar quarter, a special report shall be submitted to the NRC as defined in Action a) above.

3.3 Uranium Fuel Cycle

3.3.1 Total Dose-Uranium Fuel Cycle

A. Limiting Condition for Operation

- 1) The dose to any real individual from uranium fuel cycle sources shall be limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which shall be limited to ≤ 75 mrem) during each calendar year.

APPLICABILITY: At all times

ACTION:

- a) With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specifications 3.1.2.A, 3.2.2.A, or 3.2.3.A, calculations shall be made including direct radiation contribution from the plant and outside storage tanks to determine whether the above limits have been exceeded. If such is the case, in lieu of any other report required by Section 5.2, prepare and submit a Special Report to the Commission pursuant to Technical Specification 5.16 that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR Part 20.2203(a)(4) and 20.2203(b), shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentration of radioactive material involved, and the cause of exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in the violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

3.3.1 B. Surveillance Requirements

Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Surveillance requirements 3.1.2B, 3.2.2B and 3.2.3B and in accordance with the methodology and parameters in Part II of the ODCM.

4. RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

4.1 Monitoring Program

4.1.1 Limiting Condition for Operation

- A. The Radiological Environmental Monitoring Program shall be conducted as specified in Table 4.1.

APPLICABILITY: At all times

ACTION:

- 1) Analytical results of this program and deviations from the sampling schedule shall be reported to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report (Section 5.2).
- 2) If the level of radioactivity from calculated doses leads to a higher exposure pathway to individuals, this pathway shall be added to the Radiological Environmental Monitoring Program.
- 3) If the level of radioactivity in an environmental sampling medium exceeds the reporting level specified in Table 4.4, and the activity is attributable to plant operation, a Special Report shall be prepared and submitted to the Nuclear Regulatory Commission within 30 days from the end of the quarter (Section 5.2.3). The detection capabilities of the equipment used for the analysis of environmental samples must meet the requirements of Table 4.3 for Lower Level of Detection (LLD).
- 4) Radiological environmental sampling locations and the media that is utilized for analysis are presented in Table 4.2. Sampling locations are also illustrated on the map, Figure 1. Details of the emergency TLD locations are contained in surveillance test CH-ST-RV-0009, Environmental Sample Collection - Emergency Planning Zone Dosimeters.

- 4.1.1A 5) Deviations from the monitoring program, presented in this section and detailed in Table 4.2, are permitted if specimens are unobtainable due to mitigating circumstances such as hazardous conditions, seasonal unavailability, malfunction of equipment, or if a person discontinues participation in the program, etc. If the equipment malfunctions, corrective actions will be completed as soon as practicable. If a person no longer supplies samples, a replacement will be made if possible. All deviations from the sampling schedule will be described in the Annual Radiological Environmental Operating Report, pursuant to Section 5.2.

4.1.2 Surveillance Requirements

- A. The Radiological Environmental Monitoring Program (REMP) shall be collected and analyzed in accordance with Tables 4.1, 4.2, and 4.3.

Table 4.1 - Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site ¹	Type of Analysis ²	Frequency
1. Direct Radiation	A. Thirteen TLD indicator stations, two control stations, total of 15. B. An inner-ring of 16 stations, one in each cardinal sector in the general area of the unrestricted area boundary and within 2.5 miles. C. An outer-ring of 16 stations, 1 in each cardinal sector located outside of the inner-ring, but no more distant than approximately 5 miles.	Gamma dose Gamma dose during Site Area and General Emergencies only. Gamma dose during Site Area and General Emergencies only.	Quarterly Replaced Annually Replaced Annually
2. Air Monitoring	A. Indicator Stations 1. 3 stations in the general area of the unrestricted area boundary 2. City of Blair 3. Desoto Township 4. 2 Offsite locations B. One background station	Filter for Gross Beta ³ Charcoal for I-131 Filter for Gamma Isotopic	Weekly Weekly Quarterly composite of weekly filters
3. Water	A. Missouri River at nearest downstream drinking water intake. B. Missouri River downstream near the mixing zone. C. Missouri River upstream of Plant intake (background).	Gamma Isotopic, H-3	Monthly composite for Gamma Isotopic Analysis Quarterly composite for H-3 Analysis

Table 4.1 - Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site ¹	Type of Analysis ²	Frequency
4. Milk ⁴	A. Nearest milk animal (cow or goat) within 5 miles B. Milk animal (cow or goat) between 5 miles and 18.75 miles (background).	Gamma Isotopic and I-131	Semimonthly grazing season (May to October)
5. Fish	A. Four fish samples within vicinity of Plant discharge. B. One background sample upstream of Plant discharge.	Gamma Isotopic	Once per season (May to October)
6. Sediment	A. One sample from downstream area on the station side of the Missouri River. B. One sample from upstream of Plant Intake (background).	Gamma Isotopic	Semiannually
7. Vegetables or Food Products ⁵	A. One sample in the highest exposure pathway. B. One sample from onsite crop field C. One sample outside of 5 miles (background).	Gamma Isotopic	Once per season (May to October)

NOTES:

- 1 See Table 4.3 for required detection limits.
- 2 The Lower Limit of Detection (LLD) for analysis is defined in the ODCM in accordance with the wording of NUREG-0472, Rev. 3, Draft 7.
- 3 When a gross beta count indicates radioactivity greater than 1E-12 µCi/ml or 1 pCi/m³, a gamma spectral analysis will be performed.
- 4 If milk samples are temporarily not available at a sampling site due to mitigating circumstances, then vegetation (broadleaf, pasture grass, etc.) shall be collected as an alternate sample at the site. If there are no milk producers within the entire 5-mile radius of the plant, then vegetation shall be collected at the offsite location having the highest calculated annual average ground level D/Q. (Reference ODCM Part 2, Table 4 "Highest Potential Exposure Pathways for Estimating Dose")
- 5 Samples should be collected from garden plots of 500 ft² or more. (Reference Reg. Guide 4.8 "Environmental Technical Specifications for Nuclear Power Plants," Dec. 1975).

REFERENCE USE

Table 4.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring			TLD	Water	Milk	Sediment	Fish	Vegetables and Food Products
					Airborne Particulate	Airborne Iodine							
1	Onsite Station, 110-meter weather tower	0.53	293°/WNW	P	X	X	X						
2	Onsite Station, adjacent to old plant access road	0.59	207°/SSW	K	X	X	X						
3	Offsite Station, Intersection of Hwy. 75 and farm access road	0.94	145°/SE	G	X	X	X						
4	Blair OPPD office	2.86	305°/NW	Q	X	X	X						
5	EOF Building, North Omaha Power Station	14.9	153°/SSE	H			X						
6	Fort Calhoun, NE City Hall	5.18	150°/SSE	H			X						
7	Fence around intake gate, Desoto Wildlife Refuge	2.07	102°/ESE	F			X						
8	Onsite Station, entrance to Plant Site from Hwy. 75	0.55	191°/S	J			X						
9	Onsite Station, NW of Plant	0.68	305°/NW	Q			X						

Table 4.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring			Water	Milk	Sediment	Fish	Vegetables and Food Products
					Airborne Particulate	Airborne Iodine	TLD					
10	Onsite Station, WSW of Plant	0.61	242°/WSW	M			X					
11	Offsite Station, SE of Plant	1.07	139°/SE	G			X					
12	Metropolitan Utilities Dist., Florence Treatment Plant North Omaha, NE	14.3	154°/SSE	H				X				
13	West bank Missouri River, downstream from Plant discharge	0.45	108°/ESE	F				X		X		
14	Upstream from Intake Bldg, west bank of river	0.09	4°/N	A				X		X		
15'												
16'												
17'												
18'												
19'												
20	Mohr Dairy	9.86	186°/S	J					X ²			X
21'												
22	Fish Sampling Area, Missouri River	0.08 (R.M. 645.0)	6°/N	A							X	

REFERENCE USE

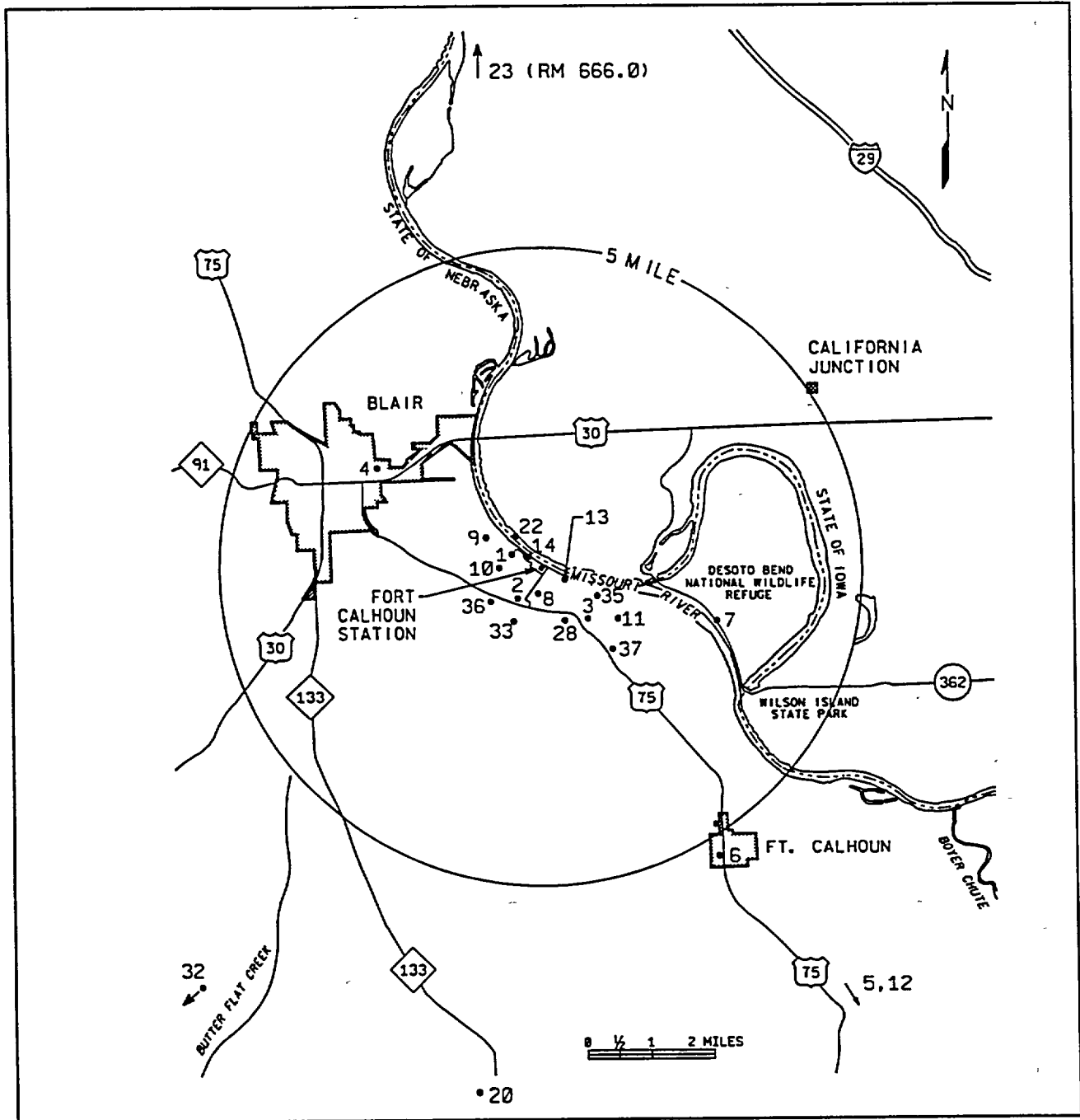
Table 4.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sediment	Fish	Vegetables and Food Products
					Airborne Particulate	Airborne Iodine						
23	Fish Sampling Area, Missouri River	17.9 (R.M. 666.0)	358°N	A							X	
24 ¹												
25 ¹												
26 ¹												
27 ¹												
28 ³	Alvin Pechnik Farm	0.94	163°SSE	H	X	X	X					X
29 ¹												
30 ¹												
31 ¹												
32	Valley Substation #902	19.6	221°SW	L	X	X	X					
33 ³	Bansen Farm	0.7	203°SSW	K				X ²				
34 ¹												
35	Onsite Farm Field	0.52	118°ESE	F								X
36 ³	Offsite Station Intersection Hwy 75/Co.Rd. P37	0.75	227°SW	L	X	X	X					
37 ³	Offsite Station Desoto Township	1.57	144°SE	G	X	X	X					

NOTES:

- (1) Location is currently discontinued and is documented in the table for historical reference only.
- (2) When a milk sample is not available at a location, a broad leaf (pasture grass) vegetation sample will be collected at that location as a substitute.
- (3) Locations represent highest potential exposure pathways as determined by the biennial Land Use Survey, performed in accordance with Part 1, Section 6.3.2, and are monitored as such.

Figure 1 - Environmental Radiological Sampling Points*



* Locations currently discontinued are not illustrated.

REFERENCE USE

Table 4.3 - Detection Capabilities For Environmental Sample Analysis Lower Limit of Detection (LLD) ^{1,2,3}

Sample	Units	Gross Beta	H-3	Mn-54	Fe-59	Co-58, Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140
Water	pCi/L	---	2.0E+03	1.5E+01	3.0E+01	1.5E+01	3.0E+01	1.5E+01	1.5E+01	1.0E+00 ⁴	1.5E+01	1.8E+01	1.5E+01
Fish	pCi/kg (wet)	---	---	1.3E+02	2.6E+02	1.3E+02	2.6E+02	---	---	---	1.3E+02	1.5E+02	---
Milk	pCi/L	---	---	---	---	---	---	---	---	1.0E+00	1.5E+01	1.8E+01	1.5E+01
Airborne Particulates or Gases	pCi/m ³	1.0E-02	---	---	---	---	---	---	---	7.0E-02	1.0E-02	1.0E-02	---
Sediment	pCi/kg (dry)	---	---	---	---	---	---	---	---	---	1.5E+02	1.8E+02	---
Grass or Broad Leaf Vegetation/ Vegetables or Food Products	pCi/kg (wet)	---	---	---	---	---	---	---	---	5	5	5	---

- 1 This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable as Plant effluents, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Part I, Section 5.2.
- 2 Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.
- 3 The LLD is defined in Part II of the ODCM.
- 4 LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.
- 5 I-131 analysis performed on broadleaf/pasture grass samples when milk is unavailable. Gamma isotopic analysis performed on food products/vegetables.

REFERENCE USE

Table 4.4 - Reporting Levels for Radioactivity Concentrations in Environmental Samples¹

Sample	Units	H-3	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140
Water	pCi/L	2.0E+04	1.0E+03	4.0E+02	1.0E+03	3.0E+02	3.0E+02	4.0E+02	4.0E+02	2.0E+00 ²	3.0E+01	5.0E+01	2.0E+02
Fish	pCi/kg (wet)	---	3.0E+04	1.0E+04	3.0E+04	1.0E+04	2.0E+04	---	---	---	1.0E+03	2.0E+03	---
Milk	pCi/L	---	---	---	---	---	---	---	---	3.0E+00	6.0E+01	7.0E+01	3.0E+02
Airborne Particulates or Gases	pCi/m ³	---	---	---	---	---	---	---	---	9.0E-01	1.0E+01	2.0E+01	---
Grass or Broad Leaf Vegetation/ Vegetables or Food Products	pCi/kg (wet)	---	---	---	---	---	---	---	---	1.0E+02	1.0E+03	2.0E+03	---

1 A Non-routine report shall be submitted when more than one of the radionuclides listed above are detected in the sampling medium and:

$$\frac{\text{Concentration 1}}{\text{Reporting Level 1}} + \frac{\text{Concentration 2}}{\text{Reporting Level 2}} + \frac{\text{Concentration 3}}{\text{Reporting Level 3}} + \dots \geq 1.0$$

When radionuclides other than those listed above are detected and are the result of Plant effluents, this report shall be submitted if the potential annual dose to a member of the general public is equal to or greater than the dose objectives of Part I, Section 3.1 and 3.2. This report is not required if the measured level of radioactivity was not the result of Plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

2 If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

4.2 Land Use Survey

4.2.1 Limiting Condition for Operation

A. A Land Use Survey shall identify the location of the nearest milk animal, nearest meat animal, nearest vegetable garden, and the nearest residence in each of the 16 cardinal sectors within a distance of five miles. The survey shall be conducted under the following conditions:

- 1) Within a one-mile radius from the Plant site, enumeration by door-to-door or equivalent counting techniques.
- 2) Within a Five-mile radius, enumeration may be conducted door-to-door or by using referenced information from county agricultural agents or other reliable sources.

APPLICABILITY: At all times

ACTION:

- a) If it is learned from this survey that milk animals, vegetable gardens and resident receptors are present at a location which yields a calculated dose greater than 20% from previously sampled location(s), the new location(s) shall be added to the monitoring program. Milk and vegetable garden sampling location(s) having the lowest calculated dose may then be dropped from the monitoring program at the end of the grazing and/or growing season during which the survey was conducted and the new location added to the monitoring program. Modifications to the air monitoring locations will be made as soon as practicable. The Nuclear Regulatory Commission shall be notified of modifications to the program in the Annual Radiological Environmental Operating Report (Section 5.2).
- b) If it is learned from this survey that a pathway for dose to a MEMBER OF THE GENERAL PUBLIC no longer exists, an additional pathway has been identified or site specific factors affecting the dose calculations for a pathway have changed, then this information should be documented in the Land Use Survey and the Annual Radioactive Effluent Release Report. This information can be used to increase the accuracy of the dose models for the Annual Radioactive Effluent Release Report as well as dose estimates performed during the reporting period (i.e., quarterly dose estimates).

4.2.2 Surveillance Requirements

- A. A land use survey shall be conducted once per 24 months between the dates of June 1 and October 1. The results of the land use survey shall be submitted to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report (Section 5.2).

4.3 Interlaboratory Comparison Program

4.3.1 Limiting Condition for Operation

- A. Analyses shall be performed on radioactive materials as part of an Interlaboratory Comparison Program that has been approved by the Nuclear Regulatory Commission.

APPLICABILITY: At all times

ACTION:

- 1) With analysis not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report (Section 5.2).

4.3.2 Surveillance Requirements

- A. The results of these analyses shall be included in the Annual Radiological Environmental Operating Report (Section 5.2).

5. ADMINISTRATIVE CONTROLS

5.1 Responsibilities

- 5.1.1 FCS Chemistry Department is responsible for the implementation and maintenance of the ODCM.
- 5.1.2 FCS Operations Department is responsible for the compliance with the ODCM in the operation of Fort Calhoun Station.

5.2 Radioactive Effluent Reporting Requirements

The reporting requirements for radioactive effluents stated in this Section are to provide assurance that the limits set forth in Section I are complied with. These reports will meet the requirements for documentation of radioactive effluents contained in 10 CFR Part 50.36a; Reg. Guide 1.21, Rev. 1; Reg. Guide 4.8, Table 1; and Reg. Guide 1.109, Rev. 1.

5.2.1 Annual Radioactive Effluent Release Report

A report covering the operation of the Fort Calhoun Station during the previous calendar year shall be submitted prior to May 1 of each year per the requirements of Technical Specifications 5.9.4.a. and 10 CFR Part 50.

The Radioactive Effluent Release Report shall include:

- A. A summary of the quantities of radioactive liquid and airborne effluents and solid waste released from the plant as outlined in Regulatory Guide 1.21, Revision 1.
- B. A summary of the meteorological conditions concurrent with the release of airborne effluents during each quarter as outlined in Regulatory Guide 1.21, Revision 1.
- C. An assessment of radiation doses from the radioactive liquid and airborne effluents released from the unit during each calendar quarter as outlined in Regulatory Guide 1.21, Revision 1. The assessment of radiation doses shall be performed in accordance with calculational methodology of the Regulatory Guide 1.109, Revision 1.
- D. Changes to the Process Control Program (PCP) or to the Offsite Dose Calculation Manual (ODCM) made during the reporting period. Each change shall be identified by markings in the margin of the affected pages clearly indicating the area of the page that was changed and shall indicate the date the change was implemented.
- E. A list and description of abnormal releases from the site to unrestricted areas of radioactive materials in gaseous and liquid effluents made during the reporting period.
- F. An explanation of why instrumentation designated in the ODCM Part I, Sections 2.1.1 and 2.2.1 was not restored to OPERABLE status within 30 days.

- 5.2.1 G. A description of any major design changes or modifications made to the Liquid and/or Gaseous Radwaste Treatment Systems or Ventilation Exhaust Systems during the reporting period.
- H. An explanation of why the liquid and/or gaseous radwaste treatment systems were not OPERABLE, causing the limits of Specifications 3.1.3.A and 3.2.4.A to be exceeded.

5.2.2 Annual Radiological Environmental Operating Report

The Annual Radiological Environmental Operating Report for the previous one year of operation shall be submitted prior to May 1 of each year. This report contains the data gathered from the Radiological Environmental Monitoring Program. The content of the report shall include:

- A. Summarized and tabulated results of the radiological environmental sampling/analysis activities following the format of Regulatory Guide 4.8, Table 1. In the event that some results are not available, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.
- B. Interpretations and statistical evaluation of the results, including an assessment of the observed impacts of the plant operation and environment.
- C. The results of participation in a NRC approved Interlaboratory Comparison Program.
- D. The results of land use survey required by Section 4.2
- E. The results of specific activity analysis in which the primary coolant exceeded the limits of Technical Specification 2.1.3. The following information shall be included:
- 1) Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded.
 - 2) Results of the last isotopic analysis for radioiodine performed prior to exceeding the limit, results of analysis while limit was exceeded and results of one analysis after the radioiodine activity was reduced to less than the limit. Each result should include date and time of sampling and the radioiodine concentrations.

- 5.2.2E
- 3) Purification system flow history starting 48 hours prior to the first sample in which the limit was exceeded.
 - 4) Graph of the I-131 concentration and one other radioiodine isotope concentration in micro-curies per gram as a function of time for the duration of the specific activity above the steadystate level, AND
 - 5) The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

5.2.3 Special Report

If the limits or requirements of Sections 3.1.2A, 3.1.3A, 3.2.2A, 3.2.3A, 3.2.4A, 3.3.1A and/or 4.1.1A.3) are exceeded, a Special Report shall be issued to the Commission, pursuant to Technical Specification 5.16. This report shall include:

- A. The results of an investigation to identify the causes for exceeding the specification.
- B. Define and initiate a program of action to reduce levels to within the specification limits.
- C. The report shall also include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the condition.

5.2.4 EPA 40 CFR Part 190 Reporting Requirements

With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of dose from Specifications 3.1.2.A, 3.2.2.A, or 3.2.3.A, calculations shall be made including direct radiation calculations, to prepare and submit a special report to the Commission within 30 days and limit the subsequent releases such that the dose to any real individual from uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except thyroid, which is limited to ≤ 75 mrem) over the calendar year. This special report shall include an analysis which demonstrates that radiation exposures to any member of the public from uranium fuel cycle sources (including all effluent pathways and direct radiation) are less than the 40 CFR Part 190 standard. Otherwise, obtain a variance from the Commission to permit releases which exceed the 40 CFR Part 190 standard. The submittal of the report is to be considered a timely request and a variance is granted pending the final action on the variance request from the Commission.

5.3 Change Mechanism

The ODCM is the controlling document for all radioactive effluent releases. It is defined as a procedure under the guidance of Technical Specification 5.8. It will be revised and reviewed by the Plant Review Committee and approved by the Plant Manager in accordance with Technical Specification 5.17. All changes to the ODCM will be forwarded to the Nuclear Regulatory Commission during the next reporting period for the Annual Radioactive Effluent Release Report in accordance with the requirements of Technical Specification 5.17.

5.4 Meteorological Data

The Annual Average χ/Q is utilized to determine the concentrations of radionuclides at the unrestricted area boundary. It is also the factor used in conjunction with the parameters and methodologies in Part II to determine unrestricted area dose on a quarterly bases or as needed. It is based on an average of the highest calculated sector χ/Q values, using all 16 sectors for each of the three previous year Annual Radioactive Effluent Release Reports, and the XOQDOQ plume trajectory model. An additional 10 percent will be added to the average for unrestricted area dose estimates performed quarterly or as needed for conservatism. When calculating χ/Q data for the Annual Radiological Effluent Release Report, if the highest calculated χ/Q for the reporting period is observed to be greater than $\pm 10\%$ of the Annual Average χ/Q previously calculated, contact the Supervisor-System Chemistry for further instructions. This model conforms with the Nuclear Regulatory Commissions Regulatory Guide 1.111.

Real time meteorological data will be utilized in the preparation of the Annual Radioactive Effluent Release Report. This data is used to calculate the joint frequency table, the dispersion coefficients and deposition factors in all 16 sectors. These are used in the calculation of doses to individuals in unrestricted areas as a result of the operation of Fort Calhoun Station. The models used, GASPAS 2 and LADTAP 2, conform with the Nuclear Regulatory Commissions Reg. Guide 1.109 and 1.21 for the reporting of doses due to routine radioactive effluent releases.

5.5 References

Regulatory Guide 1.109, Rev. 1 - Calculation of Annual Dose to man from Routine Releases of Reactor Effluents for the purpose of evaluation compliance with 10 CFR Part 50, Appendix I

Regulatory Guide 1.111, Rev. 1 - Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors.

Regulatory Guide 1.113, Rev. 1 - Estimating Aquatic Dispersion of Effluents from Accidental and Routine Releases for the purpose of Implementing Appendix I.

Regulatory Guide 4.8, Environmental Technical Specification for Nuclear Power Plants.

NUREG-0133 - Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants.

NUREG-0472, Rev. 3 - Draft Radiological Effluent Technical Specifications for PWRs.

Regulatory Guide 1.21, Rev. 1 - Measuring, Evaluating, and Reporting Radioactivity in solid wastes and Releases of Radioactivity Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants.

Code of Federal Regulations, Title 10, Part 20

Code of Federal Regulations, Title 10, Part 50

Code of Federal Regulations, Title 40, Part 190

Fort Calhoun Revised Environmental Report (Unit No. 1)-1972

Fort Calhoun Technical Specifications (Unit No. 1)

Updated Safety Analysis Report

AR 12357, Implement Recommendations of Memo FC-0133-92, Part 1, Table 2.2.1 Action 4