

# WOLF CREEK

NUCLEAR OPERATING CORPORATION

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APR 28 2000

WO 00-0019

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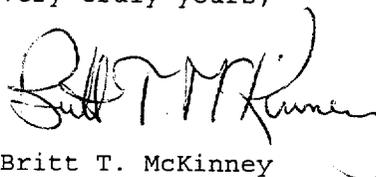
Subject: Docket No. 50-482: Wolf Creek Generating Station Annual  
Radioactive Effluent Release Report -  
Report 23

Gentlemen:

This letter transmits the enclosed Wolf Creek Generating Station (WCGS) Annual Radioactive Effluent Release Report. The report covers the period from January 1, 1999, through December 31, 1999. It is being submitted pursuant to Section 5.6.3 of the WCGS Technical Specifications. Changes to the WCGS Offsite Dose Calculation Manual and the WCGS Solid Waste Process Control Program are included as attachments to the report. There were no commitments in this submittal.

If you should have any questions regarding this submittal, please contact me at (316) 364-4112, or Mr. Karl A. (Tony) Harris at (316) 364-4038.

Very truly yours,



Britt T. McKinney

BTM/rlr

Enclosure

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**Wolf Creek Nuclear Operating Corporation**

Wolf Creek Generating Station

Docket No: 50-482  
Facility Operating License No: NPF-42

**Annual Radioactive Effluent Release Report**

**Report No. 23**

Reporting Period: January 1, 1999 - December 31, 1999

## Table of Contents

	<u>Page</u>
<b>Executive Summary</b>	<b>3</b>
<b>Section I</b>	<b>4</b>
Report of 1999 Radioactive Effluents: Liquid	4 and 5
1999 Liquid Effluents	6 and 7
1999 Liquid Cumulative Dose Summary - Table 1	8
1999 Liquid Cumulative Dose Summary - Table 2	9
Report of 1999 Radioactive Effluents: Airborne	10 and 11
1999 Gaseous Effluents	12 and 13
1999 Gaseous Cumulative Dose Summary - Table 1	14
1999 Gaseous Cumulative Dose Summary - Table 2	15
<b>Section II</b>	<b>16</b>
Offsite Dose Calculation Manual Limits	16
Maximum Permissible Concentrations (MPCs) and Effluent Concentration Limits (ECLs)	16
Average Energy	17
Measurements and Approximations of Total Radioactivity - (Liquid and Gaseous Effluents)	17 and 18
Batch Releases	19
Continuous Releases	19
Doses to a Member of the Public from Activities Inside the Site Boundary	19
Additional Information	19
1999 Effluent Concentration Limits	20
1999 Solid Waste Shipments	21 and 22
Irradiated Fuel Shipments	22
<b>Section III</b>	<b>23</b>
Meteorological Data - Hours At Each Wind Speed And Direction	24 through 31
<b>Section IV</b>	<b>32</b>
Unplanned or Abnormal Releases	32
Offsite Dose Calculation Manual	32
Major Changes to Liquid, Solid, Gaseous, or Radioactive Waste Treatment Systems	32
Land Use Census	32
Radioactive Shipments	32
Inoperability of Effluent Monitoring Instrumentation	32
Storage Tanks	32
<b>Attachment I - Wolf Creek Nuclear Operating Corporation Administrative Procedure AP 07B-003, Revision 3, "Offsite Dose Calculation Manual"</b>	
<b>Attachment II - Wolf Creek Nuclear Operating Corporation Administrative Procedure AP 07B-004, Revision 0, "Offsite Dose Calculation Manual (Radiological Environmental Monitoring Program)"</b>	
<b>Attachment III - Wolf Creek Nuclear Operating Corporation Administrative Procedure AP 31A-100, Revision 2, "Solid Waste Process Control Program"</b>	

## EXECUTIVE SUMMARY

This Annual Radioactive Effluent Release Report (Report # 23) documents the quantities of liquid and gaseous effluents and solid waste released by the Wolf Creek Generating Station (WCGS) from January 1, 1999, through December 31, 1999. The format and content of this report is in accordance with Regulatory Guide 1.21, Revision 1. Sections I, II, III, and IV of this report provide information required by NRC Regulatory Guide 1.21 and Section 7.2 of the Offsite Dose Calculation Manual (ODCM).

**Section I** --- Section I of this report lists in detail the quantities of radioactive liquid and gaseous effluents and cumulative dose summaries for 1999, tabulated for each quarter and for yearly totals. Specific ODCM effluent limits and dose limits are also listed in Section I, along with the percentage of the effluent limits actually released, and the percentages of the dose limit actually received. No effluent or dose limits were exceeded during 1999.

An elevated release pathway does not exist at WCGS. All airborne releases are considered to be ground level releases. The gaseous pathway dose determination is met by the WCGS ODCM methodology of assigning all gaseous pathways to a hypothetical individual residing at the highest annual X/Q and D/Q location, as specified in the ODCM. This results in a conservative estimate of dose to a member of the public, rather than determining each pathway dose for each release condition. A conservative error of thirty percent has been estimated in the effluent data. As stated above, no ODCM dose limits were exceeded in 1999.

**Section II** --- This section includes supplemental information on continuous and batch releases, calculated doses, and solid waste disposal. There were more gaseous batch releases in 1999 than in 1998 (74 versus 71), and more liquid batch releases as well (84 versus 35). This can be attributed to the fact that 1999 was an outage year and many liquid discharges were made from the smaller tanks in our radwaste system. Continuous release pathways remained the same as previous years and all continuous releases were monitored. Maximum estimated doses to members of the public decreased from the 1998 estimates (6.61E-01 mRem to 4.55E-01 mRem) due to decreased mRem estimates for plant deliveries, plant access road users, William Allen White Building workers, and public use of the Coffey County Lake (Wolf Creek Lake). Section II also includes additional information regarding the presence of Sb-125 in gaseous releases. During 1999, Wolf Creek changed the liquid release rate limit from a limit based on Maximum Permissible Concentrations (MPCs) to a limit based on Effluent Concentration Limits (ECLs), as contained in the current 10 CFR 20. The gaseous release limits remain unchanged.

**Section III** --- This section documents WCGS meteorological data for wind speed, wind direction, and atmospheric stability. The quantity of missing hours of data for 1999 was 1900 hours. This corresponds to approximately 78.3% data availability. This lower availability was largely due to the unavailability, for approximately 60 days, of a single required monitoring instrument on the meteorological tower. This event has been documented under the plant's corrective action program as Performance Improvement Request (PIR) 99-2474 and in NRC Inspection Report 99-11.

**Section IV** --- Planned and unplanned releases, changes to radwaste treatment systems, land use census, monitoring instruments, radwaste shipments, and storage tank quantities are given in this section. No changes or events occurred to the land use census, monitoring instruments, radwaste shipments, and storage tanks. An updated ODCM is included and submitted with this Annual Radioactive Effluent Release Report as Administrative Procedures (AP) 07B-003, Revision 3, "Offsite Dose Calculation Manual" and AP 07B-004, Revision 0, "Offsite Dose Calculation Manual (Radiological Environmental Monitoring Program)" - Attachments I and II. The WCGS Solid Waste Process Control Program was revised in 1999 and has been submitted with this report as Attachment III. No major modifications have taken place on the radwaste systems during 1999; however, as reported in last year's annual report, temporary modification TMO 98-018-HB was installed in July, 1998, to reduce liquid curies released.

## SECTION I

### REPORT OF 1999 RADIOACTIVE EFFLUENTS: LIQUID

	Unit	Quarter 1	Quarter 2
<b>A. Fission and Activation Products</b>			
1. Total Release (not including tritium, gases, alpha)	Ci	1.227E-02	1.138E-02
2. Average Diluted Concentration During Period	μCi/ml	7.097E-10	3.010E-10
3. Percent of Applicable Limit (1)	%	2.454E-01	2.276E-01
<b>B. Tritium</b>			
1. Total Release	Ci	5.148E+02	2.817E+02
2. Average Diluted Concentration During Period	μCi/ml	2.978E-05	7.437E-06
3. Percent of Applicable Limit (MPC)	%	9.927E-01	2.479 E-01
(ECL) (2)	%	2.978E+00	7.437E-01
<b>C. Dissolved and Entrained Gases</b>			
1. Total Release	Ci	3.212E-01	9.398E-01
2. Average Diluted Concentration During Period	μCi/ml	1.858E-08	2.481E-08
3. Percent of Applicable Limit (3)	%	9.290E-03	1.240E-02
<b>D. Gross Alpha Radioactivity</b>			
1. Total Release	Ci	3.110E-04	5.450E-05
<b>E. Volume of waste released (prior to dilution)</b>			
	liters	4.940E+07	2.485E+08
<b>F. Volume of dilution water used</b>			
	liters	1.724E+10	3.763E+10

1) The applicable limit for the Wolf Creek Generating Station is 5 Curies per year. (Reference 10 CFR 50, Appendix I, "Guides On Design Objectives For Light-Water Cooled Nuclear Power Reactors," Paragraph A.2). The value printed here is derived by dividing the total release Curies by 5 Curies and then multiplying the result by 100.

2) This value is derived by the following formula:

$$\% \text{ of Applicable Limit} = \frac{(\text{Average Diluted Concentration}) (100)}{(\text{MPC or ECL, Appendix B, Table 2 10CFR20} *)}$$

3) This value is derived by the following formula:

$$\% \text{ of Applicable Limit} = \frac{(\text{Average Diluted Concentration}) (100)}{(2E - 4 \text{ from ODCM Section 2.1})}$$

\* (MPC was addressed in earlier revisions of 10CFR20.)

## REPORT OF 1999 RADIOACTIVE EFFLUENTS: LIQUID

	Unit	Quarter 3	Quarter 4
<b>A. Fission and Activation Products</b>			
1. Total Release (not including tritium, gases, alpha)	Ci	1.511E-02	1.530E-02
2. Average Diluted Concentration During Period	μCi/ml	7.374E-10	8.337E-10
3. Percent of Applicable Limit (1)	%	3.022E-01	3.060E-01
<b>B. Tritium</b>			
1. Total Release	Ci	5.694E+01	3.188E+02
2. Average Diluted Concentration During Period	μCi/ml	2.779E-06	1.737E-05
3. Percent of Applicable Limit (MPC)	%	9.263E-02	5.790E-01
(ECL) (2)	%	2.779E-01	1.737E+00
<b>C. Dissolved and Entrained Gases</b>			
1. Total Release	Ci	0.000E+00	2.482E-02
2. Average Diluted Concentration During Period	μCi/ml	0.000E+00	1.353E-09
3. Percent of Applicable Limit (3)	%	0.000E+00	6.765E-04
<b>D. Gross Alpha Radioactivity</b>			
1. Total Release	Ci	7.427E-05	1.540E-05
<b>E. Volume of waste released (prior to dilution)</b>			
	liters	5.120E+07	4.119E+07
<b>F. Volume of dilution water used</b>			
	liters	2.044E+10	1.831E+10

1) The applicable limit for the Wolf Creek Generating Station is 5 Curies per year. (Reference 10 CFR 50, Appendix I, "Guides On Design Objectives For Light-Water Cooled Nuclear Power Reactors," Paragraph A.2). The value printed here is derived by dividing the total release Curies by 5 Curies and then multiplying the result by 100.

2) This value is derived by the following formula:

$$\% \text{ of Applicable Limit} = \frac{(\text{Average Diluted Concentration}) (100)}{(\text{MPC or ECL, Appendix B, Table 2 10CFR20} *)}$$

3) This value is derived by the following formula:

$$\% \text{ of Applicable Limit} = \frac{(\text{Average Diluted Concentration}) (100)}{(2E - 4 \text{ from ODCM Section 2.1})}$$

\* (MPC was addressed in earlier revisions of 10CFR20.)

### 1999 LIQUID EFFLUENTS

NUCLIDES RELEASED	Unit	Continuous Mode		Batch Mode	
		Quarter 1	Quarter 2	Quarter 1	Quarter 2
H-3	Ci	3.64E-01	5.99E-01	5.14E+02	2.81E+02
Cr-51	Ci	n/a	n/a	n/a	1.00E-04
Mn-54	Ci	<2.43E-02	<1.24E-01	6.82E-05	9.59E-05
Fe-55	Ci	<4.86E-02	<2.47E-01	<7.76E-04	<1.02E-03
Fe-59	Ci	<2.43E-02	<1.24E-01	<3.88E-04	8.00E-06
Co-57	Ci	n/a	n/a	n/a	9.06E-06
Co-58	Ci	<2.43E-02	<1.24E-01	4.16E-04	4.30E-03
Co-60	Ci	<2.43E-02	<1.24E-01	6.15E-04	1.07E-03
Zn-65	Ci	<2.43E-02	<1.24E-01	<3.88E-04	<5.11E-04
Sr-89	Ci	<2.43E-03	<1.24E-02	<3.88E-05	<5.11E-05
Sr-90	Ci	<2.43E-03	<1.24E-02	<3.88E-05	<5.11E-05
Sr-92	Ci	n/a	n/a	n/a	n/a
Nb-95	Ci	n/a	n/a	n/a	3.23E-05
Zr-95	Ci	n/a	n/a	n/a	1.12E-05
Zr-97	Ci	n/a	n/a	n/a	n/a
Mo-99	Ci	<2.43E-02	<1.24E-01	<3.88E-04	<5.11E-04
Ag-110M	Ci	n/a	n/a	n/a	n/a
Sn-113	Ci	n/a	n/a	n/a	n/a
Sn-117M	Ci	n/a	n/a	n/a	2.72E-05
Sb-124	Ci	n/a	n/a	n/a	1.33E-05
Sb-125	Ci	n/a	n/a	1.02E-02	5.15E-03
I-131	Ci	<4.86E-02	<2.47E-01	<7.76E-04	2.56E-05
Cs-134	Ci	<2.43E-02	<1.24E-01	3.54E-04	1.51E-04
Cs-137	Ci	<2.43E-02	<1.24E-01	6.43E-04	4.09E-04
Ce-141	Ci	<2.43E-02	<1.24E-01	<3.88E-04	<5.11E-04
Ce-144	Ci	<2.43E-02	<1.24E-01	<3.88E-04	<5.11E-04
Gross Alpha	Ci	2.96E-04	1.56E-05	1.48E-05	3.90E-05
Ar-41	Ci	<4.86E-01	<2.47E+00	<7.76E-03	<1.02E-02
Kr-85M	Ci	<4.86E-01	<2.47E+00	<7.76E-03	1.02E-04
Kr-85	Ci	<4.86E-01	<2.47E+00	9.09E-03	8.10E-03
Kr-87	Ci	<4.86E-01	<2.47E+00	<7.76E-03	<1.02E-02
Kr-88	Ci	<4.86E-01	<2.47E+00	<7.76E-03	<1.02E-02
Xe-131M	Ci	<4.86E-01	<2.47E+00	9.32E-03	1.25E-02
Xe-133M	Ci	<4.86E-01	<2.47E+00	5.36E-04	1.16E-02
Xe-133	Ci	<4.86E-01	2.57E-05	3.02E-01	8.87E-01
Xe-135M	Ci	<4.86E-01	<2.47E+00	<7.76E-03	<1.02E-02
Xe-135	Ci	<4.86E-01	<2.47E+00	<7.76E-03	2.01E-02

**NOTE**

“Less than” values are calculated using the Lower Limit of Detection (LLD) values listed in Table 2-1 of the ODCM multiplied by the volume of waste discharged during the respective quarter. The “less than” values are not included in the summation for the total release values.

### 1999 LIQUID EFFLUENTS

NUCLIDES RELEASED	Unit	Continuous Mode		Batch Mode	
		Quarter 3	Quarter 4	Quarter 3	Quarter 4
H-3	Ci	1.32E+00	1.51E+00	5.56E+01	3.17E+02
Cr-51	Ci	n/a	n/a	n/a	n/a
Mn-54	Ci	<2.54E-02	<2.03E-02	6.74E-05	1.60E-04
Fe-55	Ci	<5.07E-02	<4.07E-02	8.99E-04	1.16E-03
Fe-59	Ci	<2.54E-02	<2.03E-02	1.59E-06	<2.64E-04
Co-57	Ci	n/a	n/a	1.47E-05	3.25E-05
Co-58	Ci	<2.54E-02	<2.03E-02	1.96E-03	1.88E-03
Co-60	Ci	<2.54E-02	<2.03E-02	7.32E-04	4.53E-03
Rb-88	Ci	n/a	n/a	n/a	4.82E-05
Zn-65	Ci	<2.54E-02	<2.03E-02	<2.25E-04	<2.64E-04
Sr-89	Ci	<2.54E-03	<2.03E-03	<2.25E-05	<2.64E-05
Sr-90	Ci	<2.54E-03	<2.03E-03	<2.25E-05	<2.64E-05
Sr-92	Ci	n/a	n/a	n/a	n/a
Nb-95	Ci	n/a	n/a	3.23E-05	9.34E-06
Ru-103	Ci	n/a	n/a	3.26E-06	n/a
Zr-95	Ci	n/a	n/a	6.86E-06	n/a
Zr-97	Ci	n/a	n/a	n/a	n/a
Mo-99	Ci	<2.54E-02	<2.03E-02	<2.25E-04	<2.64E-04
Ag-110M	Ci	n/a	n/a	n/a	n/a
Sn-113	Ci	n/a	n/a	n/a	n/a
Sn-117M	Ci	n/a	n/a	4.80E-06	n/a
Sb-124	Ci	n/a	n/a	3.02E-06	n/a
Sb-125	Ci	n/a	n/a	9.73E-03	5.25E-03
I-131	Ci	<5.07E-02	<4.07E-02	<4.49E-04	<5.28E-04
Cs-134	Ci	<2.54E-02	<2.03E-02	5.12E-04	6.57E-04
Cs-137	Ci	<2.54E-02	<2.03E-02	1.17E-03	1.57E-03
Cs-138	Ci	n/a	n/a	n/a	8.97E-06
Ce-141	Ci	<2.54E-02	<2.03E-02	<2.25E-04	<2.64E-04
Ce-144	Ci	<2.54E-02	<2.03E-02	<2.25E-04	<2.64E-04
Gross Alpha	Ci	6.53E-05	<4.07E-03	9.02E-06	1.54E-05
Ar-41	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Kr-85M	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Kr-85	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Kr-87	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Kr-88	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Xe-131M	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Xe-133M	Ci	<5.07E-01	<4.07E-01	<4.49E-03	2.85E-04
Xe-133	Ci	<5.07E-01	<4.07E-01	<4.49E-03	2.45E-02
Xe-135M	Ci	<5.07E-01	<4.07E-01	<4.49E-03	<5.28E-03
Xe-135	Ci	<5.07E-01	<4.07E-01	<4.49E-03	7.83E-05

**NOTE**

“Less than” values are calculated using the Lower Limit of Detection (LLD) values listed in Table 2-1 of the ODCM multiplied by the volume of waste discharged during the respective quarter. The “less than” values are not included in the summation for the total release values.

**1999 LIQUID CUMULATIVE DOSE SUMMARY**  
**TABLE 1**

QUARTER 1 OF 1999	ODCM CALCULATED DOSE	ODCM <sup>1</sup> LIMIT	% OF LIMIT
TOTAL DOSE (mRem) FOR BONE	4.67E-03	5.00E+00	9.34E-02
TOTAL DOSE (mRem) FOR LIVER	7.06E-02	5.00E+00	1.41E+00
TOTAL DOSE (mRem) FOR TOTAL BODY	6.85E-02	1.50E+00	4.57E+00
TOTAL DOSE (mRem) FOR THYROID	6.28E-02	5.00E+00	1.26E-00
TOTAL DOSE (mRem) FOR KIDNEY	6.54E-02	5.00E+00	1.31E+00
TOTAL DOSE (mRem) FOR LUNG	6.37E-02	5.00E+00	1.27E+00
TOTAL DOSE (mRem) FOR GI-LLI	6.33E-02	5.00E+00	1.27E+00
QUARTER 2 OF 1999			
TOTAL DOSE (mRem) FOR BONE	1.86E-02	5.00E+00	3.72E-01
TOTAL DOSE (mRem) FOR LIVER	2.79E-01	5.00E+00	5.58E+00
TOTAL DOSE (mRem) FOR TOTAL BODY	2.70E-01	1.50E+00	1.80E+01
TOTAL DOSE (mRem) FOR THYROID	2.49E-01	5.00E+00	4.98E+00
TOTAL DOSE (mRem) FOR KIDNEY	2.58E-01	5.00E+00	5.16E+00
TOTAL DOSE (mRem) FOR LUNG	2.51E-01	5.00E+00	5.02E+00
TOTAL DOSE (mRem) FOR GI-LLI	2.54E-01	5.00E+00	5.08E+00
QUARTER 3 OF 1999			
TOTAL DOSE (mRem) FOR BONE	4.99E-03	5.00E+00	9.98E-02
TOTAL DOSE (mRem) FOR LIVER	5.20E-02	5.00E+00	1.04E+00
TOTAL DOSE (mRem) FOR TOTAL BODY	4.97E-02	1.50E+00	3.31E+00
TOTAL DOSE (mRem) FOR THYROID	4.39E-02	5.00E+00	8.78E-01
TOTAL DOSE (mRem) FOR KIDNEY	4.66E-02	5.00E+00	9.32E-01
TOTAL DOSE (mRem) FOR LUNG	4.48E-02	5.00E+00	8.97E-01
TOTAL DOSE (mRem) FOR GI-LLI	4.47E-02	5.00E+00	8.94E-01
QUARTER 4 OF 1999			
TOTAL DOSE (mRem) FOR BONE	7.93E-03	5.00E+00	1.59E-01
TOTAL DOSE (mRem) FOR LIVER	4.65E-02	5.00E+00	9.30E-01
TOTAL DOSE (mRem) FOR TOTAL BODY	4.28E-02	1.50E+00	2.86E+00
TOTAL DOSE (mRem) FOR THYROID	3.37E-02	5.00E+00	6.73E-01
TOTAL DOSE (mRem) FOR KIDNEY	3.79E-02	5.00E+00	7.59E-01
TOTAL DOSE (mRem) FOR LUNG	3.51E-02	5.00E+00	7.02E-01
TOTAL DOSE (mRem) FOR GI-LLI	3.45E-02	5.00E+00	6.90E-01
TOTALS FOR 1999			
TOTAL DOSE (mRem) FOR BONE	3.62E-02	1.00E+01	3.62E-01
TOTAL DOSE (mRem) FOR LIVER	4.48E-01	1.00E+01	4.48E+00
TOTAL DOSE (mRem) FOR TOTAL BODY	4.31E-01	3.00E+00	1.44E+01
TOTAL DOSE (mRem) FOR THYROID	3.89E-01	1.00E+01	3.89E+00
TOTAL DOSE (mRem) FOR KIDNEY	4.08E-01	1.00E+01	4.08E+00
TOTAL DOSE (mRem) FOR LUNG	3.95E-01	1.00E+01	3.95E+00
TOTAL DOSE (mRem) FOR GI-LLI	3.96E-01	1.00E+01	3.96E+00

1. Based on ODCM Section 2.2, which restricts dose to the whole body to less than or equal to 1.5 mRem per quarter and 3.0 mRem per year. Dose restriction of any organ is less than or equal to 5 mRem per quarter and 10 mRem per year.

**1999 LIQUID CUMULATIVE DOSE SUMMARY  
TABLE 2**

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
A.	Fission and Activation Products(not including H-3, gases, alpha)					
1.	Total Release - (Ci)	1.23E-02	1.14E-02	1.51E-02	1.53E-02	5.41E-02
2.	Maximum Organ Dose (mRem)	7.79E-03	3.05E-02	8.09E-03	1.28E-02	5.92E-02
3.	Organ Dose Limit (mRem)	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
4.	Percent of Limit	1.56E-01	6.10E-01	1.62E-01	2.56E-01	5.92E-01
B.	Tritium					
1.	Total Release - (Ci)	5.15E+02	2.82E+02	5.69E+01	3.19E+02	1.17E+03
2.	Maximum Organ Dose (mRem)	6.28E-02	2.48E-01	4.39E-02	3.37E-02	3.88E-01
3.	Organ Dose Limit (mRem)	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
4.	Percent of Limit	1.26E+00	4.96E+00	8.78E-01	6.74E-01	3.88E+00

This table is included to show the correlation between Curies released and the associated calculated maximum organ dose. Wolf Creek ODCM methodology is used to calculate the maximum organ dose which assumes that an individual drinks the water and eats the fish from the discharge point. ODCM Section 2.2 organ dose limits are used.

**REPORT OF 1999 RADIOACTIVE EFFLUENTS: AIRBORNE**

	Unit	Quarter 1	Quarter 2
<b>A. Fission and Activation Gases</b>			
1. Total Release	Ci	2.086E+01	2.261E+01
2. Average Release Rate for Period	μCi/sec	2.683E+00	2.876E+00
3. Percent of ODCM Limit (1)	%	1.83E-02	1.72E-02
<b>B. Iodines</b>			
1. Total Iodine-131	Ci	0.000E+00	1.717E-04
2. Average Release Rate for Period	μCi/sec	0.000E+00	2.184E-05
3. Percent of Applicable Limit (2)	%	0.000E+00	1.72E-02
<b>C. Particulates</b>			
1. Particulates with Half-lives > 8 days	Ci	0.000E+00	1.043E-04
2. Average Release Rate for Period	μCi/sec	0.000E+00	1.327E-05
3. Percent of ODCM Limit (3)	%	0.000E+00	0.000E+00
4. Gross Alpha Radioactivity	Ci	3.398E-08	5.326E-08
<b>D. Tritium</b>			
Total Release	Ci	8.634E+00	1.548E+01
Average Release Rate for Period	μCi/sec	1.110E+00	1.969E+00
Percent of ODCM Limit (4)	%	8.13E-02	1.45E-01

- 1) The percent of ODCM limit for fission and activation gases is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Qtrly Total Beta Airdose})(100)}{10 \text{ mrad}} \text{ or } \frac{(\text{Qtrly Total Gamma Airdose})(100)}{5 \text{ mrad}}$$

The largest value calculated between Gamma and Beta air dose is listed as the % of ODCM Limit.

- 2) The percent of ODCM limit for iodine is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Total Curies of Iodine - 131})(100)}{1 \text{ Curie}}$$

- 3) The percent of ODCM limit for particulates is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Highest Organ Dose Due to Particulates})(100)}{7.5 \text{ mrem}}$$

**NOTE**

This type of methodology is used since the Wolf Creek ODCM ties release limits to doses rather than Curie release rates.

- 4.) The percent of ODCM limit for tritium is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Highest Organ Dose Due to H - 3})(100)}{7.5 \text{ mrem}}$$

## REPORT OF 1999 RADIOACTIVE EFFLUENTS: AIRBORNE

	Unit	Quarter 3	Quarter 4
<b>A. Fission and Activation Gases</b>			
1. Total Release	Ci	3.619E-01	5.521E-01
2. Average Release Rate for Period	μCi/sec	4.553E-02	6.946E-02
3. Percent of ODCM Limit (1)	%	4.16E-03	6.18E-03
<b>B. Iodines</b>			
1. Total Iodine-131	Ci	0.000E+00	0.000E+00
2. Average Release Rate for Period	μCi/sec	0.000E+00	0.000E+00
3. Percent of Applicable Limit (2)	%	0.000E+00	0.000E+00
<b>C. Particulates</b>			
1. Particulates with Half-lives > 8 days	Ci	0.000E+00	0.000E+00
2. Average Release Rate for Period	μCi/sec	0.000E+00	0.000E+00
3. Percent of ODCM Limit (3)	%	0.000E+00	0.000E+00
4. Gross Alpha Radioactivity	Ci	2.539E-08	2.926E-08
<b>D. Tritium</b>			
Total Release	Ci	1.230E+01	1.433E+01
Average Release Rate for Period	μCi/sec	1.547E+00	1.803E+00
Percent of ODCM Limit (4)	%	1.16E-01	1.36E-01

- 1) The percent of ODCM limit for fission and activation gases is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Qtrly Total Beta Airdose})(100)}{10 \text{ mrad}} \text{ or } \frac{(\text{Qtrly Total Gamma Airdose})(100)}{5 \text{ mrad}}$$

The largest value calculated between Gamma and Beta air dose is listed as the % of ODCM Limit.

- 2) The percent of ODCM limit for iodine is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Total Curies of Iodine - 131})(100)}{1 \text{ Curie}}$$

- 3) The percent of ODCM limit for particulates is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Highest Organ Dose Due to Particulates})(100)}{7.5 \text{ mrem}}$$

### NOTE

**This type of methodology is used since the Wolf Creek ODCM ties release limits to doses rather than Curie release rates.**

- 4.) The percent of ODCM limit for tritium is calculated using the following methodology:

$$\% \text{ of ODCM Limit} = \frac{(\text{Highest Organ Dose Due to H - 3})(100)}{7.5 \text{ mrem}}$$

### 1999 GASEOUS EFFLUENTS

NUCLIDES RELEASED	Unit	Continuous Mode		Batch Mode	
		Quarter 1	Quarter 2	Quarter 1	Quarter 2
1. Fission and Activation Gases					
Ar-41	Ci	N/A	N/A	3.26E-01	3.85E-01
Kr-85	Ci	N/A	N/A	3.49E+00	N/A
Kr-85M	Ci	N/A	N/A	N/A	N/A
Kr-87	Ci	<2.04E+01	<2.07E+01	<2.55E-02	<1.20E+00
Kr-88	Ci	<1.75E+01	<1.77E+01	<2.18E-02	<1.03E+00
Xe-131M	Ci	N/A	N/A	N/A	N/A
Xe-133	Ci	1.66E+01	6.16E+00	1.39E-01	1.61E+01
Xe-133M	Ci	<3.69E+01	<3.74E+01	<4.61E-02	<2.17E+00
Xe-135	Ci	3.33E-01	7.23E-03	<6.82E-03	<3.22E-01
Xe-138	Ci	<4.46E+02	<4.52E+02	<5.57E-01	<2.63E+01
Total	Ci	1.69E+01	6.17E+00	3.96E+00	1.65E+01
2. Halogens (Gaseous)					
I-131	Ci	<2.56E-04	1.72E-04	<3.20E-07	<1.51E-05
I-133	Ci	<2.56E-02	<2.60E-02	<3.20E-05	<1.51E-03
Total	Ci	0.00E+00	1.72E-04	0.00E+00	0.00E+00
3. Particulates and Tritium					
H-3	Ci	8.47E+00	1.22E+01	1.65E-01	3.33E+00
Mn-54	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Fe-59	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Co-58	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Co-60	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Zn-65	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Mo-99	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Cs-134	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Cs-137	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Ce-141	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Ce-144	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Sr-89	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Sr-90	Ci	<2.56E-03	<2.60E-03	<3.20E-06	<1.51E-04
Gross Alpha	Ci	3.40E-08	5.33E-08	<3.20E-06	<1.51E-04
Sb-125	Ci	N/A	1.04E-04	N/A	N/A
Total	Ci	8.47E+00	1.22E+01	1.65E-01	3.33E+00

#### NOTE

“Less than” values for Noble Gases are calculated using the Lower Limit of Detection (LLD) values obtained at Wolf Creek Generating Station multiplied by the volume of air discharged during the respective quarter. For the Halogens and Particulates the ODCM LLD values are used.

### 1999 GASEOUS EFFLUENTS (Continued)

NUCLIDES RELEASED	Unit	Continuous Mode		Batch Mode	
		Quarter 3	Quarter 4	Quarter 3	Quarter 4
1. Fission and Activation Gases					
Ar-41	Ci	N/A	N/A	3.19E-01	4.74E-01
Kr-85	Ci	N/A	N/A	N/A	N/A
Kr-85M	Ci	N/A	N/A	N/A	N/A
Kr-87	Ci	<2.11E+01	<2.08E+01	<2.71E-02	<3.70E-02
Kr-88	Ci	<1.81E+01	<1.78E+01	<2.32E-02	<3.16E-02
Xe-131M	Ci	N/A	N/A	N/A	N/A
Xe-133	Ci	<1.20E+01	<1.18E+01	4.23E-02	7.79E-02
Xe-133M	Ci	<3.81E+01	<3.76E+01	6.45E-04	<6.69E-02
Xe-135	Ci	<5.65E+00	<5.58E+00	<7.25E-03	<9.89E-03
Xe-138	Ci	<4.61E+02	<4.55E+02	<5.92E-01	<8.08E-01
Total	Ci	0.00E+00	0.00E+00	3.62E+01	5.52E-01
2. Halogens (Gaseous)					
I-131	Ci	<2.65E-04	<2.62E-04	<3.40E-07	<4.64E-07
I-133	Ci	<2.65E-02	<2.62E-02	<3.40E-05	<4.64E-05
Total	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Particulates and Tritium					
H-3	Ci	1.17E+01	1.35E+01	6.12E-01	8.20E-01
Mn-54	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Fe-59	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Co-58	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Co-60	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Zn-65	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Mo-99	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Cs-134	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Cs-137	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Ce-141	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Ce-144	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Sr-89	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Sr-90	Ci	<2.65E-03	<2.62E-03	<3.40E-06	<4.64E-06
Gross Alpha	Ci	2.54E-08	2.93E-08	<3.40E-06	<4.64E-06
Total	Ci	1.17E+01	1.35E+01	6.12E-01	8.20E-01

**NOTE**

“Less than” values for Noble Gases are calculated using the Lower Limit of Detection (LLD) values obtained at Wolf Creek Generating Station multiplied by the volume of air discharged during the respective quarter. For the Halogens and Particulates, the ODCM LLD values are used.

**1999 GASEOUS CUMULATIVE DOSE SUMMARY**  
**TABLE 1**

QUARTER 1 OF 1999	ODCM CALCULATED DOSE	ODCM <sup>1</sup> LIMIT	% OF LIMIT
TOTAL DOSE (mRem) FOR BONE	0.00E+00	7.50E+00	0.00E+00
TOTAL DOSE (mRem) FOR LIVER	6.10E-03	7.50E+00	8.14E-02
TOTAL DOSE (mRem) FOR TOTAL BODY	6.10E-03	7.50E+00	8.14E-02
TOTAL DOSE (mRem) FOR THYROID	6.10E-03	7.50E+00	8.14E-02
TOTAL DOSE (mRem) FOR KIDNEY	6.10E-03	7.50E+00	8.14E-02
TOTAL DOSE (mRem) FOR LUNG	6.10E-03	7.50E+00	8.14E-02
TOTAL DOSE (mRem) FOR GI-LLI	6.10E-03	7.50E+00	8.14E-02
QUARTER 2 OF 1999			
TOTAL DOSE (mRem) FOR BONE	2.99E-04	7.50E+00	3.99E-03
TOTAL DOSE (mRem) FOR LIVER	1.12E-02	7.50E+00	1.50E-01
TOTAL DOSE (mRem) FOR TOTAL BODY	1.11E-02	7.50E+00	1.48E-01
TOTAL DOSE (mRem) FOR THYROID	1.10E-01	7.50E+00	1.46E+00
TOTAL DOSE (mRem) FOR KIDNEY	1.14E-02	7.50E+00	1.52E-01
TOTAL DOSE (mRem) FOR LUNG	1.09E-02	7.50E+00	1.45E-01
TOTAL DOSE (mRem) FOR GI-LLI	1.10E-02	7.50E+00	1.47E-01
QUARTER 3 OF 1999			
TOTAL DOSE (mRem) FOR BONE	0.00E+00	7.50E+00	0.00E+00
TOTAL DOSE (mRem) FOR LIVER	8.69E-03	7.50E+00	1.16E-01
TOTAL DOSE (mRem) FOR TOTAL BODY	8.69E-03	7.50E+00	1.16E-01
TOTAL DOSE (mRem) FOR THYROID	8.69E-03	7.50E+00	1.16E-01
TOTAL DOSE (mRem) FOR KIDNEY	8.69E-03	7.50E+00	1.16E-01
TOTAL DOSE (mRem) FOR LUNG	8.69E-03	7.50E+00	1.16E-01
TOTAL DOSE (mRem) FOR GI-LLI	8.69E-03	7.50E+00	1.16E-01
QUARTER 4 OF 1999			
TOTAL DOSE (mRem) FOR BONE	0.00E+0	7.50E+00	0.00E+00
TOTAL DOSE (mRem) FOR LIVER	1.02E-02	7.50E+00	1.36E-01
TOTAL DOSE (mRem) FOR TOTAL BODY	1.02E-02	7.50E+00	1.36E-01
TOTAL DOSE (mRem) FOR THYROID	1.02E-02	7.50E+00	1.36E-01
TOTAL DOSE (mRem) FOR KIDNEY	1.02E-02	7.50E+00	1.36E-01
TOTAL DOSE (mRem) FOR LUNG	1.02E-02	7.50E+00	1.36E-01
TOTAL DOSE (mRem) FOR GI-LLI	1.02E-02	7.50E+00	1.36E-01
TOTALS FOR 1999			
TOTAL DOSE (mRem) FOR BONE	3.29E-04	1.50E+01	2.19E-03
TOTAL DOSE (mRem) FOR LIVER	3.62E-02	1.50E+01	2.41E-01
TOTAL DOSE (mRem) FOR TOTAL BODY	3.61E-02	1.50E+01	2.41E-01
TOTAL DOSE (mRem) FOR THYROID	1.35E-01	1.50E+01	9.00E-01
TOTAL DOSE (mRem) FOR KIDNEY	3.64E-02	1.50E+01	2.42E-01
TOTAL DOSE (mRem) FOR LUNG	3.60E-02	1.50E+01	2.40E-01
TOTAL DOSE (mRem) FOR GI-LLI	3.60E-02	1.50E+01	2.40E-01

1. Based on Wolf Creek ODCM Section 3.2.2 which restricts dose during any calendar quarter to less than or equal to 7.5 mRem to any organ and during any calendar year to less than or equal to 15 mRem to any organ.

**1999 GASEOUS CUMULATIVE DOSE SUMMARY**  
**TABLE 2**

	Nuclides Released	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
A.	Fission and Activation Gases					
1.	Total Release - (Ci)	2.09E+01	2.26E+01	3.62E-01	5.52E-01	4.44E+01
2.	Total Gamma Airdose (mRad)	6.72E-04	7.98E-04	2.08E-04	3.09E-04	1.99E-03
3.	Gamma Airdose Limit (mRad)	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
4.	Percent of Gamma Airdose Limit	1.34E-02	1.60E-02	4.16E-03	6.19E-03	1.99E-02
5.	Total Beta Airdose (mRad)	1.83E-03	1.72E-03	7.61E-05	1.14E-04	3.74E-03
6.	Beta Airdose Limit (mRad)	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
7.	Percent of Beta Airdose Limit (mRad)	1.83E-02	1.72E-02	7.61E-04	1.14E-03	1.87E-02
B.	Particulates					
1.	Total Particulates (Ci)	0.00E+00	1.04E-04	0.00E+00	0.00E+00	1.04E-04
2.	Maximum Organ Dose (mRem)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.	Organ Dose Limit (mRem)	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
4.	Percent of Limit	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C.	Tritium					
1.	Total Release (Ci)	8.63E+00	1.55E+01	1.23E+01	1.43E+01	5.07E+01
2.	Maximum Organ Dose (mRem)	6.10E-03	1.09E-02	8.69E-03	1.02E-02	3.59E-02
3.	Organ Dose Limit (mRem)	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
4.	Percent of Limit	8.13E-02	1.45E-01	1.16E-01	1.36E-01	2.39E-01
D.	Iodine					
1.	Total I-131, I-133 (Ci)	0.00E+00	1.72E-04	0.00E+00	0.00E+00	1.72E-04
2.	Maximum Organ Dose (mRem)	0.00E+00	9.88E-02	0.00E+00	0.00E+00	9.88E-02
3.	Organ Dose Limit (mRem)	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
4.	Percent of Limit	0.00E+00	1.32E+00	0.00E+00	0.00E+00	6.59E-01

This table is included to show the correlation between Curies released and the associated calculated maximum organ dose. The maximum organ dose is calculated using Wolf Creek ODCM methodology which assumes that an individual actually resides at the release point. ODCM Section 3.2.2 organ dose limits are used.

## SECTION II

### SUPPLEMENTAL INFORMATION

#### 1. Offsite Dose Calculation Manual Limits

##### A. For liquid waste effluents

- A.1 The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to  $2 \times 10^{-4}$  microCuries/ml total activity.
- A.2 The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each unit, to UNRESTRICTED AREAS shall be limited:
- During any calendar quarter to less than or equal to 1.5 mrem to the whole body and to less than or equal to 5 mrem to any organ, and
  - During any calendar year to less than or equal to 3 mrem, to the whole body and to less than or equal to 10 mrem to any organ.

##### B. For gaseous waste effluents

- B.1 The dose rate due to radioactive material released in gaseous effluents from the site to area at and beyond the SITE BOUNDARY shall be limited to the following:
- For noble gases: Less than or equal to 500 mrem/yr to the whole body and less than or equal to 3000 mrem/yr to the skin, and
  - For Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.
- B.2 The air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the SITE BOUNDARY shall be limited to the following:
- 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
  - 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.
- B.3 The dose from Iodine-131, Iodine-133, tritium, and a radionuclide in particulate form with half-lives greater than 8 days in gaseous effluents released to area at and beyond the SITE BOUNDARY shall be limited to the following:
- During any calendar quarter: Less than or equal to 7.5 mrem to any organ, and
  - During any calendar year: Less than or equal to 15 mrem to any organ.

#### 2. Maximum Permissible Concentrations (MPCs) and Effluent Concentration Limits (ECLs)

Water - covered in Section 1.A.  
Air - covered in Section 1.B.

3. **Average Energy**

Average energy of fission and activation gaseous effluents is not applicable. See ODCM Section 3.1 for the methodology used in determining the release rate limits from noble gas releases.

4. **Measurements and Approximations of Total Radioactivity**

A. **Liquid Effluents**

Liquid Release Type	Sampling Frequency	Method of Analysis	Type of Activity Analysis
1. Batch Waste Release Tank	P Each Batch	P.H.A.	Principal Gamma Emitters
	P Each Batch	P.H.A.	I-131
a. Waste Monitor Tank	P One Batch/M	P.H.A.	Dissolved and Entrained Gases (Gamma Emitters)
b. Secondary Liquid Waste Monitor Tanks	P Each Batch	L.S. S.A.C.	H-3 Gross Alpha
	P	O.S.L.	Sr-89, Sr-90
2. Continuous Releases	Daily Grab Sample	P.H.A.	Principal Gamma Emitters
		P.H.A.	I-131
a. Steam Generator Blowdown	M Grab Sample	P.H.A.	Dissolved and entrained Gases (Gamma Emitters)
b. Turbine Building Sump/Waste Water Treatment	Daily Grab Sample	L.S.	H-3
		S.A.C.	Gross Alpha
c. Lime Sludge Pond	Daily Grab Sample	O.S.L.	Sr-89, Sr-90
		O.S.L.	Fe-55

P = prior to each batch

M = monthly

L. S. = Liquid scintillation detector

S.A.C. = scintillation alpha counter

O.S.L. = performed by an offsite laboratory

P.H.A. = gamma spectrum pulse height analysis using a High Purity Germanium detector

**B. Gaseous Waste Effluents**

Gaseous, Release Type	Sampling Frequency	Method of Analysis	Type of Activity Analysis
Waste Gas Decay Tank	P Each Tank Grab Sample	P.H.A.	Principal Gamma Emitters
Containment Purge or Vent	P Each Purge Grab Sample	P.H.A. <hr/> Gas Bubbler and L.S.	Principal Gamma Emitters <hr/> H-3 (oxide)
Unit Vent	M Grab Sample	P.H.A. <hr/> Gas Bubbler and L.S.	Principal Gamma Emitters <hr/> H-3 (oxide)
Radwaste Building Vent	M Grab Sample	P.H.A.	Principal Gamma Emitters
For Unit Vent and Radwaste Building Vent release types listed above	Continuous	P.H.A.	I-131 <hr/> I-133
	Continuous	P.H.A. Particulate Sample	Principal Gamma Emitters
	Continuous Composite	S.A.C. Particulate Sample	Gross Alpha
	Continuous	O.S.L. Composite Particulate Sample	Sr-89, Sr-90

P = prior to each batch  
M = monthly  
L.S. = Liquid scintillation detector

S.A.C. = scintillation alpha counter  
O.S.L. = performed by an offsite laboratory  
P.H.A. = gamma spectrum pulse height analysis using a High Purity Germanium detector

## 5. Batch Releases

A batch release is the discontinuous release of gaseous or liquid effluents which takes place over a finite period of time; usually hours or days.

There were 74 gaseous batch releases during the reporting period. The longest gaseous batch release lasted 9,618 minutes, while the shortest lasted 47 minutes. The average release lasted 661 minutes with a total gaseous batch release time of 48,943 minutes.

There were 84 liquid batch releases during the reporting period. The longest liquid batch release lasted 409 minutes, while the shortest lasted 30 minutes. The average release lasted 134 minutes with a total liquid batch release time of 11,271 minutes.

## 6. Continuous Releases

A continuous release is a release of gaseous or liquid effluent, which is essentially uninterrupted for extended periods during normal operation of the facility. There were four release pathways designated as continuous releases during this reporting period: Steam Generator Blowdown, Turbine Building Sump, Waste Water Treatment, and Lime Sludge Pond. There were two gas release pathways designated as continuous releases: Unit Vent and Radwaste Building Vent.

## 7. Doses to a Member of the Public from Activities Inside the Site Boundary

Four activities by members of the public were considered in this evaluation: personnel making deliveries to the plant, workers at the William Allen White Building located outside of the restricted area, the use of the access road south of the Radwaste Building, and personnel using the lake during times when fishing was allowed. The dose calculated for the maximum exposed individual for these four activities was as follows:

Plant Deliveries	4.55E-01 mRem
William Allen White Building Workers	1.06E-02 mRem
Access Road Users	4.69E-03 mRem
Lake Use	6.70E-02 mRem

The plant delivery calculations were based on deliveries 3 hours per week for 50 weeks per year. The William Allen White Building occupancy was based on normal working hours of 2000 per year. The usage factor for the access road South of the Radwaste Building was 25 hours per year. The dose to fishermen on the lake was based upon 3756 hours (12 hours a day for 313 days, based on the number of days that the lake was open to fisherman). Pathways used in the calculation were gaseous inhalation, submersion, and ground plane. All calculations were performed in accordance with the methodology and parameters in the ODCM.

## 8. Additional Information

A small amount of Sb-125 was included in gaseous releases for quarter 2 of 1999. Wolf Creek's Offsite Dose Calculation Manual (ODCM) is based on Regulatory Guide 1.109, Revision 1, which contains no dose conversion factors for Sb-125. Dose due to Sb-125 was calculated using numbers found in Regulatory Guide 1.109, Revision 0. These numbers were evaluated and determined to provide an insignificant contribution to total doses using inhalation and ingestion pathways compared to the higher concentration of tritium in these releases. The dose based on ground plane calculations would have made minor differences since the contribution of tritium in this case is zero.

### 1999 EFFLUENT CONCENTRATION LIMITS

<u>Nuclides</u>	<u>Curies</u>	<u>Average Diluted Concentration (uCi/ml)</u>	<u>10 CFR 20 ECL (uCi/ml)</u>	<u>% of ECL</u>
H-3	1.17E+03	1.25E-05	1.00E-03	1.25E+00
Cr-51	1.00E-04	1.07E-12	5.00E-04	2.13E-07
Mn-54	3.92E-04	4.17E-12	3.00E-05	1.39E-05
Fe-55	2.06E-03	2.19E-11	1.00E-04	2.19E-05
Fe-59	9.59E-06	1.02E-13	1.00E-05	1.02E-06
Co-57	5.62E-05	5.98E-13	6.00E-05	9.96E-07
Co-58	8.55E-03	9.10E-11	2.00E-05	4.55E-04
Co-60	6.95E-03	7.39E-11	3.00E-06	2.46E-03
Rb-88	4.82E-05	5.13E-13	4.00E-04	1.28E-07
Zr-95	1.80E-05	1.92E-13	2.00E-05	9.59E-07
Nb-95	7.39E-05	7.86E-13	3.00E-05	2.62E-06
Ru-103	3.26E-06	3.47E-14	3.00E-05	1.16E-07
Sn-117M	3.20E-05	3.40E-13	1.00E-08	3.40E-03
Sb-124	1.63E-05	1.74E-13	7.00E-06	2.48E-06
Sb-125	3.03E-02	3.22E-10	3.00E-05	1.07E-03
I-131	2.56E-05	2.72E-13	1.00E-06	2.72E-05
Cs-134	1.67E-03	1.78E-11	9.00E-07	1.98E-03
Cs-137	3.80E-03	4.04E-11	1.00E-06	4.04E-03
Cs-138	8.97E-06	9.54E-14	4.00E-04	2.39E-08
Kr-85M	1.02E-04	1.08E-12	2.00E-04	5.40E-07
Kr-85	1.72E-02	1.83E-10	2.00E-04	9.14E-05
Xe-131M	2.18E-02	2.32E-10	2.00E-04	1.16E-04
Xe-133	1.21E+00	1.29E-08	2.00E-04	6.46E-03
Xe-133M	1.24E-02	1.32E-10	2.00E-04	6.60E-05
Xe-135	2.02E-02	2.15E-10	2.00E-04	1.07E-04

## EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT 1999 SOLID WASTE SHIPMENTS

### A. SOLID RADWASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not irradiated fuel)

1. Type of Waste	Unit	1- Year Period	Est. Total Error %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m3*	7.13E+01**	2.50E+01
	Ci	1.22 E+02	
b. Dry compressible waste, contaminated equip. etc.	m3*	7.93E+02**	2.50E+01
	Ci	2.92E+00	
c. Irradiated components, control rods, etc.	m3*	0.00E+00	2.50E+01
	Ci	0.00E+00	
d. Other	m3*	0.00E+00	2.50E+01
	Ci	0.00E+00	

\*m3 = cubic meters    \*\* This is the volume sent offsite for volume reduction, prior to disposal.

### 2. Estimate of Major Nuclide Composition (by type of waste).

[Nuclides listed with % abundance greater than 10 %]

#### a. Spent resin, filter sludges, evaporator bottoms, etc.

<u>Nuclide Name</u>	<u>Percent Abundance</u>	<u>Curies</u>
Fe-55	38.288	4.68E+01
Ni-63	22.804	2.79E+01
Cs-137	13.327	1.63E+01
Co-60	11.016	1.35E+01

#### b. Dry compressible waste, contaminated equipment, etc.

<u>Nuclide Name</u>	<u>Percent Abundance</u>	<u>Curies</u>
Co-58	21.588	6.31E-01
Fe-55	21.191	6.19E-01
Co-60	16.296	4.76E-01
Nb-95	10.534	3.08E-01
Ni-63	10.174	2.97E-01

#### c. Irradiated components, control rods, etc.

none

#### d. Other

none

**3. Solid Waste Disposition**

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
9	Truck (Hittman Transport Services)	ALARON Corporation; Wampum, Pa.
1	Truck (Hittman Transport Services)	Barnwell Waste Management Facility; Barnwell, SC.
5	Truck (Hittman Transport Services)	GTS Duratek; Oak Ridge, Tn.
1	Truck (Hittman Transport Services)	Studsvik Processing Facility, LLC; Columbia, SC.
3	Truck (Hittman Transport Services)	Studsvik Processing Facility, LLC; Columbia, SC.
1	Truck (TRISM)	Studsvik Processing Facility, LLC; Columbia, SC.

**4. Class of Solid Waste**

- a. Class A, Class B, Class C- Corresponding to 2a
- b. Class A - corresponding to 2b
- c. Not applicable
- d. Not applicable

**5. Type of Container**

- a. LSA (Strong, tight), Type A, Type B - corresponding to 2a
- b. LSA (Strong, tight) - corresponding to 2b
- c. Not applicable
- d. Not applicable

**6. Solidification Agent**

- a. Not applicable
- b. Not applicable
- c. Not applicable
- d. Not applicable

**B. IRRADIATED FUEL SHIPMENTS (Disposition)**

No irradiated fuel shipments occurred during the 1999 period.

## **SECTION III**

### **HOURS AT EACH WIND SPEED AND DIRECTION**

This section documents WCGS meteorological data for wind speed, wind direction, and atmospheric stability.

The meteorological data supplied in the following tables covers the period from January 1, 1999, through December 31, 1999, and indicates the number of hours at each wind speed and direction for each stability class. All gaseous releases at the WCGS are ground level releases.

The quantity of missing hours in the following tables is 1900 hours. This corresponds to approximately 78.3% data availability. This lower availability was largely due to the unavailability, for approximately 60 days, of a single required temperature monitoring instrument on the meteorological tower. This event has been documented under the plant's corrective action program as Performance Improvement Request (PIR) 99-2474, and in NRC Inspection Report 99-11

**HOURS AT EACH WIND SPEED AND DIRECTION**

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: A  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	2	10	23	2	0	37
NNE	0	12	21	16	4	0	53
NE	2	17	9	1	0	0	29
ENE	1	10	16	2	0	0	29
E	1	8	17	8	0	0	34
ESE	0	8	18	11	0	0	37
SE	1	13	22	5	3	0	44
SSE	1	29	77	12	4	0	123
S	1	41	113	76	24	2	257
SSW	2	13	75	86	7	1	184
SW	1	12	26	10	0	0	49
WSW	0	14	7	9	1	0	31
W	0	7	3	4	0	0	14
WNW	0	4	6	8	8	0	26
NW	1	6	9	8	0	0	24
NNW	0	0	20	23	2	0	45
TOTAL	11	196	449	302	55	3	1016

PERIOD OF CALM (HOURS): 0

### HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: B  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	1	6	3	1	0	11
NNE	0	3	13	9	2	0	27
NE	1	6	14	0	0	0	21
ENE	1	1	4	1	0	0	7
E	0	3	9	3	0	0	15
ESE	0	4	5	1	1	0	11
SE	0	3	7	2	0	0	12
SSE	0	3	14	6	1	0	24
S	1	11	14	14	7	3	50
SSW	0	7	16	10	4	1	38
SW	0	7	1	2	0	0	10
WSW	1	0	1	2	1	0	5
W	0	3	1	4	0	0	8
WNW	0	3	4	4	6	0	17
NW	0	4	5	8	2	2	21
NNW	0	3	4	12	1	0	20
TOTAL	4	62	118	81	26	6	297

PERIOD OF CALM (HOURS): 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: C  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	1	5	8	1	0	15
NNE	2	5	16	16	2	0	41
NE	1	11	6	0	0	0	18
ENE	1	7	11	2	0	0	21
E	0	1	5	3	0	0	9
ESE	1	7	4	1	0	0	13
SE	0	8	9	2	1	0	20
SSE	0	7	9	5	2	0	23
S	0	4	9	12	5	0	30
SSW	2	5	19	18	5	0	49
SW	1	6	5	4	0	0	16
WSW	0	4	2	2	1	0	9
W	1	3	3	1	0	0	8
WNW	1	1	4	4	4	0	14
NW	0	6	7	12	9	6	40
NNW	0	3	7	11	4	2	27
TOTAL	10	79	121	101	34	8	353

PERIOD OF CALM (HOURS): 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: D  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	11	38	78	23	2	152
NNE	1	28	66	87	39	3	224
NE	6	62	60	12	2	0	142
ENE	11	64	68	7	0	0	150
E	8	30	42	18	1	0	99
ESE	7	31	27	41	3	0	109
SE	4	35	48	22	8	0	117
SSE	3	40	85	54	5	0	187
S	4	34	151	108	42	2	341
SSW	2	23	85	65	16	2	193
SW	2	23	23	10	1	1	60
WSW	3	15	17	9	3	0	47
W	2	10	15	15	3	0	45
WNW	1	9	24	38	18	1	91
NW	1	16	45	40	30	3	135
NNW	0	14	63	54	15	12	158
TOTAL	55	445	857	658	209	26	2250

PERIOD OF CALM (HOURS): 1

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: E  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	18	40	17	2	0	81
NNE	2	21	33	22	3	0	81
NE	12	50	31	0	0	0	93
ENE	12	51	26	4	0	0	93
E	5	35	22	8	0	0	70
ESE	3	48	41	9	1	0	102
SE	4	76	62	7	2	1	152
SSE	1	72	143	34	9	0	259
S	6	39	128	101	35	6	315
SSW	7	40	71	31	20	0	169
SW	4	38	11	2	0	0	55
WSW	6	18	13	6	1	2	46
W	5	19	20	4	1	3	52
WNW	3	21	9	1	1	0	35
NW	2	18	26	16	2	0	64
NNW	0	22	39	23	0	2	86
TOTAL	76	586	715	285	77	14	1753

PERIOD OF CALM (HOURS): 0

## HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999

STABILITY CLASS: F

ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	21	9	1	0	0	32
NNE	2	36	26	2	0	0	66
NE	18	22	9	0	0	0	49
ENE	10	30	3	0	0	0	43
E	7	47	9	0	0	0	63
ESE	6	58	16	1	0	0	81
SE	7	71	11	0	0	0	89
SSE	5	60	32	3	0	0	100
S	3	34	29	10	6	0	82
SSW	7	10	10	2	1	0	30
SW	3	23	3	0	0	0	29
WSW	3	14	1	0	0	0	18
W	2	6	1	0	0	0	9
WNW	3	4	1	0	0	0	8
NW	6	13	2	0	0	0	21
NNW	1	39	16	0	0	0	56
TOTAL	84	488	178	19	7	0	776

PERIOD OF CALM (HOURS): 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: G  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	3	6	5	0	0	0	14
NNE	3	36	14	0	0	0	53
NE	14	30	2	0	0	0	46
ENE	6	34	0	0	0	0	40
E	5	44	5	0	0	0	54
ESE	3	40	0	0	0	0	43
SE	5	39	0	0	0	0	44
SSE	1	22	7	0	0	0	30
S	3	19	5	0	0	0	27
SSW	0	3	3	0	0	0	6
SW	1	7	0	0	0	0	8
WSW	0	3	0	0	0	0	3
W	0	0	0	0	0	0	0
WNW	1	0	0	0	0	0	1
NW	4	14	0	0	0	0	18
NNW	3	19	5	0	0	0	27
TOTAL	52	316	46	0	0	0	414

PERIOD OF CALM (HOURS): 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: JANUARY 1 THROUGH DECEMBER 31 1999  
STABILITY CLASS: ALL  
ELEVATION: 10 METERS

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	8	60	113	130	29	2	342
NNE	10	141	189	152	50	3	545
NE	54	198	131	13	2	0	398
ENE	42	197	128	16	0	0	383
E	26	168	109	40	1	0	344
ESE	20	196	111	64	5	0	396
SE	21	245	159	38	14	1	478
SSE	11	233	367	114	21	0	746
S	18	182	449	321	119	13	1102
SSW	20	101	279	212	53	4	669
SW	12	116	69	28	1	1	227
WSW	13	68	41	28	7	2	159
W	10	48	43	28	4	3	136
WNW	9	42	48	55	37	1	192
NW	14	77	94	84	43	11	323
NNW	4	100	154	123	22	16	419
TOTAL	292	2172	2484	1446	408	57	6859

PERIOD OF CALM (HOURS): 1 HOURS OF MISSING DATA: 1900

## SECTION IV

### ADDITIONAL INFORMATION

#### 1. **Unplanned or Abnormal Releases**

There were no unplanned or abnormal releases for the reporting period of 1999.

#### 2. **Offsite Dose Calculation Manual (ODCM)**

The Wolf Creek Generating Station (WCGS) Offsite Dose Calculation Manual (ODCM), annually submitted with the WCGS Annual Radioactive Effluent Release Report, was revised in 1999. The ODCM was divided into two separate administrative procedures: AP 07B-003, "Offsite Dose Calculation Manual," and AP 07B-004, "Offsite Dose Calculation Manual (Radiological Environmental Monitoring Program)." The latest revision of the ODCM, in the form of these two administrative procedures, is being submitted with this Annual Radioactive Effluent Release Report as Attachment I and Attachment II.

#### 3. **Major Changes to Liquid, Solid, or Gaseous Radioactive Waste Treatment Systems**

No major modifications have taken place on the radwaste systems during 1999. As reported in the "1999 Annual Radioactive Effluent Release Report - Report 22," temporary modification TMO 98-018-HB, a "state-of-the-art" filtration system, was installed in July, 1998. TMO 98-018-HB consisted of a Diversified Technology's ZERO Filtration System that can be operated locally or remotely from the Radwaste Control Room. The remote operation is limited to valve manipulation, acidity control, and chemical injection. This system consists of three skids: 1) A Tubular Ultrafiltration (TUF) unit; 2) A Spiral Reverse Osmosis (SRO) unit; and 3) A Mobile Drum Dryer (DD) unit. This 98-018-HB modification is currently in service and is working well. WCGS is converting the temporary modification to a permanent design this year (year 2000).

#### 4. **Land Use Census**

No new locations for dose calculation were identified during this report period.

#### 5. **Radioactive Shipments**

Twenty shipments of radioactive waste occurred during this report period. Section II, Subsection 3, of this report contains specific details regarding each shipment's mode of transportation and destination.

#### 6. **Inoperability of Effluent Monitoring Instrumentation**

No events occurred that involved inoperable liquid or gaseous effluent monitoring instrumentation not being corrected within the time specified in ODCM Requirements Tables 2-2 and 3-2.

#### 7. **Storage Tanks**

No events leading to liquid holdup tanks or gas storage tanks exceeding the limits of Technical Requirements Manual Sections 3.10.1 or 3.10.3 occurred during 1999. Technical Specification requirements for the program are now covered by Technical Requirements Manual Section 3.10, "Explosive Gas and Storage Tank Radioactivity Monitoring."