Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247
402/636-2000

February 22, 1994
LIC-94-0039

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, DC 20555

REFERENCE: Docket No. 50-285

Gentlemen:

SUBJECT: Fort Calhoun Station (FCS) Annual Radioactive Effluent Release Report

In accordance with Technical Specification 5.9.4.a and 10 CFR 50.36a, Omaha Public Power District is enclosing the FCS Annual Radioactive Effluent Release Report for the period of January 1, 1993 through December 31, 1993. In accordance with Technical Specification 5.17.d and 5.18.d, updated copies of the Offsite Dose Calculation Manual and the Process Control Program are also enclosed.

If you should have any questions, please contact me.

Sincerely,

W. G. Gates

W. G. Gates
Vice President

WGG/mah

Enclosure

c: LeBoeuf, Lamb, Leiby & MacRae (w/o enclosure)
L. J. Callan, NRC Regional Administrator, Region IV (w/o enclosure)
S. D. Bloom, NRC Project Manager (w/o enclosure)
R. P. Mullikin, NRC Senior Resident Inspector (w/o enclosure)
G. K. Samide, American Nuclear Insurers

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PDR ADOCK 05000285
R PDR

IE48

Memorandum

PRC Reviewed
PRC Mtg. Minutes
FEB 22 1994

Date: February 17, 1994 FC-C-046-94

From: J. W. Chase

To: Distribution

SUBJECT: Annual Report for Technical Specification Section 5.9.1.b and Section 5.9.4.a - January 1, 1993 through December 31, 1993

Attached is a copy of the 1993 Annual Report for January 1, 1993 through December 31, 1993.

JW Chase

J. W. Chase
Plant Manager
Fort Calhoun Station

JWC/FKS:pk

Distribution:

W. G. Gates
T. L. Patterson
J. W. Tills
A. W. Richard
D. L. Lovett
M. A. Wilson
B. A. Schmidt
T. W. Jamieson

INTRODUCTION

This report is submitted in accordance with Sections 5.9.1.b and 5.9.4.a of the Technical Specifications of Fort Calhoun Station Unit No. 1, Facility Operating License DPR-40.

This document contains the Annual Report for Technical Specification Section 5.9.1.b and the Annual Effluent Release Report for Technical Specification 5.9.4.a for the period January 1, 1993 through December 31, 1993. 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, 1993 through December 31, 1993.

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.

J W Chase

J. W. Chase
Manager-Fort Calhoun Station

TABLE OF CONTENTS

SECTION I

QUARTERLY DOSES FROM EFFLUENTS

Offsite Dose Calculation Manual

January 1, 1993 - December 31, 1993

Quarterly Dose Calculation Results
January 1, 1993 through December 31, 1993

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 Part 50 and implemented by the 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 resultant doses do not exceed the annual limits during the remainder of the year and a special report is submitted to the NRC.

This section presents the results of the quarterly dose calculations performed since January 1, 1993. Details are shown in Tables on Pages I-3 through I-6 as to the types, sources and resultant doses from the effluents, annual limits and a comparison to the annual limits.

As can be seen by review of the quarterly calculational results, OPPD is in complaince with the ODCM. The quarterly totals are well below the 50% annual dose acceptance criteria. In addition, the summation of the quarterly totals shows OPPD to be less than the annual limits and in compliance with the regulations and the ODCM.

QUARTERLY CUMULATIVE DOSE CONTRIBUTIONS FROM RADIOACTIVE EFFLUENTS

FIRST QUARTER, 1993

I. LIQUID EFFLUENTS:	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (mREM)
Monitor/Hotel Tank:	8.25E-03	1.15E-02
Steam Generator:	1.01E-03	2.94E-07
Totals:	9.26E-03	1.15E-02
ODCM Annual Objective:	3.00E+00	1.00E+00
Percent of ODCM Annual Objective:		
This Quarter:	0.31%	0.11%
Year to Date:	0.31%	0.11%

II. GASEOUS EFFLUENTS:	TOTAL BODY GAMMA DOSE (mREM)	TOTAL BODY BETA DOSE (mREM)
A. Noble Gas Air Dose	7.36E-04	4.96E-04
ODCM Annual Objective:	1.00E+01	2.00E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.01%	0.00%
Year to Date:	0.01%	0.00%

B. I-131, H-3, and Particulates with Half-Lives > 8 Days	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (Thyroid, mREM)
* Inhalation:	4.97E-06	5.69E-06
* Ground and Food:	2.11E-07	1.53E-04
Totals:	5.18E-06	1.59E-04
ODCM Annual Objective:	1.50E+01	1.50E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.00%	0.00%
Year to Date:	0.00%	0.00%

* Using Highest of Infant or Child Dose Factors

QUARTERLY CUMULATIVE DOSE CONTRIBUTIONS FROM RADIOACTIVE EFFLUENTS

SECOND QUARTER, 1993

I. LIQUID EFFLUENTS:	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (mREM)
Monitor/Hotel Tank:	1.61E-01	1.75E-01
Steam Generator:	3.65E-04	2.98E-04
Totals:	1.61E-01	1.75E-01
ODCM Annual Objective:	3.00E+00	1.00E+00
Percent of ODCM Annual Objective:		
This Quarter:	5.38%	1.75%
Year to Date:	5.69%	1.86%

II. GASEOUS EFFLUENTS:	TOTAL BODY GAMMA DOSE (mREM)	TOTAL BODY BETA DOSE (mREM)
A. Noble Gas Air Dose	7.15E-04	5.64E-04
ODCM Annual Objective:	1.00E+01	2.00E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.01%	0.00%
Year to Date:	0.02%	0.00%

B. I-131, H-3, and Particulates with Half-Lives > 8 Days	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (Thyroid, mREM)
* Inhalation:	3.50E-05	3.65E-05
* Ground and Food:	2.72E-04	5.06E-04
Totals:	3.07E-04	5.42E-04
ODCM Annual Objective:	1.50E+01	1.50E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.00%	0.00%
Year to Date:	0.00%	0.00%

* Using Highest of Infant or Child Dose Factors

QUARTERLY CUMULATIVE DOSE CONTRIBUTIONS FROM RADIOACTIVE EFFLUENTS

THIRD QUARTER, 1993

I. LIQUID EFFLUENTS:	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (mREM)
Monitor/Hotel Tank:	9.33E-02	1.04E-01
Steam Generator:	5.19E-06	9.68E-11
Totals:	9.33E-02	1.04E-01
ODCM Annual Objective:	3.00E+00	1.00E+00
Percent of ODCM Annual Objective:		
This Quarter:	3.11%	1.04%
Year to Date:	8.80%	2.90%

II. GASEOUS EFFLUENTS:	TOTAL BODY GAMMA DOSE (mREM)	TOTAL BODY BETA DOSE (mREM)
A. Noble Gas Air Dose	1.07E-03	1.32E-03
ODCM Annual Objective:	1.00E+01	2.00E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.01%	0.01%
Year to Date:	0.03%	0.01%

B. I-131, H-3, and Particulates with Half-Lives > 8 Days	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (Thyroid, mREM)
* Inhalation:	1.04E-04	1.04E-04
* Ground and Food:	8.13E-04	7.40E-04
Totals:	9.17E-04	8.44E-04
ODCM Annual Objective:	1.50E+01	1.50E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.01%	0.01%
Year to Date:	0.01%	0.01%

* Using Highest of Infant or Child Dose Factors

QUARTERLY CUMULATIVE DOSE CONTRIBUTIONS FROM RADIOACTIVE EFFLUENTS **

FOURTH QUARTER, 1993

I. LIQUID EFFLUENTS:	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (mREM)
Monitor/Hotel Tank:	2.57E-02	3.59E-02
Steam Generator:	1.49E-04	2.32E-04
Totals:	2.58E-02	3.61E-02
ODCM Annual Objective:	3.00E+00	1.00E+00
Percent of ODCM Annual Objective:		
This Quarter:	0.86%	0.36%
Year to Date:	9.66%	3.26%

II. GASEOUS EFFLUENTS:	TOTAL BODY GAMMA DOSE (mREM)	TOTAL BODY BETA DOSE (mREM)
A. Noble Gas Air Dose	2.90E-04	4.42E-04
ODCM Annual Objective:	1.00E+01	2.00E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.00%	0.00%
Year to Date:	0.03%	0.01%

B. I-131, H-3, and Particulates with Half-Lives > 8 Days	TOTAL BODY DOSE (mREM)	CRITICAL ORGAN DOSE (Thyroid, mREM)
* Inhalation:	1.36E-04	1.93E-04
* Ground and Food:	1.01E-03	9.73E-03
Totals:	1.15E-03	9.92E-03
ODCM Annual Objective:	1.50E+01	1.50E+01
Percent of ODCM Annual Objective:		
This Quarter:	0.01%	0.07%
Year to Date:	0.02%	0.08%

* Using Highest of Infant or Child Dose Factors

** Strontium 89 and Strontium 90 dose contributions not included because results were not available at the time of this report. Values will be updated when results are recevied from the vendor.

SECTION II

ANNUAL OCCUPATIONAL EXPOSURE REPORT

Technical Specification 5.9.1.b

January 1, 1993 - December 31, 1993

FORT CALHOUN STATION
OMAHA PUBLIC POWER DISTRICT
P. O. BOX 3
FT. CALHOUN, NE. 68023

Date: 18-FEB-1994 07:30

LICENSE: DPR-40

Regulatory Guide 1.16 Information
End of Year Report 1993

Work and Job Function	Number of Personnel > 100 mrem Station	Utility	Contractor	Total man-rem * Station	Utility	Contractor
REACTOR OPERATIONS AND SURVEILLANCE						
MAINTENANCE AND CONSTRUCTION	0	0	0	0.195	0.011	0.037
OPERATIONS	22	0	0	6.816	0.000	0.005
HEALTH PHYSICS	13	0	20	5.540	0.000	4.813
SUPERVISORY	2	0	0	0.853	0.000	0.009
ENGINEERING	3	0	0	1.144	0.001	0.002
ROUTINE MAINTENANCE						
MAINTENANCE AND CONSTRUCTION	52	26	51	15.945	8.115	15.787
OPERATIONS	0	0	0	0.554	0.000	0.000
HEALTH PHYSICS	19	0	54	4.241	0.000	17.842
SUPERVISORY	2	0	1	1.239	0.002	1.171
ENGINEERING	9	0	3	3.101	0.406	2.061
INSERVICE INSPECTION						
MAINTENANCE AND CONSTRUCTION	22	10	37	5.228	3.394	15.115
OPERATIONS	0	0	0	0.073	0.000	0.000
HEALTH PHYSICS	3	0	26	0.543	0.000	7.202
SUPERVISORY	0	0	1	0.000	0.000	0.337
ENGINEERING	5	0	39	1.916	0.062	19.412
SPECIAL MAINTENANCE						
MAINTENANCE AND CONSTRUCTION	1	0	24	1.079	0.087	8.540
OPERATIONS	0	0	0	0.055	0.000	0.000
HEALTH PHYSICS	1	0	3	0.846	0.000	1.654
SUPERVISORY	0	0	0	0.063	0.000	0.048
ENGINEERING	0	0	0	0.512	0.175	0.635
WASTE PROCESSING						
MAINTENANCE AND CONSTRUCTION	0	0	0	0.019	0.000	0.004
OPERATIONS	0	0	0	0.000	0.000	0.000
HEALTH PHYSICS	5	0	1	1.079	0.000	0.882
SUPERVISORY	0	0	0	0.011	0.000	0.000
ENGINEERING	0	0	0	0.001	0.000	0.000
REFUELING						
MAINTENANCE AND CONSTRUCTION	23	19	12	8.967	8.447	6.038
OPERATIONS	0	0	0	1.784	0.000	0.000
HEALTH PHYSICS	3	0	23	0.893	0.000	5.448
SUPERVISORY	5	0	0	1.296	0.000	0.137
ENGINEERING	5	2	3	1.759	0.405	1.072
Totals						
MAINTENANCE AND CONSTRUCTION	98	55	124	31.433	20.054	45.521
OPERATIONS	22	0	0	9.282	0.000	0.005
HEALTH PHYSICS	44	0	127	13.142	0.000	37.841
SUPERVISORY	9	0	2	3.462	0.002	1.702
ENGINEERING	22	2	45	8.433	1.049	23.182
Grand Totals	195	57	298	65.752	21.105	108.251

* The total radiation exposure of the above personnel constitutes 100% of the site's exposure for the year.

Submitted by: HIS20DBA
Sorted by: None Required

Date: 17-FEB-1994 23:15
Page: 1

Year-to-Date 93 TEDE Distribution Report
All Monitored Personnel

Year-to-Date * TEDE rem	No. of Persons	Percent	Cum. Percent	TEDE Total	Percent	Cum. Percent	Ave. TEDE	Ave. Age
No Measurable Exposure	2,063	74.32	74.32	0.000	0.00	0.00	0.000	40
0.001 - 0.100	312	11.24	85.56	14.248	9.10	9.10	0.046	39
0.100 - 0.250	177	6.38	91.94	29.145	18.61	27.71	0.165	39
0.250 - 0.500	122	4.39	96.33	43.148	27.55	55.26	0.354	38
0.500 - 0.750	75	2.70	99.03	46.705	29.83	85.09	0.623	36
0.750 - 1.000	24	0.86	99.89	19.985	12.76	97.85	0.833	33
1.000 - 2.000	3	0.11	100.00	3.359	2.15	100.00	1.120	39
2.000 - 3.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
3.000 - 4.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
4.000 - 5.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
5.000 - 6.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
6.000 - 7.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
7.000 - 8.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
8.000 - 9.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
9.000 - 10.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0
> 10.000	0	0.00	100.00	0.000	0.00	100.00	0.000	0

Total Number of Monitored Personnel: 2,776 Persons
Total Exposure: 156.591 rem
Average Exposure: 0.056 rem / Person

The above information is submitted for:

(1) - The total number of individuals for whom personnel monitoring was required under 10CFR 20.1502 or 10CFR 34.33(a) during the calendar year.

OR (2) - The total number of individuals for whom personnel monitoring was provided during the calendar year including (1) above.

* Individual values exactly equal to the values separating exposure ranges are reported in the higher range.

SECTION III

RADIOACTIVE EFFLUENT RELEASES - GASEOUS EFFLUENTS

Technical Specification 5.9.4.a

Table 1A	Gaseous Effluents - Summation of All Releases
Table 1B	Not Applicable
Table 1C	Gaseous Effluents - Summation of All Releases

January 1, 1993 - December 31, 1993

Radioactive Effluent Releases - First, Seco..d, Third, and Fourth Quarters 1993

GASEOUS EFFLUENTS

Radioactive gaseous releases for the reporting period totaled 1.17E+01 Curies of inert gas. The gross gaseous activity release rates were 2.13E-04 μCi/sec for the first quarter, 3.13E-01 μCi/sec for the second quarter, 8.71E-01 μCi/sec for the third quarter, and 3.03E-01 μCi/sec for the fourth quarter.

Radioactive halogens and particulates with half-lives greater than eight days released during the reporting period totaled 4.67E-04 Curies. The halogen release rates were 7.23E-08 μCi/sec for the first quarter, 8.54E-08 μCi/sec for the second quarter, 0.00E+00 μCi/sec for the third quarter, and 5.87E-05 μCi/sec for the fourth quarter. The release rate for particulates with half lives greater than 8 days were 0.00E+00 μCi/sec for the first quarter, 1.55E-07 μCi/sec for the second quarter, 1.17E-07 μCi/sec for the third quarter and 5.04E-08 μCi/sec for the fourth quarter.

Total radioactive tritium released during the reporting period totaled 1.36E+00 Curies. Gross alpha radioactivity released during the reporting period totaled 5.67E-06 Curies.

TABLE 1A

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

ANNUAL FOR JANUARY THROUGH DECEMBER 1993

FIRST QUARTER

Nuclides in Curies		CONT	WGDT	RM060	RM041	RM057	TOTAL
A. Fission & Activation Gases							
Total Release	Ci	1.68E-03	6.98E-08	0.00E+00	0.00E+00	0.00E+00	1.68E-03
Avg Release Rate for Period	µCi/sec	2.13E-04	8.85E-09	0.00E+00	0.00E+00	0.00E+00	2.13E-04
Percent of Limit ODCM = **None**	%						
B. Iodines							
Total Release Iodine-131	Ci	0.00E+00	0.00E+00	0.00E+00	5.70E-07	0.00E+00	5.70E-07
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	7.23E-08	0.00E+00	7.23E-08
Percent of Limit ODCM = **None**	%						
C. Particulates							
Particulates w/ Half-Lives .GT. 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Percent of Limit ODCM = **None**	%						
Gross Alpha Radioactivity	Ci	0.00E+00	0.00E+00	4.61E-07	1.84E-07	0.00E+00	6.54E-07
D. Tritium							
Total Release	Ci	1.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-04
Avg Release Rate for Period	µCi/sec	2.34E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.34E-05
Percent of Limit ODCM = **None**	%						

TABLE 1A

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

ANNUAL FOR JANUARY THROUGH DECEMBER 1993

SECOND QUARTER

Nuclides in Curies		CONT	WGDT	RM060	RM041	RM057	TOTAL
A. Fission & Activation Gases							
Total Release	Ci	2.47E+00	9.13E-04	0.00E+00	0.00E+00	0.00E+00	2.47E+00
Avg Release Rate for Period	µCi/sec	3.13E-01	1.16E-04	0.00E+00	0.00E+00	0.00E+00	3.13E-01
Percent of Limit ODCM = **None**	%						
B. Iodines							
Total Release Iodine-131	Ci	0.00E+00	0.00E+00	3.49E-07	3.24E-07	0.00E+00	6.73E-07
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	4.42E-08	4.11E-08	0.00E+00	8.54E-08
Percent of Limit ODCM = **None**	%						
C. Particulates							
Particulates w/ Half-Lives .GT. 8 days	Ci	0.00E+00	0.00E+00	3.58E-07	8.63E-07	0.00E+00	1.22E-06
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	4.55E-08	1.09E-07	0.00E+00	1.55E-07
Percent of Limit ODCM = **None**	%						
Gross Alpha Radioactivity	Ci	0.00E+00	0.00E+00	1.81E-06	1.68E-07	0.00E+00	1.98E-06
D. Tritium							
Total Release	Ci	1.73E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-01
Avg Release Rate for Period	µCi/sec	2.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.20E-02
Percent of Limit ODCM = **None**	%						

TABLE 1A

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

ANNUAL FOR JANUARY THROUGH DECEMBER 1993

THIRD QUARTER

Nuclides in Curies		CONT	WGDT	RM060	RM041	RM057	TOTAL
A. Fission & Activation Gases Total Release	Ci	6.86E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.86E+00
Avg Release Rate for Period	µCi/sec	8.71E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.71E-01
Percent of Limit ODCM = **None**	%						
B. Iodines Total Release Iodine-131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Percent of Limit ODCM = **None**	%						
C. Particulates Particulates w/ Half-Lives .GT. 8 days	Ci	0.00E+00	0.00E+00	2.87E-07	6.39E-07	0.00E+00	9.26E-07
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	3.64E-08	8.10E-08	0.00E+00	1.17E-07
Percent of Limit ODCM = **None**	%						
Gross Alpha Radioactivity	Ci	0.00E+00	0.00E+00	3.95E-07	1.06E-07	0.00E+00	5.01E-07
D. Tritium Total Release	Ci	5.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.14E-01
Avg Release Rate for Period	µCi/sec	6.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.51E-02
Percent of Limit ODCM = **None**	%						

TABLE 1A

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

ANNUAL FOR JANUARY THROUGH DECEMBER 1993

FOURTH QUARTER

Nuclides in Curies		CONT	WGDT	RM060	RM041	RM057	TOTAL
A. Fission & Activation Gases Total Release	Ci	2.00E+00	3.80E-01	0.00E+00	0.00E+00	0.00E+00	2.39E+00
Avg Release Rate for Period	µCi/sec	2.54E-01	4.82E-02	0.00E+00	0.00E+00	0.00E+00	3.03E-01
Percent of Limit ODCM = **None**	%						
B. Iodines Total Release Iodine-131	Ci	0.00E+00	0.00E+00	4.63E-04	0.00E+00	0.00E+00	4.63E-04
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	5.87E-05	0.00E+00	0.00E+00	5.87E-05
Percent of Limit ODCM = **None**	%						
C. Particulates Particulates w/ Half-Lives .GT. 8 days	Ci	0.00E+00	0.00E+00	2.44E-07	1.54E-07	0.00E+00	3.97E-07
Avg Release Rate for Period	µCi/sec	0.00E+00	0.00E+00	3.09E-08	1.95E-08	0.00E+00	5.04E-08
Percent of Limit ODCM = **None**	%						
Gross Alpha Radioactivity	Ci	0.00E+00	0.00E+00	2.52E-06	2.49E-08	0.00E+00	2.54E-06
D. Tritium Total Release	Ci	6.75E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.75E-01
Avg Release Rate for Period	µCi/sec	8.56E-02	0.00E+00	0.00E+00	0.00E+002	0.00E+00	8.56E-02
Percent of Limit ODCM = **None**	%						

TABLE 1C

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

FIRST QUARTER

Nuclides(Ci)	Cont	WGDT	RM-060	RM-041	RM-057	Total
Fission Gases						
Argon-41	3.601E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.601E-04
Krypton-85	0.000E+00	6.838E-08	0.000E+00	0.000E+00	0.000E+00	6.838E-08
Krypton-85M	1.617E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.617E-06
Xenon-133	1.264E-03	1.408E-09	0.000E+00	0.000E+00	0.000E+00	1.264E-03
Xenon-133M	3.029E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.029E-06
Xenon-135	5.077E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.077E-05
Total for Period:	1.680E-03	6.978E-08	0.000E+00	0.000E+00	0.000E+00	1.680E-03
Iodines						
Iodine-131	0.000E+00	0.000E+00	0.000E+00	5.698E-07	0.000E+00	5.698E-07
Total for Period:	0.000E+00	0.000E+00	0.000E+00	5.698E-07	0.000E+00	5.698E-07
Particulates						
Total for Period:	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tritium and Gross Alpha						
Tritium	1.846E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.846E-04
Gross Alpha	0.000E+00	0.000E+00	4.605E-07	1.841E-07	0.000E+00	6.446E-07

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

TABLE 1C

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

SECOND QUARTER

Nuclides(Ci)	Cont	WGDT	RM-060	RM-041	RM-057	Total
Fission Gases						
Argon-41	3.305E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.305E-04
Krypton-85	0.000E+00	1.515E-07	0.000E+00	0.000E+00	0.000E+00	1.515E-07
Krypton-85M	3.939E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.939E-07
Xenon-133	1.721E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.721E-03
Xenon-133M	5.409E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.409E-06
Xenon-135	4.467E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.467E-05
Total for Period:	2.102E-03	1.515E-07	0.000E+00	0.000E+00	0.000E+00	2.102E-03
Iodines						
Iodine-131	0.000E+00	0.000E+00	3.487E-07	3.243E-07	0.000E+00	6.730E-07
Total for Period:	0.000E+00	0.000E+00	3.487E-07	3.243E-07	0.000E+00	6.730E-07
Particulates						
Cesium-137	0.000E+00	0.000E+00	0.000E+00	7.343E-07	0.000E+00	7.343E-07
Strontium-90	0.000E+00	0.000E+00	0.000E+00	6.443E-08	0.000E+00	6.443E-08
Thallium-208	0.000E+00	0.000E+00	3.585E-07	0.000E+00	0.000E+00	3.585E-07
Yttrium-90	0.000E+00	0.000E+00	0.000E+00	6.443E-08	0.000E+00	6.443E-08
Total for Period:	0.000E+00	0.000E+00	3.585E-07	8.631E-07	0.000E+00	1.222E-06
Tritium and Gross Alpha						
Tritium	1.397E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.397E-04
Gross Alpha	0.000E+00	0.000E+00	1.809E-06	1.681E-07	0.000E+0C	1.977E-06

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

TABLE 1C

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

THIRD QUARTER

Nuclides(Ci)	Cont	WGDT	RM-060	RM-041	RM-057	Total
Fission Gases						
Argon-41	4.719E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.719E-01
Krypton-85M	8.032E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.032E-04
Xenon-133	6.317E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.317E+00
Xenon-133M	7.895E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.895E-03
Xenon-135	6.654E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.654E-02
Total for Period:	6.864E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.864E+00
Iodines						
Total for Period:	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Particulates						
Strontium-90	0.000E+00	0.000E+00	1.434E-07	3.195E-07	0.000E+00	4.630E-07
Yttrium-90	0.000E+00	0.000E+00	1.434E-07	3.195E-07	0.000E+00	4.630E-07
Total for Period:	0.000E+00	0.000E+00	2.869E-07	6.390E-07	0.000E+00	9.259E-07
Tritium and Gross Alpha						
Tritium	5.136E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.136E-01
Gross Alpha	0.000E+00	0.000E+00	3.948E-07	1.064E-07	0.000E+00	5.012E-07

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

TABLE 1C

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

FOURTH QUARTER

Nuclides(Ci)	Cont	WGDT	RM-060	RM-041	RM-057	Total
Fission Gases						
Argon-41	1.056E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.056E-01
Krypton-85M	7.969E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.969E-04
Xenon-131M	0.000E+00	3.406E-03	0.000E+00	0.000E+00	0.000E+00	3.406E-03
Xenon-133	1.864E+00	3.759E-01	0.000E+00	0.000E+00	0.000E+00	2.240E+00
Xenon-133M	6.090E-03	1.093E-03	0.000E+00	0.000E+00	0.000E+00	7.184E-03
Xenon-135	2.897E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.897E-02
Total for Period:	2.005E+00	3.804E-01	0.000E+00	0.000E+00	0.000E+00	2.386E+00
Iodines						
Iodine-131	0.000E+00	0.000E+00	2.005E-05	0.000E+00	0.000E+00	2.005E-05
Iodine-132	0.000E+00	0.000E+00	4.431E-04	0.000E+00	0.000E+00	4.431E-04
Total for Period:	0.000E+00	0.000E+00	4.631E-04	0.000E+00	0.000E+00	4.631E-04
Particulates						
Strontium-90	0.000E+00	0.000E+00	1.219E-07	7.684E-08	0.000E+00	1.987E-07
Yttrium-90	0.000E+00	0.000E+00	1.219E-07	7.684E-08	0.000E+00	1.987E-07
Total for Period:	0.000E+00	0.000E+00	2.438E-07	1.537E-07	0.000E+00	3.974E-07
Tritium and Gross Alpha						
Tritium	6.749E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.749E-01
Gross Alpha	0.000E+00	0.000E+00	2.519E-06	2.488E-08	0.000E+00	2.543E-06

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

SECTION IV

RADIOACTIVE EFFLUENT RELEASES - LIQUID EFFLUENTS

Technical Specification 5.9.4.a

Table 2A Liquid Effluents - Summation of All Releases

Table 2B Liquid Effluents - Summation of All Releases

January 1, 1993 - December 31, 1993

LIQUID EFFLUENTS

During the reporting period, a total of 1.75E+01 Curies of radoiactive liquid materials less tritium, dissolved noble gases, and alpha were released to the Missouri River at an average concentration of 1.46E-11 µCi/ml. This represents 1.46E-03% of the limits specified in Appendix B to 10 CFR Part 20 (1.0E-06 µCi/ml for unrestricted areas). 2.17E+02 Curies of tritium were discharged at an average diluted concentration 1.81E-10 µCi/ml or 1.81E-05% of WEC (1.0[illegible] µCi/ml). Gross alpha radioactivity released during the reporting period totaled 1.97E-03 Curies.

Dilution water during the period amounted to 1.20E+15 liters, while radioactive liquid waste volume was 1.35E+11 liters.

TABLE 2A

EFFLUENT AND WASTE DISPOSAL REPORT

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

ANNUAL FOR JANUARY THROUGH DECEMBER 1993

		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
A. Fission & Activation Products Total Release (No Tritium, Gas, Alpha)	Ci	1.52E+01	1.15E+00	8.01E-01	3.61E-01
Avg Diluted Concentration	µCi/ml	4.15E-11	3.36E-12	2.27E-12	2.59E-12
Percent of Limit 10 CFR 20, App. B = 1.0E-06	%	4.15E-03	3.36E-04	2.27E-04	2.59E-04
B. Tritium Total Release	Ci	4.02E+01	8.52E+01	6.81E+01	2.35E+01
Avg Diluted Concentration	µCi/ml	1.10E-10	2.49E-10	1.93E-10	1.69E-10
Percent of Limit 10 CFR 20, App. B = 1.0E-03	%	1.10E-05	2.49E-05	1.93E-05	1.69E-05
C. Dissolved & Entrained Gases Total Release	Ci	2.22E-03	1.27E-02	7.94E-02	1.08E-02
Avg Diluted Concentration	µCi/ml	6.05E-15	3.71E-14	2.25E-13	7.71E-14
Percent of Limit ODCM = 2.0E-04 µCi/ml	%	3.03E-09	1.86E-08	1.12E-07	3.86E-08
D. Gross Alpha Radioactivity Total Release	Ci	2.99E-06	1.42E-04	2.03E-04	1.62E-03
E. Volume of Waste Release Prior to Dilution	Liters	3.88E+10	3.90E+10	3.76E+10	1.95E+10
F. Volume of Dilution Water This Period	Liters	3.67E+14	3.42E+14	3.54E+14	1.39E+14

TABLE 2B

EFFLUENT AND WASTE DISPOSAL REPORT

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

FIRST QUARTER

Nuclides(Ci)	Continuous	Batch
Silver-110M	0.000E+00	2.752E-04
Beryllium-7	0.000E+00	7.015E-05
Carbon-14	0.000E+00	1.522E+01
Cobalt-58	0.000E+00	2.484E-04
Cobalt-60	0.000E+00	2.963E-04
Chromium-51	0.000E+00	2.132E-05
Cesium-134	0.000E+00	4.666E-04
Cesium-137	0.000E+00	1.127E-03
Iron-55	0.000E+00	5.407E-03
Iodine-131	0.000E+00	7.142E-05
Lanthanum-140	0.000E+00	3.450E-06
Manganese-54	0.000E+00	2.898E-05
Niobium-95	0.000E+00	7.362E-05
Rhodium-106	0.000E+00	8.470E-06
Ruthenium-106	0.000E+00	8.470E-06
Antimony-122	0.000E+00	1.369E-06
Antimony-124	0.000E+00	6.685E-06
Antimony-125	0.000E+00	3.271E-03
Tin-113	0.000E+00	4.067E-06
Strontium-89	0.000E+00	4.190E-05
Strontium-90	5.891E-04	0.000E+00
Yttrium-90	5.891E-04	0.000E+00
Zirconium-95	0.000E+00	3.817E-05
Total for Period:	1.178E-03	1.523E+01
Dissolved and Entrained Gases		
Argon-41	0.000E+00	4.655E-06
Krypton-85M	0.000E+00	2.991E-06
Krypton-87	0.000E+00	5.160E-06
Krypton-88	0.000E+00	8.425E-06
Xenon-133	0.000E+00	2.167E-03
Xenon-135	0.000E+00	2.885E-05
Xenon-135M	0.000E+00	7.477E-06
Total for Period:	0.000E+00	2.225E-03
Other, Tritium and Alpha		
Tritium	4.699E-02	4.017E+01
Alpha	0.000E+00	2.990E-06

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

TABLE 2B

EFFLUENT AND WASTE DISPOSAL REPORT

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

SECOND QUARTER

Nuclides(Ci)	Continuous	Batch
Silver-110M	0.000E+00	1.072E-03
Beryllium-7	0.000E+00	9.218E-06
Carbon-14	0.000E+00	1.124E+00
Cobalt-57	0.000E+00	2.179E-05
Cobalt-58	0.000E+00	1.081E-03
Cobalt-60	0.000E+00	2.403E-03
Chromium-51	0.000E+00	1.728E-04
Cesium-134	0.000E+00	3.923E-04
Cesium-137	4.075E-05	1.799E-03
Iron-55	0.000E+00	1.091E-02
Iodine-129	0.000E+00	7.432E-06
Iodine-131	0.000E+00	4.389E-05
Iodine-133	0.000E+00	1.206E-06
Lanthanum-140	0.000E+00	1.183E-05
Manganese-54	0.000E+00	9.614E-05
Molybdenum-99	0.000E+00	1.219E-06
Niobium-95	0.000E+00	2.625E-04
Rhodium-106	0.000E+00	9.720E-05
Ruthenium-106	0.000E+00	9.720E-05
Antimony-122	0.000E+00	1.138E-06
Antimony-124	0.000E+00	5.039E-06
Antimony-125	0.000E+00	6.007E-03
Strontium-89	0.000E+00	2.015E-05
Strontium-90	8.439E-05	2.891E-05
Technetium-99M	0.000E+00	1.219E-06
Yttrium-90	8.439E-05	2.891E-05
Zirconium-95	0.000E+00	2.031E-04
Total for Period:	2.095E-04	1.149E+00
Dissolved and Entrained Gases		
Xenon-133	0.000E+00	1.264E-02
Xenon-133M	0.000E+00	1.175E-05
Xenon-135	0.000E+00	4.578E-05
Total for Period:	0.000E+00	1.270E-02
Other, Tritium and Alpha		
Tritium	1.635E-02	8.519E+01
Alpha	0.000E+00	1.417E-04

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

TABLE 2B

EFFLUENT AND WASTE DISPOSAL REPORT

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

THIRD QUARTER

Nuclides(Ci)	Continuous	Batch
Silver-110M	0.000E+00	5.173E-05
Barium-140	0.000E+00	4.276E-05
Carbon-14	0.000E+00	7.141E-01
Cobalt-58	0.000E+00	4.951E-04
Cobalt-60	0.000E+00	4.879E-04
Chromium-51	0.000E+00	2.347E-05
Cesium-134	0.000E+00	2.269E-04
Cesium-137	0.000E+00	1.592E-03
Iron-55	0.000E+00	7.441E-02
Iodine-129	0.000E+00	2.999E-05
Iodine-131	0.000E+00	5.242E-03
Iodine-133	0.000E+00	1.441E-04
Lanthanum-140	0.000E+00	1.173E-04
Manganese-54	0.000E+00	5.107E-05
Molybdenum-99	0.000E+00	7.503E-06
Niobium-95	0.000E+00	1.616E-05
Nickel-63	0.000E+00	3.561E-04
Phosphorus-32	0.000E+00	9.372E-06
Antimony-122	0.000E+00	6.513E-07
Antimony-125	0.000E+00	3.688E-03
Strontium-89	1.319E-04	8.612E-05
Strontium-90	0.000E+00	1.303E-05
Technetium-99M	0.000E+00	7.503E-06
Yttrium-90	0.000E+00	1.303E-05
Zirconium-95	0.000E+00	1.133E-05
Total for Period:	1.319E-04	8.012E-01
Dissolved and Entrained Gases		
Krypton-85M	0.000E+00	2.388E-06
Xenon-131M	0.000E+00	3.768E-05
Xenon-133	0.000E+00	7.804E-02
Xenon-133M	0.000E+00	6.520E-04
Xenon-135	0.000E+00	6.234E-04
Total for Period:	0.000E+00	7.936E-02
Other, Tritium and Alpha		
Tritium	0.000E+00	6.811E+01
Alpha	0.000E+00	2.026E-04

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below the Lower Limit of Detection (LLD) values.

TABLE 2B

EFFLUENT AND WASTE DISPOSAL REPORT

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

FOUTH QUARTER

Nuclides(Ci)	Continuous	Batch
Silver-110M	0.000E+00	3.064E-03
Barium-140	0.000E+00	1.201E-04
Carbon-14	0.000E+00	2.743E-02
Cerium-141	0.000E+00	1.097E-04
Cerium-144	0.000E+00	1.855E-04
Cobalt-57	0.000E+00	1.515E-04
Cobalt-58	0.000E+00	1.188E-01
Cobalt-60	4.851E-06	2.819E-03
Chromium-51	0.000E+00	1.434E-02
Cesium-134	0.000E+00	2.046E-04
Cesium-137	2.447E-05	1.737E-03
Iron-55	0.000E+00	8.853E-02
Iron-59	0.000E+00	2.360E-04
Hafnium-181	0.000E+00	4.822E-05
Iodine-129	0.000E+00	2.525E-05
Iodine-131	0.000E+00	2.540E-03
Iodine-132	0.000E+00	2.056E-05
Iodine-133	0.000E+00	9.281E-05
Lanthanum-140	0.000E+00	7.556E-04
Lanthanum-141	0.000E+00	4.520E-05
Manganese-54	0.000E+00	6.695E-04
Molybdenum-99	0.000E+00	2.393E-05
Niobium-95	0.000E+00	5.681E-03
Nickel-63	0.000E+00	1.161E-05
Praseodymium-1[illegible]4	0.000E+00	1.855E-04
Rhodium-103M	0.000E+00	2.773E-04
Ruthenium-103	0.000E+00	2.773E-04
Antimony-122	0.000E+00	2.920E-04
Antimony-124	0.000E+0[illegible]	[illegible].878E-02
Antimony-125	0.000[illegible]	[illegible].759E-02
Antimony-126	0.000[illegible]	[illegible].648E-04
Selenium-75	0.000[illegible]	1.010E-03
Tin-113	0.000E+[illegible]	2.042E-04
Strontium-89	0.000E+00	2.090E-04
Strontium-90	0.000E+00	3.512E-05
Technetium-99M	0.000E+00	2.393E-05
Tellurium-132	0.000E+00	2.110E-05
Yttrium-90	0.000E+00	3.512E-05
Zinc-65	0.000E+00	4.065E-05
Zirconium-95	0.000E+00	3.676E-03
Total for Period:	2.932E-05	3.607E-01

TABLE 2B (Continued)

Dissolved and Entrained Gases		
Xenon-133	0.000E+00	1.071E-02
Xenon-133M	0.000E+00	3.351E-05
Total for Period:	0.000E+00	1.075E-02
Other, Tritium and Alpha		
Tritium	4.993E-02	2.349E+01
Alpha	0.000E+00	1.621E-03

NOTE: Nuclides not display or reported as 0.000E+00 were determined to be below theLower Limit of Detection (LLD) values.

SECTION V

RADIOACTIVE EFFLUENT RELEASES - SOLID RADIOACTIVE WASTE

Technical Specifications 5.9.4.a, 5.17.d and 5.18.d

January 1, 1993 - December 31, 1993

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

January 1, 1993 through December 31, 1993

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	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	1	5.52	11.803	20
	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 A)		1	5.52	11.803	20
b. Dry Compressible, contaminated equipment, etc.	January	0	0	0.000	N/A
	February	2	0.23	0.186	20
	March	2	2.09	0.033	20
	April	4	0.82	0.045	20
	May	3	4.64	0.026	20
	June	1	0.24	0.005	20
	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	2	0.74	0.0039	20
	December	18	9.98	0.5826	20
Total (Type B)		32	18.74	0.881	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

III. RADIOACTIVE EFFLUENT RELEASES - SOLID RADIOACTIVE WASTE EFFLUENT AND WASTE DISPOSAL REPORT (Continued)

Type of Waste	Month Shipped	Number of Shipments	Volume Cu. Meter	Curie Content	Est. Total % Error
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	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-137	58.0%	6.850	All other nuclides constitute less than 1%
	Cs-134	31.6%	3.730	
	Fe-55	4.8%	0.560	
	Mn-54	2.2%	0.262	
	Ni-63	1.6%	0.190	
b.	Fe-55	36.3%	0.320	All other nuclides constitute less than 1%
	Co-60	23.7%	0.209	
	Cs-137	14.9%	0.131	
	Ni-63	6.0%	0.053	
	Co-58	5.9%	0.052	
	Tc-99	2.5%	0.022	
	Sb-125	1.1%	0.009	
	Mn-54	1.0%	0.009	
c.	N/A	N/A	N/A	
d.	N/A	N/A	N/A	

C. SOLID WASTE (DISPOSITION)

Number of Shipments	Transportation Mode	Destination
33	N/A	Barnwell, S.C.

D. IRRADIATED FUEL SHIPMENTS (DISPOSITION)

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

RADIOACTIVE EFFLUENT RELEASES - SOLID RADIOACTIVE
WASTE EFLFUENT AND WASTE DISPOSAL REPORT
(Continued)

E. ODCM and PCP Revisions for the period January 1, 1993 - December 31, 1993
In accordance with Technical Specification 5.17.d and 5.18.d, the radioactive effluent release report shall include any revisions to the Offsite dose Calculation Manual (ODCM) and the Process Control Program (PCP).

Four revisions were made to the Offsite Dose Calculation Manual (ODCM).

Two revisions were made to the Process Control Program (PCP).

SECTION VI

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND
SPEED BY STABILITY CLASS AND METEOROLOGICAL DATA
PER BATCH RELEASE

(Regulatory Guide 1.21)

January 1, 1993 - December 31, 1993

VI. JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED BY STABILITY CLASS AND METEOROLOGY DATA PER BATCH RELEASE

A. Meteorology data per batch tables will have -99 values signifying either invalid data or no data available.

B. Meteorological Data Recovery

Data recovery from the on-site weather tower for the period January through December 1993 was less than the previous twelve months. The regulatory recovery guide was met with a cumulative recovery rate of 72.6% from the meteorological tower with the remaining 27.4% provided by the National Weather Service. The following table is a summary of the parameters and their respective recovery rates for the period:

Parameter	Actual Recovery Rate	Recovered Parameter Hrs/ Total Parameter Hrs
WD110	0.7572	6633/8760
WD45	0.7693	6739/8760
WD10	0.7727	6769/8760
WS110	0.6446	5647/8760
WS45	0.5961	5222/8760
WS10	0.6979	6114/8760
Delta-T 100M	0.7917	6935/8760
T10M	0.7781	6816/8760

Total Possible Hours:	70,080
Actual Tower Recovery:	50,875
Recovery Rate:	0.7260

B. Meteorological Data Recovery (Continued)

Hourly meteorological data used to replace missing tower data for the months of January 1993 through December 1993 originated from the North Omaha National Weather Service and NOAA Daily Synoptic Weather Maps. This raw data was used in formulating synthetic hourly data in accordance with monthly correction factors and a proceduralized Pasquill-Turner transformation which utilizes solar angle, time of day, cloud cover, and wind speed to determine the Pasquill Class.

The tabulations of the Weather Tower Data for January 1, 1993 through December 31, 1993 look appropriate for the season as indicated. The Pasquill Classes observed for the twelve month period are detailed below.

Pasquill Class	A	B	C	D	E	F	G		Total
% Obs.	4.7	7.5	7.5	38.6	29.8	10.4	1.5	=	100.0

The data, when corrected and/or supplemented by the synthetic data, derived from NWS NOAA data brought the recovery rate up above that required for maintaining adequate recovery as specified by the Nuclear Regulatory Commission. Recovery of synthetic and actual data requires a minimum recovery rate of 90 percent for the period.

On the basis of the data and its cross-checks, the weather data as amended is completely valid for use in tabulating reactor vent releases.

TABLE 158 - A

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -2.0 TO -INF IN FREQUENCY DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	2.	4.	4.	4.	5.	4.	0.	0.	0.	0.	0.	0.	0.	0.	0.	23.	1.6
NE	0.	0.	5.	5.	3.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	14.	1.7
ENE	0.	2.	5.	3.	5.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	16.	1.6
E	0.	2.	7.	4.	4.	2.	4.	0.	0.	0.	0.	0.	0.	0.	0.	23.	1.8
ESE	0.	0.	8.	4.	2.	6.	8.	5.	5.	4.	0.	2.	0.	0.	0.	44.	3.0
SE	0.	0.	3.	1.	1.	1.	3.	2.	2.	0.	6.	2.	2.	1.	0.	24.	4.2
SSE	0.	0.	1.	2.	3.	3.	2.	1.	0.	2.	3.	4.	1.	0.	0.	22.	4.0
S	0.	0.	1.	1.	1.	0.	1.	2.	2.	1.	0.	1.	2.	0.	0.	12.	4.2
SSW	0.	0.	0.	1.	1.	1.	2.	1.	4.	2.	4.	1.	0.	0.	0.	17.	4.2
SW	0.	1.	7.	2.	1.	2.	0.	2.	0.	0.	0.	0.	0.	0.	0.	15.	1.8
WSW	0.	0.	2.	2.	0.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	6.	1.9
W	1.	2.	2.	5.	2.	1.	0.	1.	0.	0.	0.	0.	0.	0.	0.	14.	1.6
WNW	1.	3.	3.	2.	5.	0.	2.	2.	3.	2.	0.	0.	0.	0.	0.	23.	2.4
NW	0.	4.	5.	11.	13.	12.	11.	5.	4.	3.	5.	1.	0.	0.	0.	74.	2.7
NNW	0.	2.	5.	12.	6.	12.	10.	10.	4.	0.	4.	1.	0.	0.	0.	66.	2.8
N	0.	2.	3.	5.	1.	5.	1.	1.	0.	1.	0.	0.	0.	0.	0.	19.	2.1
TOTAL	4.	22.	61.	64.	53.	51.	46.	32.	24.	15.	22.	12.	5.	1.	0.	412.	2.7

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 4.7

TABLE 158 - B

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -1.7 TO -1.9 IN FREQUENCY DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.	6.	10.	15.	9.	5.	2.	0.	0.	0.	0.	0.	0.	0.	0.	47.	1.7
NE	1.	4.	10.	7.	5.	3.	0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	1.5
ENE	1.	2.	1.	4.	4.	2.	1.	0.	0.	0.	0.	0.	0.	0.	0.	15.	1.7
E	0.	6.	6.	6.	3.	3.	4.	1.	1.	1.	0.	0.	0.	0.	0.	31.	1.9
ESE	0.	1.	5.	5.	3.	4.	2.	2.	4.	2.	2.	2.	0.	0.	0.	32.	2.9
SE	0.	4.	4.	3.	8.	3.	2.	0.	2.	4.	3.	2.	0.	1.	0.	36.	3.0
SSE	0.	0.	5.	12.	7.	5.	6.	3.	0.	1.	8.	6.	0.	0.	0.	53.	3.2
S	0.	0.	4.	7.	10.	4.	1.	2.	1.	1.	3.	3.	3.	0.	0.	39.	3.2
SSW	0.	0.	0.	6.	5.	3.	2.	2.	0.	1.	3.	0.	0.	0.	0.	22.	2.9
SW	2.	0.	4.	9.	3.	1.	0.	1.	2.	2.	0.	0.	0.	0.	0.	24.	2.1
WSW	1.	0.	2.	8.	2.	1.	2.	0.	0.	0.	0.	0.	0.	0.	0.	16.	1.8
W	0.	2.	6.	8.	4.	1.	0.	1.	1.	0.	0.	0.	0.	0.	0.	23.	1.8
WNW	0.	5.	11.	16.	6.	4.	1.	1.	0.	0.	1.	1.	0.	0.	0.	46.	1.8
NW	0.	6.	16.	9.	13.	16.	10.	5.	3.	2.	10.	2.	0.	0.	0.	92.	2.7
NNW	0.	4.	9.	16.	15.	12.	12.	3.	8.	5.	11.	3.	0.	0.	0.	98.	2.9
N	4.	14.	10.	10.	8.	6.	3.	0.	1.	0.	0.	0.	0.	0.	0.	56.	1.5
TOTAL	9.	54.	103.	141.	105.	73.	48.	21.	23.	19.	41.	19.	3.	1.	0.	660.	2.4

NUMBER OF INVALID OBSERVATIONS- 0.

PERCENT OF VALID OBSERVATIONS- 7.5

TABLE 158 - C

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -1.5 TO -1.6 IN FREQUENCY   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.	1.	3.	15.	5.	4.	4.	0.	0.	0.	0.	0.	0.	0.	0.	32.	1.9
NE	0.	2.	2.	5.	10.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	21.	1.9
ENE	1.	1.	0.	4.	3.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.	1.6
E	0.	1.	1.	2.	0.	2.	4.	1.	0.	1.	0.	0.	0.	0.	0.	12.	2.5
ESE	0.	0.	7.	3.	1.	1.	2.	3.	2.	2.	2.	1.	0.	0.	0.	24.	3.0
SE	0.	1.	11.	1.	5.	1.	1.	2.	2.	1.	4.	2.	0.	2.	0.	33.	3.2
SSE	0.	0.	2.	5.	4.	4.	6.	2.	9.	2.	7.	3.	2.	1.	0.	47.	3.9
S	0.	0.	4.	5.	6.	14.	19.	6.	2.	1.	5.	4.	5.	2.	0.	73.	3.6
SSW	1.	1.	2.	5.	10.	12.	5.	2.	1.	1.	3.	0.	1.	0.	0.	44.	2.7
SW	2.	0.	4.	9.	7.	5.	5.	1.	0.	0.	5.	0.	0.	0.	0.	38.	2.5
WSW	1.	0.	2.	5.	8.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	18.	1.9
W	1.	0.	3.	7.	3.	3.	3.	0.	0.	0.	1.	0.	0.	0.	0.	21.	2.1
WNW	2.	4.	6.	8.	6.	5.	5.	0.	0.	1.	0.	0.	0.	0.	0.	37.	1.9
NW	0.	4.	12.	8.	16.	10.	15.	6.	6.	6.	6.	0.	0.	0.	0.	89.	2.7
NNW	1.	3.	8.	8.	19.	16.	18.	9.	5.	1.	12.	5.	0.	0.	0.	105.	3.0
N	0.	5.	12.	8.	17.	11.	4.	0.	0.	0.	0.	0.	0.	0.	0.	57.	1.9
TOTAL	9.	23.	79.	98.	120.	91.	92.	32.	28.	16.	45.	15.	8.	5.	0	661.	2.7

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 7.5

TABLE 158 - D

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -0.5 TO -1.4 IN FREQUENCY   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	3.	11.	26.	24.	22.	14.	6.	2.	1.	1.	1.	0.	0.	0.	0.	111.	1.8
NE	5.	14.	15.	13.	21.	10.	13.	3.	2.	0.	0.	0.	0.	0.	0.	96.	1.9
ENE	1.	10.	11.	21.	26.	11.	8.	3.	0.	0.	0.	0.	0.	0.	0.	91.	1.9
E	0.	8.	12.	26.	26.	26.	24.	2.	6.	2.	2.	1.	0.	0.	0.	135.	2.4
ESE	0.	2.	19.	32.	25.	15.	40.	37.	18.	18.	20.	7.	1.	1.	0.	235.	3.2
SE	2.	8.	29.	36.	30.	24.	27.	22.	27.	19.	20.	18.	6.	3.	1.	272.	3.3
SSE	2.	5.	12.	30.	39.	35.	46.	30.	25.	21.	49.	23.	9.	2.	2.	330.	3.6
S	0.	7.	18.	17.	23.	21.	35.	34.	14.	15.	20.	12.	15.	13.	0.	244.	3.8
SSW	1.	5.	16.	22.	17.	27.	20.	12.	8.	9.	7.	13.	6.	1.	1.	165.	3.2
SW	2.	11.	13.	17.	30.	16.	8.	10.	4.	6.	12.	3.	0.	2.	1.	135.	2.8
WSW	3.	15	16.	15.	18.	10.	4.	1.	3.	4.	0.	1.	1.	1.	0.	92.	2.0
W	7.	15.	21.	27.	15.	15.	11.	4.	4.	0.	0.	0.	0.	1.	1.	121.	1.9
WNW	8.	31.	42.	22.	18.	13.	11.	15.	8.	7.	3.	2.	0.	0.	0.	180.	2.0
NW	12.	22.	51.	56.	74.	50.	43.	41.	30.	16.	17.	16.	4.	0.	0.	432.	2.7
NNW	5.	26.	38.	52.	64.	70.	74.	61.	54.	33.	37.	8.	1.	1.	0.	524.	3.0
N	10.	24.	25.	35.	32.	24.	27.	15.	9.	8.	13.	0.	0.	0.	0.	222.	2.4
TOTAL	61.	214.	364.	445.	480.	381.	397.	292.	213.	159.	201.	104.	43.	25.	6.	3385.	2.8

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 38.6

TABLE 158 - E

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -0.4 TO +1.5 IN FREQUENCY DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	1.	15.	19.	15.	9.	8.	0.	1.	0.	0.	0.	0.	0.	0.	0.	68.	1.5
NE	2.	13.	16.	13.	4.	3.	4.	1.	0.	1.	0.	0.	0.	0.	0.	57.	1.5
ENE	0.	11.	22.	8.	10.	4.	3.	0.	0.	0.	1.	0.	0.	0.	0.	59.	1.6
E	2.	4.	21.	26.	8.	5.	5.	4.	2.	0.	0.	0.	0.	0.	0.	77.	1.8
ESE	0.	8.	43.	41.	32.	18.	13.	7.	8.	8.	5.	0.	0.	0.	0.	183.	2.2
SE	6.	20.	38.	52.	35.	25.	15.	10.	12.	10.	12.	6.	0.	1.	1.	243.	2.4
SSE	6.	10.	12.	20.	26.	24.	20.	20.	6.	15.	13.	4.	2.	0.	0.	178.	2.9
S	4.	11.	17.	39.	23.	24.	20.	11.	7.	10.	10.	10.	3.	0.	0.	189.	2.8
SSW	8.	4.	27.	27.	20.	24.	9.	6.	7.	9.	13.	9.	1.	1.	1.	166.	2.8
SW	4.	26.	21.	15.	10.	9.	8.	2.	5.	6.	2.	4.	4.	2.	1.	119.	2.4
WSW	11.	27.	23.	19.	15.	6.	7.	5.	2.	3.	3.	0.	0.	0.	0.	121.	1.7
W	18.	67.	43.	30.	19.	12.	5.	3.	1.	1.	1.	0.	0.	0.	0.	200.	1.3
WNW	28.	76.	87.	59.	32.	16.	15.	9.	8.	3.	3.	0.	2.	0.	0.	338.	1.5
NW	16.	41.	61.	52.	43.	47.	30.	12.	4.	2.	2.	3.	2.	1.	0.	316.	2.0
NNW	8.	24.	31.	29.	31.	33.	18.	9.	3.	4.	10.	0.	0.	0.	0.	200.	2.2
N	7.	13.	22.	32.	13.	5.	3.	1.	1.	0.	0.	0.	0.	0.	0.	97.	1.5
TOTAL	121.	370.	503.	477.	330.	263.	175.	101.	66.	72.	75.	36.	14.	5.	3.	2611.	2.1

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 29.8

TABLE 158 - F

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = +1.6 TO +4.0 IN FREQUENCY   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	1.	18.	6.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	27.	0.9
NE	1.	11.	11.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	24.	0.9
ENE	1.	6.	5.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	13.	0.9
E	2.	12.	11.	3.	1.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	30.	1.1
ESE	3.	16.	23.	10.	6.	5.	1.	0.	0.	0.	0.	0.	0.	0.	0.	64.	1.3
SE	1.	14.	13.	22.	12.	5.	2.	2.	0.	0.	0.	0.	0.	0.	0.	71.	1.7
SSE	4.	12.	13.	26.	7.	10.	2.	1.	0.	0.	0.	0.	0.	0.	0.	75.	1.6
S	5.	19.	11.	29.	14.	6.	1.	5.	0.	0.	1.	0.	0.	0.	0.	91.	1.6
SSW	3.	17.	24.	12.	3.	6.	4.	4.	2.	0.	2.	3.	0.	0.	0.	80.	1.9
SW	5.	12.	13.	4.	7.	0.	1.	1.	0.	2.	6.	6.	0.	0.	0.	57.	2.3
WSW	8.	17.	11.	2.	2.	2.	4.	1.	0.	0.	2.	0.	0.	0.	0.	49.	1.4
W	5.	32.	27.	7.	3.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	74.	1.0
WNW	6.	28.	35.	12.	3.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	85.	1.0
NW	2.	22.	22.	3.	5.	3.	0.	3.	0.	0.	0.	0.	0.	0.	0.	60.	1.3
NNW	3.	11.	21.	6.	2.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	44.	1.1
N	11.	19.	17.	15.	1.	1.	2.	1.	1.	0.	0.	0.	0.	0.	0.	68.	1.2
TOTAL	61.	266.	263.	155.	66.	39.	17.	18.	4.	3.	11.	9.	0.	0.	0.	912.	1.4

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 10.4

TABLE 158 - G

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = +4.1 TO +INF IN FREQUENCY DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	1.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	0.6
NE	0.	2.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.	0.9
ENE	1.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.	0.5
E	0.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	0.9
ESE	0.	3.	7.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	11.	1.0
SE	1.	2.	6.	1.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12.	1.2
SSE	1.	4.	2.	1.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	9.	1.0
S	1.	3.	1.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	7.	1.2
SSW	1.	7.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	9.	0.8
SW	1.	7.	1.	0.	1.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	11.	1.4
WSW	0.	6.	1.	1.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	9.	1.1
W	1.	3.	2.	4.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	11.	1.3
WNW	2.	4.	1.	4.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12.	1.1
NW	0	1.	2.	5.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8.	1.4
NNW	0.	1.	0.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.	1.3
N	0	5.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	6.	0.9
TOTAL	10.	51.	27.	22.	5.	1.	1.	1.	0.	0.	0.	1.	0.	0.	0.	119.	1.1

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 1.5

TABLE 158 - ALL

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -INF TO +INF IN FREQUENCY   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	8.	55.	69.	75.	50.	35.	12.	3.	1.	1.	1.	0.	0.	0.	0.	310.	1.6
NE	9.	46.	61.	44.	43.	17.	19.	4.	2.	1.	0.	0.	0.	0.	0.	246.	1.6
ENE	5.	34.	44.	41.	48.	18.	13.	3.	0.	0.	1.	0.	0.	0.	0.	207.	1.7
E	4.	34.	59.	67.	42.	38.	41.	8.	9.	5.	2.	1.	0.	0.	0.	310.	2.0
ESE	3.	30.	112.	96.	69.	49.	66.	54.	37.	34.	29.	12.	1.	1.	0.	593.	2.6
SE	10.	49.	104.	116.	93.	59.	50.	38.	45.	34.	45.	30.	8.	8.	2.	691.	2.8
SSE	13.	31.	47.	96.	86.	82.	82.	57.	40.	41.	80.	40.	14.	3.	2.	714.	3.2
S	10.	40.	56.	99.	77.	69.	78.	60.	26.	28.	39.	30.	28.	15.	0.	655.	3.1
SSW	14.	34.	69.	74.	56.	73.	42.	27.	22.	22.	32.	26.	8.	2.	2.	503.	2.8
SW	16.	57.	63.	56.	59.	33.	22.	17.	11.	16.	25.	14.	4.	4.	2.	399.	2.5
WSW	24.	65.	57.	52.	45.	22.	17.	8.	6.	7.	5.	1.	1.	1.	0.	311.	1.7
W	33.	121.	104.	88.	47.	32.	19.	9.	6.	1.	2.	0.	0.	1.	1.	464.	1.5
WNW	47.	151.	185.	123.	71.	39.	34.	27.	19.	13.	7.	3.	2.	0.	0.	721.	1.7
NW	30.	100.	169.	144.	164.	138.	109.	72.	47.	29.	40.	22.	6.	1.	0.	1071.	2.4
NNW	17.	71.	112.	125.	137.	143.	132.	92.	75.	43.	74.	17.	1.	1.	0.	1040.	2.7
N	32.	82.	89.	106.	72.	52.	40.	18.	12.	9.	13.	0.	0.	0.	0.	525.	1.9
TOTAL	275.	1000.	1400.	1402.	1159.	899.	776.	497.	358.	284.	395.	196.	73.	37.	9.	8760.	2.4

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 100.0

TABLE 159 - A

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -2.0 TO -INF IN PERCENT DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.02	0.05	0.05	0.04	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	1.6
NE	0.00	0.00	0.06	0.06	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	1.7
ENE	0.00	0.02	0.06	0.03	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	1.6
E	0.00	0.02	0.08	0.05	0.05	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	1.8
ESE	0.00	0.00	0.09	0.05	0.02	0.07	0.09	0.06	0.06	0.04	0.00	0.02	0.00	0.00	0.00	0.50	3.0
SE	0.00	0.00	0.04	0.01	0.01	0.01	0.04	0.02	0.02	0.00	0.07	0.02	0.02	0.01	0.00	0.27	4.2
SSE	0.00	0.00	0.01	0.02	0.04	0.04	0.02	0.01	0.00	0.02	0.03	0.05	0.01	0.00	0.00	0.25	4.0
S	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.03	0.03	0.01	0.00	0.01	0.02	0.00	0.00	0.14	4.2
SSW	0.00	0.00	0.00	0.01	0.01	0.01	0.03	0.01	0.05	0.02	0.05	0.01	0.00	0.00	0.00	0.20	4.2
SW	0.00	0.01	0.08	0.03	0.01	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	1.8
WSW	0.00	0.00	0.03	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	1.9
W	0.01	0.03	0.02	0.06	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	1.6
WNW	0.01	0.04	0.04	0.02	0.06	0.00	0.02	0.02	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.26	2.4
NW	0.00	0.05	0.06	0.12	0.15	0.14	0.12	0.06	0.05	0.03	0.06	0.01	0.00	0.00	0.00	0.85	2.7
NNW	0.00	0.02	0.06	0.14	0.07	0.14	0.11	0.11	0.05	0.00	0.04	0.01	0.00	0.00	0.00	0.75	2.8
N	0.00	0.02	0.04	0.06	0.01	0.06	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.22	2.1
TOTAL	0.04	0.26	0.73	0.73	0.61	0.58	0.51	0.36	0.29	0.15	0.25	0.13	0.05	0.01	0.00	4.70	2.7

NUMBER OF INVALID OBSERVATIONS- 0.

PERCENT OF VALID OBSERVATIONS- 4.7

TABLE 159 - B

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -1.7 TO -1.9 IN PERCENT   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.00	0.07	0.12	0.17	0.10	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	1.7
NE	0.01	0.05	0.11	0.08	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	1.5
ENE	0.01	0.02	0.01	0.05	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	1.7
E	0.00	0.07	0.07	0.07	0.03	0.03	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.35	1.9
ESE	0.00	0.01	0.06	0.06	0.04	0.05	0.02	0.02	0.05	0.02	0.02	0.02	0.00	0.00	0.00	0.37	2.9
SE	0.00	0.05	0.05	0.04	0.09	0.03	0.02	0.00	0.02	0.05	0.03	0.02	0.00	0.01	0.00	0.41	3.0
SSE	0.00	0.00	0.06	0.13	0.08	0.06	0.07	0.03	0.00	0.01	0.09	0.07	0.00	0.00	0.00	0.60	3.2
S	0.00	0.00	0.05	0.08	0.11	0.05	0.01	0.02	0.01	0.01	0.04	0.04	0.03	0.00	0.00	0.45	3.2
SSW	0.00	0.00	0.00	0.07	0.06	0.04	0.02	0.02	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.25	2.9
SW	0.02	0.00	0.05	0.10	0.04	0.01	0.00	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.27	2.1
WSW	0.01	0.00	0.03	0.09	0.02	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	1.8
W	0.00	0.02	0.07	0.09	0.05	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.26	1.8
WNW	0.00	0.06	0.13	0.18	0.07	0.05	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.53	1.8
NW	0.00	0.07	0.18	0.10	0.15	0.18	0.12	0.06	0.04	0.02	0.11	0.02	0.00	0.00	0.00	1.05	2.7
NNW	0.00	0.05	0.10	0.18	0.17	0.14	0.14	0.03	0.09	0.06	0.13	0.03	0.00	0.00	0.00	1.12	2.9
N	0.05	0.16	0.11	0.11	0.09	0.07	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.64	1.5
TOTAL	0.10	0.63	1.20	1.60	1.21	0.84	0.55	0.22	0.26	0.21	0.46	0.21	0.03	0.01	0.00	7.53	2.4

NUMBER OF INVALID OBSERVATIONS-   0.

PERCENT OF VALID OBSERVATIONS-   7.5

TABLE 159 - C

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -1.5 TO -1.6 IN PERCENT DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.00	0.01	0.03	0.17	0.06	0.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	1.9
NE	0.00	0.02	0.02	0.06	0.12	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.9
ENE	0.01	0.01	0.00	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.6
E	0.00	0.01	0.01	0.03	0.00	0.02	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.14	2.5
ESE	0.00	0.00	0.08	0.04	0.01	0.01	0.02	0.04	0.02	0.02	0.02	0.01	0.00	0.00	0.00	0.27	3.0
SE	0.00	0.01	0.13	0.01	0.06	0.01	0.01	0.03	0.02	0.01	0.05	0.02	0.00	0.02	0.00	0.38	3.2
SSE	0.00	0.00	0.02	0.06	0.05	0.05	0.07	0.02	0.10	0.02	0.08	0.04	0.02	0.01	0.00	0.54	3.9
S	0.00	0.00	0.04	0.06	0.07	0.16	0.22	0.07	0.02	0.01	0.06	0.04	0.06	0.02	0.00	0.83	3.6
SSW	0.01	0.01	0.02	0.06	0.11	0.14	0.06	0.02	0.01	0.01	0.04	0.00	0.01	0.00	0.00	0.50	2.7
SW	0.02	0.00	0.04	0.10	0.08	0.06	0.06	0.01	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.43	2.5
WSW	0.01	0.00	0.03	0.06	0.09	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.21	1.9
W	0.01	0.00	0.04	0.08	0.04	0.03	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.24	2.1
WNW	0.02	0.04	0.07	0.09	0.07	0.06	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.42	1.9
NW	0.00	0.05	0.14	0.09	0.18	0.11	0.17	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	1.02	2.7
NNW	0.01	0.03	0.09	0.09	0.22	0.18	0.21	0.10	0.06	0.01	0.14	0.06	0.00	0.00	0.00	1.20	3.0
N	0.00	0.06	0.14	0.09	0.19	0.12	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	1.9
TOTAL	0.09	0.25	0.90	1.14	1.38	1.03	1.06	0.37	0.31	0.17	0.53	0.17	0.09	0.05	0.00	7.54	2.7

NUMBER OF INVALID OBSERVATIONS- 0.

PERCENT OF VALID OBSERVATIONS- 7.5

TABLE 159 - D

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -0.5 TO -1.4 IN PERCENT   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.04	0.13	0.30	0.27	0.25	0.16	0.07	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	1.27	1.8
NE	0.06	0.16	0.17	0.15	0.24	0.11	0.15	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	1.10	1.9
ENE	0.01	0.11	0.13	0.24	0.30	0.13	0.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.04	1.9
E	0.00	0.09	0.14	0.30	0.30	0.30	0.27	0.02	0.07	0.02	0.02	0.01	0.00	0.00	0.00	1.54	2.4
ESE	0.00	0.02	0.22	0.36	0.28	0.17	0.46	0.42	0.21	0.21	0.23	0.08	0.01	0.01	0.00	2.68	3.2
SE	0.02	0.09	0.33	0.41	0.34	0.27	0.31	0.25	0.31	0.22	0.23	0.21	0.07	0.04	0.01	3.11	3.3
SSE	0.02	0.06	0.14	0.34	0.45	0.40	0.53	0.34	0.29	0.24	0.56	0.26	0.10	0.02	0.02	3.77	3.6
S	0.00	0.08	0.21	0.19	0.26	0.24	0.40	0.39	0.16	0.17	0.23	0.14	0.17	0.15	0.00	2.79	3.8
SSW	0.01	0.06	0.18	0.25	0.19	0.31	0.23	0.14	0.09	0.10	0.08	0.15	0.07	0.01	0.01	1.88	3.2
SW	0.02	0.13	0.15	0.19	0.34	0.18	0.09	0.11	0.05	0.07	0.14	0.04	0.00	0.02	0.01	1.54	2.8
WSW	0.04	0.17	0.18	0.17	0.21	0.11	0.05	0.01	0.03	0.05	0.00	0.01	0.01	0.01	0.00	1.05	2.0
W	0.08	0.17	0.24	0.31	0.17	0.17	0.12	0.05	0.05	0.00	0.00	0.00	0.00	0.01	0.01	1.38	1.9
WNW	0.09	0.35	0.48	0.25	0.21	0.15	0.13	0.17	0.09	0.08	0.03	0.02	0.00	0.00	0.00	2.05	2.0
NW	0.14	0.25	0.58	0.64	0.85	0.57	0.49	0.47	0.34	0.18	0.19	0.18	0.05	0.00	0.00	4.93	2.7
NNW	0.06	0.30	0.43	0.59	0.73	0.80	0.84	0.70	0.62	0.38	0.42	0.09	0.01	0.01	0.00	5.98	3.0
N	0.11	0.27	0.29	0.40	0.37	0.27	0.31	0.17	0.10	0.09	0.15	0.00	0.00	0.00	0.00	2.53	2.4
TOTAL	0.70	2.44	4.17	5.06	5.49	4.34	4.54	3.33	2.44	1.82	2.29	1.19	0.49	0.28	0.06	38.64	2.8

NUMBER OF INVALID OBSERVATIONS=   0.

PERCENT OF VALID OBSERVATIONS=   38.6

TABLE 159 - E

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -0.4 TO +1.5 IN PERCENT DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.01	0.17	0.22	0.17	0.11	0.09	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	1.5
NE	0.02	0.15	0.18	0.15	0.05	0.03	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.65	1.5
ENE	0.00	0.13	0.25	0.09	0.11	0.05	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.67	1.6
E	0.02	0.05	0.24	0.30	0.09	0.06	0.06	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.88	1.8
ESE	0.00	0.09	0.49	0.47	0.36	0.21	0.15	0.08	0.09	0.09	0.06	0.00	0.00	0.00	0.00	2.09	2.2
SE	0.07	0.23	0.43	0.59	0.40	0.29	0.17	0.11	0.14	0.11	0.14	0.07	0.00	0.01	0.01	2.77	2.4
SSE	0.07	0.11	0.14	0.23	0.30	0.27	0.23	0.23	0.07	0.17	0.15	0.04	0.02	0.00	0.00	2.03	2.9
S	0.05	0.13	0.19	0.45	0.26	0.27	0.23	0.13	0.08	0.11	0.11	0.11	0.04	0.00	0.00	2.16	2.8
SSW	0.09	0.05	0.31	0.31	0.23	0.27	0.10	0.07	0.08	0.10	0.15	0.10	0.01	0.01	0.01	1.89	2.8
SW	0.05	0.30	0.24	0.17	0.11	0.10	0.09	0.02	0.06	0.07	0.02	0.05	0.05	0.02	0.01	1.36	2.4
WSW	0.13	0.31	0.26	0.22	0.17	0.07	0.08	0.06	0.02	0.03	0.03	0.00	0.00	0.00	0.00	1.38	1.7
W	0.21	0.76	0.49	0.34	0.22	0.14	0.06	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	2.28	1.3
WNW	0.32	0.87	0.99	0.67	0.37	0.18	0.17	0.10	0.09	0.04	0.04	0.00	0.02	0.00	0.00	3.86	1.5
NW	0.18	0.47	0.70	0.59	0.49	0.54	0.34	0.14	0.05	0.02	0.02	0.04	0.02	0.01	0.00	3.61	2.0
NNW	0.09	0.27	0.35	0.33	0.35	0.38	0.21	0.10	0.04	0.05	0.11	0.00	0.00	0.00	0.00	2.28	2.2
N	0.08	0.15	0.25	0.37	0.15	0.06	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.11	1.5
TOTAL	1.39	4.24	5.73	5.45	3.77	3.01	2.00	1.14	0.76	0.81	0.85	0.41	0.16	0.05	0.03	29.80	2.1

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 29.8

TABLE 159 - F

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 - +1.6 TO +4.0 IN PERCENT   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.01	0.21	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.9
NE	0.01	0.13	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.9
ENE	0.01	0.07	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.9
E	0.02	0.14	0.13	0.03	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.34	1.1
ESE	0.04	0.18	0.26	0.11	0.07	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	1.3
SE	0.01	0.16	0.15	0.25	0.14	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	1.7
SSE	0.05	0.14	0.15	0.30	0.08	0.11	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	1.6
S	0.06	0.22	0.12	0.33	0.16	0.07	0.01	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1.04	1.6
SSW	0.04	0.19	0.27	0.14	0.03	0.07	0.05	0.05	0.02	0.00	0.02	0.03	0.00	0.00	0.00	0.91	1.9
SW	0.06	0.14	0.15	0.04	0.08	0.00	0.01	0.01	0.00	0.02	0.07	0.07	0.00	0.00	0.00	0.65	2.3
WSW	0.09	0.20	0.13	0.02	0.02	0.02	0.05	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.56	1.4
W	0.06	0.36	0.31	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	1.0
WNW	0.07	0.32	0.40	0.14	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	1.0
NW	0.02	0.25	0.25	0.04	0.06	0.04	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	1.3
NNW	0.03	0.13	0.24	0.07	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.1
N	0.13	0.22	0.20	0.17	0.01	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.78	1.2
TOTAL	0.71	3.06	3.01	1.75	0.74	0.45	0.19	0.20	0.04	0.03	0.12	0.10	0.00	0.00	0.00	10.41	1.4

NUMBER OF INVALID OBSERVATIONS- 0.

PERCENT OF VALID OBSERVATIONS- 10.4

TABLE 159 - G

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 - +4.1 TO +INF IN PERCENT   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.6
NE	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.9
ENE	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.5
E	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.9
ESE	0.00	0.04	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	1.0
SE	0.01	0.03	0.07	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.2
SSE	0.01	0.05	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.0
S	0.01	0.04	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.2
SSW	0.01	0.08	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.8
SW	0.02	0.08	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.13	1.4
WSW	0.00	0.07	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.1
W	0.01	0.04	0.02	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	1.3
WNW	0.02	0.05	0.01	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.1
NW	0.00	0.01	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	1.4
NNW	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	1.3
N	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.9
TOTAL	0.11	0.62	0.29	0.25	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1.36	1.1

NUMBER OF INVALID OBSERVATIONS= 0.

PERCENT OF VALID OBSERVATIONS= 1.5

TABLE 159 - ALL

DATA PERIOD 01/01/1993 THROUGH 12/31/1993 RUN FROM TAPE SERIES TRI-EX

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN NUCLEAR STATION

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED IN METERS/SEC FOR

DT100 = -INF TO +INF IN PERCENT   DATA USED -- WD10 ,WS10 ,DT100

SECTOR IS WIND DIRECTION NOT AFFECTED DIRECTION

SECTOR	0.0 TO 0.4	0.5 TO 0.9	1.0 TO 1.4	1.5 TO 1.9	2.0 TO 2.4	2.5 TO 2.9	3.0 TO 3.4	3.5 TO 3.9	4.0 TO 4.4	4.5 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO INF	TOTAL	UBAR
NNE	0.09	0.63	0.79	0.86	0.57	0.40	0.14	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	3.54	1.6
NE	0.10	0.53	0.70	0.50	0.49	0.19	0.22	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	2.81	1.6
ENE	0.06	0.39	0.50	0.47	0.55	0.20	0.15	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	2.36	1.7
E	0.05	0.39	0.67	0.77	0.48	0.43	0.47	0.09	0.10	0.06	0.02	0.01	0.00	0.00	0.00	3.54	2.0
ESE	0.03	0.34	1.28	1.10	0.79	0.56	0.75	0.62	0.42	0.39	0.33	0.14	0.01	0.01	0.00	6.77	2.6
SE	0.12	0.56	1.19	1.33	1.06	0.67	0.57	0.44	0.51	0.39	0.51	0.34	0.09	0.09	0.02	7.89	2.8
SSE	0.15	0.35	0.54	1.09	0.98	0.94	0.94	0.65	0.46	0.47	0.91	0.46	0.16	0.03	0.02	8.15	3.2
S	0.11	0.46	0.64	1.13	0.88	0.79	0.89	0.68	0.30	0.32	0.45	0.34	0.32	0.17	0.00	7.48	3.1
SSW	0.16	0.39	0.79	0.84	0.64	0.83	0.48	0.31	0.25	0.25	0.37	0.30	0.09	0.02	0.02	5.74	2.8
SW	0.18	0.65	0.72	0.64	0.67	0.38	0.25	0.19	0.13	0.18	0.28	0.16	0.05	0.05	0.02	4.55	2.5
WSW	0.28	0.74	0.65	0.59	0.51	0.25	0.20	0.09	0.07	0.08	0.06	0.01	0.01	0.01	0.00	3.55	1.7
W	0.38	1.38	1.19	1.00	0.54	0.37	0.22	0.10	0.07	0.01	0.02	0.00	0.00	0.01	0.01	5.30	1.5
WNW	0.54	1.72	2.11	1.40	0.81	0.45	0.39	0.31	0.22	0.15	0.08	0.03	0.02	0.00	0.00	8.23	1.7
NW	0.34	1.14	1.93	1.64	1.87	1.58	1.25	0.82	0.54	0.33	0.46	0.25	0.07	0.01	0.00	12.23	2.4
NNW	0.19	0.81	1.28	1.43	1.56	1.63	1.51	1.05	0.86	0.49	0.85	0.19	0.01	0.01	0.00	11.87	2.7
N	0.36	0.94	1.02	1.21	0.82	0.59	0.46	0.20	0.14	0.10	0.15	0.00	0.00	0.00	0.00	5.99	1.9
TOTAL	3.14	11.42	16.00	16.00	13.22	10.26	8.89	5.66	4.10	3.24	4.51	2.23	0.83	0.41	0.09	100.00	2.4

NUMBER OF INVALID OBSERVATIONS- 0.

PERCENT OF VALID OBSERVATIONS- 100.0

RELEASE NUMBER 92108 CONTAINMENT PURGE

STARTING TIME JAN 1,1993 HOUR 6 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
6	2.7	345.0	-0.5
7	2.4	340.0	-1.0
8	3.0	40.0	-1.0
9	3.3	80.0	-1.0
10	3.6	110.0	-1.0

STOP TIME JAN 1,1993 HOUR 9 MINUTE 11

STARTING TIME JAN 1,1993 HOUR 13 MINUTE 32

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	3.6	130.0	-1.0
14	3.6	130.0	-1.0
15	3.6	130.0	-1.0
16	3.6	130.0	-1.0
17	3.9	125.0	-1.0
18	3.9	115.0	-1.0
19	4.2	110.0	-1.0
20	4.8	115.0	-1.0
21	5.4	125.0	-1.0
22	6.0	130.0	-1.0
23	6.6	130.0	-1.0
24	7.8	129.0	-1.0
1	13.4	128.0	0.1
2	11.8	128.6	-0.4
3	10.6	128.4	-0.3
4	9.8	13[illegible].3	-0.7
5	10.0	124.5	0.1
6	9.6	118.4	-1.5
7	10.2	123.3	-0.5
8	9.4	123.2	-0.9
9	8.9	126.0	-1.7
10	9.0	128.6	-1.3
11	10.5	130.9	-0.1
12	9.6	135.6	-0.4
13	10.6	143.9	-0.8
14	9.1	149.8	-0.7
15	9.1	175.3	-0.9

STOP TIME JAN 2,1993 HOUR 14 MINUTE 8

RELEASE NUMBER 93001 CONTAINMENT PURGE

STARTING TIME JAN 4,1993 HOUR 18 MINUTE 9

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	3.0	306.8	1.4
19	2.4	293.6	-0.2

STOP TIME JAN 4,1993 HOUR 18 MINUTE 25

STARTING TIME JAN 4,1993 HOUR 21 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	3.6	253.9	-0.3
22	4.2	245.2	-0.3
23	3.6	310.2	0.2
24	3.0	273.0	-1.3
1	2.4	335.7	2.2
2	2.4	212.0	0.6
3	2.0	99.2	-0.5
4	2.0	56.1	0.1
5	2.0	46.4	0.7
6	2.1	137.9	2.6
7	2.4	99.1	-0.5
8	2.7	204.4	-0.8
9	2.7	103.1	0.2
10	3.0	99.1	-0.1
11	2.7	112.2	0.5
12	2.7	141.6	0.6
13	2.4	329.5	-1.0

STOP TIME JAN 5,1993 HOUR 12 MINUTE 25

RELEASE NUMBER 93001 CONTAINMENT PURGE

STARTING TIME JAN 5,1993 HOUR 12 MINUTE 35

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	2.7	141.6	0.6
13	2.4	329.5	-1.0
14	2.4	33.1	-0.5
15	2.4	336.6	-2.2
16	0.2	271.8	-0.9
17	0.2	265.9	-0.9
18	0.1	308.0	-0.5
19	0.1	317.8	0.8
20	0.1	297.2	-0.3
21	0.1	286.8	1.4
22	0.2	302.7	0.8
23	0.2	296.7	1.2
24	0.2	298.0	1.7
1	5.9	307.0	2.6
2	5.2	314.4	0.9
3	3.7	295.1	-0.8
4	2.8	288.2	0.3
5	1.4	234.6	-0.2
6	1.3	236.2	-0.7
7	2.2	273.5	-0.6
8	3.4	304.5	-0.5
9	2.7	300.4	-1.1
10	2.3	302.2	-1.7
11	1.3	260.6	-0.6
12	1.4	8.6	-1.3
13	2.5	305.1	-1.1
14	0.7	225.9	-1.7

STOP TIME JAN 6,1993 HOUR 13 MINUTE 25

STARTING TIME JAN 6,1993 HOUR 14 MINUTE 42

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	0.7	225.9	-1.7
15	4.3	190.5	-1.0
16	4.5	185.3	-1.6
17	4.2	180.3	-0.9
18	3.5	182.6	-1.3
19	3.8	151.2	-0.3
20	3.0	135.3	-0.3
21	2.5	85.1	0.7
22	2.9	106.2	0.2
23	2.8	134.7	0.6
24	2.4	118.1	2.4
1	2.0	135.8	2.5
2	2.1	85.9	1.6
3	1.6	230.5	2.7
4	3.4	38.7	0.8
5	2.3	122.2	0.6
6	2.6	104.4	2.0
7	2.3	289.0	2.6
8	1.9	39.5	0.9
9	1.8	32.0	0.3

STOP TIME JAN 7,1993 HOUR 8 MINUTE 18

RELEASE NUMBER 93001 CONTAINMENT PURGE

STARTING TIME JAN 7,1993 HOUR 10 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	2.1	333.9	-0.7
11	2.1	285.5	-1.1
12	2.4	290.5	-0.8
13	3.1	300.2	-1.2
14	3.0	304.5	-0.8
15	3.8	305.2	-1.3
16	4.6	324.1	-1.2
17	3.3	316.4	-1.6
18	4.5	315.6	-1.0
19	3.2	310.9	0.7
20	3.3	298.6	-0.2
21	2.9	280.1	0.9
22	2.8	275.2	2.0
23	2.7	272.5	1.4
24	2.4	277.9	1.4
1	2.9	285.4	1.0
2	2.3	281.4	0.9
3	2.3	290.3	0.8
4	2.3	292.4	1.9
5	1.8	285.6	0.8
6	1.6	286.2	-1.6
7	2.3	286.0	-1.1
8	2.0	277.4	-0.3
9	1.7	293.5	-0.9
10	2.1	289.3	-0.7
11	2.1	316.1	-0.6
12	2.5	356.8	-1.4
13	3.1	5.0	-1.4

STOP TIME JAN 8,1993 HOUR 12 MINUTE 30

STARTING TIME JAN 8,1993 HOUR 14 MINUTE 58

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	3.7	13.0	-1.4
15	4.2	20.5	-1.5
16	4.6	27.6	-1.7
17	4.7	26.4	-2.0
18	4.8	43.5	0.3
19	5.3	51.7	-0.3
20	5.2	31.2	-0.1
21	5.4	27.1	-2.2
22	5.5	38.2	-1.1
23	5.6	37.5	-1.2
24	4.8	17.2	-0.3
1	5.5	28.0	-1.3
2	5.2	22.3	-1.3
3	5.9	22.0	0.2
4	5.8	29.4	-1.0
5	5.8	27.5	-1.4
6	6.3	20.9	-1.0
7	5.4	7.4	-0.4
8	6.0	12.0	-1.6
9	5.9	12.2	-1.2
10	6.5	28.5	-1.6
11	7.0	26.9	-1.6
12	7.3	17.1	-1.6
13	6.6	11.0	-1.1
14	7.5	17.5	-1.0
15	6.6	12.9	-1.9
16	7.1	12.6	-1.0
17	7.1	4.1	-1.3
18	6.8	3.4	1.8
19	6.0	5.8	-0.8
20	7.0	21.9	-0.6
21	6.5	22.2	-1.1
22	5.8	14.2	0.1
23	5.2	8.9	-0.3
24	4.9	356.5	-1.2
1	4.7	346.3	-0.2
2	4.3	353.0	-0.9

3	4.0	337.5	-0.6
4	4.8	335.7	-0.5
5	4.5	343.6	-0.3
6	3.9	344.0	-0.6
7	3.8	331.2	0.4
8	4.1	338.0	0.3
9	3.0	327.0	0.8
10	3.6	295.9	1.9
11	3.9	295.2	0.5
12	2.7	313.8	-0.9
13	4.1	17.5	-1.0
14	2.7	307.2	-0.9
15	4.2	13.7	-2.2
16	3.8	30.4	-1.6
17	2.4	28.6	-0.8
18	1.1	5.8	0.5
19	1.6	37.7	0.2
20	2.8	53.7	-0.5
21	2.2	293.9	-0.3
22	2.7	71.4	1.0
23	1.9	245.2	-0.2
24	1.9	26.9	-0.1
1	0.9	246.1	0.6
2	1.4	193.6	2.7
3	3.2	145.7	-0.1
4	6.5	97.2	-1.0
5	6.6	101.9	-0.5

STOP TIME JAN 11,1993 HOUR 4 MINUTE 8

RELEASE NUMBER 93002 CONTAINMENT PURGE

STARTING TIME JAN 14,1993 HOUR 18 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	1.1	217.2	-0.2
19	0.8	240.3	0.9
20	0.7	228.0	2.3
21	1.4	188.2	1.2
22	0.1	245.9	2.6
23	0.2	117.3	2.6
24	0.3	190.4	4.6
1	0.3	116.9	2.4
2	0.8	85.7	2.7
3	0.4	231.0	2.2
4	0.2	59.4	4.7
5	0.3	236.8	2.8
6	0.6	192.7	1.1
7	2.2	98.6	1.3
8	2.7	113.4	1.7
9	3.6	106.3	1.8

STOP TIME JAN 15,1993 HOUR 8 MINUTE 34

STARTING TIME JAN 15,1993 HOUR 11 MINUTE 10

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
11	4.5	95.0	-0.3
12	6.7	101.0	-0.5
13	5.8	113.5	-0.9
14	6.2	141.6	-0.2

STOP TIME JAN 15,1993 HOUR 13 MINUTE 45

RELEASE NUMBER 93002 CONTAINMENT PURGE

STARTING TIME JAN 15,1993 HOUR 14 MINUTE 17

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	6.2	141.6	-0.2
15	8.0	160.7	-0.8
16	7.1	151.7	-1.7
17	5.7	146.4	-1.2
18	5.1	143.2	-0.6
19	4.3	136.2	0.3
20	3.7	145.3	0.2
21	3.5	148.9	1.7
22	3.8	126.1	0.6
23	3.8	125.5	-0.9
24	4.2	128.5	-0.3
1	4.5	158.6	-1.5
2	4.8	182.1	-2.6
3	5.6	204.7	1.2
4	5.3	179.2	0.7
5	5.3	181.8	-0.7
6	4.9	191.9	0.3
7	6.8	204.5	0.1
8	5.7	199.1	0.1
9	3.5	209.4	-1.2
10	6.3	221.0	-2.0

STOP TIME JAN 16,1993 HOUR 9 MINUTE 54

STARTING TIME JAN 16,1993 HOUR 14 MINUTE 3

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	2.6	294.7	-1.6
15	3.3	281.5	-1.6
16	3.2	264.8	-2.0
17	3.2	279.9	-0.5
18	2.2	282.3	1.8
19	3.6	299.7	2.2
20	7.2	306.7	-0.4
21	7.7	319.5	-0.8
22	8.1	330.4	-1.3
23	6.9	319.8	-0.1
24	6.8	318.4	0.5
1	8.8	313.6	0.7
2	6.0	309.8	2.1
3	5.5	305.6	-1.3
4	4.6	306.6	1.7
5	4.8	310.8	-0.7
6	4.5	315.4	0.6
7	2.9	311.4	2.5

STOP TIME JAN 17,1993 HOUR 6 MINUTE 45

RELEASE NUMBER 93003 CONTAINMENT PURGE

STARTING TIME JAN 20,1993 HOUR 21 MINUTE 2

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	1.5	236.1	-2.8
22	0.7	331.4	-0.6
23	1.0	295.5	-1.0
24	0.6	338.5	-0.8
1	0.3	329.3	-0.8
2	1.7	131.2	-1.2
3	1.5	134.3	-0.1
4	1.5	235.4	-0.6
5	2.4	181.8	-1.5
6	3.4	225.0	-1.9
7	1.2	153.8	0.4
8	1.6	192.8	-0.5
9	4.6	140.9	-1.6
10	5.3	151.7	-1.3
11	6.1	195.4	-1.1
12	7.9	198.8	-0.9

STOP TIME JAN 21,1993 HOUR 11 MINUTE 46

STARTING TIME JAN 21,1993 HOUR 14 MINUTE 3

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	6.4	199.6	-0.8
15	7.2	190.8	-1.5
16	6.2	226.7	-1.2
17	5.9	239.7	-0.7
18	3.7	253.1	-0.5
19	4.0	242.7	-0.9
20	4.2	264.7	0.5
21	5.1	277.9	0.5
22	7.1	267.7	0.3
23	7.5	252.9	3.8
24	8.4	260.7	1.2
1	8.5	270.5	1.2
2	6.4	269.7	1.3
3	5.5	271.9	1.3
4	6.9	269.9	0.1
5	6.2	266.5	0.6
6	3.4	310.2	0.8
7	2.3	293.8	2.4
8	4.8	242.4	1.3
9	2.9	315.4	2.4

STOP TIME JAN 22,1993 HOUR 8 MINUTE 5

RELEASE NUMBER 93003 CONTAINMENT PURGE

STARTING TIME JAN 22,1993 HOUR 8 MINUTE 58

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
8	4.8	242.4	1.3
9	2.9	315.4	2.4
10	1.4	21.7	1.8
11	4.1	214.3	1.8
12	4.7	174.1	-0.5
13	4.7	174.1	-0.6
14	10.2	166.8	-0.5
	9.9	153.7	-0.8
16	12.1	148.9	-1.3
17	13.9	143.4	-1.2
18	15.0	139.9	-0.1
19	19.9	144.4	-1.0
20	19.8	139.0	0.4
21	20.0	142.6	-0.4
22	16.9	158.8	0.2
23	16.2	157.2	0.6
24	15.0	166.1	-0.7
1	15.7	171.3	-0.1
2	17.5	201.2	-0.5
3	15.6	222.1	1.4
4	11.5	236.7	-0.3
5	10.4	255.4	-0.5
6	5.2	310.6	-0.6
7	11.2	288.0	0.3
8	11.9	291.8	0.2
9	12.8	295.8	0.9
10	13.6	297.4	-1.2
11	12.2	305.3	-1.7
12	1[illegible].8	305.3	-1.8
13	13.1	311.4	-1.5
14	15.9	316.3	-1.2
15	12.0	322.6	-1.3
16	10.1	323.3	-1.6
17	8.5	308.9	-0.9
18	10.0	306.6	0.5
19	10.6	315.8	-1.3
20	9.0	317.2	-0.7
21	7.6	305.5	0.1
22	5.9	308.5	0.1
23	7.3	311.8	0.1
24	6.7	309.3	1.5
1	6.6	310.4	-0.6
2	5.7	306.8	0.7
3	5.2	306.9	-0.7
4	5.6	299.7	0.1
5	5.2	297.8	-0.5
6	3.5	291.4	1.1
7	2.0	290.2	0.2
8	3.0	291.3	0.3
9	2.4	299.2	1.9
10	2.0	285.8	0.4
11	4.9	234.0	-0.7
12	4.5	236.0	-1.2
13	4.6	226.8	-0.5
14	4.0	216.6	-1.6
15	5.1	206.1	-1.4
16	4.2	190.5	-1.7
17	3.0	223.5	-1.6
18	3.8	205.6	-0.5
19	4.5	255.3	-1.3
20	2.5	267.8	-0.8
21	2.0	267.6	0.7
22	0.8	314.7	0.9
23	2.5	309.0	2.0
24	2.0	274.0	1.3
1	0.6	222.6	2.1
2	0.7	348.9	1.8
3	0.5	10.3	3.3
4	0.7	273.7	2.4
5	2.1	112.0	1.2
6	0.9	297.9	1.2
7	2.7	104.8	2.1

STOP TIME JAN 25,1993 HOUR 6 MINUTE 33

RELEASE NUMBER 93004 CONTAINMENT PURGE

STARTING TIME JAN 28,1993 HOUR 14 MINUTE 8

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	13.1	326.5	-1.2
15	12.1	328.7	-1.3
16	12.8	327.9	-1.1
17	11.3	333.1	-1.2
18	10.5	332.4	0.2
19	8.8	322.3	-1.8
20	7.7	322.5	-1.4
21	6.2	329.1	-0.8
22	6.7	330.0	-0.4
23	4.7	310.3	-1.3
24	3.8	306.1	0.8
1	3.6	302.6	0.5
2	2.6	292.8	-0.4
3	1.9	283.0	2.2
4	1.3	261.3	0.4
5	1.3	241.4	0.5

STOP TIME JAN 29,1993 HOUR 4 MINUTE 37

RELEASE NUMBER 93005 CONTAINMENT PURGE

STARTING TIME JAN 29,1993 HOUR 17 MINUTE 38

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	6.5	187.8	-1.8
18	5.3	184.6	0.6

STOP TIME JAN 29,1993 HOUR 17 MINUTE 52

STARTING TIME JAN 29,1993 HOUR 18 MINUTE 23

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	5.3	184.6	0.6
19	5.0	166.8	1.0
20	4.7	167.0	0.6
21	3.0	168.8	-0.9
22	3.8	235.3	-0.6
23	6.4	209.8	0.6
24	8.8	190.4	0.7
1	5.4	190.8	-0.9
2	8.3	201.1	0.4
3	12.1	198.7	0.7
4	10.8	197.4	0.1
5	3.8	166.4	0.1
6	5.3	127.0	-1.2
7	6.4	151.6	-2.3

STOP TIME JAN 30,1993 HOUR 6 MINUTE 39

RELEASE NUMBER 93005 CONTAINMENT PURGE

STARTING TIME JAN 30,1993 HOUR 8 MINUTE 28

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
8	6.7	139.0	-2.3
9	5.7	132.7	-0.7
10	9.8	205.1	-0.2

STOP TIME JAN 30,1993 HOUR 9 MINUTE 2

STARTING TIME JAN 30,1993 HOUR 10 MINUTE 10

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	9.8	205.1	-0.2
11	12.7	200.5	-1.3
12	13.0	200.8	-1.0
13	12.6	199.0	-1.5

STOP TIME JAN 30,1993 HOUR 12 MINUTE 39

RELEASE NUMBER 93005 CONTAINMENT PURGE

STARTING TIME JAN 30,1993 HOUR 15 MINUTE 48

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
15	11.8	196.0	-1.5
16	11.4	195.7	-1.8

STOP TIME JAN 30,1993 HOUR 15 MINUTE 52

STARTING TIME JAN 30,1993 HOUR 18 MINUTE 19

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	8.7	221.8	-0.6
19	10.3	206.7	-1.0
20	11.6	200.4	0.2
21	14.8	212.1	1.0
22	10.7	218.2	1.4
23	3.8	239.1	1.1
24	5.1	238.0	1.5
1	7.1	252.7	1.2
2	3.6	281.3	0.3
3	3.8	295.6	0.3
4	3.8	297.4	2.9
5	4.8	294.7	1.7
6	3.8	286.5	2.0
7	2.8	275.4	3.2
8	2.5	288.7	4.9
9	2.7	288.3	2.8
10	5.3	264.5	1.1
11	[illegible].8	282.4	0.6
12	5.4	287.6	-0.6
13	5.4	292.8	-1.0
14	5.9	292.7	-0.3
15	4.4	292.8	0.1
16	4.5	299.9	-0.3
17	3.7	298.0	-0.2
18	4.1	307.2	0.7
19	3.8	293.4	0.9
20	2.7	288.1	0.7
21	1.3	273.4	0.5
22	1.7	283.4	1.7
23	2.0	301.0	1.3
24	3.8	297.2	1.5
1	2.7	280.4	1.5
2	2.3	278.9	1.0
3	2.3	281.4	0.5
4	1.4	321.9	1.4
5	1.2	291.2	1.6
6	2.6	286.5	2.0
7	1.3	295.8	2.2
8	1.5	306.8	2.4
9	0.8	51.2	3.4
10	0.8	320.0	0.8
11	1.0	243.1	0.5
12	1.6	245.2	-1.3
13	2.5	27.7	-1.3
14	3.4	23.3	-1.5
15	1.8	347.9	-1.2
16	2.1	22.0	-1.6
17	1.9	8.4	-1.0
18	0.4	1.0	-1.3
19	0.2	268.6	0.7
20	0.1	170.1	2.0
21	0.4	119.5	1.8
22	1.1	91.9	3.8
23	1.0	115.0	2.4
24	1.0	94.1	3.9
1	1.8	104.6	2.3
2	3.6	100.3	1.7
3	4.4	108.7	-0.2
4	3.8	99.8	2.3
5	4.9	103.7	0.9
6	5.5	106.5	1.8
7	2.7	228.4	2.8

STOP TIME FEB 2,1993 HOUR 6 MINUTE 6

RELEASE NUMBER 93006 CONTAINMENT PURGE

STARTING TIME FEB 5,1993 HOUR 17 MINUTE 2

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	3.7	223.9	-1.3
18	1.6	207.0	1.8
19	1.5	173.6	-0.4
20	2.2	119.9	-0.4
21	2.5	119.6	-0.9
22	3.2	97.5	0.9
23	1.2	204.4	1.3
24	1.1	316.3	4.2
1	1.5	218.7	3.1
2	1.0	112.9	3.8
3	0.6	234.4	2.7
4	0.7	258.0	0.1
5	0.8	312.6	-1.2
6	1.6	357.0	-0.1
7	2.4	354.7	-0.9
8	1.5	358.7	-1.0
9	1.3	7.3	-1.4
10	2.0	180.6	-0.6
11	2.5	340.5	-1.2
12	2.4	173.2	-1.7
13	1.4	140.9	-0.9
14	3.1	126.2	-1.5
15	4.4	118.0	-1.3
16	5.2	129.5	-1.0
17	4.4	157.6	-1.0
18	4.6	161.7	-1.3
19	4.2	167.5	-0.7
20	4.5	165.0	0.1
21	5.2	143.2	-1.8
22	4.4	147.3	-0.7
23	4.0	149.3	-1.6
24	4.7	162.9	-1.3
1	4.4	150.1	-0.1
2	2.8	139.6	0.4
3	2.3	132.5	-1.7
4	1.3	142.2	-1.2
5	1.6	143.3	-0.9
6	0.7	209.2	0.2
7	0.4	194.5	-1.6
8	0.1	247.2	-1.8
9	1.2	287.1	-1.2
10	2.6	309.2	-1.2
11	1.9	304.0	-0.8
12	2.4	308.8	-0.6
13	2.9	319.4	-0.3
14	3.7	323.6	0.3
15	3.4	340.9	-1.3
16	2.6	324.7	-0.3
17	2.6	321.6	-0.6
18	2.9	334.0	-1.0
19	3.9	343.7	-1.1
20	3.4	341.1	-0.7
21	3.4	344.7	0.1
22	4.0	341.0	-0.3
23	3.8	0.1	0.3
24	3.4	0.5	-0.8
1	3.7	359.4	-0.9
2	3.4	349.8	-0.9
3	3.5	355.4	-2.0
4	4.1	3.2	0.2
5	4.0	5.5	-1.2
6	3.7	10.2	-0.4
7	3.7	10.3	-0.4
8	1.7	19.2	-0.7
9	1.2	350.4	-1.0
10	2.0	337.9	0.1
11	1.6	338.2	-1.0
12	0.9	286.0	-0.6
13	1.1	253.6	-0.5
14	2.8	80.5	-0.9
15	3.0	102.4	-2.2
16	3.7	41.0	-0.3
17	3.7	115.8	-0.8
18	4.4	103.6	-0.5

19	4.5	109.7	-0.6
20	5.5	119.1	0.3
21	4.9	127.5	0.1
22	5.7	122.3	-0.3
23	6.6	136.1	-0.6
24	5.8	131.5	-0.8
1	3.3	145.2	-0.3
2	1.6	173.4	-0.1
3	2.1	150.2	-0.7
4	2.2	144.0	-1.2
5	4.2	149.5	-0.6
6	3.8	175.9	-1.0
7	4.7	178.5	-0.9

STOP TIME FEB 9,1993 HOUR 6 MINUTE 30

RELEASE NUMBER 93007 CONTAINMENT PURGE

STARTING TIME FEB 11,1993 HOUR 16 MINUTE 59

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	6.1	5.4	-1.6
17	5.9	1.7	-1.1
18	5.8	347.2	-0.1
19	5.9	347.1	-0.4
20	6.2	348.1	-1.1
21	5.6	345.5	-0.6
22	5.5	349.4	-1.8
23	4.9	356.4	-1.9
24	4.2	341.6	-0.7
1	5.0	327.5	0.3
2	4.8	330.6	-1.4
3	4.9	341.0	-1.9
4	5.8	339.8	-1.7
5	4.7	332.4	-2.3
6	4.7	330.0	-1.5
7	5.2	328.5	0.2
8	5.1	334.[illegible]	-0.4
9	5.0	340.1	-1.4
10	4.2	334.4	-1.0
11	4.9	3[illegible]1.5	-2.4
12	5.6	311.8	-1.9
13	5.0	312.4	-0.7
14	5.0	314.3	-1.6
15	5.2	308.9	-1.9
16	5.6	310.2	-1.9
17	5.4	313.5	-1.8
18	4.7	316.4	-1.5
19	4.5	321.7	-0.1
20	2.4	300.0	-0.3
21	2.5	288.5	1.2
22	3.1	297.6	-0.5
23	3.1	2[illegible]2.4	-0.5
24	4.0	287.1	0.1
1	3.4	294.5	-1.5
2	3.6	289.5	-0.8
3	3.0	284.3	-1.9
4	3.5	287.0	-0.4
5	2.9	296.5	0.4
6	1.9	282.4	2.4
7	2.0	286.3	-0.2
8	3.0	287.5	-0.4
9	3.4	289.0	-1.1
10	2.7	296.7	-0.8
11	2.8	266.8	-1.9
12	4.0	259.7	-2.5
13	3.2	274.9	-1.8
14	4.6	273.5	-1.9
15	6.0	290.3	-1.4
16	6.2	295.4	-0.4
17	7.4	306.6	-1.7
18	8.0	311.6	-1.5
19	5.9	307.0	-1.4
20	4.3	291.0	-1.3
21	1.5	300.4	-1.1
22	3.9	305.3	-0.3
23	5.3	300.7	-0.2
24	6.3	314.3	-0.8
1	3.6	303.2	1.4
2	2.0	284.5	-1.1
3	3.4	318.3	0.4
4	3.2	304.4	0.5
5	1.9	283.5	1.1
6	1.5	272.3	0.8
7	3.1	268.1	-0.9
8	2.9	285.6	-0.8
9	2.5	294.9	-1.2
10	4.3	304.8	-1.5
11	4.7	304.7	-1.7
12	4.4	314.4	-1.6
13	3.0	304.3	-1.5
14	2.2	295.3	-1.4
15	1.7	305.6	-1.6
16	2.2	256.3	-1.2
17	1.0	304.2	-1.5

18	1.6	36.6	-0.5
19	0.6	350.2	-0.9
20	0.4	131.9	-0.1
21	0.3	244.6	1.9
22	0.4	144.1	-0.6
23	1.4	132.3	2.0
24	0.5	309.9	1.0
1	0.3	186.3	0.6
2	0.3	315.5	-0.2
3	0.3	155.6	-0.1
4	1.4	343.4	-0.7
5	1.9	328.4	-0.4
6	1.1	351.3	-0.3
7	2.6	37.5	-2.3

STOP TIME FEB 15,1993 HOUR 6 MINUTE 5

RELEASE NUMBER 93008 CONTAINMENT PURGE

STARTING TIME FEB 18,1993 HOUR 12 MINUTE 15

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	3.5	214.2	-1.5
13	5.1	197.1	-0.8
14	8.4	191.5	-0.1
15	6.8	187.6	-0.7
16	8.7	190.8	-1.3
17	7.4	172.8	-1.4
18	5.6	148.9	-1.1
19	5.2	134.2	-2.0
20	5.5	130.1	-0.5
21	8.8	163.3	-0.4
22	6.4	158.4	-1.7
23	4.8	166.3	-1.3
24	6.3	177.4	-0.2
1	10.2	181.8	-0.1
2	10.6	178.3	0.8
3	11.5	179.3	-0.6
4	7.3	159.9	-0.5
5	4.7	147.1	-1.1
6	4.3	141.9	-0.8
7	4.5	143.6	-0.9
8	3.1	136.0	-1.5
9	3.3	160.4	-0.7
10	3.0	184.6	-1.3
11	1.6	220.4	-1.3
12	3.2	359.4	-2.4
13	3.0	27.9	-2.7
14	4.4	27.5	-1.9
15	3.7	329.7	-1.3
16	3.3	312.8	-1.5
17	3.0	314.8	-1.8
18	2.8	306.3	-1.1
19	2.8	352.5	-1.4
20	2.3	343.5	-1.7
21	2.5	313.4	-0.7
22	2.8	299.9	-1.0
23	1.7	288.0	0.6
24	1.7	287.4	-0.8
1	1.6	290.7	-1.0
2	1.9	294.0	-2.6
3	1.5	298.6	-0.2
4	1.9	309.0	-1.1
5	1.3	353.6	-1.2
6	0.6	326.4	-0.4
7	0.8	338.7	1.2
8	1.1	30.0	-0.2
9	3.9	68.6	-1.2
10	6.0	94.5	-1.3
11	6.7	92.1	-2.1
12	6.6	85.3	-2.0
13	7.8	88.1	-1.6
14	6.5	79.4	-1.5
15	6.2	71.2	-1.2
16	7.1	70.4	-2.0
17	5.6	68.8	-1.8
18	6.2	65.2	-0.8
19	5.0	47.0	-0.9
20	5.3	51.5	-0.7
21	5.3	50.3	-0.3
22	5.3	27.8	0.1
23	5.4	12.0	-0.2
24	5.4	2.1	-1.7
1	5.4	340.0	0.2
2	4.8	341.6	-0.6
3	4.2	328.4	0.1
4	3.6	346.4	-1.3
5	4.8	345.6	-0.9
6	6.0	318.0	-1.5
7	7.2	319.8	0.2
8	8.4	319.6	2.0
9	9.6	315.7	-1.6
10	10.2	313.8	-1.3
11	9.0	316.0	-1.7
12	8.4	306.8	-2.1
13	7.8	294.6	-1.0

14	8.4	294.3	-0.9
15	8.4	295.1	-1.1
16	9.0	299.3	-0.9
17	8.4	293.0	-0.7
18	7.8	289.5	-1.1
19	7.2	293.7	0.3
20	8.4	287.7	-0.6
21	9.0	290.0	-0.4
22	8.6	295.9	0.2
23	7.8	294.1	0.9
24	7.8	299.3	0.9
1	8.4	295.0	0.4
2	7.8	298.4	-2.8
3	7.2	298.6	-1.0
4	6.6	301.0	0.2
5	6.6	308.4	0.2
6	6.6	306.1	0.2
7	6.6	288.0	0.3
8	6.6	295.4	0.3
9	6.0	300.6	-0.7
10	6.0	303.1	-1.0
11	9.2	310.9	-2.3
12	10.1	309.4	-1.5
13	7.4	300.5	-0.9
14	6.2	301.0	-1.5
15	6.5	296.4	-1.5
16	7.6	309.5	-1.3
17	7.0	310.7	-1.5
18	4.9	308.8	0.3
19	4.4	307.9	-0.7
20	3.5	299.3	0.9

STOP TIME FEB 22,1993 HOUR 19 MINUTE 39

RELEASE NUMBER 93009 CONTAINMENT PURGE

STARTING TIME FEB 25,1993 HOUR 15 MINUTE 32

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
15	4.7	17.7	-1.9
16	3.9	26.2	-1.6
17	4.2	8.9	-2.2
18	5.1	3.6	-0.6
19	7.1	358.6	0.4
20	5.9	357.3	0.6
21	3.4	345.3	-1.1
22	3.5	345.3	-0.4
23	3.5	323.2	0.7
24	4.8	309.1	3.5
1	3.9	300.0	1.5
2	4.5	306.0	1.8
3	2.0	298.1	1.9
4	2.3	302.3	0.9
5	2.8	291.3	0.4
6	3.3	296.6	1.2
7	3.5	304.5	1.0
8	1.4	276.3	0.9
9	1.9	285.2	0.4
10	2.0	289.2	1.6
11	1.9	303.2	-0.2
12	0.8	319.1	-0.7
13	1.3	328.5	-0.9
14	1.8	10.2	-1.9
15	1.2	351.3	-1.8
16	1.1	316.2	-1.3
17	2.0	29.8	-0.6
18	2.3	43.9	-0.1
19	0.8	166.2	0.4
20	4.5	117.1	0.9
21	2.3	156.1	1.5
22	2.2	151.6	0.1
23	1.3	139.3	1.4
24	2.4	106.3	0.7
1	3.9	150.7	1.4
2	5.5	122.8	1.7
3	4.8	144.5	1.1
4	7.1	187.6	0.4
5	9.7	196.9	1.4
6	10.2	201.7	1.3
7	7.8	217.1	-0.3
8	5.1	245.9	1.2
9	1.6	274.9	-0.7
10	1.3	258.4	-1.1
11	2.7	234.1	-1.7
12	2.3	294.1	-1.9
13	2.4	273.8	-1.9
14	2.6	293.2	-1.6
15	1.9	300.8	-1.6
16	1.7	289.9	-0.9
17	1.9	256.0	-1.2
18	1.4	173.9	-0.9
19	0.5	126.1	0.8
20	0.5	132.9	1.0
21	0.7	191.6	2.4
22	1.5	106.6	1.9
23	4.7	178.2	2.1
24	4.8	168.0	1.5
1	4.9	158.1	0.8
2	11.0	202.8	1.2
3	6.3	213.1	2.1
4	3.0	127.9	1.5
5	2.2	179.0	-0.2
6	2.4	150.8	-0.2
7	2.8	199.9	0.7
8	3.7	97.9	-0.3
9	3.0	99.0	0.1
10	3.0	131.2	-0.8
11	5.6	190.7	-1.0
12	11.6	205.0	-1.7
13	11.7	195.9	-1.7
14	14.8	193.5	-1.2
15	16.3	196.3	-1.1
16	15.4	194.0	-0.8

17	15.9	196.0	-0.9
18	10.4	191.9	-1.4
19	4.8	196.1	-0.4
20	1.1	262.3	-0.3
21	2.3	209.3	1.0
22	3.4	205.2	-0.1
23	6.4	208.0	-0.4
24	1.6	203.2	-0.5
1	1.8	150.4	0.6
2	6.6	203.3	1.3
3	4.0	175.9	-0.4
4	2.5	100.0	0.8
5	2.6	121.8	1.0
6	2.5	195.0	1.1
7	1.6	185.7	-0.2

STOP TIME MAR 1,1993 HOUR 6 MINUTE 15

RELEASE NUMBER 93010 CONTAINMENT PURGE

STARTING TIME MAR 4,1993 HOUR 12 MINUTE 59

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	8.3	323.7	-2.0
13	8.2	329.5	-1.2
14	7.1	329.1	-1.7
15	6.3	320.1	-0.8
16	7.1	316.5	-0.7
17	7.0	308.4	-1.0
18	5.7	305.9	-0.8
19	5.5	316.9	0.5
20	1.4	309.1	-0.3
21	1.8	300.5	1.1
22	1.0	284.7	-0.4
23	3.1	304.9	-0.3
24	3.1	314.5	0.2
1	2.1	304.0	1.0
2	2.7	306.8	0.8
3	2.9	304.2	-1.3
4	3.9	317.9	0.1
5	5.3	323.6	0.1
6	5.1	331.2	-1.0
7	3.0	321.4	-1.8
8	2.8	301.7	-1.5
9	2.2	309.2	-1.3
10	1.5	302.4	-0.6
11	2.0	290.6	-1.1
12	2.5	221.7	-0.5
13	1.9	269.8	-2.3
14	2.8	225.9	-0.7
15	2.8	199.1	-1.0
16	3.9	223.2	-0.4
17	4.4	202.5	-0.9
18	3.0	213.0	-0.2
19	2.1	132.2	0.7
20	1.8	128.5	1.5
21	4.2	182.0	1.3
22	9.2	206.5	1.4
23	6.1	207.1	0.9
24	4.4	232.3	0.7
1	1.2	273.6	0.9
2	0.9	314.9	1.6
3	0.7	203.2	3.0
4	0.5	310.6	2.2
5	0.8	179.7	2.6
6	0.1	332.2	0.1
7	2.1	303.5	0.5
8	3.0	301.4	0.1
9	2.7	294.8	-0.9
10	3.9	302.9	-1.6
11	6.4	305.8	-1.1
12	6.3	308.3	-1.3
13	7.8	313.1	-1.2
14	5.3	314.9	-1.3
15	5.0	311.0	-1.9
16	4.1	308.7	-0.5
17	4.1	303.7	-1.1
18	5.4	305.4	0.5
19	4.4	298.8	-1.2
20	1.7	282.4	0.8
21	0.6	256.5	-0.7
22	0.8	274.1	1.7

STOP TIME MAR 6,1993 HOUR 21 MINUTE 10

STARTING TIME MAR 6,1993 HOUR 22 MINUTE 23

TIME HOUR	WS1 MI	WD10 DEG	DT110 DEG C
22	0.8	274.1	1.7
23	5.8	235.5	-0.4
24	8.4	227.3	2.0
1	5.5	236.6	1.8
2	4.7	243.8	1.5
3	4.7	242.3	-0.3

4	1.5	258.1	0.7
5	2.0	268.8	1.9
6	1.1	267.8	0.3
7	2.7	286.7	-0.6
8	3.6	289.4	0.8
9	3.7	280.0	-1.1
10	4.1	286.7	-1.0
11	4.5	281.5	-1.1
12	3.6	287.7	-0.9
13	3.8	288.4	0.1
14	4.5	278.2	-0.8
15	4.3	269.7	-1.1
16	4.0	269.0	-0.3
17	4.6	276.6	0.1
18	2.7	280.4	0.2
19	3.7	276.7	0.3
20	4.7	268.0	1.7
21	3.9	271.8	-0.1
22	3.8	275.1	0.4
23	3.6	281.9	0.5
24	2.5	293.1	0.7
1	2.7	297.4	0.6
2	3.1	300.4	-1.1
3	2.5	300.6	-0.4
4	2.2	303.8	-1.2
5	1.9	297.4	0.9
6	1.8	278.6	0.4
7	2.0	281.0	0.2

STOP TIME MAR 8,1993 HOUR 6 MINUTE 20

RELEASE NUMBER 93011 CONTAINMENT PURGE

STARTING TIME MAR 11,1993 HOUR 12 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	5.0	338.7	-1.5
13	5.5	336.2	-1.2
14	6.0	339.2	-2.2
15	5.5	335.8	-1.9
16	5.7	345.6	-2.1
17	5.3	351.0	-3.0
18	3.9	349.4	-1.1
19	2.9	341.6	-0.8
20	2.0	327.1	-0.5
21	1.0	293.1	0.4
22	0.7	206.1	0.4
23	0.8	188.9	1.8
24	0.4	194.0	1.6
1	1.9	215.4	1.2
2	1.5	207.8	1.9
3	1.6	125.3	0.7
4	7.6	212.0	0.6
5	7.4	247.5	0.2
6	7.4	288.4	0.3
7	8.9	304.1	-0.7
8	11.1	310.9	-1.2
9	9.8	312.3	-0.8
10	10.7	319.7	-0.9
11	11.7	320.1	-1.7
12	10.2	320.8	-1.8
13	10.3	313.0	-1.2
14	9.8	323.0	-1.9
15	7.6	337.3	-0.6
16	7.7	334.3	-2.4
17	8.0	337.5	0.3
18	8.1	338.1	-1.0
19	7.2	334.4	0.5
20	6.1	336.8	-0.3
21	5.8	332.4	-0.7
22	5.5	331.6	-1.3
23	6.6	320.2	-0.9
24	8.6	322.9	-0.4
1	6.9	327.5	-0.2
2	6.2	340.5	-0.8
3	4.9	337.7	-0.1
4	5.7	340.0	0.1
5	5.0	343.3	0.8
6	4.4	333.5	-0.1
7	5.8	325.2	0.9
8	6.3	325.6	0.8
9	6.5	324.9	0.6
10	5.1	324.7	-0.7
11	5.0	336.0	-1.1
12	5.7	335.2	-2.5
13	4.4	347.6	-1.5
14	4.1	340.2	-2.0
15	4.7	342.1	-1.5
16	3.9	347.0	-1.8
17	1.7	309.4	-1.4
18	1.3	0.1	-1.2
19	1.6	102.3	0.5
20	1.7	125.7	-0.3
21	2.2	132.8	0.5
22	2.5	142.3	0.6
23	2.3	133.1	-0.4
24	2.6	307.8	0.4
1	2.1	113.8	1.1
2	0.6	132.7	1.0
3	0.4	98.9	0.5
4	1.0	32.6	1.1
5	2.5	25.3	-0.9
6	1.7	4.2	-1.5
7	1.8	1.5	1.4
8	2.8	3.5	-1.0
9	4.5	12.0	-1.3
10	4.6	15.5	-2.2
11	3.7	3.6	-2.3
12	3.3	46.6	-2.1
13	2.4	23.9	-1.7

14	2.2	279.0	-1.0
15	2.7	257.5	-2.1
16	4.7	101.5	-1.2
17	7.4	110.8	-1.4
18	8.2	116.8	-2.0
19	7.1	117.0	-0.4
20	5.2	110.1	0.9
21	4.8	112.0	-0.1
22	8.4	121.9	-1.3
23	11.4	121.7	-0.7
24	11.7	121.4	-0.1
1	11.9	121.8	-0.6
2	10.3	119.6	0.6
3	9.9	122.9	1.1
4	10.9	135.9	0.4
5	12.4	151.4	-1.3

STOP TIME MAR 15,1993 HOUR 4 MINUTE 57

RELEASE NUMBER 93012 CONTAINMENT PURGE

STARTING TIME MAR 18,1993 HOUR 18 MINUTE 55

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	12.4	132.4	0.4
19	10.1	132.6	-0.7
20	9.3	127.0	-0.4
21	9.0	129.0	-0.1
22	7.5	124.6	0.3
23	6.7	123.7	-0.1
24	5.1	126.3	-1.8
1	3.8	119.7	-0.2
2	4.1	115.7	0.2
3	4.6	108.8	-0.2
4	4.6	112.2	-0.6
5	4.3	115.7	-0.4
6	4.6	122.7	-0.5
7	3.1	111.0	-0.7
8	4.7	136.7	-0.4
9	8.0	153.4	-1.1
10	9.6	170.0	-2.2
11	8.2	196.5	-0.8
12	6.9	205.5	-1.4
13	4.7	216.7	-1.3
14	5.7	222.6	-1.4
15	5.4	205.3	-1.2
16	4.3	218.0	-1.9
17	3.5	241.6	-1.0
18	2.3	238.4	-0.9
19	0.6	247.7	0.6
20	0.2	1.9	0.7
21	0.6	225.6	-1.6
22	1.0	238.9	-0.1
23	1.3	184.2	0.9
24	1.4	282.4	0.6
1	1.2	296.3	0.4
2	1.4	301.7	1.2
3	2.2	300.9	-0.2
4	5.1	315.9	-0.3
5	3.1	320.7	-1.1
6	4.3	309.5	-0.2
7	3.8	305.3	-0.3
8	4.6	315.0	-0.4
9	4.6	317.5	-1.4
10	6.1	335.3	-0.9
11	5.6	336.7	-2.2
12	5.2	337.6	-1.7
13	3.7	340.2	-1.8
14	3.8	335.6	-2.1
15	2.9	342.3	-1.0
16	1.6	331.9	-2.4
17	3.1	204.7	-1.4
18	2.2	332.8	-1.6
19	1.2	291.2	-1.7
20	0.3	160.4	0.3
21	0.9	134.1	0.6
22	3.8	107.6	0.3
23	5.3	99.3	-0.1
24	3.6	99.9	-0.2
1	5.5	97.4	-0.2
2	6.1	108.8	-1.8
3	8.5	116.5	-0.3
4	7.9	120.8	-0.7
5	9.1	122.9	-0.6
6	11.0	122.5	-0.1
7	9.8	116.1	-0.4
8	11.3	112.2	0.1
9	14.6	115.0	-1.7
10	14.8	106.4	-0.6
11	13.8	111.9	-2.1
12	12.4	117.2	-1.4
13	9.3	109.7	-0.6
14	6.9	100.4	-0.1
15	6.7	106.0	-0.9
16	7.4	105.4	-0.4
17	7.3	99.7	0.1
18	6.4	98.0	-0.7
19	5.6	88.2	-0.3

20	2.2	254.2	-0.5
21	1.7	41.3	-1.1
22	1.1	14.8	0.8
23	1.3	6.9	-1.0
24	2.2	8.3	-0.2
1	1.5	8.1	-1.4
2	1.9	6.0	-1.6
3	2.2	334.2	-0.8
4	4.8	335.4	-0.6
5	5.2	337.5	-1.1
6	5.6	340.4	0.4
7	6.0	341.6	0.6
8	6.2	338.5	-0.8

STOP TIME MAR 22,1993 HOUR 7 MINUTE 48

RELEASE NUMBER 93013 CONTAINMENT PURGE

STARTING TIME MAR 25,1993 HOUR 21 MINUTE 7

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	1.2	111.1	1.3
22	2.0	118.8	2.5
23	1.6	118.1	2.5
24	1.2	98.6	3.3
1	1.4	125.4	2.7
2	3.4	120.9	2.8
3	1.7	23.9	1.0
4	1.1	40.0	0.9
5	2.7	99.0	-0.1
6	1.8	97.0	1.3
7	0.8	49.9	0.4
8	4.9	209.1	0.6
9	9.2	169.9	-1.7
10	8.3	176.5	-1.8
11	8.1	185.6	-1.8
12	9.0	171.0	-1.5
13	7.1	169.6	-2.0
14	7.5	165.3	-2.3
15	7.8	153.9	-1.4
16	7.4	153.8	-1.9
17	7.8	148.4	-1.7
18	7.4	129.0	-1.2
19	4.3	120.4	-0.1
20	3.8	125.1	2.1
21	4.0	103.6	0.9
22	4.1	115.5	1.1
23	4.5	116.1	1.3
24	5.6	118.3	0.8
1	5.2	108.8	1.1
2	5.4	132.7	0.9
3	4.0	130.7	1.8
4	3.5	138.0	3.0
5	2.9	136.5	-0.7
6	3.1	152.5	0.6
7	2.3	11.1	1.1
8	5.5	109.3	0.3
9	5.0	12.9	-0.5
10	7.5	108.8	-1.1
11	8.2	117.9	-1.5
12	11.0	139.4	-2.1
13	11.4	156.4	-2.3
14	11.4	155.2	-2.2
15	10.8	152.9	-1.5
16	9.2	149.4	-1.6
17	8.8	132.2	-1.3
18	7.8	125.2	-1.3
19	5.1	115.7	0.3
20	4.3	115.3	0.6
21	5.7	112.1	0.4
22	5.9	114.3	-0.4
23	6.5	121.5	-0.4
24	7.7	116.3	0.5
1	7.7	116.3	1.1
2	6.5	127.4	0.2
3	5.4	122.8	1.2
4	2.4	112.9	0.1
5	2.9	113.8	-0.1
6	2.5	95.4	0.7
7	3.9	95.8	1.0
8	6.7	111.4	-0.1
9	9.2	108.4	-1.9
10	8.4	103.2	-1.4
11	7.1	91.4	-1.9
12	7.9	101.1	-1.7
13	5.5	152.5	-1.9
14	7.4	225.7	-1.2
15	1.4	91.8	-1.6
16	3.7	77.8	-1.1
17	2.2	112.8	-2.1
18	2.2	94.2	-1.3
19	0.5	313.2	0.5
20	6.2	79.8	-0.8
21	6.7	89.0	-1.5
22	6.5	102.7	-1.2

23	7.2	93.6	-1.0
24	7.5	93.4	0.1
1	7.2	96.7	-0.4
2	10.0	97.8	-1.8
3	8.6	104.9	0.5
4	7.1	110.7	-0.9
5	6.0	120.5	-0.6
6	5.6	126.4	-1.2
7	5.2	124.6	-0.4

STOP TIME MAR 29,1993 HOUR 6 MINUTE 5

RELEASE NUMBER 93014 CONTAINMENT PURGE

STARTING TIME APR 1.1993 HOUR 14 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	8.9	336.8	-1.5
15	7.8	341.4	-2.1
16	6.2	342.9	-1.5
17	6.3	346.5	-2.4
18	6.3	354.3	-2.3
19	3.2	3.0	-1.1
20	4.4	355.0	0.1
21	2.8	333.7	-0.5
22	2.1	340.6	-1.1
23	1.8	345.0	-0.2
24	2.3	340.0	-0.4
1	1.3	275.1	-0.4
2	2.0	271.0	0.2
3	2.8	288.0	0.3
4	3.2	293.6	-0.3
5	1.9	273.7	-0.4
6	1.9	273.5	0.7
7	1.5	291.8	-0.3
8	1.5	320.6	-1.8
9	1.2	332.8	-1.9
10	2.3	23.8	-1.8
11	2.9	41.7	-1.5
12	4.5	60.3	-2.3
13	4.8	21.5	-1.6
14	4.0	257.7	-2.6
15	5.6	116.4	-2.2
16	6.5	84.0	-1.4
17	6.5	87.7	-1.7
18	5.6	89.3	-1.7
19	3.6	79.5	-1.2
20	2.5	239.9	-0.5
21	0.8	52.5	-0.8
22	1.3	53.3	-0.9
23	1.8	67.8	-0.7
24	1.8	75.0	-0.9
1	2.8	74.4	-0.2
2	3.3	72.5	-0.3
3	4.2	81.4	-2.4
4	4.3	94.6	0.3
5	2.1	75.4	-1.1
6	2.5	68.7	-0.4
7	4.4	81.0	-0.7
8	5.7	89.2	-1.3
9	5.1	103.0	-1.1
10	3.5	77.0	-0.9
11	4.7	87.6	-0.9
12	4.9	83.7	-1.7
13	5.1	69.9	-1.2
14	4.9	67.3	-2.1
15	4.7	71.4	-2.1
16	4.5	90.5	-2.1
17	3.7	67.1	-1.1
18	3.8	67.2	-1.7
19	1.5	54.1	-0.2
20	1.7	62.5	-0.7
21	2.0	89.2	-0.6
22	1.2	25.6	-2.2
23	0.6	348.8	-0.4
24	0.3	191.0	-0.2
1	0.7	319.9	-0.5
2	0.5	308.9	-0.9
3	0.4	289.5	-1.1
4	0.4	286.4	-0.5
5	0.9	279.4	0.7
6	0.6	284.4	1.0
7	0.5	283.0	0.4
8	0.1	259.6	-0.3
9	1.3	15.3	-0.4
10	0.6	30.9	-0.4
11	2.6	62.9	-2.2
12	7.2	107.9	-2.3
13	6.5	345.4	-3.1
14	6.3	159.2	-2.2
15	6.3	7.2	-2.3

16	5.6	87.9	-3.1
17	6.8	96.8	-2.3
18	6.3	283.2	-1.6
19	6.5	114.9	-1.1
20	4.2	106.6	-1.6
21	1.8	33.3	-0.5
22	2.3	142.3	1.3
23	2.0	156.7	1.2
24	0.6	72.0	1.9
1	0.2	158.0	2.6
2	0.1	147.5	3.2
3	0.2	212.5	1.0

STOP TIME APR 5,1993 HOUR 2 MINUTE 16

RELEASE NUMBER 93015 CONTAINMENT PURGE

STARTING TIME APR 8,1993 HOUR 14 MINUTE 32

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	7.0	321.2	-1.4
15	8.3	314.8	-1.6
16	6.9	316.9	-1.9
17	7.5	317.8	-1.8
18	6.4	328.1	-1.7
19	2.7	344.6	-1.7
20	0.3	335.4	-1.5
21	0.4	213.6	-0.1
22	0.3	207.1	1.4
23	0.5	174.1	1.5
24	2.6	109.2	4.5
1	1.9	109.6	2.6
2	1.8	112.0	1.8
3	2.5	200.5	2.4
4	3.9	185.0	0.9
5	2.8	85.9	-0.5
6	4.7	100.2	-0.8

STOP TIME APR 9,1993 HOUR 5 MINUTE 43

STARTING TIME APR 9,1993 HOUR 5 MINUTE 46

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
5	2.8	85.9	-0.5
6	4.7	100.2	-0.8
7	4.6	109.9	1.9
8	1.6	137.0	2.4
9	0.9	146.5	0.6
10	1.5	346.0	-1.7
11	2.0	53.9	-1.9
12	2.4	316.4	-2.5
13	6.3	94.0	-1.8
14	5.8	136.3	-2.3
15	3.5	178.4	-1.9
16	2.4	217.1	-2.5
17	2.4	297.4	-2.4
18	3.2	20.0	-1.9
19	2.9	23.3	-1.2
20	2.5	48.6	-0.7
21	0.9	37.2	0.4
22	0.9	79.7	-0.9
23	3.1	91.3	0.5
24	4.5	92.6	-1.0
1	3.8	79.2	-0.6
2	2.6	64.9	-0.6
3	1.7	56.8	0.2
4	2.6	71.5	0.3
5	4.2	86.6	-0.2
6	6.1	104.1	-1.3
7	5.5	99.3	-1.4
8	4.2	100.3	-0.1
9	7.6	102.0	-1.5
10	9.7	132.6	-1.6
11	12.2	109.6	-1.9
12	9.1	114.3	-2.0
13	4.9	207.0	-1.6
14	1.9	325.9	-2.2
15	1.8	352.0	-1.7
16	2.6	354.6	-2.2
17	4.2	295.1	-1.7
18	4.3	280.8	-2.3
19	4.8	288.4	-1.5
20	5.6	296.9	-1.9
21	4.7	278.3	-0.3
22	3.5	266.7	0.2
23	7.3	281.5	-0.7
24	9.5	287.0	-0.1
1	10.1	296.2	-1.0
2	9.0	285.5	-0.9
3	11.2	291.9	-1.2
4	10.2	290.6	-0.7

5	9.3	290.6	-1.3
6	8.9	294.6	-0.7
7	9.9	299.5	-0.2
8	9.3	294.7	-0.1
9	8.2	301.8	-0.9
10	9.1	308.7	-2.1
11	12.7	317.0	-2.3
12	9.3	323.2	-2.5
13	8.3	322.4	-1.9
14	8.4	330.8	-2.4
15	6.2	340.8	-2.6
16	6.3	354.1	-2.0
17	5.7	9.6	-2.3
18	5.1	357.9	-1.6
19	3.5	345.0	-2.0
20	3.3	39.8	-1.9
21	3.7	62.3	-1.8
22	3.7	75.0	-0.6
23	5.0	87.4	-0.6
24	3.2	55.8	-0.6
1	2.9	59.9	-2.0
2	3.7	48.7	-0.2
3	4.8	65.0	-1.3
4	4.7	73.2	0.3
5	5.3	65.0	-1.3
6	6.7	107.8	0.1

STOP TIME APR 12,1993 HOUR 5 MINUTE 59

RELEASE NUMBER 93016 CONTAINMENT PURGE

STARTING TIME APR 15,1993 HOUR 18 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	9.6	325.4	-0.5
19	9.8	321.1	-1.2
20	9.2	321.8	-0.2
21	8.0	323.4	-0.1
22	5.7	328.8	-0.1
23	6.4	331.7	-0.2
24	5.3	312.9	-1.1
1	4.0	309.9	-1.1
2	4.2	306.9	1.8
3	4.4	311.1	0.3
4	3.5	307.4	-0.1
5	2.9	296.2	0.6
6	3.4	293.4	0.3
7	3.5	294.1	0.9
8	3.7	301.0	0.5
9	4.3	304.1	-1.4
10	6.6	316.4	-2.3
11	5.5	324.3	-1.7
12	6.8	326.9	-2.2
13	7.9	325.5	-2.4
14	7.2	323.6	-2.5

STOP TIME APR 16,1993 HOUR 13 MINUTE 40

STARTING TIME APR 16,1993 HOUR 17 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	5.2	331.9	-2.5
18	4.0	337.1	-1.7
19	3.2	327.3	-1.9
20	2.7	285.9	-0.3
21	2.3	271.9	0.6
22	1.3	180.2	2.3
23	0.2	186.5	3.5
24	0.3	32.2	4.9
1	0.3	124.3	6.5
2	1.1	64.1	6.3

STOP TIME APR 17,1993 HOUR 1 MINUTE 5

RELEASE NUMBER 93016 CONTAINMENT PURGE

STARTING TIME APR 17,1993 HOUR 12 MINUTE 22

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	7.7	109.8	-1.4
13	11.8	142.2	-1.6
14	12.4	153.0	-1.5
15	6.9	149.9	-1.4
16	5.3	154.4	-0.9
17	4.2	152.5	-1.3
18	5.3	164.5	-1.4
19	7.2	175.0	-1.1
20	2.9	186.0	-0.8
21	2.0	175.7	-0.5
22	3.3	166.5	-0.3
23	3.2	189.8	1.5
24	5.3	170.2	0.2
1	9.8	173.8	-1.3
2	12.6	177.0	0.9
3	11.5	185.0	-1.0
4	11.9	184.4	-0.7
5	13.4	187.4	0.2
6	12.7	179.9	-1.0
7	11.5	170.7	-1.1
8	10.8	160.4	-1.1
9	13.6	169.4	-1.8
10	12.7	166.7	-1.7
11	15.3	167.8	-1.7
12	17.4	170.0	-1.7
13	16.3	171.9	-1.7
14	12.9	167.9	-1.7
15	12.6	167.5	-1.6
16	13.6	173.5	-1.8
17	13.0	175.3	-1.8
18	11.8	140.0	-1.9
19	12.4	137.8	-1.9
20	8.9	127.5	-0.8
21	10.4	145.4	-0.6
22	12.3	148.2	-0.7
23	9.9	153.8	-0.9
24	11.6	145.4	-2.1
1	5.9	241.8	-1.1
2	5.4	158.3	-0.5
3	2.5	196.6	0.3
4	5.5	147.5	-0.4
5	2.3	359.3	-0.2
6	3.6	246.5	0.4
7	0.4	244.7	-1.5
8	1.0	301.1	-0.2
9	5.0	318.7	-0.9
10	3.9	315.1	-0.4
11	7.4	319.3	-2.2
12	8.7	321.9	-1.7
13	10.6	322.6	-0.8
14	10.2	324.8	-1.5
15	10.6	323.2	-2.0
16	11.7	322.2	-1.7
17	12.1	324.3	-1.0
18	12.4	327.2	-1.1
19	12.3	328.9	-1.1
20	14.1	324.9	-1.0
21	14.8	322.0	0.1
22	12.6	329.0	-0.4
23	11.3	333.2	-1.1
24	12.7	334.2	-0.1
1	12.8	338.2	-0.4
2	13.2	337.9	-0.7
3	12.2	333.5	-1.1
4	10.7	334.9	-1.4
5	10.2	333.2	-0.9
6	10.1	332.7	-0.8
7	11.0	333.6	0.4
8	9.6	327.2	-1.7
9	10.3	329.8	-1.7
10	10.9	334.7	-1.0

STOP TIME APR 20,1993 HOUR 9 MINUTE 36

STARTING TIME APR 20,1993 HOUR 9 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
9	10.3	329.8	-1.7
10	10.9	334.7	-1.0
11	9.4	333.6	-2.3
12	9.3	343.7	-2.3
13	10.1	351.3	-1.4
14	10.7	355.0	-2.2
15	8.9	347.9	-2.0
16	8.1	334.9	-2.4
17	7.6	342.1	-1.6
18	6.1	336.3	-1.5
19	4.7	330.6	-1.2
20	4.1	316.2	-1.2
21	1.8	291.5	0.1
22	3.1	290.6	0.9
23	3.0	298.3	-1.2
24	2.8	298.7	1.0
1	2.7	300.5	0.9
2	1.3	288.9	1.0
3	0.1	299.1	1.7
4	0.4	317.8	0.8
5	0.4	305.1	0.2
6	1.7	279.4	-0.2
7	1.6	295.1	0.5

STOP TIME APR 21,1993 HOUR 6 MINUTE 18

RELEASE NUMBER 93017 CONTAINMENT PURGE

STARTING TIME APR 22,1993 HOUR 12 MINUTE 13

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	15.3	193.5	-2.2
13	15.1	190.2	-2.4
14	11.9	203.3	-2.0
15	11.1	208.8	-2.2
16	8.7	222.2	-2.0
17	6.3	240.1	-2.4
18	3.5	260.6	-2.0
19	2.9	241.5	-1.6
20	2.6	245.6	-1.2
21	3.9	292.8	1.1
22	1.9	254.0	0.6
23	0.8	262.6	-0.7
24	0.1	238.8	2.6
1	1.8	272.6	6.2
2	1.4	223.5	5.5
3	1.3	194.3	6.7
4	1.4	219.6	6.7
5	0.5	206.8	6.1
6	0.1	157.6	5.0
7	1.5	231.7	5.0
8	2.2	40.5	3.7
9	7.0	113.6	0.6
10	9.7	121.5	-0.1
11	12.0	123.1	-1.9

STOP TIME APR 23,1993 HOUR 10 MINUTE 42

STARTING TIME APR 23,1993 HOUR 12 MINUTE 11

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	15.2	288.7	-1.9
13	14.2	124.8	-1.8
14	15.4	125.0	-1.5
15	13.1	159.4	-1.0
16	14.0	168.1	-1.8
17	13.4	168.7	-2.5
18	10.0	174.7	-1.1
19	7.8	178.9	-1.5
20	5.7	196.5	-1.3
21	3.8	184.8	-1.4
22	6.3	183.8	0.4
23	10.1	191.3	0.9
24	11.9	197.4	-0.8
1	7.0	256.8	-0.1
2	6.1	263.2	-0.5
3	7.9	259.6	-0.3
4	10.2	245.0	0.5
5	9.0	256.7	-1.2
6	9.3	265.4	-1.2
7	7.2	276.6	-1.5
8	6.6	275.7	0.4
9	10.8	295.3	-1.5
10	10.3	308.2	-2.4
11	12.2	315.1	-2.8
12	11.2	315.1	-2.6

STOP TIME APR 24,1993 HOUR 11 MINUTE 2

RELEASE NUMBER 93018 CONTAINMENT PURGE

STARTING TIME APR 25,1993 HOUR 6 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
6	1.0	256.7	-0.8
7	0.2	251.6	0.2
8	0.6	299.8	-1.1
9	2.3	302.0	-0.9
10	3.9	319.6	-2.0
11	4.4	332.5	-2.5
12	6.1	312.2	-1.7
13	4.7	324.6	-1.1
14	2.6	322.1	-1.1
15	4.7	324.9	-2.1
16	4.7	347.8	-1.3
17	4.4	331.7	-1.6
18	5.1	331.4	-1.8
19	3.7	332.4	-1.7
20	2.2	331.1	-1.4
21	1.0	291.6	-0.3
22	2.9	282.7	0.8
23	2.3	278.0	0.5
24	1.7	258.8	1.2
1	2.0	268.1	1.8
2	1.7	278.1	0.2
3	1.9	267.8	1.7
4	1.1	243.0	0.7
5	2.9	335.8	1.3
6	4.0	350.5	0.6
7	3.2	182.0	1.1
8	3.5	160.9	-0.7
9	2.8	99.8	-0.5
10	6.5	104.7	-1.1
11	8.1	108.6	-1.6
12	8.2	128.1	-1.2
13	9.7	120.8	-1.6
14	12.0	125.2	-2.4
15	13.6	149.7	-2.1
16	14.7	142.6	-2.1
17	15.3	152.2	-2.0
18	13.5	150.6	-1.5
19	11.9	148.5	-1.8
20	9.7	137.6	-0.9
21	10.6	138.7	-0.3
22	10.2	131.5	-0.5
23	9.8	126.5	-0.1
24	9.9	130.4	-1.2
1	12.7	144.8	-0.6
2	13.7	151.0	-1.0
3	14.5	154.2	-1.7
4	16.7	166.6	-1.1
5	17.3	163.6	-1.5
6	15.3	171.2	-1.7
7	11.9	178.8	-0.2

STOP TIME APR 27,1993 HOUR 6 MINUTE 33

STARTING TIME APR 27,1993 HOUR 7 MINUTE 38

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
7	11.9	178.8	-0.2
8	10.9	165.4	-0.7
9	15.9	162.4	-1.0
10	17.5	168.8	-0.9
11	13.3	161.5	-1.0
12	12.8	154.2	-1.5
13	12.5	157.9	-2.1
14	12.2	161.9	-1.0
15	14.7	179.2	-1.5
16	10.6	221.5	-0.8
17	5.1	322.1	-1.4
18	3.8	333.9	-1.5
19	2.9	327.3	-1.1
20	0.8	314.6	-1.3
21	1.1	188.6	-0.6

22	1.3	280.9	0.4
23	1.8	178.6	2.3
24	2.1	264.5	1.6
1	1.6	234.5	1.3
2	1.9	48.5	5.4
3	0.6	92.5	3.2
4	0.8	237.2	5.7
5	2.9	201.3	5.2
6	1.2	45.1	[illegible].2
7	1.4	247.9	3.4
8	0.4	224.3	6.5
9	0.3	168.1	3.4
10	0.2	347.3	-0.3
11	4.8	143.2	-1.8
12	6.1	106.3	-2.4
13	7.8	107.3	-1.2
14	7.2	116.2	-2.2
15	5.3	224.4	-2.5
16	5.4	214.7	-2.1
17	2.8	40.6	-1.7
18	2.2	20.6	-2.1
19	1.1	63.9	-0.7
20	0.6	49.2	-0.9
21	4.3	306.6	-0.4
22	4.6	306.7	-1.3
23	3.2	298.6	1.1
24	3.0	307.2	-0.3
1	2.8	308.8	-1.8
2	1.7	278.1	-0.1
3	1.4	287.7	-0.7
4	1.1	284.2	-0.7
5	0.3	266.0	-0.3
6	0.6	290.1	0.8
7	0.5	261.4	0.7
8	0.7	289.8	0.2
9	1.8	317.0	-1.7
10	2.3	331.0	-1.4
11	2.0	350.5	-2.0
12	3.4	337.3	-1.9
13	3.3	341.1	-2.2
14	6.0	314.0	-2.2
15	5.4	305.6	-2.7
16	5.4	311.5	-2.8
17	5.3	310.6	-2.7
18	3.1	304.9	-1.9
19	1.8	291.0	-2.0

STOP TIME APR 29,1993 HOUR 18 MINUTE 19

RELEASE NUMBER 93018 CONTAINMENT PURGE

STARTING TIME APR 29,1993 HOUR 18 MINUTE 47

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	3.1	304.9	-1.9
19	1.8	291.0	-2.0
20	0.8	223.7	-1.3
21	0.2	178.4	1.0
22	1.1	105.9	3.2
23	1.1	106.9	4.1
24	1.3	202.0	2.0
1	1.5	296.9	0.2
2	0.5	269.2	-0.4
3	0.4	168.5	0.9
4	1.3	133.1	-0.3
5	0.3	295.3	1.8
6	1.0	237.0	0.7
7	1.3	185.4	1.6
8	0.5	233.2	-0.1
9	2.6	91.4	-0.5
10	2.5	112.2	-0.7
11	4.4	159.9	-1.4
12	2.2	256.5	-1.7
13	1.7	72.2	-1.2
14	1.4	311.1	-2.1

STOP TIME APR 30,1993 HOUR 13 MINUTE 41

STARTING TIME APR 30,1993 HOUR 13 MINUTE 41

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	1.7	72.2	-1.2
14	1.4	311.1	-2.1

STOP TIME APR 30,1993 HOUR 13 MINUTE 58

RELEASE NUMBER 93019 CONTAINMENT PURGE

STARTING TIME APR 30,1993 HOUR 17 MINUTE 55

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	2.3	305.9	-1.1
18	2.3	299.9	-1.0
19	2.2	316.0	0.1
20	0.7	311.4	-1.4
21	1.0	334.0	-0.1
22	1.9	317.3	-1.3
23	1.8	42.8	-0.9
24	2.3	50.3	-1.1
1	2.7	306.0	-1.0
2	0.7	11.1	-0.2
3	1.8	84.3	-1.8
4	3.3	219.3	0.1
5	3.8	120.3	-0.5
6	2.3	226.7	-0.5
7	0.9	286.0	-0.1
8	1.0	295.7	0.4
9	0.9	297.2	-0.2
10	1.0	303.7	-0.1
11	1.6	314.1	-0.7
12	3.5	309.5	-0.4
13	5.2	315.5	-1.1
14	5.2	323.2	-2.0
15	4.5	329.4	-1.6
16	4.3	328.6	-2.1
17	4.3	331.0	-1.6
18	5.2	325.4	-2.1
19	6.6	318.2	-0.9
20	7.4	320.8	-1.4
21	6.4	325.8	-1.9
22	5.5	322.1	-0.7
23	5.7	329.6	0.9
24	5.1	338.0	-0.4
1	6.5	333.8	-1.6
2	5.7	334.9	0.4
3	6.9	327.8	-0.5
4	5.4	340.0	0.5
5	5.4	335.8	1.0

STOP TIME MAY 2,1993 HOUR 4 MINUTE 2

RELEASE NUMBER 93020 CONTAINMENT PURGE

STARTING TIME MAY 5,1993 HOUR 17 MINUTE 5

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	6.2	114.2	-1.9
18	5.8	122.4	-2.5
19	5.4	128.7	-1.8
20	5.2	124.7	-1.6
21	5.0	121.9	-1.3
22	4.8	122.9	0.1
23	8.3	122.1	-1.3
24	5.3	128.1	-1.0
1	6.5	17.8	-1.4
2	6.1	126.8	-0.8
3	5.1	117.0	-1.3
4	3.7	118.5	-0.2
5	3.9	126.0	-0.9
6	5.1	123.9	0.1
7	3.8	123.9	-1.0
8	4.3	115.6	-1.2
9	6.8	100.5	-1.9
10	9.6	123.6	-2.6
11	11.5	151.4	-1.4
12	14.1	153.1	-1.4
13	8.4	131.0	-2.1
14	7.6	126.8	-1.7
15	6.8	139.6	-2.0
16	6.0	132.9	-1.8
17	7.0	122.5	-1.6
18	8.0	119.9	-2.0
19	9.0	115.2	-1.9
20	14.4	117.7	-1.6
21	15.9	120.5	-1.2
22	14.4	121.4	-1.4
23	10.8	132.5	-0.6
24	6.7	116.7	-0.7
1	9.1	134.8	-0.8
2	7.8	150.7	-0.5
3	7.1	149.3	-0.7
4	6.2	150.7	-1.1
5	5.9	152.0	-0.8

STOP TIME MAY 7,1993 HOUR 4 MINUTE 7

RELEASE NUMBER 93021 CONTAINMENT PURGE

STARTING TIME MAY 7,1993 HOUR 14 MINUTE 13

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	17.2	140.1	-2.2
15	17.7	137.1	-1.9
16	19.0	145.0	-1.5
17	16.4	148.4	-2.7
18	17.6	148.9	-1.5
19	17.8	142.5	-2.2
20	19.4	144.5	-1.0
21	15.5	147.2	-1.4
22	17.1	144.2	-0.7
23	20.2	146.0	-1.0
24	17.6	143.2	-1.4
1	18.2	139.4	-1.5
2	19.4	140.2	-1.4
3	15.9	155.2	-1.0
4	10.6	126.0	-1.6
5	11.0	110.3	-1.2
6	4.7	191.9	-0.7
7	6.3	120.8	-2.4
8	10.9	125.9	-1.7
9	17.1	129.1	-1.1
10	12.4	129.0	-1.6
11	10.4	152.5	-2.2
12	9.5	156.5	-1.6
13	11.1	146.7	-1.9
14	14.1	146.3	-2.2
15	10.4	116.0	-2.7
16	14.3	109.2	-1.8
17	15.0	122.0	-2.1
18	13.0	141.7	-1.3
19	10.9	161.8	-1.8
20	9.1	141.6	-1.2
21	10.4	135.4	-1.8
22	9.5	162.8	-1.6
23	6.8	171.6	-1.4
24	5.9	135.2	-1.7
1	5.8	143.3	-1.4
2	8.1	149.4	-1.1
3	8.6	149.1	-2.0
4	6.8	144.5	-1.4
5	6.5	143.4	-0.1
6	5.7	161.5	-1.4
7	5.6	168.4	-1.6
8	4.8	200.3	-0.9
9	1.4	288.6	-1.1
10	1.2	283.7	-1.9
11	3.2	301.3	-1.7
12	3.7	316.7	-2.2
13	5.4	327.6	-1.2
14	4.2	332.6	-1.8
15	4.6	338.5	-2.0
16	4.3	334.5	-1.5
17	4.5	331.3	-2.1
18	5.1	330.7	-1.1
19	5.2	331.2	-0.6
20	5.9	331.2	-1.5
21	5.1	317.3	-1.6
22	4.5	324.0	-0.9
23	3.4	325.3	-2.0
24	4.3	323.4	-0.8
1	4.8	328.6	-1.4
2	4.4	339.5	-1.8
3	[illegible].5	337.3	-1.3
4	4.2	322.4	-1.1
5	6.7	323.8	-0.6
6	6.2	324.4	-1.3
7	10.2	350.0	-0.5
8	10.0	360.0	-0.5
9	9.8	10.0	-0.5
10	9.6	20.0	-0.5

STOP TIME MAY 10,1993 HOUR 9 MINUTE 8

RELEASE NUMBER 93022 CONTAINMENT PURGE

STARTING TIME MAY 13,1993 HOUR 13 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	2.0	316.1	-1.7
14	2.2	348.4	-1.1
15	1.5	319.5	-1.5
16	1.1	276.5	-0.1
17	0.9	316.5	-0.4
18	0.1	308.2	-0.2
19	0.6	221.2	-0.4
20	0.3	197.2	-0.2
21	1.2	164.9	-1.0
22	3.0	163.9	1.5
23	3.0	179.8	2.5
24	3.0	179.7	-0.2
1	3.0	176.7	2.1
2	3.8	192.3	2.0
3	4.6	192.9	0.8
4	5.4	209.9	0.8
5	5.4	204.9	-0.6
6	5.4	211.5	0.1
7	5.4	210.8	0.4
8	5.8	206.0	-1.0
9	6.2	204.8	-1.7
10	6.6	204.7	-1.7
11	10.2	207.7	-2.4
12	10.6	209.4	-2.1
13	9.7	203.8	-2.2
14	8.8	208.2	-2.2
15	8.3	212.6	-2.3
16	8.4	221.6	-2.3
17	6.6	280.6	-1.3
18	3.7	321.2	-1.8
19	7.7	349.7	-2.0
20	3.2	353.7	-1.9
21	3.4	336.8	-1.8
22	2.3	299.7	1.3
23	0.4	290.0	1.6
24	1.7	305.4	1.7
1	3.2	273.7	2.3
2	2.0	260.1	3.1
3	2.1	286.2	3.7
4	2.2	297.8	3.0
5	2.0	260.8	2.0
6	2.3	251.4	0.7
7	0.8	291.3	1.2
8	1.8	259.2	2.8
9	1.6	239.1	0.1
10	2.7	104.3	-0.5
11	4.6	154.8	-1.0
12	6.2	206.9	-2.1
13	6.0	220.0	-1.8
14	6.9	212.7	-2.3
15	4.2	262.2	-2.6
16	0.5	285.1	-2.2
17	3.2	258.9	-1.0
18	4.5	248.4	-1.8
19	3.9	297.2	-1.7
20	5.9	338.5	-1.4
21	2.8	345.9	-1.6
22	2.9	332.6	-1.2
23	1.2	328.0	-2.0
24	3.0	319.1	-1.4
1	1.2	322.7	-2.4
2	1.3	297.7	-1.[illegible]
3	1.6	278.5	-0.8
4	1.4	261.8	-0.4
5	1.0	282.7	0.4
6	1.2	190.6	-0.7
7	1.3	247.1	0.8
8	0.5	152.0	-0.5
9	0.7	234.0	-1.1
10	2.1	249.8	-1.0
11	1.3	263.5	-1.1
12	2.0	263.2	-1.3
13	3.1	273.8	-1.9
14	3.3	287.8	-1.7

15	3.4	290.2	-2.8
16	3.3	308.0	-2.1
17	3.0	278.1	-2.2
18	1.9	293.0	-1.7
19	1.7	286.9	-1.3
20	1.5	243.5	-1.2
21	1.4	197.1	-0.6
22	2.1	189.7	1.3
23	4.1	187.0	1.9
24	4.2	187.3	-0.2
1	3.0	194.7	0.8
2	3.2	203.6	0.5
3	3.4	209.9	0.2
4	3.6	207.7	-1.1
5	4.0	201.1	0.5
6	4.4	165.7	-0.1
7	4.8	154.8	-0.5

STOP TIME MAY 17,1993 HOUR 6 MINUTE 11

RELEASE NUMBER 93023 CONTAINMENT PURGE

STARTING TIME MAY 20,1993 HOUR 16 MINUTE 15

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	2.6	261.8	-2.0
17	1.6	311.4	-2.1
18	2.4	334.4	-1.6
19	3.0	327.0	-2.5
20	2.1	349.4	-1.7
21	0.9	53.7	-1.5
22	2.2	33.3	-1.2
23	0.5	282.9	0.4
24	2.0	254.1	0.9
1	2.1	275.4	3.7

STOP TIME MAY 21,1993 HOUR 0 MINUTE 16

STARTING TIME MAY 21,1993 HOUR 1 MINUTE 21

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	2.1	275.4	3.7
2	1.4	286.9	2.6
3	0.9	284.4	1.9
4	0.8	296.5	0.2
5	0.6	288.1	-0.3
6	0.8	287.3	-0.3
7	1.0	276.2	1.2
8	1.6	309.6	2.1
9	1.0	0.4	-0.3
10	1.0	324.7	-0.5
11	1.7	332.2	-0.6
12	2.8	204.6	-0.7
13	3.0	308.2	-1.4
14	2.5	249.0	-0.8
15	3.2	145.0	-1.4
16	4.4	145.9	-1.3
17	5.5	149.4	-1.8
18	6.6	152.3	-1.7
19	6.7	139.0	-1.5
20	4.9	153.9	-1.8
21	3.8	136.3	-0.2
22	4.9	141.1	0.1
23	4.1	141.3	-0.5
24	5.1	142.1	-0.3
1	7.3	155.5	-1.9
2	7.5	165.4	-1.3
3	7.7	163.1	-1.6
4	7.8	147.8	-1.9
5	6.0	140.6	-0.5
6	9.4	153.7	-1.0
7	12.4	146.9	-1.6
8	9.6	149.6	-1.3
9	6.7	150.6	-1.2
10	6.5	132.7	-2.1
11	9.0	143.4	-1.8
12	14.9	162.5	-1.7
13	15.7	173.0	-2.3
14	10.1	189.0	[illegible]
15	7.5	178.0	[illegible]
16	8.1	171.2	[illegible]
17	7.5	163.7	[illegible]
18	9.8	155.1	-1.3
19	10.5	163.0	-1.6
20	10.2	168.4	-2.1
21	7.3	162.4	-0.5
22	3.7	146.7	-0.7
23	3.2	143.7	-1.1
24	2.4	160.8	-1.4
1	3.1	160.6	-1.8
2	1.3	223.2	-1.0
3	5.0	153.8	-1.6
4	4.7	176.3	-0.8
5	1.3	344.7	-1.3
6	3.4	183.3	-0.9
7	5.2	182.6	-1.8

8	5.9	225.2	-0.6
9	3.0	303.4	-1.8
10	4.6	306.5	-2.2
11	5.2	316.3	-2.9
12	6.2	306.0	-2.8
13	6.0	310.7	-2.6
14	7.1	314.8	-2.1
15	7.2	295.9	-2.2
16	6.2	311.8	-2.5
17	6.1	316.5	-1.7
18	5.3	314.0	-2.1
19	4.9	311.7	-1.4
20	5.2	309.8	-0.8
21	4.4	306.0	-0.9
22	6.8	318.2	-1.0
23	6.8	311.7	-0.3
24	5.7	297.7	-0.5
1	6.4	290.8	-0.9
2	7.1	295.2	-0.5
3	6.8	298.0	-0.7
4	8.3	289.0	-0.4
5	8.3	283.5	-0.1

STOP TIME MAY 24,1993 HOUR 4 MINUTE 51

RELEASE NUMBER 93024 CONTAINMENT PURGE

STARTING TIME MAY 28,1993 HOUR 16 MINUTE 27

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	6.5	42.3	-0.4
17	6.2	14.1	-0.4
18	5.9	41.3	-0.3
19	5.6	46.4	-0.2
20	5.4	318.6	-0.2
21	4.7	320.7	-0.1
22	4.8	74.4	-0.1
23	4.6	78.6	-0.1
24	4.3	69.2	-0.1
1	5.0	74.5	-1.0
2	4.9	71.8	-1.0
3	5.2	74.3	-1.0
4	4.6	65.7	-1.0
5	6.4	83.2	-1.0
6	8.5	101.1	-1.0
7	6.3	97.6	-1.0
8	4.6	72.9	-1.0
9	6.8	93.3	-1.0
10	7.2	84.4	-1.0
11	9.1	48.7	-1.0
12	10.5	117.1	-1.0
13	10.1	116.3	-1.0
14	11.4	118.8	-1.0
15	11.0	118.4	-1.0
16	9.5	129.9	-1.0
17	6.8	98.6	-1.0
18	5.9	80.4	-1.0
19	7.6	122.2	-1.0
20	9.7	132.3	-1.0
21	9.6	129.0	-1.0
22	8.3	129.8	-1.0
23	7.8	137.2	-1.0
24	7.6	145.1	-1.0
1	7.9	148.5	-1.0
2	7.1	157.5	-1.0
3	9.3	159.4	-1.0
4	8.3	169.2	-1.0
5	7.6	178.5	-1.0
6	7.2	193.9	-1.0
7	4.8	217.9	-1.0
8	2.7	228.8	-1.0
9	2.5	293.4	-1.0
10	3.6	314.9	-1.0
11	5.2	333.8	-1.0
12	5.0	326.4	-1.0
13	4.8	323.0	-1.0
14	5.7	329.4	-1.0
15	6.9	330.7	-1.0
16	8.9	327.5	-1.0
17	8.7	334.0	-1.0
18	8.6	329.7	-1.0
19	7.9	332.0	-1.0
20	8.2	333.1	-1.0
21	8.1	331.2	-1.0
22	6.4	335.4	-1.0
23	7.0	337.8	-1.0
24	5.2	334.0	-1.0
1	5.3	331.4	1.0
2	4.0	318.8	1.0
3	3.1	301.9	1.0
4	3.5	302.0	1.0
5	2.2	231.3	1.0
6	1.3	249.2	-1.0
7	1.4	5.1	-1.0
8	2.1	313.0	-1.5
9	2.9	320.8	-1.5
10	4.7	337.1	-1.5
11	5.4	337.9	-1.5
12	5.4	339.0	-1.5
13	5.6	334.4	-1.5
14	5.8	331.6	-1.5
15	6.4	334.7	-1.5
16	6.0	347.0	-1.5
17	5.3	351.1	-1.5

18	5.3	352.7	-1.5
19	5.2	346.0	1.0
20	3.4	354.6	1.0
21	2.0	318.9	1.0
22	1.3	227.7	2.5
23	1.6	160.9	2.5
24	1.6	150.5	2.5
1	2.0	183.4	0.3
2	2.2	275.3	0.2
3	1.8	156.7	0.4
4	3.8	117.7	0.4
5	4.1	124.2	0.2
6	5.6	127.8	-0.1
7	7.7	136.0	-0.1

STOP TIME JUNE 1,1993 HOUR 6 MINUTE 23

RELEASE NUMBER 93025 CONTAINMENT PURGE

STARTING TIME JUNE 3,1993 HOUR 12 MINUTE 52

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	4.8	73.0	-1.0
13	4.8	70.0	-1.0
14	4.8	73.0	-1.0
15	4.8	76.0	-1.0
16	4.8	80.0	-1.0
17	4.2	46.0	-1.0
18	3.6	33.0	-1.0
19	3.0	10.0	-1.0
20	3.0	23.0	-1.0
21	3.0	37.0	-1.0
22	3.0	50.0	-1.0
23	3.8	30.0	-1.0
24	4.6	10.0	-1.0
1	5.4	360.0	-1.0
2	5.4	13.0	-1.0
3	5.4	27.0	-1.0
4	5.4	40.0	-1.0
5	5.8	27.0	-1.0
6	6.2	13.0	-1.0
7	6.6	360.0	-1.0
8	6.2	13.0	-1.0
9	5.8	27.0	-1.0
10	5.4	40.0	-1.0
11	5.0	53.0	-1.0
12	4.6	67.0	-1.0
13	4.2	80.0	-1.0
14	3.4	54.0	-1.0
15	2.6	27.0	-1.0
16	1.8	360.0	-1.0
17	1.2	31.9	-1.0
18	0.6	8.4	-1.0
19	0.6	36.9	-1.0
20	0.6	22.6	-1.0
21	0.6	36.2	-1.0
22	0.6	20.5	-1.0
23	0.6	22.9	-1.0
24	1.2	24.5	-1.0
1	1.8	32.1	4.0
2	1.8	23.8	4.0
3	1.8	29.8	4.0
4	1.8	20.1	4.0
5	2.0	30.3	2.0
6	2.2	35.6	-0.1
7	2.4	23.6	-1.9
8	2.4	17.1	-1.9
9	2.4	33.7	-1.9
10	2.4	17.8	-1.9
11	3.6	33.8	-1.8
12	4.8	32.2	-1.8
13	6.0	32.6	-1.7
14	5.8	49.0	-1.7
15	5.6	43.9	-1.7

STOP TIME JUNE 5,1993 HOUR 14 MINUTE 0

STARTING TIME JUNE 5,1993 HOUR 14 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	5.8	49.0	-1.7
15	5.6	43.9	-1.7
16	5.4	16.3	-1.7
17	5.2	38.9	-1.6
18	5.0	138.8	-1.6
19	4.8	36.2	-1.5
20	5.0	19.0	-1.1
21	5.2	27.1	-0.8
22	5.4	8.3	-0.5
23	4.8	21.1	-0.1
24	4.2	38.0	0.8
1	3.6	23.8	1.5
2	3.6	24.6	1.5

3	3.6	18.4	1.5
4	3.6	15.9	1.5
5	4.0	41.5	0.5
6	4.4	20.1	-0.5
7	4.8	28.9	-1.5
8	4.4	31.6	-1.5
9	4.0	16.4	-1.5
10	3.6	26.9	-1.5
11	3.6	27.2	-1.5
12	3.6	33.4	-1.5
13	3.6	32.5	-1.5
14	4.4	37.7	-1.5
15	5.2	46.9	-1.5
16	6.0	28.7	-1.5
17	5.2	36.6	-1.5
18	4.4	41.7	-1.5
19	3.6	24.4	-1.5
20	3.6	42.1	-1.5
21	3.6	46.4	-1.5
22	3.6	27.4	-1.5
23	4.2	27.1	-1.1
24	4.8	22.6	-0.8
1	5.4	17.7	-0.5
2	5.2	40.7	-0.5
3	5.0	24.5	-0.5
4	4.8	16.6	-0.5
5	5.0	31.1	-0.9
6	5.2	26.7	-1.3

STOP TIME JUNE 7,1993 HOUR 5 MINUTE 8

RELEASE NUMBER 93026 CONTAINMENT PURGE

STARTING TIME JUNE 10.1993 HOUR 14 MINUTE 27

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	4.5	273.7	-1.3
15	4.9	312.5	-1.3
16	6.2	158.7	-1.3
17	5.9	158.8	-1.4
18	6.6	164.7	-1.3
19	7.1	163.8	-1.0
20	6.0	158.2	0.4
21	3.6	131.9	1.9
22	4.7	122.3	3.7
23	3.5	110.9	5.3
24	7.4	140.5	3.8
1	6.3	157.0	4.5
2	7.0	182.9	4.7
3	4.6	133.3	4.5
4	2.7	40.8	4.2
5	2.0	355.6	4.6
6	1.4	289.8	5.[illegible]
7	1.7	202.6	5.2
8	1.9	180.9	2.8
9	2.8	56.7	0.1
10	7.4	122.5	-1.1
11	9.2	319.4	-1.4
12	8.7	145.0	-1.4
13	11.5	148.0	-1.5
14	12.7	150.8	-1.6
15	14.4	145.0	-1.5
16	12.9	145.8	-1.3
17	12.2	148.3	-1.0
18	7.9	153.9	-0.6
19	6.8	143.2	-0.6
20	12.5	165.4	-0.2
21	5.7	19.5	0.3
22	14.2	111.1	-0.7
23	8.4	79.9	0.8
24	12.1	160.9	0.8
1	8.5	135.9	1.0
2	7.9	146.0	1.4
3	7.3	140.2	0.6
4	7.7	145.7	0.2
5	5.7	141.2	0.3
6	5.6	134.8	0.4
7	8.2	146.4	0.1
8	9.4	135.9	-0.6
9	8.8	139.6	-1.0
10	9.5	153.2	-1.0
11	12.0	158.4	-1.0
12	11.2	163.0	-0.9
13	6.6	150.4	-1.0
14	11.2	149.9	-0.8
15	12.4	149.8	-0.5
16	12.3	162.8	0.4
17	8.0	17.8	0.5
18	9.6	129.8	0.1
19	12.1	104.4	-0.6
20	11.9	128.6	-0.2
21	9.7	123.6	0.1
22	9.4	122.4	0.4
23	12.8	132.1	-0.2
24	7.8	147.0	-0.2
1	7.7	117.4	-0.3
2	8.1	138.7	-0.1
3	9.3	139.9	0.3
4	6.3	199.3	0.2
5	4.5	297.3	-0.2
6	6.7	177.1	1.5
7	7.6	145.2	0.4
8	3.4	289.2	0.4
9	7.8	129.8	0.8
10	7.3	151.5	0.8
11	14.9	165.4	0.2
12	8.6	214.1	-0.9
13	3.5	258.1	-1.0
14	4.8	354.1	-1.0
15	5.4	336.4	-0.8

16	5.9	333.6	-0.7
17	5.5	332.0	-0.5
18	6.3	331.8	-0.6
19	4.5	340.9	-0.7
20	3.8	334.7	-0.6
21	2.7	314.8	-0.2
22	3.5	320.2	0.4
23	3.7	308.7	1.5
24	4.5	269.3	3.5
1	4.6	264.6	4.2
2	4.3	231.0	5.1
3	3.9	259.7	5.1
4	4.0	324.8	5.5
5	4.0	277.5	5.9
6	4.7	285.9	4.4
7	3.6	294.6	2.3
8	5.3	351.7	-0.1

STOP TIME JUNE 14,1993 HOUR 7 MINUTE 52

RELEASE NUMBER 93027 CONTAINMENT PURGE

STARTING TIME JUNE 17,1993 HOUR 13 MINUTE 23

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	9.2	250.2	-1.6
14	4.8	297.8	-1.8
15	6.4	269.2	-1.5
16	8.8	329.9	-1.8
17	8.8	325.5	-1.6
18	7.1	330.8	-1.2
19	6.8	334.3	-0.8
20	4.4	285.5	-0.6
21	4.5	332.0	-0.5
22	5.6	337.1	-0.4
23	5.6	332.7	-0.5
24	4.0	326.9	-0.6
1	3.7	337.3	-0.6
2	3.5	204.5	-0.7
3	3.8	211.5	-0.5
4	2.2	333.1	-0.4
5	2.6	357.8	-0.6
6	2.9	308.8	-0.6
7	3.4	101.5	-0.5
8	5.5	103.2	-0.6
9	6.9	120.1	-0.9
10	8.5	134.2	-1.0
11	9.2	132.5	-1.1
12	7.4	133.2	-0.9
13	7.8	126.2	-1.0
14	4.9	163.6	-0.8
15	3.9	39.2	-1.1
16	7.7	198.6	-0.8
17	5.6	153.5	-0.5
18	6.1	236.1	-0.4
19	6.9	203.6	-0.8
20	4.0	266.6	-0.9
21	2.3	302.3	-0.5
22	2.5	292.5	-0.4
23	2.9	304.7	-0.6
24	3.6	303.8	-0.7
1	3.8	308.3	-0.8
2	3.6	296.7	-0.8
3	3.6	315.6	-0.9
4	4.0	313.2	-0.9
5	3.3	312.2	-0.8
6	2.8	326.0	-0.7
7	3.0	295.2	-0.7
8	4.1	326.0	-0.8
9	6.8	332.7	-0.8
10	7.2	329.8	-1.0
11	5.8	328.9	-1.1
12	6.7	329.2	-1.2
13	6.3	321.1	-1.3
14	5.0	315.2	-1.3
15	3.4	295.4	-1.4
16	3.9	316.7	-1.3
17	3.6	301.0	-1.3
18	3.5	296.8	-1.0
19	2.8	279.2	-0.9
20	2.4	313.0	-0.8
21	1.9	306.5	-0.5
22	1.6	301.4	0.1
23	1.5	287.0	1.1
24	1.6	283.2	1.4
1	1.6	205.9	1.3
2	1.6	309.2	1.4
3	1.5	218.8	0.7
4	2.0	205.6	0.8
5	1.5	295.7	1.2
6	1.5	229.7	1.1
7	1.4	123.0	1.4
8	1.8	234.1	0.2
9	2.4	172.1	-0.7
10	2.4	286.8	-1.3
11	3.4	352.1	-1.4
12	3.8	278.7	-1.2
13	4.3	245.7	-1.4
14	4.8	250.5	-1.4

15	4.6	251.9	-1.4
16	3.7	275.6	-1.4
17	3.2	236.2	-1.2
18	3.2	243.7	-1.1
19	2.7	330.7	-1.3
20	2.4	15.7	-0.9
21	1.8	5.0	0.4
22	1.6	186.3	1.6
23	1.5	281.8	2.2
24	2.3	148.6	2.2
1	2.5	111.3	2.6
2	2.8	116.7	2.5
3	1.7	90.7	2.6
4	1.4	128.3	3.1
5	1.4	279.1	2.9
6	1.3	258.4	2.7
7	1.2	289.0	2.1

STOP TIME JUNE 21,1993 HOUR 6 MINUTE 6

RELEASE NUMBER 93028 CONTAINMENT PURGE

STARTING TIME JUNE 24,1993 HOUR 20 MINUTE 47

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
20	3.7	332.3	-0.6
21	1.8	278.3	1.5
22	1.6	198.6	3.8
23	1.8	161.4	5.0
24	2.5	129.8	5.9
1	4.2	150.8	4.9
2	3.6	134.7	4.7
3	7.2	192.4	3.8
4	8.4	210.6	3.7
5	10.7	223.3	3.1
6	10.8	233.3	1.2
7	4.1	231.2	0.8
8	2.7	312.1	-0.9
9	4.2	313.3	-1.3
10	5.9	336.5	-1.2
11	6.4	333.8	-1.6
12	5.2	317.9	-2.0
13	4.3	308.7	-4.8
14	6.3	253.9	-3.6
15	5.1	288.1	-2.0
16	6.2	262.8	-1.8
17	6.8	260.4	-1.6
18	8.7	238.3	-1.3
19	4.2	250.4	-0.8
20	4.9	243.5	-0.3
21	3.1	213.3	1.1
22	3.6	203.4	2.3
23	4.3	203.6	2.8
24	5.9	201.2	3.1
1	7.9	196.4	2.7
2	4.0	279.9	1.2
3	2.1	252.7	3.2
4	7.3	242.7	1.6
5	6.1	237.5	1.6
6	6.7	237.6	1.6
7	6.5	216.5	0.9
8	7.8	203.9	-0.1
9	10.2	218.0	-1.0
10	11.6	226.0	-1.0
11	14.1	219.8	-1.0
12	10.6	230.4	-1.0
13	10.5	239.4	-1.0
14	9.9	236.6	-1.0
15	6.0	252.4	-1.0
16	5.5	250.5	-1.6
17	4.5	217.2	-1.1
18	6.0	206.3	-0.7
19	7.7	195.9	-0.4
20	4.3	208.9	0.2
21	5.1	224.0	1.0
22	3.1	208.2	1.5
23	2.8	184.6	1.2
24	2.2	267.7	0.5
1	2.2	246.8	1.2
2	1.6	292.6	2.1
3	1.7	352.6	3.8
4	1.7	309.4	2.6
5	2.0	354.7	2.6
6	3.5	151.8	3.5
7	3.0	315.6	3.4
8	3.1	109.8	0.9
9	2.7	245.2	-1.0
10	3.1	29.0	-1.0
11	3.7	36.5	-1.6
12	3.5	53.4	-1.7
13	6.6	173.6	-1.3
14	7.3	188.5	-1.4
15	7.8	171.2	-1.4
16	7.8	169.7	-1.3
17	6.8	156.2	-1.2
18	8.7	134.4	-1.2
19	9.1	136.2	-1.2
20	8.0	138.8	-0.8
21	5.3	154.3	0.1

22	3.4	164.3	2.0
23	2.0	148.3	3.6
24	2.7	119.9	3.3
1	3.7	115.9	2.1
2	8.1	139.6	0.1
3	12.0	183.0	-0.6
4	4.9	59.7	0.1
5	9.3	226.7	0.3
6	10.4	168.0	-0.3
7	3.6	337.1	-0.2

STOP TIME JUNE 28,1993 HOUR 6 MINUTE 23

RELEASE NUMBER 93029 CONTAINMENT PURGE

STARTING TIME JULY 1,1993 HOUR 18 MINUTE 45

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	2.6	137.0	2.1
19	2.4	120.0	4.0
20	3.0	130.0	4.0
21	3.6	140.0	4.0
22	4.2	150.0	4.0
23	4.0	160.0	3.2
24	3.8	170.0	2.3
1	3.6	180.0	1.5
2	3.2	154.0	1.5

STOP TIME JULY 2,1993 HOUR 1 MINUTE 21

STARTING TIME JULY 2,1993 HOUR 12 MINUTE 32

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	5.0	10.0	0.3
13	6.0	20.0	-1.5
14	5.2	43.0	-1.6
15	4.4	66.0	-1.6
16	3.6	90.0	-1.7
17	3.2	90.0	0.2
18	2.8	90.0	2.1
19	2.4	90.0	4.0
20	2.4	90.0	4.0
21	2.4	90.0	4.0
22	2.4	90.0	4.0
23	4.0	110.0	4.0
24	4.0	130.0	4.0
1	4.2	150.0	4.0
2	4.4	150.0	1.9
3	4.6	150.0	0.7
4	4.8	150.0	-0.5
5	5.2	153.0	-0.9
6	5.6	157.0	-1.3
7	6.0	160.0	-1.7
8	7.0	160.0	-1.6
9	8.0	160.0	-1.6
10	9.0	160.0	-1.5
11	9.0	160.0	-1.5
12	9.0	160.0	-1.5
13	9.0	160.0	-1.5
14	10.0	163.0	-1.1
15	11.0	167.0	-0.8
16	12.0	170.0	-0.5
17	11.6	163.0	-0.5
18	11.2	156.0	-0.5
19	10.8	150.0	-0.5
20	9.8	156.0	-0.5
21	8.8	163.0	-0.5
22	7.8	170.0	-0.5
23	8.0	173.0	-0.5
24	8.2	177.0	-0.5
1	8.4	180.0	-0.5
2	7.0	173.0	0.2
3	5.6	166.0	0.9
4	4.2	160.0	1.5
5	4.8	166.0	1.5
6	5.4	173.0	1.5
7	6.0	180.0	1.5
8	5.2	200.0	0.5
9	4.4	220.0	-0.6
10	3.6	240.0	-1.7
11	3.8	253.0	-1.7
12	4.0	264.7	-1.7
13	4.2	280.0	-1.7

STOP TIME JULY 4,1993 HOUR 12 MINUTE 42

RELEASE NUMBER 93029 CONTAINMENT PURGE

STARTING TIME JULY 4,1993 HOUR 13 MINUTE 12

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	4.2	280.0	-1.7
14	4.2	257.0	-1.7
15	4.2	233.0	-1.7
16	4.2	210.0	-1.7
17	3.8	190.0	-0.6
18	3.4	170.0	0.5
19	3.0	150.0	1.5
20	3.2	150.0	2.3
21	3.4	150.0	3.1
22	3.6	150.0	4.0
23	3.8	150.0	4.0
24	4.0	150.0	4.0
1	4.2	150.0	4.0
2	4.8	160.0	4.0
3	5.4	170.0	4.0
4	6.0	180.0	4.0
5	5.2	197.0	3.2
6	4.4	214.0	2.3
7	3.6	230.0	1.5
8	3.6	250.0	0.4
9	3.6	270.0	-0.8
10	3.6	290.0	-1.9
11	3.6	284.0	-1.9
12	3.6	277.0	-1.9
13	3.6	270.0	-1.9
14	4.0	277.0	-1.8
15	4.4	284.0	-1.8
16	4.8	290.0	-1.7
17	4.0	284.0	-0.7
18	3.2	277.0	0.4
19	2.4	270.0	1.5
20	2.8	240.0	2.3
21	3.2	210.0	3.1
22	3.6	180.0	4.0
23	3.6	177.0	4.0
24	4.0	173.0	4.0
1	4.2	170.0	4.0
2	3.8	183.0	4.0
3	3.4	197.0	4.0
4	3.0	210.0	4.0
5	3.0	184.0	3.2
6	3.0	157.0	2.3
7	3.0	130.0	1.5

STOP TIME JULY 6,1993 HOUR 6 MINUTE 2

RELEASE NUMBER 93030 CONTAINMENT PURGE

STARTING TIME JULY 8,1993 HOUR 18 MINUTE 26

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	6.2	143.0	-0.8
19	7.2	140.0	-0.5
20	7.4	150.0	0.2
21	7.6	160.0	0.9
22	7.8	170.0	1.5
23	6.2	160.0	1.5
24	4.6	150.0	1.5

STOP TIME JULY 8,1993 HOUR 23 MINUTE 6

STARTING TIME JULY 9,1993 HOUR 1 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	3.0	140.0	1.5
2	3.2	157.0	1.5
3	3.4	174.0	1.5
4	3.6	190.0	1.5
5	3.6	196.0	1.5
6	3.6	203.0	1.5
7	3.6	210.0	1.5
8	3.6	236.0	0.5
9	3.6	263.0	-0.5
10	3.6	290.0	-1.5
11	3.8	296.0	-1.6
12	4.0	303.0	-1.6
13	4.2	310.0	-1.7
14	3.8	340.0	-1.8
15	3.4	10.0	-1.8
16	3.0	40.0	-1.9
17	2.6	46.0	-1.7
18	2.2	53.0	-1.7
19	1.8	60.0	1.5
20	1.8	70.0	2.3
21	1.8	80.0	3.2
22	1.8	90.0	4.0
23	1.8	96.0	4.2
24	1.8	103.0	2.3
1	1.8	110.0	1.5
2	2.4	120.0	1.5
3	3.0	130.0	1.5
4	3.6	140.0	1.5
5	3.6	134.0	1.5
6	3.6	126.0	1.5
7	3.6	120.0	1.5
8	4.8	130.0	0.5
9	6.0	140.0	-0.5
10	7.2	150.0	-1.5
11	6.8	160.0	-1.5
12	6.4	170.0	-1.5
13	6.0	180.0	-1.5
14	5.6	193.0	-1.6
15	5.2	207.0	-1.6
16	4.8	220.0	-1.7
17	4.6	200.0	-0.7
18	4.4	180.0	0.4
19	4.2	160.0	1.5
20	4.0	154.0	1.5
21	3.8	146.0	1.5
22	3.6	140.0	1.5
23	4.4	210.0	0.9
24	5.2	280.0	0.2
1	6.0	350.0	-0.5
2	4.8	306.0	0.2
3	3.6	263.0	0.9
4	2.4	220.0	1.5
5	2.4	250.0	1.5
6	2.4	280.0	1.5
7	2.4	310.0	1.5
8	4.0	320.0	0.5
9	5.6	330.0	-0.5
10	7.2	340.0	-1.5

11	7.0	343.0	-1.5
12	6.8	347.0	-1.5
13	6.6	350.0	-1.5
14	6.6	356.0	-1.6
15	6.6	3.0	-1.6
16	6.6	10.0	-1.7
17	5.6	3.0	-0.6
18	4.6	356.0	0.5
19	3.6	350.0	1.5
20	3.0	350.0	2.3
21	2.4	350.0	3.1
22	1.8	350.0	4.0
23	2.0	350.0	3.1
24	2.2	350.0	2.3
1	2.4	350.0	1.5
2	2.2	30.0	1.5
3	2.0	17.0	1.5
4	1.8	30.0	1.5
5	2.2	43.0	1.5
6	2.6	57.0	1.5
7	3.0	70.0	1.5

STOP TIME JULY 12,1993 HOUR 6 MINUTE 25

RELEASE NUMBER 93031 CONTAINMENT PURGE

STARTING TIME JULY 15,1993 HOUR 14 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	3.8	113.0	-1.7
15	4.0	127.0	-1.7
16	4.2	140.0	-1.7
17	3.8	140.0	-1.3
18	3.4	140.0	-0.9
19	3.0	140.0	-0.5
20	3.6	146.0	-0.5
21	4.2	154.0	-0.5
22	4.8	160.0	-0.5
23	4.2	147.0	-0.5
24	3.6	133.0	-0.5
1	3.0	120.0	-0.5
2	2.6	123.0	0.2
3	2.2	127.0	0.9
4	1.8	130.0	1.5
5	2.4	127.0	0.9
6	3.0	123.0	0.2
7	3.6	120.0	-0.5
8	3.2	117.0	-0.8
9	2.8	113.0	-1.2
10	2.4	110.0	-1.5
11	2.6	124.0	-1.6
12	2.8	136.0	-1.6
13	3.0	150.0	-1.7
14	3.6	156.0	-1.7
15	4.2	164.0	-1.7
16	4.8	170.0	-1.7
17	4.0	153.0	-0.6
18	3.2	137.0	0.4
19	2.4	120.0	1.5
20	2.6	110.0	1.5
21	2.8	100.0	1.5
22	3.0	90.0	1.5
23	3.2	110.0	2.3
24	3.4	130.0	3.2
1	3.6	150.0	4.0
2	3.4	160.0	3.2
3	3.2	170.0	2.3
4	3.0	180.0	1.5
5	2.6	207.0	1.5
6	2.2	233.0	1.5
7	1.8	260.0	1.5
8	3.2	300.0	0.4
9	4.6	340.0	-0.6
10	6.0	20.0	-1.7
11	5.2	10.0	-1.6
12	4.4	360.0	-1.6
13	3.6	350.0	-1.5
14	3.0	40.0	-1.7
15	2.4	90.0	-1.7
16	1.8	140.0	-1.9
17	2.0	197.0	-0.8
18	2.2	253.0	0.4
19	2.4	310.0	1.5
20	2.2	313.0	1.5
21	2.0	317.0	1.5
22	1.8	320.0	1.5
23	1.8	320.0	1.5
24	1.8	320.0	1.5
1	1.8	320.0	1.5
2	2.0	320.0	0.8
3	2.2	320.0	0.2
4	2.4	320.0	-0.5
5	2.2	290.0	1.0
6	2.0	260.0	2.5
7	1.8	230.0	4.0
8	2.0	253.0	2.1
9	2.2	277.0	0.2
10	2.4	300.0	-1.7
11	2.6	306.0	-1.7
12	2.8	314.0	-1.7
13	3.0	320.0	-1.7
14	3.0	303.0	-1.7
15	3.0	287.0	-1.7

16	3.0	270.0	-1.7
17	2.6	276.0	-0.6
18	2.2	284.0	0.4
19	1.8	290.0	1.5
20	1.8	263.0	2.3
21	1.8	237.0	3.2
22	1.8	210.0	4.0
23	2.0	210.0	3.2
24	2.0	210.0	2.3
1	2.4	210.0	1.5
2	2.4	210.0	1.5
3	2.4	210.0	1.5
4	2.4	210.0	1.5
5	2.4	247.0	0.7
6	2.4	283.0	0.3
7	2.4	320.0	-0.5

STOP TIME   JULY 19,1993   HOUR 6 MINUTE 2

RELEASE NUMBER 93032 CONTAINMENT PURGE

STARTING TIME JULY 22,1993 HOUR 12 MINUTE 55

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	18.4	160.2	-1.1
13	21.0	165.5	-1.2
14	14.3	162.4	-1.1
15	8.5	34.2	-0.9
16	10.0	135.2	-1.2
17	9.9	132.5	-1.1
18	7.4	130.5	-1.0
19	5.6	90.0	-1.0
20	5.8	96.0	-0.7
21	8.0	104.0	-0.7
22	8.0	110.0	-0.6
23	10.0	133.0	-0.5
24	6.3	157.0	-0.2
1	3.5	180.0	-0.3
2	3.6	183.0	-0.4
3	3.8	187.0	-0.2
4	6.7	190.0	-0.2
5	8.6	173.0	-0.6
6	7.3	157.0	-0.7
7	8.4	140.0	-0.5
8	9.9	110.0	-0.6
9	8.9	80.0	-0.5
10	7.7	50.0	-0.3
11	6.6	90.0	-0.5
12	8.9	130.0	-1.2
13	14.1	170.0	-1.3
14	12.3	170.0	-1.2
15	10.1	18.1	-1.2
16	8.4	193.2	-1.1
17	6.1	177.6	-1.0
18	3.4	183.4	-0.8
19	2.2	70.0	-0.4
20	2.7	70.0	-0.4
21	1.4	70.0	0.4
22	1.2	70.0	1.1
23	1.3	70.0	1.6
24	1.8	70.0	2.0
1	1.9	266.1	1.8
2	1.3	215.0	1.0
3	1.9	326.5	0.5
4	1.8	287.2	0.8
5	3.2	308.3	0.3
6	5.6	201.6	0.1
7	12.0	209.7	-0.1
8	12.7	194.7	1.4
9	8.2	121.5	-0.1
10	7.4	128.9	-0.2
11	7.9	145.8	-1.1
12	9.6	159.7	-1.1
13	9.9	157.7	-1.0
14	8.3	117.4	-1.1
15	9.6	120.9	-1.0
16	8.8	128.1	-1.0
17	7.2	97.0	-1.0
18	7.5	105.9	-0.9
19	4.6	170.0	-0.7
20	5.5	150.0	-0.7
21	5.2	130.0	-0.5
22	8.4	110.0	-0.4
23	4.0	110.0	-0.1
24	3.3	110.0	0.5
1	2.4	201.0	0.7
2	5.8	22.2	0.4
3	6.5	44.0	0.2
4	5.4	64.7	-0.1
5	3.6	272.7	0.3
6	4.2	281.6	0.2
7	4.7	117.5	0.1
8	4.9	105.9	-0.5
9	4.3	302.9	-1.2
10	4.6	289.9	-1.5
11	4.8	300.7	-1.7
12	6.1	308.4	-1.7
13	6.2	297.6	-1.8

14	5.7	299.7	-1.8
15	5.2	318.4	-1.8
16	5.4	298.0	-1.6
17	4.0	229.5	-1.6
18	3.5	251.2	-1.4
19	2.7	228.6	-1.0
20	3.0	241.3	-0.2
21	1.5	206.7	1.8
22	3.1	205.1	2.6
23	3.5	212.6	3.1
24	2.9	161.2	3.8
1	4.0	190.0	3.8
2	4.4	190.0	4.0
3	2.4	190.0	2.0
4	2.0	190.0	3.0
5	1.5	333.0	3.1
6	1.9	347.0	3.7
7	1.8	360.0	4.3

STOP TIME JULY 26,1993 HOUR 6 MINUTE 44

RELEASE NUMBER 93033 CONTAINMENT PURGE

STARTING TIME JULY 29,1993 HOUR 16 MINUTE 48

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	4.4	165.4	-1.2
17	4.4	183.7	-1.1
18	3.8	70.0	-1.0
19	4.1	85.5	-0.8
20	4.5	95.5	-0.5
21	2.2	134.6	0.9
22	3.1	142.7	1.6
23	3.7	141.4	1.6
24	7.8	163.0	0.5
1	5.0	138.6	1.3
2	6.2	146.5	1.2
3	5.9	141.4	1.1
4	6.6	148.6	0.7
5	5.5	151.6	0.8
6	4.7	139.4	1.0
7	3.7	117.9	0.6
8	5.3	134.0	-0.1
9	7.6	128.5	-0.6
10	8.9	130.1	-0.9
11	9.1	127.1	-1.0
12	10.1	138.5	-1.0
13	9.6	145.9	-1.1
14	10.2	177.4	-1.1
15	10.1	164.9	-1.1
16	9.3	164.6	-1.0
17	6.9	8.7	-0.8
18	7.4	148.4	-0.8
19	6.7	159.5	-0.6
20	6.4	234.3	-0.3
21	5.4	32.0	0.4
22	6.0	159.8	0.9
23	7.7	161.4	0.9
24	7.8	163.0	0.5
1	7.9	164.3	0.2
2	8.0	176.6	-0.1
3	8.6	179.5	0.1
4	10.0	186.4	0.4
5	10.5	193.6	0.2
6	9.2	190.9	0.2
7	9.5	197.5	0.4
8	13.8	210.7	-0.1
9	12.2	245.2	0.4
10	6.1	258.2	-0.6
11	4.9	326.9	-1.4
12	4.8	320.7	-1.6
13	5.1	337.6	-1.6
14	3.7	1.0	-1.3
15	4.4	2.0	-1.2
16	3.3	18.5	-1.4
17	6.1	8.7	-1.4
18	7.0	148.4	-1.3
19	6.0	159.5	-1.1
20	5.2	234.3	-0.9
21	2.5	32.0	-0.6
22	2.2	350.4	-0.2
23	2.3	298.8	0.4
24	1.9	308.0	0.4
1	1.6	325.3	0.4
2	2.3	339.0	0.7
3	2.0	307.0	1.1
4	3.1	326.7	0.5
5	2.9	309.1	0.1
6	2.7	328.0	-0.3
7	2.6	317.2	-0.3
8	3.4	158.1	-0.5
9	6.6	217.0	-0.9
10	6.8	275.0	-1.1
11	7.1	333.5	-1.1
12	8.1	146.1	-1.1
13	8.0	320.0	-1.1
14	8.9	320.0	-1.2
15	7.7	320.0	-1.4
16	8.1	320.0	-1.5
17	8.0	314.0	-1.4

18	7.5	306.0	-1.1
19	5.1	300.0	-0.9
20	1.8	290.0	0.5
21	1.6	280.0	3.0
22	2.1	270.0	4.0
23	2.5	295.7	3.3
24	2.4	324.9	2.7
1	2.6	331.6	2.0
2	2.1	206.9	2.4
3	1.9	132.2	3.0
4	1.9	117.3	2.9
5	2.5	286.3	3.9
6	2.3	83.8	2.6
7	3.0	323.8	1.8

STOP TIME AUG 2,1993 HOUR 6 MINUTE 20

RELEASE NUMBER 93034 CONTAINMENT PURGE

STARTING TIME AUG 5,1993 HOUR 17 MINUTE 54

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	2.2	210.9	3.9
18	2.0	217.0	4.1
19	1.8	223.2	4.4
20	1.8	229.3	4.7
21	1.8	235.3	4.9
22	1.8	241.3	5.2
23	2.0	247.2	5.4
24	2.2	253.2	5.7
1	2.4	259.0	5.9
2	3.0	264.8	6.1
3	3.6	270.7	6.4
4	4.2	276.3	6.6
5	4.0	282.1	6.9
6	3.8	287.7	7.1
7	3.6	293.3	7.3
8	3.6	298.9	7.6
9	3.6	304.4	7.8
10	3.6	310.0	8.0
11	3.6	315.5	8.2
12	3.6	321.0	8.5
13	3.6	326.3	8.7
14	3.4	331.7	8.9
15	3.2	241.0	5.0
16	3.0	360.0	-1.5
17	2.6	20.0	-1.9
18	2.2	40.0	-1.8
19	1.8	60.0	-1.8
20	1.6	77.0	-2.1
21	1.4	93.0	-1.8
22	1.2	110.0	-1.8
23	1.8	116.0	-1.1
24	2.4	124.0	-1.8
1	3.0	130.0	2.0
2	3.2	127.0	2.0
3	3.4	123.0	-1.0
4	3.6	120.0	-1.0
5	3.4	120.0	-1.0
6	3.2	120.0	-1.0
7	3.0	120.0	-1.0
8	3.2	130.0	-1.0
9	3.4	140.0	-1.0
10	3.6	150.0	-1.0
11	4.4	160.0	-1.0
12	5.2	170.0	-1.0
13	6.0	180.0	-1.0
14	5.8	170.0	-1.0
15	5.6	160.0	-1.0
16	5.4	150.0	-1.0
17	5.0	160.0	-1.0
18	4.6	170.0	-1.0
19	4.2	180.0	2.0
20	4.4	177.0	2.0
21	4.6	173.0	2.0
22	4.8	170.0	2.0
23	5.0	167.0	2.0
24	5.2	163.0	2.0
1	5.4	160.0	2.0
2	5.6	163.0	2.0
3	5.8	167.0	2.0
4	6.0	170.0	2.0
5	5.0	160.0	2.0
6	4.0	150.0	2.0
7	3.0	140.0	-1.0
8	4.4	146.0	-1.0
9	5.8	154.0	-1.0
10	7.2	160.0	-1.0
11	7.2	157.0	-1.0
12	7.2	153.0	-1.0
13	7.2	150.0	-1.0
14	6.8	160.0	-1.0
15	6.4	170.0	-1.0
16	6.0	180.0	-1.0
17	6.2	174.0	-1.0
18	6.4	166.0	-1.0

19	6.6	160.0	2.0
20	6.4	160.0	2.0
21	6.2	160.0	2.0
22	6.0	160.0	2.0
23	6.2	160.0	2.0
24	6.0	160.0	2.0
1	4.8	180.0	2.0
2	4.8	177.0	2.0
3	4.8	173.0	2.0
4	4.8	170.0	-1.4
5	4.2	176.0	-1.7
6	3.6	184.0	-1.7

STOP TIME AUG 9,1993 HOUR 5 MINUTE 53

RELEASE NUMBER 93035 CONTAINMENT PURGE

STARTING TIME AUG 12,1993 HOUR 13 MINUTE 45

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	2.4	334.1	-1.9
14	2.4	185.1	-2.0
15	2.4	314.4	-1.6
16	2.4	25.6	-1.6
17	2.2	109.4	-1.5
18	2.0	99.1	-1.3
19	1.8	156.6	-0.7
20	2.4	199.5	1.0
21	3.0	312.7	2.0
22	3.6	297.2	1.3
23	3.2	291.2	0.8
24	2.8	309.8	0.4
1	2.4	309.4	0.1
2	2.2	313.0	-0.1
3	2.0	301.9	-0.1
4	1.8	308.5	0.1
5	1.8	300.0	-0.2
6	1.8	308.7	-0.1
7	1.8	178.7	-0.2
8	2.4	290.6	-0.4
9	3.0	94.5	-0.6
10	3.6	318.0	-0.8
11	3.4	314.3	-1.2
12	3.2	352.2	-1.2
13	3.0	23.1	-1.3
14	3.0	39.0	-1.7
15	3.0	3.3	-1.8
16	3.0	114.9	-1.6
17	2.8	133.3	-1.3
18	2.6	139.8	-1.1
19	2.4	149.3	-0.9
20	2.2	157.6	-0.2
21	2.0	143.8	0.7
22	1.8	136.9	1.1
23	2.0	143.5	1.1
24	2.2	141.3	0.9
1	2.4	124.6	0.8
2	3.2	132.3	0.6
3	4.0	145.0	0.6
4	4.8	152.4	0.4
5	4.0	162.0	0.1
6	3.2	193.9	0.1
7	2.4	145.3	0.1
8	3.4	156.7	-0.3
9	4.4	149.8	-0.7
10	5.4	149.8	-0.8
11	5.4	161.2	-0.8
12	5.4	168.0	-1.3
13	5.4	167.0	-1.3
14	5.8	172.3	-1.3
15	6.2	167.1	-1.3
16	6.6	166.9	-1.2
17	5.8	170.6	-1.0
18	5.0	167.0	-0.8
19	4.2	166.5	-0.5
20	4.8	165.9	0.2
21	5.4	167.2	0.9
22	6.0	166.0	0.3
23	6.4	162.0	0.2
24	6.8	167.6	0.1
1	7.2	168.0	-0.1
2	4.8	179.9	-0.1
3	2.4	193.9	0.2
4	2.4	261.7	0.4
5	1.4	321.3	1.2
6	2.8	302.9	1.0
7	4.2	11.4	-0.8
8	3.6	60.0	-0.8
9	3.0	68.0	-0.9
10	2.4	174.7	-0.7
11	3.0	126.1	-0.7
12	3.6	130.1	-0.6
13	4.2	119.7	-0.5
14	4.0	351.5	-1.1

15	3.8	122.3	-1.5
16	3.6	194.4	-1.2
17	3.0	134.7	-0.9
18	2.4	238.1	-1.2
19	1.8	44.8	-1.0
20	2.4	341.3	-0.7
21	2.6	17.9	-0.7
22	3.0	353.6	-0.2
23	2.6	324.1	0.1
24	2.4	53.9	-0.3
1	1.8	26.1	0.3
2	1.2	289.4	0.9
3	0.6	168.5	2.2
4	0.6	313.0	1.2
5	0.6	314.3	0.5
6	1.2	337.1	-0.5
7	1.8	12.7	-0.6

STOP TIME AUG 16,1993 HOUR 6 MINUTE 8

RELEASE NUMBER 93036 CONTAINMENT PURGE

STARTING TIME AUG 19,1993 HOUR 16 MINUTE 23

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	4.2	352.4	-1.7
17	3.4	355.0	-1.7
18	2.6	0.5	-1.1
19	1.8	344.6	-0.4
20	1.2	300.9	0.3
21	0.6	271.3	1.5
22	0.6	275.4	1.8
23	0.8	280.5	2.2
24	1.6	271.8	2.3
1	2.4	274.0	2.2
2	3.0	287.9	1.1
3	3.6	284.9	1.0
4	4.2	281.7	1.4
5	3.6	322.2	0.3
6	3.0	354.3	0.1
7	2.4	271.4	0.4
8	2.4	274.4	0.4
9	2.4	356.5	-1.3

STOP TIME AUG 20,1993 HOUR 8 MINUTE 18

STARTING TIME AUG 20,1993 HOUR 14 MINUTE 57

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	4.2	4.8	-1.7
15	3.6	231.3	-3.7
16	3.0	232.8	-3.7
17	2.6	330.2	-3.0
18	2.2	54.9	-1.3
19	1.8	66.9	-0.7
20	2.0	67.3	-0.2
21	2.2	13.7	0.5
22	2.4	283.6	1.5
23	2.6	222.2	-0.2
24	2.8	216.9	0.8
1	3.0	123.2	-1.1
2	2.6	94.1	-2.3
3	2.2	56.8	-3.2
4	1.8	19.6	-4.0
5	1.8	114.1	-0.4
6	1.8	145.2	0.7
7	1.8	124.4	0.2
8	2.2	121.0	-0.3
9	2.6	127.1	-0.8
10	3.0	106.8	-1.1
11	3.6	150.7	-1.2
12	4.2	146.8	-1.1
13	4.8	137.4	-1.1
14	4.6	142.6	-1.1
15	4.4	145.9	-1.2
16	4.2	144.5	-1.0
17	3.8	140.3	-1.1
18	3.4	131.5	-1.2
19	3.0	128.1	-1.0
20	3.2	132.6	-0.9
21	3.4	123.0	-0.8
22	3.0	114.0	-0.9
23	3.8	116.6	-0.8
24	4.0	130.3	-0.6
1	4.2	127.2	-0.5
2	3.8	149.8	-0.5
3	3.4	135.3	-0.3
4	3.0	29.2	-0.5
5	3.8	55.0	-0.8
6	4.6	80.0	-1.0
7	5.4	105.0	-1.3
8	5.0	130.0	-1.5
9	4.6	155.0	-2.0
10	4.2	183.3	-2.4
11	4.2	40.5	-4.6
12	4.2	116.2	-3.1

13	4.2	191.9	-2.0
14	4.0	205.6	-1.6
15	3.8	198.2	-1.4
16	3.6	202.6	-1.3
17	2.4	206.9	-0.9
18	1.2	214.7	-1.1
19	1.2	206.0	-0.9
20	1.2	221.5	0.3
21	1.2	272.2	2.5
22	1.2	271.8	3.0
23	1.2	195.0	3.3
24	2.4	140.9	3.1
1	3.6	291.5	2.3
2	3.6	240.7	1.2
3	3.6	216.0	-0.1
4	3.6	220.3	-0.3
5	3.6	164.4	-1.3
6	3.6	231.3	0.2
7	3.6	278.4	0.8

STOP TIME AUG 23,1993 HOUR 6 MINUTE 42

RELEASE NUMBER 93037 CONTAINMENT PURGE

STARTING TIME AUG 26.1993 HOUR 17 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	4.2	112.0	-2.8
18	3.6	105.0	-2.9
19	3.0	102.9	-2.5
20	4.6	172.9	0.4
21	6.2	161.4	1.0
22	7.8	166.5	0.7
23	6.4	149.5	-0.2
24	5.0	106.4	-2.2
1	3.6	200.0	1.5
2	3.4	235.0	1.5
3	3.2	275.0	1.5
4	3.0	310.0	1.5
5	3.8	323.0	-0.5
6	4.6	327.0	0.5
7	5.4	350.0	-1.5
8	5.2	340.0	-1.6
9	5.0	330.0	-1.6
10	4.8	320.0	-1.7
11	5.3	323.0	-1.7
12	5.9	327.0	-1.7
13	6.4	330.0	-1.7
14	4.9	360.0	-1.7
15	3.3	30.0	-1.7
16	1.8	60.0	-1.7
17	1.2	40.0	-0.2
18	0.6	20.0	-2.1
19	0.6	360.0	4.0
20	0.6	360.0	4.0
21	1.2	360.0	4.0
22	1.8	360.0	4.0
23	1.8	6.0	4.0
24	1.8	14.0	4.0
1	1.8	20.0	4.0
2	1.8	23.0	3.2
3	1.8	27.0	2.3
4	1.8	30.0	1.5
5	1.8	40.0	1.5
6	1.8	50.0	1.5
7	1.8	60.0	1.5
8	2.0	80.0	0.4
9	2.2	100.0	-0.6
10	2.4	120.0	-1.7
11	2.6	126.0	-1.6
12	2.8	134.0	-1.6
13	3.0	140.0	-1.5
14	2.8	130.0	-1.5
15	2.6	120.0	-1.5
16	2.4	110.0	-1.5
17	2.6	113.0	-0.5
18	2.8	117.0	0.5
19	3.0	120.0	1.5
20	3.6	126.0	2.3
21	4.2	134.0	3.2
22	4.8	140.0	4.0
23	3.2	153.0	3.2
24	2.3	167.0	2.3
1	3.0	180.0	1.5
2	2.8	200.0	2.3
3	2.6	220.0	3.2
4	2.4	240.0	4.0
5	3.4	220.0	3.2
6	4.4	185.0	2.3
7	5.4	160.0	1.5
8	4.2	26.9	0.4
9	3.0	26.9	-0.6
10	1.8	33.9	-1.7
11	2.6	78.1	-1.7
12	3.4	105.4	-1.7
13	4.2	9.2	-1.7
14	4.4	39.6	-1.7
15	4.6	135.5	-1.7
16	4.8	137.2	-1.7
17	4.8	136.7	-0.6
18	4.8	138.1	0.6

19	4.8	132.2	1.5
20	4.8	131.4	1.5
21	4.8	138.8	1.5
22	4.8	138.4	1.5
23	4.4	132.2	-1.5
24	4.0	130.5	-1.5
1	3.6	60.0	-0.3
2	4.0	40.0	-0.8
3	4.4	20.0	-0.8
4	4.8	360.0	-0.3
5	3.6	53.0	0.4
6	2.4	104.0	0.2
7	1.2	160.0	0.2

STOP TIME AUG 30,1993 HOUR 6 MINUTE 7

RELEASE NUMBER 93038 CONTAINMENT PURGE

STARTING TIME SEPT 2,1993 HOUR 14 MINUTE 38

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	4.9	338.3	-1.0
15	5.8	339.0	-1.3
16	5.4	335.0	-0.8
17	7.8	334.2	-0.8
18	8.0	338.5	-0.9
19	6.1	337.6	-0.8
20	3.6	336.8	0.2
21	1.7	322.4	1.5
22	3.2	327.3	1.0
23	2.8	322.7	1.3
24	2.3	314.5	1.5
1	3.3	320.0	0.6
2	2.5	330.0	0.7
3	4.1	340.0	0.4
4	4.8	350.0	0.1
5	3.8	320.0	0.2
6	2.5	285.0	0.4
7	2.4	320.0	0.7
8	2.6	330.0	-0.2
9	4.7	340.0	-0.8

STOP TIME SEPT 3,1993 HOUR 8 MINUTE 26

STARTING TIME SEPT 3,1993 HOUR 10 MINUTE 59

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	4.9	350.0	-1.3
11	4.7	320.0	-1.6
12	4.2	285.0	-1.6
13	5.0	250.0	-1.6
14	4.1	327.9	-1.6
15	3.7	314.6	-1.4
16	4.4	345.1	-1.6
17	4.0	315.9	-1.4
18	5.0	214.0	-1.1
19	4.0	211.3	-0.6
20	3.4	199.2	1.0
21	2.7	203.2	3.2
22	5.5	199.6	2.8
23	7.6	195.1	3.1
24	8.1	193.1	3.3
1	7.8	187.4	4.0
2	7.9	182.2	3.9
3	6.0	170.2	2.2
4	8.1	189.8	1.4
5	9.6	199.7	1.1
6	11.6	207.7	1.3
7	12.8	209.0	1.8
8	5.2	198.1	0.1
9	3.7	240.6	-1.0
10	4.3	261.6	-1.5
11	3.4	314.8	-1.8
12	4.7	350.1	-1.6
13	5.1	348.3	-1.6
14	5.6	348.1	-1.4
15	5.6	4.4	-1.4
16	6.3	357.4	-1.2
17	6.2	358.7	-1.1
18	5.5	354.6	-0.8
19	3.4	344.4	-0.3
20	2.3	295.2	1.1
21	2.3	278.2	2.4
22	1.9	268.5	1.8
23	2.2	304.5	1.8
24	2.3	285.4	1.5
1	2.7	291.4	1.7
2	3.4	308.8	1.1
3	5.1	18.7	-0.3
4	4.9	120.6	-0.6
5	4.3	306.3	-0.4
6	4.0	318.8	-0.5

7	3.9	243.4	-0.6
8	3.6	310.7	-0.4
9	3.6	330.8	-0.7
10	3.8	14.2	-0.8
11	4.4	1.7	-0.9
12	5.8	56.0	-0.8
13	4.4	39.8	-0.8
14	5.2	43.4	-0.9
15	6.0	61.2	-1.0
16	4.5	46.6	-1.1
17	4.5	34.6	-1.1
18	4.2	31.2	-1.1
19	3.4	8.7	-1.0
20	3.4	7.7	-0.6
21	1.7	228.2	-0.3
22	1.8	264.2	0.2
23	1.9	279.8	0.6
24	2.2	292.7	1.3
1	2.0	295.7	2.0
2	2.3	294.7	1.5
3	1.3	261.4	0.8
4	2.3	307.8	0.7
5	2.7	290.6	0.5
6	1.5	282.3	0.5
7	1.6	277.8	0.6
8	2.0	290.7	0.9

STOP TIME SEPT 6,1993 HOUR 7 MINUTE 48

RELEASE NUMBER 93039 CONTAINMENT PURGE

STARTING TIME SEPT 9,1993 HOUR 14 MINUTE 53

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	10.7	336.8	-1.4
15	11.7	337.8	-1.5
16	11.4	331.7	-1.6
17	10.6	333.5	-1.4
18	10.9	336.4	-1.0
19	9.8	333.9	-0.6
20	5.5	332.9	0.5
21	2.1	333.8	1.9
22	2.4	332.2	2.1
23	3.0	325.8	1.7
24	2.7	327.3	1.7

STOP TIME SEPT 9,1993 HOUR 23 MINUTE 40

STARTING TIME SEPT 9,1993 HOUR 23 MINUTE 54

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
23	3.0	325.8	1.7
24	2.7	327.3	1.7
1	2.9	316.1	1.9
2	2.5	317.8	1.9
3	2.3	329.5	2.7
4	2.1	327.5	2.3
5	1.8	307.0	2.6
6	2.4	339.7	2.1
7	3.3	351.4	2.0
8	3.1	330.4	1.0
9	4.7	337.4	-0.6
10	6.1	334.0	-1.3
11	6.1	350.7	-1.6
12	6.7	336.6	-1.7
13	6.5	327.5	-1.9
14	6.2	326.3	-2.0
15	6.5	336.1	-1.9
16	5.5	321.7	-1.8
17	4.7	344.6	-1.6
18	3.3	319.9	-1.3
19	1.5	279.9	-0.4
20	1.6	203.4	2.7
21	2.1	152.3	4.5
22	2.2	112.6	5.4
23	2.6	319.3	5.4
24	5.7	111.8	3.6
1	6.6	121.9	3.0
2	7.2	132.6	1.9
3	8.5	138.9	1.2
4	7.3	136.0	1.4
5	7.8	128.8	1.7
6	8.9	223.6	0.6
7	11.6	167.9	-0.3
8	10.8	166.8	-0.4
9	12.2	171.4	-0.8
10	15.8	173.4	-1.1
11	18.1	181.9	-1.3
12	15.7	185.5	-1.4
13	17.4	190.5	-1.5
14	18.6	187.3	-1.5
15	18.7	186.1	-1.4
16	18.1	188.2	-1.3
17	17.1	189.5	-1.1
18	12.1	186.3	-0.7
19	6.6	167.9	-0.5
20	5.6	142.9	0.5
21	4.7	137.8	1.5
22	6.1	139.5	1.7
23	7.5	168.0	1.0
24	12.2	184.6	1.3
1	13.7	196.0	1.1
2	13.6	200.7	1.3
3	14.1	201.5	2.0
4	13.4	207.7	1.7

5	12.3	200.9	1.5
6	8.2	179.0	1.2
7	8.2	173.0	1.5
8	6.5	162.9	0.8
9	13.4	186.3	-0.1
10	15.5	192.8	-0.9
11	17.5	195.3	-1.2
12	18.2	188.7	-1.3
13	19.1	189.3	-1.3
14	17.8	184.6	-1.5
15	15.5	187.9	-1.4
16	17.9	189.5	-1.2
17	17.8	185.3	-1.0
18	16.4	185.9	-0.7
19	12.8	177.8	-0.3
20	10.7	166.0	-0.1
21	11.5	164.3	-0.1
22	13.3	160.0	-0.2
23	14.4	167.5	-0.4
24	14.5	165.6	-0.5
1	15.6	168.7	-0.5
2	13.3	167.3	-0.4
3	12.4	167.2	-0.4
4	13.1	167.1	-0.4
5	10.9	198.8	-0.4
6	8.6	198.0	-0.2
7	10.6	182.2	-0.2
8	9.2	189.7	-0.1
9	5.7	319.4	-0.5
10	5.4	320.0	-0.8

STOP TIME SEPT 13,1993 HOUR 9 MINUTE 43

RELEASE NUMBER 93040 CONTAINMENT PURGE

STARTING TIME SEPT 16,1993 HOUR 17 MINUTE 4

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	9.5	164.5	-1.5
18	8.4	162.4	-1.3
19	5.2	157.2	-0.7
20	3.1	135.3	2.3
21	4.5	121.0	3.4
22	5.6	140.6	3.4
23	6.0	151.9	2.5
24	5.0	123.0	2.0
1	4.0	106.8	1.8
2	3.4	91.8	1.2
3	3.5	94.9	0.8
4	3.3	98.5	0.9
5	2.6	288.2	1.7
6	1.4	246.5	2.0
7	1.1	175.2	2.0
8	5.0	118.4	1.2
9	6.2	118.0	-0.1

STOP TIME SEPT 17,1993 HOUR 8 MINUTE 58

STARTING TIME SEPT 17,1993 HOUR 10 MINUTE 39

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	6.8	124.9	-1.1
11	7.0	177.3	-1.4
12	5.9	148.8	-1.4
13	6.3	165.2	-1.3
14	5.2	250.0	-1.1
15	4.1	329.5	-0.9
16	4.9	358.3	-1.3
17	4.1	2.9	-1.3
18	5.3	342.9	-1.2
19	5.2	352.5	-1.0
20	3.0	352.8	-0.8
21	2.7	9.0	-0.7
22	3.1	355.2	-0.7
23	3.0	1.2	-0.8
24	3.3	20.6	-0.8
1	2.9	57.7	-0.8
2	4.0	77.5	-0.8
3	2.8	5.7	-0.7
4	3.0	41.7	-0.6
5	3.6	95.9	-0.3
6	2.9	23.6	-0.3
7	2.9	22.6	-0.5
8	2.4	332.5	-0.6
9	2.8	337.1	-0.6
10	4.3	74.8	-0.7
11	6.8	101.8	-0.8
12	9.5	99.2	-1.0
13	5.7	89.0	-0.9
14	4.1	77.7	-0.9
15	4.5	82.8	-0.9
16	6.9	97.7	-1.1
17	8.6	102.4	-1.0
18	8.2	103.7	-0.9
19	7.3	100.9	-0.7
20	7.0	102.1	-0.7
21	9.5	106.6	-0.8
22	8.3	63.2	-0.6
23	7.1	91.0	-0.6
24	7.7	95.8	-0.6
1	4.6	31.1	-0.7
2	6.7	102.9	-0.6
3	9.2	110.6	-0.6
4	10.1	107.6	-0.6
5	8.4	125.0	-0.6
6	8.0	119.1	-0.5
7	11.7	110.7	-0.7
8	7.9	108.2	-0.7
9	5.2	127.1	-0.6

10	7.4	155.9	-0.9
11	11.9	137.6	-0.8
12	10.4	144.8	-1.1
13	11.5	149.8	-1.1
14	9.6	161.3	-0.9
15	11.8	166.2	-1.1
16	9.2	165.8	-1.0
17	9.1	159.7	-1.0
18	9.3	160.1	-1.1
19	9.2	162.2	-0.9
20	9.2	170.2	-0.7
21	11.5	172.0	-0.5
22	10.5	165.1	-0.5
23	10.4	169.5	-0.7
24	11.1	188.5	-0.8
1	10.6	199.1	-0.7
2	9.0	206.6	-0.6
3	7.0	227.4	-0.6
4	7.2	230.5	-0.3
5	6.4	244.4	-0.1
6	8.0	246.3	0.1

STOP TIME SEPT 20.1993 HOUR 5 MINUTE 52

RELEASE NUMBER 93041 CONTAINMENT PURGE

STARTING TIME SEPT 21,1993 HOUR 16 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	13.9	164.6	-1.4
17	15.9	163.1	-1.3
18	13.8	160.5	-1.1
19	11.3	163.7	-0.7
20	7.8	157.0	-0.2
21	5.4	148.4	0.3
22	2.3	149.4	1.8
23	2.4	245.1	2.2
24	2.6	262.6	1.8
1	4.2	24.9	1.8
2	3.4	159.5	2.1
3	3.3	354.0	2.5
4	3.1	223.8	1.5
5	3.7	272.6	1.3
6	6.2	106.2	0.1
7	6.6	130.4	-0.5
8	7.1	147.7	-0.6
9	4.4	115.1	-0.6
10	3.9	288.8	-0.5
11	5.1	339.6	-0.5
12	6.2	335.1	-0.6
13	6.4	341.5	-0.7
14	6.9	349.2	-1.1
15	7.4	346.0	-1.1
16	7.3	354.0	-1.2
17	5.8	343.9	-0.6
18	4.4	339.9	-0.3
19	6.9	339.2	-0.4
20	6.1	335.5	-0.4
21	5.9	328.5	-0.4
22	6.0	343.3	-0.6
23	5.3	346.4	-0.7
24	4.3	342.4	-0.7
1	4.8	346.6	-0.8
2	4.0	338.0	-0.8
3	4.1	345.5	-0.8
4	4.7	344.3	-0.8
5	3.8	330.0	-0.5
6	3.7	320.4	-0.2
7	3.6	318.0	-0.1
8	4.0	325.4	-0.3
9	5.4	346.8	-1.0
10	7.5	357.0	-1.4
11	7.5	1.4	-1.7
12	6.7	5.4	-1.8
13	6.0	4.2	-1.7
14	5.1	15.7	-1.8
15	5.4	67.1	-1.7
16	4.6	315.9	-1.7
17	4.3	34.4	-1.6
18	3.5	69.4	-1.2
19	1.8	355.4	-0.1
20	1.5	257.9	2.0
21	1.1	253.0	2.4
22	1.0	214.2	2.0
23	1.3	270.1	1.6
24	1.6	273.0	1.3
1	1.1	255.9	1.3
2	1.1	230.7	0.9
3	1.6	295.3	0.6
4	1.6	224.9	0.7
5	2.3	1.9	0.6
6	2.3	265.4	0.2
7	1.7	275.3	0.4
8	2.5	12.1	-0.3
9	3.2	92.6	-0.7
10	3.5	77.1	-1.0
11	4.5	127.5	-1.2
12	5.1	133.6	-1.3
13	4.2	108.0	-1.5
14	5.0	210.2	-1.6
15	3.9	99.9	-1.5
16	4.3	150.3	-1.2
17	3.2	235.9	-1.2

18	3.6	166.8	-1.0
19	2.0	244.3	-0.7
20	2.0	323.5	-0.3
21	1.8	300.2	0.1
22	2.3	312.0	0.3
23	1.7	286.5	0.2
24	2.1	286.8	0.2
1	2.9	278.1	0.1
2	3.3	237.5	0.1
3	2.5	210.7	0.1
4	1.9	285.8	-0.1
5	3.5	338.2	-0.4
6	4.8	337.7	-0.6
7	5.2	335.7	-0.5
8	3.8	329.1	-0.6
9	3.9	340.3	-0.7
10	2.6	2.6	-0.9
11	2.9	5.0	-1.1
12	4.8	340.1	-1.4
13	4.5	7.9	-1.6
14	4.5	0.5	-1.6
15	4.3	339.7	-1.8
16	4.6	338.6	-1.8
17	4.4	343.1	-1.7
18	3.7	347.3	-1.3
19	1.7	296.2	0.4
20	1.6	166.8	2.9
21	2.1	153.0	4.4
22	3.0	126.5	4.9
23	2.6	120.2	5.0
24	2.1	103.2	3.8
1	4.6	188.2	2.8
2	2.8	327.7	1.9
3	6.2	261.1	0.6
4	3.0	297.0	0.5
5	1.6	281.3	2.3
6	2.8	331.2	1.1
7	5.1	327.1	0.2
8	9.2	330.4	-0.2
9	11.2	331.7	-0.7
10	12.4	330.6	-1.2
11	12.7	329.0	-1.6
12	13.1	326.3	-1.7
13	12.5	325.0	-1.9
14	12.7	325.6	-1.8
15	12.6	326.3	-1.7
16	11.6	326.1	-1.4
17	10.8	331.4	-1.2
18	11.7	332.0	-1.0
19	7.8	335.8	-0.8
20	6.2	333.7	-0.7
21	4.6	331.9	0.2
22	3.0	337.9	1.2
23	2.4	351.2	1.7
24	2.2	332.5	1.5
1	1.8	308.0	1.6
2	1.8	301.6	2.0
3	1.8	307.5	2.5
4	1.8	315.1	2.8
5	2.2	318.5	3.0
6	2.6	249.4	3.0
7	3.0	231.1	2.8
8	3.2	206.6	0.9
9	3.4	255.7	-0.4
10	3.6	218.4	-1.0
11	5.5	223.8	-1.4
12	6.8	212.6	-1.4
13	8.4	209.7	-1.8
14	9.5	215.1	-1.7

STOP TIME SEPT 27,1993 HOUR 13 MINUTE 55

RELEASE NUMBER 93042 CONTAINMENT PURGE

STARTING TIME SEPT 27,1993 HOUR 14 MINUTE 14

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	9.5	215.1	-1.7
15	10.9	217.2	-1.7
16	11.3	216.7	-1.6
17	11.8	229.0	-1.3
18	8.7	235.5	-0.8
19	6.9	297.0	-0.2
20	6.3	327.8	1.0
21	3.8	329.5	2.3
22	4.9	325.3	1.4
23	6.2	326.8	1.0
24	4.8	325.5	1.0
1	8.4	314.7	2.0
2	8.6	313.8	2.5
3	8.8	331.0	2.3

STOP TIME SEPT 28,1993 HOUR 2 MINUTE 2

RELEASE NUMBER 93043 CONTAINMENT PURGE

STARTING TIME SEPT 28,1993 HOUR 2 MINUTE 42

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
2	8.6	313.8	2.5
3	8.8	331.0	2.3
4	9.0	353.7	3.1
5	7.6	349.6	2.1
6	6.2	337.5	1.5

STOP TIME SEPT 28,1993 HOUR 5 MINUTE 50

RELEASE NUMBER 93044 CONTAINMENT PURGE

STARTING TIME SEPT 28,1993 HOUR 5 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
5	7.6	349.6	2.1
6	6.2	337.5	1.5
7	4.8	329.6	0.9
8	4.4	323.8	0.4
9	4.0	332.0	-0.8
10	3.6	334.7	-1.4

STOP TIME SEPT 28,1993 HOUR 9 MINUTE 44

STARTING TIME SEPT 28,1993 HOUR 16 MINUTE 45

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	15.0	340.0	-1.5
17	12.7	330.0	-1.2

STOP TIME SEPT 28,1993 HOUR 16 MINUTE 45

RELEASE NUMBER 93045 CONTAINMENT PURGE

STARTING TIME SEPT 28,1993 HOUR 16 MINUTE 45

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	15.0	340.0	-1.5
17	12.7	330.0	-1.2
18	10.3	333.0	-0.8

STOP TIME SEPT 28,1993 HOUR 17 MINUTE 18

STARTING TIME SEPT 28,1993 HOUR 17 MINUTE 43

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	12.7	330.0	-1.2
18	10.3	333.0	-0.8
19	8.0	330.0	-0.5
20	7.4	336.0	0.2
21	6.6	344.0	0.8
22	6.0	350.0	1.5
23	5.0	320.0	2.3

STOP TIME SEPT 28,1993 HOUR 22 MINUTE 27

RELEASE NUMBER 93046 CONTAINMENT PURGE

STARTING TIME SEPT 28,1993 HOUR 22 MINUTE 27

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
22	6.0	350.0	1.5
23	5.0	320.0	2.3
24	4.0	290.0	3.8
1	1.8	260.0	4.0
2	1.2	295.0	4.0
3	0.6	325.0	4.0
4	0.6	360.0	4.0
5	0.6	3.0	4.0
6	1.2	7.0	4.0
7	1.8	10.0	4.0
8	1.8	315.0	2.2
9	1.8	265.0	0.3
10	1.8	210	-1.5

STOP TIME 29.1993 HOUR 9 MINUTE 50

RELEASE NUMBER 93047 CONTAINMENT PURGE

STARTING TIME SEPT 29,1993 HOUR 9 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
9	1.8	265.0	0.3
10	1.8	210.0	-1.5
11	2.2	190.0	-1.5
12	2.6	170.0	-1.5
13	3.0	150.0	-1.5
14	3.4	153.0	-1.6
15	3.8	157.0	-1.6

STOP TIME SEPT 29,1993 HOUR 14 MINUTE 5

RELEASE NUMBER 93048 CONTAINMENT PURGE

STARTING TIME SEPT 29,1993 HOUR 14 MINUTE 5

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	3.4	153.0	-1.6
15	3.8	157.0	-1.6
16	4.2	160.0	-1.7
17	3.8	157.0	-1.3
18	3.4	153.0	-0.9
19	3.0	150.0	-0.5
20	3.6	147.0	0.3
21	4.2	143.0	0.7
22	1.5	140.0	1.5
23	1.5	146.0	1.5
24	0.0	154.0	1.5
1	6.6	160.0	1.5
2	6.8	163.0	0.8
3	7.0	167.0	0.2
4	7.2	170.0	-0.5
5	7.0	167.0	-0.5
6	6.8	163.0	-0.5

STOP TIME SEPT 30,1993 HOUR 5 MINUTE 0

RELEASE NUMBER 93049 CONTAINMENT PURGE

STARTING TIME SEPT 30,1993 HOUR 5 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
5	7.0	167.0	-0.5
6	6.8	163.0	-0.5
7	6.6	160.0	-0.5
8	12.5	166.5	-0.5
9	13.0	163.7	-0.9
10	12.3	163.6	-1.3
11	13.8	167.2	-1.5
12	14.8	168.5	-1.5
13	17.1	179.0	-1.7
14	14.9	182.6	-1.6
15	17.6	188.5	-1.5
16	15.9	192.9	-1.6
17	12.4	215.3	-1.4
18	8.6	232.7	-1.1
19	3.9	224.4	0.3
20	1.8	107.7	4.3
21	2.5	12.9	4.2
22	2.7	306.8	4.5

STOP TIME SEPT 30,1993 HOUR 21 MINUTE 35

RELEASE NUMBER 93050 CONTAINMENT PURGE

STARTING TIME SEPT 30,1993 HOUR 22 MINUTE 16

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
22	2.7	306.8	4.5
23	3.1	340.0	3.3
24	2.2	289.6	0.9
1	4.2	340.0	1.5
2	5.2	340.0	0.9
3	6.2	340.0	0.3
4	7.2	340.0	-0.5
5	7.4	343.0	-0.5
6	7.6	347.0	-0.5
7	7.8	350.0	-0.5
8	7.4	344.0	-0.8
9	7.0	336.0	-1.2
10	6.6	330.0	-1.5

STOP TIME OCT 1.1993 HOUR 9 MINUTE 42

RELEASE NUMBER 93051 CONTAINMENT PURGE

STARTING TIME OCT 1,1993 HOUR 9 MINUTE 42

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
9	7.0	336.0	-1.2
10	6.6	330.0	-1.5
11	6.6	324.0	-1.5
12	6.6	323.0	-1.5
13	6.6	320.0	-1.5
14	6.6	326.0	-1.5
15	6.6	334.0	-1.5
16	6.6	340.0	-1.5
17	5.0	337.0	0.3
18	3.4	333.0	2.2
19	1.8	330.0	4.0
20	1.4	340.0	4.0
21	1.0	350.0	4.0
22	0.6	360.0	4.0
23	2.0	360.0	10.9

STOP TIME OCT 1,1993 HOUR 22 MINUTE 45

RELEASE NUMBER 93052 CONTAINMENT PURGE

STARTING TIME OCT 1,1993 HOUR 22 MINUTE 45

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG
22	0.6	360.0	4.0
23	2.0	360.0	10.9
24	3.4	360.0	10.8
1	4.8	360.0	-0.5
2	4.6	360.0	-0.5
3	4.4	360.0	0.5
4	4.2	360.0	-0.5
5	3.6	357.0	-0.5
6	2.4	353.0	-0.5
7	1.8	350.0	-0.5
8	1.8	347.0	-0.8
9	1.8	343.0	-1.2
10	1.8	340.0	-1.5
11	2.4	310.0	-1.5
12	3.0	280.0	-1.5
13	3.0	250.0	-1.5
14	3.6	256.0	-1.5
15	3.6	264.0	-1.5

STOP TIME OCT 2,1993 HOUR 14 MINUTE 44

RELEASE NUMBER 93053 CONTAINMENT PURGE

STARTING TIME OCT 3,1993 HOUR 1 MINUTE 10

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	3.0	210.0	4.0
2	3.0	210.0	4.0
3	3.0	210.0	4.0
4	6.0	210.0	4.0
5	3.0	213.0	4.0
6	3.0	217.0	4.0
7	3.0	220.0	4.0

STOP TIME OCT 3,1993 HOUR 6 MINUTE 38

RELEASE NUMBER 93054 CONTAINMENT PURGE

STARTING TIME OCT 3,1993 HOUR 14 MINUTE 14

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	5.0	243.0	-1.5
15	5.2	257.0	-1.5
16	5.4	270.0	-1.5
17	4.4	257.0	-0.5
18	3.4	243.0	0.5
19	2.4	230.0	1.5
20	2.4	227.0	1.5
21	2.4	223.0	1.5
22	2.4	220.0	1.5

STOP TIME OCT 3,1993 HOUR 21 MINUTE 15

RELEASE NUMBER 93055 CONTAINMENT PURGE

STARTING TIME OCT 3,1993 HOUR 21 MINUTE 15

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	2.4	223.0	1.5
22	2.4	220.0	1.5
23	2.6	226.0	1.5
24	2.8	234.0	1.5
1	3.0	240.0	1.5
2	3.0	234.0	1.5
3	3.0	226.0	1.5
4	3.0	220.0	1.5
5	3.0	250.0	1.5
6	3.0	280.0	1.5
7	3.0	310.0	1.5
8	4.4	324.0	0.8
9	5.8	336.0	0.2
10	7.2	350.0	-0.5
11	5.8	356.0	-0.9
12	4.4	4.0	-1.3
13	3.0	10.0	-1.7
14	3.6	10.0	-1.7
15	4.2	10.0	-1.7
16	4.8	10.0	-1.7
17	3.4	7.0	-0.6
18	2.0	3.0	0.4
19	0.6	360.0	1.5
20	1.2	30.0	1.5
21	1.8	60.0	1.5
22	2.4	90.0	1.5
23	2.4	96.0	2.3
24	2.4	104.0	3.2
1	2.4	110.0	4.0
2	3.0	120.0	4.0
3	3.6	130.0	4.0
4	4.2	140.0	4.0
5	4.2	143.0	4.0

STOP TIME OCT 5,1993 HOUR 4 MINUTE 26

STARTING TIME OCT 5,1993 HOUR 4 MINUTE 52

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
4	4.2	140.0	4.0
5	4.2	143.0	4.0
6	4.2	147.0	4.0
7	4.2	150.0	4.0
8	4.8	144.0	3.2
9	5.4	136.0	2.3
10	6.0	130.0	1.5
11	6.0	133.0	0.8
12	6.0	137.0	0.2
13	6.0	140.0	-0.5
14	6.8	150.0	-0.8
15	7.6	160.0	-1.2
16	8.4	170.0	-1.5
17	8.0	167.0	-1.2
18	7.6	163.0	-0.8
19	7.2	160.0	-0.5
20	7.6	170.0	-0.5

STOP TIME OCT 5,1993 HOUR 19 MINUTE 17

RELEASE NUMBER 93056 CONTAINMENT PURGE

STARTING TIME OCT 5,1993 HOUR 19 MINUTE 17

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
19	7.2	160.0	-0.5
20	7.6	170.0	-0.5
21	8.0	180.0	-0.5
22	8.4	190.0	-0.5
23	8.4	190.0	-0.5
24	8.4	190.0	-0.5
1	8.4	190.0	-0.5
2	7.4	184.0	0.2
3	6.4	176.0	0.8
4	5.4	170.0	1.5
5	5.4	180.0	1.5
6	5.4	190.0	1.5
7	5.4	200.0	1.5
8	5.6	197.0	0.5
9	5.8	193.0	-0.5
10	6.0	190.0	-1.5
11	6.8	180.0	-1.2
12	7.6	170.0	-0.8
13	8.4	160.0	-0.5
14	8.4	166.0	-0.5
15	8.4	174.0	-0.5
16	8.4	180.0	-0.5
17	7.6	177.0	-0.5

STOP TIME OCT 6,1993 HOUR 16 MINUTE 47

RELEASE NUMBER 93058 CONTAINMENT PURGE

STARTING TIME OCT 7,1993 HOUR 1 MINUTE 35

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	7.8	190.0	-0.5
2	7.6	190.0	-0.5
3	7.4	190.0	-0.5
4	7.2	190.0	-0.5
5	6.8	193.0	-0.5
6	6.4	197.0	-0.5
7	6.0	200.0	-0.5
8	6.0	206.0	-0.8
9	6.0	214.0	-1.2
10	6.0	220.0	-1.5
11	6.2	214.0	-1.5
12	6.4	206.0	-1.5
13	6.6	200.0	-1.5

STOP TIME OCT 7,1993 HOUR 12 MINUTE 28

RELEASE NUMBER 93059 CONTAINMENT PURGE

STARTING TIME OCT 7,1993 HOUR 12 MINUTE 28

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	6.4	206.0	-1.5
13	6.6	200.0	-1.5
14	6.0	194.0	-1.6
15	5.4	186.0	-1.6
16	4.8	180.0	-1.7
17	4.8	170.0	-1.3
18	4.8	160.0	-0.9
19	4.8	150.0	-0.5
20	5.0	153.0	-0.5
21	5.2	157.0	-0.5
22	5.4	160.0	-0.5
23	5.4	163.0	-0.5
24	5.4	167.0	-0.5
1	5.4	170.0	-0.5
2	4.6	167.0	0.2
3	3.8	163.0	0.8
4	3.0	160.0	1.5
5	3.0	146.0	1.5
6	3.0	134.0	1.5
7	3.0	120.0	1.5
8	3.2	126.0	0.8
9	3.4	134.0	0.2
10	3.6	140.0	-0.5
11	3.4	123.0	-0.5
12	3.2	107.0	-0.5
13	3.0	90.0	-0.5
14	4.8	66.0	-0.5

STOP TIME OCT 8,1993 HOUR 13 MINUTE 50

STARTING TIME OCT 8,1993 HOUR 14 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	4.8	66.0	-0.5
15	6.6	44.0	-0.5
16	8.4	20.0	-0.5
17	8.4	14.0	-0.5
18	8.4	6.0	-0.5
19	8.4	360.0	-0.5
20	9.2	360.0	-0.5
21	10.0	360.0	-0.5
22	10.8	360.0	-0.5
23	11.2	3.0	-0.5
24	11.6	7.0	-0.5
1	12.0	10.0	-0.5
2	11.6	7.0	-0.5
3	11.2	3.0	-0.5
4	10.8	360.0	-0.5
5	9.6	357.0	-0.5
6	8.4	353.0	-0.5
7	7.2	350.0	-0.5
8	7.2	350.0	-0.5
9	7.2	350.0	-0.5
10	7.2	350.0	-0.5
11	7.2	347.0	-0.5
12	7.2	343.0	-0.5
13	7.2	340.0	-0.5
14	7.0	337.0	-0.8

STOP TIME OCT 9,1993 HOUR 13 MINUTE 2

RELEASE NUMBER 93060 CONTAINMENT PURGE

STARTING TIME OCT 9,1993 HOUR 13 MINUTE 2

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	7.2	340.0	-0.5
14	7.0	337.0	-0.8
15	6.8	333.0	-1.2
16	6.6	330.0	-1.5
17	5.0	336.0	0.4
18	3.4	344.0	2.2
19	1.8	350.0	4.0
20	2.2	347.0	4.0
21	2.6	343.0	4.0
22	3.0	340.0	4.0
23	2.6	354.0	1.5
24	2.2	6.0	1.3
1	1.8	20.0	4.0
2	2.0	325.0	4.0
3	2.2	275.0	4.0
4	2.4	220.0	4.0
5	2.2	226.0	4.0
6	2.0	234.0	4.0
7	1.8	240.0	4.0
8	2.8	240.0	2.1
9	3.8	240.0	0.2
10	4.8	240.0	-1.7
11	4.4	240.0	-1.6
12	4.4	240.0	-1.6
13	3.6	240.0	-1.5
14	3.6	226.0	-1.5
15	3.6	214.0	-1.5
16	3.6	200.0	-1.5
17	3.0	210.0	-0.5
18	2.4	220.0	0.5
19	1.8	230.0	1.5
20	2.0	236.0	1.5
21	2.2	244.0	1.5
22	2.4	250.0	1.5
23	2.6	233.0	2.3
24	2.8	217.0	3.2
1	3.0	200.0	4.0
2	3.0	206.0	4.0
3	3.0	214.0	4.0
4	3.0	220.0	4.0
5	3.6	206.0	3.2
6	4.2	194.0	2.3
7	4.8	180.0	1.5
8	4.6	197.0	0.4
9	4.4	213.0	-0.6
10	4.2	230.0	-1.7
11	4.6	224.0	-1.3
12	5.0	216.0	-0.9
13	5.4	210.0	-0.5

STOP TIME OCT 11,1993 HOUR 12 MINUTE 27

RELEASE NUMBER 93061 CONTAINMENT PURGE

STARTING TIME OCT 11,1993 HOUR 12 MINUTE 27

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	5.0	216.0	-0.9
13	5.4	210.0	-0.5
14	5.2	220.0	-0.8
15	5.0	230.0	-1.2

STOP TIME OCT 11,1993 HOUR 14 MINUTE 45

STARTING TIME OCT 12,1993 HOUR 1 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	1.8	250.0	4.0
2	2.2	285.0	3.2
3	2.6	325.0	2.3
4	3.0	360.0	1.5
5	2.8	3.0	1.5
6	2.6	7.0	1.5
7	2.4	10.0	1.5
8	2.8	3.0	0.4
9	3.2	257.0	-0.6
10	3.6	250.0	-1.7
11	4.0	35.0	-1.6
12	4.4	350.0	-1.6
13	4.8	350.0	-1.5
14	4.6	360.0	-1.5
15	4.4	10.0	-1.5
16	4.2	20.0	-1.5
17	3.6	20.0	-0.5
18	2.8	20.0	0.5
19	2.4	20.0	1.5

STOP TIME OCT 12,1993 HOUR 18 MINUTE 41

RELEASE NUMBER 93062 CONTAINMENT PURGE

STARTING TIME OCT 12,1993 HOUR 21 MINUTE 54

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	2.0	45.0	3.2
22	1.8	60.0	4.0
23	2.0	74.0	4.0
24	2.2	86.0	4.0
1	2.4	100.0	4.0
2	2.8	106.0	3.2
3	3.2	114.0	2.3
4	3.6	120.0	1.5
5	3.0	117.0	2.3
6	2.6	113.0	3.2
7	1.8	110.0	4.0

STOP TIME OCT 13,1993 HOUR 6 MINUTE 21

RELEASE NUMBER 93063 CONTAINMENT PURGE

STARTING TIME OCT 16,1993 HOUR 2 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
2	3.2	354.0	1.5
3	3.4	346.0	1.5
4	3.6	340.0	1.5
5	3.6	346.0	1.5
6	3.6	354.0	1.5
7	3.6	360.0	1.5
8	3.6	13.0	0.4
9	3.6	27.0	-0.6
10	3.6	40.0	-1.7
11	3.6	30.0	-1.7
12	3.6	20.0	-1.7
13	3.6	10.0	-1.7
14	3.6	16.0	-1.7
15	3.6	24.0	-1.7
16	3.6	30.0	-1.7
17	3.8	24.0	-1.3
18	4.0	16.0	-0.9
19	4.2	10.0	-0.5
20	4.0	7.0	0.2
21	3.8	3.0	0.8
22	3.6	360.0	1.5
23	3.6	357.0	1.5
24	3.6	353.0	1.5
1	3.6	350.0	1.5
2	3.2	350.0	2.3

STOP TIME OCT 17,1993 HOUR 1 MINUTE 16

RELEASE NUMBER 93064 CONTAINMENT PURGE

STARTING TIME OCT 17,1993 HOUR 1 MINUTE 37

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	3.6	350.0	1.5
2	3.2	350.0	2.3
3	2.8	350.0	3.2
4	2.4	350.0	4.0
5	2.2	344.0	3.2
6	2.0	336.0	2.3
7	1.8	330.0	1.5
8	1.8	347.0	0.4
9	1.8	3.0	-0.6
10	1.8	20.0	-1.7
11	1.8	17.0	-1.7
12	1.8	13.0	-1.7
13	1.8	10.0	-1.7
14	1.4	7.0	-1.7
15	1.0	3.0	-1.7
16	0.6	360.0	-1.7
17	0.6	360.0	-0.6
18	0.6	360.0	0.4
19	0.6	360.0	1.5
20	1.0	50.0	2.3
21	1.4	100.0	3.2
22	1.8	150.0	4.0

STOP TIME OCT 17,1993 HOUR 21 MINUTE 7

STARTING TIME OCT 18,1993 HOUR 2 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
2	1.8	110.0	3.2
3	1.8	80.0	2.3
4	1.8	50.0	1.5
5	1.8	40.0	2.3
6	1.8	30.0	3.2
7	1.8	20.0	1.5
8	1.8	30.0	0.4
9	1.8	40.0	-0.6
10	1.8	50.0	-1.7
11	1.4	33.0	-1.7
12	1.0	17.0	-1.7
13	0.6	360.0	-1.7
14	1.2	10.0	-1.7
15	1.8	20.0	-1.7
16	2.4	30.0	-1.7
17	1.8	20.0	-0.6
18	1.2	10.0	0.4
19	0.6	360.0	1.5
20	1.0	3.0	2.3
21	1.4	7.0	3.2
22	1.8	10.0	4.0

STOP TIME OCT 18,1993 HOUR 21 MINUTE 50

RELEASE NUMBER 93065 CONTAINMENT PURGE

STARTING TIME OCT 18,1993 HOUR 21 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	1.4	7.0	3.2
22	1.8	10.0	4.0
23	1.8	20.0	4.0
24	1.8	30.0	4.0
1	1.8	40.0	4.0
2	2.0	27.0	4.0
3	2.2	13.0	4.0
4	2.4	360.0	4.0
5	2.2	25.0	3.2
6	2.0	45.0	2.3
7	1.8	70.0	1.5
8	1.4	45.0	0.4
9	1.0	25.0	-0.6
10	0.6	360.0	-1.7
11	1.2	315.0	-1.7
12	1.8	265.0	-1.7
13	2.4	220.0	-1.7
14	1.8	265.0	-1.8

STOP TIME OCT 19,1993 HOUR 13 MINUTE 50

RELEASE NUMBER 93066 CONTAINMENT PURGE

STARTING TIME OCT 19,1993 HOUR 13 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	2.4	220.0	-1.7
14	1.8	265.0	-1.8
15	1.2	315.0	-1.8
16	0.6	360.0	-1.9
17	1.2	315.0	-1.4
18	1.8	265.0	-0.9
19	2.4	220.0	-0.5
20	1.8	265.0	1.0
21	1.2	315.0	2.5
22	0.6	360.0	4.0
23	1.2	45.0	4.0
24	1.8	85.0	4.0

STOP TIME OCT 19,1993 HOUR 23 MINUTE 54

RELEASE NUMBER 93067 CONTAINMENT PURGE

STARTING TIME OCT 20,1993 HOUR 0 MINUTE 1

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	2.4	130.0	4.0
2	1.8	85.0	4.0

STOP TIME OCT 20,1993 HOUR 1 MINUTE 25

STARTING TIME OCT 20,1993 HOUR 1 MINUTE 54

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	2.4	130.0	4.0
2	1.8	85.0	4.0
3	1.2	45.0	4.0
4	0.6	360.0	4.0
5	1.2	65.0	3.2
6	1.8	125.0	2.3
7	2.4	190.0	1.5
8	2.6	235.0	0.4
9	2.8	275.0	-0.6
10	3.0	320.0	-1.7
11	4.8	317.0	-1.3
12	6.6	313.0	-0.9
13	8.4	310.0	-0.5
14	8.6	310.0	-0.5
15	8.8	310.0	-0.5
16	9.0	310.0	-0.5
17	7.2	310.0	0.2
18	5.4	310.0	0.8
19	3.6	310.0	1.5
20	3.6	307.0	1.5
21	3.6	303.0	1.5
22	3.6	300.0	1.5
23	3.2	306.0	1.5
24	2.8	314.0	1.5
1	2.4	320.0	1.5

STOP TIME OCT 21,1993 HOUR 0 MINUTE 9

RELEASE NUMBER 93068 CONTAINMENT PURGE

STARTING TIME OCT 21,1993 HOUR 0 MINUTE 9

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	2.4	320.0	1.5
2	2.4	300.0	1.5
3	2.4	280.0	1.5
4	2.4	260.0	1.5
5	2.4	266.0	1.5
6	2.4	274.0	1.5
7	2.4	280.0	1.5
8	2.8	280.0	0.4
9	3.2	280.0	-0.6
10	3.6	280.0	-1.7
11	3.6	290.0	-1.7
12	3.6	300.0	-1.7
13	3.6	310.0	-1.7
14	3.2	307.0	-1.7
15	2.8	303.0	-1.7
16	2.4	300.0	-1.7
17	2.2	260.0	-0.6

STOP TIME OCT 21,1993 HOUR 16 MINUTE 30

RELEASE NUMBER 93069 CONTAINMENT PURGE

STARTING TIME OCT 21,1993 HOUR 16 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	2.4	300.0	-1.7
17	2.2	260.0	-0.6
18	2.0	220.0	0.4
19	1.8	180.0	1.5
20	2.4	174.0	2.3
21	3.0	166.0	3.2
22	3.6	160.0	4.0
23	3.8	163.0	4.0
24	4.0	167.0	4.0
1	4.2	170.0	4.0
2	4.2	176.0	4.0
3	4.2	184.0	4.0
4	4.2	190.0	4.0
5	4.4	180.0	3.2
6	4.6	170.0	2.3
7	4.8	160.0	1.5
8	5.0	160.0	0.5
9	5.2	160.0	-0.5
10	5.4	160.0	-1.5
11	5.2	166.0	-1.6

STOP TIME OCT 22,1993 HOUR 10 MINUTE 24

STARTING TIME OCT 22,1993 HOUR 11 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
11	5.2	166.0	-1.6
12	5.0	174.0	-1.6
13	4.8	180.0	-1.7
14	4.8	180.0	-1.7
15	4.8	180.0	-1.7
16	4.8	180.0	-1.7
17	4.6	183.0	-1.3
18	4.4	187.0	-0.9
19	4.2	190.0	-0.5
20	4.2	190.0	0.2
21	4.2	190.0	0.8
22	4.2	190.0	1.5
23	4.0	187.0	1.5
24	3.8	183.0	1.5

STOP TIME OCT 22,1993 HOUR 23 MINUTE 45

RELEASE NUMBER 93069 CONTAINMENT PURGE

STARTING TIME OCT 23,1993 HOUR 0 MINUTE 18

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	3.6	180.0	1.5
2	3.8	190.0	1.5
3	4.0	200.0	1.5
4	4.2	210.0	1.5
5	4.4	196.0	1.5
6	4.6	184.0	1.5
7	4.8	170.0	1.5
8	4.8	187.0	0.5
9	4.8	203.0	-0.5

STOP TIME OCT 23,1993 HOUR 8 MINUTE 5

STARTING TIME OCT 23,1993 HOUR 8 MINUTE 32

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
8	4.8	187.0	0.5
9	4.8	203.0	-0.5
10	4.8	220.0	-1.5

STOP TIME OCT 23,1993 HOUR 9 MINUTE 57

RELEASE NUMBER 93070 CONTAINMENT PURGE

STARTING TIME OCT 23,1993 HOUR 9 MINUTE 57

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
9	4.8	203.0	-0.5
10	4.8	220.0	-1.5
11	6.0	214.0	-1.2
12	7.2	206.0	-0.8
13	8.4	200.0	-0.5
14	8.0	200.0	-0.5
15	7.6	200.0	-0.5
16	7.2	200.0	-0.5
17	7.0	197.0	-0.5
18	6.8	193.0	-0.5
19	6.6	190.0	-0.5
20	6.2	193.0	-0.5
21	5.8	197.0	-0.5
22	5.4	200.0	-0.5

STOP TIME OCT 23,1993 HOUR 21 MINUTE 36

STARTING TIME OCT 23,1993 HOUR 22 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
22	5.4	200.0	-0.5
23	4.8	200.0	0.2
24	4.2	200.0	0.8
1	3.6	200.0	1.5
2	3.8	210.0	1.5
3	4.0	220.0	1.5
4	4.2	230.0	1.5
5	4.4	227.0	0.8
6	4.6	223.0	0.2
7	4.8	220.0	-0.5
8	4.4	223.0	-0.9
9	4.0	227.0	-1.3
10	3.6	230.0	-1.7
11	4.0	220.0	-1.7
12	4.4	210.0	-1.7
13	4.8	200.0	-1.7
14	4.6	194.0	-1.7
15	4.4	186.0	-1.7
16	4.2	180.0	-1.7
17	4.2	174.0	-1.3
18	4.2	166.0	-0.9
19	4.2	160.0	-0.5
20	4.0	174.0	0.2
21	3.8	186.0	0.8
22	3.6	200.0	1.5
23	3.6	197.0	2.3
24	3.6	193.0	3.2

STOP TIME OCT 24,1993 HOUR 24 MINUTE 0

RELEASE NUMBER 93070 CONTAINMENT PURGE

STARTING TIME OCT 24,1993 HOUR 2 MINUTE 44

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
2	3.8	210.0	1.5
3	4.0	220.0	1.5
4	4.2	230.0	1.5
5	4.4	227.0	0.8
6	4.6	223.0	0.2
7	4.8	220.0	-0.5
8	4.4	223.0	-0.9
9	4.0	227.0	-1.3
10	3.6	230.0	-1.7
11	4.0	220.0	-1.7
12	4.4	210.0	-1.7

STOP TIME OCT 24,1993 HOUR 11 MINUTE 48

STARTING TIME OCT 24,1993 HOUR 12 MINUTE 4

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	4.4	210.0	-1.7
13	4.8	200.0	-1.7
14	4.6	194.0	-1.7
15	4.4	186.0	-1.7
16	4.2	180.0	-1.7
17	4.2	174.0	-1.3
18	4.2	166.0	-0.9
19	4.2	160.0	-0.5
20	4.0	174.0	0.2
21	3.8	186.0	0.8
22	3.6	200.0	1.5
23	3.6	197.0	2.3
24	3.6	193.0	3.2
1	3.6	190.0	4.0
2	4.0	190.0	3.2
3	4.4	190.0	2.3
4	4.8	190.0	1.5
5	4.8	187.0	1.5
6	4.8	183.0	1.5
7	4.8	180.0	1.5

STOP TIME OCT 25,1993 HOUR 6 MINUTE 20

RELEASE NUMBER 93071 CONTAINMENT PURGE

STARTING TIME OCT 25,1993 HOUR 6 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
6	4.8	183.0	1.5
7	4.8	180.0	1.5
8	4.6	205.0	0.8
9	4.4	235.0	0.2
10	4.2	260.0	-0.5
11	6.0	295.0	-0.5
12	7.8	325.0	-0.5
13	9.6	360.0	-0.5
14	8.8	346.0	-0.8
15	8.0	334.0	-1.2
16	7.2	320.0	-1.5
17	6.4	320.0	-1.2
18	5.6	320.0	-0.8
19	4.8	320.0	-0.5
20	5.2	317.0	0.2
21	5.6	313.0	0.8
22	6.0	310.0	1.5
23	5.2	270.0	1.5
24	4.4	230.0	1.5
1	4.1	319.7	0.3
2	3.6	319.6	-0.1
3	7.1	327.5	-0.6
4	8.0	328.1	-0.7
5	9.4	326.2	-0.7
6	7.4	327.1	-0.7
7	5.9	323.0	-0.7
8	4.4	318.2	-0.2
9	4.3	312.1	-0.6
10	8.5	321.4	-1.4
11	11.2	325.9	-1.6
12	11.9	330.9	-1.5
13	11.5	330.2	-1.7
14	9.8	334.5	-1.4
15	9.9	332.3	-1.5
16	11.2	337.3	-1.3
17	11.1	330.9	-1.2
18	9.5	332.7	-1.0
19	9.0	333.6	-0.9
20	8.8	331.0	-0.9
21	8.7	330.6	-1.0
22	8.6	331.2	-0.9
23	8.4	334.8	-1.0
24	6.1	242.4	-1.0
1	8.0	329.6	-0.9
2	7.1	332.5	-0.9
3	6.2	330.8	-0.9
4	6.4	318.7	-0.5
5	8.3	321.2	0.6
6	8.7	320.1	1.1
7	6.8	306.2	0.3
8	5.7	308.4	0.4
9	4.6	258.7	-0.1
10	4.4	314.9	-1.5
11	6.2	252.5	-1.8
12	7.4	253.3	-1.8

STOP TIME OCT 27,1993 HOUR 11 MINUTE 52

RELEASE NUMBER 93072 CONTAINMENT PURGE

STARTING TIME OCT 27,1993 HOUR 11 MINUTE 52

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
11	6.2	252.5	-1.8
12	7.4	253.3	-1.8
13	7.8	235.7	-1.9
14	9.2	232.7	-1.8
15	10.0	223.1	-1.7
16	12.4	219.7	-1.6
17	12.7	206.8	-1.3
18	10.0	192.9	-0.9
19	7.2	181.9	-0.3
20	7.4	180.2	-0.4
21	7.6	182.9	-0.5
22	7.8	183.0	-0.5

STOP TIME OCT 27,1993 HOUR 21 MINUTE 18

STARTING TIME OCT 27,1993 HOUR 22 MINUTE 28

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
22	7.8	183.0	-0.5
23	7.6	184.5	-0.[illegible]
24	7.4	199.7	-0.3
1	7.2	210.3	-0.4
2	6.8	211.2	-0.3
3	6.4	215.6	-0.2
4	6.0	226.7	-0.2
5	5.6	230.8	0.3
6	5.2	241.2	1.0
7	4.8	275.0	0.5
8	6.6	322.3	1.0
9	8.4	322.6	0.4
10	9.9	330.5	-0.8
11	12.1	331.3	-1.4
12	11.4	325.5	-1.6

STOP TIME OCT 28,1993 HOUR 11 MINUTE 42

RELEASE NUMBER 93073 CONTAINMENT PURGE

STARTING TIME OCT 29,1993 HOUR 2 MINUTE 35

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
2	7.8	315.8	-0.6
3	7.1	318.1	-0.5
4	5.5	311.2	-0.5
5	7.3	314.8	-0.7

STOP TIME OCT 29,1993 HOUR 4 MINUTE 45

STARTING TIME OCT 29,1993 HOUR 12 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
12	12.9	335.9	-1.8
13	12.3	331.9	-1.8

STOP TIME OCT 29,1993 HOUR 12 MINUTE 36

RELEASE NUMBER 93073 CONTAINMENT PURGE

STARTING TIME OCT 29,1993 HOUR 13 MINUTE 20

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	12.3	331.9	-1.8
14	11.8	337.2	-1.8

STOP TIME OCT 29,1993 HOUR 13 MINUTE 30

STARTING TIME OCT 29,1993 HOUR 19 MINUTE 7

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
19	9.7	333.1	-1.2
20	8.1	333.2	-0.9
21	9.1	328.1	-0.9
22	8.6	330.5	-1.0
23	8.5	327.6	-1.0

STOP TIME OCT 29,1993 HOUR 22 MINUTE 53

RELEASE NUMBER 93075 CONTAINMENT PURGE

STARTING TIME OCT 31,1993 HOUR 8 MINUTE 3

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
8	1.0	233.7	2.1
9	1.4	137.2	1.4

STOP TIME OCT 31,1993 HOUR 8 MINUTE 8

STARTING TIME OCT 31,1993 HOUR 8 MINUTE 55

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
8	1.0	233.7	2.1
9	1.4	137.2	1.4
10	1.6	164.2	-0.4
11	2.3	351.1	-1.8
12	5.1	196.9	-1.6
13	6.3	187.6	-1.6
14	6.4	189.6	-1.7
15	7.2	192.4	-1.6
16	7.4	190.9	-1.5
17	7.2	185.4	-1.5
18	7.3	174.1	-1.2
19	5.7	156.4	-0.3
20	5.0	149.7	0.9
21	6.3	129.7	1.5
22	6.3	130.8	1.7

STOP TIME OCT 31,1993 HOUR 21 MINUTE 15

RELEASE NUMBER 93076 CONTAINMENT PURGE

STARTING TIME NOV 1,1993 HOUR 16 MINUTE 42

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	13.6	166.0	-1.3
17	10.8	161.1	-1.0
18	6.2	157.3	-0.6
19	5.4	141.8	0.1
20	4.9	135.6	0.5
21	4.9	154.8	0.3
22	6.4	181.7	-0.2
23	7.3	215.9	-0.5
24	9.8	225.4	0.3
1	5.4	249.7	0.6
2	2.7	298.6	-0.5
3	4.0	314.3	-0.8
4	3.9	316.4	-0.8
5	3.2	312.1	-0.8
6	3.1	303.8	-0.7
7	3.0	296.6	-0.4
8	5.6	287.8	-0.4
9	3.7	310.0	-1.5

STOP TIME NOV 2,1993 HOUR 8 MINUTE 41

STARTING TIME NOV 2,1993 HOUR 11 MINUTE 15

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
11	5.4	317.6	-1.8
12	4.2	305.8	-2.0
13	6.7	306.3	-2.3
14	9.1	294.2	-2.3
15	8.0	279.2	-2.2
16	7.7	277.1	-1.8
17	7.0	276.3	-1.0
18	6.4	268.7	1.0
19	6.9	256.8	2.6
20	4.7	217.4	3.1
21	6.1	206.4	3.4
22	8.3	201.3	3.4
23	9.7	202.5	2.0
24	12.5	215.6	1.2
1	13.6	212.0	0.3
2	14.7	219.7	0.2
3	14.8	226.3	1.0
4	14.5	233.6	1.0
5	12.3	241.7	1.8
6	8.7	244.8	2.6
7	8.1	237.9	4.2
8	4.3	240.3	-0.2
9	6 7	212.7	-0.8
10	F.7	199.7	-1.4

STOP TIME NOV 3,1993 HOUR 9 MINUTE 41

RELEASE NUMBER 93077 CONTAINMENT PURGE

STARTING TIME NOV 3,1993 HOUR 9 MINUTE 41

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
9	6.7	212.7	-0.8
10	8.7	199.7	-1.4
11	9.7	197.4	-1.5
12	11.6	201.3	-1.4
13	13.7	204.2	-1.3
14	13.1	215.9	-1.4
15	10.8	213.5	-1.1
16	8.3	203.2	-0.9
17	7.5	201.0	-0.4
18	5.6	196.1	0.2
19	6.7	210.2	1.0
20	9.1	197.1	1.6
21	10.7	200.5	0.7
22	11.5	195.3	0.4
23	12.3	196.3	0.1
24	12.7	201.5	-0.1
1	13.1	205.4	-0.3
2	14.6	211.1	-0.5
3	14.4	212.7	-0.5
4	14.8	211.8	-0.4
5	8.6	173.6	-0.2
6	8.4	204.1	-0.5
7	9.5	276.5	0.4
8	10.5	297.1	0.4
9	10.3	310.9	-0.8
10	10.4	315.8	-1.7
11	11.3	320.6	-1.9
12	11.3	320.1	-2.2
13	13.2	322.4	-2.1
14	12.8	319.2	-2.1
15	11.4	312.4	-1.9
16	10.0	311.1	-1.3
17	10.0	293.8	-1.2
18	10.5	298.2	-1.0
19	8.0	288.5	-1.0
20	7.9	289.8	-1.2
21	10.5	307.4	-1.3
22	12.4	312.9	-1.3
23	12.7	318.7	-1.3
24	14.2	323.4	-1.3
1	15.3	324.8	-1.2
2	15.0	324.3	-1.3

STOP TIME NOV 5,1993 HOUR 1 MINUTE 0

RELEASE NUMBER 93078 CONTAINMENT PURGE

STARTING TIME NOV 5,1993 HOUR 1 MINUTE 0

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	15.3	324.8	-1.2
2	15.0	324.3	-1.3
3	12.8	322.3	-1.3
4	16.3	327.5	-1.3
5	14.7	326.8	-1.3
6	14.6	324.3	-1.3
7	12.9	326.3	-1.3
8	12.9	325.9	-1.3
9	12.8	323.1	-1.4
10	14.8	328.0	-1.4
11	12.5	323.4	-1.6
12	13.3	327.9	-1.8
13	12.5	325.6	-1.8
14	12.4	328.0	-1.8
15	11.0	323.2	-1.7
16	12.7	324.4	-1.6
17	10.6	324.9	-1.4
18	10.5	329.1	-1.3
19	9.5	333.0	-1.3
20	9.1	335.1	-1.3
21	8.8	337.8	-1.3
22	7.6	332.2	-1.2
23	8.7	336.2	-1.2
24	9.1	331.9	-1.3
1	7.8	332.6	-1.2

STOP TIME NOV 6,1993 HOUR 0 MINUTE 2

STARTING TIME NOV 6,1993 HOUR 1 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	7.8	332.6	-1.2
2	9.5	332.3	-1.3
3	9.0	325.8	-1.2

STOP TIME NOV 6,1993 HOUR 2 MINUTE 42

RELEASE NUMBER 93080 CONTAINMENT PURGE

STARTING TIME NOV 12,1993 HOUR 1 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	3.8	70.0	-0.3
2	5.5	70.0	-1.2
3	6.8	70.0	-1.2
4	5.6	70.0	-0.9
5	7.0	73.0	-0.8
6	7.6	77.0	-0.7
7	8.8	80.0	-0.8
8	9.0	90.0	-0.7
9	10.0	100.0	-0.7
10	9.8	110.0	-0.7
11	10.8	107.0	-0.7
12	12.0	103.0	-0.6
13	13.9	100.0	-0.6
14	14.6	115.0	-0.7
15	14.1	125.0	-0.5
16	12.0	140.0	-0.3
17	12.1	138.0	-0.5
18	11.3	137.4	-0.5
19	11.0	139.5	-0.5
20	11.0	141.2	-0.3
21	14.3	155.9	-0.6
22	16.2	156.6	-0.6

STOP TIME NOV 12,1993 HOUR 21 MINUTE 30

RELEASE NUMBER 93083 CONTAINMENT PURGE

STARTING TIME NOV 19,1993 HOUR 16 MINUTE 36

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	7.2	310.0	-0.5
17	5.8	295.0	0.2
18	4.4	275.0	0.8
19	3.0	260.0	1.5
20	2.8	266.0	2.3
21	2.6	274.0	3.2
22	2.4	280.0	4.0
23	2.4	0.0	4.0
24	2.4	0.0	4.0
1	2.4	260.0	4.0
2	2.4	263.0	4.0

STOP TIME NOV 20,1993 HOUR 1 MINUTE 19

STARTING TIME NOV 20,1993 HOUR 1 MINUTE 47

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	2.4	260.0	4.0
2	2.4	263.0	4.0
3	2.4	267.0	4.0
4	2.4	270.0	4.0
5	2.4	260.0	3.2
6	2.4	250.0	2.3
7	2.4	240.0	1.5
8	2.8	237.0	0.4
9	3.2	235.0	-0.6
10	3.6	224.1	-1.7
11	6.2	226.7	-1.5
12	11.1	216.3	-1.5
13	12.5	222.0	-1.5
14	12.7	214.9	-1.5
15	12.7	227.7	-1.4
16	11.5	231.6	-1.1

STOP TIME NOV 20,1993 HOUR 15 MINUTE 21

RELEASE NUMBER 93083 CONTAINMENT PURGE

STARTING TIME NOV 20,1993 HOUR 16 MINUTE 18

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
16	11.5	231.6	-1.1
17	8.0	230.4	-0.5
18	8.4	220.4	0.9
19	10.7	221.3	2.2
20	11.7	221.4	2.5
21	12.4	217.5	3.0
22	11.7	212.4	2.5
23	12.7	215.3	3.2
24	14.9	217.4	5.1
1	15.0	215.3	3.9

STOP TIME NOV 21,1993 HOUR 0 MINUTE 7

STARTING TIME NOV 21,1993 HOUR 4 MINUTE 10

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
4	13.4	220.5	3.4
5	12.9	216.6	2.4
6	6.5	239.1	0.7
7	2.5	240.0	-0.4

STOP TIME NOV 21,1993 HOUR 6 MINUTE 35

RELEASE NUMBER 93083 CONTAINMENT PURGE

STARTING TIME NOV 21,1993 HOUR 6 MINUTE 40

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
6	6.5	239.1	0.7
7	2.5	240.0	-0.4
8	4.2	168.6	0.4
9	4.4	203.3	-0.3
10	4.6	248.6	-1.1

STOP TIME NOV 21,1993 HOUR 9 MINUTE 11

STARTING TIME NOV 21,1993 HOUR 13 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	6.5	229.3	-1.6
14	7.5	225.8	-1.5
15	6.9	228.2	-1.4
16	5.1	226.5	-1.2
17	4.6	193.0	-0.2
18	3.1	114.0	1.3
19	3.0	115.6	2.8
20	2.7	179.6	4.1
21	2.4	37.2	4.4
22	4.8	200.9	3.9
23	7.2	214.8	3.6
24	4.3	251.2	2.2
1	4.5	107.3	1.4
2	4.0	135.1	2.6
3	4.9	130.7	2.3
4	5.0	120.3	1.9
5	5.3	123.9	2.0
6	[illegible].6	111.7	1.5
7	[illegible].6	112.0	1.3
8	1.2	221.4	2.2
9	1.2	274.9	0.8
10	4.2	118.5	-0.5
11	8.5	123.0	-1.1
12	9.0	124.9	-1.1
13	10.6	104.1	-1.2
14	11.5	156.9	-1.1
15	8.4	150.6	-1.0
16	7.5	141.6	-0.7
17	5.3	130.1	-0.5
18	5.7	146.1	-0.4
19	8.2	153.0	-0.5
20	9.4	153.4	-0.4
21	11.3	155.5	-0.5
22	10.5	159.6	-0.5
23	6.4	143.7	0.5
24	4.8	142.7	1.2
1	3.1	237.9	2.1
2	2.5	294.0	1.2
3	3.8	300.2	0.3
4	3.5	309.0	-0.6
5	4.8	319.3	-0.8
6	5.7	329.3	-0.8
7	6.1	340.4	-0.8
8	7.0	342.5	-0.9

STOP TIME NOV 23,1993 HOUR 7 MINUTE 40

RELEASE NUMBER 93084 CONTAINMENT PURGE

STARTING TIME NOV 24,1993 HOUR 13 MINUTE 41

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
13	8.8	317.3	-1.4
14	4.0	321.4	-1.5
15	7.2	322.3	-1.3
16	4.9	327.5	-1.4
17	4.1	327.0	-1.3
18	3.5	318.0	-1.3
19	3.7	316.5	-1.3
20	3.8	316.0	-1.3
21	4.3	313.4	-1.3
22	5.4	307.9	-1.3
23	4.5	309.7	-1.3
24	5.0	306.5	1.3
1	5.4	304.6	1.4
2	4.6	306.9	-1.4
3	4.4	302.4	-1.3

STOP TIME NOV 25,1993 HOUR 2 MINUTE 9

STARTING TIME NOV 25,1993 HOUR 2 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
2	4.6	306.9	-1.4
3	4.4	302.4	-1.3
4	4.3	293.5	-1.2
5	4.3	298.6	-0.8
6	3.2	283.4	-0.8
7	3.8	285.6	-0.6
8	3.3	289.1	-0.5
9	4.2	276.1	-1.0
10	3.8	279.9	-1.5
11	4.0	286.1	-1.8
12	3.9	286.4	-1.9
13	3.4	283.0	-2.0
14	3.7	290.7	-1.9
15	4.0	292.8	-1.8
16	3.9	292.2	-1.5
17	3.8	296.0	-0.9
18	3.6	281.0	0.1
19	4.0	278.7	0.1
20	4.2	279.3	0.2
21	4.7	285.8	0.2
22	4.8	289.5	0.6
23	5.4	289.0	0.6
24	6.0	285.3	1.8
1	5.9	276.8	1.0
2	5.9	274.3	0.8
3	5.8	264.3	0.8
4	5.1	246.7	1.4
5	4.5	223.9	2.1
6	5.0	225.3	2.6
7	4.8	230.3	2.4
8	5.2	222.8	2.1
9	5.1	222.4	0.5
10	4.6	231.3	-1.1
11	4.0	225.8	-1.5
12	4.1	232.1	-1.6
13	5.0	199.0	-1.5
14	4.8	197.0	-1.6
15	4.9	196.0	-1.5
16	4.4	244.5	-1.3
17	4.4	228.2	-1.0
18	5.1	228.2	-0.9
19	5.3	235.7	-0.9
20	5.6	239.4	-0.8
21	7.0	252.9	-0.8
22	7.6	264.0	-0.9
23	7.3	261.7	-0.9
24	5.5	265.9	-1.0
1	6.3	259.5	-0.9
2	7.4	264.2	-0.9
3	6.2	259.7	-1.1

4	6.8	251.5	-1.1
5	4.8	234.6	-1.0
6	5.3	218.3	-0.6
7	7.0	199.9	-0.6
8	7.6	205.5	-0.5
9	7.4	211.6	-0.5
10	6.3	221.0	-0.8
11	5.3	248.2	-0.8
12	6.4	308.3	-1.1
13	8.1	318.5	-1.3
14	7.4	319.6	-1.4
15	7.7	317.9	-1.3
16	8.2	321.6	-1.2
17	8.1	324.6	-1.1
18	3.5	323.6	-0.9
19	1.8	334.5	-0.8
20	2.2	352.5	-0.4
21	5.1	315.1	-0.9
22	5.1	307.1	-0.9
23	5.1	298.9	-1.0
24	4.4	301.8	-1.0
1	2.7	303.8	-0.9
2	1.3	280.2	-0.7
3	0.5	209.2	-0.3
4	1.2	249.1	0.7
5	1.2	6.5	0.8
6	3.6	123.9	1.6
7	4.0	352.4	1.9
8	3.8	194.5	1.8
9	4.4	124.7	-0.1
10	4.3	144.0	-0.7
11	5.7	201.5	-1.3
12	4.2	242.4	-1.5
13	5.2	273.7	-1.7
14	4.6	283.5	-1.6
15	6.1	287.0	-1.2
16	6.3	297.4	-0.9
17	4.1	299.3	-0.1
18	5.5	303.4	0.2
19	4.8	285.2	1.1
20	6.1	286.5	1.0
21	7.9	294.3	0.4
22	6.4	304.6	0.2
23	5.6	304.5	0.3
24	6.5	307.6	0.3
1	4.2	289.6	0.4
2	4.0	296.7	0.8
3	3.0	316.0	0.6
4	2.9	302.7	0.8
5	2.6	296.4	0.9
6	2.3	306.5	1.2
7	2.5	298.6	1.2
8	2.7	289.0	1.2

STOP TIME NOV 29,1993 HOUR 7 MINUTE 30

RELEASE NUMBER 93085 CONTAINMENT PURGE

STARTING TIME DEC 1,1993 HOUR 17 MINUTE 35

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	2.9	286.3	-0.2
18	1.6	292.2	1.2
19	1.3	316.8	1.7
20	0.8	300.5	2.3
21	1.2	265.0	3.0
22	1.3	235.8	2.5
23	1.0	295.0	3.7
24	1.4	352.0	3.2
1	2.0	190.9	2.9
2	2.1	193.5	2.5
3	2.7	194.1	3.5
4	4.8	291.4	3.9

STOP TIME DEC 2,1993 HOUR 3 MINUTE 51

STARTING TIME DEC 2,1993 HOUR 4 MINUTE 47

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
4	4.8	291.4	3.9
5	2.5	315.0	0.8
6	2.6	342.7	0.9
7	1.4	258.8	2.3
8	3.3	145.7	0.8
9	2.8	131.6	0.3
10	2.5	208.9	-0.5
11	2.9	294.9	-1.3
12	2.9	311.6	-1.3
13	3.1	342.0	-1.1
14	4.1	342.5	-1.3
15	2.0	328.8	-1.1
16	4.2	334.0	-1.1
17	3.8	358.9	-0.6
18	3.4	285.7	0.4
19	3.0	283.6	1.6
20	3.4	277.4	1.6
21	3.8	282.4	1.6
22	4.2	208.7	1.8
23	4.0	299.1	2.2
24	3.8	210.0	1.7
1	3.6	340.6	2.0
2	3.8	327.3	2.1
3	4.0	253.8	1.8
4	4.2	270.1	1.2
5	4.0	311.8	1.3
6	3.8	40.0	1.8
7	3.6	132.0	0.9
8	3.2	143.5	0.5
9	2.8	270.3	0.7
10	2.4	203.0	0.6
11	3.2	315.3	0.8
12	4.0	334.4	-1.0
13	4.8	336.1	-1.1
14	5.0	338.5	-1.1
15	5.6	328.5	-1.3
16	4.8	336.0	-1.1
17	5.2	323.4	-1.0
18	4.8	326.3	-0.5
19	4.2	323.2	-0.4
20	3.5	327.5	-0.7
21	4.2	328.9	-0.9
22	4.3	333.6	-0.8
23	4.7	326.8	-0.9
24	3.6	321.4	-1.0
1	1.6	290.7	-0.5
2	1.7	310.7	0.2
3	3.2	315.9	-0.2
4	3.6	326.4	-0.8
5	2.4	318.9	-0.8
6	1.5	301.1	-0.8
7	1.3	302.1	-0.9
8	1.1	245.4	-0.9

9	0.8	193.2	-0.9
10	1.4	250.2	-1.1
11	2.3	287.3	-1.3
12	1.5	315.0	-1.3
13	1.9	289.8	-1.3
14	3.1	236.9	-1.3
15	5.4	131.3	-1.3
16	8.9	126.0	-1.2
17	6.8	127.7	-0.5
18	6.1	125.9	-0.2
19	6.7	138.0	-0.4
20	7.5	143.3	-0.5
21	8.7	148.0	-0.4
22	8.9	154.3	-0.5
23	8.3	150.9	-0.4
24	10.6	159.4	-0.3
1	10.4	159.8	-0.6
2	10.9	161.2	-0.6
3	13.5	164.8	-0.5
4	15.5	170.2	-0.6
5	14.3	168.4	-0.7
6	9.8	166.4	-0.8
7	8.1	165.9	-0.8
8	13.3	158.9	-0.6
9	14.8	170.1	-0.8
10	13.6	164.1	-1.1
11	10.3	167.8	-1.1
12	8.9	206.3	-1.1
13	7.0	282.6	-1.3
14	9.7	290.9	-0.9
15	8.2	284.8	-0.8
16	11.7	300.0	-0.9
17	11.1	299.6	-0.9
18	14.0	304.2	-0.8
19	13.4	299.0	-0.9
20	15.4	312.6	-0.9
21	15.8	313.2	-0.9
22	16.7	311.8	-0.9
23	15.1	315.3	-1.0
24	15.3	314.5	-1.0
1	15.1	319.0	-1.1
2	14.5	316.7	-1.1
3	12.6	312.5	-1.0
4	11.7	313.6	-0.9
5	8.9	309.6	-0.9
6	8.1	306.3	-0.9
7	7.7	307.7	-0.8

STOP TIME DEC 6,1993 HOUR 6 MINUTE 3

RELEASE NUMBER 93086 CONTAINMENT PURGE

STARTING TIME DEC 9,1993 HOUR 17 MINUTE 58

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	6.4	235.0	-1.2
18	7.4	275.0	-0.8
19	8.4	310.0	-0.5
20	6.8	304.0	0.2
21	5.2	296.0	0.8
22	3.6	290.0	1.5
23	4.0	293.0	1.5
24	4.4	297.0	1.5
1	4.8	300.0	1.5
2	4.8	297.0	1.5
3	4.8	293.0	1.5
4	4.8	290.0	1.5
5	5.0	293.0	1.5
6	5.2	297.0	1.5
7	5.4	300.0	1.5
8	6.8	303.0	0.8
9	8.2	307.0	0.2
10	9.6	310.0	-0.5
11	9.6	320.0	-0.5
12	9.6	330.0	-0.5
13	9.6	340.0	-0.5
14	9.2	340.0	-0.5
15	8.8	340.0	-0.5
16	8.4	340.0	-0.5
17	7.6	340.0	0.2
18	6.8	340.0	0.8
19	6.0	340.0	1.5
20	5.2	343.0	2.3
21	4.4	347.0	3.2
22	3.6	350.0	4.0
23	3.2	360.0	4.0
24	2.8	10.0	4.0
1	2.4	20.0	4.0
2	2.6	45.0	4.0
3	2.8	75.0	4.0

STOP TIME DEC 11,1993 HOUR 2 MINUTE 54

STARTING TIME DEC 11,1993 HOUR 4 MINUTE 4

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
4	3.0	100.0	4.0
5	3.0	115.0	4.0
6	3.0	125.0	4.0
7	3.0	140.0	4.0
8	4.0	150.0	2.2
9	5.0	160.0	0.3
10	6.0	170.0	-1.5

STOP TIME DEC 11,1993 HOUR 9 MINUTE 10

RELEASE NUMBER 93086 CONTAINMENT PURGE

STARTING TIME DEC 11,1993 HOUR 11 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
11	6.0	170.0	-1.5
12	6.0	170.0	-1.5
13	6.0	170.0	-1.5
14	6.2	170.0	-1.2
15	6.4	170.0	-0.8
16	6.6	170.0	-0.5
17	7.2	167.0	-0.5
18	7.8	163.0	-0.5
19	8.4	160.0	-0.5
20	8.2	163.0	-0.5
21	8.0	167.0	-0.5
22	7.8	170.0	-0.5
23	7.6	170.0	-0.5
24	7.4	170.0	-0.5
1	7.2	170.0	-0.5
2	7.0	170.0	0.2
3	6.8	170.0	0.8
4	6.6	170.0	1.5
5	7.6	170.0	0.8
6	8.6	170.0	0.2
7	9.6	170.0	-0.5
8	9.8	170.0	-0.5
9	10.0	170.0	-0.5
10	10.2	170.0	-0.5
11	10.0	185.0	-0.5
12	9.8	195.0	-0.5
13	9.6	210.0	-0.5
14	9.8	205.0	-0.5
15	10.0	200.0	-0.5
16	10.2	190.0	-0.5
17	9.2	184.0	-0.5
18	8.2	176.0	-0.5
19	7.2	170.0	-0.5
20	7.6	167.0	-0.5
21	8.0	163.0	-0.5
22	8.4	160.0	-0.5
23	7.8	160.0	-0.5
24	7.2	160.0	-0.5
1	6.6	160.0	-0.5
2	6.0	160.0	-0.5
3	5.4	160.0	-0.5
4	4.8	160.0	-0.5
5	3.4	105.0	-0.5
6	2.0	55.0	-0.5
7	0.6	360.0	-0.5

STOP TIME DEC 13,1993 HOUR 6 MINUTE 15

RELEASE NUMBER 93087 CONTAINMENT PURGE

STARTING TIME DEC 16,1993 HOUR 21 MINUTE 45

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	2.6	140.0	-0.5
22	2.4	150.0	-0.5
23	2.2	144.0	-0.5
24	2.0	136.0	-0.5
1	1.8	130.0	-0.5
2	2.0	150.0	-0.5
3	2.2	170.0	-0.5
4	2.4	190.0	-0.5
5	3.0	196.0	-0.5
6	3.6	204.0	-0.5
7	4.2	210.0	-0.5
8	3.8	195.0	-0.5
9	3.4	185.0	-0.5
10	3.0	170.0	-0.5
11	3.2	185.0	-0.5

STOP TIME DEC 17,1993 HOUR 10 MINUTE 38

STARTING TIME DEC 17,1993 HOUR 10 MINUTE 42

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	3.0	170.0	-0.5
11	3.2	185.0	-0.5
12	3.4	195.0	-0.5
13	3.6	210.0	-0.5
14	4.4	216.0	-0.5
15	5.2	224.0	-0.5
16	6.0	230.0	-0.5
17	5.6	236.0	-0.5
18	5.2	244.0	-0.5
19	4.8	250.0	-0.5
20	4.6	260.0	0.2
21	4.4	270.0	0.8
22	4.2	280.0	1.5
23	4.4	290.0	0.8
24	4.6	300.0	0.2
1	4.8	310.0	-0.3
2	5.0	307.0	-0.3
3	5.2	303.0	-0.3
4	5.4	300.0	-0.3
5	6.0	300.0	-0.3
6	6.6	300.0	-0.3
7	7.2	300.0	-0.3
8	7.6	303.0	-0.3
9	8.0	307.0	-0.3
10	8.4	310.0	-0.5
11	7.6	310.0	-0.5
12	6.8	310.0	-0.5
13	6.0	310.0	-0.5
14	5.2	300.0	-0.5
15	4.4	290.0	-0.5
16	3.6	280.0	-0.5
17	3.6	277.0	-0.5
18	3.6	273.0	-0.5
19	3.6	270.0	-0.5
20	3.2	253.0	-0.5
21	2.8	237.0	-0.5
22	2.4	220.0	-0.5
23	2.8	205.0	0.2
24	3.2	185.0	0.8
1	3.6	170.0	1.5
2	4.2	176.0	0.8
3	4.8	184.0	0.2
4	5.4	190.0	-0.5
5	5.2	190.0	-0.5
6	5.0	204.0	-0.5
7	4.8	210.0	-0.5
8	4.8	223.0	-0.8
9	4.8	237.0	-1.2
10	4.8	250.0	-1.5
11	5.0	270.0	-1.5

12	5.2	290.0	-1.5
13	5.4	310.0	-1.5
14	6.0	310.0	-1.2
15	6.6	310.0	-0.8
16	7.2	310.0	-0.5
17	6.4	313.0	-0.5
18	5.6	317.0	-0.5
19	4.8	320.0	-0.5
20	5.6	326.0	-0.5
21	6.4	334.0	-0.5
22	7.2	340.0	-0.5
23	6.2	315.0	0.2
24	5.2	295.0	0.8
1	4.2	270.0	1.5
2	5.4	285.0	0.8
3	6.6	295.0	0.2
4	7.8	310.0	-0.5
5	8.0	316.0	-0.5
6	8.2	324.0	-0.5
7	8.4	330.0	-0.5

STOP TIME DEC 20,1993 HOUR 6 MINUTE 9

RELEASE NUMBER 93088 CONTAINMENT PURGE

STARTING TIME DEC 22,1993 HOUR 18 MINUTE 2

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
18	1.7	285.2	-0.1
19	1.0	246.8	0.2
20	0.9	280.0	0.2
21	0.9	282.2	0.3
22	1.0	240.3	0.3
23	0.6	293.7	0.1
24	0.9	276.9	0.1
1	0.6	282.1	-0.1
2	0.8	300.1	-0.1
3	0.8	144.8	-0.1
4	0.9	146.5	-0.2
5	3.4	121.5	-0.3
6	3.3	123.7	-0.3
7	3.2	126.4	-0.3
8	3.2	112.9	-0.3
9	3.6	76.3	-1.0
10	4.0	249.5	-1.0
11	4.0	220.0	-1.0
12	4.0	240.0	-1.0
13	3.3	260.0	-1.0
14	3.3	280.0	-1.0
15	3.0	305.0	-1.0
16	3.9	334.0	-1.0
17	3.8	336.6	-1.0
18	3.1	332.9	-1.0
19	2.9	323.7	-0.2
20	2.4	314.5	-0.1
21	3.0	317.9	-0.1
22	2.3	314.2	-0.1
23	2.9	319.3	-0.2
24	1.2	304.7	-0.1
1	0.9	293.6	0.1
2	0.7	283.4	0.1
3	0.7	347.5	0.1
4	3.5	250.4	-0.1
5	3.2	193.5	-0.2
6	4.4	203.0	-0.2
7	4.3	186.1	-0.2
8	4.1	126.2	-0.3
9	4.8	140.3	-1.0
10	5.9	177.6	-1.0
11	5.9	187.1	-1.0
12	6.2	200.5	-1.0
13	7.4	217.5	-1.0
14	7.1	236.7	-1.0
15	5.4	265.0	-1.0
16	5.8	311.6	-1.0
17	5.5	325.5	-1.0
18	4.3	311.5	-1.0
19	3.8	299.8	-0.1
20	4.2	303.9	-0.1
21	5.6	297.0	-0.1
22	10.9	323.7	-0.1
23	11.6	326.7	-0.2
24	10.9	329.6	-0.2
1	9.4	325.8	-0.2
2	7.0	328.0	-0.2
3	5.5	329.8	-0.2
4	6.1	325.8	-0.2
5	5.5	322.0	-0.2
6	5.8	330.0	-0.2
7	6.0	325.1	-0.2
8	5.0	323.6	-0.2
9	4.5	323.6	-1.0
10	4.8	326.2	-1.0
11	4.1	333.6	-1.0
12	3.2	308.5	-1.0
13	2.6	259.3	-1.0
14	3.5	217.0	-1.0
15	4.4	165.8	-1.0
16	5.6	127.3	-1.0
17	5.9	133.5	-1.0
18	5.9	128.1	-1.0
19	6.0	135.6	-0.2

20	7.8	163.6	-0.2
21	11.6	185.9	-0.2
22	13.9	212.0	-0.1
23	13.5	222.0	-0.1
24	9.7	242.6	-0.1
1	4.2	262.3	-0.1
2	4.0	263.7	-0.1
3	3.8	268.0	-0.1
4	2.6	316.7	-0.1
5	3.2	302.6	-0.1
6	3.5	353.7	-0.3
7	3.2	80.0	-0.3
8	3.2	80.0	-0.3
9	3.5	80.0	-1.0
10	3.6	80.0	-1.0
11	4.2	86.0	-1.0
12	4.9	94.0	-1.0
13	5.2	100.0	-1.0
14	5.0	97.0	-1.0
15	5.0	93.0	-1.0
16	5.0	90.0	-1.0
17	4.0	80.0	-1.0
18	3.6	70.0	-1.0
19	2.6	60.0	-0.2
20	2.4	45.0	-0.3
21	2.5	35.0	-0.3
22	2.1	20.0	-0.2
23	2.1	30.0	-0.3
24	2.7	40.0	-0.3
1	2.7	50.0	-0.3
2	2.7	35.0	-0.3
3	3.0	25.0	-0.3
4	3.3	10.0	-0.3
5	3.7	13.0	-0.3
6	4.8	17.0	-0.3
7	4.1	20.0	-0.3
8	5.4	20.0	-0.3
9	5.3	20.0	-0.7
10	4.6	20.0	-0.7
11	4.9	35.0	-0.7
12	4.7	45.0	-0.7
13	5.0	60.0	-0.7
14	4.8	45.0	-0.7
15	4.8	35.0	-0.7
16	5.3	20.0	-0.7
17	4.8	20.0	-0.7
18	5.0	20.0	-0.7
19	3.7	20.0	-0.3
20	4.5	17.0	-0.3
21	3.6	13.0	-0.3
22	3.6	10.0	-0.3
23	4.2	20.0	-0.3
24	4.3	30.0	-0.3
1	4.2	40.0	-0.3
2	3.6	43.0	-0.3
3	4.2	47.0	-0.3
4	3.4	50.0	-0.3
5	2.4	56.0	-0.3
6	3.2	64.0	-0.3
7	2.9	70.0	-0.3

STOP TIME DEC 28,1993 HOUR 6 MINUTE 15

RELEASE NUMBER 93001 DECAY TANK PURGE

STARTING TIME FEB 16,1993 HOUR 10 MINUTE 28

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	6.8	317.8	-1.6
11	7.0	317.8	-1.0

STOP TIME FEB 16,1993 HOUR 10 MINUTE 35

STARTING TIME FEB 16,1993 HOUR 10 MINUTE 36

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
10	6.8	317.8	-1.6
11	7.0	317.8	-1.0
12	6.9	320.3	-0.5
13	7.0	317.0	-1.6
14	7.1	315.0	-1.8
15	7.2	312.2	-2.0
16	6.7	310.4	-0.8
17	8.0	312.7	-1.5
18	6.9	318.1	-1.6

STOP TIME FEB 16,1993 HOUR 17 MINUTE 15

RELEASE NUMBER 93002 DECAY TANK PURGE

STARTING TIME MAY 19,1993 HOUR 21 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
21	2.3	343.2	-1.6
22	0.6	314.3	-0.8
23	2.1	276.0	-0.7
24	3.3	303.8	0.4
1	3.5	288.3	-0.1
2	3.5	298.5	1.3
3	2.6	286.5	0.2
4	2.6	290.1	1.0

STOP TIME MAY 20,1993 HOUR 3 MINUTE 15

RELEASE NUMBER 93003 DECAY TANK PURGE

STARTING TIME OCT 6,1993 HOUR 17 MINUTE 25

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
17	7.6	177.0	-0.5
18	6.8	173.0	-0.5
19	6.0	170.0	-0.5
20	6.6	170.0	-0.5
21	7.2	170.0	-0.5
22	7.8	170.0	-0.5
23	7.8	176.0	-0.5
24	7.8	184.0	-0.5

STOP TIME OCT 6,1993 HOUR 23 MINUTE 25

RELEASE NUMBER 93004 DECAY TANK PURGE

STARTING TIME OCT 8,1993 HOUR 14 MINUTE 30

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	4.8	66.0	-0.5
15	6.6	44.0	-0.5
16	8.4	20.0	-0.5
17	8.4	14.0	-0.5
18	8.4	6.0	-0.5
19	8.4	360.0	-0.5
20	9.2	360.0	-0.5
21	10.0	360.0	-0.5

STOP TIME OCT 8,1993 HOUR 20 MINUTE 52

RELEASE NUMBER 93005 DECAY TANK PURGE

STARTING TIME NOV 3,1993 HOUR 4 MINUTE 9

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
4	14.5	233.6	1.0
5	12.3	241.7	1.8
6	8.7	244.8	2.6
7	8.1	237.9	4.2
8	4.3	240.3	-0.2
9	6.7	212.7	-0.8
10	8.7	199.7	-1.4
11	9.7	197.4	-1.5

STOP TIME NOV 3,1993 HOUR 10 MINUTE 12

RELEASE NUMBER 93006 DECAY TANK PURGE

STARTING TIME NOV 18,1993 HOUR 11 MINUTE 28

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
11	15.5	195.8	-1.3
12	15.4	201.6	-1.2
13	13.7	198.3	-1.2
14	13.8	197.0	-1.2
15	13.5	198.4	-1.2
16	10.1	200.4	-1.1
17	9.8	198.2	-0.9
18	5.5	164.8	-0.5

STOP TIME NOV 18,1993 HOUR 17 MINUTE 46

RELEASE NUMBER 93007 DECAY TANK PURGE

STARTING TIME NOV 24,1993 HOUR 22 MINUTE 21

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
22	5.4	307.9	-1.3
23	4.5	309.7	-1.3

STOP TIME NOV 24,1993 HOUR 22 MINUTE 45

STARTING TIME NOV 25,1993 HOUR 0 MINUTE 50

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
1	5.4	304.6	-1.4
2	4.6	306.9	-1.4
3	4.4	302.6	-1.3
4	4.3	293.5	-1.2
5	4.3	298.6	-0.8
6	3.2	283.4	-0.8
7	3.8	285.6	-0.6
8	3.3	289.1	-0.5
9	4.2	276.1	-1.0
10	3.8	279.9	-1.5

STOP TIME NOV 25,1993 HOUR 9 MINUTE 50

RELEASE NUMBER 93008 DECAY TANK PURGE

STARTING TIME NOV 25,1993 HOUR 14 MINUTE 51

TIME HOUR	WS10 MPH	WD10 DEG	DT110 DEG C
14	3.7	290.7	-1.9
15	4.0	292.8	-1.8
16	3.9	292.2	-1.5
17	3.8	296.0	-0.9
18	3.6	281.0	0.1
19	4.0	278.7	0.1
20	4.2	279.3	0.2
21	4.7	285.8	0.2
22	4.8	289.5	0.6
23	5.4	289.0	0.6

STOP TIME NOV 25,1993 HOUR 22 MINUTE 8

SECTION VII

POTENTIAL DOSES TO INDIVIDUALS AND POPULATIONS

(Regulatory Guide 1.21)

January 1, 1993 - December 31, 1993

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 millirem (mrem) to an average adult, teenager, child, infant using the annual configuration of the GASPAR program. Results to each receptor are shown in Tables VII-A-1 through VII-A-33. Also, the doses to the same groups, Table VII-B-1, in units of millirads (mrad), due to gamma and beta radiation carried by air, were computed using GASPAR. In its annual configuration, GASPAR assumes that all release rates are entered in curies per year (Ci/yr).

The inputs to GASPAR for the annual period from January 1, 1993 through December 31, 1993 were as follows:

(1) All gaseous effluents were as described in Section III.

(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 were described in Section IV.

(3) Annual "X/Qs" at the actual receptor locations, which are corrected for open terrain and plume depletion are calculated according to Regulatory Guide 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 its 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 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 manrems for all individuals within a 50 mile radius. Results are shown in Table VII-C-1. 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 760,413, based on the 1990 census, was used to define the sector segments within a 50 mile radius of the plant.

(2) Production of milk, meat, and vegetation are based on 1973 annual data for Nebraska as recommended by the NRC for use in GASPAR.

C. Potential Annual Doses to Individuals from Liquid Releases

The body, skin, and organ mrem for liquid releases were calculated for all significant liquid pathways using the annual configuration of the LADTAP program. Dose conversion factors used by LADTAP for ingestion and shoreline deposition are shown in Table VII-D-1. Results are shown in Tables VII-D-2 through VII-D-9.

The inputs to LADTAP for the semiannual period from January 1, 1993 through December 31, 1993 were as follows:

(1) All liquid effluents were as described in Section IV, except for the entrained gases (Ar-41, Xe-131M, Xe-133M, Xe-133, Xe-135M, Xe-135, Kr-85M, Kr-87, and Kr-88).

(2) A plant discharge rate of 802.0 cubic feet per second (CFS) was utilized.

(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) A drinking water transport time of 6.6 hours to the Omaha intake and 7.0 hours to the Council Bluffs intake for the ALARA doses in Table VII-D-2 through VII-D-5 was used. For Tables VII-D-6 through VII-D-9, 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 in Tables VII-D-6 through VII-D-9 was chosen to present a 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.

D. Potential Annual Doses to Population from Liquid Releases

The LADTAP program in its annual configuration was also used to calculate the total body and organ doses for the population of 760,413 within a 50 mile radius of the plant. Results are shown in Tables VII-E-1 through VII-E-6. 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 sportfish, commercial fish, recreation and biota were calculated based on a distance of two miles downstream as approximately the distance to the nearest recreational facility - DeSoto Bend National Wildlife Refuge.

(2) The total fish harvest for both sport and commercial purposes was calculated using an average commercial fish catch for Nebraska.

E. Direct Radiation Doses to Individuals and Population

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.

TABLE VII-A-1

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 1 RES,VEG
AT 4.58 MILES N

BETA AIR DOSE = 6.65E-05 MILLRADS
GAMMA AIR DOSE = 3.56E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.20E-05	2.20E-05	2.20E-05	2.20E-05	2.20E-05	2.20E-05	2.26E-05	5.05E-05
GROUND	9.59E-08	9.59E-08	9.59E-08	9.59E-08	9.59E-08	9.59E-08	9.59E-08	1.12E-07
VEGET								
ADULT	1.84E-05	1.70E-05	6.02E-06	1.70E-05	1.69E-05	2.17E-05	1.69E-05	1.69E-05
TEEN	2.12E-05	1.95E-05	7.50E-06	1.94E-05	1.94E-05	2.33E-05	1.93E-05	1.93E-05
CHILD	3.30E-05	3.01E-05	1.25E-05	3.01E-05	3.00E-05	3.60E-05	2.99E-05	2.99E-05
INHAL								
ADULT	9.36E-06	9.34E-06	3.01E-07	9.35E-06	9.35E-06	1.06E-05	9.37E-06	9.34E-06
TEEN	9.42E-06	9.40E-06	3.28E-07	9.41E-06	9.41E-06	1.10E-05	9.45E-06	9.40E-06
CHILD	8.33E-06	8.31E-06	3.09E-07	8.32E-06	8.32E-06	9.98E-06	8.36E-06	8.31E-06
INFANT	4.79E-06	4.78E-06	1.27E-07	4.79E-06	4.79E-06	6.28E-06	4.81E-06	4.78E-06

TABLE VII-A-2

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 2 RES,VEG
AT 1.86 MILES NNE

BETA AIR DOSE = 4.07E-04 MILLRADS
GAMMA AIR DOSE = 2.88E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.82E-04	1.82E-04	1.82E-04	1.82E-04	1.82E-04	1.82E-04	1.86E-04	3.79E-04
GROUND	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	6.40E-07
VEGET								
ADULT	1.03E-04	9.52E-05	3.41E-05	9.47E-05	9.44E-05	1.22E-04	9.42E-05	9.41E-05
TEEN	1.18E-04	1.09E-04	4.24E-05	1.09E-04	1.08E-04	1.31E-04	1.08E-04	1.08E-04
CHILD	1.85E-04	1.68E-04	7.06E-05	1.68E-04	1.68E-04	2.02E-04	1.67E-04	1.67E-04
INHAL								
ADULT	5.23E-05	5.22E-05	1.86E-06	5.22E-05	5.22E-05	6.01E-05	5.23E-05	5.22E-05
TEEN	5.26E-05	5.25E-05	2.03E-06	5.26E-05	5.26E-05	6.21E-05	5.28E-05	5.25E-05
CHILD	4.66E-05	4.64E-05	1.91E-06	4.65E-05	4.65E-05	5.64E-05	4.67E-05	4.64E-05
INFANT	2.68E-05	2.67E-05	7.88E-07	2.67E-05	2.67E-05	3.56E-05	2.69E-05	2.67E-05

TABLE VII-A-3

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 3 RES
AT 1.47 MILES NE

BETA AIR DOSE = 6.18E-04 MILLRADS
GAMMA AIR DOSE = 4.53E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.87E-04	2.87E-04	2.87E-04	2.87E-04	2.87E-04	2.87E-04	2.93E-04	5.91E-04
GROUND	7.93E-07	7.93E-07	7.93E-07	7.93E-07	7.93E-07	7.93E-07	7.93E-07	9.27E-07
INHAL ADULT	7.83E-05	7.81E-05	2.85E-06	7.82E-05	7.82E-05	9.03E-05	7.84E-05	7.81E-05
TEEN	7.88E-05	7.86E-05	3.11E-06	7.87E-05	7.87E-05	9.32E-05	7.91E-05	7.86E-05
CHILD	6.97E-05	6.95E-05	2.92E-06	6.96E-05	6.96E-05	8.47E-05	6.99E-05	6.95E-05
INFANT	4.01E-05	4.00E-05	1.20E-06	4.00E-05	4.00E-05	5.35E-05	4.03E-05	4.00E-05

TABLE VII-A-4

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 4 VEG
AT 3.32 MILES NE

BETA AIR DOSE = 1.04E-04 MILLRADS
GAMMA AIR DOSE = 5.93E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.69E-05	3.69E-05	3.69E-05	3.69E-05	3.69E-05	3.69E-05	3.78E-05	8.25E-05
GROUND	1.14E-07	1.14E-07	1.14E-07	1.14E-07	1.14E-07	1.14E-07	1.14E-07	1.33E-07
VEGET								
ADULT	2.75E-05	2.59E-05	7.15E-06	2.58E-05	2.58E-05	3.15E-05	2.57E-05	2.57E-05
TEEN	3.17E-05	2.97E-05	8.90E-06	2.96E-05	2.95E-05	3.43E-05	2.95E-05	2.95E-05
CHILD	4.94E-05	4.58E-05	1.48E-05	4.59E-05	4.57E-05	5.29E-05	4.57E-05	4.56E-05

TABLE VII-A-5

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 5 RES,VEG
AT 4.79 MILES ENE

BETA AIR DOSE = 5.78E-05 MILLRADS
GAMMA AIR DOSE = 2.67E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.68E-05	3.96E-05
GROUND	4.00E-08	4.00E-08	4.00E-08	4.00E-08	4.00E-08	4.00E-08	4.00E-08	4.67E-08
VEGET								
ADULT	1.59E-05	1.54E-05	2.53E-06	1.53E-05	1.53E-05	1.73E-05	1.53E-05	1.53E-05
TEEN	1.83E-05	1.76E-05	3.15E-06	1.76E-05	1.75E-05	1.92E-05	1.75E-05	1.75E-05
CHILD	2.84E-05	2.72E-05	5.24E-06	2.72E-05	2.71E-05	2.96E-05	2.71E-05	2.71E-05
INHAL								
ADULT	8.49E-06	8.47E-06	2.71E-07	8.47E-06	8.47E-06	9.59E-06	8.49E-06	8.47E-06
TEEN	8.54E-06	8.52E-06	2.96E-07	8.53E-06	8.53E-06	9.89E-06	8.56E-06	8.52E-06
CHILD	7.55E-06	7.53E-06	2.79E-07	7.54E-06	7.54E-06	9.02E-06	7.57E-06	7.53E-06
INFANT	4.34E-06	4.33E-06	1.15E-07	4.34E-06	4.34E-06	5.68E-06	4.36E-06	4.33E-06

TABLE VII-A-6

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 6 RES
AT 4.67 MILES E

BETA AIR DOSE = 9.02E-05 MILLRADS
GAMMA AIR DOSE = 4.29E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.62E-05	2.62E-05	2.62E-05	2.62E-05	2.62E-05	2.62E-05	2.71E-05	6.32E-05
GROUND	6.32E-08	6.32E-08	6.32E-08	6.32E-08	6.32E-08	6.32E-08	6.32E-08	7.38E-08
INHAL ADULT	1.31E-05	1.31E-05	4.22E-07	1.31E-05	1.31E-05	1.49E-05	1.31E-05	1.31E-05
TEEN	1.32E-05	1.32E-05	4.61E-07	1.32E-05	1.32E-05	1.53E-05	1.33E-05	1.32E-05
CHILD	1.17E-05	1.17E-05	4.34E-07	1.17E-05	1.17E-05	1.40E-05	1.17E-05	1.17E-05
INFANT	6.72E-06	6.71E-06	1.79E-07	6.72E-06	6.72E-06	8.80E-06	6.76E-06	6.71E-06

TABLE VII-A-7

FORT CALHOUN 1   RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 7 VEG
AT 4.92 MILES E

BETA AIR DOSE = 8.22E-05 MILLRADS
GAMMA AIR DOSE = 3.89E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.38E-05	2.38E-05	2.38E-05	2.38E-05	2.38E-05	2.38E-05	2.46E-05	5.74E-05
GROUND	5.91E-08	5.91E-08	5.91E-08	5.91E-08	5.91E-08	5.91E-08	5.91E-08	6.91E-08
VEGET								
ADULT	2.25E-05	2.17E-05	3.73E-06	2.16E-05	2.16E-05	2.46E-05	2.16E-05	2.16E-05
TEEN	2.59E-05	2.48E-05	4.64E-06	2.48E-05	2.48E-05	2.72E-05	2.47E-05	2.47E-05
CHILD	4.02E-05	3.84E-05	7.73E-06	3.84E-05	3.83E-05	4.21E-05	3.83E-05	3.83E-05

TABLE VII-A-8

FORT CALHOUN 1   RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 8 RES,VEG
AT 4.19 MILES ESE

BETA AIR DOSE = 1.57E-04 MILLRADS
GAMMA AIR DOSE = 7.83E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.81E-05	4.81E-05	4.81E-05	4.81E-05	4.81E-05	4.81E-05	4.96E-05	1.13E-04
GROUND	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.43E-07
VEGET								
ADULT	4.26E-05	4.08E-05	7.70E-06	4.07E-05	4.07E-05	4.68E-05	4.06E-05	4.06E-05
TEEN	4.89E-05	4.68E-05	9.59E-06	4.67E-05	4.66E-05	5.16E-05	4.65E-05	4.65E-05
CHILD	7.60E-05	7.22E-05	1.60E-05	7.23E-05	7.22E-05	7.98E-05	7.21E-05	7.20E-05
INHAL								
ADULT	2.26E-05	2.25E-05	7.34E-07	2.25E-05	2.25E-05	2.56E-05	2.26E-05	2.25E-05
TEEN	2.27E-05	2.27E-05	8.02E-07	2.27E-05	2.27E-05	2.64E-05	2.28E-05	2.26E-05
CHILD	2.01E-05	2.00E-05	7.55E-07	2.00E-05	2.00E-05	2.40E-05	2.01E-05	2.00E-05
INFANT	1.15E-05	1.15E-05	3.11E-07	1.15E-05	1.15E-05	1.51E-05	1.16E-05	1.15E-05

TABLE VII-A-9

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 9 RES.VEG
AT 1.68 MILES SE

BETA AIR DOSE = 9.36E-04 MILLRADS
GAMMA AIR DOSE = 6.51E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.11E-04	4.11E-04	4.11E-04	4.11E-04	4.11E-04	4.11E-04	4.19E-04	8.59E-04
GROUND	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.88E-06
VEGET								
ADULT	2.43E-04	2.21E-04	1.00E-04	2.19E-04	2.19E-04	2.99E-04	2.18E-04	2.18E-04
TEEN	2.81E-04	2.53E-04	1.25E-04	2.52E-04	2.51E-04	3.17E-04	2.50E-04	2.49E-04
CHILD	4.39E-04	3.89E-04	2.08E-04	3.90E-04	3.88E-04	4.89E-04	3.87E-04	3.86E-04
INHAL								
ADULT	1.21E-04	1.21E-04	4.35E-06	1.21E-04	1.21E-04	1.39E-04	1.21E-04	1.21E-04
TEEN	1.22E-04	1.22E-04	4.75E-06	1.22E-04	1.22E-04	1.44E-04	1.22E-04	1.21E-04
CHILD	1.08E-04	1.07E-04	4.46E-06	1.08E-04	1.08E-04	1.31E-04	1.08E-04	1.07E-04
INFANT	6.19E-05	6.18E-05	1.84E-06	6.19E-05	6.19E-05	8.25E-05	6.23E-05	6.18E-05

TABLE VII-A-10

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 10 RES
AT 0.88 MILES SSE

BETA AIR DOSE = 3.37E-03 MILLRADS
GAMMA AIR DOSE = 2.72E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.76E-03	3.47E-03
GROUND	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06	9.83E-06
INHAL								
ADULT	4.10E-04	4.09E-04	1.53E-05	4.09E-04	4.09E-04	4.75E-04	4.10E-04	4.09E-04
TEEN	4.12E-04	4.11E-04	1.68E-05	4.12E-04	4.12E-04	4.90E-04	4.14E-04	4.11E-04
CHILD	3.65E-04	3.64E-04	1.57E-05	3.64E-04	3.64E-04	4.45E-04	3.66E-04	3.64E-04
INFANT	2.10E-04	2.09E-04	6.48E-06	2.09E-04	2.09E-04	2.81E-04	2.11E-04	2.09E-04

TABLE VII-A-11

FORT CALHOUN 1   RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 11 VEG
AT 1.11 MILES SSE

BETA AIR DOSE = 1.92E-03 MILLRADS
GAMMA AIR DOSE = 1.55E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	9.88E-04	9.88E-04	9.88E-04	9.88E-04	9.88E-04	9.88E-04	1.00E-03	1.97E-03
GROUND	4.46E-06	4.46E-06	4.46E-06	4.46E-06	4.46E-06	4.46E-06	4.46E-06	5.21E-06
VEGET								
ADULT	4.92E-04	4.30E-04	2.76E-04	4.26E-04	4.24E-04	6.47E-04	4.22E-04	4.22E-04
TEEN	5.69E-04	4.93E-04	3.43E-04	4.89E-04	4.86E-04	6.69E-04	4.84E-04	4.83E-04
CHILD	8.92E-04	7.56E-04	5.71E-04	7.59E-04	7.53E-04	1.03E-03	7.49E-04	7.48E-04

TABLE VII-A-12

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 12 BEEF
AT 2.51 MILES SSE

BETA AIR DOSE = 2.90E-04 MILLRADS
GAMMA AIR DOSE = 2.03E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.29E-04	1.29E-04	1.29E-04	1.29E-04	1.29E-04	1.29E-04	1.31E-04	2.68E-04
GROUND	5.91E-07	5.91E-07	5.91E-07	5.91E-07	5.91E-07	5.91E-07	[illegible]	6.90E-07
MEAT								
ADULT	9.86E-06	9.71E-06	5.68E-07	9.75E-06	9.73E-06	1.33E-05	9.70[illegible]	[illegible]9E-06
TEEN	5.88E-06	5.79E-06	3.76E-07	5.83E-06	5.81E-06	8.42E-06	5.79E-06	5.78E-06
CHILD	7.11E-06	6.99E-06	5.05E-07	7.05E-06	7.02E-06	1.10E-05	6.99E-06	6.98E-06

TABLE VII-A-13

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 13 RES,VEG
AT 0.72 MILES S

BETA AIR DOSE = 4.55E-03 MILLRADS
GAMMA AIR DOSE = 3.54E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.25E-03	2.25E-03	2.25E-03	2.25E-03	2.25E-03	2.25E-03	2.29E-03	4.55E-03
GROUND	6.55E-06	6.55E-06	6.55E-06	6.55E-06	6.55E-06	6.55E-06	6.55E-06	7.66E-06
VEGET ADULT	1.12E-03	1.03E-03	4.06E-04	1.02E-03	1.02E-03	1.35E-03	1.02E-03	1.02E-03
TEEN	1.29E-03	1.18E-03	5.05E-04	1.17E-03	1.17E-03	1.44E-03	1.16E-03	1.16E-03
CHILD	2.01E-03	1.81E-03	8.41E-04	1.82E-03	1.81E-03	2.22E-03	1.80E-03	1.80E-03
INHAL ADULT	5.64E-04	5.63E-04	2.13E-05	5.63E-04	5.64E-04	6.53E-04	5.65E-04	5.63E-04
TEEN	5.68E-04	5.66E-04	2.33E-05	5.67E-04	5.67E-04	6.74E-04	5.70E-04	5.66E-04
CHILD	5.02E-04	5.01E-04	2.19E-05	5.01E-04	5.01E-04	6.13E-04	5.04E-04	5.01E-04
INFANT	2.89E-04	2.88E-04	9.01E-06	2.88E-04	2.88E-04	3.87E-04	2.90E-04	2.88E-04

TABLE VII-A-14

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 14 BEEF
AT 1.98 MILES S

BETA AIR DOSE = 4.26E-04 MILLRADS
GAMMA AIR DOSE = 3.00E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.90E-04	1.90E-04	1.90E-04	1.90E-04	1.90E-04	1.90E-04	1.94E-04	3.95E-04
GROUND	5.05E-07	5.05E-07	5.05E-07	5.05E-07	5.05E-07	5.05E-07	5.05E-07	5.90E-07
MEAT								
ADULT	1.43E-05	1.42E-05	4.85E-07	1.42E-05	1.42E-05	1.73E-05	1.42E-05	1.42E-05
TEEN	8.54E-06	8.46E-06	3.21E-07	8.49E-06	8.48E-06	1.07E-05	8.46E-06	8.45E-06
CHILD	1.03E-05	1.02E-05	4.32E-07	1.03E-05	1.02E-05	1.36E-05	1.02E-05	1.02E-05

TABLE VII-A-15

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 15 COW
AT 2.74 MILES S

BETA AIR DOSE = 2.02E-04 MILLRADS
GAMMA AIR DOSE = 1.24E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.79E-05	7.79E-05	7.79E-05	7.79E-05	7.79E-05	7.79E-05	7.97E-05	1.70E-04
GROUND	2.38E-07	2.38E-07	2.38E-07	2.38E-07	2.38E-07	2.38E-07	2.38E-07	2.77E-07
COW MILK								
ADULT	1.68E-05	1.66E-05	7.31E-07	1.68E-05	1.67E-05	3.68E-05	1.66E-05	1.66E-05
TEEN	2.19E-05	2.16E-05	1.09E-06	2.19E-05	2.18E-05	5.36E-05	2.16E-05	2.16E-05
CHILD	3.46E-05	3.41E-05	2.01E-06	3.47E-05	3.45E-05	9.74E-05	3.41E-05	3.41E-05
INFANT	5.24E-05	5.18E-05	2.58E-06	5.30E-05	5.25E-05	2.05E-04	5.18E-05	5.17E-05

TABLE VII-A-16

FORT CALHOUN 1   RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 16 RES
AT 0.63 MILES SSW

BETA AIR DOSE = 2.95E-03 MILLRADS
GAMMA AIR DOSE = 2.40E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.53E-03	1.53E-03	1.53E-03	1.53E-03	1.53E-03	1.53E-03	1.56E-03	3.06E-03
GROUND	2.71E-07	2.71E-07	2.71E-07	2.71E-07	2.71E-07	2.71E-07	2.71E-07	3.17E-07
INHAL								
ADULT	3.58E-04	3.57E-04	1.37E-05	3.57E-04	3.57E-04	4.15E-04	3.58E-04	3.57E-04
TEEN	3.60E-04	3.59E-04	1.50E-05	3.59E-04	3.60E-04	4.29E-04	3.61E-04	3.59E-04
CHILD	3.18E-04	3.17E-04	1.41E-05	3.18E-04	3.18E-04	3.89E-04	3.19E-04	3.17E-04
INFANT	1.83E-04	1.83E-04	5.79E-06	1.83E-04	1.83E-04	2.46E-04	1.84E-04	1.82E-04

TABLE VII-A-17

FORT CALHOUN 1   RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 17 VEG
AT 1.14 MILES SSW

BETA AIR DOSE = 8.22E-04 MILLRADS
GAMMA AIR DOSE = 6.30E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.01E-04	4.01E-04	4.01E-04	4.01E-04	4.01E-04	4.01E-04	4.08E-04	8.13E-04
GROUND	3.16E-07	3.16E-07	3.16E-07	3.16E-07	3.16E-07	3.16E-07	3.16E-07	3.69E-07
VEGET								
ADULT	1.89E-04	1.85E-04	1.96E-05	1.85E-04	1.85E-04	2.00E-04	1.84E-04	1.84E-04
TEEN	2.17E-04	2.12E-04	2.44E-05	2.12E-04	2.11E-04	2.24E-04	2.11E-04	2.11E-04
CHILD	3.37E-04	3.27E-04	4.06E-05	3.28E-04	3.27E-04	3.47E-04	3.27E-04	3.27E-04

TABLE VII-A-18

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 18 BEEF
AT 1.99 MILES SSW

BETA AIR DOSE = 2.14E-04 MILLRADS
GAMMA AIR DOSE = 1.49E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	9.45E-05	9.45E-05	9.45E-05	9.45E-05	9.45E-05	9.45E-05	9.63E-05	1.97E-04
GROUND	2.95E-07	2.95E-07	2.95E-07	2.95E-07	2.95E-07	2.95E-07	2.95E-07	3.45E-07
MEAT								
ADULT	7.24E-06	7.16E-06	2.84E-07	7.19E-06	7.17E-06	8.98E-06	7.16E-06	7.16E-06
TEEN	4.32E-06	4.27E-06	1.88E-07	4.29E-06	4.28E-06	5.59E-06	4.27E-06	4.27E-06
CHILD	5.22E-06	5.16E-06	2.53E-07	5.19E-06	5.17E-06	7.15E-06	5.16E-06	5.16E-06

TABLE VII-A-19

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 19 RES
AT 0.72 MILES SW

BETA AIR DOSE = 2.09E-03 MILLRADS
GAMMA AIR DOSE = 1.74E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.13E-03	2.20E-03
GROUND	5.61E-07	5.61E-07	5.61E-07	5.61E-07	5.61E-07	5.61E-07	5.61E-07	6.55E-07
INHAL ADULT	2.50E-04	2.50E-04	9.49E-06	2.50E-04	2.50E-04	2.91E-04	2.51E-04	2.50E-04
TEEN	2.52E-04	2.51E-04	1.04E-05	2.52E-04	2.52E-04	3.00E-04	2.53E-04	2.51E-04
CHILD	2.23E-04	2.22E-04	9.73E-06	2.22E-04	2.22E-04	2.72E-04	2.24E-04	2.22E-04
INFANT	1.28E-04	1.28E-04	4.01E-06	1.28E-04	1.28E-04	1.72E-04	1.29E-04	1.28E-04

TABLE VII-A-20

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 20 BEEF
AT 0.82 MILES SW

BETA AIR DOSE = 1.56E-03 MILLRADS
GAMMA AIR DOSE = 1.27E-03 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	8.13E-04	8.13E-04	8.13E-04	8.13E-04	8.13E-04	8.13E-04	8.26E-04	1.62E-03
GROUND	2.36E-06	2.36E-06	2.36E-06	2.36E-06	2.36E-06	2.36E-06	2.36E-06	2.75E-06
MEAT								
ADULT	4.94E-05	4.88E-05	2.25E-06	4.90E-05	4.89E-05	6.32E-05	4.88E-05	4.87E-05
TEEN	2.95E-05	2.91E-05	1.49E-06	2.93E-05	2.92E-05	3.96E-05	2.91E-05	2.91E-05
CHILD	3.56E-05	3.52E-05	2.00E-06	3.54E-05	3.53E-05	5.10E-05	3.51E-05	3.51E-05

TABLE VII-A-21

PORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 21 VEG
AT 2.35 MILES SW

BETA AIR DOSE = 1.34E-04 MILLRADS
GAMMA AIR DOSE = 9.24E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	5.84E-05	5.84E-05	5.84E-05	5.84E-05	5.84E-05	5.84E-05	5.95E-05	1.22E-04
GROUND	9.39E-09	9.39E-09	9.39E-09	9.39E-09	9.39E-09	9.39E-09	9.39E-09	1.10E-08
VEGET								
ADULT	3.15E-05	3.14E-05	5.84E-07	3.14E-05	3.14E-05	3.18E-05	3.13E-05	3.13E-05
TEEN	3.61E-05	3.59E-05	7.27E-07	3.59E-05	3.59E-05	3.63E-05	3.59E-05	3.59E-05
CHILD	5.59E-05	5.56E-05	1.21E-06	5.56E-05	5.56E-05	5.62E-05	5.56E-05	5.56E-05

TABLE VII-A-22

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 22 RES
AT 1.05 MILES WSW

BETA AIR DOSE = 7.22E-04 MILLRADS
GAMMA AIR DOSE = 5.87E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.75E-04	3.75E-04	3.75E-04	3.75E-04	3.75E-04	3.75E-04	3.81E-04	7.47E-04
GROUND	2.79E-08	2.79E-08	2.79E-08	2.79E-08	2.79E-08	2.79E-08	2.79E-08	3.26E-08
INHAL ADULT	8.76E-05	8.74E-05	3.26E-06	8.75E-05	8.75E-05	1.02E-04	8.77E-05	8.74E-05
TEEN	8.82E-05	8.80E-05	3.57E-06	8.81E-05	8.81E-05	1.05E-04	8.85E-05	8.79E-05
CHILD	7.80E-05	7.78E-05	3.35E-06	7.79E-05	7.79E-05	9.51E-05	7.82E-05	7.78E-05
INFANT	4.48E-05	4.47E-05	1.38E-06	4.48E-05	4.48E-05	6.01E-05	4.51E-05	4.47E-05

TABLE VII-A-23

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 23 VEG
AT 1.23 MILES WSW

BETA AIR DOSE = 4.88E-04 MILLRADS
GAMMA AIR DOSE = 3.82E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.43E-04	2.43E-04	2.43E-04	2.43E-04	2.43E-04	2.43E-04	2.47E-04	4.90E-04
GROUND	1.03E-07	1.03E-07	1.03E-07	1.03E-07	1.03E-07	1.03E-07	1.03E-07	1.21E-07
VEGET								
ADULT	1.10E-04	1.09E-04	6.39E-06	1.09E-04	1.08E-04	1.14E-04	1.08E-04	1.08E-04
TEEN	1.26E-04	1.24E-04	7.96E-06	1.24E-04	1.24E-04	1.28E-04	1.24E-04	1.24E-04
CHILD	1.96E-04	1.92E-04	1.33E-05	1.93E-04	1.92E-04	1.99E-04	1.92E-04	1.92E-04

TABLE VII-A-24

PORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 24 BEEF
AT 2.45 MILES WSW

BETA AIR DOSE = 9.67E-05 MILLRADS
GAMMA AIR DOSE = 6.44E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.06E-05	4.06E-05	4.06E-05	4.06E-05	4.06E-05	4.06E-05	4.14E-05	8.60E-05
GROUND	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.46E-07
MEAT								
ADULT	3.32E-06	3.29E-06	1.20E-07	3.30E-06	3.29E-06	4.06E-06	3.29E-06	3.29E-06
TEEN	1.98E-06	1.96E-06	7.94E-08	1.97E-06	1.97E-06	2.52E-06	1.96E-06	1.96E-06
CHILD	2.40E-06	2.37E-06	1.07E-07	2.38E-06	2.38E-06	3.21E-06	2.37E-06	2.37E-06

TABLE VII-A-25

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 25 RES
AT 1.17 MILES W

BETA AIR DOSE = 6.32E-04 MILLRADS
GAMMA AIR DOSE = 4.65E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04	3.00E-04	6.06E-04
GROUND	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.30E-06
INHAL								
ADULT	8.00E-05	7.98E-05	2.92E-06	7.98E-05	7.99E-05	9.22E-05	8.00E-05	7.97E-05
TEEN	8.05E-05	8.03E-05	3.19E-06	8.04E-05	8.04E-05	9.52E-05	8.07E-05	8.02E-05
CHILD	7.12E-05	7.10E-05	3.00E-06	7.10E-05	7.11E-05	8.65E-05	7.14E-05	7.10E-05
INFANT	4.09E-05	4.08E-05	1.23E-06	4.09E-05	4.09E-05	5.46E-05	4.11E-05	4.08E-05

TABLE VII-A-26

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 26 VEG
AT 1.20 MILES W

BETA AIR DOSE = 6.52E-04 MILLRADS
GAMMA AIR DOSE = 5.26E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.35E-04	3.35E-04	3.35E-04	3.35E-04	3.35E-04	3.35E-04	3.41E-04	6.70E-04
GROUND	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.11E-06	1.30E-06
VEGET								
ADULT	1.60E-04	1.45E-04	6.86E-05	1.44E-04	1.44E-04	1.99E-04	1.43E-04	1.43E-04
TEEN	1.85E-04	1.66E-04	8.54E-05	1.65E-04	1.64E-04	2.10E-04	1.64E-04	1.64E-04
CHILD	2.89E-04	2.55E-04	1.42E-04	2.56E-04	2.55E-04	3.24E-04	2.54E-04	2.53E-04

TABLE VII-A-27

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 27 BEEF
AT 2.06 MILES W

BETA AIR DOSE = 1.79E-04 MILLRADS
GAMMA AIR DOSE = 1.31E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	8.29E-05	8.29E-05	8.29E-05	8.29E-05	8.29E-05	8.29E-05	8.45E-05	1.71E-04
GROUND	2.73E-07	2.73E-07	2.73E-07	2.73E-07	2.73E-07	2.73E-07	2.73E-07	3.19E-07
MEAT								
ADULT	5.97E-06	5.90E-06	2.62E-07	5.92E-06	5.91E-06	7.58E-06	5.90E-06	5.89E-06
TEEN	3.56E-06	3.52E-06	1.73E-07	3.54E-06	3.53E-06	4.73E-06	3.52E-06	3.52E-06
CHILD	4.31E-06	4.25E-06	2.33E-07	4.28E-06	4.26E-06	6.09E-06	4.25E-06	4.25E-06

TABLE VII-A-28

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 28 RES,VEG
AT 2.04 MILES WNW

BETA AIR DOSE = 3.29E-04 MILLRADS
GAMMA AIR DOSE = 2.40E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.52E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04	1.55E-04	3.14E-04
GROUND	5.28E-07	5.28E-07	5.28E-07	5.28E-07	5.28E-07	5.28E-07	5.28E-07	6.17E-07
VEGET ADULT	8.36E-05	7.63E-05	3.28E-05	7.58E-05	7.56E-05	1.02E-04	7.54E-05	7.53E-05
TEEN	9.65E-05	8.74E-05	4.08E-05	8.70E-05	8.66E-05	1.08E-04	8.63E-05	8.62E-05
CHILD	1.51E-04	1.34E-04	6.80E-05	1.35E-04	1.34E-04	1.67E-04	1.34E-04	1.34E-04
INHAL ADULT	4.18E-05	4.17E-05	1.48E-06	4.18E-05	4.18E-05	4.81E-05	4.19E-05	4.17E-05
TEEN	4.21E-05	4.20E-05	1.61E-06	4.20E-05	4.21E-05	4.97E-05	4.22E-05	4.20E-05
CHILD	3.72E-05	3.71E-05	1.52E-06	3.72E-05	3.72E-05	4.51E-05	3.74E-05	3.71E-05
INFANT	2.14E-05	2.14E-05	6.25E-07	2.14E-05	2.14E-05	2.85E-05	2.15E-05	2.14E-05

TABLE VII-A-29

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 29 BEEF
AT 2.74 MILES WNW

BETA AIR DOSE = 1.74E-04 MILLRADS
GAMMA AIR DOSE = 1.19E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.51E-05	7.51E-05	7.51E-05	7.51E-05	7.51E-05	7.51E-05	7.66E-05	1.58E-04
GROUND	2.67E-07	2.67E-07	2.67E-07	2.67E-07	2.67E-07	2.67E-07	2.67E-07	3.12E-07
MEAT								
ADULT	5.93E-06	5.86E-06	2.57E-07	5.88E-06	5.87E-06	7.50E-06	5.85E-06	5.85E-06
TEEN	3.54E-06	3.50E-06	1.70E-07	3.51E-06	3.50E-06	4.69E-06	3.49E-06	3.49E-06
CHILD	4.27E-06	4.22E-06	2.29E-07	4.25E-06	4.23E-06	6.02E-06	4.22E-06	4.22E-06

TABLE VII-A-30

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 30 RES,VEG
AT 2.43 MILES NW

BETA AIR DOSE = 2.74E-04 MILLRADS
GAMMA AIR DOSE = 1.90E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.22E-04	2.51E-04
GROUND	4.14E-07	4.14E-07	4.14E-07	4.14E-07	4.14E-07	4.14E-07	4.14E-07	4.83E-07
VEGET								
ADULT	7.05E-05	6.47E-05	2.58E-05	6.44E-05	6.42E-05	8.49E-05	6.40E-05	6.40E-05
TEEN	8.13E-05	7.42E-05	3.21E-05	7.38E-05	7.35E-05	9.06E-05	7.33E-05	7.33E-05
CHILD	1.27E-04	1.14E-04	5.34E-05	1.14E-04	1.14E-04	1.40E-04	1.14E-04	1.13E-04
INHAL								
ADULT	3.55E-05	3.55E-05	1.23E-06	3.55E-05	3.55E-05	4.08E-05	3.56E-05	3.54E-05
TEEN	3.58E-05	3.57E-05	1.35E-06	3.57E-05	3.57E-05	4.21E-05	3.59E-05	3.57E-05
CHILD	3.16E-05	3.16E-05	1.26E-06	3.16E-05	3.16E-05	3.82E-05	3.17E-05	3.15E-05
INFANT	1.82E-05	1.81E-05	5.21E-07	1.82E-05	1.82E-05	2.41E-05	1.83E-05	1.81E-05

TABLE VII-A-31

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 31 COW,PORK,BEEF
AT 3.47 MILES NW

BETA AIR DOSE = 1.30E-04 MILLRADS
GAMMA AIR DOSE = 8.28E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	5.20E-05	5.20E-05	5.20E-05	5.20E-05	5.20E-05	5.20E-05	5.31E-05	1.12E-04
GROUND	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07	2.05E-07
MEAT								
ADULT	4.54E-06	4.50E-06	1.70E-07	4.51E-06	4.50E-06	5.58E-06	4.49E-06	4.49E-06
TEEN	2.71E-06	2.68E-06	1.12E-07	2.69E-06	2.69E-06	3.47E-06	2.68E-06	2.68E-06
CHILD	3.27E-06	3.24E-06	1.51E-07	3.26E-06	3.25E-06	4.43E-06	3.24E-06	3.24E-06
COW MILK								
ADULT	1.07E-05	1.06E-05	5.41E-07	1.07E-05	1.07E-05	2.55E-05	1.06E-05	1.05E-05
TEEN	1.40E-05	1.38E-05	8.04E-07	1.40E-05	1.39E-05	3.75E-05	1.38E-05	1.37E-05
CHILD	2.21E-05	2.17E-05	1.49E-06	2.21E-05	2.20E-05	6.85E-05	2.17E-05	2.17E-05
INFANT	3.34E-05	3.30E-05	1.91E-06	3.38E-05	3.35E-05	1.47E-04	3.30E-05	3.29E-05

TABLE VII-A-32

FORT CALHOUN 1   RECEPTORS IN ALL SECTORS   02-16-94
SPECIAL LOCATION # 32   RES
AT 2.02 MILES NNW

BETA AIR DOSE = 3.60E-04 MILLRADS
GAMMA AIR DOSE = 2.49E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.60E-04	3.29E-04
GROUND	6.64E-07	6.64E-07	6.64E-07	6.64E-07	6.64E-07	6.64E-07	6.64E-07	7.75E-07
INHAL								
ADULT	4.68E-05	4.67E-05	1.66E-06	4.67E-05	4.67E-05	5.37E-05	4.68E-05	4.66E-05
TEEN	4.71E-05	4.70E-05	1.81E-06	4.70E-05	4.70E-05	5.54E-05	4.72E-05	4.69E-05
CHILD	4.16E-05	4.15E-05	1.70E-06	4.16E-05	4.16E-05	5.04E-05	4.18E-05	4.15E-05
INFANT	2.39E-05	2.39E-05	7.01E-07	2.39E-05	2.39E-05	3.18E-05	2.41E-05	2.39E-05

TABLE VII-A-33

FORT CALHOUN 1 RECEPTORS IN ALL SECTORS 02-16-94
SPECIAL LOCATION # 33 VEG
AT 4.14 MILES NNW

BETA AIR DOSE = 7.87E-05 MILLRADS
GAMMA AIR DOSE = 4.48E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.78E-05	2.78E-05	2.78E-05	2.78E-05	2.78E-05	2.78E-05	2.86E-05	6.24E-05
GROUND	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.25E-07	1.45E-07
VEGET ADULT	2.16E-05	1.98E-05	7.81E-06	1.97E-05	1.97E-05	2.59E-05	1.96E-05	1.96E-05
TEEN	2.49E-05	2.27E-05	9.73E-06	2.26E-05	2.25E-05	2.77E-05	2.25E-05	2.25E-05
CHILD	3.89E-05	3.50E-05	1.62E-05	3.51E-05	3.49E-05	4.27E-05	3.48E-05	3.48E-05

TABLE VII-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, 1993 TO DECEMBER 31, 1993

MAXIMUM SITE BOUNDARY GAMMA AIR DOSE = 2.31E-03 MILLIRAD

MAXIMUM SITE BOUNDARY BETA AIR DOSE = 2.74E-03 MILLIRAD

TABLE VII-C-1

FORT CALHOUN SEMIANNUAL 01/93-12/93 TRI-EX TOWER DATA 02-05-94
ALARA INTEGRATED POPULATION DOSE SUMMARY (MANREM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.02E-03 32.00%	1.02E-03 32.73%	1.02E-03 75.45%	1.02E-03 32.71%	1.02E-03 32.74%	1.02E-03 24.85%	1.08E-03 33.90%	3.07E-03 59.36%
GROUND	5.56E-06 0.17%	5.56E-06 0.18%	5.56E-06 0.41%	5.56E-06 0.18%	5.56E-06 0.18%	5.56E-06 0.13%	5.56E-06 0.17%	6.49E-06 0.13%
INHAL	8.27E-04 25.82%	8.26E-04 26.37%	2.37E-05 1.75%	8.26E-04 26.35%	8.26E-04 26.38%	9.36E-04 22.70%	8.28E-04 26.04%	8.25E-04 15.98%
VEGET	9.32E-04 29.11%	8.67E-04 27.68%	2.86E-04 21.08%	8.66E-04 27.63%	8.64E-04 27.60%	1.43E-03 34.70%	8.60E-04 27.05%	8.60E-04 16.64%
COW MILK	2.17E-04 6.78%	2.14E-04 6.84%	1.10E-05 0.81%	2.17E-04 6.92%	2.16E-04 6.90%	4.88E-04 11.83%	2.14E-04 6.74%	2.14E-04 4.14%
MEAT	1.96E-04 6.11%	1.94E-04 6.20%	6.78E-06 0.50%	1.95E-04 6.21%	1.94E-04 6.21%	2.39E-04 5.79%	1.94E-04 6.10%	1.94E-04 3.75%
TOTAL	3.20E-03	3.13E-03	1.36E-03	3.13E-03	3.13E-03	4.12E-03	3.18E-03	5.16E-03

TABLE VII-D-1

FT. CALHOUN SEMIANNUAL   RELEASES FOR JAN 1993 TO DEC 1993 02-05-93   RETS

DISCHARGE=8.02E+02 CFS SOURCE TERM MULTIPLIER=1.00E+00
50-MILE POPULATION=7.60E+05 FRACTION --- ADULT=0.66
TEENAGER=0.14
CHILD=0.20

FRESHWATER SITE
FT. CALHOUN S. TERMS01/93-12/93
NO RECONCENTRATION OF NUCLIDES

* * * ADULT DOSE FACTORS * * *

		INGESTION DOSE FACTORS (MREM/PCI INTAKE)							SHORELINE (MREM/HR)/(PCI/M**2)		
NUCLIDE	CURIE/YR	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY	RECON
47AG 110M	4.46E-03	1.60E-07	1.48E-07	8.79E-08	0.00E+00	2.91E-07	0.00E+00	6.04E-05	2.10E-08	1.80E-08	1.00E+00
56BA 140	1.63E-04	2.03E-05	2.55E-08	1.33E-06	0.00E+00	8.67E-09	1.46E-08	4.18E-05	2.40E-09	2.10E-09	1.00E+00
4BE 7	7.94E-05	2.74E-09	6.21E-09	3.05E-09	0.00E+00	6.56E-09	0.00E+00	1.08E-06	0.00E+00	0.00E+00	1.00E+00
6C 14	1.71E+01	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	0.00E+00	0.00E+00	1.00E+00
58CE 141	1.10E-04	9.36E-09	6.33E-09	7.18E-10	0.00E+00	2.94E-09	0.00E+00	2.42E-05	6.20E-10	5.50E-10	1.00E+00
58CE 144	1.86E-04	4.88E-07	2.04E-07	2.62E-08	0.00E+00	1.21E-07	0.00E+00	1.65E-04	3.70E-10	3.20E-10	1.00E+00
27CO 57	1.73E-04	0.00E+00	1.75E-07	2.91E-07	0.00E+00	0.00E+00	0.00E+00	4.44E-06	1.00E-09	9.10E-10	1.00E+00
27CO 58	1.21E-01	0.00E+00	7.45E-07	1.67E-06	0.00E+00	0.00E+00	0.00E+00	1.51E-05	8.20E-09	7.00E-09	1.00E+00
27CO 60	6.01E-03	0.00E+00	2.14E-06	4.72E-06	0.00E+00	0.00E+00	0.00E+00	4.02E-05	2.00E-08	1.70E-08	1.00E+00
24CR 51	1.46E-02	0.00E+00	0.00E+00	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07	2.60E-10	2.20E-10	1.00E+00
55CS 134	1.29E-03	6.22E-05	1.48E-04	1.21E-04	0.00E+00	4.79E-05	1.59E-05	2.59E-06	1.40E-08	1.20E-08	1.00E+00
55CS 137	6.32E-03	7.97E-05	1.09E-04	7.14E-05	0.00E+00	3.70E-05	1.23E-05	2.11E-06	4.90E-09	4.20E-09	1.00E+00
26FE 55	1.79E-01	2.75E-06	1.90E-06	4.43E-07	0.00E+00	0.00E+00	1.06E-06	1.09E-06	0.00E+00	0.00E+00	1.00E+00
26FE 59	2.36E-04	4.34E-06	1.02E-05	3.91E-06	0.00E+00	0.00E+00	2.85E-06	3.40E-05	9.40E-09	8.00E-09	1.00E+00
1H 3	2.17E+02	0.00E+00	1.0[illegible]E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	0.00E+00	0.00E+00	1.00E+00
72HF 181	4.82E-05	4.70E-09	2.56E-08	2.08E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
53I 129	6.27E-05	3.27E-06	2.81E-06	9.21E-06	7.23E-03	6.04E-06	0.00E+00	4.44E-07	7.50E-10	4.50E-10	1.00E+00
53I 131	7.90E-03	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	0.00E+00	1.57E-06	3.40E-09	2.80E-09	1.00E+00
53I 132	2.06E-05	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	0.00E+00	1.02E-07	2.00E-08	1.70E-08	1.00E+00
53I 133	2.38E-04	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	0.00E+00	2.22E-06	4.50E-09	3.70E-09	1.00E+00
57LA 140	8.88E-04	2.50E-09	1.26E-09	3.33E-10	0.00E+00	0.00E+00	0.00E+00	9.25E-05	1.70E-08	1.50E-08	1.00E+00
57LA 141	4.52E-05	3.19E-10	9.90E-11	1.62E-11	0.00E+00	0.00E+00	0.00E+00	1.18E-05	2.80E-10	2.50E-10	1.00E+00
25MN 54	8.46E-04	0.00E+00	4.57E-06	8.72E-07	0.00E+00	1.36E-06	0.00E+00	1.40E-05	6.80E-09	5.80E-09	1.00E+00
42MO 99	3.27E-05	0.00E+00	4.31E-06	8.20E-07	0.00E+00	9.76E-06	0.00E+00	9.99E-06	2.20E-09	1.90E-09	1.00E+00
41NB 95	6.03E-03	6.22E-09	3.46E-09	1.86E-09	0.00E+00	3.42E-09	0.00E+00	2.10E-05	6.00E-09	5.10E-09	1.00E+00
28NI 63	3.68E-04	1.30E-04	9.01E-06	4.36E-06	0.00E+00	0.00E+00	0.00E+00	1.88E-06	0.00E+00	0.00E+00	1.00E+00
15P 32	9.37E-06	1.93E-04	1.20E-05	7.46E-06	0.00E+00	0.00E+00	0.00E+00	2.17E-05	0.00E+00	0.00E+00	1.00E+00
59PR 144	1.86E-04	4.88E-07	2.04E-07	2.62E-08	0.00E+00	1.21E-07	0.00E+00	1.65E-04	3.70E-10	3.20E-10	1.00E+00
45RH 103M	2.77E-04	1.85E-07	0.00E+00	7.97E-08	0.00E+00	7.06E-07	0.00E+00	2.16E-05	4.20E-09	3.60E-09	1.00E+00
44RU 103	2.77E-04	1.85E-07	0.00E+00	7.97E-08	0.00E+00	7.06E-07	0.00E+00	2.16E-05	4.20E-09	3.60E-09	1.00E+00
45RH 106	1.06E-04	2.75E-06	0.00E+00	3.48E-07	0.00E+00	5.31E-06	0.00E+00	1.78E-04	1.80E-09	1.50E-09	1.00E+00
44RU 106	1.06E-04	2.75E-06	0.00E+00	3.48E-07	0.00E+00	5.31E-06	0.00E+00	1.78E-04	1.80E-09	1.50E-09	1.00E+00
51SB 122	2.95E-04	2.25E-07	4.41E-09	6.55E-08	3.16E-09	0.00E+00	1.17E-07	6.59E-05	0.00E+00	0.00E+00	1.00E+00
51SB 124	1.88E-02	2.80E-06	5.29E-08	1.11E-06	6.79E-09	0.00E+00	2.18E-06	7.95E-05	1.50E-08	1.30E-08	1.00E+00
51SB 125	8.06E-02	1.79E-06	2.00E-08	4.26E-07	1.82E-09	0.00E+00	1.38E-06	1.97E-05	3.50E-09	3.10E-09	1.00E+00
51SB 126	4.65E-04	1.15E-06	2.34E-08	4.15E-07	7.04E-09	0.00E+00	7.05E-07	9.40E-05	1.00E-08	8.90E-09	1.00E+00
34SE 75	1.01E-03	0.00E+00	4.90E-06	1.91E-06	0.00E+00	7.15E-06	0.00E+00	7.15E-07	0.00E+00	0.00E+00	1.00E+00
50SN 113	2.08E-04	7.91E-06	2.18E-07	4.53E-07	1.29E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
38SR 89	4.89E-04	3.08E-04	0.00E+00	8.84E-06	0.00E+00	0.00E+00	0.00E+00	4.94E-05	6.50E-13	5.60E-13	1.00E+00
38SR 90	7.51E-04	7.58E-03	0.00E+00	1.86E-03	0.00E+00	0.00E+00	0.00E+00	2.19E-04	0.00E+00	0.00E+00	1.00E+00
43TC 99M	3.27E-05	2.47E-10	6.98E-10	8.89E-09	0.00E+00	1.06E-08	3.42E-10	4.13E-07	1.10E-09	9.60E-10	1.00E+00
52TE 132	2.11E-05	2.52E-05	1.63E-06	1.53E-06	1.80E-06	1.57E-05	0.00E+00	7.71E-05	2.00E-09	1.70E-09	1.00E+00
39Y 90	7.71E-05	9.62E-09	0.00E+00	2.58E-10	0.00E+00	0.00E+00	0.00E+00	1.02E-04	2.60E-12	2.20E-12	1.00E+00
30ZN 65	4.07E-05	4.84E-06	1.54E-05	6.96E-06	0.00E+00	1.03E-05	0.00E+00	9.70E-06	4.60E-09	4.00E-09	1.00E+00
40ZR 95	3.93E-03	3.04E-08	9.75E-09	6.60E-09	0.00E+00	1.53E-08	0.00E+00	3.09E-05	5.80E-09	5.00E-09	1.00E+00

TABLE VII-D-1

* * * TEENAGER DOSE FACTORS * * *

NUCLIDE	CURIE/YR	INGESTION DOSE FACTORS (MREM/PCI INTAKE) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SHORELINE (MREM/HR)/(PCI/M**2) SKIN	TOTAL BODY	RECON
47AG 110M	4.46E-03	2.05E-07	1.94E-07	1.18E-07	0.00E+00	3.70E-07	0.00E+00	5.45E-05			
56BA 140	1.63E-04	2.84E-05	3.48E-08	1.83E-06	0.00E+00	1.18E-08	2.34E-08	4.38E-05			
4BE 7	7.94E-05	3.92E-09	8.79E-09	4.35E-09	0.00E+00	9.37E-09	0.00E+00	1.08E-06			
6C 14	1.71E+01	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07			
58CE 141	1.10E-04	1.33E-08	8.88E-09	1.02E-09	0.00E+00	4.18E-09	0.00E+00	2.54E-05			
58CE 144	1.86E-04	6.96E-07	2.88E-07	3.74E-08	0.00E+00	1.72E-07	0.00E+00	1.75E-04			
27CO 58	1.21E-01	0.00E+00	9.72E-07	2.24E-06	0.00E+00	0.00E+00	0.00E+00	1.34E-05			
27CO 60	6.01E-03	0.00E+00	2.81E-06	6.33E-06	0.00E+00	0.00E+00	0.00E+00	3.66E-05			
55CS 134	1.29E-03	8.37E-05	1.97E-04	9.14E-05	0.00E+00	6.26E-05	2.39E-05	2.45E-06			
55CS 137	6.32E-03	1.12E-04	1.49E-04	5.19E-05	0.00E+00	5.07E-05	1.97E-05	2.12E-06			
1H 3	2.17E+02	0.00E+00	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07			
72HF 181	4.82E-05	6.72E-09	3.63E-08	2.97E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00			
53I 129	6.27E-05	4.66E-06	3.92E-06	6.54E-06	4.77E-03	7.01E-06	0.00E+00	4.57E-07			
53I 131	7.90E-03	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	0.00E+00	1.62E-06			
53I 133	2.38E-04	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	0.00E+00	2.58E-06			
57LA 140	8.88E-04	3.48E-09	1.71E-09	4.55E-10	0.00E+00	0.00E+00	0.00E+00	9.82E-05			
41NB 95	6.03E-03	8.22E-09	4.56E-09	2.51E-09	0.00E+00	4.42E-09	0.00E+00	1.95E-05			
59PR 144	1.86E-04	6.96E-07	2.88E-07	3.74E-08	0.00E+00	1.72E-07	0.00E+00	1.75E-04			
45RH 103M	2.77E-04	2.55E-07	0.00E+00	1.09E-07	0.00E+00	8.99E-07	0.00E+00	2.13E-05			
44RU 103	2.77E-04	2.55E-07	0.00E+00	1.09E-07	0.00E+00	8.99E-07	0.00E+00	2.13E-05			
45RH 106	1.06E-04	3.92E-06	0.00E+00	4.94E-07	0.00E+00	7.56E-06	0.00E+00	1.88E-04			
44RU 106	1.06E-04	3.92E-06	0.00E+00	4.94E-07	0.00E+00	7.56E-06	0.00E+00	1.88E-04			
51SB 122	2.95E-04	3.21E-07	6.24E-09	9.35E-08	4.22E-09	0.00E+00	2.02E-07	6.91E-05			
34SE 75	1.01E-03	0.00E+00	6.95E-06	2.74E-06	0.00E+00	1.02E-05	0.00E+00	7.15E-07			
50SN 113	2.08E-04	1.13E-05	3.08E-07	6.48E-07	1.72E-07	0.00E+00	0.00E+00	0.00E+00			
38SR 89	4.89E-04	4.40E-04	0.00E+00	1.26E-05	0.00E+00	0.00E+00	0.00E+00	5.24E-05			
38SR 90	7.51E-04	8.30E-03	0.00E+00	2.05E-03	0.00E+00	0.00E+00	0.00E+00	2.33E-04			
52TE 132	2.11E-05	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	0.00E+00	7.00E-05			
39Y 90	7.71E-05	1.37E-08	0.00E+00	3.69E-10	0.00E+00	0.00E+00	0.00E+00	1.13E-04			
40ZR 95	3.93E-03	4.12E-08	1.30E-08	8.94E-09	0.00E+00	1.91E-08	0.00E+00	3.00E-05			

TABLE VII-D-1

* * * CHILD DOSE FACTORS * * *

	(MREM/PCI INTAKE)	INGESTION DOSE FACTORS						SHORELINE (MREM/HR)/(PCI/M**2)		
NUCLIDS	CURIE/YR	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY	RECON
47AG 110M	4.46E-03	5.39E-07	3.64E-07	2.91E-07	0.00E+00	6.78E-07	0.00E+00	4.33E-05			
56BA 140	1.63E-04	8.31E-05	7.28E-08	4.85E-06	0.00E+00	2.37E-08	4.34E-08	4.21E-05			
4BE 7	7.94E-05	1.17E-08	1.99E-08	1.30E-08	0.00E+00	1.97E-08	0.00E+00	1.12E-06			
6C 14	1.71E+01	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06			
58CE 141	1.10E-04	3.97E-08	1.98E-08	2.94E-09	0.00E+00	8.68E-09	0.00E+00	2.47E-05			
58CE 144	1.86E-04	2.08E-06	6.52E-07	1.11E-07	0.00E+00	3.61E-07	0.00E+00	1.70E-04			
27CO 58	1.21E-01	0.00E+00	1.80E-06	5.51E-06	0.00E+00	0.00E+00	0.00E+00	1.05E-05			
27CO 60	6.01E-03	0.00E+00	5.29E-06	1.56E-05	0.00E+00	0.00E+00	0.00E+00	2.93E-05			
55CS 134	1.29E-03	2.34E-04	3.84E-04	8.10E-05	0.00E+00	1.19E-04	4.27E-05	2.07E-06			
55CS 137	6.32E-03	3.27E-04	3.13E-04	4.62E-05	0.00E+00	1.02E-04	3.67E-05	1.96E-06			
1H 3	2.17E+02	0.00E+00	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07			
72HF 181	4.82E-05	2.01E-08	8.22E-08	8.88E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00			
53I 129	6.27E-05	1.39E-05	8.53E-06	7.62E-06	5.58E-03	1.44E-05	0.00E+00	4.29E-07			
53I 131	7.90E-03	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	0.00E+00	1.54E-06			
53I 133	2.38E-04	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	0.00E+00	2.95E-06			
57LA 140	8.88E-04	1.01E-08	3.53E-09	1.19E-09	0.00E+00	0.00E+00	0.00E+00	9.84E-05			
41NB 95	6.03E-03	2.25E-08	8.76E-09	6.26E-09	0.00E+00	8.23E-09	0.00E+00	1.62E-05			
59PR 144	1.86E-04	2.08E-06	6.52E-07	1.11E-07	0.00E+00	3.61E-07	0.00E+00	1.70E-04			
45RH 103M	2.77E-04	7.31E-07	0.00E+00	2.81E-07	0.00E+00	1.84E-06	0.00E+00	1.89E-05			
44RU 103	2.77E-04	7.31E-07	0.00E+00	2.81E-07	0.00E+00	1.84E-06	0.00E+00	1.89E-05			
45RH 106	1.06E-04	1.17E-05	0.00E+00	1.46E-06	0.00E+00	1.58E-05	0.00E+00	1.82E-04			
44RU 106	1.06E-04	1.17E-05	0.00E+00	1.46E-06	0.00E+00	1.58E-05	0.00E+00	1.82E-04			
51SB 122	2.95E-04	9.60E-07	1.41E-08	2.79E-07	1.27E-08	0.00E+00	3.91E-07	7.55E-05			
34SE 75	1.01E-03	0.00E+00	1.57E-05	8.17E-06	0.00E+00	2.14E-05	0.00E+00	7.37E-07			
50SN 113	2.08E-04	3.38E-05	6.98E-07	1.94E-06	5.15E-07	0.00E+00	0.00E+00	0.00E+00			
38SR 89	4.89E-04	1.32E-03	0.00E+00	3.77E-05	0.00E+00	0.00E+00	0.00E+00	5.11E-05			
38SR 90	7.51E-04	1.70E-02	0.00E+00	4.31E-03	0.00E+00	0.00E+00	0.00E+00	2.29E-04			
52TE 132	2.11E-05	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	0.00E+00	4.50E-05			
39Y 90	7.71E-05	4.11E-08	0.00E+00	1.10E-09	0.00E+00	0.00E+00	0.00E+00	1.17E-04			
40ZR 95	3.93E-03	1.16E-07	2.55E-08	2.27E-08	0.00E+00	3.65E-08	0.00E+00	2.66E-05			

TABLE VII-D-1

* * * INFANT DOSE FACTORS * * *

NUCLIDE	CURIE/YR	INGESTION DOSE FACTORS (MREM/PCI INTAKE)							SHORELINE (MREM/HR)/(PCI/M**2)		
		BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY	RECON
47AG 110M	4.46E-03	9.96E-07	7.27E-07	4.81E-07	0.00E+00	1.04E-06	0.00E+00	3.77E-05			
56BA 140	1.63E-04	1.71E-04	1.71E-07	8.81E-06	0.00E+00	4.06E-08	1.05E-07	4.20E-05			
4BE 7	7.94E-05	2.25E-08	4.70E-08	2.53E-08	0.00E+00	3.34E-08	0.00E+00	1.11E-06			
6C 14	1.71E+01	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06			
58CE 141	1.10E-04	7.87E-08	4.80E-08	5.65E-09	0.00E+00	1.48E-08	0.00E+00	2.48E-05			
58CE 144	1.86E-04	2.98E-06	1.22E-06	1.67E-07	0.00E+00	4.93E-07	0.00E+00	1.71E-04			
27CO 58	1.21E-01	0.00E+00	3.60E-06	8.98E-06	0.00E+00	0.00E+00	0.00E+00	8.97E-06			
27CO 60	6.01E-03	0.00E+00	1.08E-05	2.55E-05	0.00E+00	0.00E+00	0.00E+00	2.57E-05			
55CS 134	1.29E-03	3.77E-04	7.03E-04	7.10E-05	0.00E+00	1.81E-04	7.42E-05	1.91E-06			
55CS 137	6.32E-03	5.22E-04	6.11E-04	4.33E-05	0.00E+00	1.64E-04	6.64E-05	1.91E-06			
1H 3	2.17E+02	0.00E+00	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07			
72HF 181	4.82E-05	3.92E-08	1.97E-07	1.74E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00			
53I 129	6.27E-05	2.86E-05	2.12E-05	1.55E-05	1.36E-02	2.51E-05	0.00E+00	4.24E-07			
53I 131	7.90E-03	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	0.00E+00	1.51E-06			
53I 133	2.38E-04	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	0.00E+00	3.08E-06			
57LA 140	8.88E-04	2.11E-08	8.32E-09	2.14E-09	0.00E+00	0.00E+00	0.00E+00	9.77E-05			
41NB 95	6.03E-03	4.20E-08	1.73E-08	1.00E-08	0.00E+00	1.24E-08	0.00E+00	1.46E-05			
59PR 144	1.86E-04	2.98E-06	1.22E-06	1.67E-07	0.00E+00	4.93E-07	0.00E+00	1.71E-04			
45RH 103M	2.77E-04	1.48E-06	0.00E+00	4.95E-07	0.00E+00	3.08E-06	0.00E+00	1.80E-05			
44RU 103	2.77E-04	1.48E-06	0.00E+00	4.95E-07	0.00E+00	3.08E-06	0.00E+00	1.80E-05			
45RH 106	1.06E-04	2.41E-05	0.00E+00	3.01E-06	0.00E+00	2.85E-05	0.00E+00	1.83E-04			
44RU 106	1.06E-04	2.41E-05	0.00E+00	3.01E-06	0.00E+00	2.85E-05	0.00E+00	1.83E-04			
51SB 122	2.95E-04	2.03E-06	3.72E-08	5.92E-07	3.15E-08	0.00E+00	1.06E-06	7.65E-05			
34SE 75	1.01E-03	0.00E+00	3.96E-05	1.70E-05	0.00E+00	3.83E-05	0.00E+00	7.34E-07			
50SN 113	2.08E-04	6.39E-05	1.65E-06	3.89E-06	1.15E-06	0.00E+00	0.00E+00	0.00E+00			
38SR 89	4.89E-04	2.51E-03	0.00E+00	7.20E-05	0.00E+00	0.00E+00	0.00E+00	5.16E-05			
38SR 90	7.51E-04	1.85E-02	0.00E+00	4.71E-03	0.00E+00	0.00E+00	0.00E+00	2.31E-04			
52TE 132	2.11E-05	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	0.00E+00	3.81E-05			
39Y 90	7.71E-05	8.69E-08	0.00E+00	2.33E-09	0.00E+00	0.00E+00	0.00E+00	1.20E-04			
40ZR 95	3.93E-03	2.06E-07	5.02E-08	3.56E-08	0.00E+00	5.41E-08	0.00E+00	2.50E-05			

TABLE VII-D-2

* * * AS LOW AS REASONABLY ACHIEVABLE * * *

A D U L T   D O S E S

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
	DOSE (MREM PER YR INTAKE)							
FISH		9.02E-01	1.86E-01	1.84E-01	1.80E-01	1.82E-01	1.80E-01	1.95E-01
DRINKING		1.84E-03	1.12E-03	1.15E-03	1.57E-03	1.09E-03	1.09E-03	1.28E-03
SHORELINE	3.17E-05	2.75E-05	2.75E-05	2.75E-05	2.75E-05	2.75E-05	2.75E-05	2.75E-05
SWIMMING	0.00E+00	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
BOATING	0.00E+00	5.00E-07	5.00E-07	5.00E-07	5.00E-07	5.00E-07	5.00E-07	5.00E-07
TOTAL	3.17E-05	9.04E-01	1.88E-01	1.86E-01	1.82E-01	1.83E-01	1.81E-01	1.96E-01

	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

SHOREWIDTH FACTOR=0.2

*

* * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		C 14 99%	C 14 96% CS 137 2%	C 14 97% CS 137 1%	C 14 99%	C 14 98% CS 137 1%	C 14 99%	C 14 91% NB 95 7%
DRINKING		C 14 87% SR 90 10%	C 14 28% CS 137 2% FE 55 1% H 3 67%	C 14 27% CS 137 1% H 3 65% SR 90 4%	C 14 20% H 3 48% I 131 30%	C 14 29% H 3 69%	C 14 29% H 3 69%	C 14 25% CO 58 4% H 3 58% SB 124 3% SB 125 4%
SHORELINE	AG 110M 3% CO 58 10% CO 60 28% CS 134 1% CS 137 14% SB 124 2% SB 125 39%	AG 110M 3% CO 58 9% CO 60 27% CS 134 1% CS 137 13% SB 124 2% SB 125 39%						
SWIMMING		AG 110M 5% CO 58 49% CO 60 6% CS 137 1% I 131 1% NB 95 1% SB 124 15% SB 125 14% ZR 95 1%						

TABLE VII-D-3

* * * AS LOW AS REASONABLY ACHIEVABLE * * *

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

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
	DOSE (MREM PER YR INTAKE)							
FISH		9.82E-01	2.03E-01	1.98E-01	1.96E-01	1.98E-01	1.96E-01	2.06E-01
DRINKING		1.79E-03	8.92E-04	9.09E-04	1.27E-03	8.64E-04	8.64E-04	9.92E-04
SHORELINE	1.77E-04	1.53E-04	1.53E-04	1.53E-04	1.53E-04	1.53E-04	1.53E-04	1.53E-04
SWIMMING	0.00E+00	5.58E-06	5.58E-06	5.58E-06	5.58E-06	5.58E-06	5.58E-06	5.58E-06
BOATING	0.00E+00	2.79E-06	2.79E-06	2.79E-06	2.79E-06	2.79E-06	2.79E-06	2.79E-06
TOTAL	1.77E-04	9.84E-01	2.04E-01	1.99E-01	1.97E-01	1.99E-01	1.97E-01	2.07E-01

	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

SHOEEWIDTH FACTOR=0.2

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		C 14 99%	C 14 96% CS 137 2%	C 14 98% CS 137 1%	C 14 99%	C 14 98%	C 14 99%	C 14 94% NB 95 5%
DRINKING		C 14 89% SR 90 8%	C 14 35% CS 137 2% H 3 59%	C 14 35% H 3 58% SR 90 3%	C 14 25% H 3 41% I 131 32%	C 14 37% H 3 61%	C 14 37% H 3 61%	C 14 32% CO 58 3% H 3 53% SB 124 3% SB 125 3%
SHORELINE	AG 110M 3% CO 58 10% CO 60 28% CS 134 1% CS 137 14% SB 124 2% SB 125 39%	AG 110M 3% CO 58 9% CO 60 27% CS 134 1% CS 137 13% SB 124 2% SB 125 39%						
SWIMMING		AG 110M 5% CO 58 49% CO 60 6% CS 137 1% I 131 1% NB 95 1% SB 124 15% SB 125 14% ZR 95 1%						

TABLE VII-D-4

* * * AS LOW AS REASONABLY ACHIEVABLE * * *

C H I L D   D O S E S

PATHWAY	DOSE (MREM PER YR INTAKE) SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		1.26E+00	2.57E-01	2.52E-01	2.52E-01	2.53E-01	2.52E-01	2.55E-01
DRINKING		5.16E-03	2.05E-03	2.08E-03	2.96E-03	2.00E-03	1.99E-03	2.10E-03
SHORELINE	3.70E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05
SWIMMING	0.00E+00	1.17E-06	1.17E-06	1.17E-06	1.17E-06	1.17E-06	1.17E-06	1.17E-06
BOATING	0.00E+00	5.83E-07	5.83E-07	5.83E-07	5.83E-07	5.83E-07	5.83E-07	5.83E-07
TOTAL	3.70E-05	1.27E+00	2.59E-01	2.54E-01	2.55E-01	2.55E-01	2.54E-01	2.57E-01

	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	

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		C 14 99%	C 14 97%	C 14 99%	C 14 99%	C 14 99%	C 14 99%	C 14 98%
			CS 137 2%					NB 95 1%
DRINKING		C 14 92%	C 14 46%	C 14 45%	C 14 32%	C 14 47%	C 14 48%	C 14 45%
		SR 90 5%	CS 137 2%	H 3 48%	H 3 34%	H 3 50%	H 3 51%	CO 58 1%
			H 3 49%	SR 90 3%	I 131 32%			H 3 48%
								SB 124 1%
								SB 125 1%
SHORELINE	AG 110M 3%	AG 110M 3%						
	CO 58 10%	CO 58 9%						
	CO 60 28%	CO 60 27%						
	CS 134 1%	CS 134 1%						
	CS 137 14%	CS 137 13%						
	SB 124 2%	SB 124 2%						
	SB 125 39%	SB 125 39%						
SWIMMING		AG 110M 5%						
		CO 58 49%						
		CO 60 6%						
		CS 137 1%						
		I 131 1%						
		NB 95 1%						
		SB 124 15%						
		SB 125 14%						
		ZR 95 1%						

TABLE VII-D-5

* * * AS LOW AS REASONABLY ACHIEVABLE * * *

I N F A N T   D O S E S

PATHWAY	DOSE (MREM PER YR 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		6.35E-03	2.38E-03	2.37E-03	3.85E-03	2.32E-03	2.30E-03	2.37E-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	6.35E-03	2.38E-03	2.37E-03	3.85E-03	2.32E-03	2.30E-03	2.37E-03

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)
FISH	0.0	7.3	24.00
DRINKING	330.0	30.8	18.60

SHOREWIDTH FACTOR=0.2

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	TH'ROID	KIDNEY	LUNG	GI-LLI
DRINKING		C 14 95%	C 14 54%	C 14 54%	C 14 33%	C 14 55%	C 14 56%	C 14 54%
		SR 90 3%	CS 137 2%	H 3 42%	H 3 25%	H 3 43%	H 3 43%	H 3 42%
			H 3 41%	SR 90 2%	I 131 39%			SB 125 1%

TABLE VII-D-6

* * * SELECTED LOCATION * * *

LOCATION IS SITE DISCHG.

A D U L T   D O S E S

DOSE (MREM PER YR INTAKE)

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		6.58E+00	1.36E+00	1.35E+00	1.31E+00	1.33E+00	1.31E+00	1.42E+00
DRINKING		5.67E-02	3.45E-02	3.55E-02	4.86E-02	3.35E-02	3.35E-02	3.95E-02
SHORELINE	2.31E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
SWIMMING	0.00E+00	7.30E-06	7.30E-06	7.30E-06	7.30E-06	7.30E-06	7.30E-06	7.30E-06
BOATING	0.00E+00	3.65E-06	3.65E-06	3.65E-06	3.65E-06	3.65E-06	3.65E-06	3.65E-06
TOTAL	2.31E-04	6.64E+00	1.40E+00	1.38E+00	1.36E+00	1.36E+00	1.35E+00	1.46E+00

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)
FISH	21.0	1.0	24.00
DRINKING	730.0	1.0	12.00
SHORELINE	12.0	1.0	0.00
SWIMMING	12.0	1.0	0.00
BOATING	12.0	1.0	0.00

SHOREWIDTH FACTOR=0.2

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		C 14 99%	C 14 96% CS 137 2%	C 14 97% CS 137 1%	C 14 99%	C 14 98% CS 137 1%	C 14 99%	C 14 91% NB 95 7%
DRINKING		C 14 87% SR 90 10%	C 14 28% CS 137 2% FE 55 1% H 3 67%	C 14 27% CS 137 1% H 3 65% SR 90 4%	C 14 20% H 3 47% I 131 30%	C 14 29% H 3 69%	C 14 29% H 3 69%	C 14 24% CO 58 4% H 3 58% SB 124 3% SB 125 4%
SHORELINE	AG 110M 3% CO 58 10% CO 60 28% CS 134 1% CS 137 14% SB 124 2% SB 125 39%	AG 110M 3% CO 58 9% CO 60 27% CS 134 1% CS 137 13% SB 124 2% SB 125 39%						
SWIMMING		AG 110M 5% CO 58 49% CO 60 6% CS 137 1% I 131 1% NB 95 1% SB 124 15% SB 125 14% ZR 95 1%						

TABLE VII-D-7

* * * SELECTED LOCATION * * *

LOCATION IS SITE DISCHG.

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

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
	DOSE (MREM PER YR INTAKE)							
FISH		7.17E+00	1.48E+00	1.45E+00	1.43E+00	1.44E+00	1.43E+00	1.51E+00
DRINKING		5.51E-02	2.75E-02	2.80E-02	3.94E-02	2.66E-02	2.66E-02	3.06E-02
SHORELINE	1.29E-03	1.12E-03	1.12E-03	1.12E-03	1.12E-03	1.12E-03	1.12E-03	1.12E-03
SWIMMING	0.00E+00	4.08E-05	4.08E-05	4.08E-05	4.08E-05	4.08E-05	4.08E-05	4.08E-05
BOATING	0.00E+00	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05
TOTAL	1.29E-03	7.22E+00	1.51E+00	1.48E+00	1.47E+00	1.47E+00	1.46E+00	1.54E+00

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	16.0	1.0	24.00	
DRINKING	510.0	1.0	12.00	
SHORELINE	67.0	1.0	0.00	
SWIMMING	67.0	1.0	0.00	
BOATING	67.0	1.0	0.00	

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		C 14 99%	C 14 96%	C 14 98%	C 14 99%	C 14 98%	C 14 99%	C 14 94%
			CS 137 2%	CS 137 1%				NB 95 5%
DRINKING		C 14 89%	C 14 35%	C 14 35%	C 14 25%	C 14 37%	C 14 37%	C 14 32%
		SR 90 8%	CS 137 2%	H 3 58%	H 3 41%	H 3 61%	H 3 61%	CO 58 3%
			H 3 59%	SR 90 3%	I 131 32%			H 3 53%
								SB 124 3%
								SB 125 3%
SHORELINE	AG 110M 3%	AG 110M 3%						
	CO 58 10%	CO 58 9%						
	CO 60 28%	CO 60 27%						
	CS 134 1%	CS 134 1%						
	CS 137 14%	CS 137 13%						
	SB 124 2%	SB 124 2%						
	SB 125 39%	SB 125 39%						
SWIMMING		AG 110M 5%						
		CO 58 49%						
		CO 60 6%						
		CS 137 1%						
		I 131 1%						
		NB 95 1%						
		SB 124 15%						
		SB 125 14%						
		ZR 95 1%						

TABLE VII-D-8

* * * SELECTED LOCATION * * *

LOCATION IS SITE DISCHG.

C H I L D   D O S E S

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
	DOSE (MREM PER YR INTAKE)							
FISH		9.20E+00	1.88E+00	1.84E+00	1.84E+00	1.85E+00	1.84E+00	1.86E+00
DRINKING		1.59E-01	6.31E-02	6.41E-02	9.20E-02	6.15E-02	6.12E-02	6.48E-02
SHORELINE	2.70E-04	2.34E-04	2.34E-04	2.34E-04	2.34E-04	2.34E-04	2.34E-04	2.34E-04
SWIMMING	0.00E+00	8.52E-06	8.52E-06	8.52E-06	8.52E-06	8.52E-06	8.52E-06	8.52E-06
BOATING	0.00E+00	4.26E-06	4.26E-06	4.26E-06	4.26E-06	4.26E-06	4.26E-06	4.26E-06
TOTAL	2.70E-04	9.36E+00	1.94E+00	1.90E+00	1.93E+00	1.91E+00	1.90E+00	1.93E+00

	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

SHOREWIDTH FACTOR=0.2

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		C 14 99%	C 14 97% CS 137 2%	C 14 99%	C 14 99%	C 14 99%	C 14 99%	C 14 98% NB 95 1%
DRINKING		C 14 92% SR 90 5%	C 14 46% CS 137 2% H 3 49%	C 14 45% H 3 48% SR 90 3%	C 14 31% H 3 34% I 131 33%	C 14 47% H 3 50%	C 14 48% H 3 51%	C 14 45% CO 58 1% H 3 48% SB 124 1% SB 125 1%
SHORELINE	AG 110M 3% CO 58 10% CO 60 28% CS 134 1% CS 137 14% SB 124 2% SB 125 39%	AG 110M 3% CO 58 9% CO 60 27% CS 134 1% CS 137 13% SB 124 2% SB 125 39%						
SWIMMING		AG 110M 5% CO 58 49% CO 60 6% CS 137 1% I 131 1% NB 95 1% SB 124 15% SB 125 14% ZR 95 1%						

TABLE VII-D-9

* * * SELECTED LOCATION * * *

LOCATION IS SITE DISCHG.

I N F A N T   D O S E S

DOSE (MREM PER YR INTAKE)

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		0.00E+00	0.00E+00	0.00E+00	).00E+00	0.00E+00	0.00E+00	0.00E+00
DRINKING		1.96E-01	7.33E-02	7.31E-02	1.20E-01	7.13E-02	7.10E-02	7.30E-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	1.96E-01	7.33E-02	7.31E-02	1.20E-01	7.13E-02	7.10E-02	7.30E-02

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

SHOREWIDTH FACTOR=0.2

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING		C 14 95%	C 14 54%	C 14 54%	C 14 33%	C 14 55%	C 14 56%	C 14 54%
		SR 90 3%	CS 137 2%	H 3 42%	H 3 25%	H 3 43%	H 3 43%	H 3 42%
			H 3 41%	SR 90 2%	I 131 40%			SB 125 1%

TABLE VII-E-1

* * * FISH CONSUMPTION POPULATION DOSES * * *
MAN-REM

__________SPORTFISH HARVEST__________

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
			DOSE (MAN-REM)						
FISH	ADULT	5.81E+04	2.45E+00	5.07E-01	5.01E-01	4.89E-01	4.34E-01	4.90E-01	5.25E-01
FISH	TEENAGER	9.29E+03	5.60E-01	1.16E-01	1.13E-01	1.12E-01	1.13E-01	1.12E-01	1.17E-01
FISH	CHILD	5.61E+03	1.01E+00	2.06E-01	2.02E-01	2.01E-01	2.02E-01	2.01E-01	2.03E-01
FISH	TOTAL	7.30E+04	4.02E+00	8.29E-01	8.16E-01	8.01E-01	8.09E-01	8.03E-01	8.46E-01

DILUTION	CATCH	TIME(HR)-INCLUDES FOOD PROCESSING TIME OF 1.68E+02 HR	POPULATION=1.28E+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

* * * ISOTOPE CONTRIBUTION * * *

AGE GROUP	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
ADULT							
	C 14 99%	C 14 96%	C 14 97%	C 14 99%	C 14 98%	C 14 99%	C 14 92%
		CS 137 2%	CS 137 1%		CS 137 1%		NB 95 6%
TEENAGER							
	C 14 99%	C 14 96%	C 14 98%	C 14 99%	C 14 98%	C 14 99%	C 14 95%
		CS 137 2%	CS 137 1%				NB 95 4%
CHILD							
	C 14 99%	C 14 97%	C 14 99%	C 14 99%	C 14 99%	C 14 99%	C 14 98%
		CS 137 2%					NB 95 1%

TABLE VII-E-2

* * * FISH CONSUMPTION POPULATION DOSES * * *
MAN-REM

__________COMMERCIAL HARVEST__________

PATHWAY	AGE GROUP	USAGE	DOSE (MAN-REM) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	3.46E+06	2.42E-01	5.01E-02	4.96E-02	4.83E-02	4.88E-02	4.84E-02	5.18E-02
FISH	TEENAGER	5.54E+05	5.54E-02	1.14E-02	1.12E-02	1.10E-02	1.12E-02	1.11E-02	1.15E-02
FISH	CHILD	3.35E+05	9.97E-02	2.04E-02	1.99E-02	1.99E-02	2.00E-02	1.99E-02	2.01E-02
FISH	TOTAL	4.35E+06	3.98E-01	8.19E-02	8.07E-02	7.92E-02	8.00E-02	7.94E-02	8.34E-02

DILUTION	CATCH	TIME(HR)-INCLUDES FOOD PROCESSING TIME OF 2.40E+02 HR	POPULATION=7.60E+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

* * * ISOTOPE CONTRIBUTION * * *

AGE GROUP	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
ADULT							
	C 14 99%	C 14 96%	C 14 97%	C 14 99%	C 14 98%	C 14 99%	C 14 93%
		CS 137 2%	CS 137 1%		CS 137 1%		NB 95 6%
TEENAGER							
	C 14 99%	C 14 96%	C 14 98%	C 14 99%	C 14 98%	C 14 99%	C 14 95%
		CS 137 2%	CS 137 1%				NB 95 4%
CHILD							
	C 14 99%	C 14 97%	C 14 99%	C 14 99%	C 14 99%	C 14 99%	C 14 98%
		CS 137 2%					NB 95 1%

__________NEPA DOSES__________

NOTE--TOTAL NEPA DOSE MUST INCLUDE SPORT CATCH, DOSES BELOW ARE FOR COMMERCIAL CATCH ONLY

PATHWAY	AGE GROUP	USAGE	DOSE (MAN-REM) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	5.81E+04	2.45E+00	5.07E-01	5.01E-01	4.89E-01	4.94E-01	4.90E-01	5.23E-01
FISH	TEENAGER	9.29E+03	5.60E-01	1.16E-01	1.13E-01	1.12E-01	1.13E-01	1.12E-01	1.17E-01
FISH	CHILD	5.61E+03	1.01E+00	2.06E-01	2.02E-01	2.01E-01	2.02E-01	2.01E-01	2.03E-01
FISH	TOTAL	7.30E+04	4.02E+00	8.29E-01	8.16E-01	8.01E-01	8.09E-01	8.03E-01	8.43E-01

TABLE VII-E-3

* * * POPULATION WATER CONSUMPTION DOSES * * *

PATHWAY	AGE GROUP	USAGE	DOSE (MAN-REM) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	ADULT	1.29E+08	3.26E-01	1.98E-01	2.04E-01	2.74E-01	1.92E-01	1.93E-01	2.27E-01
DRINKING	TEENAGER	1.93E+07	6.75E-02	3.37E-02	3.43E-02	4.72E-02	3.26E-02	3.26E-02	3.74E-02
DRINKING	CHILD	2.75E+07	2.78E-01	1.10E-01	1.12E-01	1.57E-01	1.08E-01	1.07E-01	1.13E-01
DRINKING	TOTAL	1.76E+08	6.72E-01	3.42E-01	3.51E-01	4.78E-01	3.33E-01	3.33E-01	3.78E-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

* * * ISOTOPE CONTRIBUTION * * *

AGE GROUP	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
ADULT							
	C 14 87%	C 14 28%	C 14 27%	C 14 20%	C 14 29%	C 14 29%	C 14 25%
	SR 90 10%	CS 137 2%	CS 137 1%	H 3 48%	H 3 69%	H 3 69%	CO 58 4%
		FE 55 1%	H 3 65%	I 131 29%			H 3 58%
		H 3 67%	SR 90 4%				SB 124 3%
							SB 125 4%
TEENAGPP							
	C 14 89%	C 14 35%	C 14 35%	C 14 25%	C 14 37%	C 14 37%	C 14 32%
	SR 90 8%	CS 137 2%	H 3 58%	H 3 42%	H 3 61%	H 3 61%	CO 58 3%
		H 3 59%	SR 90 3%	I 131 31%			H 3 53%
							SB 124 3%
CHILD							
	C 14 92%	C 14 46%	C 14 45%	C 14 32%	C 14 47%	C 14 48%	C 14 45%
	SR 90 5%	CS 137 2%	H 3 48%	H 3 34%	H 3 50%	H 3 51%	CO 58 1%
		H 3 49%	SR 90 3%	I 131 32%			H 3 48%
							SB 124 1%

TABLE VII-E-4

* * * POPULATION WATER CONSUMPTION DOSES * * *

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
			DOSE (MAN-REM)						
DRINKING	ADULT	2.12E+07	5.28E-02	3.21E-02	3.30E-02	4.43E-02	3.11E-02	3.12E-02	3.67E-02
DRINKING	TEENAGER	3.17E+06	1.09E-02	5.45E-03	5.55E-03	7.64E-03	5.28E-03	5.28E-03	6.06E-03
DRINKING	CHILD	4.52E+06	4.50E-02	1.79E-02	1.82E-02	2.55E-02	1.74E-02	1.73E-02	1.83E-02
DRINKING	TOTAL	2.89E+07	1.09E-01	5.54E-02	5.67E-02	7.74E-02	5.38E-02	5.38E-02	6.11E-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

* * * ISOTOPE CONTRIBUTION * * *

AGE GROUP	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
ADULT							
	C 14 87%	C 14 28%	C 14 27%	C 14 20%	C 14 29%	C 14 29%	C 14 25%
	SR 90 10%	CS 137 2%	CS 137 1%	H 3 48%	H 3 69%	H 3 69%	CO 58 4%
		FE 55 1%	H 3 65%	I 131 29%			H 3 58%
		H 3 67%	SR 90 4%				SB 124 3%
							SB 125 4%
TEENAGER							
	C 14 89%	C 14 35%	C 14 35%	C 14 25%	C 14 37%	C 14 37%	C 14 32%
	SR 90 8%	CS 137 2%	H 3 58%	H 3 42%	H 3 61%	H 3 61%	CO 58 3%
		H 3 59%	SR 90 3%	I 131 31%			H 3 53%
							SB 124 3%
CHILD							
	C 14 92%	C 14 46%	C 14 45%	C 14 [illegible]2%	C 14 47%	C 14 48%	C 14 45%
	SR 90 5%	CS 137 2%	H 3 48%	H 3 34%	H 3 50%	H 3 51%	CO 58 1%
		H 3 49%	SR 90 3%	I 131 32%			H 3 48%
							SB 124 1%

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

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	CUMUL TOTAL	2.05E+08	7.80E-01	3.98E-01	4.07E-01	5.56E-01	3.86E-01	3.86E-01	4.39E-01

__________HYDROSPHERE TRITIUM DOSE__________

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
WATER	TOTAL	2.20E+00	3.66E-08	3.66E-08	3.66E-08	3.66E-08	3.66E-08	3.66E-08	3.66E-08

TABLE VII-E-5

* * * RECREATION POPULATION DOSES * * *

PATHWAY	AGE GROUP	USAGE	DOSE(MAN-REM) SKIN	TOTAL BODY	THYROID
SHORELINE	TOTAL POPUL	4.10E+07	1.08E-01	9.38E-02	9.38E-02

LOCATION- DOWN STREAM

DILUTION=0.73E+01   TRANSIT TIME=0.67E+00 HR   SWF=0.2

* * * ISOTOPE CONTRIBUTION * * *

AGE GROUP	SKIN	TOTAL BODY
ADULT		
	AG 110M 3%	AG 110M 3%
	CO 58 10%	CO 58 9%
	CO 60 28%	CO 60 27%
	CS 134 1%	CS 134 1%
	CS 137 14%	CS 137 13%
	SB 124 2%	SB 124 2%
	SB 125 39%	SB 125 39%

PATHWAY	AGE GROUP	USAGE	DOSE(MAN-REM) SKIN	TOTAL BODY	THYROID
SWIMMING	TOTAL POPUL	4.10E+07	0.00E+00	3.42E-03	3.42E-03

LOCATION- DOWN STREAM

DILUTION=0.73E+01   TRANSIT TIME=0.67E+00 HR

* * * ISOTOPE CONTRIBUTION * * *

AGE GROUP	SKIN	TOTAL BODY
ADULT		
		AG 110M 5%
		CO 58 49%
		CO 60 6%
		CS 137 1%
		I 131 1%
		NB 95 1%
		SB 124 15%
		SB 125 14%
		ZR 95 1%

PATHWAY	AGE GROUP	USAGE	DOSE(MAN-REM) SKIN	TOTAL BODY	THYROID
BOATING	TOTAL POPUL	4.10E+07	0.00E+00	1.71E-03	1.71E-03

TABLE VII-E-6

LOCATION- DOWN STREAM

DILUTION-0.73E+01 TRANSIT TIME-0.67E+00 HR

* * * DOSE TO BIOTA * * *

MRADS PER YR

DILUTION- 1.00E+00 TRANSIT TIME- 0.00E+00 HR

	INTERNAL	EXTERNAL	TOTAL
FISH	1.03E+02	7.37E-01	1.04E+02
INVERTEBRATE	2.04E+02	1.47E+00	2.05E+02
ALGAE	1.04E+02	5.33E-03	1.04E+02
MUSKRAT	1.63E+02	4.90E-01	1.63E+02
RACCOON	5.28E+01	3.66E-01	5.31E+01
HERON	2.11E+02	4.89E-01	2.12E+02
DUCK	1.63E+02	7.34E-01	1.64E+02

* * * ISOTOPE CONTRIBUTION * * *

PATHWAY		BODY
FISH	C 14	99%
INVERTEBRATE	C 14	99%
ALGAE	C 14	98%
MUSKRAT	C 14	97%
	SR 90	1%
RACCOON	C 14	99%
HERON	C 14	98%
	CS 137	1%
DUCK	C 14	97%
	SR 90	1%

Fort Calhoun Station
Unit No. 1

CH-ODCM-0001

CHEMISTRY PROCEDURE

Title: OFF-SITE DOSE CALCULATION MANUAL (ODCM)

Setpoint/Procedure Form Number (FC-68):	40606
Reason for Change:	The procedural details of the RETs were transferred to this procedure per guidance of Generic Letter 89-01. Removal of VIAS signals from the particulate and iodine radiation monitors. Incorporated On-Going Commitment CID 920102/01.
Contact Person:	Bruce Reneaud

PART I

ADMINISTRATIVE SECTION

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PART IV

1.0 INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is the controlling document for the Fort Calhoun Station's (FCS) Radiological Effluent and Environmental Monitoring programs. The programs are necessary to ensure the requirements set forth in 10 CFR 20, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR 50, Appendix I. The document is subdivided into four sections as outlined below:

Part I, Introduction - consists of information necessary for the effective use of the ODCM.

Part II, Radiological Effluent Controls - consists of 5 separate sections including:

Section 1 Radiological Effluent Release Limits

Section 2 Radiological Effluent Release Requirements

Section 3 Radiological Effluent Sampling and Analysis Requirements

Section 4 Radiological Effluent Reporting Requirements

Section 5 Radiological Environmental Monitoring Requirements

Together these sections provide the controls used to permit radioactive material releases from the Fort Calhoun Station.

Part III, Radiological Effluent Radiation Monitor Calculation - provides radiation monitor setpoint calculations for the liquid and gaseous release pathways.

Part IV, Radiological Effluent Monitoring Calculations - provides the methodology necessary to calculate doses to individuals as a result of radioactive gaseous and liquid releases from Fort Calhoun.

The ODCM has been prepared in accordance with the guidance of Nuclear Regulatory Commissions Reg. Guide 1.109, Rev. 1.

The Radiological Effluent Controls Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Release Limits - All Sections

B. Radiological Effluent Release Requirements - All Sections

C. Radiological Effluent Sampling and Analysis Requirements - All Sections

D. Radiological Effluent Reporting Requirements - Sections 4.1, 4.2, 4.3 and 4.6

2.0 ADMINISTRATIVE

The Radiological Environmental Monitoring Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Reporting Requirements - Sections 4.4 and 4.5

B. Radiological Environmental Monitoring Requirements - All Sections

2.1 Responsibilities

2.1.1 Nuclear Operation Division Chemistry Department is responsible for the implementation and maintenance of the ODCM.

2.1.2 Nuclear Operation Division Operation Department is responsible for the compliance with the ODCM in the operation of Fort Calhoun Station.

2.2 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 Report in accordance with the requirements of Technical Specification 5.17.

3.0 METEOROLOGICAL DATA

The Annual Average χ/Q is utilized to determine the concentrations of radionuclides at the site boundary. This dispersion factor coincides with the highest calculated annual average value for the Fort Calhoun Station. It is based on 3 years of Onsite Meteorological data and the MESODIF II plume trajectory model. This model conforms with the Nuclear Regulatory Commissions Regulatory Guide 1.111. The model employs the sector averaged equations that are utilized for long-term releases. This type of release (long term) is not dependent solely on atmospheric conditions for complying with 10 CFR 20 concentration limits at the site boundary.

Real time meteorological data will be utilized in the preparation of the Annual Report. This data is used to calculate the joint frequency table and 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, GASPAR and LADTAP, conform with the Nuclear Regulatory Commissions Reg. Guide 1.109 and 1.21 for the reporting of doses due to routine radioactive effluent releases.

4.0 DEFINITIONS

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.

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.

Venting

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

Unrestricted Area

Any area at or beyond the site boundary access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials.

5.0 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 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.

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 is 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

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

Fort Calhoun Technical Specifications (Unit No. 1)

Updated Safety Analysis Report

Commitment Documents:

IMPLEMENTING STEP	COMMITMENT NUMBER (CID)	SOURCE DOCUMENT
Part II, 2.2.3.1 C.2	920102/01	FC-0133-92

PART II

RADIOLOGICAL EFFLUENT CONTROLS

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS

The limits and conditions for the controlled release of radioactive material in liquid and gaseous effluents stated in this Section are to ensure that these releases result in concentrations of radioactive materials in liquid and gaseous effluents released to unrestricted areas that are within the limits specified in 10 CFR 20 and to ensure that the release of radioactive material to the environment be as low as reasonably achievable in conformance with 10 CFR 50.34a and 50.36a. To meet these criteria, the following requirements must be met for all radioactive liquid and gaseous effluents from FCS:

1.1 Liquid Effluents

1.1.1 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 20 for liquid effluents in unrestricted areas. For dissolved or entrained noble gases, the concentration shall be limited to 2.0 E-04 μCi/ml, total activity.

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.

1.1.2 Annual Design Objectives

1.1.2.1 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed <u>3</u> millirems to the <u>total body</u>.

1.1.2.2 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed <u>10</u> millirems to <u>any organ</u>.

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.1.2.3 The radiation dose contributions from radioactive materials in liquid effluents released to unrestricted areas shall be determined, in accordance with Part IV, Section 2.1, 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:

A. Make an investigation to identify the causes for such releases.

B. Define and initiate a program of action to reduce such releases to the design levels.

C. 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.

1.2 Gaseous Effluents

1.2.1 The release rate of radioactive material in gaseous effluents shall be controlled such that the instantaneous concentrations for these radionuclides do not exceed the values specified in 10 CFR 20 for gaseous effluents in unrestricted areas at and beyond the site boundary.

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.

1.2.2 Annual Design Objectives

1.2.2.1 The gamma air dose in unrestricted areas due to the release of noble gases in gaseous effluents shall not exceed 10 millirads during any calendar year;

1.2.2.2 The beta air dose in unrestricted areas due to the release of noble gases in gaseous effluents shall not exceed 20 millirads during any calendar year; and

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.2.2.3 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 gaseous effluents shall not exceed 15 millirems from all exposure pathways during any calendar year.

1.2.2.4 The radiation dose contributions from radioactive materials in gaseous effluents shall be determined, in accordance with the Part IV, section 2.2, on a quarterly basis. If the dose contribution, due to the cumulative release of gaseous effluents averaged over a calendar quarter exceeds one-half of the annual design objectives, the following course of actions shall be taken:

A. Make an investigation to identify the cause for such release rates.

B. Define and initiate a program of action to reduce such releases to design levels.

C. 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.

1.3 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.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS

The requirements for the release of radioactive liquid and gaseous effluents from FCS stated in this Section are to ensure that the limits of Section 1 will be met, as well as to allow for operational flexibility. When any of the requirements for release of radioactive effluents cannot be complied with, the release shall not be permitted to occur or it shall be immediately terminated, if it is in progress.

2.1 Liquid Effluent Releases

The equipment or subsystem(s) of the liquid radwaste treatment system as identified in the Part III, section 2.1, shall be operable. If the radioactive liquid effluents were discharged without treatment by one or more of the pieces of equipment or subsystem(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reasons for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1 Monitor and Hotel Waste Tanks

During release of radioactive liquid effluents, the following conditions shall be met:

2.1.1.1 There shall be sufficient dilution flow so that, at site discharge:

$$\sum_{i=1}^{n} C_i / mpc_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

mpc_i = 10 CFR 20, Appendix B, Table 2, Column 2 limits.

2.1.1.2 The overboard header effluent radiation monitor shall be set in accordance with Part III to alarm and automatically close the discharge valve prior to exceeding 10 CFR 20 limits at discharge.

2.1.1.3 The liquid effluent radioactivity shall be continuously monitored during the release. If the effluent radiation monitor is inoperable, effluent releases may continue provided that: (prior to initiating a release)

A. At least two independent samples are analyzed in accordance with applicable chemistry procedures.

B. At least two qualified individuals independently verify the release rate calculations.

2.1.1.4 The liquid effluent radioactivity shall be continuously recorded during the release. If the process radiation monitor chart recorder is inoperable and the process radiation monitor is operable then effluent releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1.5 The liquid effluent flow rate shall be continuously monitored and recorded during the release. If the flow rate recorder is inoperable, effluent releases may continue provided the flow rate is determined at least once per four hours during actual release.

2.1.2 Steam Generator

During the release of steam generator blowdown to the discharge tunnel, the following conditions shall be met:

2.1.2.1 There shall be sufficient dilution flow so that, at site discharge:

$$\sum_{i=1}^{n} C_i / mpc_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

mpc_i = 10 CFR 20, Appendix B, Table 2, Column 1 limit.

2.1.2.2 The steam generator blowdown radiation monitors shall be set in accordance with Part III to alarm and automatically close the blowdown isolation valves prior to exceeding 10 CFR 20 limits at dishcarge.

2.1.2.3 The radioactivity for each blowdown line shall be continuously monitored by the blowdown radiation monitors and recorded.

A. If one of the two radiation monitors is inoperable, the activity for both blowdown lines shall be monitored by the operable radiation monitor within 2 hours of the discovery of the inoperability.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.2.3 B. If both radiation monitors are inoperable, steam generator liquid releases may continue provided grab samples are analyzed for principal gamma emitters at a sensitivity of 5.0E-07 μCi/ml and recorded at least daily when the specific activity of Steam Generator Blowdown is less than or equal to 0.01 μCi/gram dose equivalent I-131 and at least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 μCi/gram dose equivalent I-131.

2.1.2.4 The radioactivity for each blowdown line shall be continuously recorded. If the process radiation monitor chart recorder is not operational, Steam Generator releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.2 Gaseous Effluent Releases

The equipment or subsystem(s) of the gaseous radwaste treatment system as identified in Part III, Section 2.2, shall be operable. If the radioactive gaseous effluents were discharged without treatment by one or more of the equipment or subsystems(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reason for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1 Gaseous Auxiliary Building Exhaust Stack

The Auxiliary Building Exhaust Stack noble gas monitor, particulate sampler, or iodine sampler may be inoperable provided that:

A. Whenever 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 2).

B. Whenever the Auxiliary Building Exhaust Stack iodine or particulate sampler(s) is/are inoperable, ventilation of the auxiliary building and releases from the gaseous waste discharge header, containmnet pressure relief line or the containment purge line may continue through the Auxiliary Building Exhaust Stack provided sample collection using auxiliary sample collection equipment is initiated within 2 hours of the discovery of the inoperability in accordance with Table 2.

2.2.1.1 During release of gaseous radioactive effluents from containment pressure relief line to the Auxiliary Building Exhaust Stack, the following conditions shall be met:

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at site boundary (see Part III, Figure 1).

C. At least one Auxiliary Building exhaust fan shall be in operation.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.1 D. The Auxiliary Building Exhaust Stack gaseous radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the process radiation monitor is operable then releases from containment may continue provided that the gaseous radioactivity level is recorded manually at least once per four hours during the actual release.

E. The containment flow rate shall be monitored and automatically recorded during the release. If the flow rate monitor or recorder is inoperable, releases from the containment may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.2.1.2 During the release of gaseous radioactive effluents from the containment purge line:

A. The conditions set forth in Section 2.2.1.1 shall be met.

B. A noble gas monitor shall monitor the containment building atmosphere.

2.2.1.3 During the release of gaseous effluents from the gaseous waste discharge header:

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at site boundary (see Part III, Figure 1).

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.3 C. If the Auxiliary Building Exhaust Stack radiation monitor is inoperable, effluent releases may continue provided that (prior to release):

1) At least two independent samples are analyzed in accordance with the applicable chemistry procedure.

2) At least two qualified individuals independently verify the release rate calculations.

D. At least one Auxiliary Building exhaust fan shall be in operation.

E. The Auxiliary Building exhaust stack gaseous radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the process radiation monitor is operable then releases from waste gas decay tanks may continue provided that the gaseous radioactivity level is recorded manually at least once per four hours during the actual release.

F. The waste gas discharge header flow rate shall be monitored and automatically recorded during releases. If the flow rate monitor or recorder is inoperable, releases may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.2.2 Condenser Offgas

2.2.2.1 During power operation, the condenser air ejector 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 2)

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.3 Laboratory and Radioactive Waste Processing Building Stack

2.2.3.1 During the release of gaseous effluents from the Laboratory and Radioactive Waste Processing Building (LRWPB) the following conditions shall be met:

A. The LRWPB noble gas monitor, iodine sampler and particulate sampler shall be operational.

B. The LRWPB noble gas radiation monitor shall be set in accordance with Part III to alarm at its predetermined setpoints.

C. The Laboratory and Radioactive Waste Processing Building (LRWPB) Stack noble gas monitor, particulate sampler or iodine sampler may be inoperable and effluents via this pathway may continue provided:

1) If the noble gas monitor is inoperable, grab samples will be taken once per 24 hours and analyzed for principal gamma emitters.

[2)] If the iodine or particulate sampler(s) is/are 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 discovery of the inoperability in accordance with Table 2.

D. The LRWPB Stack flow rate shall be monitored and recorded during ventilation of the LRWPB. If the flow rate monitor or recorder is inoperable, ventilation may continue provided the flow rate is determined and recorded manually at least once per four hours.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS

The sampling and analysis requirements stated in this Section will provide reasonable assurance that radioactive materials present in the liquid and gaseous effluents will be properly identified and accurately quantified. This information will serve as the basis for determining doses to individuals as a result of radioactive effluents from FCS.

Records shall be maintained and reports of the sampling and results of analyses shall be submitted to the Nuclear Regulatory Commission in accordance with Section 4 of these Controls. Sampling, analysis and operability testing will typically be documented on Surveillance Tests or on Release Permits or Summaries.

3.1 Liquid Effluents

3.1.1 Radioactive liquid effluent sampling and activity analyses shall be performed in accordance with Table 1. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration at the point of release is limited to 10 CFR 20 limits for unrestricted areas.

3.1.2 Prior to release of each batch of liquid effluent, the batch shall be mixed, sampled, and analyzed for principal gamma emitters. When operational or other limitations preclude specific gamma radionuclide analysis of each batch:

3.1.2.1 Gross radioactivity measurements shall be made to estimate the quantity and concentrations of radioactive materials released in the batch.

3.1.2.2 A weekly sample composite from proportional aliquots from each batch released during the week shall be analyzed for the principal gamma-emitting radionuclides.

3.1.3 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 Section 4 of Part II.

3.1.4 The radiation monitors for liquid effluents shall have their operability tested in accordance with the requirements in Table 3, Item A.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.2 Gaseous Effluents

3.2.1 Radioactive gaseous effluent sampling and activity analyses shall be performed in accordance with Table 2. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration of radioactive materials is limited to 10 CFR 20 limits for unrestricted areas.

3.2.2 The radiation monitors for gaseous effluents shall have their operability tested in accordance with the requirements in Table 3, Item B.

3.3 Lower Limit of Detection (LLD)

The lower limit of detection (LLD) for liquid and gaseous discharges, referenced in Tables 1 and 2 of the Radiological Effluent Controls (Part II), is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 * s_b}{E * V * D * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD = the lower limit of detection as defined above, in either picoCuries or microCuries, per unit mass or volume as a function of the value of D

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate, as counts per minute

E = the counting efficiency, as counts per disintegration

V = the sample size in units of mass or volume

D = 2.22E+06 of disintegrations per minute per microCurie or 2.22 disintegrations per minute per picoCurie

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.3 Y = the fractional radiochemical yield, when applicable

λ = the radioactive decay constant for the particular radionuclide

Δt = the elapsed time for the plant effluent between the midpoint of sample collection and time of counting

Appropriate values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an A Priori limit representing the capability of a measurement system and not as a limit for a particular measurement.

LLD verifications will be performed on a periodic basis. This determination is to ensure that the counting system is able to detect levels of radiation at the LLD values for the specific type of analysis required by Tables 1 and 2. They will be performed with a blank (non-radioactive) sample in the same counting geometry as the actual sample.

4.0 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 1 are complied with. These reports will meet the requirements for documentation of radioactive effluents contained in 10 CFR 50.36a; Reg. Guide 1.21, Rev. 1; Reg. Guide 4.8, Table 1; and Reg. Guide 1.109, Rev. 1.

4.1 Annual Radioactive Effluent Release Report

A report covering the operation of the Fort Calhoun Station during the previous calender year shall be submitted within 90 days after January 1 of each year per the requirements of 10CFR 50.36a.

The radioactive effluent release report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the plant as outlined in Regulatory Guide 1.21, Revision 1.

The radioactive effluent release report shall include a summary of the meteorological conditions concurrent with the release of gaseous effluents during each quarter as outlined in Regulatory Guide 1.21, Revision 1.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.1 The radioactive effluent release report shall include an assessment of radiation doses from the radioactive liquid and gaseous 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.

The radioactive effluent release report shall include any 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.

4.2 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:

4.2.1 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.

4.2.2 Interpretations and statistical evaluation of the results, including an assessment of the observed impacts of the plant operation and environment.

4.2.3 The results of participation in a NRC approved Interlaboratory Comparison Program.

4.2.4 The results of land use survey required by Part II, Section 5.4.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.2.5 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:

4.2.5.1 Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded;

A. 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;

B. Purification system flow history starting 48 hours prior to the first sample in which the limit was exceeded;

C. 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

D. The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

4.3 Non-Routine Report

If a confirmed measured radionuclide concentration in an environmental sampling medium averaged over any calendar quarter sampling period exceeds the reporting level referenced in Table 7, and if the radioactivity is attributable to plant operation, a written report shall be submitted to the Nuclear Regulatory Commission within 30 days from the end of the quarter.

The report shall include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the anomalous result.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.4 EPA 40 CFR 190 Reporting Requirements

With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Part II, sections 1.1.2, 1.1.3, 1.2.2, 1.2.3, or 1.2.4, based on quarterly and annual calculations, 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 $\leq$ 25 mrem to the total body or any organ (except thyroid, which is limited to $\leq$ 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 190 standard. Otherwise, obtain a variance from the Commission to permit releases which exceed the 40 CFR 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.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

The requirements set forth in this Section will provide reasonable assurance that radioactive liquid and gaseous effluent releases to the environment in and around Fort Calhoun Station are monitored and that any deviation of radiation levels above background will be identified.

5.1 Radiological environmental monitoring shall be conducted according to Table 4. 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 (Part II, Section 4.4).

5.2 If the level of radioactivity, from calculated doses, in the Annual Radiological Effluent Release Report leads to a higher exposure pathway to individuals, this pathway shall be added to the Radiological Environmental Monitoring Program.

5.3 If the level of radioactivity in an environmental sampling medium exceeds the reporting level specified in Table 7, a Non-routine Report shall be prepared and submitted to the Nuclear Regulatory Commission (Part II, Section 4.5). The detection capabilities of the equipment used for the analysis of Environmental Samples must meet the requirements of Table 6 for Lower Level of Detection (LLD).

5.4 A land use survey shall be conducted once per 24 months between the dates of June 1 and October 1. This 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 results of the land use survey shall be submitted to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report (Part II, Section 4.4). The survey shall be conducted under the following conditions:

5.4.1 Within a one-mile radius from the plant site, enumeration by door-to-door or equivalent counting techniques.

5.4.2 Within a five-mile radius, enumeration by using referenced information from county agricultural agents or other reliable sources.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

5.4.3 If it is learned from this survey that milk animals are present at a location which yields a calculated dose greater than from previously sampled location(s), the new location(s) shall be added to the monitoring program. The 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 is then added to the monitoring program. Also, any location(s) from which milk can no longer be obtained may be dropped and replaced if practicable from the monitoring program and the Nuclear Regulatory Commission shall be notified in the Annual Radiological Environmental Operating Report (Part II, Section 4.4).

5.4.4 Radiological Environmental Sampling locations and the media that is utilized for analysis are presented in Table 5. Details of the emergency TLD locations are contained in Emergency Preparedness Implementing Procedures.

5.5 Analyses shall be performed on radioactive materials as part of an Interlaboratory Comparison Program that has been approved by the Nuclear Regulatory Commission. The results of these analyses shall be included in the Annual Radiological Environmental Operating Report.

5.6 Deviations from the monitoring program, presented in this section and detailed in Table 4, are permitted if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of equipment, or if a person discontinues participation in the program and other legitimate reasons. If the equipment malfunctions, corrective actions will be complete as soon as practicable. If a person no longer supplies samples, a replacement will be made. All deviations from the sampling schedule will be described in the Annual Radiological Environmental Operating Report, pursuant to Part II, Section 4.4.

TABLE 1

Radioactive Liquid Waste Sampling and Analysis

A. **Monitor & Hotel Waste Tanks Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Each Batch	Principal Gamma Emitters(2)(3)	5.0 E-07
	I-131(2)	1.0 E-06
Monthly From One Batch	Dissolved Noble Gases(2) (Gamma Emitters)	1.0 E-05
Monthly Composite(7)	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite(7)	Sr-89, Sr-90	5.0 E-08

B. **Steam Generator Blowdown**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Weekly Composite(7)	Principal Gamma Emitters(3)	5.0 E-07
	I-131(5)	1.0 E-06
Monthly	Dissolved Noble Gases (Gamma Emitters)	1.0 E-05
Monthly Composite(7)	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite(7)	Sr-89, Sr-90	5.0 E-08

TABLE 2

Radioactive Gaseous Waste Sampling and Analysis

A. **Gas Decay Tank Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[1]
Prior to each release	Principal Gamma Emitters[4]	1.0 E-04

B. **Containment Purge Releases or Containment**

Pressure Relief Line Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[1]
Prior to each release	Principal Gamma Emitters[4]	1.0 E-04
Prior to each release	H-3	1.0 E-06

C. **Condenser Air Ejector Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[1]
Monthly[6]	Tritium (H-3)	1.0 E-06
Monthly	Principal Gamma Emitters[4]	1.0 E-04

TABLE 2
(Continued)

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

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[1]
Weekly (Charcoal Sample)	I-131	1.0 E-12
Weekly (Particulates)	Principal Gamma Emitters[4], I-131 and Particulates with half-lives > eight days.	1.0 E-11
Monthly Composite	Gross α	1.0 E-11
Quarterly Composite (Particulates)	Sr-89, Sr-90	1.0 E-11

TABLES 1 and 2
(Continued)

NOTES:

(1) LLD is defined in Part II, Section 3.3.

(2) Gross Radioactivity is defined as the determination of radioactivity levels without regard to specific radionuclide identification and individual isotopic quantification.

(3) 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, Ce-141, and Ce-144.

(4) 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, Ce-141, Ce-144 for particulate emissions.

(5) 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 1.0 E-06 microCurie/milliliter.

(6) Required only when steam generator blowdown radioactivity for tritium (Table 1, Item B) exceeds 3.0 E-03 microCurie/milliliter.

(7) 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.

TABLE 3

Radiation and Environmental Monitors
Operability Test Requirements

A. Liquid Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-054 A/B	X(2)	X	X	X	-
RM-055/55A	-	-	X	X	X

B. Gaseous Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-043	X	X	X	X	-
RM-057	X	X	X	X	-
RM-062/51(1)	X	X	X	X	X
RM-041/42 Sampler	X	-	-	X	-
RM-060 Sampler Flow Rate	X	-	-	X	-

C. Envirnmntl. Monitors	Monthly Operations Check	Annual Air Flow Calibration
RM-035 - 039	X	X

NOTES:

(1) RM-051 will be substituted for RM-062 when it is sampling the Auxiliary Building Ventilation Stack.

(2) Visual flowcheck daily

TABLE 4

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
1. Direct Radiation	A. Ten TLD indicator stations, one control station, total of 11.	Gamma dose	Quarterly
	B. An inner-ring of 16 stations, one in each meteorological sector in the general area of the site boundary and within 2.5 miles.	Gamma dose during site Area and General Emergencies only.	Replaced Annually
	C. An outer-ring of 16 stations, 1 in each meteorological sector located outside of the inner-ring, but no more distant than approximately 5 miles(5).	Gamma dose during site Area and General Emergencies only.	Replaced Annually
2. Air Monitoring	A. Indicator Stations	1) Filter for Gross Beta(3)	Weekly
	1. 3 stations in the general area of the Site Boundary.	2) Charcoal for I-131	Weekly
	2. City of Blair	3) Filter for Gamma Isotopic	Quarterly composite of wkly. fltrs.
	B. One background station	Same as A. above	
3. Water	A. Missouri River at nearest downstream drinking water intake.	Gamma Isotopic, H-3	Monthly composite for Gamma Isotopic Analysis
	B. Missouri River downstream near the mixing zone.		Quarterly composite for H-3 Analysis
	C. Missouri River upstream of plant intake (background).		
4. Milk(4)	A. Nearest family cow when available or one dairy farm within 5 miles.	Gamma Isotopic and I-131	Semimonthly grazing season (May to October)
	B. One dairy farm between 5 miles and 18.75 miles. (Background)		
5. Fish	A. Four fish samples within vicinity of plant discharge.	Gamma Isotopic	Once per season (May to October)
	B. One background sample upstream of plant discharge.		
6. Sediment	One sample from downstream area on the station side of the Missouri River.	Gamma Isotopic	Semiannually

TABLE 4
(Continued)

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
7. **Vegetables or Food Products**	A. One sample outside of 5 miles. (Background) B. One sample in the highest exposure pathway.	Gamma Isotopic	Once per season (May to October)

Notes:

(1) See Table 6 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/m^3, a gamma spectral analysis will be performed.

(4) When milk samples are not available, a broad leaf vegetation or pasture grass sample shall be collected, when available.

(5) Details of the Emergency TLD Stations are contained in Emergency Preparedness Implementing Procedures.

TABLE 5

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from (north)	Airborne Particulate	Airborne Iodine	TLD	Surface Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
1	Onsite Station No. 1, 110-meter weather tower	0.5	293°	X	X	X					
2	Onsite Station No. 2, adjacent to old plant access road	0.6	208°	X	X	X					
3	Offsite Station No. 3, intersection of Hwy. 75 and farm access road	0.8	145°	X	X	X					
4	Blair OPPD office	3.0	303°	X	X	X					
5	EOF Building, North Omaha Power Station	17.5	157°	X	X	X					
6	Fort Calhoun City Hall	4.8	149°			X					
7	Fence around intake gate, Desoto Wildlife Refuge	2.0	101°			X					
8	Entrance to Plant Site from Hwy. 75	0.6	180°			X					
9	NW of Plant	1.0	310°			X					
10	WSW of Plant	0.7	250°			X					
11	SE of Plant	0.9	130°			X					
12	Met. Utilities Dist., Florence Treatment Plant North Omaha, NE	17.0	156°				X				
13	West bank Missouri River, downstream from reactor building	0.5	106°				X		X		
14	125' upstream from intake bldg., west bank of river	0.1	345°				X		X		

TABLE 5
(Continued)

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from (north)	Airborne Particulate	Airborne Iodine	TLD	Well Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
15	Smith Farm(1)	1.9	133°				X				
16	OPPD Onsite Well(1)	0.1	154°				X				
17	Headquarters Bldg.,(1) Desoto Wildlife Refuge	3.1	53°				X				
18	Miller Farm(3) (Discontinued Milk)	0.8	206°								X
19	Flynn Dairy(2)	3.4	310°					X			
20	Mohr Dairy(1)(2)(3)	7.9	187°					X			X
21	Japp Dairy(2)	6.3	219°					X			
22	Fish Sampling Area - Missouri River	R.M. 645.0	-							X	
23	Fish Sampling Area - Missouri River	R.M. 666.0	-							X	
24	Legenhausen Farm (Discontinued)	0.7	207°								
25	Seltz Farm(2)	2.7	168°					X			
26	Vegetation(3) (High Expos. Pthwy. for Veg.)										X
27	Vegetation(3) (Background)										X

Notes:

(1) Sampling not required for pathway modeling, collections performed for additional information only.

(2) When a milk sample is not available at a location, a broad leaf vegetation sample will be collected at that location as a substitute.

(3) Vegetation sites chosen based on Land Use Survey and Semiannual Radioactive Effluent Release Report.

TABLE 6

Detection Capabilities for Environmental Sample Analysis(1)(2)(3)
Lower Limit of Detection (LLD)

Sample	Units	Gross Beta	H-3	Mn-54	Fe-59	Co-58, 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	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
Air Particulate or Gases	pCi/m^3	1.0E-02	--	--	--	--	--	--	--	7.0E-02	--	--	--
Sediment	pCi/kg (dry)	--	--	--	--	--	--	--	--	--	1.5E+02	1.8E+02	--
Grass or Broad Leaf Vegetation/ Vegetables	pCi/kg (wet)	--	--	--	--	--	--	--	--	6.0E+01	6.0E+01	8.0E+01	--

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(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 Surveillance Report pursuant to Part II, Section 5.1.

(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, for purposes of these specifications, as the smallest concentration or radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22E{+}06 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

TABLE 7

Reporting Levels for Radioactivity Concentrations in Environmental Samples(1)

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	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
Air Particulate or Gases	pCi/m^3	--	--	--	--	--	--	--	--	9.0E-01	--	--	--
Grass or Broad Leaf Vegetation/ Vegetables	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:

$$\frac{\text{Concentration (1)}}{\text{Reporting Level (1)}} + \frac{\text{Concentration (2)}}{\text{Reporting Level (2)}} + \text{- - - - - -} \geq 1.0$$

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 II, Section 1.1 and 1.2. 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.

PART III

RADIOLOGICAL EFFLUENT RADIATION MONITOR CALCULATIONS

1.0 EFFLUENT MONITOR SETPOINTS

1.1 Liquid Effluents

There are two liquid discharge pathways to the Missouri River. These pathways originate with the radioactive liquid waste processing system (monitor or hotel tanks) and the steam generator blowdown system. Both of these pathways empty into the circulating water system which discharges to the Missouri River (see Figure 1). Figure 2 depicts the liquid discharge pathways and associated radiation monitors. Figure 3 depicts the methods of liquid effluent treatment. A detailed discussion of the liquid effluent treatment system is presented in Section 2.1.

The flowrate for dilution water varies with the number of circulating water pumps in service and with the operation of the warm water recirculation. Some warm water from the condenser outlet is diverted from the circulating water discharge to upstream of the intake structure to help prevent ice from forming on the circulating water pump intakes during winter months. The varying dilution flowrate is accounted for in the dilution calculations for monitor tank and stream generation releases.

Alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the concentration of radioactive material released in liquid effluents to unrestricted areas shall be less than the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2.

Cs-137 is the most abundant radionuclide in liquid effluent streams and is used to calibrate the liquid effluent monitors.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2 Liquid Effluent Radiation Monitors

1.2.1 Steam Generator Blowdown Monitors (RM-054A and B)

These process radiation detectors monitor the flow through the steam generator blowdown lines and automatically close the blowdown isolation valves if the monitor high alarm setpoint is reached. The high alarm setpoint calculations are based on controlling the discharge at 10 CFR 20 limits of 1.0E-07 μCi/ml for unrestricted areas.

The following calculations for maximum concentration and alarm setpoints are valid when steam generator blowdown is the only liquid release pathway. For simultaneous radioactive liquid releases of steam generator blowdown and monitor tank discharge, refer to Section 1.5.1.

The maximum allowable concentration in the blowdown line is calculated as follows:

$$A_o = \frac{(1.0E\text{-}07\ \mu Ci/ml)\ (X_o)}{Y_o}$$

Where:

1.0E-07 μCi/ml = 10 CFR 20 Limit for unidentified radionuclides at site discharge (I-129, Ra-226 and Ra-228 are not present).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)

Y_o = Blowdown flow rate (gpm). (Normal blowdown flow rate is based on 2 transfer pumps with a design flow of 135 gpm each, 270 gpm total. Other flow rates may be used, as required.)

A_o = Maximum allowable blowdown concentration (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.1 The high alarm setpoint (CPM) =

$$.85 \ [\ (S_f)\ (A_o) + B\ ]$$

Where:

.85 = Correction factor for instrument meter error.

S_f = Detector sensitivity factor (CPM/µCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable blowdown line activity (µCi/ml).

B = Background (CPM).

Setpoints may be recalculated based on adjusted dilution flow and adjusted blowdown flow.

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified prior to automatic actuation of the blowdown isolation valves.

1.2.2 Overboard Discharge Header Monitor (RM-055 or RM-055A)

This process radiation monitor provides control of the waste monitor tank effluent by monitoring the overboard header prior to its discharge into the circulating water discharge tunnel. The concentration of activity at discharge is controlled below the 10 CFR 20 limit of 1.0E-07 µCi/ml for unrestricted areas for unidentified isotopes by the high alarm setpoint which closes the overboard flow control valve.

The following calculations for maximum concentration and alarm setpoints are valid when Monitor Tank discharge is the only liquid release pathway. For simultaneous radioactive liquid releases of monitor tank discharge and steam generator blowdown, refer to Section 1.5.1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The maximum allowable concentration in the overboard discharge header is:

$$A_o = \frac{(1.0E\text{-}07\ \mu Ci/ml)\ (X_o)}{Y_o}$$

Where:

1.0E-07 mCi/ml =	10 CFR 20 Limit for unidentified radionuclides at site discharge (I-129, Ra-226 and Ra-228 are not present).
X_o =	Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)
Y_o =	Maximum monitor tank discharge flow rate (gpm). (Normal monitor tank maximum flow is 50 gpm. Other flow rates may be used, as required.)
A_o =	Maximum allowable activity in discharge header (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The high alarm setpoint (CPM) =

$$.85\ [\ (S_f)\ (A_o) + B\ ]$$

Where:

.85 = Correction factor for instrument meter error.

S_f = Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable concentration in discharge header (μCi/ml).

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to automatic actuation of the overboard flow control valve.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.3 Gaseous Effluents

The gaseous effluent monitoring instrumentation for controlling and monitoring normal radioactive material releases in accordance with 10 CFR 20, Appendix B, Table 2, Column 1 limits for unrestricted areas (see Figure 1), are summarized as follows:

A. Auxiliary Building - The Auxiliary Building Exhaust Stack receives discharges from the waste gas decay tanks, containment purge, containment vent systems and the auxiliary building ventilation system. Effluents are monitored by RM-062, a noble gas activity monitor. Additionally, noble gas activity monitor, RM-051, provides redundant back-up monitoring capabilities to the RM-062 monitor. Iodine monitoring and sampling capabilities are provided by RM-060. Particulate monitoring is provided by RM-061. Redundant particulate monitoring is provided by RM-050. Ventilation Isolation Actuation Signal (VIAS) is actuated by exceeding a monitor's alarm setpoint. Actuation of VIAS will isolate releases from containment and waste gas decay tanks. The Auxiliary Building Exhaust fans will remain in operation.

B. Laboratory and Radioactive Waste Process-ing Building (LRWPB) - Noble gas, iodine, and particulate monitoring is provided by Radiation Monitors RM-043, RM-042, and RM-041, respectively. These radiation monitors do not serve a control function.

C. Condenser Off-Gas Monitors - Noble gas activity is monitored by RM-057. The condenser off-gas is discharged directly to the environment. Exceeding the high alarm setpoint on RM-057 will activate isolation of main steam to the Auxiliary Steam System.

A gaseous radioactive waste flow diagram with the applicable, associated radiation monitoring instrumentation and controls is presented as Figure 4. The gaseous waste disposal system is presented in Figure 5. A detailed discussion of the gaseous effluent treatment system is presented in Section 2.2.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4 Gaseous Effluent Radiation Monitors

1.4.1 Auxiliary Building Exhaust Stack Particulate Activity Monitor (RM-061/RM-050)

Either of these monitors may be used to measure airborne particulate activity in the exhaust stack. The detector is located adjacent to a section of moveable filter paper on a capstan drive. The monitor alarm setpoint is based on 10 CFR 20 limits of 1.0 E-10 mCi/cc at the site boundary.

The following calculations for maximum release rate and alarm setpoint are valid when the Auxiliary Building Exhaust Stack is the only gaseous release pathway. For simultaneous gaseous releases from Auxiliary Building Exhaust Stack, condenser off-gas, and the LRWPB Exhaust Stack, refer to Section 1.5.2. The maximum allowable release rate for stack particulates is calculated as follows:

$$\frac{(1.0E\text{-}10\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)} \times (1.0E\text{+}06\, cc/m^3) = 2.0E\text{+}01\ \mu Ci/\sec$$

Where:

1.0E-10 μCi/cc =	10 CFR 20 Limit at site boundary for unidentified isotopes.
5.0E-06 sec/m³ =	Annual average dispersion factor at the site boundary.
1.0E+06 cc/m³ =	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\ \frac{(2.0E\text{+}01)\ (S_F)\ (F_s)\ (T)}{(F_v)} + B\ \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.1 Where:

.85 = Correction for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi). (Sensitivity based on Cs-137).

F_s = Monitor sample flow rate (SCFM).

T = Effective monitor response time (sec).

F_v = Auxiliary Building Exhaust stack flow rate (SCFM). (Default maximum flow rate is 122500 cfm for 3 Auxiliary Building exhaust fans and 2 containment purge fans in operation. Other flow rates may be used, as required.)

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to exceeding the alarm setpoint.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.2 Auxiliary Building Exhaust Stack Gaseous Activity Monitor (RM-062/RM-051)

Either of these monitors may be used to measure gaseous activity in the exhaust stack. The gas is monitored after passing through a particulate filter. The monitor controls gaseous activity releases so that the 10 CFR 20 limit for the unrestricted areas of 3.0E-07 μCi/cc, based upon Xe-133, is not exceeded. The Ventilation Isolation Actuation Signal is initiated when the high alarm setpoint is reached.

The following calculations for maximum release rate and alarm setpoint are valid when Auxiliary Building Exhaust Stack is the only gaseous release pathway. For simultaneous gaseous releases from Auxiliary Building Exhaust Stack, condenser off-gas and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for stack gaseous activity is calculated as follows:

$$\frac{(3.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)} \times (1.0E{+}06\ cc/m^3) = 6.0E{+}04\ \ \mu Ci/\sec$$

Where:

3.0E-07 μCi/cc = 10 CFR 20 Limit at site boundary (based upon Xe-133).

5.0E-06 sec/m³ = Annual average dispersion factor at the site boundary.

1.0E+06 cc/m³ = Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\ \frac{(6.00E{+}04)\ (S_p)\ (60)}{(F_v)\ (28317)} + B\ \right]$$

1.0 <u>EFFLUENT MONITOR SETPOINTS</u> (Continued)

1.4.2 Where:

.85 =	Correction for instrument meter error.
S_f =	Detector sensitivity factor (CPM/ μCi/cc). (Sensitivity based on Xe-133)
60 =	Conversion (seconds to minutes).
28317 =	Conversion factor (ft^3 to cc).
F_v =	Auxiliary Building Exhaust stack flow rate (SCFM). (Default maximum flow rate is 122500 cfm for 3 Auxiliary Building exhaust fans and 2 containment purge fans in operation. Other flow rates may be used, as required.)
B =	Background (CPM).

An alarm setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to actuation of VIAS.

1.4.3 Auxiliary Building Exhaust Stack Iodine Activity Monitor (RM-060)

RM-060 monitors the gaseous waste discharged from the exhaust stack for Iodine-131 activity by continuously counting a charcoal cartridge and pre-filter through which a sample of exhaust stack air is passing at a known rate. The monitor alarm setpoint is based on the 10 CFR 20 limit for Iodine-131 at the site boundary.

The following calculations for maximum release rate and alarm setpoint are valid when Auxiliary Building Exhaust Stack is the only gaseous release pathway. For simultaneous gaseous releases from Auxiliary Building Exhaust Stack, condenser off-gas and the LRWPB Exhaust Stack, refer to Section 1.5.2.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.3 The maximum allowable release rate for stack iodine is calculated as follows:

$$\frac{(1.0E\text{-}10\ \mu Ci/cc)}{(5.0E\text{-}06\ \text{sec}/m^3)} \times (1.0E\text{+}06\ cc/m^3) = 2.0E\text{+}01\ \mu Ci/\text{sec}$$

Where:

1.0E-10 μCi/cc = 10 CFR 20 Limit at site boundary (based upon I-131).

5.0E-06 sec/m³ = Annual average dispersion factor at site boundary.

1.0E+06 cc/m³ = Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\ \frac{(2.0E\text{+}01)\ (S_F)\ (F_S)\ (T)\ (E)}{(F_v)} + B\ \right]$$

Where:

.85 = Correction for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi). (Sensitivity based on I-131)

F_s = Monitor sample flow rate (SCFM).

T = Effective monitor response time (sec).

F_v = Auxiliary Building Exhaust stack flow rate (SCFM). (Default maximum flow rate is 122500 cfm for 3 Auxiliary Building exhaust fans and 2 containment purge fans in operation. Other flow rates may be used, as required.)

E = Charcoal filter collection efficiency.

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.4 Condenser Air Ejector Monitor (RM-057)

This monitor is located in the turbine building and monitors the condenser off-gas. The purpose of this monitor is to monitor the condenser off-gas discharges so that the 10 CFR 20 limit for unrestricted areas of 3.0E-07 μCi/cc, based upon Xe-133, is not exceeded.

The following calculations for maximum release rate and alarm setpoint are valid when condenser off-gas is the only gaseous release pathway. For simultaneous gaseous releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for condenser air ejector monitor is as follows:

$$\frac{(3.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ sec/m^3)} \times (1.0E\text{+}06\ cc/m^3) = 6.0E\text{+}04\ \ \mu Ci/sec$$

Where:

3.0E-07 μCi/cc	=	10 CFR 20 Limit at site boundary (based upon Xe-133).
5.0E-06 sec/m³	=	Annual average dispersion factor at the site boundary.
1.0E+06 cc/m³	=	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\ \frac{(6.00E\text{+}04)\ (S_F)\ (60)}{(F_v)\ \ (28317)}\ +B\ \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.4 Where:

.85	=	Correction for instrument meter error.
S_F	=	Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on Xe-133)
60	=	Conversion (seconds to minutes).
28317	=	Conversion factor (ft^3 to cc).
F_v	=	Vent stack flow rate (SCFM). Default maximum flow rate is 4755 scfm (3 vacuum pumps in hogging mode. Other flow rates may be used, as required.)
B	=	Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, allowing time for corrective actions prior to exceeding the alarm setpoint and tripping of the auxiliary steam supply valve, RCV-978.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.5 Laboratory and Radioactive Waste Processing Building (LRWPB) Exhaust Stack Particulate Activity Monitor (RM-041)

This monitor is used to measure airborne particulate activity in the LRWPB exhaust stack. The detector is located adjacent to a removable filter paper. The monitor alarm setpoint is based on 10 CFR 20 limits of 1.0E-10 μCi/cc at the site boundary.

The following calculations for maximum release rate and alarm setpoint are valid when LRWPB Exhaust Stack is the only gaseous release pathway. For simultaneous gaseous releases from Auxiliary Building Exhaust Stack, condenser off-gas, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for stack particulates is calculated as follows:

$$\frac{(1.0E\text{-}10\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)}\ x\ (1.0E{+}06\ cc/m^3) = 2.0E{+}01\ \mu Ci/\sec$$

Where:

1.0E-10 mCi/cc	=	10 CFR 20 Limits at site boundary for unidentified isotopes.
5.0E-06 sec/m³	=	Annual average dispersion factor at the site boundary.
1.0E+06 cc/m³	=	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\ \frac{(2.0E{+}01)\ (S_F)\ (F)\ (T)}{(F_V)} + B\ \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.5 Where:

.85	=	Correction for instrument meter error.
S_F	=	Detector sensitivity factor (CPM/μCi). (Sensitivity based on Cs-137).
F_s	=	Monitor sample flow rate (SCFM).
T	=	Effective monitor response time (sec).
F_v	=	LRWPB Exhaust stack flow rate (SCFM). (Default maximum flow rate is 28700 cfm. Other flow rates may be used, if required.)
B	=	Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to exceeding the alarm setpoint.

This monitor alarms in the Control Room. There are no automatic control functions associated with the actuation of the alarm.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.6 Laboratory and Radioactive Waste Processing Building Exhaust Stack Iodine Activity Monitor (RM-042)

RM-042 monitors the gaseous waste discharged from the LRWPB for Iodine-131 activity by continuously counting a charcoal filter cartridge through which a sample of LRWPB exhaust air is passing at a known rate. The monitor alarm setpoint is based on the 10 CFR 20 limit for Iodine-131 at the site boundary.

The following calculations for maximum release rate and alarm setpoint are valid when LRWPB Exhaust Stack is the only gaseous release pathway. For simultaneous gaseous releases from Auxiliary Building Exhaust Stack, condenser off-gas, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for stack iodine is calculated as follows:

$$\frac{(1.0E\text{-}10\ \mu Ci/cc)}{(5.0E\text{-}06\ sec/m^3)} \times (1.0E{+}06\,cc/m^3) = 2.0E{+}01\ \mu Ci/sec$$

Where:

1.0E-10 μCi/cc =	10 CFR 20 Limit at site boundary (based upon I-131).
5.0E-06 sec/m^3 =	Annual average dispersion factor at the site boundary.
1.0E+06 cc/m^3 =	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\frac{(2.0E{+}01)\ (S_F)\ (F)\ (T)\ (E)}{(F_V)} + B \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.6 Where:

.85 = Correction for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi). (Sensitivity based on I-131)

F_s = Monitor sample flow rate (SCFM).

T = Effective monitor response time (sec).

F_v = LRWPB Exhaust stack flow rate (SCFM). (Default flow rate is 28700 cfm. Other flow rates may be used, if required.)

E = Charcoal filter collection efficiency.

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified.

This monitor alarms in the Control Room. There are no automatic control functions associated with the actuation of the alarm.

1.4.7 Laboratory and Radioactive Waste Processing Building Exhaust Stack Gaseous Activity Monitor (RM-043)

RM-043 is located in the Radwaste Building and samples the LRWPB Exhaust Stack. The monitor alarm setpoint is based on the 10 CFR 20 limit for Xe-133 at the site boundary.

The following calculations for maximum release rate and alarm setpoint are valid when the LRWPB Exhaust Stack is the only gaseous release pathway. For simultaneous gaseous releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for RM-043 is as follows:

$$\frac{(3.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ sec/m^3)} \times (1.0E{+}06\, cc/m^3) = 6.0E{+}04\ \mu Ci/\text{sec}$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.7 Where:

$3.0E\text{-}07\ \mu Ci/cc$ = 10 CFR 20 Limit at site boundary (based upon Xe-133).

$5.0E\text{-}06\ sec/m^3$ = Annual average dispersion factor at the site boundary.

$1.0E\text{+}06\ cc/m^3$ = Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\frac{(6.00E\text{+}04)\ (S_F)\ (60)}{(F_v)\ (28317)} + B \right]$$

Where:

.85 = Correction for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on XE-133)

60 = Conversion (seconds to minutes).

28317 = Conversion factor (ft^3 to cc).

F_v = LRWPB Exhaust stack flow rate (SCFM). (Default flow rate is 28700 cfm. Other flow rates may be used if required.

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified.

This monitor alarms in the Control Room. There are no automatic control functions associated with the actuation of the alarm.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5 Simultaneous Release Pathways

1.5.1 Liquid Release Pathways

The liquid radiation monitors (RM054A and B, RM055, and RM055A) control liquid releases so that 10 CFR 20 limits of 1.0E-07 µCi/ml for unidentified isotopes in unrestricted areas are not exceeded. There are two liquid release pathways that contribute to the concentration at discharge to unrestricted areas. These are Steam Generator Blowdown and Monitor Tank Overboard Discharge Header. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.2 so that unrestricted area concentration limits are not exceeded.

The calculations for the alarm setpoints for the liquid effluent monitors will be adjusted as follows:

$$A_T = K_o A_o + K_1 A_1$$

$$A_T = \frac{K_o\ (1.0E\text{-}07\ \mu Ci/ml)\ (X_o)}{Y_o} + \frac{K_1\ (1.0E\text{-}07\ \mu Ci/ml)\ (X_o)}{Y_1}$$

Where:

A_s = Sum of individual maximum allowable concentrations for Steam Generator and Monitor Tank prior to dilution for simultaneous liquid releases (µCi/ml)

A_o = Maximum allowable concentration in Steam Generator blowdown Line (µCi/ml)

A_1 = Maximum allowable concentration in Monitor Tank Discharge Line (µCi/ml)

K_o = Proportionality constant for Steam Generator (See Table 1)

K_1 = Proportionality constant for Monitor Tank (See Table 1)

X_o = Total dilution flow in Discharge Tunnel (GPM)

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.1 Where:

Y_0 = Steam Generator Blowdown flowrate (GPM)

Y_1 = Monitor Tank Discharge flowrate (GPM)

The High Alarm Setpoint for Steam Generator Blowdown monitors, RM054A and B, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_o\ S_{Fo}\ A_o + B_o]$$

The High Alarm Setpoint for Monitor Tank Discharge monitors, RM055 and 55A, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_1\ S_{F1}\ A_1 + B_1]$$

Where:

S_{Fo} = Detector Sensitivity factor for RM054A/B, CPM/(μCi/ml), based on Cs-137.

S_{F1} = Detector Sensitivity factor for RM055/55A, CPM/(μCi/ml), based on Cs-137.

A_o = Maximum allowable concentration in SG Blowdown line. (μCi/ml)

A_1 = Maximum allowable concentration in MT Discharge line. (μCi/ml)

B_o = RM054 A or B background countrate. (CPM)

B_1 = RM055 or 55A background countrate. (CPM)

Where:

K_o, K_1 = Proportionality constants. See Table 1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Gaseous Release Pathway

The gaseous radiation monitors (RM041, RM042, RM043, RM057, RM060, RM061, and RM062) control gaseous releases so that 10 CFR 20 limits of 3.0E-07 μCi/cc for gases and 1.0E-10 μCi/cc for iodines and particulates in unrestricted areas are not exceeded. There are three pathways that contribute to the concentration at site boundary. These are the Auxiliary Building Exhaust Stack, Condenser Off-gas, and the LRWPB Exhaust Stack. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.4 to ensure that unrestricted area concentration limits are not exceeded.

The calculations for the alarm setpoints for the gaseous effluent monitors will be adjusted as follows:

The maximum allowable release rates for simultaneous releases is:

$$Max.\ Release\ Rate = \sum_{i=0}^{6} K_i R_i = \sum_{i=0}^{6} K_i \frac{Conc_i}{\chi/Q}$$

Where:

R_o = RM061/RM050 release rate (μCi/sec)
R_1 = RM062/RM051 release rate (μCi/sec)
R_2 = RM060 release rate (μCi/sec)
R_3 = RM057 release rate (μCi/sec)
R_4 = RM041 release rate (μCi/sec)
R_5 = RM042 release rate (μCi/sec)
R_6 = RM043 release rate (μCi/sec)

$K_o \rightarrow K_6$ = Proportionality constants. See Table 1.

$Conc_i$ = Radionuclide concentration for the monitor of interest.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 The maximum release rate is then:

$$\left[\frac{K_o(1.0E\text{-}10\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_1(3.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_2(1.0E\text{-}10\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \right.$$

$$\frac{K_3(3.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_4(1.0E\text{-}10\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_5(1.0E\text{-}10\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} +$$

$$\left. \frac{K_6(3.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} \right] 1.0E\text{+}06\ \frac{cc}{m^3} = Max.\ Release\ Rate$$

The alarm setpoints for the gaseous effluent monitors will then be:

$$RM061/50 = .85\ \left[\ K_o\ \frac{(2.0\ E\text{+}01)\ (S_F)(F_S)(T)}{F_V} + B\ \right]$$

$$RM062/51 = .85\ \left[\ K_1\ \frac{(6.0\ E\text{+}04)\ (S_F)(60)}{F_V\ (28317)} + B\ \right]$$

$$RM060 = .85\ \left[\ K_2\ \frac{(2.0\ E\text{+}01)\ (S_F)(F_S)(T)(E)}{F_V} + B\ \right]$$

$$RM057 = .85\ \left[\ K_3\ \frac{(6.0\ E\text{+}04)\ (S_F)(60)}{(F_V)\ (28317)} + B\ \right]$$

$$RM041 = .85\ \left[\ K_4\ \frac{(2.0\ E\text{+}01)\ (S_F)(F_S)(T)}{(F_V)} + B\ \right]$$

$$RM042 = .85\ \left[\ K_5\ \frac{(2.0\ E\text{+}01)\ (S_F)(F_S)(T)(E)}{(F_V)} + B\ \right]$$

$$RM043 = .85\ \left[\ K_6\ \frac{(6.0\ E\text{+}04)\ (S_F)(60)}{(F_V)\ (28317)} + B\ \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Where:

.85	=	Correction factor for instrument meter error.
$K_0 \rightarrow K_6$	=	Proportionality contents. See Table 1.
S_F	=	Detector sensitivity factor.
F_S	=	Monitor sample flow rate.
T	=	Effective monitor response time.
E	=	Charcoal filter collection efficiency.
F_V	=	Vent stack flowrate. (Condenser off-gas flowrate for RM057, LRWPB Exhaust stack flow rate for RM041/42/43, Auxiliary Building Exhaust Stack flow rate for RM061/50, 62/51 and 60).
B	=	Monitor background count rate.
60	=	Constant of unit conversion (60 sec/min).

TABLE 1

Proportionally Constants for Simultaneous Release Pathways

a. Liquid Effluents	$K_0 + K_1 \leq 1$
K_0 = .30	RM054A/B
K_1 = .70	RM055/55A
b. Gaseous Effluents	$S_i\ K_i \leq 1$
K_0 = .05	RM061/50
K_1 = .40	RM062/51
K_2 = .35	RM060
K_3 = .05	RM057
K_4 = .05	RM041
K_5 = .05	RM042
K_6 = .05	RM043

NOTE: The constants are based on prior knowledge and may be updated as necessary to provide for plant operations.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.1 Liquid Radwaste Treatment System

The major equipment or subsystem(s) of the liquid radwaste treatment system are comprised of the waste filters, monitor tanks, and evaporator. This equipment, including associated pumps, valves and piping, is used in different combinations on an as-needed basis to process the liquid effluent to provide compliance with the as low as is reasonably achievable philosophy and the applicable section of 10 CFR Part 20. The liquid radwaste treatment system is described in Section 11.1.2 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405 M-100, M-9 and M-8.

A filtration/ion exchange (FIX) system may be utilized for processing liquid radwaste in the event the waste evaporator is not in service. 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 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 Part II, Section 2.1.

Every effort will be made to process all liquid waste, except from the hotel waste tanks, through the evaporator or FIX before entering the monitor tanks. If the radioactive liquid waste is discharged without processing and it appears that 1/2 of the annual objective will be exceeded during the calendar quarter, a special report shall be submitted to the Commission pursuant to Part II, Section 2.1.

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.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.2 Gaseous Radwaste Treatment System

The waste gases at Fort Calhoun Station are 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 gases are treated in these gas decay tanks by holding the gases 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 gaseous wastes from the gas decay tanks are discharged without processing in accordance with the above conditions, a special report shall be submitted to the Commission pursuant to Part II, Section 2.2.

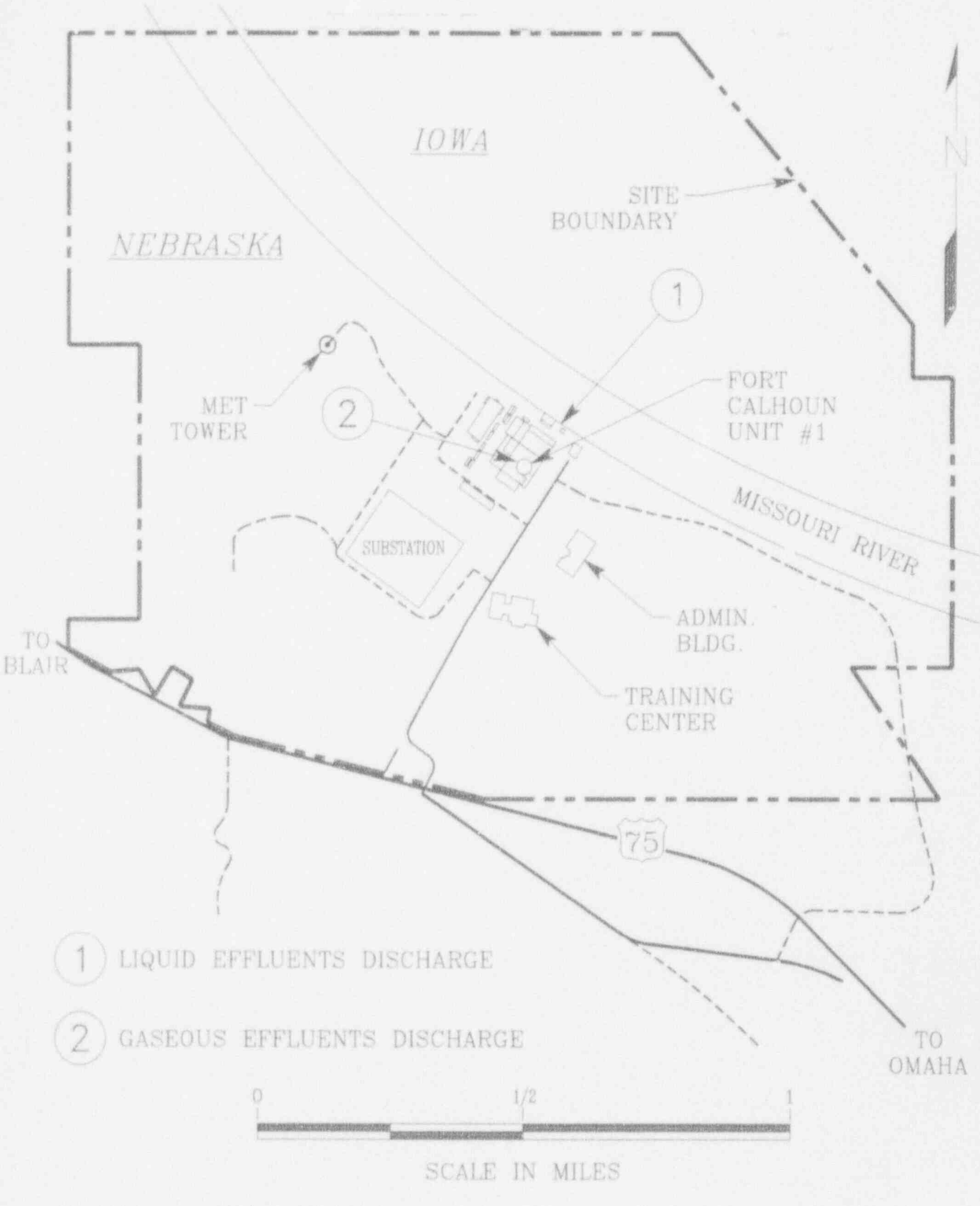
The radioactive effluents from the controlled access area of the auxiliary building are filtered by the HEPA filters in the auxiliary building ventilation system. If the radioactive gaseous wastes are discharged without the HEPA filters, a special report shall be submitted to the NRC pursuant to Part II, Section 2.2.

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 Appendix I dose design evaluation and doses through the gaseous pathways were well below the design objectives. The unavailability of hydrogen purge filters will not be considered a reportable event as per Part II, Section 2.2.

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, a special report shall be submitted to the Commission pursuant to Part II, Section 2.2.

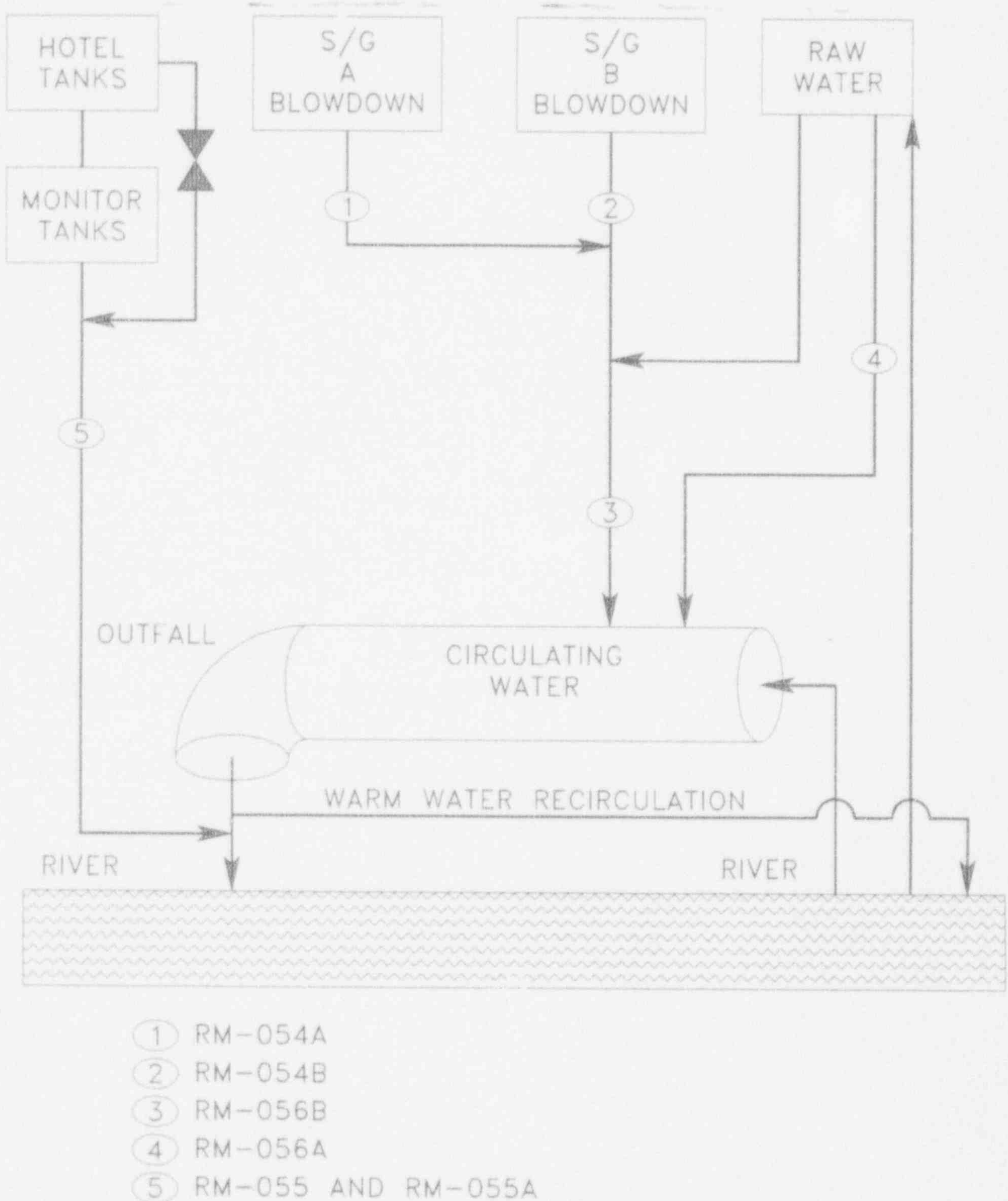
The gaseous radwaste treatment system is described in Section 11.1.3 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405-M-1 and M-261.

Figure 1



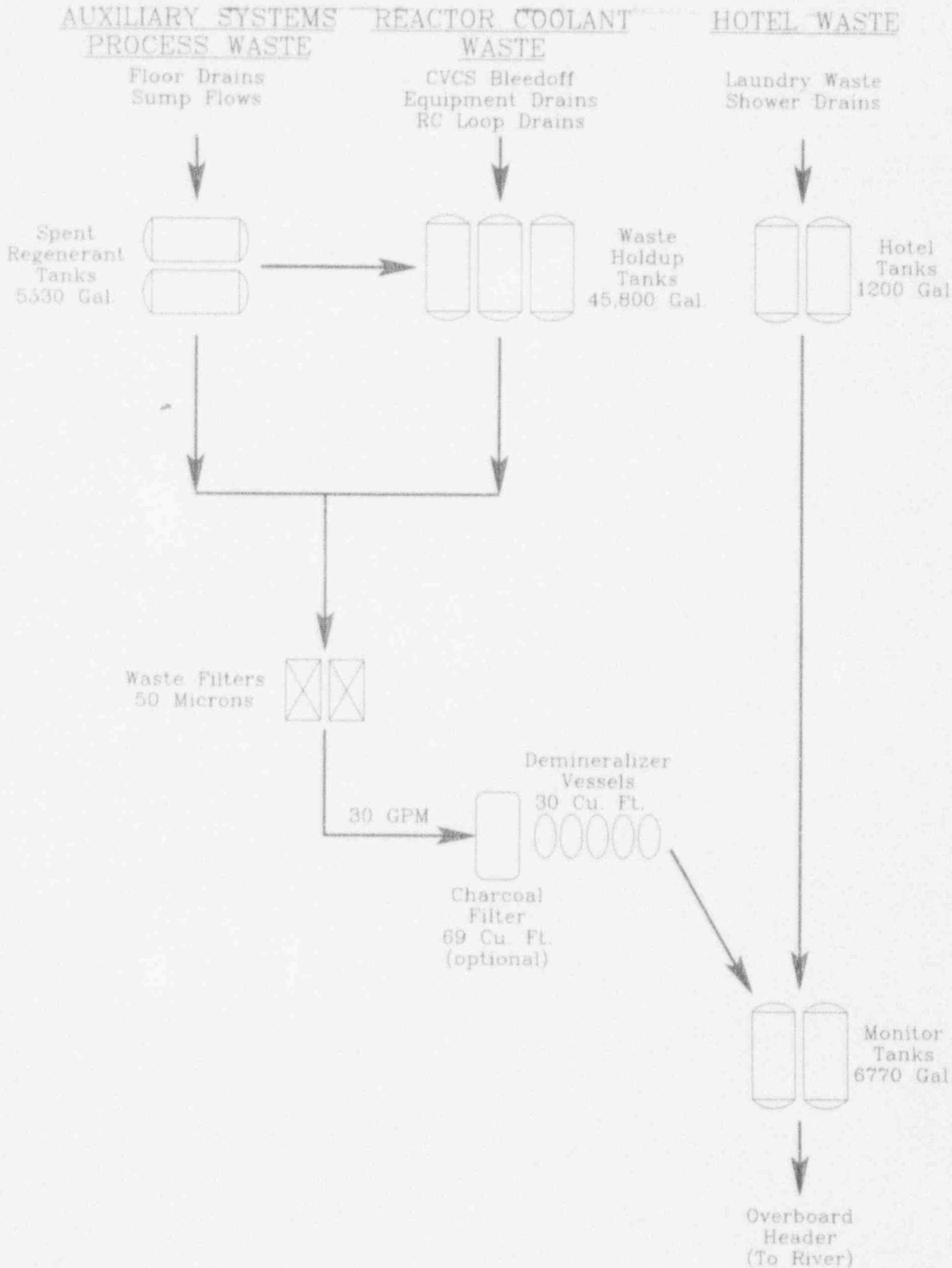
EXCLUSION AND SITE BOUNDARY MAP

Figure 2



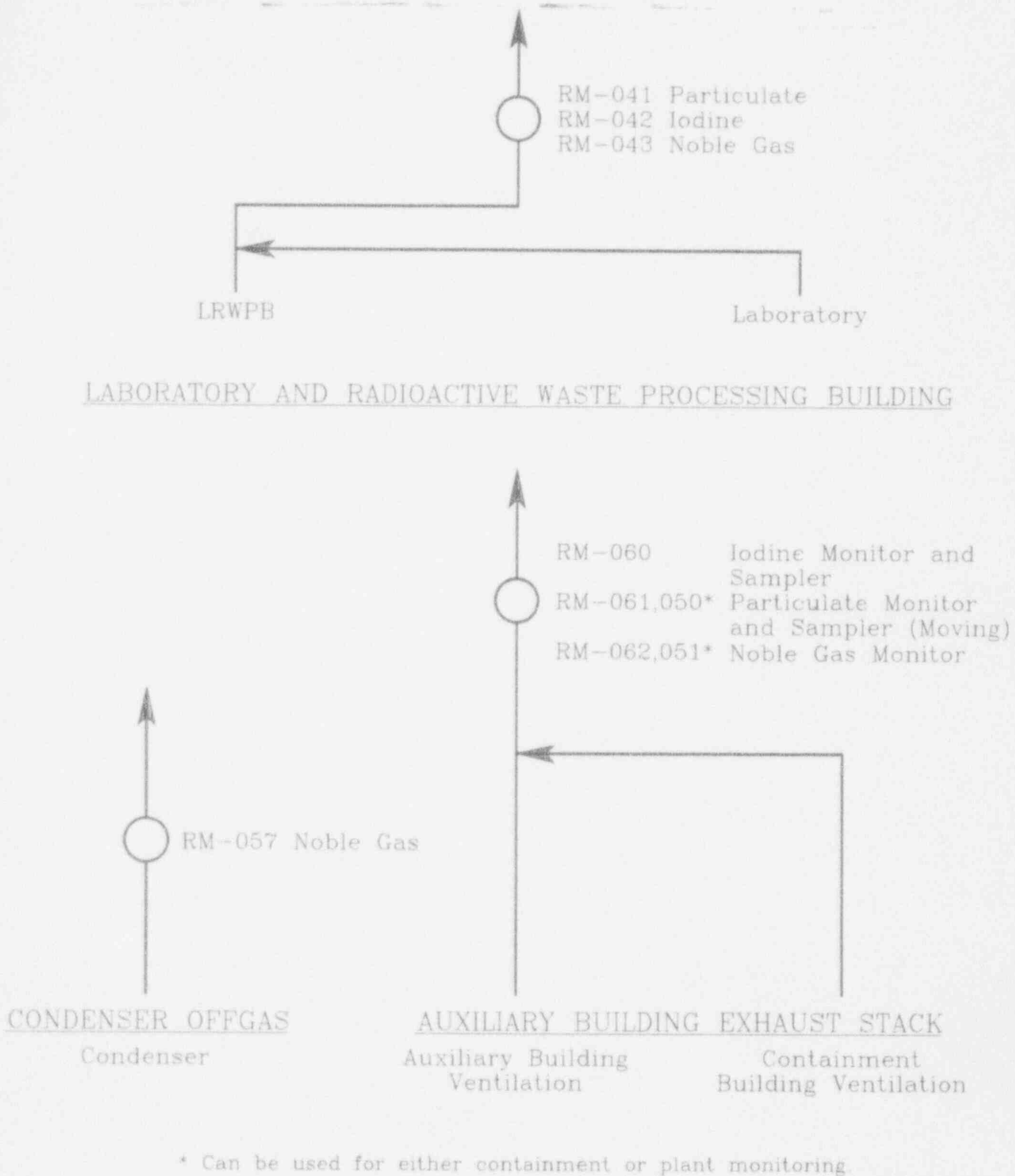
LIQUID RADIOACTIVE DISCHARGE PATHWAYS

Figure 3



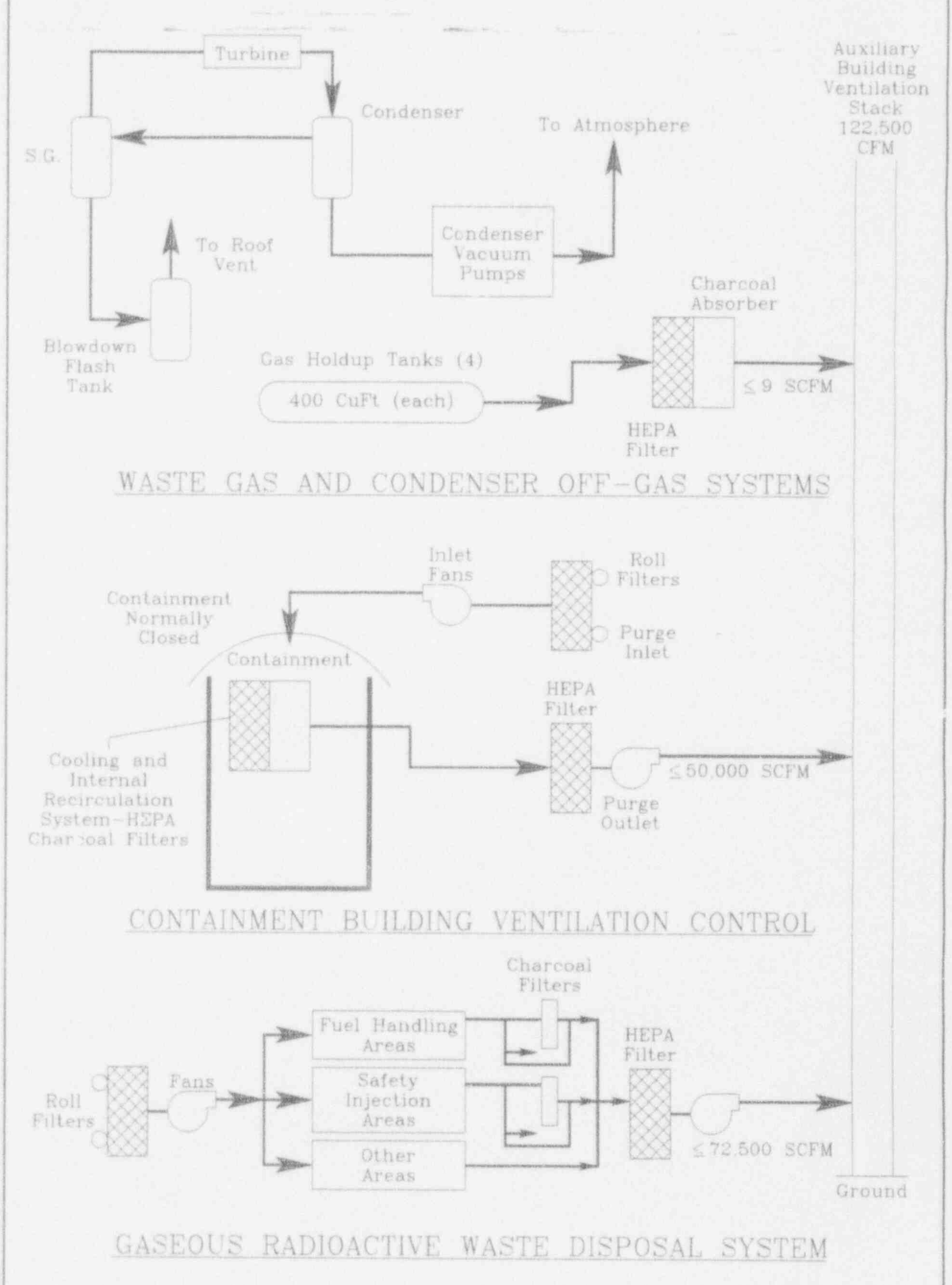
LIQUID RADIOACTIVE WASTE DISPOSAL SYSTEM

Figure 4



GASEOUS RADIOACTIVE DISCHARGE PATHWAYS

Figure 5


Turbine
Condenser
S.G.
To Atmosphere
Auxiliary Building Ventilation Stack 122,500 CFM
To Roof Vent
Condenser Vacuum Pumps
Charcoal Absorber
Blowdown Flash Tank
Gas Holdup Tanks (4)
400 CuFt (each)
≤ 9 SCFM
HEPA Filter
WASTE GAS AND CONDENSER OFF-GAS SYSTEMS
Inlet Fans
Roll Filters
Containment Normally Closed
Purge Inlet
Containment
HEPA Filter
Cooling and Internal Recirculation System-HEPA Charcoal Filters
≤ 50,000 SCFM
Purge Outlet
CONTAINMENT BUILDING VENTILATION CONTROL
Charcoal Filters
Fuel Handling Areas
HEPA Filter
Fans
Safety Injection Areas
Roll Filters
Other Areas
≤ 72,500 SCFM
Ground
GASEOUS RADIOACTIVE WASTE DISPOSAL SYSTEM

PART IV

RADIOLOGICAL EFFLUENT MONITORING CALCULATIONS

1.0 EFFLUENT CONCENTRATIONS

1.1 Liquid Effluent Concentrations

The concentration of radioactive material in liquid effluents (after dilution in the Circulating Water System) will be limited to the concentrations as specified in Appendix B, Table 2, Column 2. For batch releases (Monitor and Hotel Waste Tanks and Steam Generators) and for continuous releases (Steam Generator Blowdown), the analyses will be performed in accordance with Part II, Table 1, and the concentration of each radionuclide at the point of discharge will be calculated, based on the following equation:

Radionuclide concentration at Site Discharge:

$$A_i = \frac{a_i\, f}{F + f}$$

$$\text{and} \sum_{i=1}^{n} A_i \;/\; MPC_i \leq 1$$

Where:

A_i = concentration at the point of discharge for radionuclide, i, in µCi/ml.

a_i = concentration of radionuclide, i, in the undiluted effluent in µCi/ml.

f = undiluted effluent flowrate, in gpm.

F = total diluted effluent flowrate in gpm.

MPC_i = maximum permissible concentration for radionuclide, i, per 10 CFR 20, Appendix B, Table 2, Column 2.

1.0 EFFLUENT CONCENTRATIONS

NOTE: In addition to the above defined method, Notes 1 through 4 of 10 CFR Part 20, Appendix B, will also be applicable.

1.2 Gas Effluent Concentrations

The concentration at the site boundary, due to noble gas releases, will be limited to less than Appendix B, Table 2, Column 1, values for unrestricted areas. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event a gaseous release from the station result in an alarm setpoint being exceeded, an evaluation of the site boundary concentration resulting from the release will be performed:

To determine the concentration and MPC fraction summation at site boundary, the following equations will be used:

$$A_i = K_o Q_i \ (\chi/Q)$$

$$\text{and } \sum_{i=1}^{n} A_i/MPC_i \leq 1$$

Where:

A_i = Concentration of radionuclide, i, at site boundary

K_o = Constant of unit conversion. (1E-6m^3 /cc)

MPC_i = Maximum permissible concentration (10 CFR 20, Appendix B, Table 2, Column 1 value for radionuclide, i)

Q_i = The release rate of radionuclides i, in gaseous effluents from all vent releases (in μCi/sec.)

(χ/Q) = 5E-6 sec/m^3. For all vent releases. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary

As appropriate, simultaneous releases from the Auxiliary Building Ventilation Stack, Laboratory and Radwaste Building Stack and condenser off gas will be considered in evaluating compliance with the release rate limits of 10 CFR 20. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. Historical annual average dispersion parameters, as presented in Table 3, may be used for evaluating the gaseous effluent dose rate.

1.0 EFFLUENT CONCENTRATIONS

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding those more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding 10 CFR 20 limits. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based upon the above criteria, no further analyses are required for demonstrating compliance with 10 CFR 20.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS

2.1 Liquid Effluent Dose Calculations

Three pathways for human exposure to liquid releases from FCS to the Missouri River exists: 1) fish, 2) drinking water, and 3) Shoreline deposition. Fish are considered to be taken from the vicinity of the plant discharge. The drinking water for Omaha is located 19 miles downstream from FCS. The dilution factors for these pathways are derived from the Revised Environmental Report for FCS, (1974), (page 4-29 and 4-31). This report states that during Low-Low river conditions, the concentration at Omaha's water intake will be ≤14% of the concentration at discharge from FCS and will average 3%. This equates to a dilution factor of 7.14, which is used to calculate the maximum dose to an individual from liquid pathways and a dilution factor of 3? 33, for calculating the average dose. All pathways combine to give the dose to an individual in unrestricted areas.

10 CFR 50, App. I restricts the dose to individuals in the unrestricted areas from radioactive materials in liquid effluents from the Fort Calhoun Station to the following limits:

- during any calendar quarter
  ≤1.5 mrem to total body
  ≤5.0 mrem to any organ and
- during any calendar year
  ≤ 3.0 mrem to total body
  ≤ 10.0 mrem to any organ

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 The following calculational methods shall be used for determining the dose or dose commitment from liquid effluents.

Doses from Liquid Effluent Pathways

A. POTABLE WATER

$$R_{apj} = 1100 \frac{U_{ap} M_p}{F} \sum_{i=1}^{n} Q_i D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in ℓ/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of withdrawal of drinking water, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/ sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

D_{aipj} is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of water, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 B. AQUATIC FOODS

$$R_{apj} = 1100 \frac{U_{ap}M_p}{F} \sum_{i=1}^{n} Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in kg/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of harvest of aquatic food, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

B_{ip} = is the equilibrium bioaccumulation factor for radionuclide, i, in pathway, p, expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/liter), in (pCi/kg)/(pCi/liter). Table 2

D_{aipj} = is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of food, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 C. SHORELINE DEPOSITS

$$R_{apj} = 110{,}000 \frac{U_{ap} M_p W}{F} \sum_{i=1}^{n} Q_i T_{ip} D_{aipj} [\exp(-\lambda_i t_p)] [1 - \exp(-\lambda_i t_b)]$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the exposure time for an individual of age group, a, associated with pathway, p, in hr/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of exposure, dimensionless. Table 3

W = is the shore-width factor, dimensionless. Table 16

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

T_{ip} = is the radioactive half life of radionuclide, i, in days.

D_{aipj} = is the dose factor specific radionuclide, i, which can be used to calculate the radiation dose from exposure to a given concentration of a radionu-clide in sediment, expressed as a ratio of the dose rate (in mrem/hr) and the areal radionuclide concentration (in pCi/m^2). Table 7

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure, in hours. Table 16

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours. Table 16

110,000 = Constant [(100 * pCi * yr * ft^3)/(Ci * sec * L)]

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Gaseous Effluent Dose Calculations

2.2.1 Noble Gas

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from radioactive materials in gaseous effluents from the Fort Calhoun Station to the following limits:

- During any calendar quarter
  $\leq$5 mrad-gamma air dose
  $\leq$10 mrad-beta air dose

  and

- During any calendar year
  $\leq$10 mrad-gamma air dose
  $\leq$20 mrad-beta air dose

The following general equations shall be used to calculate the gamma-air and beta-air doses:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

Doses from Gaseous Effluent Pathways

2.2 A. Annual Gamma/Beta Air Dose from All Other Noble Gas Releases

$$D^{\gamma}(r,\Theta) \text{ or } D^{\beta}(r,\Theta) = 3.17 \times 10^{4} \sum_{i=1}^{n} Q_i [\chi/Q]^{D}(r,\Theta)(DF_i^{\gamma} \text{ or } DF_i^{\beta})$$

Where:

$DF_i^{\gamma}, DF_i^{\beta}$ = are the gamma and beta air dose factors for a uniform semi-infinite cloud of radionuclide, i, in mrad-m^3/pCi-yr. Table 1

$D^{\gamma}(r,\Theta)$ or $D^{\beta}(r,\Theta)$ = are the annual gamma and beta air doses at distance r, in the sector at angle Θ, from the discharge point, in mrad/yr.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

$[\chi/Q]^{D}(r,\Theta)$ = is the annual average gaseous dispersion factor at distance r, in the sector at angle θ, in sec/m^3. Table 3

3.17×10^4 = is the number of pci per ci divided by the number of seconds per year.

B. Annual Total Body Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = S_F \sum_{i=1}^{n} \chi_i(r,\Theta) DFB_i$$

Where:

DFB_i = is the total body dose factor for a semi-infinite cloud of the radionuclide, i, which includes the attenuation of 5 g/cm^2 of tissue, in mrem-m^3/pCi-yr. Table 1

$D_{\infty}^{T}(r,\Theta)$ = is the annual total body dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

$\chi_i(r,\Theta)$ = is the annual average ground-level concentration of radionuclide, i, at distance r, in the sector at angle Θ, in pCi/m^3. Table 3

S_F = Shielding Factor. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C. Annual Skin Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = 1.11\ S_F \sum_{i=1}^{n} \chi_i(r,\Theta)\, DF_i^{\gamma} + \sum_{i=1}^{n} \chi_i(r,\Theta)\, DFS_i$$

Where:

$D_s^T(r,\Theta)$ = is the annual skin dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

DFS_i = is the beta skin dose factor for a semiinfinite cloud of radionuclide, i, in mrem-m^3/pCi-yr. Table 1

1.11 = is the average ratio of tissue to air energy absorption coefficients.

2.2.2 Radioiodine, Tritium, and Particulates

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from radioactive materials in gaseous effluents from the Fort Calhoun Station to:

- During any calendar quarter
  ≤7.5 mrem to any organ

  and

- During any calendar year
  ≤15 mrem to any organ

The dose to an individual from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in gaseous effluents released to unrestricted areas (See Part III, Figure 1) should be determined by the following expressions:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 **NOTE**: In all cases, for releases of tritium, use the dispersion parameter for inhalation (χ/Q).

A. Annual Organ Dose from External Irradiation from Radioactivity Deposited on the Ground Plane

A.1 The ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined by:

$$C_i^G(r,\Theta) = \frac{[1.0x10^{12}]\ [\delta_i(r,\Theta)Q_i]}{\lambda_i}\ [1-\exp(^-\lambda_i t_b)]$$

Where:

C_i^G = is the ground plane concentration of the radionuclide, i, at distance r, in the sector at angle θ, from the release point, in pCi/m^2.

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

t_b = is the time period over which the accumulation is evaluated, which is assumed to be 15 years (mid-point of plant operating life). Table 16

$\delta_i(r,\theta)$ = is the annual average relative deposition of radionuclide, i, at distance r, in the sector at angle θ, considering depletion of the plume by deposition during transport, in m^{-2}. Table 3

λ_i = is the radiological decay constant for radionuclide, i, in yr^{-1}.

$1.0x10^{12}$ = is the number of pCi per Ci

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 A.2 The annual organ dose is then calculated using the following equation:

$$D_j^G(r,\Theta) = 8760\ S_F \sum_{i=1}^{n} C_i^G(r,\Theta)\, DFG_{ij}$$

Where:

$C_i^G(r,\theta)$ = is the ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2.

DFG_{ij} = is the open field ground plane dose conversion factor for organ, j, from radionuclide, i, in mrem-m^2/pCi-hr. Table 7

$D_j^G(r,\theta)$ = is the annual dose to the organ, j, at distance r, in the sector at angle θ, in mrem/yr.

S_F = is the shielding factor that accounts for the dose reduction due to shielding provided by residential structures during occupancy, dimensionless. Table 16

8760 = is the number of hours in a year

2.0 <u>RADIOACTIVE EFFLUENT DOSE CALCULATIONS</u> (Continued)

2.2 B. Annual Dose from Inhalation of Radionuclides in Air

B.1 The annual average airborne concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined as:

$$\chi_i(r,\theta) = 3.17 \times 10^4 Q_i [\chi/Q]^D (r,\theta)$$

<u>Where</u>:

Q_i	=	is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.
$\chi_i(r,\theta)$	=	is the annual average ground-level concentration of radionuclide, i, in air at distance r, in the sector at angle θ, in pCi/m^3.
$[\chi/Q]^D(r,\theta)$	=	is the annual average atmosphere dispersion factor, in sec/m^3 (see R.G. 1.111). This includes depletion (for radioiodines and particulates) and radiological decay of the plume. Table 3
3.17×10^4	=	is the number of pCi/Ci divided by the number of sec/yr.

B.2 The annual dose associated with inhalation of all radionuclides to organ, j, of an individual in age group, a, is then:

$$D_{ja}^{A}(r,\Theta) = R_a \sum_{i=1}^{n} \chi_i (r,\theta) \, DFA_{ija}$$

<u>Where:</u>

$D_{ja}^{A}(r,\theta)$	=	is the annual dose to organ, j, of an individual in the age group, a, at distance r, in the sector at angle θ, due to inhalation, in mrem/yr.
R_a	=	is the annual air intake for individuals in the age group, a, in m^3/yr. Table 5
DFA_{ija}	=	is the inhalation dose factor for radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 8-11

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C. Concentrations of Radionuclides in Foods and Vegetation from Atmospheric Releases

C.1 Parameters for Calculating Concentrations in Forage, Produce, and Leafy Vegetables, excluding Carbon-14 and Tritium

$$C_i^V(r,\theta) = d_i(r,\theta)\left[\frac{r[1-\exp(-\lambda_{Ei}t_e)]}{Y_v\lambda_{Ei}} + \frac{B_{iv}[1-\exp(-\lambda_i t_b)]}{P\lambda_i}\right]\exp(-\lambda_i t_h)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in and on vegetation at distance r, in the sector at angle θ, in pCi/kg.

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2 hr.

The deposition rate from the plume is defined by: (Reg. Guide 1.109, Rev. 1, Page 1.109-26, Equa. C-6)

$$d_i(r,\theta) = 1.1 \times 10^8 \delta_i(r,\theta) Q_i$$

Where:

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i.

$\delta_i(r,\theta)$ = is the relative deposition of radionuclide, i, considering depletion and decay, in m^{-2} (see Regulatory Guide 1.111). Table 3

$1.1\text{x}10^8$ = is the number of pCi/Ci (10^{12}) divided by the number of hours per year (8760).

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

2.0 RA ACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 For radioiodines, the model considers only the elemental fraction of the effluent:

$$d_i\ (r_1\ \theta) = 5.5 \times 10^7\ \delta_i\ (r_1\ \theta)\ Q_i$$

Where:

$d_i\ (r_1\ \theta)$ = The deposition rate of radioiodine, i.

5.5×10^7 = The number of pCi/Ci (10^{12}) divided by the number of hours per year (8760), then multiplied by the amount of radioiodine emissions considered to be nonelemental (0.5).

$\delta_i\ (r,\ \theta)$ = The relative deposition of radioiodine, i, considering depletion and decay, in m^{-2}. Table 3.

Q_i = The total (elemental and nonelemental) radioiodine, i, emission rate.

r = is the fraction of deposited activity retained on crops, dimensionless. Table 16

λ_{Ei} = is the effective removal rate constant for radionuclide, i, from crops, in hr^{-1}.

$\lambda_{Ei} = \lambda_i + \lambda_w$
$\lambda_w = 0.0021/hr$. Table 16

t_e = is the time period that crops are exposed to contamination during the growing season, in hours. Table 16

Y_v = is the agricultural productivity (yield) in kg (wet weight)/m^2. Table 16

B_{iv} = is the concentration factor for uptake of radionuclide, i, from soil by edible parts of crops, in pCi/ kg (wet weight) per pCi/kg dry soil. Table 4

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours (mid-point of plant life). Table 16

P = is the effective "surface density" for soil, in kg (dry soil)/m^2. Table 16

t_h = is the holdup time that represents the time interval between harvest and consumption of the food, in hours. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Different values for the parameters t_e, Y_v, and t_h, may be used to allow the use of the Equation for different purposes: estimating concentrations in produce consumed by man; in leafy vegetables consumed by man; in forage consumed directly as pasture grass by dairy cows, beef cattle, or goats; and in forage consumed as stored feed by dairy cows, beef cattle or goats. See Table 16

C.2 Parameters for Calculating Radionuclide Concentration in Milk, excluding Carbon-14 and Tritium

C.2.1 Parameters for Calculating the Concentration of Radionuclide, i, in the Animal's Feed (Milk Cow, Beef Cow, and Goat)

$$C_i^V(r,\Theta) = f_p f_s C_i^P(r,\Theta) + (1 - f_p) C_i^S(r,\Theta) + f_p(1 - f_s) C_i^S(r,\Theta)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

$C_i^P(r,\theta)$ = is the concentration of radionuclide, i, on pasture grass (calculated using Equation C.2.1 with t_h=0), in pCi/kg.

$C_i^S(r,\theta)$ = is the concentration of radionuclide, i, in stored feeds (calculated using Equation C.2.1 with t_h=90 days), in pCi/kg.

f_p = is the fraction of the year that animals graze on pasture. Table 16

f_s = is the fraction of daily feed that is pasture grass while the animal grazes on pasture. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.2.2 Parameters for Calculating Radionuclide Concentration in Cow and Goat Milk

$$C_i^M(r,\Theta) = F_m C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^M(r,\theta)$ = is the concentration of radionuclide, i, in milk, in pCi/liter.

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

F_m = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each liter of milk, in days/liter. Table 4

Q_F = is the amount of feed consumed by the animal per day, in kg/day. Table 6

t_f = is the average transport time of the radionuclide, i, from the feed to the milk and to the receptor (a value of 2 days is assumed). Table 16

λ_i = is the radiological decay constant of radionuclide, i, in days^{-1}.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.3 Parameters for Calculating Radionuclide Concentration in Cow Meat, excluding Carbon-14 and Tritium

$$C_i^F(r,\Theta) = F_f C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^F(r,\theta)$ = is the concentration of radionuclide, i, in meat, in pCi/liter.

F_f = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each kilogram of flesh, in days/kilogram. Table 4

t_s = is the average time from slaughter to consumption. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.4 Parameters for Calculating the Carbon-14 Concentrations in Vegetation

Carbon-14 is assumed to be released in oxide form (CO or CO_2). The concentration of Carbon-14 in vegetation is calculated by assuming that its ratio to the natural carbon in vegetation is the same as the ratio of Carbon-14 to natural carbon in the atmosphere surrounding the vegetation. Also, in the case of intermittent releases, such as from gaseous waste decay tanks, the parameter p is employed to account for the fractional equilibrium ratio achieved. The parameter, p, is defined as the ratio of the total annual release time (for Carbon-14 atmospheric releases) to the total annual time during which photosynthesis occurs (taken to be 4400 hrs), under the condition that the value of p should never exceed unity. For continuous Carbon-14 releases, p is taken to be unity. These considerations yield the following relationship:

$$C_{14}^{V}(r,\Theta) = 3.17 \times 10^{7} pQ_{14}[\chi/Q](r,\Theta)\ 0.11/0.16$$

$$= 2.2 \times 10^{7} pQ_{14}[\chi/Q](r,\Theta)$$

Where:

$C_{14}^{V}(r,\theta)$ = is the concentration of Carbon-14 in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

Q_{14} = is the annual release rate of Carbon 14, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

p = is the fractional equilibrium ratio, dimensionless. P=1 (Reg. Guide 1.109, Rev. 1, pg. 26).

0.11 = is the fraction of total plant mass that is natural carbon, dimensionless.

0.16 = is equal to the concentration of natural carbon in the atmosphere, in g/m^3.

3.17×10^{7} = is equal to $(1.0 \times 10^{12}$pci/ci$)(1.0 \times 10^{3}$ g/kg$)$ $(3.15 \times 10^{7}$ sec/yr$)$.

2.0 <u>RADIOACTIVE EFFLUENT DOSE CALCULATIONS</u> (Continued)

2.2 C.5 Parameters for Calculating Tritium Concentrations in Vegetation

The concentration of tritium in vegetation is calculated from its concentration in the air surrounding the vegetation.

$$C_T^V(r,\Theta) = 3.17 \times 10^7 Q_T[\chi/Q](r,\Theta)\ (0.75)(0.5/H)$$

$$= 1.2 \times 10^7 Q_T[\chi/Q](r,\Theta)/H$$

<u>Where</u>:

$C_T^V(r,\theta)$ = is the concentration of Tritium in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

H = is the absolute humidity of the atmosphere at distance r, in the sector at angle θ, in g/m^3. H=8 gm/kg.

Q_T = is the annual release rate of Tritium, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

0.5 = is the ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless.

0.75 = is the fraction of total plant mass that is water, dimensionless.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D. Annual Dose from Atmospherically Released Radionuclides in Foods

D.1 The total annual dose to organ, j, of an individual in age group, a, resulting from ingestion of all radionuclides in produce, milk, and leafy vegetables is given by:

$$D^D_{ja}(r,\Theta) = \sum_i DFI_{ija}\left[U^V_a f_g C^V_i(r,\Theta) + U^m_a C^m_i(r,\Theta) + U^F_a C^F_i(r,\Theta) + U^L_a f_\ell C^L_i(r,\Theta)\right]$$

Where:

$D^D_{ja}(r,\Theta)$ = is the annual dose to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15.

$U^V_a, U^m_a,$ = are the ingestion rates of produce (non-leafy vegetables, fruits, and grains); milk, meat, and leafy U^F_a, U^L_a vegetables, respectively for individuals in age group, a. Table 5.

Values of F_g and f_ℓ are 0.76 and 1.0, respectively.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.1 Calculating the Ingested Dose from Leafy and Non-Leafy (produce) Vegetation for Radionuclide, i, to Each Organ, j, and Age Group, a

$$D^D_{ja}(r,\Theta) = DFI_{ija}\left[U^L_a f_l C^L_i(r,\Theta) + U^V_a f_g C^V_i(r,\Theta)\right]$$

Where:

$D^D_{ja}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in vegetation, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pci. Tables 12-15

U^L_a, U^V_a = are the ingestion rates of leafy vegetables and produce (non-leafy vegetables, fruits, and grains), for individuals in age group, a, in kg/yr. Table 5

C^L_i = is the concentration of radionuclide, i, in and on leafy vegetation, in pCi/kg.

C^V_i = is the concentration of radionuclide, i, in and on produce, in pCi/kg.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.2 Calculation Determining the Ingested Dose from Cow Milk for Radionuclide, i, Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_a^M C_i^M(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\Theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in cow milk, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_a^M = is the ingestion rate of cow milk for individuals in age group, a, in ℓ/yr. Table 5

C_i^M = is the radionuclide concentration in cow milk, in pCi/kg. Equation C.2.2

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.3 Calculation Determining the Ingested Dose from Meat for Radionuclide, i, to Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_{a}^{F}C_{i}^{F}(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in meat, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_{a}^{f} = is the ingestion rate of meat for individuals in age group, a in kg/yr. Table 5

C_{i}^{f} = is the radionuclide, i, concentration in meat, in pCi/ kg.

TABLE 1

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

Nuclide	β-air* (DF^b_i)	β-Skin** (DFS_i)	γ-Air* (DF^c_i)	γ-Body** (DFB_i)
KR-83m	2.88E-04	--	1.93E-05	7.56E-08
KR-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03
KR-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05
KR-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03
KR-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02
KR-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02
KR-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03

* $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

** $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

*** 2.88E-04 = 2.88×10^{-4}

TABLE 2

BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)

FRESHWATER

Element	Fish	Invertebrate
H	9.0E-01	9.0E-01
C	4.6E+03	9.1E+03
NA	1.0E+02	2.0E+02
P	1.0E+05	2.0E+04
CR	2.0E+02	2.0E+03
MN	4.0E+02	9.0E+04
FE	1.0E+02	3.2E+03
CO	5.0E+01	2.0E+02
NI	1.0E+02	1.0E+02
CU	5.0E+01	4.0E+02
ZN	2.0E+03	1.0E+04
BR	4.2E+02	3.3E+02
RB	2.0E+03	1.0E+03
SR	3.0E+01	1.0E+02
Y	2.5E+01	1.0E+03
ZR	3.3E+00	6.7E+00
NB	3.0E+04	1.0E+02
MO	1.0E+01	1.0E+01
TC	1.5E+01	5.0E+00
RU	1.0E+01	3.0E+02
RH	1.0E+01	3.0E+02
TE	4.0E+02	6.1E+03
I	1.5E+01	5.0E+00
CS	2.0E+03	1.0E+03
BA	4.0E+00	2.0E+02
LA	2.5E+01	1.0E+03
CE	1.0E+00	1.0E+03
PR	2.5E+01	1.0E+03
ND	2.5E+01	1.0E+03
W	1.2E+03	1.0E+01
NP	1.0E+01	4.0E+02

TABLE 3

CONTROLLING LOCATIONS, PATHWAYS AND ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS

Location	Pathway(s)	Controlling Age Group	Atmospheric Dispersion χ/Q ($\chi/Q(r,\theta)$) (sec/m^3)	D/Q ($\delta(r,\theta)$) (1/m^3)
Site Boundary	Noble Gases Direct Exposure	N/A	5.0E-06	N/A
Site Boundary	Inhalation	Child	5.0E-06	N/A
Site Boundary	Gamma-Air Beta-Air	N/A	5.0E-06	N/A
Miller Farm* 0.8 miles SSW	milk, ground plane, meat, inhalation, and vegetation	Child	5.0E-06	1.6E-08
Site Boundary	Liquid	N/A	Mixing Ratio, M_p	7.14
M.U.D. Intake	Liquid	N/A	Mixing Ratio, M_p	30.8

* Location is subject to change depending on the results of the Land Use survey performed annually in accordance with Part II, Section 5.4

TABLE 4

STABLE ELEMENT TRANSFER DATA

Element	B_{iv} Veg/Soil	F_m (Cow) Milk (d/λ)	F_f Meat (d/kg)
H	4.8E+00	1.0E-02	1.2E-02
C	5.5E+00	1.2E-02	3.1E-02
Na	5.2E-02	4.0E-02	3.0E-02
P	1.1E+00	2.5E-02	4.6E-02
Cr	2.5E-04	2.2E-03	2.4E-03
Mn	2.9E-02	2.5E-04	8.0E-04
Fe	6.6E-04	1.2E-03	4.0E-02
Co	9.4E-03	1.0E-03	1.3E-02
Ni	1.9E-02	6.7E-03	5.3E-02
Cu	1.2E-01	1.4E-02	8.0E-03
Zn	4.0E-01	3.9E-02	3.0E-02
Rb	1.3E-01	3.0E-02	3.1E-02
Sr	1.7E-02	8.0E-04	6.0E-04
Y	2.6E-03	1.0E-05	4.6E-03
Zr	1.7E-04	5.0E-06	3.4E-02
Nb	9.4E-03	2.5E-03	2.8E-01
Mo	1.2E-01	7.5E-03	8.0E-03
Tc	2.5E-01	2.5E-02	4.0E-01
Ru	5.0E-02	1.0E-06	4.0E-01
Rh	1.3E+01	1.0E-02	1.5E-03
Ag	1.5E-01	5.0E-02	1.7E-02
Te	1.3E+00	1.0E-03	7.7E-02
I	2.0E-02	6.0E-03	2.9E-03
Cs	1.0E-02	1.2E-02	4.0E-03
Ba	5.0E-03	4.0E-04	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04	1.2E-03
Pr	2.5E-03	5.0E-06	4.7E-03
Nd	2.4E-03	5.0E-06	3.3E-03
W	1.8E-02	5.0E-04	1.3E-03
Np	2.5E-03	5.0E-06	2.0E-04

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

TABLE 5

RECOMMENDED VALUES FOR U_{AP} TO BE USED FOR THE MAXIMUM EXPOSED INDIVIDUAL IN LIEU OF SITE SPECIFIC DATA

Pathway	Infant	Child	Teen	Adult
Fruits, vegetables, & grain (kg/yr)	-	520	630	520
Leafy vegetables (kg/yr)	-	26	42	64
Milk (ℓ/yr)	330	330	400	310
Meat & poultry (kg/yr)	-	41	65	110
Fish (fresh or salt) (kg/yr)	-	6.9	16	21
Other Seafood (kg/yr)	-	1.7	3.8	5
Drinking water (ℓ/yr)	330	510	510	730
Shoreline recreation (hr/yr)	-	14	67	12
Inhalation (m^3/yr)	1400	3700	8000	8000

TABLE 6

ANIMAL CONSUMPTION RATES

Animal	Q_F Feed or Forage [Kg/day (wet weigh)]	Q_{AW} Water (ℓ/day)
Milk Cow	50	60
Beef Cattle	50	50
Goats	6	8

TABLE 7

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Nr-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08

TABLE 7
(Continued)

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Page 1 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	-	-	-	1.08E-05
CR 51	-	-	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN 54	-	4.95E-06	7.87E-07	-	1.23E-06	1.75E-04	9.67E-06
MN 56	-	1.55E-10	2.29E-11	-	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	-	-	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	-	-	1.27E-04	2.35E-05
CO 58	-	1.98E-07	2.59E-07	-	-	1.16E-04	1.33E-05
CO 60	-	1.44E-06	1.85E-06	-	-	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	-	-	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	-	-	7.00E-07	1.54E-06
CU 64	-	1.83E-10	7.69E-11	-	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	5.82E-06	-	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	-	5.27E-12	1.15E-07	2.04E-09
BR 83	-	-	3.01E-08	-	-	-	2.90E-08
BR 84	-	-	3.91E-08	-	-	-	2.05E-13
BR 85	-	-	1.60E-09	-	-	-	LT E-24
RB 86	-	1.69E-05	7.37E-06	-	-	-	2.08E-06
RB 88	-	4.84E-08	2.41E-08	-	-	-	4.18E-19
RB 89	-	3.20E-08	2.12E-08	-	-	-	1.16E-21
SR 89	3.80E-05	-	1.09E-06	-	-	1.75E-04	4.37E-05
SR 90	1.24E-02	-	7.62E-04	-	-	1.20E-03	9.02E-05
SR 91	7.74E-09	-	3.13E-10	-	-	4.56E-06	2.39E-05
SR 92	8.43E-10	-	3.64E-11	-	-	2.06E-06	5.38E-06
Y 90	2.61E-07	-	7.01E-09	-	-	2.12E-05	6.32E-05
Y 91M	3.26E-11	-	1.27E-12	-	-	2.40E-07	1.66E-10
Y 91	5.78E-05	-	1.55E-06	-	-	2.13E-04	4.81E-05
Y 92	1.29E-09	-	3.77E-11	-	-	1.96E-06	9.19E-06
Y 93	1.18E-08	-	3.26E-10	-	-	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	-	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	-	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	-	9.67E-07	6.31E-05	1.30E-05
MO 99	-	1.51E-08	2.87E-09	-	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	-	5.52E-12	9.55E-08	5.20E-07

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	5.22E-15	7.52E-15	7.38E-14	-	1.35E-13	4.99E-08	1.36E-21
RU 103	1.91E-07	-	8.23E-08	-	7.29E-07	6.31E-05	1.38E-05
RU 105	9.88E-11	-	3.89E-11	-	1.27E-10	1.37E-06	6.02E-06
RU 106	8.64E-06	-	1.09E-06	-	1.67E-05	1.17E-03	1.14E-04
AG 110M	1.35E-06	1.25E-06	7.43E-07	-	2.46E-06	5.79E-04	3.78E-05
TE 125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE 127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE 127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE 129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE 129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE 131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE 131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE 132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	-	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	-	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	-	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	-	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	-	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	-	6.56E-07
CS 134	4.66E-05	1.06E-04	9.10E-05	-	3.59E-05	1.22E-05	1.30E-06
CS 136	4.88E-06	1.83E-05	1.38E-05	-	1.07E-05	1.50E-06	1.46E-06
CS 137	5.98E-05	7.76E-05	5.35E-05	-	2.78E-05	9.40E-06	1.05E-06
CS 138	4.14E-08	7.76E-08	4.05E-08	-	6.00E-08	6.07E-09	2.33E-13
BA 139	1.17E-10	8.32E-14	3.42E-12	-	7.78E-14	4.70E-07	1.12E-07
BA 140	4.88E-06	6.13E-09	3.21E-07	-	2.09E-09	1.59E-04	2.73E-05
BA 141	1.25E-11	9.41E-15	4.20E-13	-	8.75E-15	2.42E-07	1.45E-17
BA 142	3.29E-12	3.38E-15	2.07E-13	-	2.86E-15	1.49E-07	1.96E-26
LA 140	4.30E-08	2.17E-08	5.73E-09	-	-	1.70E-05	5.73E-05
LA 142	8.54E-11	3.88E-11	9.65E-12	-	-	7.91E-07	2.64E-07
CE 141	2.49E-06	1.69E-06	1.91E-07	-	7.83E-07	4.52E-05	1.50E-05
CE 143	2.33E-08	1.72E-08	1.91E-09	-	7.60E-09	9.97E-06	2.83E-05
CE 144	4.29E-04	1.79E-04	2.30E-05	-	1.06E-04	9.72E-04	1.02E-04
PR 143	1.17E-06	4.69E-07	5.80E-08	-	2.70E-07	3.51E-05	2.50E-05
PR 144	3.76E-12	1.56E-12	1.91E-13	-	8.81E-13	1.27E-07	2.69E-18
[illegible] 147	6.59E-07	7.62E-07	4.56E-08	-	4.45E-07	2.76E-05	2.16E-05
[illegible] 187	1.06E-09	8.85E-10	3.10E-10	-	-	3.63E-06	1.94E-05
NP 239	2.87E-08	2.82E-09	1.55E-09	-	8.75E-09	4.70E-06	1.49E-05

TABLE 9
INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	-	-	-	1.16E-05
CR 51	-	-	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	-	6.39E-06	1.05E-06	-	1.59E-06	2.48E-04	8.35E-06
MN 56	-	2.12E-10	3.15E-11	-	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	-	-	1.55E-05	7.99E-07
FE 59	1.99E-06	4.62E-06	1.79E-06	-	-	1.91E-04	2.23E-05
CO 58	-	2.59E-07	3.47E-07	-	-	1.68E-04	1.19E-05
CO 60	-	1.89E-06	2.48E-06	-	-	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	-	-	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	-	-	1.17E-06	4.59E-06
CU 64	-	2.54E-10	1.06E-10	-	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.82E-06	1.67E-05	7.80E-06	-	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	-	7.53E-12	1.98E-07	3.56E-08
BR 83	-	-	4.30E-08	-	-	-	LT E-24
BR 84	-	-	5.41E-08	-	-	-	LT E-24
BR 85	-	-	2.29E-09	-	-	-	LT E-24
RB 86	-	2.38E-05	1.05E-05	-	-	-	2.21E-06
RB 88	-	6.82E-08	3.40E-08	-	-	-	3.65E-15
RB 89	-	4.40E-08	2.91E-08	-	-	-	4.22E-17
SR 89	5.43E-05	-	1.56E-06	-	-	3.02E-04	4.64E-05
SR 90	1.35E-02	-	8.35E-04	-	-	2.06E-03	9.56E-05
SR 91	1.10E-08	-	4.39E-10	-	-	7.59E-06	3.24E-05
SR 92	1.19E-09	-	5.08E-11	-	-	3.43E-06	1.49E-05
Y 90	3.73E-07	-	1.00E-08	-	-	3.66E-05	6.99E-05
Y 91M	4.63E-11	-	1.77E-12	-	-	4.00E-07	3.77E-09
Y 91	8.26E-05	-	2.21E-06	-	-	3.67E-04	5.11E-05
Y 92	1.84E-09	-	5.36E-11	-	-	3.35E-06	2.06E-05
Y 93	1.69E-08	-	4.65E-10	-	-	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	-	8.42E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	-	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	-	1.25E-06	9.39E-05	1.21E-05
MO 99	-	2.11E-08	4.03E-09	-	5.14E-08	1.92E-05	3.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	-	7.20E-12	1.44E-07	7.66E-07

TABLE 9
INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	7.40E-15	1.05E-14	1.03E-13	-	1.90E-13	8.34E-08	1.09E-16
RU 103	2.63E-07	-	1.12E-07	-	9.29E-07	9.79E-05	1.36E-05
RU 105	1.40E-10	-	5.42E-11	-	1.76E-10	2.27E-06	1.13E-05
RU 106	1.23E-05	-	1.55E-06	-	2.38E-05	2.01E-03	1.20E-04
AG 110M	1.73E-06	1.64E-06	9.99E-07	-	3.13E-06	8.44E-04	3.41E-05
TE 125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	-	6.70E-05	9.38E-06
TE 127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE 127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE 129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE 129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE 131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE 131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE 132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	-	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	-	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	-	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	-	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	-	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	-	8.69E-07
CS 134	6.28E-05	1.41E-04	6.86E-05	-	4.69E-05	1.83E-05	1.22E-06
CS 136	6.44E-06	2.42E-05	1.71E-05	-	1.38E-05	2.22E-06	1.36E-06
CS 137	8.38E-05	1.06E-04	3.89E-05	-	3.80E-05	1.51E-05	1.06E-06
CS 138	5.82E-08	1.07E-07	5.58E-08	-	8.28E-08	9.84E-09	3.38E-11
BA 139	1.67E-10	1.18E-13	4.87E-12	-	1.11E-13	8.08E-07	8.06E-07
BA 140	6.84E-06	8.38E-09	4.40E-07	-	2.85E-09	2.54E-04	2.86E-05
BA 141	1.78E-11	1.32E-14	5.93E-13	-	1.23E-14	4.11E-07	9.33E-14
BA 142	4.62E-12	4.63E-15	2.84E-13	-	3.92E-15	2.39E-07	5.99E-20
LA 140	5.99E-08	2.95E-08	7.82E-09	-	-	2.68E-05	6.09E-05
LA 142	1.20E-10	5.31E-11	1.32E-11	-	-	1.27E-06	1.50E-06
CE 141	3.55E-06	2.37E-06	2.71E-07	-	1.11E-06	7.67E-05	1.58E-05
CE 143	3.32E-08	2.42E-08	2.70E-09	-	1.08E-08	1.63E-05	3.19E-05
CE 144	6.11E-04	2.53E-04	3.28E-05	-	1.51E-04	1.67E-03	1.08E-04
PR 143	1.67E-06	6.64E-07	8.28E-08	-	3.86E-07	6.04E-05	2.67E-05
PR 144	5.37E-12	2.20E-12	2.72E-13	-	1.26E-12	2.19E-07	2.94E-14
ND 147	9.83E-07	1.07E-06	6.41E-08	-	6.28E-07	4.65E-05	2.28E-05
[illegible] 187	1.50E-09	1.22E-09	4.29E-10	-	-	5.92E-06	2.21E-05
NP 239	4.23E-08	3.99E-09	2.21E-09	-	1.25E-08	8.11E-06	1.65E-05

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	-	-	-	1.14E-05
CR 51	-	-	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	-	1.16E-05	2.57E-06	-	2.71E-06	4.26E-04	6.19E-06
MN 56	-	4.48E-10	8.43E-11	-	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	-	-	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	-	-	3.43E-04	1.91E-05
CO 58	-	4.79E-07	8.55E-07	-	-	2.99E-04	9.29E-06
CO 60	-	3.55E-06	6.12E-06	-	-	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	-	-	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	-	-	2.21E-06	2.27E-05
CU 64	-	5.39E-10	2.90E-10	-	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	-	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	-	1.58E-11	3.84E-07	2.75E-06
BR 83	-	-	1.28E-07	-	-	-	LT E-24
BR 84	-	-	1.48E-07	-	-	-	LT E-24
BR 85	-	-	6.84E-09	-	-	-	LT E-24
RB 86	-	5.36E-05	3.09E-05	-	-	-	2.16E-06
RB 88	-	1.52E-07	9.90E-08	-	-	-	4.66E-09
RB 89	-	9.33E-08	7.85E-08	-	-	-	5.11E-10
SR 89	1.62E-04	-	4.66E-06	-	-	5.83E-04	4.52E-05
SR 90	2.73E-02	-	1.74E-03	-	-	3.99E-03	9.28E-05
SR 91	3.28E-08	-	1.24E-09	-	-	1.44E-05	4.70E-05
SR 92	3.54E-09	-	1.42E-10	-	-	6.49E-06	6.55E-05
Y 90	1.11E-06	-	2.99E-08	-	-	7.07E-05	7.24E-05
Y 91M	1.37E-10	-	4.98E-12	-	-	7.60E-07	4.64E-07
Y 91	2.47E-04	-	6.59E-06	-	-	7.10E-04	4.97E-05
Y 92	5.50E-09	-	1.57E-10	-	-	6.46E-06	6.46E-05
Y 93	5.04E-08	-	1.38E-09	-	-	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	-	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	-	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	-	2.33E-06	1.66E-04	1.00E-05
MO 99	-	4.66E-08	1.15E-08	-	1.06E-07	3.66E-05	3.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	-	1.37E-11	2.57E-07	1.30E-06

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.19E-14	2.30E-14	2.91E-13	-	3.92E-13	1.58E-07	4.41E-09
RU 103	7.55E-07	-	2.90E-07	-	1.90E-06	1.79E-04	1.21E-05
RU 105	4.13E-10	-	1.50E-10	-	3.63E-10	4.30E-06	2.69E-05
RU 106	3.68E-05	-	4.57E-06	-	4.97E-05	3.87E-03	1.16E-04
AG 110M	4.56E-06	3.08E-06	2.47E-06	-	5.74E-06	1.48E-03	2.71E-05
TE 125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	-	1.29E-04	9.13E-06
TE 127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE 127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE 129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE 129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE 131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE 131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE 132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	-	1.38E-06
I 131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	-	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	-	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	-	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	-	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	-	1.20E-06
CS 134	1.76E-04	2.74E-04	6.07E-05	-	8.93E-05	3.27E-05	1.04E-06
CS 136	1.76E-05	4.62E-05	3.14E-05	-	2.58E-05	3.93E-06	1.13E-06
CS 137	2.45E-04	2.23E-04	3.47E-05	-	7.63E-05	2.81E-05	9.78E-07
CS 138	1.71E-07	2.27E-07	1.50E-07	-	1.68E-07	1.84E-08	7.29E-08
BA 139	4.98E-10	2.66E-13	1.45E-11	-	2.33E-13	1.56E-06	1.56E-05
BA 140	2.00E-05	1.75E-08	1.17E-06	-	5.71E-09	4.71E-04	2.75E-05
BA 141	5.29E-11	2.95E-14	1.72E-12	-	2.56E-14	7.89E-07	7.44E-08
BA 142	1.35E-11	9.73E-15	7.54E-13	-	7.87E-15	4.44E-07	7.41E-10
LA 140	1.74E-07	6.08E-08	2.04E-08	-	-	4.94E-05	6.10E-05
LA 142	3.50E-10	1.11E-10	3.49E-11	-	-	2.35E-06	2.05E-05
CE 141	1.06E-05	5.28E-06	7.8[illegible]E-07	-	2.31E-06	1.47E-04	1.53E-05
CE 143	9.89E-08	5.37E-08	7.77E-09	-	2.26E-08	3.12E-05	3.44E-05
CE 144	1.83E-03	5.72E-04	9.77E-05	-	3.17E-04	3.23E-03	1.05E-04
PR 143	4.99E-06	1.50E-06	2.47E-07	-	8.11E-07	1.17E-04	2.63E-05
PR 144	1.61E-11	4.99E-12	8.10E-13	-	2.64E-12	4.23E-07	5.32E-08
ND 147	2.92E-06	2.36E-06	1.84E-07	-	1.30E-06	8.87E-05	2.22E-05
W 187	4.41E-09	2.61E-09	1.17E-09	-	-	1.11E-05	2.46E-05
NP 239	1.26E-07	9.04E-09	6.35E-09	-	2.63E-08	1.57E-05	1.73E-05

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.53E-05	-	-	-	1.15E-05
CR 51	-	-	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	-	1.81E-05	3.56E-06	-	3.56E-06	7.14E-04	5.04E-06
MN 56	-	1.10E-09	1.58E-10	-	7.86E-10	8.95E-06	5.12E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	-	-	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	-	-	7.25E-04	1.77E-05
CO 58	-	8.71E-07	1.30E-06	-	-	5.55E-04	7.95E-06
CO 60	-	5.73E-06	8.41E-06	-	-	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	-	-	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	-	-	5.80E-06	3.58E-05
CU 64	-	1.34E-09	5.53E-10	-	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	-	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	-	2.87E-11	1.05E-06	9.44E-06
BR 83	-	-	2.72E-07	-	-	-	LT E-24
BR 84	-	-	2.86E-07	-	-	-	LT E-24
BR 85	-	-	1.46E-08	-	-	-	LT E-24
RB 86	-	1.36E-04	6.30E-05	-	-	-	2.17E-06
RB 88	-	3.98E-07	2.05E-07	-	-	-	2.42E-07
RB 89	-	2.29E-07	1.47E-07	-	-	-	4.87E-08
SR 89	2.84E-04	-	8.15E-06	-	-	1.45E-03	4.57E-05
SR 90	2.92E-02	-	1.85E-03	-	-	8.03E-03	9.36E-05
SR 91	6.83E-08	-	2.47E-09	-	-	3.76E-05	5.24E-05
SR 92	7.50E-09	-	2.79E-10	-	-	1.70E-05	1.00E-04
Y 90	2.35E-06	-	6.30E-08	-	-	1.92E-04	7.43E-05
Y 91M	2.91E-10	-	9.90E-12	-	-	1.99E-06	1.68E-06
Y 91	4.20E-04	-	1.12E-05	-	-	1.75E-03	5.02E-05
Y 92	1.17E-08	-	3.29E-10	-	-	1.75E-05	9.04E-05
Y 93	1.07E-07	-	2.91E-09	-	-	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	-	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	-	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	-	3.37E-06	3.42E-04	9.05E-06
MO 99	-	1.18E-07	2.31E-08	-	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-13	2.06E-12	2.66E-11	-	2.22E-11	5.79E-07	1.45E-06

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	4.65E-14	5.88E-14	5.80E-13	-	6.99E-13	4.17E-07	6.03E-07
RU 103	1.44E-06	-	4.85E-07	-	3.03E-06	3.94E-04	1.15E-05
RU 105	8.74E-10	-	2.93E-10	-	6.42E-10	1.12E-05	3.46E-05
RU 106	6.20E-05	-	7.77E-06	-	7.61E-05	8.26E-03	1.17E-04
AG 110M	7.13E-06	5.16E-06	3.57E-06	-	7.80E-06	2.62E-03	2.36E-05
TE 125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	-	3.19E-04	9.22E-06
TE 127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE 127	1.59E-09	6.81E-10	3.40E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE 129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE 129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE 131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE 131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE 132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	-	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	-	7.56E-07
I 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	-	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	-	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	-	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	-	1.31E-06
CS 134	2.83E-04	5.02E-04	5.32E-05	-	1.36E-04	5.69E-05	9.53E-07
CS 136	3.45E-05	9.61E-05	3.78E-05	-	4.03E-05	8.40E-06	1.02E-06
CS 137	3.92E-04	4.37E-04	3.25E-05	-	1.23E-04	5.09E-05	9.53E-07
CS 138	3.61E-07	5.58E-07	2.84E-07	-	2.93E-07	4.67E-08	6.26E-07
BA 139	1.06E-09	7.03E-13	3.07E-11	-	4.23E-13	4.25E-06	3.64E-05
BA 140	4.00E-05	4.00E-08	2.07E-06	-	9.59E-09	1.14E-03	2.74E-05
BA 141	1.12E-10	7.70E-14	3.55E-12	-	4.64E-14	2.12E-06	3.39E-06
BA 142	2.84E-11	2.36E-14	1.40E-12	-	1.36E-14	1.11E-06	4.95E-07
LA 140	3.61E-07	1.43E-07	3.68E-08	-	-	1.20E-04	6.06E-05
LA 142	7.36E-10	2.69E-10	6.46E-11	-	-	5.87E-06	4.25E-05
CE 141	1.98E-05	1.19E-05	1.42E-06	-	3.75E-06	3.69E-04	1.54E-05
CE 143	2.09E-07	1.38E-07	1.58E-08	-	4.03E-08	8.30E-05	3.55E-05
CE 144	2.28E-03	8.65E-04	1.26E-04	-	3.84E-04	7.03E-03	1.06E-04
PR 143	1.00E-05	3.74E-06	4.99E-07	-	1.41E-06	3.09E-04	2.66E-05
PR 144	3.42E-11	1.32E-11	1.72E-12	-	4.80E-12	1.15E-06	3.06E-06
ND 147	5.67E-06	5.81E-06	3.57E-07	-	2.25E-06	2.30E-04	2.23E-05
W 187	9.26E-09	6.44E-09	2.23E-09	-	-	2.83E-05	2.54E-05
NP 239	2.65E-07	2.37E-08	1.34E-08	-	4.73E-08	4.25E-05	1.78E-05

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	-	-	-	2.17E-05
CR 51	-	-	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	-	4.57E-06	8.72E-07	-	1.36E-06	-	1.40E-05
MN 56	-	1.15E-07	2.04E-08	-	1.46E-07	-	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	-	-	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	-	-	2.85E-06	3.40E-05
CO 58	-	7.45E-07	1.67E-06	-	-	-	1.51E-05
CO 60	-	2.14E-06	4.72E-06	-	-	-	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	-	-	-	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	-	-	-	1.74E-06
CU 64	-	8.33E-08	3.91E-08	-	2.10E-07	-	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	-	1.03E-05	-	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	-	1.28E-08	-	2.96E-09
BR 83	-	-	4.02E-08	-	-	-	5.79E-08
BR 84	-	-	5.21E-08	-	-	-	4.09E-13
BR 85	-	-	2.14E-09	-	-	-	LT E-24
RB 86	-	2.11E-05	9.83E-06	-	-	-	4.16E-06
RB 88	-	6.05E-08	3.21E-08	-	-	-	8.36E-19
RB 89	-	4.01E-08	2.82E-08	-	-	-	2.33E-21
SR 89	3.08E-04	-	8.84E-06	-	-	-	4.94E-05
SR 90	7.58E-03	-	1.86E-03	-	-	-	2.19E-04
SR 91	5.67E-06	-	2.29E-07	-	-	-	2.70E-05
SR 92	2.15E-06	-	9.30E-08	-	-	-	4.26E-05
Y 90	9.62E-09	-	2.58E-10	-	-	-	1.02E-04
Y 91M	9.09E-11	-	3.52E-12	-	-	-	2.67E-10
Y 91	1.41E-07	-	3.77E-09	-	-	-	7.76E-05
Y 92	8.45E-10	-	2.47E-11	-	-	-	1.48E-05
Y 93	2.68E-09	-	7.40E-11	-	-	-	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	-	1.53E-08	-	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	-	5.12E-10	-	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	-	3.42E-09	-	2.10E-05
MO 99	-	4.31E-06	8.20E-07	-	9.76E-06	-	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	-	1.06E-08	3.42E-10	4.13E-07

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.54E-10	3.66E-10	3.59E-09	-	6.59E-09	1.87E-10	1.10E-21
RU 103	1.85E-07	-	7.97E-08	-	7.06E-07	-	2.16E-05
RU 105	1.54E-08	-	6.08E-09	-	1.99E-07	-	9.42E-06
RU 106	2.75E-06	-	3.48E-07	-	5.31E-06	-	1.78E-04
AG 110M	1.60E-07	1.48E-07	8.79E-08	-	2.91E-07	-	6.04E-05
TE 125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	-	1.07E-05
TE 127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	-	2.27E-05
TE 127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	-	8.68E-06
TE 129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	-	5.79E-05
TE 129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	-	2.37E-08
TE 131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	-	8.40E-05
TE 131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	-	2.79E-09
TE 132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	-	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	-	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	-	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	-	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	-	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	-	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	-	1.31E-06
CS 134	6.22E-05	1.48E-04	1.21E-04	-	4.79E-05	1.59E-05	2.59E-06
CS 136	6.51E-06	2.57E-05	1.85E-05	-	1.43E-05	1.96E-06	2.92E-06
CS 137	7.97E-05	1.09E-04	7.14E-05	-	3.70E-05	1.23E-05	2.11E-06
CS 138	5.52E-08	1.09E-07	5.40E-08	-	8.01E-08	7.91E-09	4.65E-13
BA 139	9.70E-08	6.91E-11	2.84E-09	-	6.46E-11	3.92E-11	1.72E-07
BA 140	2.03E-05	2.55E-08	1.33E-06	-	8.67E-09	1.46E-08	4.18E-05
BA 141	4.71E-08	3.56E-11	1.59E-09	-	3.31E-11	2.02E-11	2.22E-17
BA 142	2.13E-08	2.19E-11	1.34E-09	-	1.85E-11	1.24E-11	3.00E-26
LA 140	2.50E-09	1.26E-09	3.33E-10	-	-	-	9.25E-05
LA 142	1.28E-10	5.82E-11	1.45E-11	-	-	-	4.25E-07
CE 141	9.36E-09	6.33E-09	7.18E-10	-	2.94E-09	-	2.42E-05
CE 143	1.65E-09	1.22E-06	1.35E-10	-	5.37E-10	-	4.56E-05
CE 144	4.88E-07	2.04E-07	2.62E-08	-	1.21E-07	-	1.65E-04
PR 143	9.20E-09	3.69E-09	4.56E-10	-	2.13E-09	-	4.03E-05
PR 144	3.01E-11	1.25E-11	1.53E-12	-	7.05E-12	-	4.33E-18
ND 147	6.29E-09	7.27E-09	4.35E-10	-	4.25E-09	-	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	-	-	-	2.82E-05
NP 239	1.19E-09	1.17E-10	6.45E-11	-	3.65E-10	-	2.40E-05

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	-	-	-	2.32E-05
CR 51	-	-	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	-	5.90E-06	1.17E-06	-	1.76E-06	-	1.21E-05
MN 56	-	1.58E-07	2.81E-08	-	2.00E-07	-	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	-	-	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	-	-	4.32E-06	3.24E-05
CO 58	-	9.72E-07	2.24E-06	-	-	-	1.34E-05
CO 60	-	2.81E-06	6.33E-06	-	-	-	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	-	-	-	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	-	-	-	5.19E-06
CU 64	-	1.15E-07	5.41E-08	-	2.91E-07	-	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	-	1.28E-05	-	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	-	1.83E-08	-	5.16E-08
BR 83	-	-	5.74E-08	-	-	-	LT E-24
BR 84	-	-	7.22E-08	-	-	-	LT E-24
BR 85	-	-	3.05E-09	-	-	-	LT E-24
RB 86	-	2.98E-05	1.40E-05	-	-	-	4.41E-06
RB 88	-	8.52E-08	4.54E-08	-	-	-	7.30E-15
RB 89	-	5.50E-08	3.89E-08	-	-	-	8.43E-17
SR 89	4.40E-04	-	1.26E-05	-	-	-	5.24E-05
SR 90	8.30E-03	-	2.05E-03	-	-	-	2.33E-04
SR 91	8.07E-06	-	3.21E-07	-	-	-	3.66E-05
SR 92	3.05E-06	-	1.30E-07	-	-	-	7.77E-05
Y 90	1.37E-08	-	3.69E-10	-	-	-	1.13E-04
Y 91M	1.29E-10	-	4.93E-12	-	-	-	6.09E-09
Y 91	2.01E-07	-	5.39E-09	-	-	-	8.24E-05
Y 92	1.21E-09	-	3.50E-11	-	-	-	3.32E-05
Y 93	3.83E-09	-	1.05E-10	-	-	-	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	-	1.91E-08	-	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	-	7.11E-10	-	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	-	4.42E-09	-	1.95E-05
MO 99	-	6.03E-06	1.15E-06	-	1.38E-05	-	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	-	1.38E-08	5.14E-10	6.08E-07

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	3.60E-10	5.12E-10	5.03E-09	-	9.26E-09	3.12E-10	8.75E-17
RU 103	2.55E-07	-	1.09E-07	-	8.99E-07	-	2.13E-05
RU 105	2.18E-08	-	8.46E-09	-	2.75E-07	-	1.76E-05
RU 106	3.92E-06	-	4.94E-07	-	7.56E-06	-	1.88E-04
AG 110M	2.05E-07	1.94E-07	1.18E-07	-	3.70E-07	-	5.45E-05
TE 125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	-	-	1.13E-05
TE 127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	-	2.41E-05
TE 127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	-	1.22E-05
TE 129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	-	6.12E-05
TE 129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	-	2.45E-07
TE 131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	-	9.39E-05
TE 131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	-	2.29E-09
TE 132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	-	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	-	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	-	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	-	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	-	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	-	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	-	1.74E-06
CS 134	8.37E-05	1.97E-04	9.14E-05	-	6.26E-05	2.39E-05	2.45E-06
CS 136	8.59E-06	3.38E-05	2.27E-05	-	1.84E-05	2.90E-06	2.72E-06
CS 137	1.12E-04	1.49E-04	5.19E-05	-	5.07E-05	1.97E-05	2.12E-06
CS 138	7.76E-08	1.49E-07	7.45E-08	-	1.10E-07	1.28E-08	4.76E-11
BA 139	1.39E-07	9.78E-11	4.05E-09	-	9.22E-11	6.74E-11	1.24E-06
BA 140	2.84E-05	3.48E-08	1.83E-06	-	1.18E-08	2.34E-08	4.38E-05
BA 141	6.71E-08	5.01E-11	2.24E-09	-	4.65E-11	3.43E-11	1.43E-13
BA 142	2.99E-08	2.99E-11	1.84E-09	-	2.53E-11	1.99E-11	9.18E-20
LA 140	3.48E-09	1.71E-09	4.55E-10	-	-	-	9.28E-05
LA 142	1.79E-10	7.95E-11	1.98E-11	-	-	-	2.42E-06
CE 141	1.33E-08	8.88E-09	1.02E-09	-	4.18E-09	-	2.54E-05
CE 143	2.35E-09	1.71E-06	1.91E-10	-	7.67E-10	-	5.14E-05
CE 144	6.96E-07	2.88E-07	3.74E-08	-	1.72E-07	-	1.75E-04
PR 143	1.31E-08	5.23E-09	6.52E-10	-	3.04E-09	-	4.31E-05
PR 144	4.30E-11	1.76E-11	2.18E-12	-	1.01E-11	-	4.74E-14
ND 147	9.38E-09	1.02E-08	6.11E-10	-	5.99E-09	-	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	-	-	-	3.22E-05
NP 239	1.76E-09	1.66E-10	9.22E-11	-	5.21E-10	-	2.67E-05

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.25E-04	3.86E-05	3.18E-05	-	-	-	2.28E-05
CR 51	-	-	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	-	1.07E-05	2.85E-06	-	3.00E-06	-	8.98E-06
MN 56	-	3.34E-07	7.54E-08	-	4.04E-07	-	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	-	-	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	-	-	7.74E-06	2.78E-05
CO 58	-	1.80E-06	5.51E-06	-	-	-	1.05E-05
CO 60	-	5.29E-06	1.56E-05	-	-	-	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	-	-	-	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	-	-	-	2.56E-05
CU 64	-	2.45E-07	1.48E-07	-	5.92E-07	-	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	-	2.30E-05	-	6.41E-06
ZN 69	4.38E-08	6.33E-08	5.85E-09	-	3.84E-08	-	3.99E-06
BR 83	-	-	1.71E-07	-	-	-	LT E-24
BR 84	-	-	1.98E-07	-	-	-	LT E-24
BR 85	-	-	9.12E-09	-	-	-	LT E-24
RB 86	-	6.70E-05	4.12E-05	-	-	-	4.31E-06
RB 88	-	1.90E-07	1.32E-07	-	-	-	9.32E-09
RB 89	-	1.17E-07	1.04E-07	-	-	-	1.02E-09
SR 89	1.32E-03	-	3.77E-05	-	-	-	5.11E-05
SR 90	1.70E-02	-	4.31E-03	-	-	-	2.29E-04
SR 91	2.40E-05	-	9.06E-07	-	-	-	5.30E-05
SR 92	9.03E-06	-	3.62E-07	-	-	-	1.71E-04
Y 90	4.11E-08	-	1.10E-09	-	-	-	1.17E-04
Y 91M	3.82E-10	-	1.39E-11	-	-	-	7.48E-07
Y 91	6.02E-07	-	1.61E-08	-	-	-	8.02E-05
Y 92	3.60E-09	-	1.03E-10	-	-	-	1.04E-04
Y 93	1.14E-08	-	3.13E-10	-	-	-	1.70E-04
ZR 95	1.16E-07	2.55E-08	2.27E-08	-	3.65E-08	-	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	-	1.45E-09	-	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	-	8.23E-09	-	1.62E-05
MO 99	-	1.33E-05	3.29E-06	-	2.84E-05	-	1.10E-05
TC 99M	9.23E-10	1.81E-09	3.00E-08	-	2.63E-08	9.19E-10	1.03E-06

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	1.07E-09	1.12E-09	1.42E-08	-	1.91E-08	5.92E-10	3.56E-09
RU 103	7.31E-07	-	2.81E-07	-	1.84E-06	-	1.89E-05
RU 105	6.45E-08	-	2.34E-08	-	5.67E-07	-	4.21E-05
RU 106	1.17E-05	-	1.46E-06	-	1.58E-05	-	1.82E-04
AG 110M	5.39E-07	3.64E-07	2.91E-07	-	6.78E-07	-	4.33E-05
TE 125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	-	-	1.10E-05
TE 127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	-	2.34E-05
TE 127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	-	1.84E-05
TE 129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	-	5.94E-05
TE 129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	-	8.34E-06
TE 131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	-	1.01E-04
TE 131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	-	4.36E-07
TE 132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	-	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	-	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	-	1.54E-06
I 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	-	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	-	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	-	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	-	2.40E-06
CS 134	2.34E-04	3.84E-04	8.10E-05	-	1.19E-04	4.27E-05	2.07E-06
CS 136	2.35E-05	6.46E-05	4.18E-05	-	3.44E-05	5.13E-06	2.27E-06
CS 137	3.27E-04	3.13E-04	4.62E-05	-	1.02E-04	3.67E-05	1.96E-06
CS 138	2.28E-07	3.17E-07	2.01E-07	-	2.23E-07	2.40E-08	1.46E-07
BA 139	4.14E-07	2.21E-10	1.20E-08	-	1.93E-10	1.30E-10	2.39E-05
BA 140	8.31E-05	7.28E-08	4.85E-06	-	2.37E-08	4.34E-08	4.21E-05
BA 141	2.00E-07	1.12E-10	6.51E-09	-	9.69E-11	6.58E-10	1.14E-07
BA 142	8.74E-08	6.29E-11	4.88E-09	-	5.09E-11	3.70E-11	1.14E-09
LA 140	1.01E-08	3.53E-09	1.19E-09	-	-	-	9.84E-05
LA 142	5.24E-10	1.67E-10	5.23E-11	-	-	-	3.31E-05
CE 141	3.97E-08	1.98E-08	2.94E-09	-	8.68E-09	-	2.47E-05
CE 143	6.99E-09	3.79E-06	5.49E-10	-	1.59E-09	-	5.55E-05
CE 144	2.08E-06	6.52E-07	1.11E-07	-	3.61E-07	-	1.70E-04
PR 143	3.93E-08	1.18E-08	1.95E-09	-	6.39E-09	-	4.24E-05
PR 144	1.29E-10	3.99E-11	6.49E-12	-	2.11E-11	-	8.59E-08
ND 147	2.79E-08	2.26E-08	1.75E-09	-	1.24E-08	-	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	-	-	-	3.57E-05
NP 239	5.25E-09	3.77E-10	2.65E-10	-	1.09E-09	-	2.79E-05

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	-	-	-	2.30E-05
CR 51	-	-	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	-	1.99E-05	4.51E-06	-	4.41E-06	-	7.31E-06
MN 56	-	8.18E-07	1.41E-07	-	7.03E-07	-	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	-	-	4.36E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	-	-	1.59E-05	2.57E-05
CO 58	-	3.60E-06	8.98E-06	-	-	-	8.97E-06
CO 60	-	1.08E-05	2.55E-05	-	-	-	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	-	-	-	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	-	-	-	4.05E-05
CU 64	-	6.09E-07	2.82E-07	-	1.03E-06	-	1.25E-05
ZN 65	1.84E-05	6.31E-05	2.91E-05	-	3.06E-05	-	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	-	6.98E-08	-	1.37E-05
BR 83	-	-	3.63E-07	-	-	-	LT E-24
BR 84	-	-	3.82E-07	-	-	-	LT E-24
BR 85	-	-	1.94E-08	-	-	-	LT E-24
RB 86	-	1.70E-04	8.40E-05	-	-	-	4.35E-06
RB 88	-	4.98E-07	2.73E-07	-	-	-	4.85E-07
RB 89	-	2.86E-07	1.97E-07	-	-	-	9.74E-08
SR 89	2.51E-03	-	7.20E-05	-	-	-	5.16E-05
SR 90	1.85E-02	-	4.71E-03	-	-	-	2.31E-04
SR 91	5.00E-05	-	1.81E-06	-	-	-	5.92E-05
SR 92	1.92E-05	-	7.13E-07	-	-	-	2.07E-04
Y 90	8.69E-08	-	2.33E-09	-	-	-	1.20E-04
Y 91M	8.10E-10	-	2.76E-11	-	-	-	2.70E-06
Y 91	1.13E-06	-	3.01E-08	-	-	-	8.10E-05
Y 92	7.65E-09	-	2.15E-10	-	-	-	1.46E-04
Y 93	2.43E-08	-	6.62E-10	-	-	-	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	-	5.41E-08	-	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	-	2.56E-09	-	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	-	1.24E-08	-	1.46E-05
MO 99	-	3.40E-05	6.63E-06	-	5.08E-05	-	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	-	4.26E-08	2.07E-09	1.15E-06

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.27E-09	2.86E-09	2.83E-08	-	3.40E-08	1.56E-09	4.86E-07
RU 103	1.48E-06	-	4.95E-07	-	3.08E-06	-	1.80E-05
RU 105	1.36E-07	-	4.58E-08	-	1.00E-06	-	5.41E-05
RU 106	2.41E-05	-	3.01E-06	-	2.85E-05	-	1.83E-04
AG 110M	9.96E-07	7.27E-07	4.81E-07	-	1.04E-06	-	3.77E-05
TE 125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	-	-	1.11E-05
TE 127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	-	2.36E-05
TE 127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	-	2.10E-05
TE 129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	-	5.97E-05
TE 129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	-	2.27E-05
TE 131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	-	1.03E-04
TE 131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	-	7.11E-06
TE 132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	-	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	-	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	-	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	-	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	-	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	-	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	-	2.62E-06
CS 134	3.77E-04	7.03E-04	7.10E-05	-	1.81E-04	7.42E-05	1.91E-06
CS 136	4.59E-05	1.35E-04	5.04E-05	-	5.38E-05	1.10E-05	2.05E-06
CS 137	5.22E-04	6.11E-04	4.33E-05	-	1.64E-04	6.64E-05	1.91E-06
CS 138	4.81E-07	7.82E-07	3.79E-07	-	3.90E-07	6.09E-08	1.25E-06
BA 139	8.81E-07	5.84E-10	2.55E-08	-	3.51E-10	3.54E-10	5.58E-05
BA 140	1.71E-04	1.71E-07	8.81E-06	-	4.06E-08	1.05E-07	4.20E-05
BA 141	4.25E-07	2.91E-10	1.34E-08	-	1.75E-10	1.77E-10	5.19E-06
BA 142	1.84E-07	1.53E-10	9.06E-09	-	8.81E-11	9.26E-11	7.59E-07
LA 140	2.11E-08	8.32E-09	2.14E-09	-	-	-	9.77E-05
LA 142	1.10E-09	4.04E-10	9.67E-11	-	-	-	6.86E-05
CE 141	7.87E-08	4.80E-08	5.65E-09	-	1.48E-08	-	2.48E-05
CE 143	1.48E-08	9.82E-06	1.12E-09	-	2.86E-09	-	5.73E-05
CE 144	2.98E-06	1.22E-06	1.67E-07	-	4.93E-07	-	1.71E-04
PR 143	8.13E-08	3.04E-08	4.03E-09	-	1.13E-08	-	4.29E-05
PR 144	2.74E-10	1.06E-10	1.38E-11	-	3.84E-11	-	4.93E-06
ND 147	5.53E-08	5.68E-08	3.48E-09	-	2.19E-08	-	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	-	-	-	3.69E-05
NP 239	1.11E-08	9.93E-10	5.61E-10	-	1.98E-09	-	2.87E-05

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Page 1 of 2

Parameter Symbol	Definition	Values
f_g	Fraction of produce ingested grown in garden of interest.	0.76
f_ℓ	Fraction of leafy vegetables grown in garden of interest.	1.0
P	Effective surface density of soil (assumes a 15 cm plow layer, expressed in dry weight)	240 kg/m^2
r	Fraction of deposited activity retained on crops, leafy vegetables, or pasture grass.	0.25 1.0 (for iodines) 0.2 (for other particulates)
S_f	Attenuation factor accounting for shielding provided by residential structures.	0.7 (for maximum individuals) 0.5 (for general population)
t_b	Period of long-term buildup for activity in sediment or soil (nominally 15 yr).	1.31 x 10^5 hr
t_e	Period of crop, leafy vegetable, or pasture grass exposure during growing season.	720 hrs (30 days, for grass-cow-milk-man pathway) 1440 hrs (60 days for crop/vegetation-man pathway)
t_f	Transport time from animal feed-milk-man provided by residential structures.	2 days (for max. individual) 4 days (for gen. population)
t_h	Time delay between harvest of vegetation or crops and ingestion. i) For ingestion of forage by animals	Zero (for pasture grass) 2160 hr (90 days for stored feed)

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Page 2 of 2

Parameter Symbol	Definition	Values
	ii) For ingestion of crops by man	24 hr (1 day, for leafy vegetables & max. individual) feed) 1440 hr (60 days for produce & maximum individual) 336 hr (14 days for general population)
t_p	Environmental transit time, release to receptor (add time from release to exposure individual) point to minimums shown for distribution)	12 hr (for max. 24 hr (for gen. population) 24 hr (for max. individual) 168 hr (7 days for population sport fish doses) 240 hr (10 days for population commercial fish doses)
t_s	Average time from slaughter of meat animal to consumption.	20 days
Y_v	Agricultural producitivity by unit area (measured in wet weight)	0.7 kg/m^2 (for grass-cow-milk man pathway) 2.0 kg/m^2 (for produce or leafy vegetables ingested by man)
W	Shore-width factor for river shoreline	0.2
λ_w	Rate constant for removal of activity on plant or leaf surfaces by weathering (corresponds to a 14-day half-life)	0.0021 hr^{-1}

Fort Calhoun Station
Unit No. 1

CH-ODCM-0001

CHEMISTRY PROCEDURE

Title: OFF-SITE DOSE CALCULATION MANUAL (ODCM)

Setpoint/Procedure
Form Number (FC-68): 10644

Reason for Change: Incorporate 10 CFR 20 changes.

Contact Person: Mark Puckett

PART I

ADMINISTRATIVE SECTION

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PART IV

1.0 INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is the controlling document for the Fort Calhoun Station's (FCS) Radiological Effluent and Environmental Monitoring programs. The programs are necessary to ensure the requirements set forth in 10 CFR 20, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR 50, Appendix I. The document is subdivided into four sections as outlined below:

Part I, Introduction - consists of information necessary for the effective use of the ODCM.

Part II, Radiological Effluent Controls - consists of 5 separate sections including:

Section 1 Radiological Effluent Release Limits

Section 2 Radiological Effluent Release Requirements

Section 3 Radiological Effluent Sampling and Analysis Requirements

Section 4 Radiological Effluent Reporting Requirements

Section 5 Radiological Environmental Monitoring Requirements

Together these sections provide the controls used to permit radioactive material releases from the Fort Calhoun Station.

Part III, Radiological Effluent Radiation Monitor Calculation - provides radiation monitor setpoint calculations for the liquid and airborne release pathways. 7/93

Part IV, Radiological Effluent Monitoring Calculations - provides the methodology necessary to calculate doses to individuals as a result of radioactive airborne and liquid releases from Fort Calhoun. 7/93

The ODCM has been prepared in accordance with the guidance of Nuclear Regulatory Commissions Reg. Guide 1.109, Rev. 1.

The Radiological Effluent Controls Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Release Limits - All Sections

B. Radiological Effluent Release Requirements - All Sections

C. Radiological Effluent Sampling and Analysis Requirements - All Sections

D. Radiological Effluent Reporting Requirements - Sections 4.1 and 4.4 7/93

2.0 ADMINISTRATIVE

The Radiological Environmental Monitoring Program consists of the following sections in the Radiological Effluent Controls: 7/93

A. Radiological Effluent Reporting Requirements - Sections 4.2 and 4.3

B. Radiological Environmental Monitoring Requirements - All Sections

2.1 Responsibilities

2.1.1 Nuclear Operation Division Chemistry Department is responsible for the implementation and maintenance of the ODCM.

2.1.2 Nuclear Operation Division Operation Department is responsible for the compliance with the ODCM in the operation of Fort Calhoun Station.

2.2 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 Report in accordance with the requirements of Technical Specification 5.17.

3.0 METEOROLOGICAL DATA

The Annual Average χ/Q is utilized to determine the concentrations of radionuclides at the unrestricted area boundary. This dispersion factor coincides with the highest calculated annual average value for the Fort Calhoun Station. It is based on 3 years of Onsite Meteorological data and the MESODIF II plume trajectory model. This model conforms with the Nuclear Regulatory Commissions Regulatory Guide 1.111. The model employs the sector averaged equations that are utilized for long-term releases. This type of release (long term) is not dependent solely on atmospheric conditions for complying with 10 CFR 20 concentration limits at the unrestricted area boundary. 7/93 7/93

Real time meteorological data will be utilized in the preparation of the Annual Report. This data is used to calculate the joint frequency table and 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, GASPAR and LADTAP, conform with the Nuclear Regulatory Commissions Reg. Guide 1.109 and 1.21 for the reporting of doses due to routine radioactive effluent releases.

4.0 DEFINITIONS

7/93

Air Effluent Concentration (AEC)

Radionuclide limits listed in 10 CFR 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.

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.

Venting

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

Unrestricted Area

7/93

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

7/93

Water Effluent Concentration (WEC)

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

5.0 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 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.

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 is 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

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

Fort Calhoun Technical Specifications (Unit No. 1)

Updated Safety Analysis Report

Commitment Documents:

IMPLEMENTING STEP	COMMITMENT NUMBER (CID)	SOURCE DOCUMENT
Part II, 2.2.3.1 C.2	920102/01	FC-0133-92

PART II

RADIOLOGICAL EFFLUENT CONTROLS

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS

The limits and conditions for the controlled release of radioactive material in liquid and airborne effluents are to ensure that these releases result in concentrations that are within the limits specified in 10 CFR 20, and to ensure that releases of radioactive material to the environment be as low as reasonably achievable in conformance with 10 CFR 50.34a and 50.36a. To meet these criteria, the following requirements must be met for all radioactive liquid and airborne effluents from FCS: 7/93

1.1 Liquid Effluents

1.1.1 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 20 for liquid effluents at site discharge. For dissolved or entrained noble gases, the concentration shall be limited to 2.0 E-04 μCi/ml, total activity. 7/93

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. 7/93

1.1.2 Annual Design Objectives

1.1.2.1 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.

1.1.2.2 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed 10 millirems to any organ.

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.1.2.3 The radiation dose contributions from radioactive materials in liquid effluents released at site discharge shall be determined, in accordance with Part IV, Section 2.1, 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: 7/93

A. Make an investigation to identify the causes for such releases.

B. Define and initiate a program of action to reduce such releases to the design levels.

C. 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.

7/93

1.2 Airborne Effluents

7/93

1.2.1 The release rate of radioactive material in airborne effluents shall be controlled such that the instantaneous concentrations for these radionuclides do not exceed the values specified in 10 CFR 20 for airborne effluents at the unrestricted area boundary. 7/93

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.

1.2.2 Annual Design Objectives

1.2.2.1 The gamma air dose in unrestricted areas due to the release of noble gases in airborne effluents shall not exceed 10 millirads during any calendar year; 7/93

1.2.2.2 The beta air dose in unrestricted areas due to the release of noble gases in airborne effluents shall not exceed 20 millirads during any calendar year; and 7/93

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.2.2.3 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 15 millirems from all exposure pathways during any calendar year. 7/93

1.2.2.4 The radiation dose contributions from radioactive materials in airborne effluents shall be determined, in accordance with the Part IV, section 2.2, on a quarterly basis. If the dose contribution, due to the cumulative release of airborne effluents averaged over a calendar quarter exceeds one-half of the annual design objectives, the following course of actions shall be taken: 7/93 7/93

A. Make an investigation to identify the cause for such release rates.

B. Define and initiate a program of action to reduce such releases to design levels.

C. 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.

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

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS

7/93

The requirements for the release of radioactive liquid and airborne effluents from FCS stated in this Section are to ensure that the limits of Section 1 will be met, as well as to allow for operational flexibility. When any of the requirements for release of radioactive effluents cannot be complied with, the release shall not be permitted to occur or it shall be immediately terminated, if it is in progress.

2.1 Liquid Effluent Releases

The equipment or subsystem(s) of the liquid radwaste treatment system as identified in the Part III, section 2.1, shall be operable. If the radioactive liquid effluents were discharged without treatment by one or more of the pieces of equipment or subsystem(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reasons for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1 Monitor and Hotel Waste Tanks

During release of radioactive liquid effluents, the following conditions shall be met:

2.1.1.1 There shall be sufficient dilution flow so that, at site discharge: 7/93

$$\sum_{i=1}^{n} C_i/wec_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge. 7/93

wec_i = 10 CFR 20, Appendix B, Table 2, Column 2 limits.

2.1.1.2 The overboard header effluent radiation monitor shall be set in accordance with Part III to alarm and automatically close the discharge valve prior to exceeding 10 CFR 20 limits at site discharge. 7/93

2.1.1.3 The liquid effluent radioactivity shall be continuously monitored during the release. If the effluent radiation monitor is inoperable, effluent releases may continue provided that: (prior to initiating a release)

A. At least two independent samples are analyzed in accordance with applicable chemistry procedures.

B. At least two qualified individuals independently verify the release rate calculations.

2.1.1.4 The liquid effluent radioactivity shall be continuously recorded during the release. If the process radiation monitor chart recorder is inoperable and the process radiation monitor is operable then effluent releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1.5 The liquid effluent flow rate shall be continuously monitored and recorded during the release. If the flow rate recorder is inoperable, effluent releases may continue provided the flow rate is determined at least once per four hours during actual release.

2.1.2 Steam Generator

During the release of steam generator blowdown to the discharge tunnel, the following conditions shall be met:

2.1.2.1 There shall be sufficient dilution flow so that, at site discharge: 7/93

$$\sum_{i=1}^{n} C_i / wec_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

wec_i = 10 CFR 20, Appendix B, Table 2, Column 2 limit. 7/93

2.1.2.2 The steam generator blowdown radiation monitors shall be set in accordance with Part III to alarm and automatically close the blowdown isolation valves prior to exceeding 10 CFR 20 limits at site dishcarge. 7/93

2.1.2.3 The radioactivity for each blowdown line shall be continuously monitored by the blowdown radiation monitors and recorded.

A. If one of the two radiation monitors is inoperable, the activity for both blowdown lines shall be monitored by the operable radiation monitor within 2 hours of the declaration, by Shift Supervisor, of inoperability. 7/93

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.2.3 B. If both radiation monitors are inoperable, steam generator liquid releases may continue provided grab samples are analyzed for principal gamma emitters at a sensitivity of 5.0E-07 μCi/ml and recorded at least daily when the specific activity of Steam Generator Blowdown is less than or equal to 0.01 μCi/gram dose equivalent I-131 and at least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 μCi/gram dose equivalent I-131.

2.1.2.4 The radioactivity for each blowdown line shall be continuously recorded. If the process radiation monitor chart recorder is not operational, Steam Generator releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.2 Airborne Effluent Releases

The equipment or subsystem(s) of the gaseous radwaste treatment system as identified in Part III, Section 2.2, shall be operable. If the radioactive airborne effluents were discharged without treatment by one or more of the equipment 7/93
or subsystems(s) identified in that section 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 7/93
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:

A. Identification of equipment or subsystem(s) not operable and reason for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1 Auxiliary Building Exhaust Stack

7/93

2.2.1.1 During the ventilation of airborne effluents from the Auxiliary Building through the Auxiliary Building Exhaust Stack, the following conditions shall be met:

A. The Auxiliary Building Exhaust Stack Noble Gas Monitors, iodine sampler and particulate sampler, shall be operational, OR:

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 2).

2) If the Auxiliary Building Exhaust Stack iodine or particulate sampler(s) is/are 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 using auxiliary sample collection equipment is initiated within 2 hours of the declaration, by the Shift Supervisor, of inoperability in accordance with Table 2. 7/93

7/93

B. The Auxiliary Building Exhaust Stack Noble Gas Radiation Monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

7/93

2.2.1.1 C. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from the Auxiliary Building may continue provided that the radioactivity level is recorded manually at least once per four hours during the actual release.

D. The Auxiliary Building Exhaust Stack flowrate shall be monitored and recorded during ventilation of the Auxiliary Building. If the flowrate monitor or recorder is inoperable, ventilation may continue provided the flowrate is determined and recorded manually at least once per four hours.

2.2.1.2 During release of airborne effluents from containment pressure relief line to the Auxiliary Building Exhaust Stack, the following conditions shall be met:

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1). 7/93

C. At least one Auxiliary Building exhaust fan shall be in operation.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.2 D. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from containment may continue provided that the radioactivity level is recorded manually at least once per four hours during the actual release. 7/93 7/93 7/93

E. The containment flow rate shall be monitored and automatically recorded during the release. If the flow rate monitor or recorder is inoperable, releases from the containment may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.2.1.3 During the release of airborne effluents from the containment purge line: 7/93

A. The conditions set forth in Section 2.2.1.2 shall be met.

B. A noble gas monitor shall monitor the containment building atmosphere.

2.2.1.4 During the release of airborne effluents from the gaseous waste discharge header: 7/93

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational, OR:

1) If the Auxiliary Building Exhaust Stack noble gas monitor is inoperable, effluent releases may continue provided that (prior to release): 7/93

a) At least two independent samples are analyzed in accordance with the applicable chemistry procedure.

b) At least two qualified individuals independently verify the release rate calculations.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.3 B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1). 7/93

C. At least one Auxiliary Building exhaust fan shall be in operation.

D. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from waste gas decay tanks may continue provided that the gaseous radioactivity level is recorded manually at least once per four hours during the actual release. 7/93 7/93

E. The waste gas discharge header flow rate shall be monitored and automatically recorded during releases. If the flow rate monitor or recorder is inoperable, releases may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.2.2 Condenser Offgas

2.2.2.1 During power operation, the condenser air ejector 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 2)

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.3 Laboratory and Radioactive Waste Processing Building Stack

7/93

2.2.3.1 During the release of airborne effluents from the Laboratory and Radioactive Waste Processing Building (LRWPB) the following conditions shall be met:

A. The LRWPB noble gas monitor, iodine sampler and particulate sampler shall be operational, OR:

7/93

1) 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 and analyzed for principal gamma emitters.

[2)] If the iodine or particulate sampler(s) is/are 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, by the Shift Supervisor, of inoperability in accordance with Table 2. 7/93

B. The LRWPB noble gas radiation monitor shall be set in accordance with Part III to alarm at its predetermined setpoints.

C. The LRWPB Stack flow rate shall be monitored and recorded during ventilation of the LRWPB. If the flow rate monitor or recorder is inoperable, ventilation may continue provided the flow rate is determined and recorded manually at least once per four hours.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS

The sampling and analysis requirements stated in this Section will provide reasonable assurance that radioactive materials present in the liquid and airborne effluents will be properly identified and accurately quantified. This information will serve as the basis for determining doses to individuals as a result of radioactive effluents from FCS. 7/93

Records shall be maintained and reports of the sampling and results of analyses shall be submitted to the Nuclear Regulatory Commission in accordance with Section 4 of these Controls. Sampling, analysis and operability testing will typically be documented on Surveillance Tests or on Release Permits or Summaries.

3.1 Liquid Effluents

3.1.1 Radioactive liquid effluent sampling and activity analyses shall be performed in accordance with Table 1. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration at the point of release is limited to 10 CFR 20 limits for unrestricted areas.

3.1.2 Prior to release of each batch of liquid effluent, the batch shall be mixed, sampled, and analyzed for principal gamma emitters. When operational or other limitations preclude specific gamma radionuclide analysis of each batch:

3.1.2.1 Gross radioactivity measurements shall be made to estimate the quantity and concentrations of radioactive materials released in the batch.

3.1.2.2 A weekly sample composite from proportional aliquots from each batch released during the week shall be analyzed for the principal gamma-emitting radionuclides.

3.1.3 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 II, Section 4. 7/93

3.1.4 The radiation monitors for liquid effluents shall have their operability tested in accordance with the requirements in Table 3, Item A.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.2 Airborne Effluents 7/93

3.2.1 Radioactive airborne effluent sampling and activity analyses shall be performed in accordance with Table 2. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration of radioactive materials is limited to 10 CFR 20 limits at the unrestricted area boundary. 7/93 7/93

3.2.2 The radiation monitors/samplers for airborne effluents shall have their operability tested in accordance with the requirements in Table 3, Item B. 7/93

3.3 Lower Limit of Detection (LLD)

The lower limit of detection (LLD) for liquid and airborne effluent discharges, referenced in Part II, Tables 1 and 2, is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal. 7/93

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 * s_b}{E * V * D * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD = the lower limit of detection as defined above, in either picoCuries or microCuries, per unit mass or volume as a function of the value of D

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate, as counts per minute

E = the counting efficiency, as counts per disintegration

V = the sample size in units of mass or volume

D = 2.22E+06 of disintegrations per minute per microCurie or 2.22 disintegrations per minute per picoCurie

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.3 Y = the fractional radiochemical yield, when applicable

λ = the radioactive decay constant for the particular radionuclide

Δt = the elapsed time for the plant effluent between the midpoint of sample collection and time of counting

Appropriate values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an A Priori limit representing the capability of a measurement system and not as a limit for a particular measurement.

LLD verifications will be performed on a periodic basis. This determination is to ensure that the counting system is able to detect levels of radiation at the LLD values for the specific type of analysis required by Tables 1 and 2. They will be performed with a blank (non-radioactive) sample in the same counting geometry as the actual sample.

4.0 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 1 are complied with. These reports will meet the requirements for documentation of radioactive effluents contained in 10 CFR 50.36a; Reg. Guide 1.21, Rev. 1; Reg. Guide 4.8, Table 1; and Reg. Guide 1.109, Rev. 1.

4.1 Annual Radioactive Effluent Release Report

A report covering the operation of the Fort Calhoun Station during the previous calender year shall be submitted within 90 days after January 1 of each year per the requirements of 10CFR 50.36a.

The radioactive effluent release report shall include 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. 7/93

The radioactive effluent release report shall include 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. 7/93

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.1 The radioactive effluent release report shall include 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. 7/93

The radioactive effluent release report shall include any 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.

4.2 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:

4.2.1 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.

4.2.2 Interpretations and statistical evaluation of the results, including an assessment of the observed impacts of the plant operation and environment.

4.2.3 The results of participation in a NRC approved Interlaboratory Comparison Program.

4.2.4 The results of land use survey required by Part II, Section 5.4.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.2.5 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:

4.2.5.1 Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded.

4.2.5.2 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.

4.2.5.3 Purification system flow history starting 48 hours prior to the first sample in which the limit was exceeded.

4.2.5.4 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

4.2.5.5 The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

4.3 Non-Routine Report

If a confirmed measured radionuclide concentration in an environmental sampling medium averaged over any calendar quarter sampling period exceeds the reporting level referenced in Table 7, and if the radioactivity is attributable to plant operation, a written report shall be submitted to the Nuclear Regulatory Commission within 30 days from the end of the quarter.

The report shall include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the anomalous result.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.4 EPA 40 CFR 190 Reporting Requirements

With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Part II, Sections 1.1.2, 1.2.2, or 1.3, based on quarterly and annual calculations, 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 190 standard. Otherwise, obtain a variance from the Commission to permit releases which exceed the 40 CFR 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. 7/93

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

The requirements set forth in this Section will provide reasonable assurance that radioactive liquid and airborne effluent releases to the environment in and around Fort Calhoun Station are monitored and that any deviation of radiation levels above background will be identified. 7/93

5.1 Radiological environmental monitoring shall be conducted according to Table 4. 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 (Part II, Section 4.2). 7/93

5.2 If the level of radioactivity, from calculated doses, in the Annual Radiological Effluent Release Report leads to a higher exposure pathway to individuals, this pathway shall be added to the Radiological Environmental Monitoring Program.

5.3 If the level of radioactivity in an environmental sampling medium exceeds the reporting level specified in Table 7, a Non-routine Report shall be prepared and submitted to the Nuclear Regulatory Commission (Part II, Section 4.3). The detection capabilities of the equipment used for the analysis of Environmental Samples must meet the requirements of Table 6 for Lower Level of Detection (LLD). 7/93

5.4 A land use survey shall be conducted once per 24 months between the dates of June 1 and October 1. This 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 results of the land use survey shall be submitted to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report (Part II, Section 4.2). The survey shall be conducted under the following conditions: 7/93

5.4.1 Within a one-mile radius from the plant site, enumeration by door-to-door or equivalent counting techniques.

5.4.2 Within a five-mile radius, enumeration by using referenced information from county agricultural agents or other reliable sources.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

5.4.3 If it is learned from this survey that milk animals are present at a location which yields a calculated dose greater than from previously sampled location(s), the new location(s) shall be added to the monitoring program. The 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 is then added to the monitoring program. Also, any location(s) from which milk can no longer be obtained may be dropped and replaced if practicable from the monitoring program and the Nuclear Regulatory Commission shall be notified in the Annual Radiological Environmental Operating Report (Part II, Section 4.2). 7/93

5.4.4 Radiological Environmental Sampling locations and the media that is utilized for analysis are presented in Table 5. Details of the emergency TLD locations are contained in Emergency Preparedness Implementing Procedures.

5.5 Analyses shall be performed on radioactive materials as part of an Interlaboratory Comparison Program that has been approved by the Nuclear Regulatory Commission. The results of these analyses shall be included in the Annual Radiological Environmental Operating Report.

5.6 Deviations from the monitoring program, presented in this section and detailed in Table 4, are permitted if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of equipment, or if a person discontinues participation in the program and other legitimate reasons. If the equipment malfunctions, corrective actions will be complete as soon as practicable. If a person no longer supplies samples, a replacement will be made. All deviations from the sampling schedule will be described in the Annual Radiological Environmental Operating Report, pursuant to Part II, Section 4.2. 7/93

TABLE 1

7/93

Radioactive Liquid Effluent Sampling and Analysis

A. **Monitor & Hotel Waste Tanks Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[1]
Each Batch	Principal Gamma Emitters[2][3]	5.0 E-07
	I-131[2]	1.0 E-06
Monthly From One Batch	Dissolved Noble Gases[2] (Gamma Emitters)	1.0 E-05
Monthly Composite[7]	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite[7]	Sr-89, Sr-90	5.0 E-08

B. **Steam Generator Blowdown**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[1]
Weekly Composite[7]	Principal Gamma Emitters[3]	5.0 E-07
	I-131[5]	1.0 E-06
Monthly	Dissolved Noble Gases (Gamma Emitters)	1.0 E-05
Monthly Composite[7]	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite[7]	Sr-89, Sr-90	5.0 E-08

TABLE 2

7/93

Radioactive Airborne Effluent Sampling and Analysis

A. Gas Decay Tank Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu Ci/ml$)(1)
Prior to each release	Principal Gamma Emitters(4)	1.0 E-04

B. Containment Purge Releases or Containment

Pressure Relief Line Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu Ci/ml$)(1)
Prior to each release	Principal Gamma Emitters(4)	1.0 E-04
Prior to each release	H-3	1.0 E-06

C. Condenser Air Ejector Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ($\mu Ci/ml$)(1)
Monthly(6)	Tritium (H-3)	1.0 E-06
Monthly	Principal Gamma Emitters(4)	1.0 E-04

TABLE 2
(Continued)

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

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

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TABLES 1 and 2
(Continued)

NOTES:

(1) LLD is defined in Part II, Section 3.3.

(2) Gross Radioactivity is defined as the determination of radioactivity levels without regard to specific radionuclide identification and individual isotopic quantification.

(3) 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, Ce-141, and Ce-144.

(4) 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, Ce-141, Ce-144 for particulate emissions.

(5) 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 1.0 E-06 microCurie/milliliter.

(6) Required only when steam generator blowdown radioactivity for tritium (Table 1, Item B) exceeds 3.0 E-03 microCurie/milliliter.

(7) 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.

TABLE 3

Radiation and Environmental Monitors
Operability Test Requirements

A. Liquid Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-054 A/B	X(2)	X	X	X	-
RM-055/55A	-	-	X	X	X

B. Gaseous Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-043	X	X	X	X	-
RM-057	X	X	X	X	-
RM-062/51(1)	X	X	X	X	X
RM-041/42 Sampler	X	-	-	X	-
RM-060 Sampler Flow Rate	X	-	-	X	-

C. Envirnmntl. Monitors	Monthly Operations Check	Annual Air Flow Calibration
RM-035 → 039	X	X

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NOTES:

(1) RM-051 will be substituted for RM-062 when it is sampling the Auxiliary Building Exhaust Stack.

(2) Visual flowcheck daily

TABLE 4

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site[1]	Types of Analysis[2]	Frequency
1. Direct Radiation	A. Ten TLD indicator stations, one control station, total of 11.	Gamma dose	Quarterly
	B. An inner-ring of 16 stations, one in each meteorological sector in the general area of the unrestricted area boundary and within 2.5 miles.	Gamma dose during site Area and General Emergencies only.	Replaced Annually
	C. An outer-ring of 16 stations, 1 in each meteorological sector located outside of the inner-ring, but no more distant than approximately 5 miles[5].	Gamma dose during site Area and General Emergencies only.	Replaced Annually
2. Air Monitoring	A. Indicator Stations	1) Filter for Gross Beta[3]	Weekly
	1. 3 stations in the general area of the unrestricted area boundary	2) Charcoal for I-131	Weekly
	2. City of Blair	3) Filter for Gamma Isotopic	Quarterly composite of wkly. fltrs.
	B. One background station	Same as A. above	
3. Water	A. Missouri River at nearest downstream drinking water intake.	Gamma Isotopic, H-3	Monthly composite for Gamma Isotopic Analysis
	B. Missouri River downstream near the mixing zone.		Quarterly composite for H-3 Analysis
	C. Missouri River upstream of plant intake (background).		
4. Milk[4]	A. Nearest family cow when available or one dairy farm within 5 miles.	Gamma Isotopic and I-131	Semimonthly grazing season (May to October)
	B. One dairy farm between 5 miles and 18.75 miles. (Background)		
5. Fish	A. Four fish samples within vicinity of plant discharge.	Gamma Isotopic	Once per season (May to October)
	B. One background sample upstream of plant discharge.		
6. Sediment	One sample from downstream area on the station side of the Missouri River.	Gamma Isotopic	Semiannually

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TABLE 4
(Continued)

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
7. **Vegetables or Food Products**	A. One sample outside of 5 miles. (Background) B. One sample in the highest exposure pathway.	Gamma Isotopic	Once per season (May to October)

Notes:

(1) See Table 6 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/m^3, a gamma spectral analysis will be performed.

(4) When milk samples are not available, a broad leaf vegetation or pasture grass sample shall be collected, when available.

(5) Details of the Emergency TLD Stations are contained in Emergency Preparedness Implementing Procedures.

TABLE 5

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from north)	Airborne Particulate	Airborne Iodine	TLD	Surface Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
1	Onsite Station No. 1, 110-meter weather tower	0.5	293°	X	X	X					
2	Onsite Station No. 2, adjacent to old plant access road	0.6	208°	X	X	X					
3	Offsite Station No. 3, intersection of Hwy. 75 and farm access road	0.8	145°	X	X	X					
4	Blair OPPD office	3.0	303°	X	X	X					
5	EOF Building, North Omaha Power Station	17.5	157°	X	X	X					
6	Fort Calhoun City Hall	4.8	149°			X					
7	Fence around intake gate, Desoto Wildlife Refuge	2.0	101°			X					
8	Entrance to Plant Site from Hwy. 75	0.6	180°			X					
9	NW of Plant	1.0	310°			X					
10	WSW of Plant	0.7	250°			X					
11	SE of Plant	0.9	130°			X					
12	Met. Utilities Dist., Florence Treatment Plant North Omaha, NE	17.0	156°				X				
13	West bank Missouri River, downstream from reactor building	0.5	106°				X		X		
14	125' upstream from intake bldg., west bank of river	0.1	345°				X		X		

TABLE 5
(Continued)

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from (north)	Airborne Particulate	Airborne Iodine	TLD	Well Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
15	Smith Farm(1)	1.9	133°				X				
16	OPPD Onsite Well(1)	0.1	154°				X				
17	Headquarters Bldg.,(1) Desoto Wildlife Refuge	3.1	53°				X				
18	Miller Farm(3) (Discontinued Milk)	0.8	206°								X
19	Flynn Dairy(2)	3.4	310°					X			
20	Mohr Dairy(1)(2)(3)	7.9	187°					X			X
21	Japp Dairy(2)	6.3	219°					X			
22	Fish Sampling Area - Missouri River	R.M. 645.0	-							X	
23	Fish Sampling Area - Missouri River	R.M. 666.0	-							X	
24	Legenhausen Farm (Discontinued)	0.7	207°								
25	Seltz Farm(2)	2.7	168°					X			
26	Vegetation(3) (High Expos. Pthwy. for Veg.)										X
27	Vegetation(3) (Background)										X

Notes:

(1) Sampling not required for pathway modeling, collections performed for additional information only.

(2) When a milk sample is not available at a location, a broad leaf vegetation sample will be collected at that location as a substitute.

(3) Vegetation sites chosen based on Land Use Survey and Semiannual Radioactive Effluent Release Report.

TABLE 6

Detection Capabilities for Environmental Sample Analysis(1)(2)(3)
Lower Limit of Detection (LLD)

Sample	Units	Gross Beta	H-3	Mn-54	Fe-59	Co-58, 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	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
Air Particulate or Gases	pCi/m^3	1.0E-02	--	--	--	--	--	--	--	7.0E-02	--	--	--
Sediment	pCi/kg (dry)	--	--	--	--	--	--	--	--	--	1.5E+02	1.8E+02	--
Grass or Broad Leaf Vegetation/ Vegetables	pCi/kg (wet)	--	--	--	--	--	--	--	--	6.0E+01	6.0E+01	8.0E+01	--

(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 Surveillance Report pursuant to Part II, Section 5.1.

(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, for purposes of these specifications, as the smallest concentration or radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22E{+}06 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

TABLE 7

Reporting Levels for Radioactivity Concentrations in Environmental Samples[1]

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	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
Air Particulate or Gases	pCi/m^3	--	--	--	--	--	--	--	--	9.0E-01	--	--	--
Grass or Broad Leaf Vegetation/ Vegetables	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:

$$\frac{\text{Concentration (1)}}{\text{Reporting Level (1)}} + \frac{\text{Concentration (2)}}{\text{Reporting Level (2)}} + \text{- - - - - -} \geq 1.0$$

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 II, Section 1.1 and 1.2. 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.

PART III

RADIOLOGICAL EFFLUENT RADIATION MONITOR CALCULATIONS

1.0 EFFLUENT MONITOR SETPOINTS

1.1 Liquid Effluents

There are two liquid discharge pathways to the Missouri River. These pathways originate with the radioactive liquid waste processing system (monitor or hotel tanks) and the steam generator blowdown system. Both of these pathways empty into the circulating water system which discharges to the Missouri River (see Figure 1). Figure 2 depicts the liquid discharge pathways and associated radiation monitors. Figure 3 depicts the methods of liquid effluent treatment. A detailed discussion of the liquid effluent treatment system is presented in Section 2.1.

The flowrate for dilution water varies with the number of circulating water pumps in service and with the operation of the warm water recirculation. Some warm water from the condenser outlet is diverted from the circulating water discharge to upstream of the intake structure to help prevent ice from forming on the circulating water pump intakes during winter months. The varying dilution flowrate is accounted for in the dilution calculations for monitor tank and stream generation releases.

Alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the concentration of 7/93
radioactive material released in liquid effluents at site discharge shall be less than the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2.

Cs-137 is the most abundant radionuclide in liquid effluent streams and is used to calibrate the liquid effluent monitors.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2 Liquid Effluent Radiation Monitors

1.2.1 Steam Generator Blowdown Monitors (RM-054A and B)

These process radiation detectors monitor the flow through the steam generator blowdown lines and automatically close the blowdown isolation valves if the monitor high alarm setpoint is reached. The high alarm setpoint calculations are based on controlling the discharge at 10 CFR 20 limits of 1.0E-06 μCi/ml at site discharge. 7/93

The following calculations for maximum concentration and alarm setpoints are valid when steam generator blowdown is the only liquid release pathway. For simultaneous radioactive liquid releases of steam generator blowdown and monitor tank discharge, refer to Section 1.5.1.

The maximum allowable concentration in the blowdown line is calculated as follows: 7/93

$$A_o = \frac{(1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o}$$

Where: 7/93

1.0E-06 mCi/ml = 10 CFR 20 Limit for unidentified radionuclides at site discharge (10 CFR 20, Appendix B, Note 2).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)

Y_o = Blowdown flow rate (gpm). (Normal blowdown flow rate is based on 2 transfer pumps with a design flow of 135 gpm each, 270 gpm total. Other flow rates may be used, as required.)

A_o = Maximum allowable blowdown concentration (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.1 The high alarm setpoint (CPM) =

$$.85\ [\ (S_f)\ (A_o) + B\ ]$$

Where:

.85 = Correction factor for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable blowdown line activity (μCi/ml).

B = Background (CPM).

Setpoints may be recalculated based on adjusted dilution flow and adjusted blowdown flow.

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified prior to automatic actuation of the blowdown isolation valves.

1.2.2 Overboard Discharge Header Monitor (RM-055 or RM-055A)

This process radiation monitor provides control of the waste monitor tank effluent by monitoring the overboard header prior to its discharge into the circulating water discharge tunnel. The concentration of activity at discharge is controlled below the 10 CFR 20 limit of 1.0E-06 μCi/ml at site discharge for unidentified isotopes by the high alarm setpoint which closes the overboard flow control valve. 7/93

The following calculations for maximum concentration and alarm setpoints are valid when Monitor Tank discharge is the only liquid release pathway. For simultaneous radioactive liquid releases of monitor tank discharge and steam generator blowdown, refer to Section 1.5.1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The maximum allowable concentration in the overboard discharge header is:

7/93

$$A_o = \frac{(1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o}$$

Where:

7/93

1.0E-06 mCi/ml= 10 CFR 20 Limit for unidentified radionuclides at site discharge (10 CFR 20, Appendix B, Note 2).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)

Y_o = Maximum monitor tank discharge flow rate (gpm). (Normal monitor tank maximum flow is 50 gpm. Other flow rates may be used, as required.)

A_o = Maximum allowable activity in discharge header (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The high alarm setpoint (CPM) =

$.85 \quad [\ (S_f\ (A_o) + B]$

Where:

.85	=	Correction factor for instrument meter error.
S_f	=	Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).
A_o	=	Maximum allowable concentration in discharge header (μCi/ml).
B	=	Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to automatic actuation of the overboard flow control valve.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.3 Airborne Effluents

The airborne effluent monitoring instrumentation for controlling and monitoring normal radioactive material releases in accordance with 10 CFR 20, Appendix B, Table 2, Column 1 limits at the unrestricted area boundary (see Figure 1), are summarized as follows:

A. Auxiliary Building - The Auxiliary Building Exhaust Stack receives discharges from the waste gas decay tanks, containment purge, containment vent systems and the auxiliary building ventilation system. Effluents are monitored by RM-062, a noble gas activity monitor. Additionally, noble gas activity monitor, RM-051, provides redundant back-up monitoring capabilities to the RM-062 monitor. Iodine and particulate sampling capabilities are provided by RM-060. Ventilation Isolation Actuation Signal (VIAS) is actuated by exceeding a monitor's alarm setpoint. Actuation of VIAS will isolate releases from containment and waste gas decay tanks. The Auxiliary Building Exhaust fans will remain in operation.

B. Laboratory and Radioactive Waste Process-ing Building (LRWPB) - Noble gas, iodine, and particulate monitoring and sampling is provided by Radiation Monitors RM-043, RM-042, and RM-041, respectively. These radiation monitors/samplers do not serve a control function.

C. Condenser Off-Gas Monitors - Noble gas activity is monitored by RM-057. The condenser off-gas is discharged directly to the environment. Exceeding the high alarm setpoint on RM-057 will activate isolation of main steam to the Auxiliary Steam System.

An airborne radioactive waste flow diagram with the applicable, associated radiation monitoring instrumentation and controls is presented as Figure 4. The airborne waste disposal system is presented in Figure 5. A detailed discussion of the airborne effluent treatment system is presented in Section 2.2.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

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1.4 Airborne Effluent Radiation Monitors

1.4.1 Auxiliary Building Exhaust Stack Noble Gas Activity Monitor (RM-062/RM-051)

Either of these monitors may be used to measure the noble gas activity in the exhaust stack. The noble gas is monitored after passing through a particulate filter. The monitor controls airborne releases so that the 10 CFR 20 limit at the unrestricted area boundary of 5.0E-07 µCi/cc, based upon Xe-133, is not exceeded. The Ventilation Isolation Actuation Signal is initiated when the high alarm setpoint is reached.

The following calculations for maximum release rate and alarm setpoint are valid when Auxiliary Building Exhaust Stack is the only airborne release pathway. For simultaneous airborne releases from Auxiliary Building Exhaust Stack, Condenser Off-gas and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for stack airborne activity is calculated as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)} \times (1.0E{+}06\ cc/m^3) = 1.0E{+}05\ \mu Ci/\sec$$

Where:

5.0E-07 µCi/cc = 10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).

5.0E-06 sec/m³ = Annual average dispersion factor at the unrestricted area boundary.

1.0E+06 cc/m³ = Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ [\ \frac{(1.0E{+}05)\ (S_p)\ (60)}{(F_v)\ (28317)} + B\ ]$$

1.0 <u>EFFLUENT MONITOR SETPOINTS</u> (Continued)

1.4.1 Where:

.85 =	Correction for instrument meter error.
S_F =	Detector sensitivity factor (CPM/ μCi/cc). (Sensitivity based on Xe-133)
60 =	Conversion (seconds to minutes).
28317 =	Conversion factor (ft^3 to cc).
F_v =	Auxiliary Building Exhaust stack flow rate (SCFM). (Default maximum flow rate is 122500 cfm for 3 Auxiliary Building exhaust fans and 2 containment purge fans in operation. Other flow rates may be used, as required.)
B =	Background (CPM).

An alarm setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to actuation of VIAS.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.2 Condenser Air Ejector Monitor (RM-057)

This monitor is located in the turbine building and monitors the condenser off-gas. The purpose of this monitor is to monitor the condenser off-gas discharges so that the 10 CFR 20 limit at the unrestricted area boundary of 5.0E-07 μCi/cc, based upon Xe-133, is not exceeded. 7/93

The following calculations for maximum release rate and alarm setpoint are valid when condenser off-gas is the only airborne release pathway. For simultaneous airborne releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2. 7/93

The maximum allowable release rate for condenser air ejector monitor is as follows: 7/93

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \text{sec}/m^3)} \times (1.0E\text{+}06\ cc/m^3) = 1.0E\text{+}05\ \mu Ci/\text{sec}$$

Where:

5.0E-07 μCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m^3	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m^3	=	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\left[\frac{(1.0E\text{+}05)\ (S_F)\ (60)}{(F_v)\ (28317)} + B\right]$$

1.0 <u>EFFLUENT MONITOR SETPOINTS</u> (Continued)

1.4.2 Where:

.85	=	Correction for instrument meter error.
S_F	=	Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on Xe-133)
60	=	Conversion (seconds to minutes).
28317	=	Conversion factor (ft^3 to cc).
F_v	=	Vent stack flow rate (SCFM). Default maximum flow rate is 4755 scfm (3 vacuum pumps in hogging mode. Other flow rates may be used, as required.)
B	=	Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, allowing time for corrective actions prior to exceeding the alarm setpoint and tripping of the auxiliary steam supply valve, RCV-978.

1.0 EFFLUENT MONITOR SETPOINTS (Continued) 7/93

1.4.3 Laboratory and Radioactive Waste Processing Building Exhaust Stack Noble Gas Activity Monitor (RM-043)

RM-043 is located in the Radwaste Building and samples the LRWPB Exhaust Stack. The monitor alarm setpoint is based on the 10 CFR 20 limit for Xe-133 at the unrestricted area boundary. 7/93

The following calculations for maximum release rate and alarm setpoint are valid when the LRWPB Exhaust Stack is the only airborne release pathway. For simultaneous airborne releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2. 7/93

The maximum allowable release rate for RM-043 is as follows:

7/93

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)} \times (1.0E{+}06\,cc/m^3) = 1.0E{+}05\ \mu Ci/\sec$$

Where:

7/93

5.0E-07 μCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m³	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m³	=	Constant of unit conversion.

1.0 <u>EFFLUENT MONITOR SETPOINTS</u> (Continued) 7/93

1.4.3 The high alarm setpoint (CPM): 7/93

$$Setpoint = .85\left[\frac{(1.0E{+}05)\ (S_F)\ (60)}{(F_v)\ (28317)} + B\right]$$

Where:

- .85 = Correction for instrument meter error.
- S_F = Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on XE-133)
- 60 = Conversion (seconds to minutes).
- 28317 = Conversion factor (ft^3 to cc).
- F_v = LRWPB Exhaust stack flow rate (SCFM). (Default flow rate is 28700 cfm. Other flow rates may be used if required.
- B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified.

This monitor alarms in the Control Room. There are no automatic control functions associated with the actuation of the alarm.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5 Simultaneous Release Pathways

1.5.1 Liquid Release Pathways

The liquid radiation monitors (RM054A and B, RM055, and RM055A) control liquid releases so that 10 CFR 20 limit of 1.0E-06 μCi/ml for unidentified isotopes at site discharge is not exceeded. There are two liquid release pathways that contribute to the concentration at site discharge. These are Steam Generator Blowdown and Monitor Tank Overboard Discharge Header. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.2 so that unrestricted area concentration limits are not exceeded. 7/93

The calculations for the alarm setpoints for the liquid effluent monitors will be adjusted as follows:

$$A_t = K_o A_o + K_1 A_1$$

7/93

$$A_t = \frac{K_o\ (1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o} + \frac{K_1\ (1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_1}$$

Where:

A_s = Sum of individual maximum allowable concentrations for Steam Generator and Monitor Tank prior to dilution for simultaneous liquid releases (μCi/ml)

A_o = Maximum allowable concentration in Steam Generator blowdown Line (μCi/ml)

A_1 = Maximum allowable concentration in Monitor Tank Discharge Line (μCi/ml)

K_o = Proportionality constant for Steam Generator (See Table 1)

K_1 = Proportionality constant for Monitor Tank (See Table 1)

X_o = Total dilution flow in Discharge Tunnel (GPM)

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.1 Where:

Y_o = Steam Generator Blowdown flowrate (GPM)

Y_1 = Monitor Tank Discharge flowrate (GPM)

The High Alarm Setpoint for Steam Generator Blowdown monitors, RM054A and B, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_o\ S_{Fo}\ A_o + B_o]$$

The High Alarm Setpoint for Monitor Tank Discharge monitors, RM055 and 55A, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_1\ S_{F1}\ A_1 + B_1]$$

Where:

S_{Fo} = Detector Sensitivity factor for RM054A/B, CPM/(μCi/ml), based on Cs-137.

S_{F1} = Detector Sensitivity factor for RM055/55A, CPM/(μCi/ml), based on Cs-137.

A_o = Maximum allowable concentration in SG Blowdown line. (μCi/ml)

A_1 = Maximum allowable concentration in MT Discharge line. (μCi/ml)

B_o = RM054 A or B background countrate. (CPM)

B_1 = RM055 or 55A background countrate. (CPM)

Where:

K_o, K_1 = Proportionality constants. See Table 1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Airborne Release Pathway

The noble gas radiation monitors (RM043, RM057, and RM062) control airborne releases so that 10 CFR 20 limits of 5.0E-07 μCi/cc for noble gases at the unrestricted area boundary is not exceeded. There are three pathways that contribute to the concentration at the unrestricted area boundary. These are the Auxiliary Building Exhaust Stack, Condenser Off-gas, and the LRWPB Exhaust Stack. When more than one pathway is utilized f radioactive releases, it is necessary to adjust the ala setpoints given in Section 1.4 to ensure that unrestricted area concentration limits are not exceeded. 7/93

The calculations for the alarm setpoints for the airborne effluent monitors will be adjusted as follows: 7/93

The maximum allowable release rates for simultaneous releases is: 7/93

$$Max.\ Release\ Rate = \sum_{i=0}^{4} K_i R_i = \sum_{i=0}^{4} K_i \frac{Conc_i}{\chi/Q}$$

Where: 7/93

R_0 = RM061/RM050 release rate (μCi/sec)
R_1 = RM062/RM051 release rate (μCi/sec)
R_2 = RM057 release rate (μCi/sec)
R_3 = RM043 release rate (μCi/sec)
R_4 = RM041/42 releaserate (μCi/sec)
$K_0 \rightarrow K_4$ = Proportionality constants. See Table 1.

$Conc_i$ = Radionuclide concentration for the monitor of interest.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 The maximum release rate is then:

$$\left[\frac{K_1(5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_3(5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \right.$$

$$\left. \frac{K_6(5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} \right] 1.0E{+}06\ \frac{cc}{m^3} = Max.\ Release\ Rate$$

The alarm setpoints for the noble gas monitors will then be:

$$RM062/51 = .85 \left[K_0 \frac{(1.0\ E{+}05)\ (S_F)(60)}{F_V\ (28317)} + B \right]$$

$$RM057 = .85 \left[K_1 \frac{(1.0\ E{+}05)\ (S_F)(60)}{(F_V)\ (28317)} + B \right]$$

$$RM043 = .85 \left[K_2 \frac{(1.0\ E{+}05)\ (S_F)(60)}{(F_V)\ (28317)} + B \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Where:

.85	=	Correction factor for instrument meter error.
$K_o \rightarrow K_4$	=	Proportionality contents. See Table 1. 7/93
S_F	=	Detector sensitivity factor. 7/93
F_V	=	Vent stack flowrate. (Condenser off-gas flowrate for RM057, LRWPB Exhaust stack flow rate for RM043, Auxiliary Building Exhaust Stack flow rate for RM62/51).
B	=	Monitor background count rate.
60	=	Constant of unit conversion (60 sec/min).

TABLE 1

Proportionally Constants for Simultaneous Release Pathways

a. Liquid Effluents	$K_0 + K_1 \leq 1$	
$K_0 = .30$	RM054A/B	
$K_1 = .70$	RM055/55A	
b. Gaseous Effluents	$S_i\ K_i \leq 1$	
$K_0 = .10$	RM061/50	
$K_1 = .70$	RM062/51	(when RM051 is in the Auxiliary Building Exhaust Stack Position)
$K_2 = .05$	RM057	
$K_3 = .05$	RM043	
$K_4 = .10$	RM041/42	

7/93

NOTE: The constants are based on prior knowledge and may be updated as necessary to provide for plant operations.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.1 Liquid Radwaste Treatment System

The major equipment or subsystem(s) of the liquid radwaste treatment system are comprised of the waste filters, monitor tanks, and evaporator. This equipment, including associated pumps, valves and piping, is used in different combinations on an as-needed basis to process the liquid effluent to provide compliance with the as low as is reasonably achievable philosophy and the applicable section of 10 CFR Part 20. The liquid radwaste treatment system is described in Section 11.1.2 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405-M-100, M-9 and M-8.

A filtration/ion exchange (FIX) system may be utilized for processing liquid radwaste in the event the waste evaporator is not in service. 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 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 Part II, Section 2.1. 7/93

Every effort will be made to process all liquid waste, except from the hotel waste tanks, through the evaporator or FIX before entering the monitor tanks. If the radioactive liquid waste is discharged without processing and it appears that 1/2 of the annual objective will be exceeded during the calendar quarter, a special report shall be submitted to the Commission pursuant to Part II, Section 2.1.

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.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.2 Airborne Radwaste Treatment 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 7/93
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, 7/93
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, a special report shall be
submitted to the Commission pursuant to Part II, Section 2.2.

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 7/93
effluents are discharged without the HEPA filters, a special
report shall be submitted to the NRC pursuant to Part II,
Section 2.2.

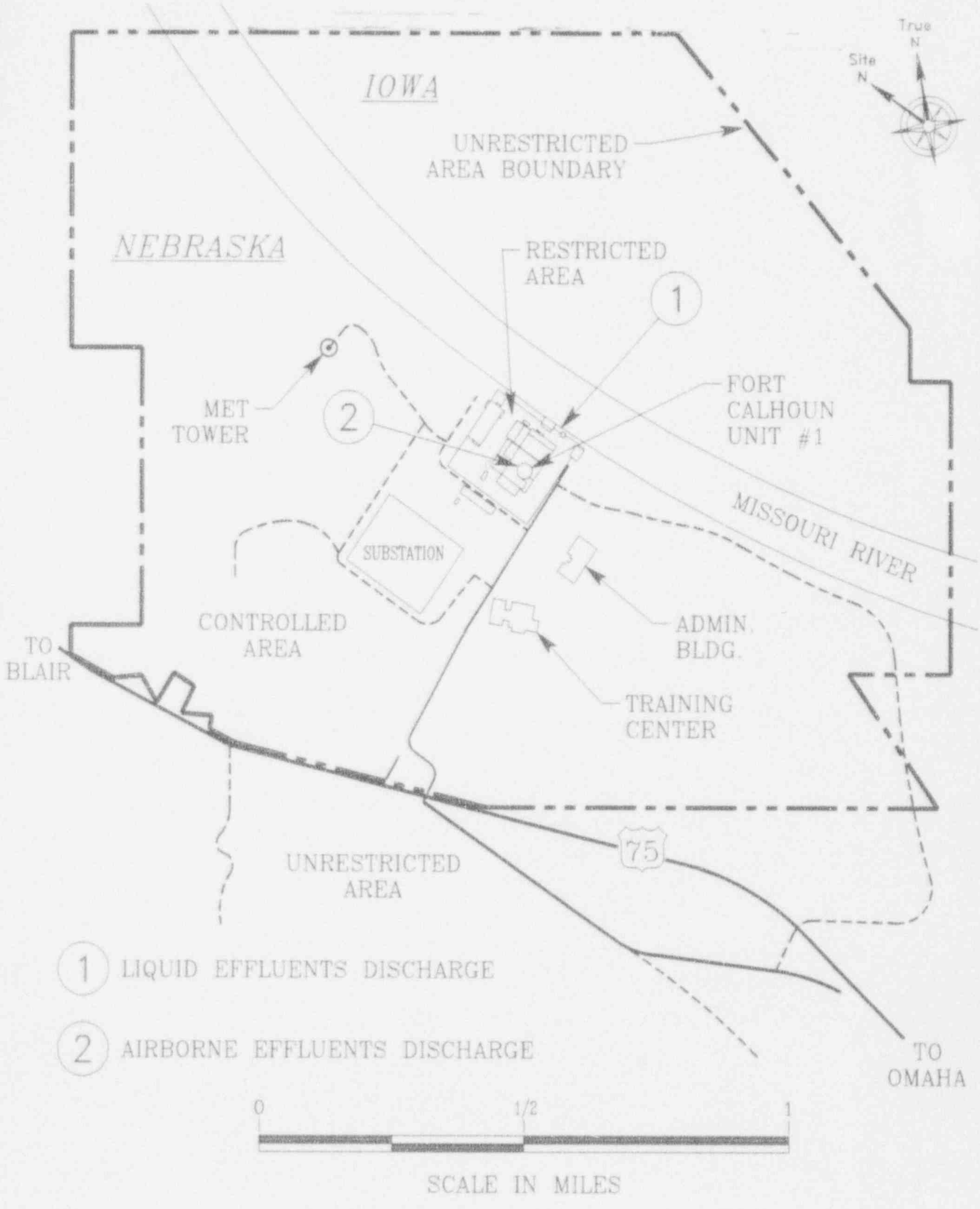
The discharge from the gas decay tanks is routed through
charcoal and HEPA filter unit VA-82. No credit was taken for 7/93
the operation of hydrogen purge filters during the 10 CFR 50,
Appendix I dose design evaluation and doses through the airborne
effluent pathways were well below the design objectives.
The unavailability of hydrogen purge filters will not
be considered a reportable event as per Part II, Section 2.2.

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, a
special report shall be submitted to the Commission pursuant to
Part II, Section 2.2.

7/93

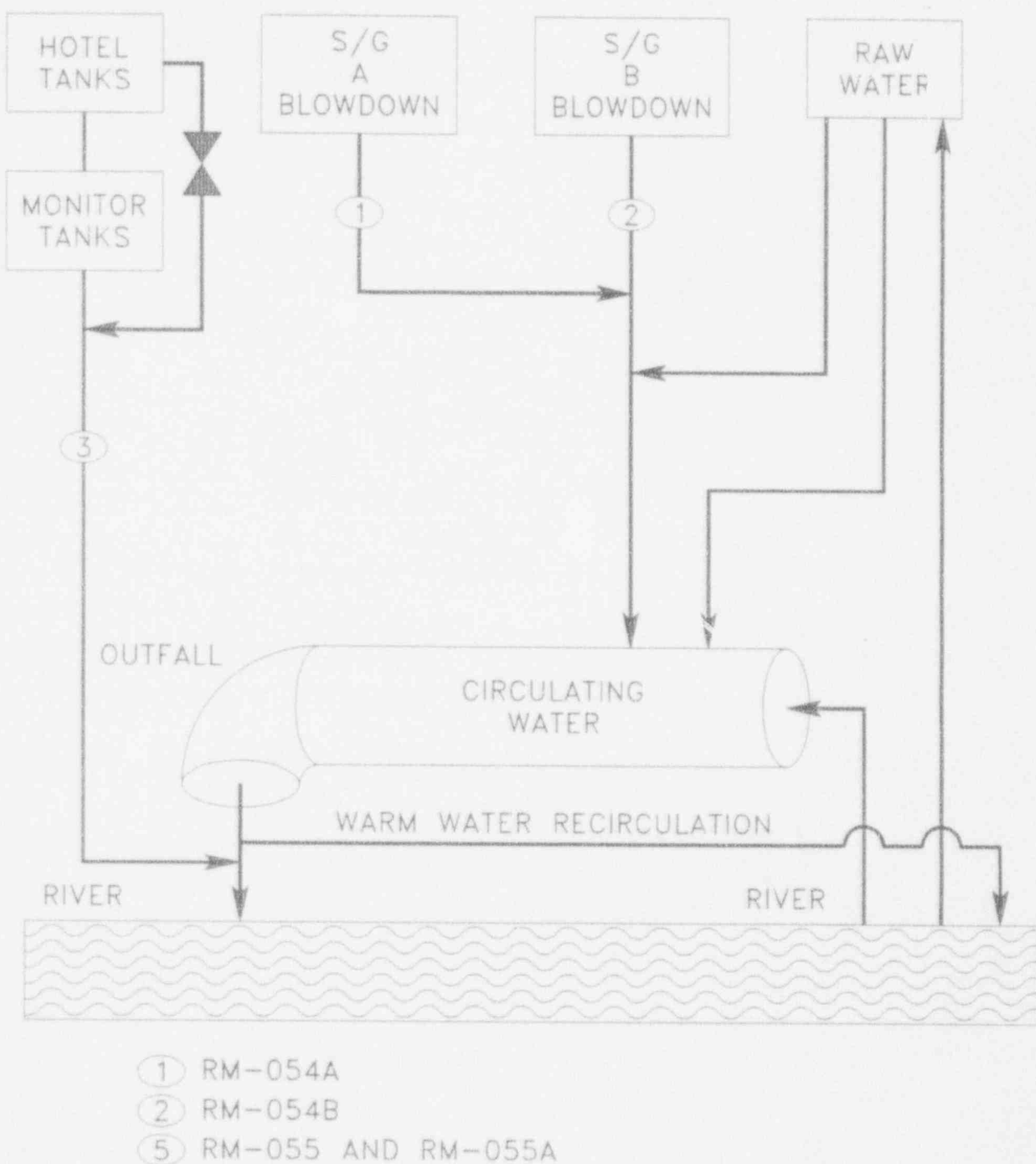
The airborne radwaste treatment system is described in
Section 11.1.3 of the USAR. For effluent release points and
monitor locations refer to P&ID's 11405-M-1 and M-261.

Figure 1



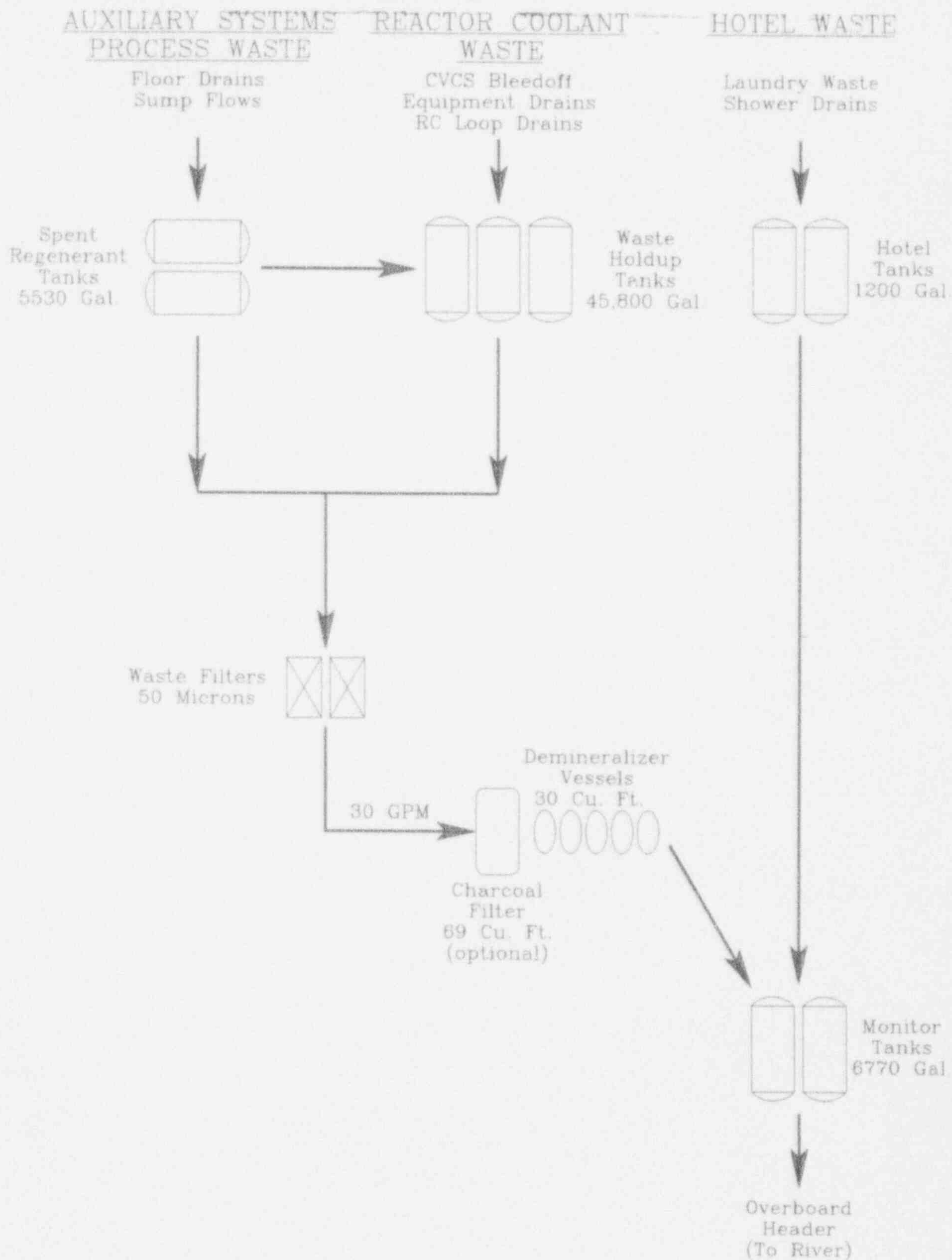
EXCLUSION AND SITE BOUNDARY MAP

Figure 2



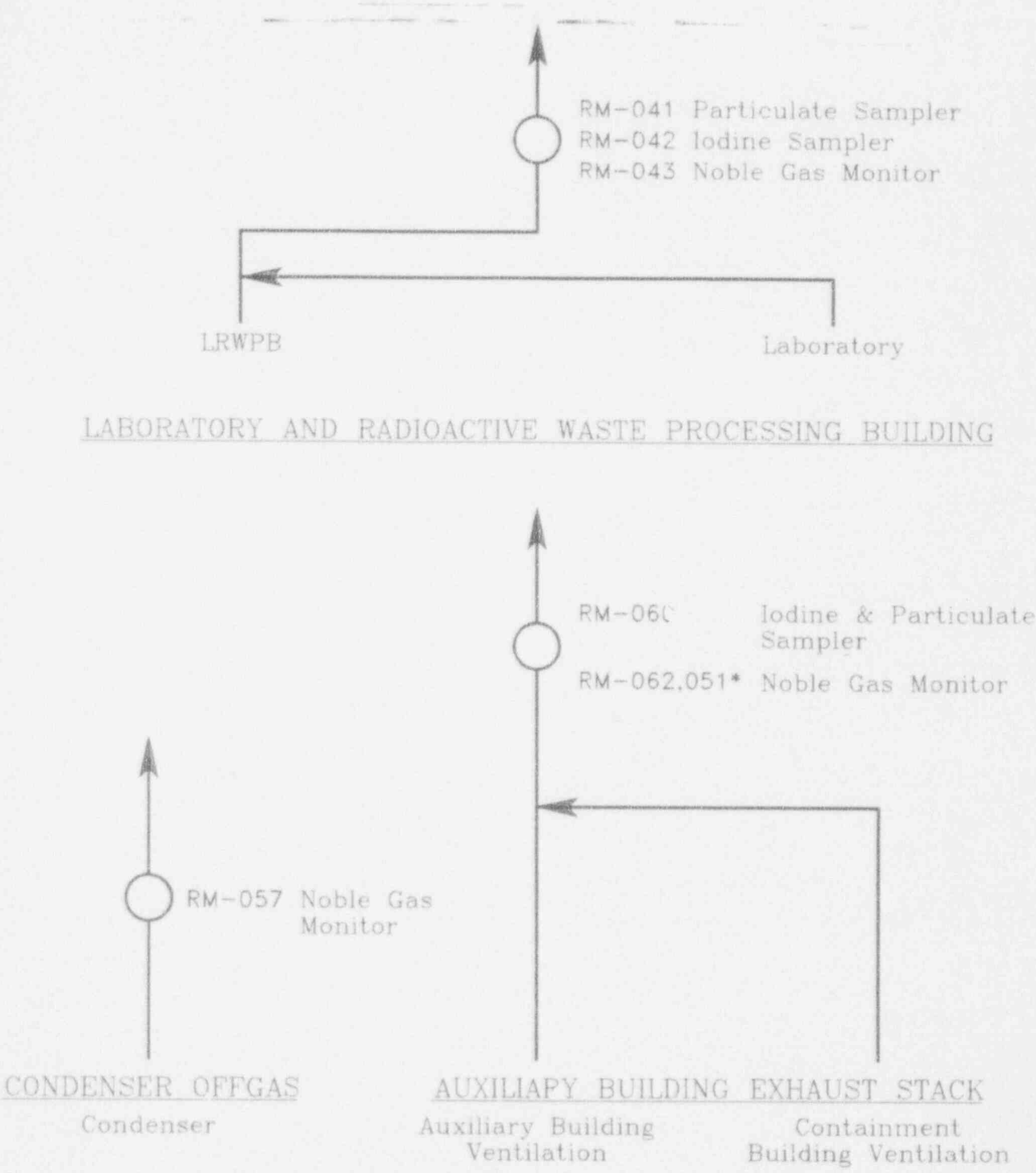
LIQUID RADIOACTIVE DISCHARGE PATHWAYS

Figure 3



LIQUID RADIOACTIVE WASTE DISPOSAL SYSTEM

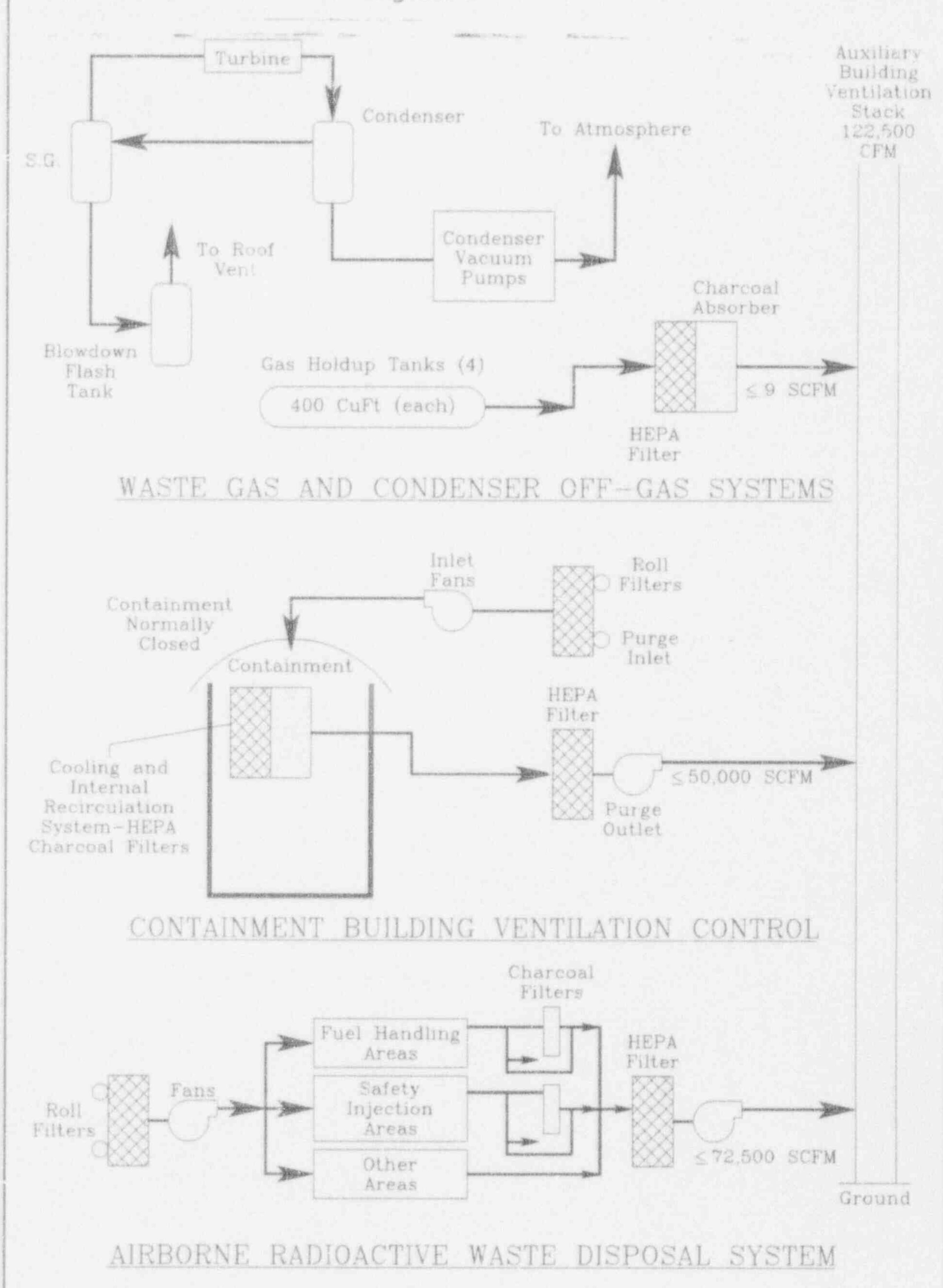
Figure 4



* Can be used for either containment or auxiliary building exhaust stack monitoring.

AIRBORNE EFFLUENT DISCHARGE PATHWAYS

Figure 5


Turbine
Condenser
S.G.
To Atmosphere
Auxiliary Building Ventilation Stack 122,500 CFM
To Roof Vent
Condenser Vacuum Pumps
Charcoal Absorber
Blowdown Flash Tank
Gas Holdup Tanks (4)
400 CuFt (each)
≤ 9 SCFM
HEPA Filter
WASTE GAS AND CONDENSER OFF-GAS SYSTEMS
Inlet Fans
Roll Filters
Containment Normally Closed
Purge Inlet
Containment
HEPA Filter
Cooling and Internal Recirculation System-HEPA Charcoal Filters
≤ 50,000 SCFM
Purge Outlet
CONTAINMENT BUILDING VENTILATION CONTROL
Charcoal Filters
Fuel Handling Areas
HEPA Filter
Roll Filters
Fans
Safety Injection Areas
Other Areas
≤ 72,500 SCFM
Ground
AIRBORNE RADIOACTIVE WASTE DISPOSAL SYSTEM

PART IV

RADIOLOGICAL EFFLUENT MONITORING CALCULATIONS

1.0 EFFLUENT CONCENTRATIONS

1.1 Liquid Effluent Concentrations

The concentration of radioactive material in liquid effluents (after dilution in the Circulating Water System) will be limited to the concentrations as specified in 10 CFR 20, Appendix B, Table 2, Column 2. For batch releases (Monitor and Hotel Waste Tanks and Steam Generators) and for continuous releases (Steam Generator Blowdown), the analyses will be performed in accordance with Part II, Table 1, and the concentration of each radionuclide at site discharge will be calculated, based on the following equation: 7/93 7/93

Radionuclide concentration at site discharge:

$$A_i = \frac{a_i f}{F + f}$$

7/93

$$\text{and} \sum_{i=1}^{n} A_i / wec_i \leq 1$$

Where:

7/93

A_i = concentration at site discharge for radionuclide, i, in μCi/ml.

a_i = concentration of radionuclide, i, in the undiluted effluent in μCi/ml.

f = undiluted effluent flowrate, in gpm.

F = total diluted effluent flowrate in gpm.

7/93

wec_i = water effluent concentration limit for radionuclide, i, per 10 CFR 20, Appendix B, Table 2, Column 2.

1.0 EFFLUENT CONCENTRATIONS

NOTE: In addition to the above defined method, Notes 1 through 4 of 10 CFR Part 20, Appendix B, will also be applicable.

7/93

1.2 Airborne Effluent Concentrations

7/93

The concentration at the unrestricted area boundary, due to airborne effluent releases, will be limited to less than Appendix B, Table 2, Column 1, values. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event an airborne effluent release from the station result in an alarm setpoint being exceeded, an evaluation of the unrestricted area boundary concentration resulting from the release will be performed: 7/93

7/93

To determine the concentration and air effluent concentration (aec) fraction summation at the unrestricted area boundary, the following equations will be used:

$$A_i = K_o\, Q_i\, (\chi/Q)$$

7/93

$$\text{and } \sum_{i=1}^{n} A_i/aec_i \leq 1$$

Where:

7/93

A_i = Concentration of radionuclide, i, at the unrestricted area boundary

K_o = Constant of unit conversion. ($1E\text{-}6 m^3$ /cc)

7/93

aec_i = Air effluent concentration limit (10 CFR 20, Appendix B, Table 2, Column 1 value for radionuclide, i)

7/93

Q_i = The release rate of radionuclides i, in airborne effluents from all vent releases (in μCi/sec.)

(χ/Q) = 5E-6 sec/m^3. For all vent releases. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary

1.0 EFFLUENT CONCENTRATIONS

As appropriate, simultaneous releases from the Auxiliary Building Ventilation Stack, Laboratory and Radwaste Building Stack and condenser off gas will be considered in evaluating compliance with the release rate limits of 10 CFR 20. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. Historical annual average dispersion parameters, as presented in Table 3, may be used for evaluating the airborne effluent dose rate. 7/93

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding those more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding 10 CFR 20 limits. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based upon the above criteria, no further analyses are required for demonstrating compliance with 10 CFR 20.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS

2.1 Liquid Effluent Dose Calculations

Three pathways for human exposure to liquid releases from FCS to the Missouri River exists: 1) fish, 2) drinking water, and 3) Shoreline deposition. Fish are considered to be taken from the vicinity of the plant discharge. The drinking water for Omaha is located 19 miles downstream from FCS. The dilution factors for these pathways are derived from the Revised Environmental Report for FCS, (1974), (page 4-29 and 4-31). This report states that during Low-Low river conditions, the concentration at Omaha's water intake will be ≤14% of the concentration at discharge from FCS and will average 3%. This equates to a dilution factor of 7.14, which is used to calculate the maximum dose to an individual from liquid pathways and a dilution factor of 33.33, for calculating the average dose. All pathways combine to give the dose to an individual in unrestricted areas.

10 CFR 50, App. I restricts the dose to individuals in the unrestricted areas from radioactive materials in liquid effluents from the Fort Calhoun Station to the following limits:

- during any calendar quarter
  ≤1.5 mrem to total body
  ≤5.0 mrem to any organ and

- during any calendar year
  ≤ 3.0 mrem to total body
  ≤ 10.0 mrem to any organ

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 The following calculational methods shall be used for determining the dose or dose commitment from liquid effluents.

Doses from Liquid Effluent Pathways

A. POTABLE WATER

$$R_{apj} = 1100 \frac{U_{ap}M_p}{F} \sum_{i=1}^{n} Q_i D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in ℓ/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of withdrawal of drinking water, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/ sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

D_{aipj} = is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of water, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 B. AQUATIC FOODS

$$R_{apj} = 1100 \frac{U_{ap}M_p}{F} \sum_{i=1}^{n} Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in kg/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of harvest of aquatic food, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

B_{ip} = is the equilibrium bioaccumulation factor for radionuclide, i, in pathway, p, expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/liter), in (pCi/kg)/(pCi/liter). Table 2

D_{aipj} = is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of food, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 C. SHORELINE DEPOSITS

$$R_{apj} = 110,000 \frac{U_{ap} M_p W}{F} \sum_{i=1}^{n} Q_i T_{ip} D_{aipj} [\exp(-\lambda_i t_p)][1-\exp(-\lambda_i t_b)]$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the exposure time for an individual of age group, a, associated with pathway, p, in hr/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of exposure, dimensionless. Table 3

W = is the shore-width factor, dimensionless. Table 16

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

T_{ip} = is the radioactive half life of radionuclide, i, in days.

D_{aipj} = is the dose factor specific radionuclide, i, which can be used to calculate the radiation dose from exposure to a given concentration of a radionu-clide in sediment, expressed as a ratio of the dose rate (in mrem/hr) and the areal radionuclide concentration (in pCi/m^2). Table 7

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure, in hours. Table 16

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours. Table 16

110,000 = Constant [(100 * pCi * yr * ft^3)/(Ci * sec * L)]

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Airborne Effluent Dose Calculations 7/93

2.2.1 Noble Gas

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from noble gases in airborne effluents from the Fort Calhoun Station to the following limits: 7/93

- During any calendar quarter
  $\leq$5 mrad-gamma air dose
  $\leq$10 mrad-beta air dose

  and

- During any calendar year
  $\leq$10 mrad-gamma air dose
  $\leq$20 mrad-beta air dose

The following general equations shall be used to calculate the gamma-air and beta-air doses:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

7/93

Doses from Noble Gases

2.2 A. Annual Gamma/Beta Air Dose from All Other Noble Gas Releases

$$D^{\gamma}(r,\Theta) \ or \ D^{\beta}(r,\Theta) = 3.17 \times 10^{4} \sum_{i=1}^{n} Q_i [\chi/Q]^{D}(r,\Theta)\,(DF_i^{\gamma} \ or \ DF_i^{\beta})$$

Where:

$DF_i^{\gamma}, DF_i^{\beta}$ = are the gamma and beta air dose factors for a uniform semi-infinite cloud of radionuclide, i, in mrad-m^3/pCi-yr. Table 1

$D^{\gamma}(r,\Theta)$ or $D^{\beta}(r,\Theta)$ = are the annual gamma and beta air doses at distance r, in the sector at angle Θ, from the discharge point, in mrad/yr.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

$[\chi/Q]^{D}(r,\Theta)$ = is the annual average gaseous dispersion factor at distance r, in the sector at angle θ, in sec/m^3. Table 3

3.17×10^{4} = is the number of pci per ci divided by the number of seconds per year.

B. Annual Total Body Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = S_F \sum_{i=1}^{n} \chi_i(r,\Theta)\, DFB_i$$

Where:

DFB_i = is the total body dose factor for a semi-infinite cloud of the radionuclide, i, which includes the attenuation of 5 g/cm^2 of tissue, in mrem-m^3/pCi-yr. Table 1

$D_{\infty}^{T}(r,\Theta)$ = is the annual total body dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

$\chi_i(r,\Theta)$ = is the annual average ground-level concentration of radionuclide, i, at distance r, in the sector at angle Θ, in pCi/m^3. Table 3

S_F = Shielding Factor. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C. Annual Skin Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = 1.11\ S_F \sum_{i=1}^{n} \chi_i(r,\Theta)\, DF_i^{\gamma} + \sum_{i=1}^{n} \chi_i(r,\Theta)\, DFS_i$$

Where:

$D_s^T(r,\Theta)$ = is the annual skin dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

DFS_i = is the beta skin dose factor for a semiinfinite cloud of radionuclide, i, in mrem-m^3/pCi-yr. Table 1

1.11 = is the average ratio of tissue to air energy absorption coefficients.

2.2.2 Radioiodine, Tritium, and Particulates

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from radioactive materials in gaseous airborne from the Fort Calhoun Station to: 7/93

- During any calendar quarter
  ≤7.5 mrem to any organ

  and

- During any calendar year
  ≤15 mrem to any organ

The dose to an individual from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in airborne effluents released to unrestricted areas (See Part III, Figure 1) should be determined by the following expressions: 7/93

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 **NOTE**: In all cases, for releases of tritium, use the dispersion parameter for inhalation (χ/Q).

A. Annual Organ Dose from External Irradiation from Radioactivity Deposited on the Ground Plane

A.1 The ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined by:

$$C_i^G(r,\Theta) = \frac{[1.0x10^{12}]\ [\delta_i(r,\Theta)Q_i]}{\lambda_i}\ [1-\exp(^-\lambda_i t_b)]$$

Where:

C_i^G = is the ground plane concentration of the radionuclide, i, at distance r, in the sector at angle θ, from the release point, in pCi/m^2.

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

t_b = is the time period over which the accumulation is evaluated, which is assumed to be 15 years (mid-point of plant operating life). Table 16

$\delta_i(r,\theta)$ = is the annual average relative deposition of radionuclide, i, at distance r, in the sector at angle θ, considering depletion of the plume by deposition during transport, in m^{-2}. Table 3

λ_i = is the radiological decay constant for radionuclide, i, in yr^{-1}.

$1.0x10^{12}$ = is the number of pCi per Ci

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 A.2 The annual organ dose is then calculated using the following equation:

$$D_j^G(r,\Theta) = 8760\ S_F \sum_{i=1}^{n} C_i^G(r,\Theta)\, DFG_{ij}$$

Where:

$C_i^G(r,\theta)$ = is the ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2.

DFG_{ij} = is the open field ground plane dose conversion factor for organ, j, from radionuclide, i, in $mrem\text{-}m^2/pCi\text{-}hr$. Table 7

$D_j^G(r,\theta)$ = is the annual dose to the organ, j, at distance r, in the sector at angle θ, in mrem/yr.

S_F = is the shielding factor that accounts for the dose reduction due to shielding provided by residential structures during occupancy, dimensionless. Table 16

8760 = is the number of hours in a year

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 B. Annual Dose from Inhalation of Radionuclides in Air

B.1 The annual average airborne concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined as:

$$\chi_i(r,\theta) = 3.17 \times 10^4 Q_i [\chi/Q]^D(r,\theta)$$

Where:

Q_i	=	is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.
$\chi_i(r,\theta)$	=	is the annual average ground-level concentration of radionuclide, i, in air at distance r, in the sector at angle θ, in pCi/m^3.
$[\chi/Q]^D(r,\theta)$	=	is the annual average atmosphere dispersion factor, in sec/m^3 (see R.G. 1.111). This includes depletion (for radioiodines and particulates) and radiological decay of the plume. Table 3
3.17×10^4	=	is the number of pCi/Ci divided by the number of sec/yr.

B.2 The annual dose associated with inhalation of all radionuclides to organ, j, of an individual in age group, a, is then:

$$D_{ja}^A(r,\Theta) = R_a \sum_{i=1}^{n} \chi_i\,(r,\theta)\; DFA_{ija}$$

Where:

$D_{ja}^A(r,\theta)$	=	is the annual dose to organ, j, of an individual in the age group, a, at distance r, in the sector at angle θ, due to inhalation, in mrem/yr.
R_a	=	is the annual air intake for individuals in the age group, a, in m^3/yr. Table 5
DFA_{ija}	=	is the inhalation dose factor for radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 8-11

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C. Concentrations of Radionuclides in Foods and Vegetation from Atmospheric Releases

C.1 Parameters for Calculating Concentrations in Forage, Produce, and Leafy Vegetables, excluding Carbon-14 and Tritium

$$C_i^V(r,\theta) = d_i(r,\theta)\left[\frac{r[1-\exp(-\lambda_{Ei}t_e)]}{Y_v\lambda_{Ei}} + \frac{B_{iv}[1-\exp(-\lambda_i t_b)]}{P\lambda_i}\right]\exp(-\lambda_i t_h)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in and on vegetation at distance r, in the sector at angle θ, in pCi/kg.

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2 hr.

The deposition rate from the plume is defined by:
(Reg. Guide 1.109, Rev. 1, Page 1.109-26, Equa. C-6)

$$d_i(r,\theta) = 1.1 \times 10^8 \delta_i(r,\theta) Q_i$$

Where:

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i.

$\delta_i(r,\theta)$ = is the relative deposition of radionuclide, i, considering depletion and decay, in m^{-2} (see Regulatory Guide 1.111). Table 3

$1.1\text{x}10^8$ = is the number of pCi/Ci (10^{12}) divided by the number of hours per year (8760).

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 For radioiodines, the model considers only the elemental fraction of the effluent:

$$d_i\ (r_1\ \theta) = 5.5\ X\ 10^7\ \delta_i\ (r_1\ \theta)\ Q_i$$

Where:

$d_i\ (r_1\ \theta)$ = The deposition rate of radioiodine, i.

5.5×10^7 = The number of pCi/Ci (10^{12}) divided by the number of hours per year (8760), then multiplied by the amount of radioiodine emissions considered to be nonelemental (0.5).

$\delta_i\ (r,\ \theta)$ = The relative deposition of radioiodine, i, considering depletion and decay, in m^{-2}. Table 3.

Q_i = The total (elemental and nonelemental) radioiodine, i, emission rate.

r = is the fraction of deposited activity retained on crops, dimensionless. Table 16

λ_{Ei} = is the effective removal rate constant for radionuclide, i, from crops, in hr^{-1}.

$\lambda_{Ei} = \lambda_i + \lambda_w$
$\lambda_w = 0.0021/hr$. Table 16

t_e = is the time period that crops are exposed to contamination during the growing season, in hours. Table 16

Y_v = is the agricultural productivity (yield) in kg (wet weight)/m^2. Table 16

B_{iv} = is the concentration factor for uptake of radionuclide, i, from soil by edible parts of crops, in pCi/ kg (wet weight) per pCi/kg dry soil. Table 4

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours (mid-point of plant life). Table 16

P = is the effective "surface density" for soil, in kg (dry soil)/m^2. Table 16

t_h = is the holdup time that represents the time interval between harvest and consumption of the food, in hours. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Different values for the parameters t_e, Y_v, and t_h, may be used to allow the use of the Equation for different purposes: estimating concentrations in produce consumed by man; in leafy vegetables consumed by man; in forage consumed directly as pasture grass by dairy cows, beef cattle, or goats; and in forage consumed as stored feed by dairy cows, beef cattle or goats. See Table 16

C.2 Parameters for Calculating Radionuclide Concentration in Milk, excluding Carbon-14 and Tritium

C.2.1 Parameters for Calculating the Concentration of Radionuclide, i, in the Animal's Feed (Milk Cow, Beef Cow, and Goat)

$$C_i^V(r,\Theta) = f_p f_s C_i^P(r,\Theta) + (1 - f_p) C_i^S(r,\Theta) + f_p(1 - f_s) C_i^S(r,\Theta)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

$C_i^P(r,\theta)$ = is the concentration of radionuclide, i, on pasture grass (calculated using Equation C.2.1 with t_h=0), in pCi/kg.

$C_i^S(r,\theta)$ = is the concentration of radionuclide, i, in stored feeds (calculated using Equation C.2.1 with t_h=90 days), in pCi/kg.

f_p = is the fraction of the year that animals graze on pasture. Table 16

f_s = is the fraction of daily feed that is pasture grass while the animal grazes on pasture. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.2.2 Parameters for Calculating Radionuclide Concentration in Cow and Goat Milk

$$C_i^M(r,\Theta) = F_m C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^M(r,\theta)$ = is the concentration of radionuclide, i, in milk, in pCi/liter.

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

F_m = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each liter of milk, in days/liter. Table 4

Q_F = is the amount of feed consumed by the animal per day, in kg/day. Table 6

t_f = is the average transport time of the radionuclide, i, from the feed to the milk and to the receptor (a value of 2 days is assumed). Table 16

λ_i = is the radiological decay constant of radionuclide, i, in days^{-1}.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.3 Parameters for Calculating Radionuclide Concentration in Cow Meat, excluding Carbon-14 and Tritium

$$C_i^F(r,\Theta) = F_f C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^F(r,\theta)$ = is the concentration of radionuclide, i, in meat, in pCi/liter.

F_f = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each kilogram of flesh, in days/kilogram. Table 4

t_s = is the average time from slaughter to consumption. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.4 Parameters for Calculating the Carbon-14 Concentrations in Vegetation

Carbon-14 is assumed to be released in oxide form (CO or CO_2). The concentration of Carbon-14 in vegetation is calculated by assuming that its ratio to the natural carbon in vegetation is the same as the ratio of Carbon-14 to natural carbon in the atmosphere surrounding the vegetation. Also, in the case of intermittent releases, such as from gaseous waste decay tanks, the parameter p is employed to account for the fractional equilibrium ratio achieved. The parameter, p, is defined as the ratio of the total annual release time (for Carbon-14 atmospheric releases) to the total annual time during which photosynthesis occurs (taken to be 4400 hrs), under the condition that the value of p should never exceed unity. For continuous Carbon-14 releases, p is taken to be unity. These considerations yield the following relationship:

$$C_{14}^{V}(r,\Theta) = 3.17 \times 10^{7} p Q_{14} [\chi/Q](r,\Theta)\ 0.11/0.16$$

$$= 2.2 \times 10^{7} p Q_{14} [\chi/Q](r,\Theta)$$

Where:

$C_{14}^{V}(r,\theta)$ = is the concentration of Carbon-14 in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

Q_{14} = is the annual release rate of Carbon 14, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

p = is the fractional equilibrium ratio, dimensionless. P=1 (Reg. Guide 1.109, Rev. 1, pg. 26).

0.11 = is the fraction of total plant mass that is natural carbon, dimensionless.

0.16 = is equal to the concentration of natural carbon in the atmosphere, in g/m^3.

3.17×10^7 = is equal to $(1.0 \times 10^{12}$pci/ci$)(1.0 \times 10^3$ g/kg$)$ $(3.15 \times 10^7$ sec/yr$)$.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.5 Parameters for Calculating Tritium Concentrations in Vegetation

The concentration of tritium in vegetation is calculated from its concentration in the air surrounding the vegetation.

$$C_T^V(r,\Theta) = 3.17 \times 10^7 Q_T[\chi/Q](r,\Theta)\ (0.75)(0.5/H)$$

$$= 1.2 \times 10^7 Q_T[\chi/Q](r,\Theta)/H$$

Where:

$C_T^V(r,\theta)$ = is the concentration of Tritium in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

H = is the absolute humidity of the atmosphere at distance r, in the sector at angle θ, in g/m^3. H=8 gm/kg.

Q_T = is the annual release rate of Tritium, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

0.5 = is the ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless.

0.75 = is the fraction of total plant mass that is water, dimensionless.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D. Annual Dose from Atmospherically Released Radionuclides in Foods

D.1 The total annual dose to organ, j, of an individual in age group, a, resulting from ingestion of all radionuclides in produce, milk, and leafy vegetables is given by:

$$D_{ja}^{D}(r,\Theta) = \sum_{i} DFI_{ija}\left[U_{a}^{V} f_{g} C_{i}^{V}(r,\Theta) + U_{a}^{m} C_{i}^{m}(r,\Theta) + U_{a}^{F} C_{i}^{F}(r,\Theta) + U_{a}^{L} f_{\ell} C_{i}^{L}(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15.

$U_a^v, U_a^m,$ = are the ingestion rates of produce (non-leafy vegetables, fruits, and grains); milk, meat, and leafy U_a^f, U_a^L vegetables, respectively for individuals in age group, a. Table 5.

Values of F_g and f_ℓ are 0.76 and 1.0, respectively.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.1 Calculating the Ingested Dose from Leafy and Non-Leafy (produce) Vegetation for Radionuclide, i, to Each Organ, j, and Age Group, a

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_{a}^{L} f_{\ell} C_{i}^{L}(r,\Theta) + U_{a}^{V} f_{g} C_{i}^{V}(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in vegetation, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pci. Tables 12-15

U_{a}^{L}, U_{a}^{V} = are the ingestion rates of leafy vegetables and produce (non-leafy vegetables, fruits, and grains), for individuals in age group, a, in kg/yr. Table 5

C_{i}^{L} = is the concentration of radionuclide, i, in and on leafy vegetation, in pCi/kg.

C_{i}^{V} = is the concentration of radionuclide, i, in and on produce, in pCi/kg.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.2 Calculation Determining the Ingested Dose from Cow Milk for Radionuclide, i, Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_{a}^{M}C_{i}^{M}(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in cow milk, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_{a}^{M} = is the ingestion rate of cow milk for individuals in age group, a, in ℓ/yr. Table 5

C_{i}^{M} = is the radionuclide concentration in cow milk, in pCi/kg. Equation C.2.2

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.3 Calculation Determining the Ingested Dose from Meat for Radionuclide, i, to Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_a^F C_i^F(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in meat, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_a^f = is the ingestion rate of meat for individuals in age group, a in kg/yr. Table 5

C_i^f = is the radionuclide, i, concentration in meat, in pCi/ kg.

TABLE 1

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

Nuclide	β-air* (DF^{b}_{i})	β-Skin** (DFS_i)	γ-Air* (DF^{c}_{i})	γ-Body** (DFB_i)
KR-83m	2.88E-04	--	1.93E-05	7.56E-08
KR-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03
KR-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05
KR-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03
KR-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02
KR-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02
KR-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03

* $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

** $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

*** 2.88E-04 = 2.88×10^{-4}

TABLE 2

BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)

FRESHWATER

Element	Fish	Invertebrate
H	9.0E-01	9.0E-01
C	4.6E+03	9.1E+03
NA	1.0E+02	2.0E+02
P	1.0E+05	2.0E+04
CR	2.0E+02	2.0E+03
MN	4.0E+02	9.0E+04
FE	1.0E+02	3.2E+03
CO	5.0E+01	2.0E+02
NI	1.0E+02	1.0E+02
CU	5.0E+01	4.0E+02
ZN	2.0E+03	1.0E+04
BR	4.2E+02	3.3E+02
RB	2.0E+03	1.0E+03
SR	3.0E+01	1.0E+02
Y	2.5E+01	1.0E+03
ZR	3.3E+00	6.7E+00
NB	3.0E+04	1.0E+02
MO	1.0E+01	1.0E+01
TC	1.5E+01	5.0E+00
RU	1.0E+01	3.0E+02
RH	1.0E+01	3.0E+02
TE	4.0E+02	6.1E+03
I	1.5E+01	5.0E+00
CS	2.0E+03	1.0E+03
BA	4.0E+00	2.0E+02
LA	2.5E+01	1.0E+03
CE	1.0E+00	1.0E+03
PR	2.5E+01	1.0E+03
ND	2.5E+01	1.0E+03
W	1.2E+03	1.0E+01
NP	1.0E+01	4.0E+02

TABLE 3

CONTROLLING LOCATIONS, PATHWAYS AND ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS

Location	Pathway(s)	Controlling Age Group	Atmospheric Dispersion χ/Q ($\chi/Q(r,\Theta)$) (sec/m^3)	Atmospheric Dispersion D/Q ($\delta(r,\Theta)$) (1/m^3)	
Unrestricted Area Boundary	Noble Gases Direct Exposure	N/A	5.0E-06	N/A	7/93
Unrestricted Area Boundary	Inhalation	Child	5.0E-06	N/A	7/93
Unrestricted Area Boundary	Gamma-Air Beta Air	N/A	5.0E-06	N/A	7/93
Miller Farm* 0.8 miles SSW	milk, ground plane, meat, inhalation, and vegetation	Child	5.0E-06	1.6E-08	
Site Discharge	Liquid	N/A	Mixing Ratio, M_p	7.14	7/93
M.U.D. Intake	Liquid	N/A	Mixing Ratio, M_p	30.8	

* Location is subject to change depending on the results of the Land Use survey performed annually in accordance with Part II, Section 5.4

TABLE 4

STABLE ELEMENT TRANSFER DATA

Element	B_{iv} Veg/Soil	F_m (Cow) Milk (d/ℓ)	F_f Meat (d/kg)
H	4.8E+00	1.0E-02	1.2E-02
C	5.5E+00	1.2E-02	3.1E-02
Na	5.2E-02	4.0E-02	3.0E-02
P	1.1E+00	2.5E-02	4.6E-02
Cr	2.5E-04	2.2E-03	2.4E-03
Mn	2.9E-02	2.5E-04	8.0E-04
Fe	6.6E-04	1.2E-03	4.0E-02
Co	9.4E-03	1.0E-03	1.3E-02
Ni	1.9E-02	6.7E-03	5.3E-02
Cu	1.2E-01	1.4E-02	8.0E-03
Zn	4.0E-01	3.9E-02	3.0E-02
Rb	1.3E-01	3.0E-02	3.1E-02
Sr	1.7E-02	8.0E-04	6.0E-04
Y	2.6E-03	1.0E-05	4.6E-03
Zr	1.7E-04	5.0E-06	3.4E-02
Nb	9.4E-03	2.5E-03	2.8E-01
Mo	1.2E-01	7.5E-03	8.0E-03
Tc	2.5E-01	2.5E-02	4.0E-01
Ru	5.0E-02	1.0E-06	4.0E-01
Rh	1.3E+01	1.0E-02	1.5E-03
Ag	1.5E-01	5.0E-02	1.7E-02
Te	1.3E+00	1.0E-03	7.7E-02
I	2.0E-02	6.0E-03	2.9E-03
Cs	1.0E-02	1.2E-02	4.0E-03
Ba	5.0E-03	4.0E-04	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04	1.2E-03
Pr	2.5E-03	5.0E-06	4.7E-03
Nd	2.4E-03	5.0E-06	3.3E-03
W	1.8E-02	5.0E-04	1.3E-03
Np	2.5E-03	5.0E-06	2.0E-04

TABLE 5

RECOMMENDED VALUES FOR U_{AP} TO BE USED FOR THE MAXIMUM EXPOSED INDIVIDUAL IN LIEU OF SITE SPECIFIC DATA

Pathway	Infant	Child	Teen	Adult
Fruits, vegetables, & grain (kg/yr)	-	520	630	520
Leafy vegetables (kg/yr)	-	26	42	64
Milk (ℓ/yr)	330	330	400	310
Meat & poultry (kg/yr)	-	41	65	110
Fish (fresh or salt) (kg/yr)	-	6.9	16	21
Other Seafood (kg/yr)	-	1.7	3.8	5
Drinking water (ℓ/yr)	330	510	510	730
Shoreline recreation (hr/yr)	-	14	67	12
Inhalation (m^3/yr)	1400	3700	8000	8000

TABLE 6

ANIMAL CONSUMPTION RATES

Animal	Q_F Feed or Forage [Kg/day (wet weigh)]	Q_{AW} Water (ℓ/day)
Milk Cow	50	60
Beef Cattle	50	50
Goats	6	8

TABLE 7

Page 1 of 2

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Nr-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08

TABLE 7
(Continued)

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Page 1 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	-	-	-	1.08E-05
CR 51	-	-	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-[illegible]7
MN 54	-	4.95E-06	7.87E-07	-	1.23E-06	1.75E-04	9.67E-06
MN 56	-	1.55E-10	2.29E-11	-	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	-	-	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	-	-	1.27E-04	2.35E-05
CO 58	-	1.98E-07	2.59E-07	-	-	1.16E-04	1.33E-05
CO 60	-	1.44E-06	1.85E-06	-	-	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	-	-	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	-	-	7.00E-07	1.54E-06
CU 64	-	1.83E-10	7.69E-11	-	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	5.82E-06	-	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	-	5.27E-12	1.15E-07	2.04E-09
BR 83	-	-	3.01E-08	-	-	-	2.90E-08
BR 84	-	-	3.91E-08	-	-	-	2.05E-13
BR 85	-	-	1.60E-09	-	-	-	LT E-24
RB 86	-	1.69E-05	7.37E-06	-	-	-	2.08E-06
RB 88	-	4.84E-08	2.41E-08	-	-	-	4.18E-19
RB 89	-	3.20E-08	2.12E-08	-	-	-	1.16E-21
SR 89	3.80E-05	-	1.09E-06	-	-	1.75E-04	4.37E-05
SR 90	1.24E-02	-	7.62E-04	-	-	1.20E-03	9.02E-05
SR 91	7.74E-09	-	3.13E-10	-	-	4.56E-06	2.39E-05
SR 92	8.43E-10	-	3.64E-11	-	-	2.06E-06	5.38E-06
Y 90	2.61E-07	-	7.01E-09	-	-	2.12E-05	6.32E-05
Y 91M	3.26E-11	-	1.27E-12	-	-	2.40E-07	1.66E-10
Y 91	5.78E-05	-	1.55E-06	-	-	2.13E-04	4.81E-05
Y 92	1.29E-09	-	3.77E-11	-	-	1.96E-06	9.19E-06
Y 93	1.18E-08	-	3.26E-10	-	-	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	-	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	-	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	-	9.67E-07	6.31E-05	1.30E-05
MO 99	-	1.51E-08	2.87E-09	-	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	-	5.52E-12	9.55E-08	5.20E-07

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	5.22E-15	7.52E-15	7.38E-14	-	1.35E-13	4.99E-08	1.36E-21
RU 103	1.91E-07	-	8.23E-08	-	7.29E-07	6.31E-05	1.38E-05
RU 105	9.88E-11	-	3.89E-11	-	1.27E-10	1.37E-06	6.02E-06
RU 106	8.64E-06	-	1.09E-06	-	1.67E-05	1.17E-03	1.14E-04
AG 110M	1.35E-06	1.25E-06	7.43E-07	-	2.46E-06	5.79E-04	3.78E-05
TE 125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE 127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE 127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE 129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE 129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE 131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE 131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE 132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	-	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	-	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	-	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	-	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	-	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	-	6.56E-07
CS 134	4.66E-05	1.06E-04	9.10E-05	-	3.59E-05	1.22E-05	1.30E-06
CS 136	4.88E-06	1.83E-05	1.38E-05	-	1.07E-05	1.50E-06	1.46E-06
CS 137	5.98E-05	7.76E-05	5.35E-05	-	2.78E-05	9.40E-06	1.05E-06
CS 138	4.14E-08	7.76E-08	4.05E-08	-	6.00E-08	6.07E-09	2.33E-13
BA 139	1.17E-10	8.32E-14	3.42E-12	-	7.78E-14	4.70E-07	1.12E-07
BA 140	4.88E-06	6.13E-09	3.21E-07	-	2.09E-09	1.59E-04	2.73E-05
BA 141	1.25E-11	9.41E-15	4.20E-13	-	8.75E-15	2.42E-07	1.45E-17
BA 142	3.29E-12	3.38E-15	2.07E-13	-	2.86E-15	1.49E-07	1.96E-26
LA 140	4.30E-08	2.17E-08	5.73E-09	-	-	1.70E-05	5.73E-05
LA 142	8.54E-11	3.88E-11	9.65E-12	-	-	7.91E-07	2.64E-07
CE 141	2.49E-06	1.69E-06	1.91E-07	-	7.83E-07	4.52E-05	1.50E-05
CE 143	2.33E-08	1.72E-08	1.91E-09	-	7.60E-09	9.97E-06	2.83E-05
CE 144	4.29E-04	1.79E-04	2.30E-05	-	1.06E-04	9.72E-04	1.02E-04
PR 143	1.17E-06	4.69E-07	5.80E-08	-	2.70E-07	3.51E-05	2.50E-05
PR 144	3.76E-12	1.56E-12	1.91E-13	-	8.81E-13	1.27E-07	2.69E-18
ND 147	6.59E-07	7.62E-07	4.56E-08	-	4.45E-07	2.76E-05	2.16E-05
W 187	1.06E-09	8.85E-10	3.10E-10	-	-	3.63E-06	1.94E-05
NP 239	2.87E-08	2.82E-09	1.55E-09	-	8.75E-09	4.70E-06	1.49E-05

TABLE 9
INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	-	-	-	1.16E-05
CR 51	-	-	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	-	6.39E-06	1.05E-06	-	1.59E-06	2.48E-04	8.35E-06
MN 56	-	2.12E-10	3.15E-11	-	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	-	-	1.55E-05	7.99E-07
FE 59	1.99E-06	4.62E-06	1.79E-06	-	-	1.91E-04	2.23E-05
CO 58	-	2.59E-07	3.47E-07	-	-	1.68E-04	1.19E-05
CO 60	-	1.89E-06	2.48E-06	-	-	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	-	-	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	-	-	1.17E-06	4.59E-06
CU 64	-	2.54E-10	1.06E-10	-	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.82E-06	1.67E-05	7.80E-06	-	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	-	7.53E-12	1.98E-07	3.56E-08
BR 83	-	-	4.30E-08	-	-	-	LT E-24
BR 84	-	-	5.41E-08	-	-	-	LT E-24
BR 85	-	-	2.29E-09	-	-	-	LT E-24
RB 86	-	2.38E-05	1.05E-05	-	-	-	2.21E-06
RB 88	-	6.82E-08	3.40E-08	-	-	-	3.65E-15
RB 89	-	4.40E-08	2.91E-08	-	-	-	4.22E-17
SR 89	5.43E-05	-	1.56E-06	-	-	3.02E-04	4.64E-05
SR 90	1.35E-02	-	8.35E-04	-	-	2.06E-03	9.56E-05
SR 91	1.10E-08	-	4.39E-10	-	-	7.59E-06	3.24E-05
SR 92	1.19E-09	-	5.08E-11	-	-	3.43E-06	1.49E-05
Y 90	3.73E-07	-	1.00E-08	-	-	3.66E-05	6.99E-05
Y 91M	4.63E-11	-	1.77E-12	-	-	4.00E-07	3.77E-09
Y 91	8.26E-05	-	2.21E-06	-	-	3.67E-04	5.11E-05
Y 92	1.84E-09	-	5.36E-11	-	-	3.35E-06	2.06E-05
Y 93	1.69E-08	-	4.65E-10	-	-	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	-	8.42E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	-	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	-	1.25E-06	9.39E-05	1.21E-05
MO 99	-	2.11E-08	4.03E-09	-	5.14E-08	1.92E-05	3.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	-	7.20E-12	1.44E-07	7.66E-07

TABLE 9
INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	7.40E-15	1.05E-14	1.03E-13	-	1.90E-13	8.34E-08	1.09E-16
RU 103	2.63E-07	-	1.12E-07	-	9.29E-07	9.79E-05	1.36E-05
RU 105	1.40E-10	-	5.42E-11	-	1.76E-10	2.27E-06	1.13E-05
RU 106	1.23E-05	-	1.55E-06	-	2.38E-05	2.01E-03	1.20E-04
AG 110M	1.73E-06	1.64E-06	9.99E-07	-	3.13E-06	8.44E-04	3.41E-05
TE 125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	-	6.70E-05	9.38E-06
TE 127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE 127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE 129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE 129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE 131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE 131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE 132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	-	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	-	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	-	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	-	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	-	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	-	8.69E-07
CS 134	6.28E-05	1.41E-04	6.86E-05	-	4.69E-05	1.83E-05	1.22E-06
CS 136	6.44E-06	2.42E-05	1.71E-05	-	1.38E-05	2.22E-06	1.36E-06
CS 137	8.38E-05	1.06E-04	3.89E-05	-	3.80E-05	1.51E-05	1.06E-06
CS 138	5.82E-08	1.07E-07	5.58E-08	-	8.28E-08	9.84E-09	3.38E-11
BA 139	1.67E-10	1.18E-13	4.87E-12	-	1.11E-13	8.08E-07	8.06E-07
BA 140	6.84E-06	8.38E-09	4.40E-07	-	2.85E-09	2.54E-04	2.86E-05
BA 141	1.78E-11	1.32E-14	5.93E-13	-	1.23E-14	4.11E-07	9.33E-14
BA 142	4.62E-12	4.63E-15	2.84E-13	-	3.92E-15	2.39E-07	5.99E-20
LA 140	5.99E-08	2.95E-08	7.82E-09	-	-	2.68E-05	6.09E-05
LA 142	1.20E-10	5.31E-11	1.32E-11	-	-	1.27E-06	1.50E-06
CE 141	3.55E-06	2.37E-06	2.71E-07	-	1.11E-06	7.67E-05	1.58E-05
CE 143	3.32E-08	2.42E-08	2.70E-09	-	1.08E-08	1.63E-05	3.19E-05
CE 144	6.11E-04	2.53E-04	3.28E-05	-	1.51E-04	1.67E-03	1.08E-04
PR 143	1.67E-06	6.64E-07	8.28E-08	-	3.86E-07	6.04E-05	2.67E-05
PR 144	5.37E-12	2.20E-12	2.72E-13	-	1.26E-12	2.19E-07	2.94E-14
ND 147	9.83E-07	1.07E-06	6.41E-08	-	6.28E-07	4.65E-05	2.28E-05
W 187	1.50E-09	1.22E-09	4.29E-10	-	-	5.92E-06	2.21E-05
NP 239	4.23E-08	3.99E-09	2.21E-09	-	1.25E-08	8.11E-06	1.65E-05

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	-	-	-	1.14E-05
CR 51	-	-	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	-	1.16E-05	2.57E-06	-	2.71E-06	4.26E-04	6.19E-06
MN 56	-	4.48E-10	8.43E-11	-	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	-	-	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	-	-	3.43E-04	1.91E-05
CO 58	-	4.79E-07	8.55E-07	-	-	2.99E-04	9.29E-06
CO 60	-	3.55E-06	6.12E-06	-	-	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	-	-	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	-	-	2.21E-06	2.27E-05
CU 64	-	5.39E-10	2.90E-10	-	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	-	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	-	1.58E-11	3.84E-07	2.75E-06
BR 83	-	-	1.28E-07	-	-	-	LT E-24
BR 84	-	-	1.48E-07	-	-	-	LT E-24
BR 85	-	-	6.84E-09	-	-	-	LT E-24
RB 86	-	5.36E-05	3.09E-05	-	-	-	2.16E-06
RB 88	-	1.52E-07	9.90E-08	-	-	-	4.66E-09
RB 89	-	9.33E-08	7.85E-08	-	-	-	5.11E-10
SR 89	1.62E-04	-	4.66E-06	-	-	5.83E-04	4.52E-05
SR 90	2.73E-02	-	1.74E-03	-	-	3.99E-03	9.28E-05
SR 91	3.28E-08	-	1.24E-09	-	-	1.44E-05	4.70E-05
SR 92	3.54E-09	-	1.42E-10	-	-	6.49E-06	6.55E-05
Y 90	1.11E-06	-	2.99E-08	-	-	7.07E-05	7.24E-05
Y 91M	1.37E-10	-	4.98E-12	-	-	7.60E-07	4.64E-07
Y 91	2.47E-04	-	6.59E-06	-	-	7.10E-04	4.97E-05
Y 92	5.50E-09	-	1.57E-10	-	-	6.46E-06	6.46E-05
Y 93	5.04E-08	-	1.38E-09	-	-	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	-	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	-	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	-	2.33E-06	1.66E-04	1.00E-05
MO 99	-	4.66E-08	1.15E-08	-	1.06E-07	3.66E-05	3.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	-	1.37E-11	2.57E-07	1.30E-06

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.19E-14	2.30E-14	2.91E-13	-	3.92E-13	1.58E-07	4.41E-09
RU 103	7.55E-07	-	2.90E-07	-	1.90E-06	1.79E-04	1.21E-05
RU 105	4.13E-10	-	1.50E-10	-	3.63E-10	4.30E-06	2.69E-05
RU 106	3.68E-05	-	4.57E-06	-	4.97E-05	3.87E-03	1.16E-04
AG 110M	4.56E-06	3.08E-06	2.47E-06	-	5.74E-06	1.48E-03	2.71E-05
TE 125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	-	1.29E-04	9.13E-06
TE 127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE 127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE 129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE 129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE 131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE 131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE 132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	-	1.38E-06
I 131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	-	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	-	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	-	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	-	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	-	1.20E-06
CS 134	1.76E-04	2.74E-04	6.07E-05	-	8.93E-05	3.27E-05	1.04E-06
CS 136	1.76E-05	4.62E-05	3.14E-05	-	2.58E-05	3.93E-06	1.13E-06
CS 137	2.45E-04	2.23E-04	3.47E-05	-	7.63E-05	2.81E-05	9.78E-07
CS 138	1.71E-07	2.27E-07	1.50E-07	-	1.68E-07	1.84E-08	7.29E-08
BA 139	4.98E-10	2.66E-13	1.45E-11	-	2.33E-13	1.56E-06	1.56E-05
BA 140	2.00E-05	1.75E-08	1.17E-06	-	5.71E-09	4.71E-04	2.75E-05
BA 141	5.29E-11	2.95E-14	1.72E-12	-	2.56E-14	7.89E-07	7.44E-08
BA 142	1.35E-11	9.73E-15	7.54E-13	-	7.87E-15	4.44E-07	7.41E-10
LA 140	1.74E-07	6.08E-08	2.04E-08	-	-	4.94E-05	6.10E-05
LA 142	3.50E-10	1.11E-10	3.49E-11	-	-	2.35E-06	2.05E-05
CE 141	1.06E-05	5.28E-06	7.83E-07	-	2.31E-06	1.47E-04	1.53E-05
CE 143	9.89E-08	5.37E-08	7.77E-09	-	2.26E-08	3.12E-05	3.44E-05
CE 144	1.83E-03	5.72E-04	9.77E-05	-	3.17E-04	3.23E-03	1.05E-04
PR 143	4.99E-06	1.50E-06	2.47E-07	-	8.11E-07	1.17E-04	2.63E-05
PR 144	1.61E-11	4.99E-12	8.10E-13	-	2.64E-12	4.23E-07	5.32E-08
ND 147	2.92E-06	2.36E-06	1.84E-07	-	1.30E-06	8.87E-05	2.22E-05
W 187	4.41E-09	2.61E-09	1.17E-09	-	-	1.11E-05	2.46E-05
NP 239	1.26E-07	9.04E-09	6.35E-09	-	2.63E-08	1.57E-05	1.73E-05

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.53E-05	-	-	-	1.15E-05
CR 51	-	-	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	-	1.81E-05	3.56E-06	-	3.56E-06	7.14E-04	5.04E-06
MN 56	-	1.10E-09	1.58E-10	-	7.86E-10	8.95E-06	5.12E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	-	-	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	-	-	7.25E-04	1.77E-05
CO 58	-	8.71E-07	1 30E-06	-	-	5.55E-04	7.95E-06
CO 60	-	5.73E-06	8.41E-06	-	-	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	-	-	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	-	-	5.80E-06	3.58E-05
CU 64	-	1.34E-09	5.53E-10	-	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	-	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	-	2.87E-11	1.05E-06	9.44E-06
BR 83	-	-	2.72E-07	-	-	-	LT E-24
BR 84	-	-	2.86E-07	-	-	-	LT E-24
BR 85	-	-	1.46E-08	-	-	-	LT E-24
RB 86	-	1.36E-04	6.30E-05	-	-	-	2.17E-06
RB 88	-	3.98E-07	2.05E-07	-	-	-	2.42E-07
RB 89	-	2.29E-07	1.47E-07	-	-	-	4.87E-08
SR 89	2.84E-04	-	8.15E-06	-	-	1.45E-03	4.57E-05
SR 90	2.92E-02	-	1.85E-03	-	-	8.03E-03	9.36E-05
SR 91	6.83E-08	-	2.47E-09	-	-	3.76E-05	5.24E-05
SR 92	7.50E-09	-	2.79E-10	-	-	1.70E-05	1.00E-04
Y 90	2.35E-06	-	6.30E-08	-	-	1.92E-04	7.43E-05
Y 91M	2.91E-10	-	9.90E-12	-	-	1.99E-06	1.68E-06
Y 91	4.20E-04	-	1.12E-05	-	-	1.75E-03	5.02E-05
Y 92	1.17E-08	-	3.29E-10	-	-	1.75E-05	9.04E-05
Y 93	1.07E-07	-	2.91E-09	-	-	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	-	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	-	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	-	3.37E-06	3.42E-04	9.05E-06
MO 99	-	1.18E-07	2.31E-08	-	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-13	2.06E-12	2.66E-11	-	2.22E-11	5.79E-07	1.45E-06

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	4.65E-14	5.88E-14	5.80E-13	-	6.99E-13	4.17E-07	6.03E-07
RU 103	1.44E-06	-	4.85E-07	-	3.03E-06	3.94E-04	1.15E-05
RU 105	8.74E-10	-	2.93E-10	-	6.42E-10	1.12E-05	3.46E-05
RU 106	6.20E-05	-	7.77E-06	-	7.61E-05	8.26E-03	1.17E-04
AG 110M	7.13E-06	5.16E-06	3.57E-06	-	7.80E-06	2.62E-03	2.36E-05
TE 125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	-	3.19E-04	9.22E-06
TE 127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE 127	1.59E-09	6.81E-10	3.40E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE 129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE 129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE 131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE 131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE 132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	-	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	-	7.56E-07
I 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	-	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	-	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	-	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	-	1.31E-06
CS 134	2.83E-04	5.02E-04	5.32E-05	-	1.36E-04	5.69E-05	9.53E-07
CS 136	3.45E-05	9.61E-05	3.78E-05	-	4.03E-05	8.40E-06	1.02E-06
CS 137	3.92E-04	4.37E-04	3.25E-05	-	1.23E-04	5.09E-05	9.53E-07
CS 138	3.61E-07	5.58E-07	2.84E-07	-	2.93E-07	4.67E-08	6.26E-07
BA 139	1.06E-09	7.03E-13	3.07E-11	-	4.23E-13	4.25E-06	3.64E-05
BA 140	4.00E-05	4.00E-08	2.07E-06	-	9.59E-09	1.14E-03	2.74E-05
BA 141	1.12E-10	7.70E-14	3.55E-12	-	4.64E-14	2.12E-06	3.39E-06
BA 142	2.84E-11	2.36E-14	1.40E-12	-	1.36E-14	1.11E-06	4.95E-07
LA 140	3.61E-07	1.43E-07	3.68E-08	-	-	1.20E-04	6.06E-05
LA 142	7.36E-10	2.69E-10	6.46E-11	-	-	5.87E-06	4.25E-05
CE 141	1.98E-05	1.19E-05	1.42E-06	-	3.75E-06	3.69E-04	1.54E-05
CE 143	2.09E-07	1.38E-07	1.58E-08	-	4.03E-08	8.30E-05	3.55E-05
CE 144	2.28E-03	8.65E-04	1.26E-04	-	3.84E-04	7.03E-03	1.06E-04
PR 143	1.00E-05	3.74E-06	4.99E-07	-	1.41E-06	3.09E-04	2.66E-05
PR 144	3.42E-11	1.32E-11	1.72E-12	-	4.80E-12	1.15E-06	3.06E-06
ND 147	5.67E-06	5.81E-06	3.57E-07	-	2.25E-06	2.30E-04	2.23E-05
W 187	9.26E-09	6.44E-09	2.23E-09	-	-	2.83E-05	2.54E-05
NP 239	2.65E-07	2.37E-08	1.34E-08	-	4.73E-08	4.25E-05	1.78E-05

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	-	-	-	2.17E-05
CR 51	-	-	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	-	4.57E-06	8.72E-07	-	1.36E-06	-	1.40E-05
MN 56	-	1.15E-07	2.04E-08	-	1.46E-07	-	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	-	-	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	-	-	2.85E-06	3.40E-05
CO 58	-	7.45E-07	1.67E-06	-	-	-	1.51E-05
CO 60	-	2.14E-06	4.72E-06	-	-	-	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	-	-	-	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	-	-	-	1.74E-06
CU 64	-	8.33E-08	3.91E-08	-	2.10E-07	-	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	-	1.03E-05	-	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	-	1.28E-08	-	2.96E-09
BR 83	-	-	4.02E-08	-	-	-	5.79E-08
BR 84	-	-	5.21E-08	-	-	-	4.09E-13
BR 85	-	-	2.14E-09	-	-	-	LT E-24
RB 86	-	2.11E-05	9.83E-06	-	-	-	4.16E-06
RB 88	-	6.05E-08	3.21E-08	-	-	-	8.36E-19
RB 89	-	4.01E-08	2.82E-08	-	-	-	2.33E-21
SR 89	3.08E-04	-	8.84E-06	-	-	-	4.94E-05
SR 90	7.58E-03	-	1.86E-03	-	-	-	2.19E-04
SR 91	5.67E-06	-	2.29E-07	-	-	-	2.70E-05
SR 92	2.15E-06	-	9.30E-08	-	-	-	4.26E-05
Y 90	9.62E-09	-	2.58E-10	-	-	-	1.02E-04
Y 91M	9.09E-11	-	3.52E-12	-	-	-	2.67E-10
Y 91	1.41E-07	-	3.77E-09	-	-	-	7.76E-05
Y 92	8.45E-10	-	2.47E-11	-	-	-	1.48E-05
Y 93	2.68E-09	-	7.40E-11	-	-	-	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	-	1.53E-08	-	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	-	5.12E-10	-	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	-	3.42E-09	-	2.10E-05
MO 99	-	4.31E-06	8.20E-07	-	9.76E-06	-	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	-	1.06E-08	3.42E-10	4.13E-07

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.54E-10	3.66E-10	3.59E-09	-	6.59E-09	1.87E-10	1.10E-21
RU 103	1.85E-07	-	7.97E-08	-	7.06E-07	-	2.16E-05
RU 105	1.54E-08	-	6.08E-09	-	1.99E-07	-	9.42E-06
RU 106	2.75E-06	-	3.48E-07	-	5.31E-06	-	1.78E-04
AG 110M	1.60E-07	1.48E-07	8.79E-08	-	2.91E-07	-	6.04E-05
TE 125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	-	1.07E-05
TE 127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	-	2.27E-05
TE 127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	-	8.68E-06
TE 129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	-	5.79E-05
TE 129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	-	2.37E-08
TE 131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	-	8.40E-05
TE 131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	-	2.79E-09
TE 132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	-	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	-	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	-	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	-	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	-	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	-	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	-	1.31E-06
CS 134	6.22E-05	1.48E-04	1.21E-04	-	4.79E-05	1.59E-05	2.59E-06
CS 136	6.51E-06	2.57E-05	1.85E-05	-	1.43E-05	1.96E-06	2.92E-06
CS 137	7.97E-05	1.09E-04	7.14E-05	-	3.70E-05	1.23E-05	2.11E-06
CS 138	5.52E-08	1.09E-07	5.40E-08	-	8.01E-08	7.91E-09	4.65E-13
BA 139	9.70E-08	6.91E-11	2.84E-09	-	6.46E-11	3.92E-11	1.72E-07
BA 140	2.03E-05	2.55E-08	1.33E-06	-	8.67E-09	1.46E-08	4.18E-05
BA 141	4.71E-08	3.56E-11	1.59E-09	-	3.31E-11	2.02E-11	2.22E-17
BA 142	2.13E-08	2.19E-11	1.34E-09	-	1.85E-11	1.24E-11	3.00E-26
LA 140	2.50E-09	1.26E-09	3.33E-10	-	-	-	9.25E-05
LA 142	1.28E-10	5.82E-11	1.45E-11	-	-	-	4.25E-07
CE 141	9.36E-09	6.33E-09	7.18E-10	-	2.94E-09	-	2.42E-05
CE 143	1.65E-09	1.22E-06	1.35E-10	-	5.37E-10	-	4.56E-05
CE 144	4.88E-07	2.04E-07	2.62E-08	-	1.21E-07	-	1.65E-04
PR 143	9.20E-09	3.69E-09	4.56E-10	-	2.13E-09	-	4.03E-05
PR 144	3.01E-11	1.25E-11	1.53E-12	-	7.05E-12	-	4.33E-18
ND 147	6.29E-09	7.27E-09	4.35E-10	-	4.25E-09	-	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	-	-	-	2.82E-05
NP 239	1.19E-09	1.17E-10	6.45E-11	-	3.65E-10	-	2.40E-05

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	-	-	-	2.32E-05
CR 51	-	-	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	-	5.90E-06	1.17E-06	-	1.76E-06	-	1.21E-05
MN 56	-	1.58E-07	2.81E-08	-	2.00E-07	-	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	-	-	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	-	-	4.32E-06	3.24E-05
CO 58	-	9.72E-07	2.24E-06	-	-	-	1.34E-05
CO 60	-	2.81E-06	6.33E-06	-	-	-	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	-	-	-	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	-	-	-	5.19E-06
CU 64	-	1.15E-07	5.41E-08	-	2.91E-07	-	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	-	1.28E-05	-	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	-	1.83E-08	-	5.16E-08
BR 83	-	-	5.74E-08	-	-	-	LT E-24
BR 84	-	-	7.22E-08	-	-	-	LT E-24
BR 85	-	-	3.05E-09	-	-	-	LT E-24
RB 86	-	2.98E-05	1.40E-05	-	-	-	4.41E-06
RB 88	-	8.52E-08	4.54E-08	-	-	-	7.30E-15
RB 89	-	5.50E-08	3.89E-08	-	-	-	8.43E-17
SR 89	4.40E-04	-	1.26E-05	-	-	-	5.24E-05
SR 90	8.30E-03	-	2.05E-03	-	-	-	2.33E-04
SR 91	8.07E-06	-	3.21E-07	-	-	-	3.66E-05
SR 92	3.05E-06	-	1.30E-07	-	-	-	7.77E-05
Y 90	1.37E-08	-	3.69E-10	-	-	-	1.13E-04
Y 91M	1.29E-10	-	4.93E-12	-	-	-	6.09E-09
Y 91	2.01E-07	-	5.39E-09	-	-	-	8.24E-05
Y 92	1.21E-09	-	3.50E-11	-	-	-	3.32E-05
Y 93	3.83E-09	-	1.05E-10	-	-	-	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	-	1.91E-08	-	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	-	7.11E-10	-	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	-	4.42E-09	-	1.95E-05
MO 99	-	6.03E-06	1.15E-06	-	1.38E-05	-	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	-	1.38E-08	5.14E-10	6.08E-07

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	3.60E-10	5.12E-10	5.03E-09	-	9.26E-09	3.12E-10	8.75E-17
RU 103	2.55E-07	-	1.09E-07	-	8.99E-07	-	2.13E-05
RU 105	2.18E-08	-	8.46E-09	-	2.75E-07	-	1.76E-05
RU 106	3.92E-06	-	4.94E-07	-	7.56E-06	-	1.88E-04
AG 110M	2.05E-07	1.94E-07	1.18E-07	-	3.70E-07	-	5.45E-05
TE 125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	-	-	1.13E-05
TE 127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	-	2.41E-05
TE 127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	-	1.22E-05
TE 129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	-	6.12E-05
TE 129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	-	2.45E-07
TE 131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	-	9.39E-05
TE 131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	-	2.29E-09
TE 132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	-	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	-	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	-	1.62E-06
[illegible] 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	-	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	-	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	-	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	-	1.74E-06
CS 134	8.37E-05	1.97E-04	9.14E-05	-	6.26E-05	2.39E-05	2.45E-06
CS 136	8.59E-06	3.38E-05	2.27E-05	-	1.84E-05	2.90E-06	2.72E-06
CS 137	1.12E-04	1.49E-04	5.19E-05	-	5.07E-05	1.97E-05	2.12E-06
CS 138	7.76E-08	1.49E-07	7.45E-08	-	1.10E-07	1.28E-08	4.76E-11
BA 139	1.39E-07	9.78E-11	4.05E-09	-	9.22E-11	6.74E-11	1.24E-06
BA 140	2.84E-05	3.48E-08	1.83E-06	-	1.18E-08	2.34E-08	4.38E-05
BA 141	6.71E-08	5.01E-11	2.24E-09	-	4.65E-11	3.43E-11	1.43E-13
BA 142	2.99E-08	2.99E-11	1.84E-09	-	2.53E-11	1.99E-11	9.18E-20
LA 140	3.48E-09	1.71E-09	4.55E-10	-	-	-	9.28E-05
LA 142	1.79E-10	7.95E-11	1.98E-11	-	-	-	2.42E-06
CE 141	1.33E-08	8.88E-09	1.02E-09	-	4.18E-09	-	2.54E-05
CE 143	2.35E-09	1.71E-06	1.91E-10	-	7.67E-10	-	5.14E-05
CE 144	6.96E-07	2.88E-07	3.74E-08	-	1.72E-07	-	1.75E-04
PR 143	1.31E-08	5.23E-09	6.52E-10	-	3.04E-09	-	4.31E-05
PR 144	4.30E-11	1.76E-11	2.18E-12	-	1.01E-11	-	4.74E-14
[illegible] 147	9.38E-09	1.02E-08	6.11E-10	-	5.99E-09	-	3.68E-05
[illegible] 187	1.46E-07	1.19E-07	4.17E-08	-	-	-	3.22E-05
NP 239	1.76E-09	1.66E-10	9.22E-11	-	5.21E-10	-	2.67E-05

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.25E-04	3.86E-05	3.18E-05	-	-	-	2.28E-05
CR 51	-	-	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	-	1.07E-05	2.85E-06	-	3.00E-06	-	8.98E-06
MN 56	-	3.34E-07	7.54E-08	-	4.04E-07	-	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	-	-	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	-	-	7.74E-06	2.78E-05
CO 58	-	1.80E-06	5.51E-06	-	-	-	1.05E-05
CO 60	-	5.29E-06	1.56E-05	-	-	-	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	-	-	-	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	-	-	-	2.56E-05
CU 64	-	2.45E-07	1.48E-07	-	5.92E-07	-	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	-	2.30E-05	-	6.41E-06
ZN 69	4.38E-08	6.33E-08	5.85E-09	-	3.84E-08	-	3.99E-06
BR 83	-	-	1.71E-07	-	-	-	LT E-24
BR 84	-	-	1.98E-07	-	-	-	LT E-24
BR 85	-	-	9.12E-09	-	-	-	LT E-24
RB 86	-	6.70E-05	4.12E-05	-	-	-	4.31E-06
RB 88	-	1.90E-07	1.32E-07	-	-	-	9.32E-09
RB 89	-	1.17E-07	1.04E-07	-	-	-	1.02E-09
SR 89	1.32E-03	-	3.77E-05	-	-	-	5.11E-05
SR 90	1.70E-02	-	4.31E-03	-	-	-	2.29E-04
SR 91	2.40E-05	-	9.06E-07	-	-	-	5.30E-05
SR 92	9.03E-06	-	3.62E-07	-	-	-	1.71E-04
Y 90	4.11E-08	-	1.10E-09	-	-	-	1.17E-04
Y 91M	3.82E-10	-	1.39E-11	-	-	-	7.48E-07
Y 91	6.02E-07	-	1.61E-08	-	-	-	8.02E-05
Y 92	3.60E-09	-	1.03E-10	-	-	-	1.04E-04
Y 93	1.14E-08	-	3.13E-10	-	-	-	1.70E-04
ZR 95	1.16E-07	2.55E-08	2.27E-08	-	3.65E-08	-	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	-	1.45E-09	-	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	-	8.23E-09	-	1.62E-05
MO 99	-	1.33E-05	3.29E-06	-	2.84E-05	-	1.10E-05
TC 99M	9.23E-10	1.81E-09	3.00E-08	-	2.63E-08	9.19E-10	1.03E-06

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	1.07E-09	1.12E-09	1.42E-08	-	1.91E-08	5.92E-10	3.56E-09
RU 103	7.31E-07	-	2.81E-07	-	1.84E-06	-	1.89E-05
RU 105	6.45E-08	-	2.34E-08	-	5.67E-07	-	4.21E-05
RU 106	1.17E-05	-	1.46E-06	-	1.58E-05	-	1.82E-04
AG 110M	5.39E-07	3.64E-07	2.91E-07	-	6.78E-07	-	4.33E-05
TE 125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	-	-	1.10E-05
TE 127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	-	2.34E-05
TE 127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	-	1.84E-05
TE 129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	-	5.94E-05
TE 129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	-	8.34E-06
TE 131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	-	1.01E-04
TE 131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	-	4.36E-07
TE 132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	-	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	-	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	-	1.54E-06
I 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	-	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	-	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	-	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	-	2.40E-06
CS 134	2.34E-04	3.84E-04	8.10E-05	-	1.19E-04	4.27E-05	2.07E-06
CS 136	2.35E-05	6.46E-05	4.18E-05	-	3.44E-05	5.13E-06	2.27E-06
CS 137	3.27E-04	3.13E-04	4.62E-05	-	1.02E-04	3.67E-05	1.96E-06
CS 138	2.28E-07	3.17E-07	2.01E-07	-	2.23E-07	2.40E-08	1.46E-07
BA 139	4.14E-07	2.21E-10	1.20E-08	-	1.93E-10	1.30E-10	2.39E-05
BA 140	8.31E-05	7.28E-08	4.85E-06	-	2.37E-08	4.34E-08	4.21E-05
BA 141	2.00E-07	1.12E-10	6.51E-09	-	9.69E-11	6.58E-10	1.14E-07
BA 142	8.74E-08	6.29E-11	4.88E-09	-	5.09E-11	3.70E-11	1.14E-09
LA 140	1.01E-08	3.53E-09	1.19E-09	-	-	-	9.84E-05
LA 142	5.24E-10	1.67E-10	5.23E-11	-	-	-	3.31E-05
CE 141	3.97E-08	1.98E-08	2.94E-09	-	8.68E-09	-	2.47E-05
CE 143	6.99E-09	3.79E-06	5.49E-10	-	1.59E-09	-	5.55E-05
CE 144	2.08E-06	6.52E-07	1.11E-07	-	3.61E-07	-	1.70E-04
PR 143	3.93E-08	1.18E-08	1.95E-09	-	6.39E-09	-	4.24E-05
PR 144	1.29E-10	3.99E-11	6.49E-12	-	2.11E-11	-	8.59E-08
ND 147	2.79E-08	2.26E-08	1.75E-09	-	1.24E-08	-	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	-	-	-	3.57E-05
NP 239	5.25E-09	3.77E-10	2.65E-10	-	1.09E-09	-	2.79E-05

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Page 1 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	-	-	-	2.30E-05
CR 51	-	-	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	-	1.99E-05	4.51E-06	-	4.41E-06	-	7.31E-06
MN 56	-	8.18E-07	1.41E-07	-	7.03E-07	-	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	-	-	4.36E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	-	-	1.59E-05	2.57E-05
CO 58	-	3.60E-06	8.98E-06	-	-	-	8.97E-06
CO 60	-	1.08E-05	2.55E-05	-	-	-	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	-	-	-	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	-	-	-	4.05E-05
CU 64	-	6.09E-07	2.82E-07	-	1.03E-06	-	1.25E-05
ZN 65	1.84E-05	6.31E-05	2.91E-05	-	3.06E-05	-	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	-	6.98E-08	-	1.37E-05
BR 83	-	-	3.63E-07	-	-	-	LT E-24
BR 84	-	-	3.82E-07	-	-	-	LT E-24
BR 85	-	-	1.94E-08	-	-	-	LT E-24
RB 86	-	1.70E-04	8.40E-05	-	-	-	4.35E-06
RB 88	-	4.98E-07	2.73E-07	-	-	-	4.85E-07
RB 89	-	2.86E-07	1.97E-07	-	-	-	9.74E-08
SR 89	2.51E-03	-	7.20E-05	-	-	-	5.16E-05
SR 90	1.85E-02	-	4.71E-03	-	-	-	2.31E-04
SR 91	5.00E-05	-	1.81E-06	-	-	-	5.92E-05
SR 92	1.92E-05	-	7.13E-07	-	-	-	2.07E-04
Y 90	8.69E-08	-	2.33E-09	-	-	-	1.20E-04
Y 91M	8.10E-10	-	2.76E-11	-	-	-	2.70E-06
Y 91	1.13E-06	-	3.01E-08	-	-	-	8.10E-05
Y 92	7.65E-09	-	2.15E-10	-	-	-	1.46E-04
Y 93	2.43E-08	-	6.62E-10	-	-	-	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	-	5.41E-08	-	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	-	2.56E-09	-	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	-	1.24E-08	-	1.46E-05
MO 99	-	3.40E-05	6.63E-06	-	5.08E-05	-	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	-	4.26E-08	2.07E-09	1.15E-06

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.27E-09	2.86E-09	2.83E-08	-	3.40E-08	1.56E-09	4.86E-07
RU 103	1.48E-06	-	4.95E-07	-	3.08E-06	-	1.80E-05
RU 105	1.36E-07	-	4.58E-08	-	1.00E-06	-	5.41E-05
RU 106	2.41E-05	-	3.0[illegible]	-	2.85E-05	-	1.83E-04
AG 110M	9.96E-07	7.27E-07	4.8[illegible]	-	1.04E-06	-	3.77E-05
TE 125M	2.33E-05	7.79E-06	3.15E-[illegible]	7.84E-06	-	-	1.11E-05
TE 127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	-	2.36E-05
TE 127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	-	2.10E-05
TE 129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	-	5.97E-05
TE 129	2.84E-07	9.79E-08	6.63E-08	2.3[illegible]	7.07E-07	-	2.27E-05
TE 131M	1.52E-05	6.12E-06	5.05E-06	1.24[illegible]	4.21E-05	-	1.03E-04
TE 131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	-	7.11E-06
TE 132	2.08E-05	1.03E-0[illegible]	9.61E-06	1.52E-05	6.44E-05	-	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	-	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	-	1.51E-06
[illegible] 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	-	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.[illegible]03	2.14E-05	-	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.1[illegible]05	1.99E-06	-	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	-	2.62E-06
CS 134	3.77E-04	7.03E-04	7.10E-05	-	1.81E-04	7.42E-05	1.91E-06
CS 136	4.59E-05	1.35E-04	5.04E-05	-	5.38E-05	1.10E-05	2.05E-06
CS 137	5.22E-04	6.11E-04	4.33E-05	-	1.64E-04	6.64E-05	1.91E-06
CS 138	4.81E-07	7.82E-07	3.79E-07	-	3.90E-07	6.09E-08	1.25E-06
BA 139	8.81E-07	5.84E-10	2.55E-08	-	3.51E-10	3.54E-10	5.58E-05
BA 140	1.71E-04	1.71E-07	8.81E-06	-	4.06E-08	1.05E-07	4.20E-05
BA [illegible]1	4.25E-07	2.91E-10	1.34E-08	-	1.75E-10	1.77E-10	5.19E-06
BA 142	1.84E-07	1.53E-10	9.06E-09	-	8.81E-11	9.26E-11	7.59E-07
LA 140	2.11E-08	8.32E-09	2.14E-09	-	-	-	9.77E-05
LA 142	1.10E-09	4.04E-10	9.67E-11	-	-	-	6.86E-05
CE 141	7.87E-08	4.80E-08	5.65E-09	-	1.48E-08	-	2.48E-05
CE 143	1.48E-08	9.82E-06	1.12E-09	-	2.86E-09	-	5.73E-05
CE 144	2.98E-06	1.22E-06	1.67E-07	-	4.93E-07	-	1.71E-04
PR 143	8.13E-08	3.04E-08	4.03E-09	-	1.13E-08	-	4.29E-05
PR 144	2.74E-10	1.06E-10	1.38E-11	-	3.84E-11	-	4.93E-06
[illegible] 147	5.53E-08	5.68E-08	3.48E-09	-	2.19E-08	-	3.60E-05
[illegible] 187	9.03E-07	6.28E-07	2.17E-07	-	-	-	3.69E-05
NP 239	1.11E-08	9.93E-10	5.61E-10	-	1.98E-09	-	2.87E-05

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Parameter Symbol	Definition	Values
f_g	Fraction of produce ingested grown in garden of interest.	0.76
f_ℓ	Fraction of leafy vegetables grown in garden of interest.	1.0
P	Effective surface density of soil (assumes a 15 cm plow layer, expressed in dry weight)	240 kg/m^2
r	Fraction of deposited activity retained on crops, leafy vegetables, or pasture grass.	0.25 1.0 (for iodines) 0.2 (for other particulates)
S_F	Attenuation factor accounting for shielding provided by residential structures.	0.7 (for maximum individuals) 0.5 (for general population)
t_b	Period of long-term buildup for activity in sediment or soil (nominally 15 yr).	1.31×10^5 hr
t_e	Period of crop, leafy vegetable, or pasture grass exposure during growing season.	720 hrs (30 days, for grass-cow-milk-man pathway) 1440 hrs (60 days for crop/ vegetation-man pathway)
t_f	Transport time from animal feed-milk-man provided by residential structures.	2 days (for max. individual) 4 days (for gen. population)
t_h	Time delay between harvest of vegetation or crops and ingestion. i) For ingestion of forage by animals	Zero (for pasture grass) 2160 hr (90 days for stored feed)

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Parameter Symbol	Definition	Values
	ii) For ingestion of crops by man	24 hr (1 day, for leafy vegetables & max. individual) feed) 1440 hr (60 days for produce & maximum individual) 336 hr (14 days for general population)
t_p	Environmental transit time, release to receptor (add time from release to exposure individual) point to minimums shown for distribution)	12 hr (for max. 24 hr (for gen. population) 24 hr (for max. individual) 168 hr (7 days for population sport fish doses) 240 hr (10 days for population commercial fish doses)
t_s	Average time from slaughter of meat animal to consumption.	20 days
Y_v	Agricultural producitivity by unit area (measured in wet weight)	0.7 kg/m^2 (for grass-cow-milk man pathway) 2.0 kg/m^2 (for produce or leafy vegetables ingested by man)
W	Shore-width factor for river shoreline	0.2
λ_w	Rate constant for removal of activity on plant or leaf surfaces by weathering (corresponds to a 14-day half-life)	0.0021 hr^{-1}

Fort Calhoun Station
Unit No. 1

CH-ODCM-0001

CHEMISTRY PROCEDURE

Title: OFF-SITE DOSE CALCULATION MANUAL (ODCM)

FC-68 Number:	40924
Reason for Change:	To allow a manually isolatable vent path to be used for containment venting following completion of the ILRT.
Contact Person:	Doug Molzer

PART I

ADMINISTRATIVE SECTION

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PART IV

1.0 INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is the controlling document for the Fort Calhoun Station's (FCS) Radiological Effluent and Environmental Monitoring programs. The programs are necessary to ensure the requirements set forth in 10 CFR 20, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR 50, Appendix I. The document is subdivided into four sections as outlined below:

Part I, Introduction - consists of information necessary for the effective use of the ODCM.

Part II, Radiological Effluent Controls - consists of 5 separate sections including:

Section 1 Radiological Effluent Release Limits

Section 2 Radiological Effluent Release Requirements

Section 3 Radiological Effluent Sampling and Analysis Requirements

Section 4 Radiological Effluent Reporting Requirements

Section 5 Radiological Environmental Monitoring Requirements

Together these sections provide the controls used to permit radioactive material releases from the Fort Calhoun Station.

Part III, Radiological Effluent Radiation Monitor Calculation - provides radiation monitor setpoint calculations for the liquid and airborne release pathways.

Part IV, Radiological Effluent Monitoring Calculations - provides the methodology necessary to calculate doses to individuals as a result of radioactive airborne and liquid releases from Fort Calhoun.

The ODCM has been prepared in accordance with the guidance of Nuclear Regulatory Commissions Reg. Guide 1.109, Rev. 1.

The Radiological Effluent Controls Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Release Limits - All Sections

B. Radiological Effluent Release Requirements - All Sections

C. Radiological Effluent Sampling and Analysis Requirements - All Sections

D. Radiological Effluent Reporting Requirements - Sections 4.1 and 4.4

2.0 ADMINISTRATIVE

The Radiological Environmental Monitoring Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Reporting Requirements - Sections 4.2 and 4.3

B. Radiological Environmental Monitoring Requirements - All Sections

2.1 Responsibilities

2.1.1 Nuclear Operation Division Chemistry Department is responsible for the implementation and maintenance of the ODCM.

2.1.2 Nuclear Operation Division Operation Department is responsible for the compliance with the ODCM in the operation of Fort Calhoun Station.

2.2 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 Report in accordance with the requirements of Technical Specification 5.17.

3.0 METEOROLOGICAL DATA

The Annual Average χ/Q is utilized to determine the concentrations of radionuclides at the unrestricted area boundary. This dispersion factor coincides with the highest calculated annual average value for the Fort Calhoun Station. It is based on 3 years of Onsite Meteorological data and the MESODIF II plume trajectory model. This model conforms with the Nuclear Regulatory Commissions Regulatory Guide 1.111. The model employs the sector averaged equations that are utilized for long-term releases. This type of release (long term) is not dependent solely on atmospheric conditions for complying with 10 CFR 20 concentration limits at the unrestricted area boundary.

Real time meteorological data will be utilized in the preparation of the Annual Report. This data is used to calculate the joint frequency table and 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, GASPAR and LADTAP, conform with the Nuclear Regulatory Commissions Reg. Guide 1.109 and 1.21 for the reporting of doses due to routine radioactive effluent releases.

4.0 DEFINITIONS

Air Effluent Concentration (AEC)

Radionuclide limits listed in 10 CFR 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.

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.

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 20, Appendix B, Table 2, Column 2.

5.0 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 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.

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 is 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

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

Fort Calhoun Technical Specifications (Unit No. 1)

Updated Safety Analysis Report

Commitment Documents:

IMPLEMENTING STEP	COMMITMENT NUMBER (CID)	SOURCE DOCUMENT
Part II, 2.2.3.1 C.2	920102/01	FC-0133-92

PART II

RADIOLOGICAL EFFLUENT CONTROLS

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS

The limits and conditions for the controlled release of radioactive material in liquid and airborne effluents are to ensure that these releases result in concentrations that are within the limits specified in 10 CFR 20, and to ensure that releases of radioactive material to the environment be as low as reasonably achievable in conformance with 10 CFR 50.34a and 50.36a. To meet these criteria, the following requirements must be met for all radioactive liquid and airborne effluents from FCS:

1.1 Liquid Effluents

1.1.1 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 20 for liquid effluents at site discharge. For dissolved or entrained noble gases, the concentration shall be limited to 2.0 E-04 μCi/ml, total activity.

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.

1.1.2 Annual Design Objectives

1.1.2.1 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed <u>3</u> millirems to the <u>total body</u>.

1.1.2.2 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed <u>10</u> millirems to <u>any organ</u>.

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.1.2.3 The radiation dose contributions from radioactive materials in liquid effluents released at site discharge shall be determined, in accordance with Part IV, Section 2.1, 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:

A. Make an investigation to identify the causes for such releases.

B. Define and initiate a program of action to reduce such releases to the design levels.

C. 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.

1.2 Airborne Effluents

1.2.1 The release rate of radioactive material in airborne effluents shall be controlled such that the instantaneous concentrations for these radionuclides do not exceed the values specified in 10 CFR 20 for airborne effluents at the unrestricted area boundary.

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.

1.2.2 Annual Design Objectives

1.2.2.1 The gamma air dose in unrestricted areas due to the release of noble gases in airborne effluents shall not exceed 10 millirads during any calendar year;

1.2.2.2 The beta air dose in unrestricted areas due to the release of noble gases in airborne effluents shall not exceed 20 millirads during any calendar year; and

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.2.2.3 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 15 millirems from all exposure pathways during any calendar year.

1.2.2.4 The radiation dose contributions from radioactive materials in airborne effluents shall be determined, in accordance with the Part IV, section 2.2, on a quarterly basis. If the dose contribution, due to the cumulative release of airborne effluents averaged over a calendar quarter exceeds one-half of the annual design objectives, the following course of actions shall be taken:

A. Make an investigation to identify the cause for such release rates.

B. Define and initiate a program of action to reduce such releases to design levels.

C. 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.

1.3 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.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS

The requirements for the release of radioactive liquid and airborne effluents from FCS stated in this Section are to ensure that the limits of Section 1 will be met, as well as to allow for operational flexibility. When any of the requirements for release of radioactive effluents cannot be complied with, the release shall not be permitted to occur or it shall be immediately terminated, if it is in progress.

2.1 Liquid Effluent Releases

The equipment or subsystem(s) of the liquid radwaste treatment system as identified in the Part III, section 2.1, shall be operable. If the radioactive liquid effluents were discharged without treatment by one or more of the pieces of equipment or subsystem(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reasons for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1 Monitor and Hotel Waste Tanks

During release of radioactive liquid effluents, the following conditions shall be met:

2.1.1.1 There shall be sufficient dilution flow so that, at site discharge:

$$\sum_{i=1}^{n} C_i / wec_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

wec_i = 10 CFR 20, Appendix B, Table 2, Column 2 limits.

2.1.1.2 The overboard header effluent radiation monitor shall be set in accordance with Part III to alarm and automatically close the discharge valve prior to exceeding 10 CFR 20 limits at site discharge.

2.1.1.3 The liquid effluent radioactivity shall be continuously monitored during the release. If the effluent radiation monitor is inoperable, effluent releases may continue provided that: (prior to initiating a release)

A. At least two independent samples are analyzed in accordance with applicable chemistry procedures.

B. At least two qualified individuals independently verify the release rate calculations.

2.1.1.4 The liquid effluent radioactivity shall be continuously recorded during the release. If the process radiation monitor chart recorder is inoperable and the process radiation monitor is operable then effluent releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1.5 The liquid effluent flow rate shall be continuously monitored and recorded during the release. If the flow rate recorder is inoperable, effluent releases may continue provided the flow rate is determined at least once per four hours during actual release.

2.1.2 Steam Generator

During the release of steam generator blowdown to the discharge tunnel, the following conditions shall be met:

2.1.2.1 There shall be sufficient dilution flow so that, at site discharge:

$$\sum_{i=1}^{n} C_i/wec_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

wec_i = 10 CFR 20, Appendix B, Table 2, Column 2 limit.

2.1.2.2 The steam generator blowdown radiation monitors shall be set in accordance with Part III to alarm and automatically close the blowdown isolation valves prior to exceeding 10 CFR 20 limits at site dishcarge.

2.1.2.3 The radioactivity for each blowdown line shall be continuously monitored by the blowdown radiation monitors and recorded.

A. If one of the two radiation monitors is inoperable, the activity for both blowdown lines shall be monitored by the operable radiation monitor within 2 hours of the declaration, by Shift Supervisor, of inoperability.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.2.3 B. If both radiation monitors are inoperable, steam generator liquid releases may continue provided grab samples are analyzed for principal gamma emitters at a sensitivity of 5.0E-07 μCi/ml and recorded at least daily when the specific activity of Steam Generator Blowdown is less than or equal to 0.01 μCi/gram dose equivalent I-131 and at least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 μCi/gram dose equivalent I-131.

2.1.2.4 The radioactivity for each blowdown line shall be continuously recorded. If the process radiation monitor chart recorder is not operational, Steam Generator releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.2 Airborne Effluent Releases

The equipment or subsystem(s) of the gaseous radwaste treatment system as identified in Part III, Section 2.2, shall be operable. If the radioactive airborne effluents were discharged without treatment by one or more of the equipment or subsystems(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reason for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1 Auxiliary Building Exhaust Stack

2.2.1.1 During the ventilation of airborne effluents from the Auxiliary Building through the Auxiliary Building Exhaust Stack, the following conditions shall be met:

A. The Auxiliary Building Exhaust Stack Noble Gas Monitors, iodine sampler and particulate sampler, shall be operational, OR:

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 2).

2) If the Auxiliary Building Exhaust Stack iodine or particulate sampler(s) is/are 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 using auxiliary sample collection equipment is initiated within 2 hours of the declaration, by the Shift Supervisor, of inoperability in accordance with Table 2.

B. The Auxiliary Building Exhaust Stack Noble Gas Radiation Monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.1 C. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from the Auxiliary Building may continue provided that the radioactivity level is recorded manually at least once per four hours during the actual release.

D. The Auxiliary Building Exhaust Stack flowrate shall be monitored and recorded during ventilation of the Auxiliary Building. If the flowrate monitor or recorder is inoperable, ventilation may continue provided the flowrate is determined and recorded manually at least once per four hours.

2.2.1.2 During release of airborne effluents from containment pressure relief line to the Auxiliary Building Exhaust Stack, the following conditions shall be met:

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

C. At least one Auxiliary Building exhaust fan shall be in operation.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.2 D. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from containment may continue provided that the radioactivity level is recorded manually at least once per four hours during the actual release.

E. The containment flow rate shall be monitored and automatically recorded during the release. If the flow rate monitor or recorder is inoperable, releases from the containment may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.2.1.3 During release of gaseous radioactive effluent from Containment Penetration M72 or M74 (Integrated Leak Rate Test Depressurization Vent Path) to the Auxiliary Building Stack: 8/30

A. The conditions set forth in Section 2.2.1.2 shall be met.

B. Automatic release termination capability is not required provided manual isolation can be accomplished in accordance with the requirements of SS-ST-ILRT-0001.

2.2.1.4 During the release of airborne effluents from the containment purge line:

A. The conditions set forth in Section 2.2.1.2 shall be met.

B. A noble gas monitor shall monitor the containment building atmosphere.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.5 During the release of airborne effluents from the gaseous waste discharge header:

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational, OR:

1) If the Auxiliary Building Exhaust Stack noble gas monitor is inoperable, effluent releases may continue provided that (prior to release):

a) At least two independent samples are analyzed in accordance with the applicable chemistry procedure.

b) At least two qualified individuals independently verify the release rate calculations.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

C. At least one Auxiliary Building exhaust fan shall be in operation.

D. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from waste gas decay tanks may continue provided that the gaseous radioactivity level is recorded manually at least once per four hours during the actual release.

E. The waste gas discharge header flow rate shall be monitored and automatically recorded during releases. If the flow rate monitor or recorder is inoperable, releases may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.2 Condenser Offgas

2.2.2.1 During power operation, the condenser air ejector 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 2)

2.2.3 Laboratory and Radioactive Waste Processing Building Stack

2.2.3.1 During the release of airborne effluents from the Laboratory and Radioactive Waste Processing Building (LRWPB) the following conditions shall be met:

A. The LRWPB noble gas monitor, iodine sampler and particulate sampler shall be operational, OR:

1) 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 and analyzed for principal gamma emitters.

[2)] If the iodine or particulate sampler(s) is/are 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, by the Shift Supervisor, of inoperability in accordance with Table 2.

B. The LRWPB noble gas radiation monitor shall be set in accordance with Part III to alarm at its predetermined setpoints.

C. The LRWPB Stack flow rate shall be monitored and recorded during ventilation of the LRWPB. If the flow rate monitor or recorder is inoperable, ventilation may continue provided the flow rate is determined and recorded manually at least once per four hours.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS

The sampling and analysis requirements stated in this Section will provide reasonable assurance that radioactive materials present in the liquid and airborne effluents will be properly identified and accurately quantified. This information will serve as the basis for determining doses to individuals as a result of radioactive effluents from FCS.

Records shall be maintained and reports of the sampling and results of analyses shall be submitted to the Nuclear Regulatory Commission in accordance with Section 4 of these Controls. Sampling, analysis and operability testing will typically be documented on Surveillance Tests or on Release Permits or Summaries.

3.1 Liquid Effluents

3.1.1 Radioactive liquid effluent sampling and activity analyses shall be performed in accordance with Table 1. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration at the point of release is limited to 10 CFR 20 limits for unrestricted areas.

3.1.2 Prior to release of each batch of liquid effluent, the batch shall be mixed, sampled, and analyzed for principal gamma emitters. When operational or other limitations preclude specific gamma radionuclide analysis of each batch:

3.1.2.1 Gross radioactivity measurements shall be made to estimate the quantity and concentrations of radioactive materials released in the batch.

3.1.2.2 A weekly sample composite from proportional aliquots from each batch released during the week shall be analyzed for the principal gamma-emitting radionuclides.

3.1.3 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 II, Section 4.

3.1.4 The radiation monitors for liquid effluents shall have their operability tested in accordance with the requirements in Table 3, Item A.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.2 Airborne Effluents

3.2.1 Radioactive airborne effluent sampling and activity analyses shall be performed in accordance with Table 2. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration of radioactive materials is limited to 10 CFR 20 limits at the unrestricted area boundary.

3.2.2 The radiation monitors/samplers for airborne effluents shall have their operability tested in accordance with the requirements in Table 3, Item B.

3.3 Lower Limit of Detection (LLD)

The lower limit of detection (LLD) for liquid and airborne effluent discharges, referenced in Part II, Tables 1 and 2, is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 * s_b}{E * V * D * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD = the lower limit of detection as defined above, in either picoCuries or microCuries, per unit mass or volume as a function of the value of D

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate, as counts per minute

E = the counting efficiency, as counts per disintegration

V = the sample size in units of mass or volume

D = 2.22E+06 of disintegrations per minute per microCurie or 2.22 disintegrations per minute per picoCurie

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.3 Y = the fractional radiochemical yield, when applicable

λ = the radioactive decay constant for the particular radionuclide

Δt = the elapsed time for the plant effluent between the midpoint of sample collection and time of counting

Appropriate values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an A Priori limit representing the capability of a measurement system and not as a limit for a particular measurement.

LLD verifications will be performed on a periodic basis. This determination is to ensure that the counting system is able to detect levels of radiation at the LLD values for the specific type of analysis required by Tables 1 and 2. They will be performed with a blank (non-radioactive) sample in the same counting geometry as the actual sample.

4.0 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 1 are complied with. These reports will meet the requirements for documentation of radioactive effluents contained in 10 CFR 50.36a; Reg. Guide 1.21, Rev. 1; Reg. Guide 4.8, Table 1; and Reg. Guide 1.109, Rev. 1.

4.1 Annual Radioactive Effluent Release Report

A report covering the operation of the Fort Calhoun Station during the previous calender year shall be submitted within 90 days after January 1 of each year per the requirements of 10CFR 50.36a.

The radioactive effluent release report shall include 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.

The radioactive effluent release report shall include 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.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.1 The radioactive effluent release report shall include 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.

The radioactive effluent release report shall include any 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.

4.2 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:

4.2.1 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.

4.2.2 Interpretations and statistical evaluation of the results, including an assessment of the observed impacts of the plant operation and environment.

4.2.3 The results of participation in a NRC approved Interlaboratory Comparison Program.

4.2.4 The results of land use survey required by Part II, Section 5.4.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.2.5 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:

4.2.5.1 Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded.

4.2.5.2 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.

4.2.5.3 Purification system flow history starting 48 hours prior to the first sample in which the limit was exceeded.

4.2.5.4 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

4.2.5.5 The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

4.3 Non-Routine Report

If a confirmed measured radionuclide concentration in an environmental sampling medium averaged over any calendar quarter sampling period exceeds the reporting level referenced in Table 7, and if the radioactivity is attributable to plant operation, a written report shall be submitted to the Nuclear Regulatory Commission within 30 days from the end of the quarter.

The report shall include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the anomalous result.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.4 EPA 40 CFR 190 Reporting Requirements

With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Part II, Sections 1.1.2, 1.2.2, or 1.3, based on quarterly and annual calculations, 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 190 standard. Otherwise, obtain a variance from the Commission to permit releases which exceed the 40 CFR 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.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

The requirements set forth in this Section will provide reasonable assurance that radioactive liquid and airborne effluent releases to the environment in and around Fort Calhoun Station are monitored and that any deviation of radiation levels above background will be identified.

5.1 Radiological environmental monitoring shall be conducted according to Table 4. 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 (Part II, Section 4.2).

5.2 If the level of radioactivity, from calculated doses, in the Annual Radiological Effluent Release Report leads to a higher exposure pathway to individuals, this pathway shall be added to the Radiological Environmental Monitoring Program.

5.3 If the level of radioactivity in an environmental sampling medium exceeds the reporting level specified in Table 7, a Non-routine Report shall be prepared and submitted to the Nuclear Regulatory Commission (Part II, Section 4.3). The detection capabilities of the equipment used for the analysis of Environmental Samples must meet the requirements of Table 6 for Lower Level of Detection (LLD).

5.4 A land use survey shall be conducted once per 24 months between the dates of June 1 and October 1. This 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 results of the land use survey shall be submitted to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report (Part II, Section 4.2). The survey shall be conducted under the following conditions:

5.4.1 Within a one-mile radius from the plant site, enumeration by door-to-door or equivalent counting techniques.

5.4.2 Within a five-mile radius, enumeration by using referenced information from county agricultural agents or other reliable sources.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

5.4.3 If it is learned from this survey that milk animals are present at a location which yields a calculated dose greater than from previously sampled location(s), the new location(s) shall be added to the monitoring program. The 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 is then added to the monitoring program. Also, any location(s) from which milk can no longer be obtained may be dropped and replaced if practicable from the monitoring program and the Nuclear Regulatory Commission shall be notified in the Annual Radiological Environmental Operating Report (Part II, Section 4.2).

5.4.4 Radiological Environmental Sampling locations and the media that is utilized for analysis are presented in Table 5. Details of the emergency TLD locations are contained in Emergency Preparedness Implementing Procedures.

5.5 Analyses shall be performed on radioactive materials as part of an Interlaboratory Comparison Program that has been approved by the Nuclear Regulatory Commission. The results of these analyses shall be included in the Annual Radiological Environmental Operating Report.

5.6 Deviations from the monitoring program, presented in this section and detailed in Table 4, are permitted if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of equipment, or if a person discontinues participation in the program and other legitimate reasons. If the equipment malfunctions, corrective actions will be complete as soon as practicable. If a person no longer supplies samples, a replacement will be made. All deviations from the sampling schedule will be described in the Annual Radiological Environmental Operating Report, pursuant to Part II, Section 4.2.

TABLE 1

Radioactive Liquid Effluent Sampling and Analysis

A. **Monitor & Hotel Waste Tanks Releases**

Sampling Frequency	Type of Acti ity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Each Batch	Principal Gamma Emitters(2)(3)	5.0 E-07
	I-131(2)	1.0 E-06
Monthly From One Batch	Dissolved Noble Gases(2) (Gamma Emitters)	1.0 E-05
Monthly Composite(7)	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite(7)	Sr-89, Sr-90	5.0 E-08

B. **Steam Generator Blowdown**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Weekly Composite(7)	Principal Gamma Emitters(3)	5.0 E-07
	I-131(5)	1.0 E-06
Monthly	Dissolved Noble Gases (Gamma Emitters)	1.0 E-05
Monthly Composite(7)	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite(7)	Sr-89, Sr-90	5.0 E-08

TABLE 2

Radioactive Airborne Effluent Sampling and Analysis

A. **Gas Decay Tank Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[(1)]
Prior to each release	Principal Gamma Emitters[(4)]	1.0 E-04

B. **Containment Purge Releases or Containment**

Pressure Relief Line Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[(1)]
Prior to each release	Principal Gamma Emitters[(4)]	1.0 E-04
Prior to each release	H-3	1.0 E-06

C. **Condenser Air Ejector Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[(1)]
Monthly[(6)]	Tritium (H-3)	1.0 E-06
Monthly	Principal Gamma Emitters[(4)]	1.0 E-04

TABLE 2
(Continued)

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

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

TABLES 1 and 2
(Continued)

NOTES:

(1) LLD is defined in Part II, Section 3.3.

(2) Gross Radioactivity is defined as the determination of radioactivity levels without regard to specific radionuclide identification and individual isotopic quantification.

(3) 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, Ce-141, and Ce-144.

(4) 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, Ce-141, Ce-144 for particulate emissions.

(5) 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 1.0 E-06 microCurie/milliliter.

(6) Required only when steam generator blowdown radioactivity for tritium (Table 1, Item B) exceeds 3.0 E-03 microCurie/milliliter.

(7) 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.

TABLE 3

Radiation and Environmental Monitors
Operability Test Requirements

A. Liquid Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-054 A/B	X(2)	X	X	X	-
RM-055/55A	-	-	X	X	X

B. Gaseous Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-043	X	X	X	X	-
RM-057	X	X	X	X	-
RM-062/51(1)	X	X	X	X	X
RM-041/42 Sampler	X	-	-	X	-
RM-060 Sampler Flow Rate	X	-	-	X	-

C. Envirnmntl. Monitors	Monthly Operations Check	Annual Air Flow Calibration
RM-035 → 039	X	X

NOTES:

(1) RM-051 will be substituted for RM-062 when it is sampling the Auxiliary Building Exhaust Stack.

(2) Visual flowcheck daily

TABLE 4

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
1. Direct Radiation	A. Ten TLD indicator stations, one control station, total of 11.	Gamma dose	Quarterly
	B. An inner-ring of 16 stations, one in each meteorological sector in the general area of the unrestricted area boundary and within 2.5 miles.	Gamma dose during site Area and General Emergencies only.	Replaced Annually
	C. An outer-ring of 16 stations, 1 in each meteorological sector located outside of the inner-ring, but no more distant than approximately 5 miles(5).	Gamma dose during site Area and General Emergencies only.	Replaced Annually
2. Air Monitoring	A. Indicator Stations	1) Filter for Gross Beta(3)	Weekly
	1. 3 stations in the general area of the unrestricted area boundary	2) Charcoal for I-131	Weekly
	2. City of Blair	3) Filter for Gamma Isotopic	Quarterly composite of wkly. fltrs.
	B. One background station	Same as A. above	
3. Water	A. Missouri River at nearest downstream drinking water intake.	Gamma Isotopic, H-3	Monthly composite for Gamma Isotopic Analysis
	B. Missouri River downstream near the mixing zone.		Quarterly composite for H-3 Analysis
	C. Missouri River upstream of plant intake (background).		
4. Milk(4)	A. Nearest family cow when available or one dairy farm within 5 miles.	Gamma Isotopic and I-131	Semimonthly grazing season (May to October)
	B. One dairy farm between 5 miles and 18.75 miles. (Background)		
5. Fish	A. Four fish samples within vicinity of plant discharge.	Gamma Isotopic	Once per season (May to October)
	B. One background sample upstream of plant discharge.		
6. Sediment	One sample from downstream area on the station side of the Missouri River.	Gamma Isotopic	Semiannually

TABLE 4
(Continued)

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
7. **Vegetables or Food Products**	A. One sample outside of 5 miles. (Background) B. One sample in the highest exposure pathway.	Gamma Isotopic	Once per season (May to October)

Notes:

(1) See Table 6 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/m^3, a gamma spectral analysis will be performed.

(4) When milk samples are not available, a broad leaf vegetation or pasture grass sample shall be collected, when available.

(5) Details of the Emergency TLD Stations are contained in Emergency Preparedness Implementing Procedures.

TABLF 5

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from (north)	Airborne Particulate	Airborne Iodine	TLD	Surface Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
1	Onsite Station No. 1, 110-meter weather tower	0.5	293°	X	X	X					
2	Onsite Station No. 2, adjacent to old plant access road	0.6	208°	X	X	X					
3	Offsite Station No. 3, intersection of Hwy. 75 and farm access road	0.8	145°	X	X	X					
4	Blair OPPD office	3.0	303°	X	X	X					
5	EOF Building, North Omaha Power Station	17.5	157°	X	X	X					
6	Fort Calhoun City Hall	4.8	149°			X					
7	Fence around intake gate, Desoto Wildlife Refuge	2.0	101°			X					
8	Entrance to Plant Site from Hwy. 75	0.6	180°			X					
9	NW of Plant	1.0	310°			X					
10	WSW of Plant	0.7	250°			X					
11	SE of Plant	0.9	130°			X					
12	Met. Utilities Dist., Florence Treatment Plant North Omaha, NE	17.0	156°				X				
13	West bank Missouri River, downstream from reactor building	0.5	106°				X		X		
14	125' upstream from intake bldg., west bank of river	0.1	345°				X		X		

TABLE 5
(Continued)

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from (north)	Airborne Particulate	Airborne Iodine	TLD	Well Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
15	Smith Farm(1)	1.9	133°				X				
16	OPPD Onsite Well(1)	0.1	154°				X				
17	Headquarters Bldg.,(1) Desoto Wildlife Refuge	3.1	53°				X				
18	Miller Farm(3) (Discontinued Milk)	0.8	206°								X
19	Flynn Dairy(2)	3.4	310°					X			
20	Mohr Dairy(1)(2)(3)	7.9	187°					X			X
21	Japp Dairy(2)	6.3	219°					X			
22	Fish Sampling Area - Missouri River	R.M. 645.0	-							X	
23	Fish Sampling Area - Missouri River	R.M. 666.0	-							X	
24	Legenhausen Farm (Discontinued)	0.7	207°								
25	Seltz Farm(2)	2.7	168°					X			
26	Vegetation(3) (High Expos. Pthwy. for Veg.)										X
27	Vegetation(3) (Background)										X

Notes:

(1) Sampling not required for pathway modeling, collections performed for additional information only.

(2) When a milk sample is not available at a location, a broad leaf vegetation sample will be collected at that location as a substitute.

(3) Vegetation sites chosen based on Land Use Survey and Semiannual Radioactive Effluent Release Report.

TABLE 6

Detection Capabilities for Environmental Sample Analysis[1][2][3]
Lower Limit of Detection (LLD)

Sample	Units	Gross Beta	H-3	Mn-54	Fe-59	Co-58, 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	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
Air Particulate or Gases	pCi/m^3	1.0E-02	--	--	--	--	--	--	--	7.0E-02	--	--	--
Sediment	pCi/kg (dry)	--	--	--	--	--	--	--	--	--	1.5E+02	1.8E+02	--
Grass or Broad Leaf Vegetation/ Vegetables	pCi/kg (wet)	--	--	--	--	--	--	--	--	6.0E+01	6.0E+01	8.0E+01	--

(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 Surveillance Report pursuant to Part II, Section 5.1.

(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, for purposes of these specifications, as the smallest concentration or radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$\text{LLD} = \frac{4.66\ s_b}{E \cdot V \cdot 2.22\text{E+06} \cdot Y \cdot \exp(-\lambda \Delta t)}$$

TABLE 7

Reporting Levels for Radioactivity Concentrations in Environmental Samples(1)

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	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
Air Particulate or Gases	pCi/m^3	--	--	--	--	--	--	--	--	9.0E-01	--	--	--
Grass or Broad Leaf Vegetation/ Vegetables	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:

$$\frac{\text{Concentration} \quad (1)}{\text{Reporting Level} \quad (1)} + \frac{\text{Concentration} \quad (2)}{\text{Reporting Level} \quad (2)} + \cdots \geq 1.0$$

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 II, Section 1.1 and 1.2. 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.

PART III

RADIOLOGICAL EFFLUENT RADIATION MONITOR CALCULATIONS

1.0 EFFLUENT MONITOR SETPOINTS

1.1 Liquid Effluents

There are two liquid discharge pathways to the Missouri River. These pathways originate with the radioactive liquid waste processing system (monitor or hotel tanks) and the steam generator blowdown system. Both of these pathways empty into the circulating water system which discharges to the Missouri River (see Figure 1). Figure 2 depicts the liquid discharge pathways and associated radiation monitors. Figure 3 depicts the methods of liquid effluent treatment. A detailed discussion of the liquid effluent treatment system is presented in Section 2.1.

The flowrate for dilution water varies with the number of circulating water pumps in service and with the operation of the warm water recirculation. Some warm water from the condenser outlet is diverted from the circulating water discharge to upstream of the intake structure to help prevent ice from forming on the circulating water pump intakes during winter months. The varying dilution flowrate is accounted for in the dilution calculations for monitor tank and stream generation releases.

Alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the concentration of radioactive material released in liquid effluents at site discharge shall be less than the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2.

Cs-137 is the most abundant radionuclide in liquid effluent streams and is used to calibrate the liquid effluent monitors.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2 Liquid Effluent Radiation Monitors

1.2.1 Steam Generator Blowdown Monitors (RM-054A and B)

These process radiation detectors monitor the flow through the steam generator blowdown lines and automatically close the blowdown isolation valves if the monitor high alarm setpoint is reached. The high alarm setpoint calculations are based on controlling the discharge at 10 CFR 20 limits of 1.0E-06 μCi/ml at site discharge.

The following calculations for maximum concentration and alarm setpoints are valid when steam generator blowdown is the only liquid release pathway. For simultaneous radioactive liquid releases of steam generator blowdown and monitor tank discharge, refer to Section 1.5.1.

The maximum allowable concentration in the blowdown line is calculated as follows:

$$A_o = \frac{(1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o}$$

Where:

1.0E-06 mCi/ml = 10 CFR 20 Limit for unidentified radionuclides at site discharge (10 CFR 20, Appendix B, Note 2).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)

Y_o = Blowdown flow rate (gpm). (Normal blowdown flow rate is based on 2 transfer pumps with a design flow of 135 gpm each, 270 gpm total. Other flow rates may be used, as required.)

A_o = Maximum allowable blowdown concentration (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.1 The high alarm setpoint (CPM) =

$$.85 \; [\; (S_F) \; (A_o) + B \;]$$

Where:

.85 = Correction factor for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable blowdown line activity (μCi/ml).

B = Background (CPM).

Setpoints may be recalculated based on adjusted dilution flow and adjusted blowdown flow.

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified prior to automatic actuation of the blowdown isolation valves.

1.2.2 Overboard Discharge Header Monitor (RM-055 or RM-055A)

This process radiation monitor provides control of the waste monitor tank effluent by monitoring the overboard header prior to its discharge into the circulating water discharge tunnel. The concentration of activity at discharge is controlled below the 10 CFR 20 limit of 1.0E-06 μCi/ml at site discharge for unidentified isotopes by the high alarm setpoint which closes the overboard flow control valve.

The following calculations for maximum concentration and alarm setpoints are valid when Monitor Tank discharge is the only liquid release pathway. For simultaneous radioactive liquid releases of monitor tank discharge and steam generator blowdown, refer to Section 1.5.1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The maximum allowable concentration in the overboard discharge header is:

$$A_o = \frac{(1.0E\text{-}06\ \mu Ci/ml)\ \ (X_o)}{Y_o}$$

Where:

1.0E-06 mCi/ml= 10 CFR 20 Limit for unidentified radionuclides at site discharge (10 CFR 20, Appendix B, Note 2).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)

Y_o = Maximum monitor tank discharge flow rate (gpm). (Normal monitor tank maximum flow is 50 gpm. Other flow rates may be used, as required.)

A_o = Maximum allowable activity in discharge header (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The high alarm setpoint (CPM) =

$.85 \; [\, (S_f \, (A_o) + B]$

Where:

$.85$ = Correction factor for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable concentration in discharge header (μCi/ml).

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to automatic actuation of the overboard flow control valve.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.3 Airborne Effluents

The airborne effluent monitoring instrumentation for controlling and monitoring normal radioactive material releases in accordance with 10 CFR 20, Appendix B, Table 2, Column 1 limits at the unrestricted area boundary (see Figure 1), are summarized as follows:

A. Auxiliary Building - The Auxiliary Building Exhaust Stack receives discharges from the waste gas decay tanks, containment purge, containment vent systems and the auxiliary building ventilation system. Effluents are monitored by RM-062, a noble gas activity monitor. Additionally, noble gas activity monitor, RM-051, provides redundant back-up monitoring capabilities to the RM-062 monitor. Iodine and particulate sampling capabilities are provided by RM-060. Ventilation Isolation Actuation Signal (VIAS) is actuated by exceeding a monitor's alarm setpoint. Actuation of VIAS will isolate releases from containment and waste gas decay tanks. The Auxiliary Building Exhaust fans will remain in operation.

B. Laboratory and Radioactive Waste Process-ing Building (LRWPB) - Noble gas, iodine, and particulate monitoring and sampling is provided by Radiation Monitors RM-043, RM-042, and RM-041, respectively. These radiation monitors/samplers do not serve a control function.

C. Condenser Off-Gas Monitors - Noble gas activity is monitored by RM-057. The condenser off-gas is discharged directly to the environment. Exceeding the high alarm setpoint on RM-057 will activate isolation of main steam to the Auxiliary Steam System.

An airborne radioactive waste flow diagram with the applicable, associated radiation monitoring instrumentation and controls is presented as Figure 4. The airborne waste disposal system is presented in Figure 5. A detailed discussion of the airborne effluent treatment system is presented in Section 2.2.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4 Airborne Effluent Radiation Monitors

1.4.1 Auxiliary Building Exhaust Stack Noble Gas Activity Monitor (RM-062/RM-051)

Either of these monitors may be used to measure the noble gas activity in the exhaust stack. The noble gas is monitored after passing through a particulate filter. The monitor controls airborne releases so that the 10 CFR 20 limit at the unrestricted area boundary of 5.0E-07 μCi/cc, based upon Xe-133, is not exceeded. The Ventilation Isolation Actuation Signal is initiated when the high alarm setpoint is reached.

The following calculations for maximum release rate and alarm setpoint are valid when Auxiliary Building Exhaust Stack is the only airborne release pathway. For simultaneous airborne releases from Auxiliary Building Exhaust Stack, Condenser Off-gas and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for stack airborne activity is calculated as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)}\ x\ (1.0E\text{+}06\ cc/m^3) = 1.0E\text{+}05\ \mu Ci/\sec$$

Where:

5.0E-07 μCi/cc = 10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).

5.0E-06 sec/m³ = Annual average dispersion factor at the unrestricted area boundary.

1.0E+06 cc/m³ = Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ [\ \frac{(1.0E\text{+}05)\ (S_F)\ (60)}{(F_V)\ (28317)} + B\ ]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.1 Where:

.85 =	Correction for instrument meter error.
S_F =	Detector sensitivity factor (CPM/ μCi/cc). (Sensitivity based on Xe-133)
60 =	Conversion (seconds to minutes).
28317 =	Conversion factor (ft^3 to cc).
F_v =	Auxiliary Building Exhaust stack flow rate (SCFM). (Default maximum flow rate is 122500 cfm for 3 Auxiliary Building exhaust fans and 2 containment purge fans in operation. Other flow rates may be used, as required.)
B =	Background (CPM).

An alarm setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to actuation of VIAS.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.2 Condenser Air Ejector Monitor (RM-057)

This monitor is located in the turbine building and monitors the condenser off-gas. The purpose of this monitor is to monitor the condenser off-gas discharges so that the 10 CFR 20 limit at the unrestricted area boundary of 5.0E-07 μCi/cc, based upon Xe-133, is not exceeded.

The following calculations for maximum release rate and alarm setpoint are valid when condenser off-gas is the only airborne release pathway. For simultaneous airborne releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for condenser air ejector monitor is as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \text{sec}/m^3)} \times (1.0E{+}06\ cc/m^3) = 1.0E{+}05\ \mu Ci/\text{sec}$$

Where:

5.0E-07 μCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m^3	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m^3	=	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ [\ \frac{(1.0E{+}05)\ (S_F)\ (60)}{(F_v)\ (28317)} + B\ ]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.2 Where:

.85	=	Correction for instrument meter error.
S_F	=	Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on Xe-133)
60	=	Conversion (seconds to minutes).
28317	=	Conversion factor (ft^3 to cc).
F_v	=	Vent stack flow rate (SCFM). Default maximum flow rate is 4755 scfm (3 vacuum pumps in hogging mode. Other flow rates may be used, as required.)
B	=	Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, allowing time for corrective actions prior to exceeding the alarm setpoint and tripping of the auxiliary steam supply valve, RCV-978.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.3 Laboratory and Radioactive Waste Processing Building Exhaust Stack Noble Gas Activity Monitor (RM-043)

RM-043 is located in the Radwaste Building and samples the LRWPB Exhaust Stack. The monitor alarm setpoint is based on the 10 CFR 20 limit for Xe-133 at the unrestricted area boundary.

The following calculations for maximum release rate and alarm setpoint are valid when the LRWPB Exhaust Stack is the only airborne release pathway. For simultaneous airborne releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for RM-043 is as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)} \times (1.0E{+}06\,cc/m^3) = 1.0E{+}05\ \mu Ci/\sec$$

Where:

5.0E-07 µCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m^3	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m^3	=	Constant of unit conversion.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.3 The high alarm setpoint (CPM):

$$Setpoint = .85 \left[\frac{(1.0E{+}05)\ (S_F)\ (60)}{(F_v)\ \ (28317)} + B \right]$$

Where:

.85 = Correction for instrument meter error.

S_f = Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on XE-133)

60 = Conversion (seconds to minutes).

28317 = Conversion factor (ft^3 to cc).

F_v = LRWPB Exhaust stack flow rate (SCFM). (Default flow rate is 28700 cfm. Other flow rates may be used if required.

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified.

This monitor alarms in the Control Room. There are no automatic control functions associated with the actuation of the alarm.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5 Simultaneous Release Pathways

1.5.1 Liquid Release Pathways

The liquid radiation monitors (RM054A and B, RM055, and RM055A) control liquid releases so that 10 CFR 20 limit of 1.0E-06 μCi/ml for unidentified isotopes at site discharge is not exceeded. There are two liquid release pathways that contribute to the concentration at site discharge. These are Steam Generator Blowdown and Monitor Tank Overboard Discharge Header. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.2 so that unrestricted area concentration limits are not exceeded.

The calculations for the alarm setpoints for the liquid effluent monitors will be adjusted as follows:

$$A_t = K_o A_o + K_1 A_1$$

$$A_t = \frac{K_o\ (1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o} + \frac{K_1\ (1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_1}$$

Where:

A_s = Sum of individual maximum allowable concentrations for Steam Generator and Monitor Tank prior to dilution for simultaneous liquid releases (μCi/ml)

A_0 = Maximum allowable concentration in Steam Generator blowdown Line (μCi/ml)

A_1 = Maximum allowable concentration in Monitor Tank Discharge Line (μCi/ml)

K_0 = Proportionality constant for Steam Generator (See Table 1)

K_1 = Proportionality constant for Monitor Tank (See Table 1)

X_0 = Total dilution flow in Discharge Tunnel (GPM)

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.1 Where:

Y_o = Steam Generator Blowdown flowrate (GPM)

Y_1 = Monitor Tank Discharge flowrate (GPM)

The High Alarm Setpoint for Steam Generator Blowdown monitors, RM054A and B, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_o\ S_{Fo}\ A_o + B_o]$$

The High Alarm Setpoint for Monitor Tank Discharge monitors, RM055 and 55A, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_1\ S_{F1}\ A_1 + B_1]$$

Where:

S_{Fo} = Detector Sensitivity factor for RM054A/B, CPM/(μCi/ml), based on Cs-137.

S_{F1} = Detector Sensitivity factor for RM055/55A, CPM/(μCi/ml), based on Cs-137.

A_o = Maximum allowable concentration in SG Blowdown line. (μCi/ml)

A_1 = Maximum allowable concentration in MT Discharge line. (μCi/ml)

B_o = RM054 A or B background countrate. (CPM)

B_1 = RM055 or 55A background countrate. (CPM)

Where:

K_o, K_1 = Proportionality constants. See Table 1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Airborne Release Pathway

The noble gas radiation monitors (RM043, RM057, and RM062) control airborne releases so that 10 CFR 20 limits of 5.0E-07 μCi/cc for noble gases at the unrestricted area boundary is not exceeded. There are three pathways that contribute to the concentration at the unrestricted area boundary. These are the Auxiliary Building Exhaust Stack, Condenser Off-gas, and the LRWPB Exhaust Stack. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.4 to ensure that unrestricted area concentration limits are not exceeded.

The calculations for the alarm setpoints for the airborne effluent monitors will be adjusted as follows:

The maximum allowable release rates for simultaneous releases is:

$$Max.\ Release\ Rate = \sum_{i=0}^{4} K_i R_i = \sum_{i=0}^{4} K_i \frac{Conc_i}{\chi/Q}$$

Where:

R_0 = RM061/RM050 release rate (μCi/sec)
R_1 = RM062/RM051 release rate (μCi/sec)
R_2 = RM057 release rate (μCi/sec)
R_3 = RM043 release rate (μCi/sec)
R_4 = RM041/42 releaserate (μCi/sec)
$K_0 \rightarrow K_4$ = Proportionality constants. See Table 1.

$Conc_i$ = Radionuclide concentration for the monitor of interest.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 The maximum release rate is then:

$$\left[\frac{K_1 (5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_3 (5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \right.$$

$$\left. \frac{K_6 (5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} \right] 1.0E{+}06\ \frac{cc}{m^3} = Max.\ Release\ Rate$$

The alarm setpoints for the noble gas monitors will then be:

$$RM062/51 = .85 \left[K_0 \frac{(1.0\ E{+}05)\ (S_F)(60)}{F_V\ (28317)} + B \right]$$

$$RM057 = .85 \left[K_1 \frac{(1.0\ E{+}05)\ (S_F)(60)}{(F_V)\ (28317)} + B \right]$$

$$RM043 = .85 \left[K_2 \frac{(1.0\ E{+}05)\ (S_F)(60)}{(F_V)\ (28317)} + B \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Where:

.85	=	Correction factor for instrument meter error.
$K_0 \rightarrow K_4$	=	Proportionality contents. See Table 1.
S_F	=	Detector sensitivity factor.
F_V	=	Vent stack flowrate. (Condenser off-gas flowrate for RM057, LRWPB Exhaust stack flow rate for RM043, Auxiliary Building Exhaust Stack flow rate for RM62/51).
B	=	Monitor background count rate.
60	=	Constant of unit conversion (60 sec/min).

TABLE 1

Proportionally Constants for Simultaneous Release Pathways

a. Liquid Effluents	$K_0 + K_1 \leq 1$	
$K_0 = .30$	RM054A/B	
$K_1 = .70$	RM055/55A	
b. Gaseous Effluents	$S_i\ K_i \leq 1$	
$K_0 = .10$	RM061/50	
$K_1 = .70$	RM062/51	(when RM051 is in the Auxiliary Building Exhaust Stack Position)
$K_2 = .05$	RM057	
$K_3 = .05$	RM043	
$K_4 = .10$	RM041/42	

NOTE: The constants are based on prior knowledge and may be updated as necessary to provide for plant operations.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.1 Liquid Radwaste Treatment System

The major equipment or subsystem(s) of the liquid radwaste treatment system are comprised of the waste filters, monitor tanks, and evaporator. This equipment, including associated pumps, valves and piping, is used in different combinations on an as-needed basis to process the liquid effluent to provide compliance with the as low as is reasonably achievable philosophy and the applicable section of 10 CFR Part 20. The liquid radwaste treatment system is described in Section 11.1.2 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405-M-100, M-9 and M-8.

A filtration/ion exchange (FIX) system may be utilized for processing liquid radwaste in the event the waste evaporator is not in service. 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 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 Part II, Section 2.1.

Every effort will be made to process all liquid waste, except from the hotel waste tanks, through the evaporator or FIX before entering the monitor tanks. If the radioactive liquid waste is discharged without processing and it appears that 1/2 of the annual objective will be exceeded during the calendar quarter, a special report shall be submitted to the Commission pursuant to Part II, Section 2.1.

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.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.2 Airborne Radwaste Treatment 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, a special report shall be submitted to the Commission pursuant to Part II, Section 2.2.

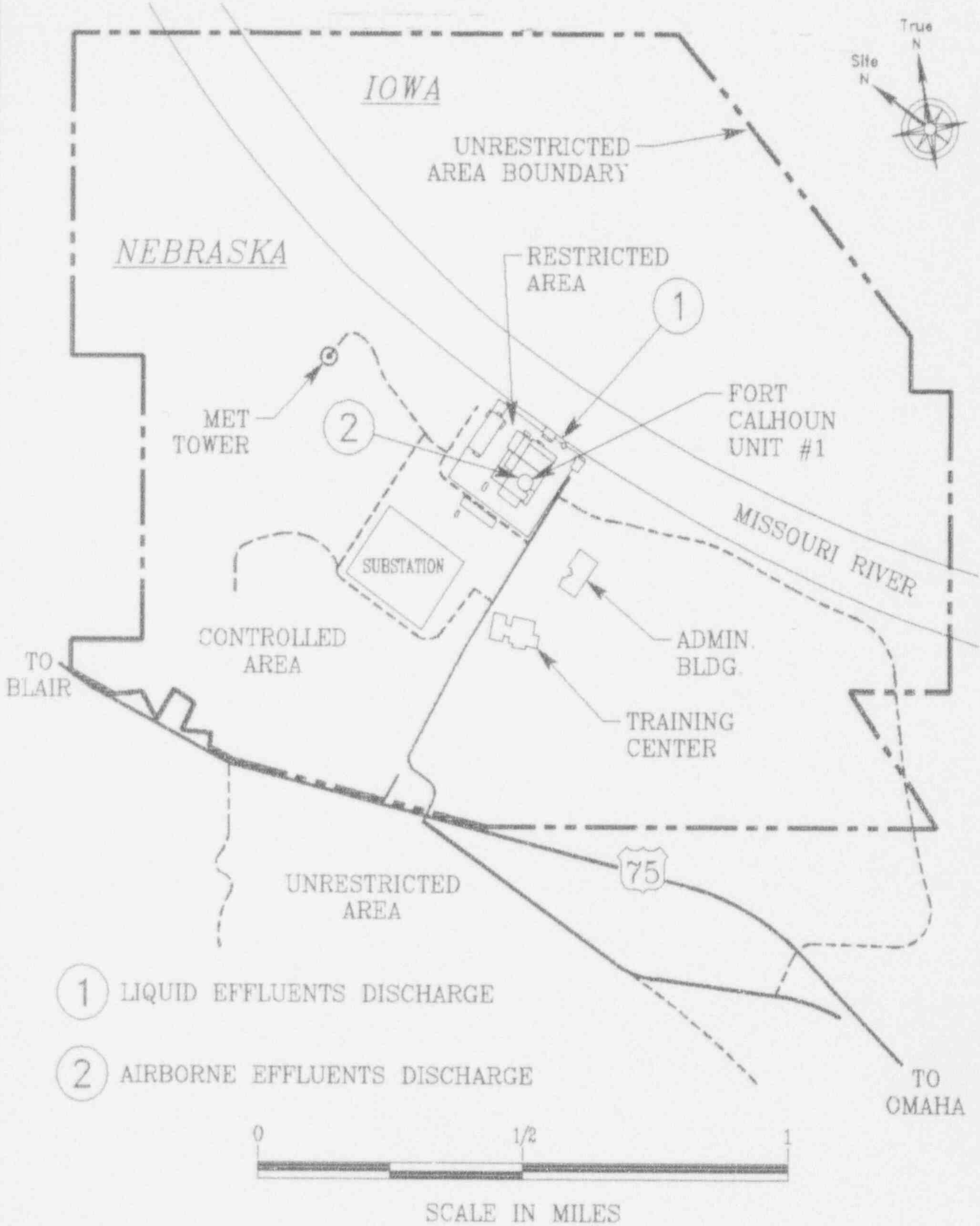
The radioactive effluents from the controlled access area of the auxiliary building are filtered by the HEPA filters in the auxiliary building ventilation system. If the radioactive effluents are discharged without the HEPA filters, a special report shall be submitted to the NRC pursuant to Part II, Section 2.2.

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 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 as per Part II, Section 2.2.

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, a special report shall be submitted to the Commission pursuant to Part II, Section 2.2.

The airborne radwaste treatment system is described in Section 11.1.3 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405-M-1 and M-261.

Figure 1



EXCLUSION AND SITE BOUNDARY MAP

Figure 2

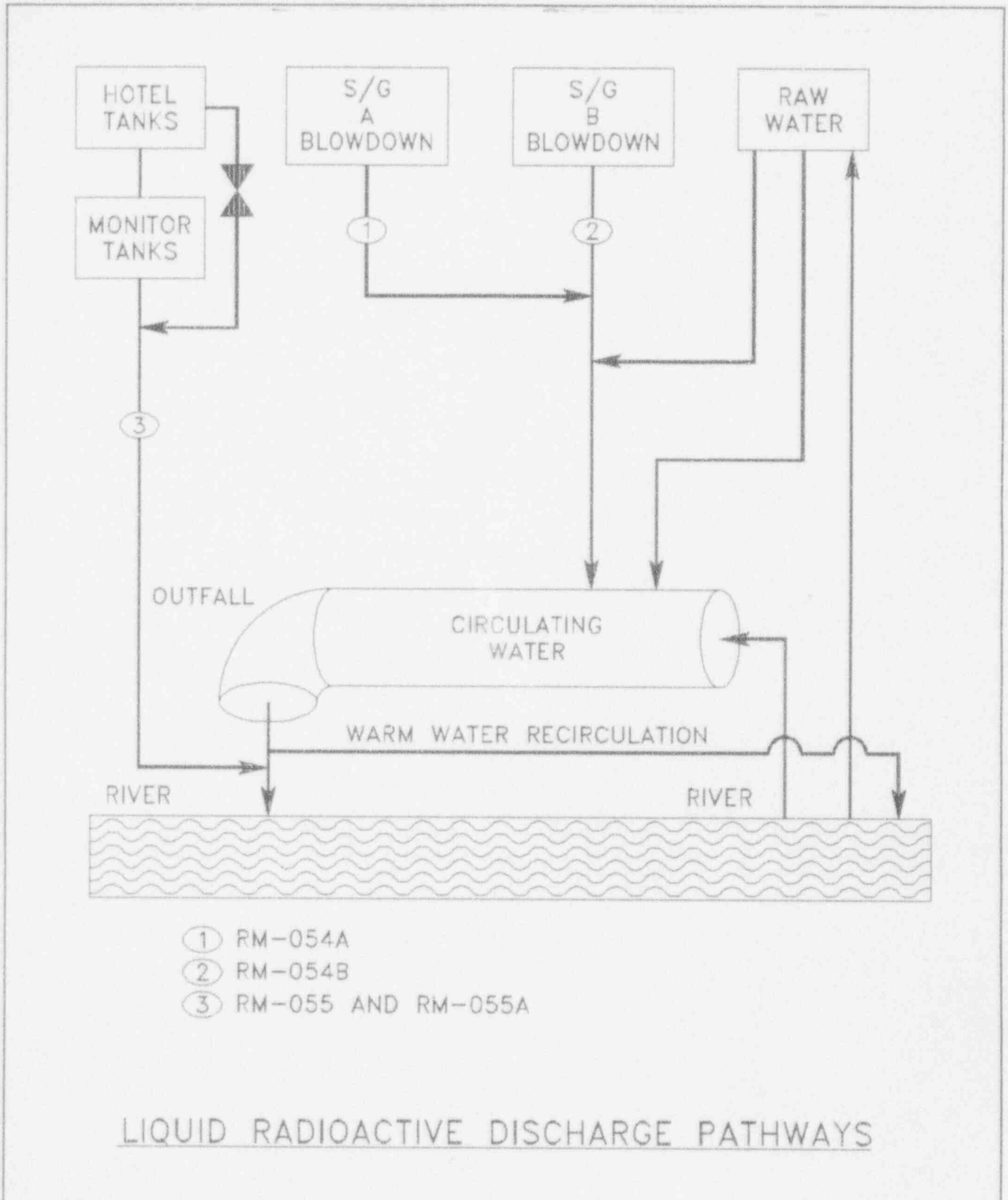
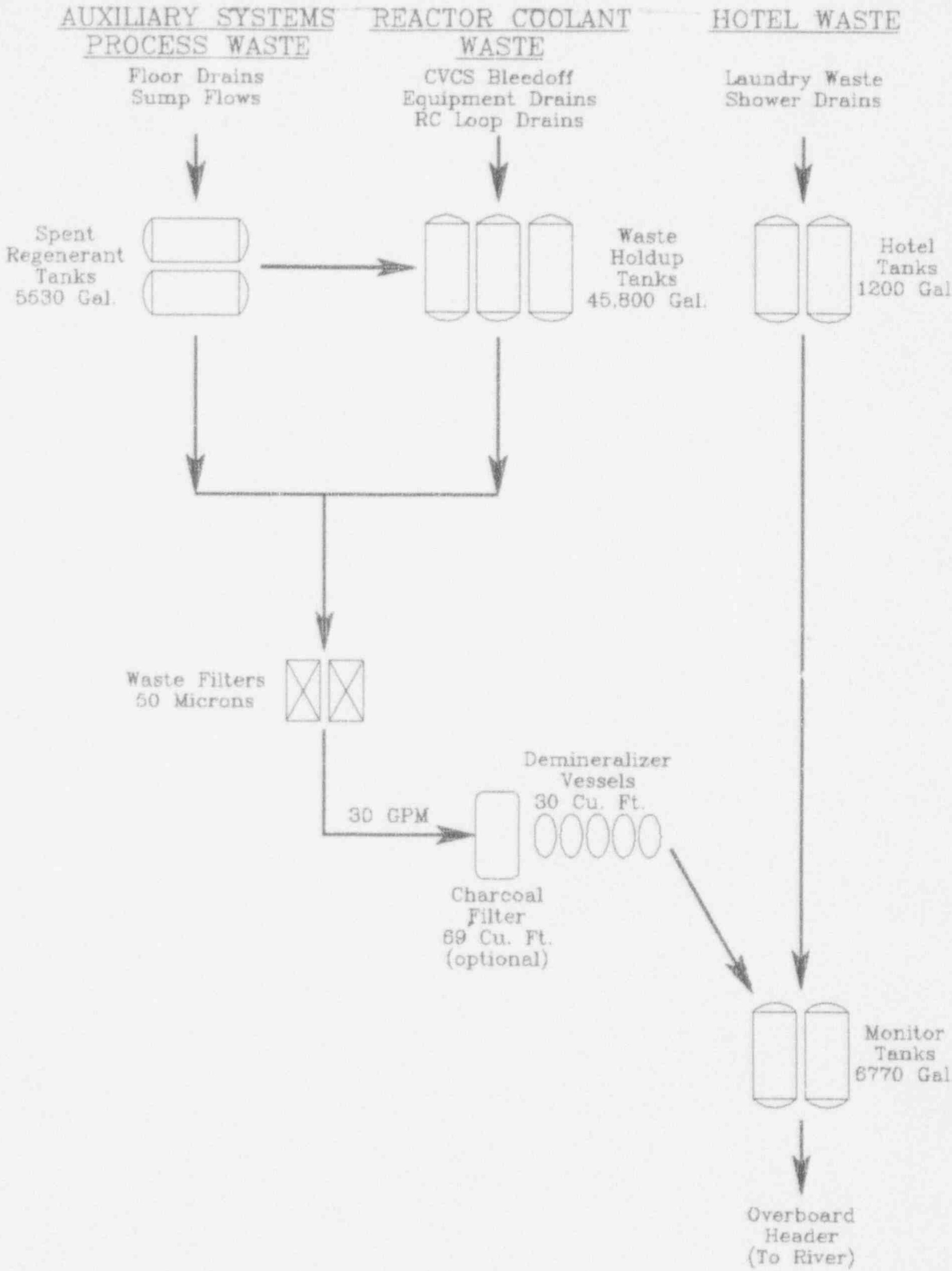


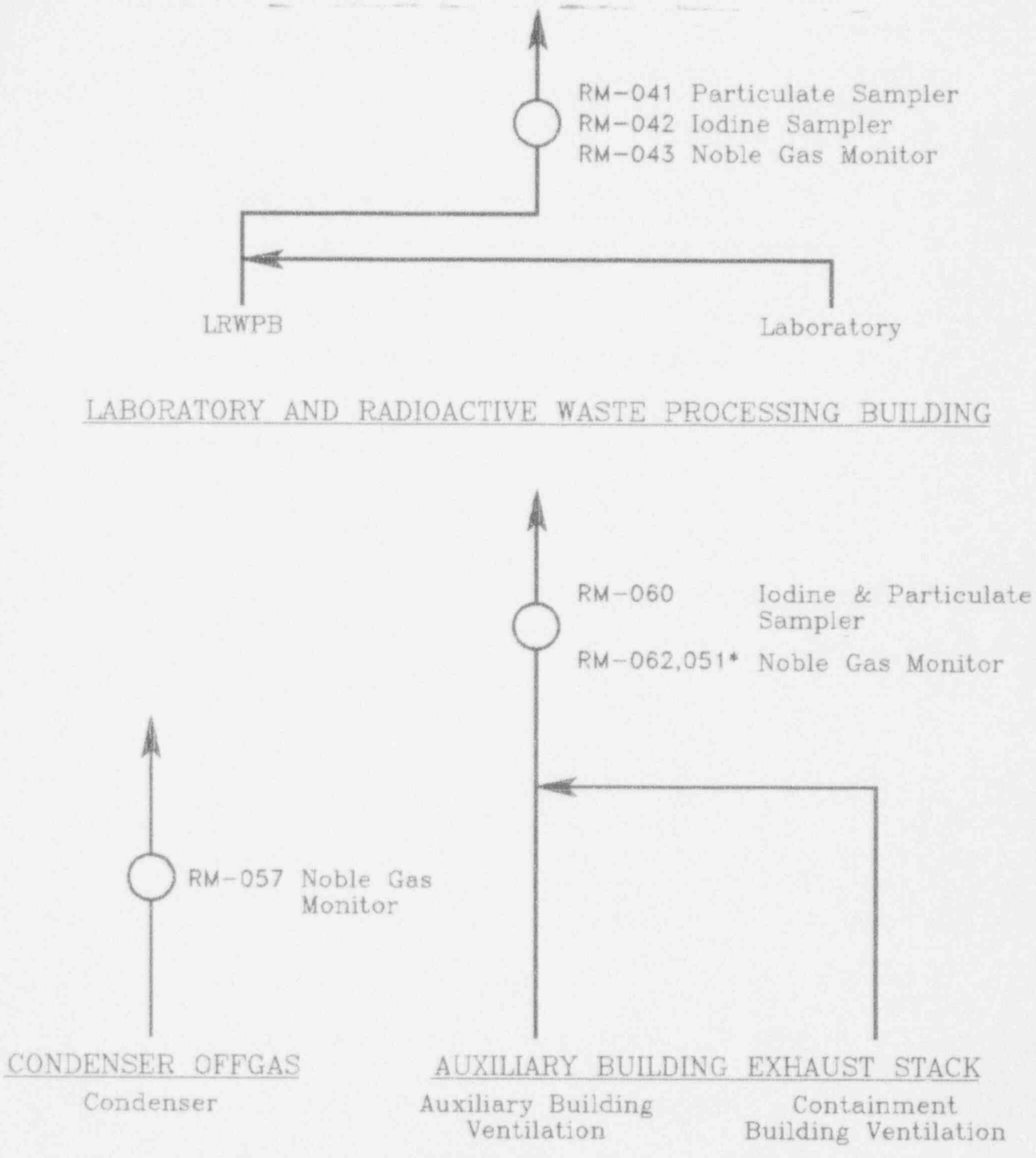
Figure 2 CH8915E

Figure 3



LIQUID RADIOACTIVE WASTE DISPOSAL SYSTEM

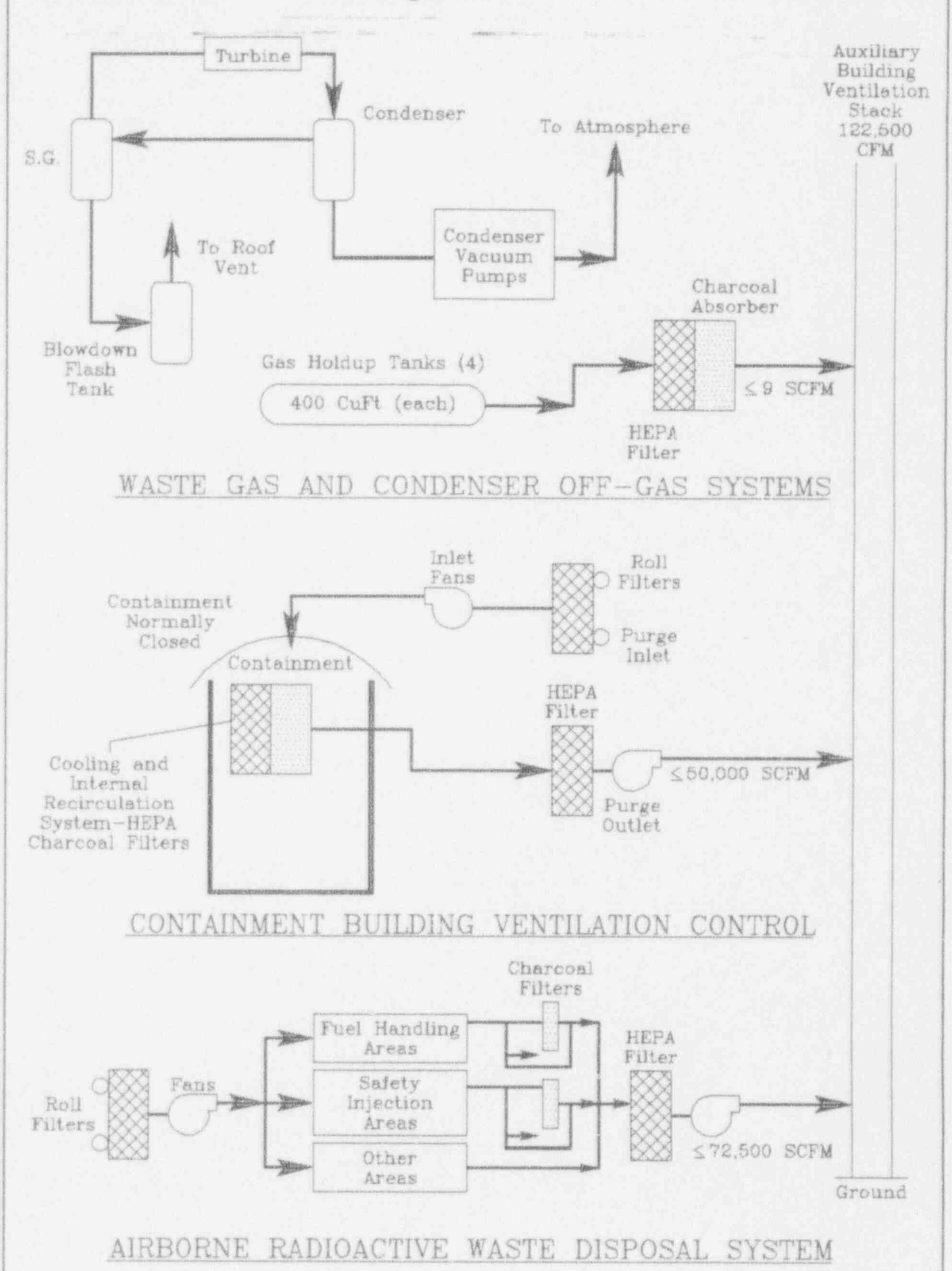
Figure 4



* Can be used for either containment or auxiliary building exhaust stack monitoring.

AIRBORNE EFFLUENT DISCHARGE PATHWAYS

Figure 5


Turbine
Condenser
S.G.
To Atmosphere
Auxiliary Building Ventilation Stack 122,500 CFM
To Roof Vent
Condenser Vacuum Pumps
Charcoal Absorber
Blowdown Flash Tank
Gas Holdup Tanks (4)
400 CuFt (each)
≤ 9 SCFM
HEPA Filter
WASTE GAS AND CONDENSER OFF-GAS SYSTEMS
Inlet Fans
Roll Filters
Containment Normally Closed
Purge Inlet
Containment
HEPA Filter
Cooling and Internal Recirculation System-HEPA Charcoal Filters
≤ 50,000 SCFM
Purge Outlet
CONTAINMENT BUILDING VENTILATION CONTROL
Charcoal Filters
Fuel Handling Areas
HEPA Filter
Roll Filters
Fans
Safety Injection Areas
Other Areas
≤ 72,500 SCFM
Ground
AIRBORNE RADIOACTIVE WASTE DISPOSAL SYSTEM

PART IV

RADIOLOGICAL EFFLUENT MONITORING CALCULATIONS

1.0 EFFLUENT CONCENTRATIONS

1.1 Liquid Effluent Concentrations

The concentration of radioactive material in liquid effluents (after dilution in the Circulating Water System) will be limited to the concentrations as specified in 10 CFR 20, Appendix B, Table 2, Column 2. For batch releases (Monitor and Hotel Waste Tanks and Steam Generators) and for continuous releases (Steam Generator Blowdown), the analyses will be performed in accordance with Part II, Table 1, and the concentration of each radionuclide at site discharge will be calculated, based on the following equation:

Radionuclide concentration at site discharge:

$$A_i = \frac{a_i f}{F + f}$$

$$\text{and } \sum_{i=1}^{n} A_i / wec_i \leq 1$$

Where:

A_i = concentration at site discharge for radionuclide, i, in µCi/ml.

a_i = concentration of radionuclide, i, in the undiluted effluent in µCi/ml.

f = undiluted effluent flowrate, in gpm.

F = total diluted effluent flowrate in gpm.

wec_i = water effluent concentration limit for radionuclide, i, per 10 CFR 20, Appendix B, Table 2, Column 2.

1.0 EFFLUENT CONCENTRATIONS

NOTE: In addition to the above defined method, Notes 1 through 4 of 10 CFR Part 20, Appendix B, will also be applicable.

1.2 Airborne Effluent Concentrations

The concentration at the unrestricted area boundary, due to airborne effluent releases, will be limited to less than Appendix B, Table 2, Column 1, values. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event an airborne effluent release from the station result in an alarm setpoint being exceeded, an evaluation of the unrestricted area boundary concentration resulting from the release will be performed:

To determine the concentration and air effluent concentration (aec) fraction summation at the unrestricted area boundary, the following equations will be used:

$$A_i = K_o Q_i (\chi/Q)$$

$$\text{and } \sum_{i=1}^{n} A_i/aec_i \leq 1$$

Where:

A_i = Concentration of radionuclide, i, at the unrestricted area boundary

K_o = Constant of unit conversion. ($1E\text{-}6 m^3/cc$)

aec_i = Air effluent concentration limit (10 CFR 20, Appendix B, Table 2, Column 1 value for radionuclide, i)

Q_i = The release rate of radionuclides i, in airborne effluents from all vent releases (in $\mu Ci/sec.$)

(χ/Q) = 5E-6 sec/m^3. For all vent releases. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary

1.0 EFFLUENT CONCENTRATIONS

As appropriate, simultaneous releases from the Auxiliary Building Ventilation Stack, Laboratory and Radwaste Building Stack and condenser off gas will be considered in evaluating compliance with the release rate limits of 10 CFR 20. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. Historical annual average dispersion parameters, as presented in Table 3, may be used for evaluating the airborne effluent dose rate.

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding those more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding 10 CFR 20 limits. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based upon the above criteria, no further analyses are required for demonstrating compliance with 10 CFR 20.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS

2.1 Liquid Effluent Dose Calculations

Three pathways for human exposure to liquid releases from FCS to the Missouri River exists: 1) fish, 2) drinking water, and 3) Shoreline deposition. Fish are considered to be taken from the vicinity of the plant discharge. The drinking water for Omaha is located 19 miles downstream from FCS. The dilution factors for these pathways are derived from the Revised Environmental Report for FCS, (1974), (page 4-29 and 4-31). This report states that during Low-Low river conditions, the concentration at Omaha's water intake will be ≤14% of the concentration at discharge from FCS and will average 3%. This equates to a dilution factor of 7.14, which is used to calculate the maximum dose to an individual from liquid pathways and a dilution factor of 33.33, for calculating the average dose. All pathways combine to give the dose to an individual in unrestricted areas.

10 CFR 50, App. I restricts the dose to individuals in the unrestricted areas from radioactive materials in liquid effluents from the Fort Calhoun Station to the following limits:

- during any calendar quarter
  ≤1.5 mrem to total body
  ≤5.0 mrem to any organ and
- during any calendar year
  ≤ 3.0 mrem to total body
  ≤ 10.0 mrem to any organ

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 The following calculational methods shall be used for determining the dose or dose commitment from liquid effluents.

Doses from Liquid Effluent Pathways

A. POTABLE WATER

$$R_{apj} = 1100 \frac{U_{ap}M_p}{F} \sum_{i=1}^{n} Q_i D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj}	=	is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.
U_{ap}	=	is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in ℓ/yr. Table 5
M_p	=	is the mixing ratio (reciprocal of the dilution factor) at the point of withdrawal of drinking water, dimensionless. Table 3
F	=	is the flow rate of the liquid effluent, in ft^3/ sec.
Q_i	=	is the annual release rate of radionuclide, i, in Ci/yr.
D_{aipj}	=	is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15
λ_i	=	is the radiological decay constant of radionuclide, i, in hr^{-1}.
t_p	=	is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of water, in hours. Table 16
1100	=	Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 B. AQUATIC FOODS

$$R_{apj} = 1100 \frac{U_{ap}M_p}{F} \sum_{i=1}^{n} Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in kg/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of harvest of aquatic food, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

B_{ip} = is the equilibrium bioaccumulation factor for radionuclide, i, in pathway, p, expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/liter), in (pCi/kg)/(pCi/liter). Table 2

D_{aipj} = is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of food, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 C. SHORELINE DEPOSITS

$$R_{apj} = 110{,}000 \frac{U_{ap}M_pW}{F} \sum_{i=1}^{n} Q_iT_{ip}D_{aipj}[\exp(-\lambda_i t_p)][1-\exp(-\lambda_i t_b)]$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the exposure time for an individual of age group, a, associated with pathway, p, in hr/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of exposure, dimensionless. Table 3

W = is the shore-width factor, dimensionless. Table 16

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

T_{ip} = is the radioactive half life of radionuclide, i, in days.

D_{aipj} = is the dose factor specific radionuclide, i, which can be used to calculate the radiation dose from exposure to a given concentration of a radionu-clide in sediment, expressed as a ratio of the dose rate (in mrem/hr) and the areal radionuclide concentration (in pCi/m^2). Table 7

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure, in hours. Table 16

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours. Table 16

110,000 = Constant [(100 * pCi * yr * ft^3)/(Ci * sec * L)]

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Airborne Effluent Dose Calculations

2.2.1 Noble Gas

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from noble gases in airborne effluents from the Fort Calhoun Station to the following limits:

- During any calendar quarter
  $\leq$5 mrad-gamma air dose
  $\leq$10 mrad-beta air dose

  and

- During any calendar year
  $\leq$10 mrad-gamma air dose
  $\leq$20 mrad-beta air dose

The following general equations shall be used to calculate the gamma-air and beta-air doses:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

Doses from Noble Gases

2.2 A. Annual Gamma/Beta Air Dose from All Other Noble Gas Releases

$$D^{\gamma}(r,\Theta) \text{ or } D^{\beta}(r,\Theta) = 3.17 \times 10^{4} \sum_{i=1}^{n} Q_i [\chi/Q]^{D}(r,\Theta)\,(DF_i^{\gamma} \text{ or } DF_i^{\beta})$$

Where:

$DF_i^{\gamma}, DF_i^{\beta}$ = are the gamma and beta air dose factors for a uniform semi-infinite cloud of radionuclide, i, in mrad-m^3/pCi-yr. Table 1

$D^{\gamma}(r,\Theta)$ or $D^{\beta}(r,\Theta)$ = are the annual gamma and beta air doses at distance r, in the sector at angle Θ, from the discharge point, in mrad/yr.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

$[\chi/Q]^{D}(r,\Theta)$ = is the annual average gaseous dispersion factor at distance r, in the sector at angle θ, in sec/m^3. Table 3

3.17×10^4 = is the number of pci per ci divided by the number of seconds per year.

B. Annual Total Body Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = S_F \sum_{i=1}^{n} \chi_i(r,\Theta)\,DFB_i$$

Where:

DFB_i = is the total body dose factor for a semi-infinite cloud of the radionuclide, i, which includes the attenuation of 5 g/cm^2 of tissue, in mrem-m^3/pCi-yr. Table 1

$D_{\infty}^{T}(r,\Theta)$ = is the annual total body dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

$\chi_i(r,\Theta)$ = is the annual average ground-level concentration of radionuclide, i, at distance r, in the sector at angle Θ, in pCi/m^3. Table 3

S_F = Shielding Factor. Table 16

2.0 <u>RADIOACTIVE EFFLUENT DOSE CALCULATIONS</u> (Continued)

2.2 C. Annual Skin Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = 1.11\ S_F \sum_{i=1}^{n} \chi_i(r,\Theta)\, DF_i^{\gamma} + \sum_{i=1}^{n} \chi_i(r,\Theta)\, DFS_i$$

Where:

$D_S^T(r,\Theta)$ = is the annual skin dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

DFS_i = is the beta skin dose factor for a semiinfinite cloud of radionuclide, i, in mrem-m^3/pCi-yr. Table 1

1.11 = is the average ratio of tissue to air energy absorption coefficients.

2.2.2 Radioiodine, Tritium, and Particulates

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from radioactive materials in gaseous airborne from the Fort Calhoun Station to:

- During any calendar quarter
  ≤7.5 mrem to any organ

  and

- During any calendar year
  ≤15 mrem to any organ

The dose to an individual from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in airborne effluents released to unrestricted areas (See Part III, Figure 1) should be determined by the following expressions:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 **NOTE**: In all cases, for releases of tritium, use the dispersion parameter for inhalation (χ/Q).

A. Annual Organ Dose from External Irradiation from Radioactivity Deposited on the Ground Plane

A.1 The ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined by:

$$C_i^G(r,\Theta) = \frac{[1.0x10^{12}]\ [\delta_i(r,\Theta)Q_i]}{\lambda_i}\ [1-\exp(^-\lambda_i t_b)]$$

Where:

C_i^G	=	is the ground plane concentration of the radionuclide, i, at distance r, in the sector at angle θ, from the release point, in pCi/m^2.
Q_i	=	is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.
t_b	=	is the time period over which the accumulation is evaluated, which is assumed to be 15 years (mid-point of plant operating life). Table 16
$\delta_i(r,\theta)$	=	is the annual average relative deposition of radionuclide, i, at distance r, in the sector at angle θ, considering depletion of the plume by deposition during transport, in m^{-2}. Table 3
λ_i	=	is the radiological decay constant for radionuclide, i, in yr^{-1}.
$1.0x10^{12}$	=	is the number of pCi per Ci

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 A.2 The annual organ dose is then calculated using the following equation:

$$D_j^G(r,\Theta) = 8760\ S_F \sum_{i=1}^{n} C_i^G(r,\Theta)\, DFG_{ij}$$

Where:

$C_i^G(r,\theta)$ = is the ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2.

DFG_{ij} = is the open field ground plane dose conversion factor for organ, j, from radionuclide, i, in mrem-m^2/pCi-hr. Table 7

$D_j^G(r,\theta)$ = is the annual dose to the organ, j, at distance r, in the sector at angle θ, in mrem/yr.

S_F = is the shielding factor that accounts for the dose reduction due to shielding provided by residential structures during occupancy, dimensionless. Table 16

8760 = is the number of hours in a year

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 B. Annual Dose from Inhalation of Radionuclides in Air

B.1 The annual average airborne concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined as:

$$\chi_i(r,\theta) = 3.17 \times 10^4 Q_i [\chi/Q]^D(r,\theta)$$

Where:

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

$\chi_i(r,\theta)$ = is the annual average ground-level concentration of radionuclide, i, in air at distance r, in the sector at angle θ, in pCi/m^3.

$[\chi/Q]^D(r,\theta)$ = is the annual average atmosphere dispersion factor, in sec/m^3 (see R.G. 1.111). This includes depletion (for radioiodines and particulates) and radiological decay of the plume. Table 3

3.17×10^4 = is the number of pCi/Ci divided by the number of sec/yr.

B.2 The annual dose associated with inhalation of all radionuclides to organ, j, of an individual in age group, a, is then:

$$D_{ja}^{A}(r,\Theta) = R_a \sum_{i=1}^{n} \chi_i\ (r,\theta)\ DFA_{ija}$$

Where:

$D_{ja}^{A}(r,\theta)$ = is the annual dose to organ, j, of an individual in the age group, a, at distance r, in the sector at angle θ, due to inhalation, in mrem/yr.

R_a = is the annual air intake for individuals in the age group, a, in m^3/yr. Table 5

DFA_{ija} = is the inhalation dose factor for radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 8-11

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C. Concentrations of Radionuclides in Foods and Vegetation from Atmospheric Releases

C.1 Parameters for Calculating Concentrations in Forage, Produce, and Leafy Vegetables, excluding Carbon-14 and Tritium

$$C_i^V(r,\theta) = d_i(r,\theta)\left[\frac{r[1-\exp(-\lambda_{Ei}t_e)]}{Y_v\lambda_{Ei}} + \frac{B_{iv}[1-\exp(-\lambda_i t_b)]}{P\lambda_i}\right]\exp(-\lambda_i t_h)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in and on vegetation at distance r, in the sector at angle θ, in pCi/kg.

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2 hr.

The deposition rate from the plume is defined by:
(Reg. Guide 1.109, Rev. 1, Page 1.109-26, Equa. C-6)

$$d_i(r,\theta) = 1.1 \times 10^8 \delta_i(r,\theta) Q_i$$

Where:

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i.

$\delta_i(r,\theta)$ = is the relative deposition of radionuclide, i, considering depletion and decay, in m^{-2} (see Regulatory Guide 1.111). Table 3

1.1×10^8 = is the number of pCi/Ci (10^{12}) divided by the number of hours per year (8760).

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 For radioiodines, the model considers only the elemental fraction of the effluent:

$$d_i\ (r_1\ \theta) = 5.5 \times 10^7\ \delta_i\ (r_1\ \theta)\ Q_i$$

Where:

$d_i\ (r_1\ \theta)$ = The deposition rate of radioiodine, i.

5.5×10^7 = The number of pCi/Ci (10^{12}) divided by the number of hours per year (8760), then multiplied by the amount of radioiodine emissions considered to be nonelemental (0.5).

$\delta_i\ (r,\ \theta)$ = The relative deposition of radioiodine, i, considering depletion and decay, in m^{-2}. Table 3.

Q_i = The total (elemental and nonelemental) radioiodine, i, emission rate.

r = is the fraction of deposited activity retained on crops, dimensionless. Table 16

λ_{Ei} = is the effective removal rate constant for radionuclide, i, from crops, in hr^{-1}.

$\lambda_{Ei} = \lambda_i + \lambda_w$
$\lambda_w = 0.0021/hr$. Table 16

t_e = is the time period that crops are exposed to contamination during the growing season, in hours. Table 16

Y_v = is the agricultural productivity (yield) in kg (wet weight)/m^2. Table 16

B_{iv} = is the concentration factor for uptake of radionuclide, i, from soil by edible parts of crops, in pCi/ kg (wet weight) per pCi/kg dry soil. Table 4

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours (mid-point of plant life). Table 16

P = is the effective "surface density" for soil, in kg (dry soil)/m^2. Table 16

t_h = is the holdup time that represents the time interval between harvest and consumption of the food, in hours. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Different values for the parameters t_e, Y_v, and t_h, may be used to allow the use of the Equation for different purposes: estimating concentrations in produce consumed by man; in leafy vegetables consumed by man; in forage consumed directly as pasture grass by dairy cows, beef cattle, or goats; and in forage consumed as stored feed by dairy cows, beef cattle or goats. See Table 16

C.2 Parameters for Calculating Radionuclide Concentration in Milk, excluding Carbon-14 and Tritium

C.2.1 Parameters for Calculating the Concentration of Radionuclide, i, in the Animal's Feed (Milk Cow, Beef Cow, and Goat)

$$C_i^V(r,\Theta) = f_p f_s C_i^P(r,\Theta) + (1 - f_p) C_i^S(r,\Theta) + f_p(1 - f_s) C_i^S(r,\Theta)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

$C_i^P(r,\theta)$ = is the concentration of radionuclide, i, on pasture grass (calculated using Equation C.2.1 with t_h=0), in pCi/kg.

$C_i^S(r,\theta)$ = is the concentration of radionuclide, i, in stored feeds (calculated using Equation C.2.1 with t_h=90 days), in pCi/kg.

f_p = is the fraction of the year that animals graze on pasture. Table 16

f_s = is the fraction of daily feed that is pasture grass while the animal grazes on pasture. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.2.2 Parameters for Calculating Radionuclide Concentration in Cow and Goat Milk

$$C_i^M(r,\Theta) = F_m C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^M(r,\theta)$ = is the concentration of radionuclide, i, in milk, in pCi/liter.

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

F_m = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each liter of milk, in days/liter. Table 4

Q_F = is the amount of feed consumed by the animal per day, in kg/day. Table 6

t_f = is the average transport time of the radionuclide, i, from the feed to the milk and to the receptor (a value of 2 days is assumed). Table 16

λ_i = is the radiological decay constant of radionuclide, i, in days^{-1}.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.3 Parameters for Calculating Radionuclide Concentration in Cow Meat, excluding Carbon-14 and Tritium

$$C_i^F(r,\Theta) = F_f C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^F(r,\theta)$ = is the concentration of radionuclide, i, in meat, in pCi/liter.

F_f = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each kilogram of flesh, in days/kilogram. Table 4

t_s = is the average time from slaughter to consumption. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.4 Parameters for Calculating the Carbon-14 Concentrations in Vegetation

Carbon-14 is assumed to be released in oxide form (CO or CO_2). The concentration of Carbon-14 in vegetation is calculated by assuming that its ratio to the natural carbon in vegetation is the same as the ratio of Carbon-14 to natural carbon in the atmosphere surrounding the vegetation. Also, in the case of intermittent releases, such as from gaseous waste decay tanks, the parameter p is employed to account for the fractional equilibrium ratio achieved. The parameter, p, is defined as the ratio of the total annual release time (for Carbon-14 atmospheric releases) to the total annual time during which photosynthesis occurs (taken to be 4400 hrs), under the condition that the value of p should never exceed unity. For continuous Carbon-14 releases, p is taken to be unity. These considerations yield the following relationship:

$$C_{14}^{V}(r,\Theta) = 3.17 \times 10^{7} p Q_{14} [\chi/Q](r,\Theta)\ 0.11/0.16$$

$$= 2.2 \times 10^{7} p Q_{14} [\chi/Q](r,\Theta)$$

Where:

$C_{14}^{V}(r,\theta)$ = is the concentration of Carbon-14 in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

Q_{14} = is the annual release rate of Carbon 14, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

p = is the fractional equilibrium ratio, dimensionless. P=1 (Reg. Guide 1.109, Rev. 1, pg. 26).

0.11 = is the fraction of total plant mass that is natural carbon, dimensionless.

0.16 = is equal to the concentration of natural carbon in the atmosphere, in g/m^3.

3.17×10^7 = is equal to $(1.0 \times 10^{12}$ pci/ci$)(1.0 \times 10^{3}$ g/kg$)$ $(3.15 \times 10^{7}$ sec/yr$)$.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.5 Parameters for Calculating Tritium Concentrations in Vegetation

The concentration of tritium in vegetation is calculated from its concentration in the air surrounding the vegetation.

$$C_T^V(r,\Theta) = 3.17 \times 10^7 Q_T[\chi/Q](r,\Theta)\ (0.75)(0.5/H)$$

$$= 1.2 \times 10^7 Q_T[\chi/Q](r,\Theta)/H$$

Where:

$C_T^V(r,\theta)$ = is the concentration of Tritium in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

H = is the absolute humidity of the atmosphere at distance r, in the sector at angle θ, in g/m^3. H=8 gm/kg.

Q_T = is the annual release rate of Tritium, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

0.5 = is the ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless.

0.75 = is the fraction of total plant mass that is water, dimensionless.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D. Annual Dose from Atmospherically Released Radionuclides in Foods

D.1 The total annual dose to organ, j, of an individual in age group, a, resulting from ingestion of all radionuclides in produce, milk, and leafy vegetables is given by:

$$D_{ja}^{D}(r,\Theta) = \sum_{i} DFI_{ija}\left[U_a^V f_g C_i^V(r,\Theta) + U_a^m C_i^m(r,\Theta) + U_a^F C_i^F(r,\Theta) + U_a^L f_\ell C_i^L(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15.

$U_a^v, U_a^m,$ = are the ingestion rates of produce (non-leafy vegetables, fruits, and grains); milk, meat, and leafy U_a^f, U_a^L vegetables, respectively for individuals in age group, a. Table 5.

Values of F_g and f_ℓ are 0.76 and 1.0, respectively.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.1 Calculating the Ingested Dose from Leafy and Non-Leafy (produce) Vegetation for Radionuclide, i, to Each Organ, j, and Age Group, a

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_{a}^{L}f_{l}C_{i}^{L}(r,\Theta) + U_{a}^{V}f_{g}C_{i}^{V}(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in vegetation, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pci. Tables 12-15

U_{a}^{L}, U_{a}^{V} = are the ingestion rates of leafy vegetables and produce (non-leafy vegetables, fruits, and grains), for individuals in age group, a, in kg/yr. Table 5

C_{i}^{L} = is the concentration of radionuclide, i, in and on leafy vegetation, in pCi/kg.

C_{i}^{V} = is the concentration of radionuclide, i, in and on produce, in pCi/kg.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.2 Calculation Determining the Ingested Dose from Cow Milk for Radionuclide, i, Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_a^M C_i^M(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in cow milk, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_a^M = is the ingestion rate of cow milk for individuals in age group, a, in ℓ/yr. Table 5

C_i^M = is the radionuclide concentration in cow milk, in pCi/kg. Equation C.2.2

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.3 Calculation Determining the Ingested Dose from Meat for Radionuclide, i, to Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_a^F C_i^F(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in meat, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_a^f = is the ingestion rate of meat for individuals in age group, a in kg/yr. Table 5

C_i^F = is the radionuclide, i, concentration in meat, in pCi/ kg.

TABLE 1

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

Nuclide	β-air* (DF^b_i)	β-Skin** (DFS_i)	γ-Air* (DF^c_i)	γ-Body** (DFB_i)
KR-83m	2.88E-04	--	1.93E-05	7.56E-08
KR-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03
KR-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05
KR-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03
KR-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02
KR-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02
KR-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03

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* $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

** $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

*** 2.88E-04 = 2.88×10^{-4}

TABLE 2

BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)

Element	FRESHWATER Fish	FRESHWATER Invertebrate
H	9.0E-01	9.0E-01
C	4.6E+03	9.1E+03
NA	1.0E+02	2.0E+02
P	1.0E+05	2.0E+04
CR	2.0E+02	2.0E+03
MN	4.0E+02	9.0E+04
FE	1.0E+02	3.2E+03
CO	5.0E+01	2.0E+02
NI	1.0E+02	1.0E+02
CU	5.0E+01	4.0E+02
ZN	2.0E+03	1.0E+04
BR	4.2E+02	3.3E+02
RB	2.0E+03	1.0E+03
SR	3.0E+01	1.0E+02
Y	2.5E+01	1.0E+03
ZR	3.3E+00	6.7E+00
NB	3.0E+04	1.0E+02
MO	1.0E+01	1.0E+01
TC	1.5E+01	5.0E+00
RU	1.0E+01	3.0E+02
RH	1.0E+01	3.0E+02
TE	4.0E+02	6.1E+03
I	1.5E+01	5.0E+00
CS	2.0E+03	1.0E+03
BA	4.0E+00	2.0E+02
LA	2.5E+01	1.0E+03
CE	1.0E+00	1.0E+03
PR	2.5E+01	1.0E+03
ND	2.5E+01	1.0E+03
W	1.2E+03	1.0E+01
NP	1.0E+01	4.0E+02

TABLE 3

CONTROLLING LOCATIONS, PATHWAYS AND ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS

Location	Pathway(s)	Controlling Age Group	Atmospheric Dispersion χ/Q ($\chi/Q(r,\theta)$) (sec/m^3)	Atmospheric Dispersion D/Q ($\delta(r,\theta)$) (1/m^3)
Unrestricted Area Boundary	Noble Gases Direct Exposure	N/A	5.0E-06	N/A
Unrestricted Area Boundary	Inhalation	Child	5.0E-06	N/A
Unrestricted Area Boundary	Gamma-Air Beta-Air	N/A	5.0E-06	N/A
Miller Farm* 0.8 miles SSW	milk, ground plane, meat, inhalation, and vegetation	Child	5.0E-06	1.6E-08
Site Discharge	Liquid	N/A	Mixing Ratio, M_p	7.14
M.U.D. Intake	Liquid	N/A	Mixing Ratio, M_p	30.8

* Location is subject to change depending on the results of the Land Use survey performed annually in accordance with Part II, Section 5.4

TABLE 4

STABLE ELEMENT TRANSFER DATA

Element	B_{iv} Veg/Soil	F_m (Cow) Milk (d/λ)	F_f Meat (d/kg)
H	4.8E+00	1.0E-02	1.2E-02
C	5.5E+00	1.2E-02	3.1E-02
Na	5.2E-02	4.0E-02	3.0E-02
P	1.1E+00	2.5E-02	4.6E-02
Cr	2.5E-04	2.2E-03	2.4E-03
Mn	2.9E-02	2.5E-04	8.0E-04
Fe	6.6E-04	1.2E-03	4.0E-02
Co	9.4E-03	1.0E-03	1.3E-02
Ni	1.9E-02	6.7E-03	5.3E-02
Cu	1.2E-01	1.4E-02	8.0E-03
Zn	4.0E-01	3.9E-02	3.0E-02
Rb	1.3E-01	3.0E-02	3.1E-02
Sr	1.7E-02	8.0E-04	6.0E-04
Y	2.6E-03	1.0E-05	4.6E-03
Zr	1.7E-04	5.0E-06	3.4E-02
Nb	9.4E-03	2.5E-03	2.8E-01
Mo	1.2E-01	7.5E-03	8.0E-03
Tc	2.5E-01	2.5E-02	4.0E-01
Ru	5.0E-02	1.0E-06	4.0E-01
Rh	1.3E+01	1.0E-02	1.5E-03
Ag	1.5E-01	5.0E-02	1.7E-02
Te	1.3E+00	1.0E-03	7.7E-02
I	2.0E-02	6.0E-03	2.9E-03
Cs	1.0E-02	1.2E-02	4.0E-03
Ba	5.0E-03	4.0E-04	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04	1.2E-03
Pr	2.5E-03	5.0E-06	4.7E-03
Nd	2.4E-03	5.0E-06	3.3E-03
W	1.8E-02	5.0E-04	1.3E-03
Np	2.5E-03	5.0E-06	2.0E-04

TABLE 5

RECOMMENDED VALUES FOR U_{AP} TO BE USED FOR THE MAXIMUM EXPOSED INDIVIDUAL IN LIEU OF SITE SPECIFIC DATA

Pathway	Infant	Child	Teen	Adult
Fruits, vegetables, & grain (kg/yr)	-	520	630	520
Leafy vegetables (kg/yr)	-	26	42	64
Milk (ℓ/yr)	330	330	400	310
Meat & poultry (kg/yr)	-	41	65	110
Fish (fresh or salt) (kg/yr)	-	6.9	16	21
Other Seafood (kg/yr)	-	1.7	3.8	5
Drinking water (ℓ/yr)	330	510	510	730
Shoreline recreation (hr/yr)	-	14	67	12
Inhalation (m^3/yr)	1400	3700	8000	8000

TABLE 6

ANIMAL CONSUMPTION RATES

Animal	Q_F Feed or Forage [Kg/day (wet weigh)]	Q_{AW} Water (ℓ/day)
Milk Cow	50	60
Beef Cattle	50	50
Goats	6	8

TABLE 7

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Nr-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08

TABLE 7
(Continued)

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EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	-	-	-	1.08E-05
CR 51	-	-	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN 54	-	4.95E-06	7.87E-07	-	1.23E-06	1.75E-04	9.67E-06
MN 56	-	1.55E-10	2.29E-11	-	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	-	-	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	-	-	1.27E-04	2.35E-05
CO 58	-	1.98E-07	2.59E-07	-	-	1.16E-04	1.33E-05
CO 60	-	1.44E-06	1.85E-06	-	-	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	-	-	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	-	-	7.00E-07	1.54E-06
CU 64	-	1.83E-10	7.69E-11	-	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	5.82E-06	-	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	-	5.27E-12	1.15E-07	2.04E-09
BR 83	-	-	3.01E-08	-	-	-	2.90E-08
BR 84	-	-	3.91E-08	-	-	-	2.05E-13
BR 85	-	-	1.60E-09	-	-	-	LT E-24
RB 86	-	1.69E-05	7.37E-06	-	-	-	2.08E-06
RB 88	-	4.84E-08	2.41E-08	-	-	-	4.18E-19
RB 89	-	3.20E-08	2.12E-08	-	-	-	1.16E-21
SR 89	3.80E-05	-	1.09E-06	-	-	1.75E-04	4.37E-05
SR 90	1.24E-02	-	7.62E-04	-	-	1.20E-03	9.02E-05
SR 91	7.74E-09	-	3.13E-10	-	-	4.56E-06	2.39E-05
SR 92	8.43E-10	-	3.64E-11	-	-	2.06E-06	5.38E-06
Y 90	2.61E-07	-	7.01E-09	-	-	2.12E-05	6.32E-05
Y 91M	3.26E-11	-	1.27E-12	-	-	2.40E-07	1.66E-10
Y 91	5.78E-05	-	1.55E-06	-	-	2.13E-04	4.81E-05
Y 92	1.29E-09	-	3.77E-11	-	-	1.96E-06	9.19E-06
Y 93	1.18E-08	-	3.26E-10	-	-	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	-	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	-	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	-	9.67E-07	6.31E-05	1.30E-05
MO 99	-	1.51E-08	2.87E-09	-	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	-	5.52E-12	9.55E-08	5.20E-07

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	5.22E-15	7.52E-15	7.38E-14	-	1.35E-13	4.99E-08	1.36E-21
RU 103	1.91E-07	-	8.23E-08	-	7.29E-07	6.31E-05	1.38E-05
RU 105	9.88E-11	-	3.89E-11	-	1.27E-10	1.37E-06	6.02E-06
RU 106	8.64E-06	-	1.09E-06	-	1.67E-05	1.17E-03	1.14E-04
AG 110M	1.35E-06	1.25E-06	7.43E-07	-	2.46E-06	5.79E-04	3.78E-05
TE 125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE 127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE 127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE 129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE 129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE 131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE 131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE 132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	-	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	-	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	-	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	-	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	-	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	-	6.56E-07
CS 134	4.66E-05	1.06E-04	9.10E-05	-	3.59E-05	1.22E-05	1.30E-06
CS 136	4.88E-06	1.83E-05	1.38E-05	-	1.07E-05	1.50E-06	1.46E-06
CS 137	5.98E-05	7.76E-05	5.35E-05	-	2.78E-05	9.40E-06	1.05E-06
CS 138	4.14E-08	7.76E-08	4.05E-08	-	6.00E-08	6.07E-09	2.33E-13
BA 139	1.17E-10	8.32E-14	3.42E-12	-	7.78E-14	4.70E-07	1.12E-07
BA 140	4.88E-06	6.13E-09	3.21E-07	-	2.09E-09	1.59E-04	2.73E-05
BA 141	1.25E-11	9.41E-15	4.20E-13	-	8.75E-15	2.42E-07	1.45E-17
BA 142	3.29E-12	3.38E-15	2.07E-13	-	2.86E-15	1.49E-07	1.96E-26
LA 140	4.30E-08	2.17E-08	5.73E-09	-	-	1.70E-05	5.73E-05
LA 142	8.54E-11	3.88E-11	9.65E-12	-	-	7.91E-07	2.64E-07
CE 141	2.49E-06	1.69E-06	1.91E-07	-	7.83E-07	4.52E-05	1.50E-05
CE 143	2.33E-08	1.72E-08	1.91E-09	-	7.60E-09	9.97E-06	2.83E-05
CE 144	4.29E-04	1.79E-04	2.30E-05	-	1.06E-04	9.72E-04	1.02E-04
PR 143	1.17E-06	4.69E-07	5.80E-08	-	2.70E-07	3.51E-05	2.50E-05
PR 144	3.76E-12	1.56E-12	1.91E-13	-	8.81E-13	1.27E-07	2.69E-18
ND 147	6.59E-07	7.62E-07	4.56E-08	-	4.45E-07	2.76E-05	2.16E-05
W 187	1.06E-09	8.85E-10	3.10E-10	-	-	3.63E-06	1.94E-05
NP 239	2.87E-08	2.82E-09	1.55E-09	-	8.75E-09	4.70E-06	1.49E-05

TABLE 9
INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	-	-	-	1.16E-05
CR 51	-	-	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	-	6.39E-06	1.05E-06	-	1.59E-06	2.48E-04	8.35E-06
MN 56	-	2.12E-10	3.15E-11	-	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	-	-	1.55E-05	7.99E-07
FE 59	1.99E-06	4.62E-06	1.79E-06	-	-	1.91E-04	2.23E-05
CO 58	-	2.59E-07	3.47E-07	-	-	1.68E-04	1.19E-05
CO 60	-	1.89E-06	2.48E-06	-	-	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	-	-	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	-	-	1.17E-06	4.59E-06
CU 64	-	2.54E-10	1.06E-10	-	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.[illegible]2E-06	1.67E-05	7.80E-06	-	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	-	7.53E-12	1.98E-07	3.56E-08
BR 83	-	-	4.30E-08	-	-	-	LT E-24
BR 84	-	-	5.41E-08	-	-	-	LT E-24
BR 85	-	-	2.29E-09	-	-	-	LT E-24
RB 86	-	2.38E-05	1.05E-05	-	-	-	2.21E-06
RB 88	-	6.82E-08	3.40E-08	-	-	-	3.65E-15
RB 89	-	4.40E-08	2.91E-08	-	-	-	4.22E-17
SR 89	5.43E-05	-	1.56E-06	-	-	3.02E-04	4.64E-05
SR 90	1.35E-02	-	8.35E-04	-	-	2.06E-03	9.56E-05
SR 91	1.10E-08	-	4.39E-10	-	-	7.59E-06	3.24E-05
SR 92	1.19E-09	-	5.08E-11	-	-	3.43E-06	1.49E-05
Y 90	3.73E-07	-	1.00E-08	-	-	3.66E-05	6.99E-05
Y 91M	4.63E-11	-	1.77E-12	-	-	4.00E-07	3.77E-09
Y 91	8.26E-05	-	2.21E-06	-	-	3.67E-04	5.11E-05
Y 92	1.84E-09	-	5.36E-11	-	-	3.35E-06	2.06E-05
Y 93	1.69E-08	-	4.65E-10	-	-	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	-	8.42E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	-	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	-	1.25E-06	9.39E-05	1.21E-05
MO 99	-	2.11E-08	4.03E-09	-	5.14E-08	1.92E-05	3.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	-	7.20E-12	1.44E-07	7.66E-07

TABLE 9

INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	7.40E-15	1.05E-14	1.03E-13	-	1.90E-13	8.34E-08	1.09E-16
RU 103	2.63E-07	-	1.12E-07	-	9.29E-07	9.79E-05	1.36E-05
RU 105	1.40E-10	-	5.42E-11	-	1.76E-10	2.27E-06	1.13E-05
RU 106	1.23E-05	-	1.55E-06	-	2.38E-05	2.01E-03	1.20E-04
AG 110M	1.73E-06	1.64E-06	9.99E-07	-	3.13E-06	8.44E-04	3.41E-05
TE 125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	-	6.70E-05	9.38E-06
TE 127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE 127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE 129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE 129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE 131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE 131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE 132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	-	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	-	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	-	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	-	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	-	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	-	8.69E-07
CS 134	6.28E-05	1.41E-04	6.86E-05	-	4.69E-05	1.83E-05	1.22E-06
CS 136	6.44E-06	2.42E-05	1.71E-05	-	1.38E-05	2.22E-06	1.36E-06
CS 137	8.38E-05	1.06E-04	3.89E-05	-	3.80E-05	1.51E-05	1.06E-06
CS 138	5.82E-08	1.07E-07	5.58E-08	-	8.28E-08	9.84E-09	3.38E-11
BA 139	1.67E-10	1.18E-13	4.87E-12	-	1.11E-13	8.08E-07	8.06E-07
BA 140	6.84E-06	8.38E-09	4.40E-07	-	2.85E-09	2.54E-04	2.86E-05
BA 141	1.78E-11	1.32E-14	5.93E-13	-	1.23E-14	4.11E-07	9.33E-14
BA 142	4.62E-12	4.63E-15	2.84E-13	-	3.92E-15	2.39E-07	5.99E-20
LA 140	5.99E-08	2.95E-08	7.82E-09	-	-	2.68E-05	6.09E-05
LA 142	1.20E-10	5.31E-11	1.32E-11	-	-	1.27E-06	1.50E-06
CE 141	3.55E-06	2.37E-06	2.71E-07	-	1.11E-06	7.67E-05	1.58E-05
CE 143	3.32E-08	2.42E-08	2.70E-09	-	1.08E-08	1.63E-05	3.19E-05
CE 144	6.11E-04	2.53E-04	3.28E-05	-	1.51E-04	1.67E-03	1.08E-04
PR 143	1.67E-06	6.64E-07	8.28E-08	-	3.86E-07	6.04E-05	2.67E-05
PR 144	5.37E-12	2.20E-12	2.72E-13	-	1.26E-12	2.19E-07	2.94E-14
ND 147	9.83E-07	1.07E-06	6.41E-08	-	6.28E-07	4.65E-05	2.28E-05
W 187	1.50E-09	1.22E-09	4.29E-10	-	-	5.92E-06	2.21E-05
NP 239	4.23E-08	3.99E-09	2.21E-09	-	1.25E-08	8.11E-06	1.65E-05

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	-	-	-	1.14E-05
CR 51	-	-	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	-	1.16E-05	2.57E-06	-	2.71E-06	4.26E-04	6.19E-06
MN 56	-	4.48E-10	8.43E-11	-	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	-	-	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	-	-	3.43E-04	1.91E-05
CO 58	-	4.79E-07	8.55E-07	-	-	2.99E-04	9.29E-06
CO 60	-	3.55E-06	6.12E-06	-	-	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	-	-	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	-	-	2.21E-06	2.27E-05
CU 64	-	5.39E-10	2.90E-10	-	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	-	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	-	1.58E-11	3.84E-07	2.75E-06
BR 83	-	-	1.28E-07	-	-	-	LT E-24
BR 84	-	-	1.48E-07	-	-	-	LT E-24
BR 85	-	-	6.84E-09	-	-	-	LT E-24
RB 86	-	5.36E-05	3.09E-05	-	-	-	2.16E-06
RB 88	-	1.52E-07	9.90E-08	-	-	-	4.66E-09
RB 89	-	9.33E-08	7.85E-08	-	-	-	5.11E-10
SR 89	1.62E-04	-	4.66E-06	-	-	5.83E-04	4.52E-05
SR 90	2.73E-02	-	1.74E-03	-	-	3.99E-03	9.28E-05
SR 91	3.28E-08	-	1.24E-09	-	-	1.44E-05	4.70E-05
SR 92	3.54E-09	-	1.42E-10	-	-	6.49E-06	6.55E-05
Y 90	1.11E-06	-	2.99E-08	-	-	7.07E-05	7.24E-05
Y 91M	1.37E-10	-	4.98E-12	-	-	7.60E-07	4.64E-07
Y 91	2.47E-04	-	6.59E-06	-	-	7.10E-04	4.97E-05
Y 92	5.50E-09	-	1.57E-10	-	-	6.46E-06	6.46E-05
Y 93	5.04E-08	-	1.38E-09	-	-	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	-	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	-	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	-	2.33E-06	1.66E-04	1.00E-05
MO 99	-	4.66E-08	1.15E-08	-	1.06E-07	3.66E-05	3.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	-	1.37E-11	2.57E-07	1.30E-06

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.19E-14	2.30E-14	2.91E-13	-	3.92E-13	1.58E-07	4.41E-09
RU 103	7.55E-07	-	2.90E-07	-	1.90E-06	1.79E-04	1.21E-05
RU 105	4.13E-10	-	1.50E-10	-	3.63E-10	4.30E-06	2.69E-05
RU 106	3.68E-05	-	4.57E-06	-	4.97E-05	3.87E-03	1.16E-04
AG 110M	4.56E-06	3.08E-06	2.47E-06	-	5.74E-06	1.48E-03	2.71E-05
TE 125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	-	1.29E-04	9.13E-06
TE 127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE 127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE 129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE 129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE 131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE 131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE 132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	-	1.38E-06
I 131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	-	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	-	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	-	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	-	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	-	1.20E-06
CS 134	1.76E-04	2.74E-04	6.07E-05	-	8.93E-05	3.27E-05	1.04E-06
CS 136	1.76E-05	4.62E-05	3.14E-05	-	2.58E-05	3.93E-06	1.13E-06
CS 137	2.45E-04	2.23E-04	3.47E-05	-	7.63E-05	2.81E-05	9.78E-07
CS 138	1.71E-07	2.27E-07	1.50E-07	-	1.68E-07	1.84E-08	7.29E-08
BA 139	4.98E-10	2.66E-13	1.45E-11	-	2.33E-13	1.56E-06	1.56E-05
BA 140	2.00E-05	1.75E-08	1.17E-06	-	5.71E-09	4.71E-04	2.75E-05
BA 141	5.29E-11	2.95E-14	1.72E-12	-	2.56E-14	7.89E-07	7.44E-08
BA 142	1.35E-11	9.73E-15	7.54E-13	-	7.87E-15	4.44E-07	7.41E-10
LA 140	1.74E-07	6.08E-08	2.04E-08	-	-	4.94E-05	6.10E-05
LA 142	3.50E-10	1.11E-10	3.49E-11	-	-	2.35E-06	2.05E-05
CE 141	1.06E-05	5.28E-06	7.83E-07	-	2.31E-06	1.47E-04	1.53E-05
CE 143	9.89E-08	5.37E-08	7.77E-09	-	2.26E-08	3.12E-05	3.44E-05
CE 144	1.83E-03	5.72E-04	9.77E-05	-	3.17E-04	3.23E-03	1.05E-04
PR 143	4.99E-06	1.50E-06	2.47E-07	-	8.11E-07	1.17E-04	2.63E-05
PR 144	1.61E-11	4.99E-12	8.10E-13	-	2.64E-12	4.23E-07	5.32E-08
ND 147	2.92E-06	2.36E-06	1.84E-07	-	1.30E-06	8.87E-05	2.22E-05
[illegible] 187	4.41E-09	2.61E-09	1.17E-09	-	-	1.11E-05	2.46E-05
NP 239	1.26E-07	9.04E-09	6.35E-09	-	2.63E-08	1.57E-05	1.73E-05

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.53E-05	-	-	-	1.15E-05
CR 51	-	-	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	-	1.81E-05	3.56E-06	-	3.56E-06	7.14E-04	5.04E-06
MN 56	-	1.10E-09	1.58E-10	-	7.86E-10	8.95E-06	5.12E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	-	-	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	-	-	7.25E-04	1.77E-05
CO 58	-	8.71E-07	1.30E-06	-	-	5.55E-04	7.95E-06
CO 60	-	5.73E-06	8.41E-06	-	-	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	-	-	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	-	-	5.80E-06	3.58E-05
CU 64	-	1.34E-09	5.53E-10	-	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	-	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	-	2.87E-11	1.05E-06	9.44E-06
BR 83	-	-	2.72E-07	-	-	-	LT E-24
BR 84	-	-	2.86E-07	-	-	-	LT E-24
BR 85	-	-	1.46E-08	-	-	-	LT E-24
RB 86	-	1.36E-04	6.30E-05	-	-	-	2.17E-06
RB 88	-	3.98E-07	2.05E-07	-	-	-	2.42E-07
RB 89	-	2.29E-07	1.47E-07	-	-	-	4.87E-08
SR 89	2.84E-04	-	8.15E-06	-	-	1.45E-03	4.57E-05
SR 90	2.92E-02	-	1.85E-03	-	-	8.03E-03	9.36E-05
SR 91	6.83E-08		2.47E-09	-	-	3.76E-05	5.24E-05
SR 92	7.50E-09	-	2.79E-10	-	-	1.70E-05	1.00E-04
Y 90	2.35E-06		6.30E-08	-	-	1.92E-04	7.43E-05
Y 91M	2.91E-10	-	9.90E-12	-	-	1.99E-06	1.68E-06
Y 91	4.20E-04	-	1.12E-05	-	-	1.75E-03	5.02E-05
Y 92	1.17E-08	-	3.29E-10	-	-	1.75E-05	9.04E-05
Y 93	1.07E-07	-	2.91E-09	-	-	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	-	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	-	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	-	3.37E-06	3.42E-04	9.05E-06
MO 99	-	1.18E-07	2.31E-08	-	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-13	2.06E-12	2.66E-11	-	2.22E-11	5.79E-07	1.45E-06

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	4.65E-14	5.88E-14	5.80E-13	-	6.99E-13	4.17E-07	6.03E-07
RU 103	1.44E-06	-	4.85E-07	-	3.03E-06	3.94E-04	1.15E-05
RU 105	8.74E-10	-	2.93E-10	-	6.42E-10	1.12E-05	3.46E-05
RU 106	6.20E-05	-	7.77E-06	-	7.61E-05	8.26E-03	1.17E-04
AG 110M	7.13E-06	5.16E-06	3.57E-06	-	7.80E-06	2.62E-03	2.36E-05
TE 125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	-	3.19E-04	9.22E-06
TE 127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE 127	1.59E-09	6.81E-10	3.40E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE 129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE 129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE 131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE 131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE 132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	-	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	-	7.56E-07
[illegible] 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	-	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	-	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	-	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	-	1.31E-06
CS 134	2.83E-04	5.02E-04	5.32E-05	-	1.36E-04	5.69E-05	9.53E-07
CS 136	3.45E-05	9.61E-05	3.78E-05	-	4.03E-05	8.40E-06	1.02E-06
CS 137	3.92E-04	4.37E-04	3.25E-05	-	1.23E-04	5.09E-05	9.53E-07
CS 138	3.61E-07	5.58E-07	2.84E-07	-	2.93E-07	4.67E-08	6.26E-07
BA 139	1.06E-09	7.03E-13	3.07E-11	-	4.23E-13	4.25E-06	3.64E-05
BA 140	4.00E-05	4.00E-08	2.07E-06	-	9.59E-09	1.14E-03	2.74E-05
BA 141	1.12E-10	7.70E-14	3.55E-12	-	4.64E-14	2.12E-06	3.39E-06
BA 142	2.84E-11	2.36E-14	1.40E-12	-	1.36E-14	1.11E-06	4.95E-07
LA 140	3.61E-07	1.43E-07	3.68E-08	-	-	1.20E-04	6.06E-05
LA 142	7.36E-10	2.69E-10	6.46E-11	-	-	5.87E-06	4.25E-05
CE 141	1.98E-05	1.19E-05	1.42E-06	-	3.75E-06	3.69E-04	1.54E-05
CE 143	2.09E-07	1.38E-07	1.58E-08	-	4.03E-08	8.30E-05	3.55E-05
CE 144	2.28E-03	8.65E-04	1.26E-04	-	3.84E-04	7.03E-03	1.06E-04
PR 143	1.00E-05	3.74E-06	4.99E-07	-	1.41E-06	3.09E-04	2.66E-05
PR 144	3.42E-11	1.32E-11	1.72E-12	-	4.80E-12	1.15E-06	3.06E-06
[illegible] 147	5.67E-06	5.81E-06	3.57E-07	-	2.25E-06	2.30E-04	2.23E-05
[illegible] 187	9.26E-09	6.44E-09	2.23E-09	-	-	2.83E-05	2.54E-05
NP 239	2.65E-07	2.37E-08	1.34E-08	-	4.73E-08	4.25E-05	1.78E-05

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	-	-	-	2.17E-05
CR 51	-	-	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	-	4.57E-06	8.72E-07	-	1.36E-06	-	1.40E-05
MN 56	-	1.15E-07	2.04E-08	-	1.46E-07	-	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	-	-	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	-	-	2.85E-06	3.40E-05
CO 58	-	7.45E-07	1.67E-06	-	-	-	1.51E-05
CO 60	-	2.14E-06	4.72E-06	-	-	-	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	-	-	-	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	-	-	-	1.74E-06
CU 64	-	8.33E-08	3.91E-08	-	2.10E-07	-	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	-	1.03E-05	-	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	-	1.28E-08	-	2.96E-09
BR 83	-	-	4.02E-08	-	-	-	5.79E-08
BR 84	-	-	5.21E-08	-	-	-	4.09E-13
BR 85	-	-	2.14E-09	-	-	-	LT E-24
RB 86	-	2.11E-05	9.83E-06	-	-	-	4.16E-06
RB 88	-	6.05E-08	3.21E-08	-	-	-	8.36E-19
RB 89	-	4.01E-08	2.82E-08	-	-	-	2.33E-21
SR 89	3.08E-04	-	8.84E-06	-	-	-	4.94E-05
SR 90	7.58E-03	-	1.86E-03	-	-	-	2.19E-04
SR 91	5.67E-06	-	2.29E-07	-	-	-	2.70E-05
SR 92	2.15E-06	-	9.30E-08	-	-	-	4.26E-05
Y 90	9.62E-09	-	2.58E-10	-	-	-	1.02E-04
Y 91M	9.09E-11	-	3.52E-12	-	-	-	2.67E-10
Y 91	1.41E-07	-	3.77E-09	-	-	-	7.76E-05
Y 92	8.45E-10	-	2.47E-11	-	-	-	1.48E-05
Y 93	2.68E-09	-	7.40E-11	-	-	-	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	-	1.53E-08	-	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	-	5.12E-10	-	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	-	3.42E-09	-	2.10E-05
MO 99	-	4.31E-06	8.20E-07	-	9.76E-06	-	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	-	1.06E-08	3.42E-10	4.13E-07

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.54E-10	3.66E-10	3.59E-09	-	6.59E-09	1.87E-10	1.10E-21
RU 103	1.85E-07	-	7.97E-08	-	7.06E-07	-	2.16E-05
RU 105	1.54E-08	-	6.08E-09	-	1.99E-07	-	9.42E-06
RU 106	2.75E-06	-	3.48E-07	-	5.31E-06	-	1.78E-04
AG 110M	1.60E-07	1.48E-07	8.79E-08	-	2.91E-07	-	6.04E-05
TE 125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	-	1.07E-05
TE 127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	-	2.27E-05
TE 127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	-	8.68E-06
TE 129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	-	5.79E-05
TE 129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	-	2.37E-08
TE 131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	-	8.40E-05
TE 131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	-	2.79E-09
TE 132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	-	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	-	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	-	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	-	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	-	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	-	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	-	1.31E-06
CS 134	6.22E-05	1.48E-04	1.21E-04	-	4.79E-05	1.59E-05	2.59E-06
CS 136	6.51E-06	2.57E-05	1.85E-05	-	1.43E-05	1.96E-06	2.92E-06
CS 137	7.97E-05	1.09E-04	7.14E-05	-	3.70E-05	1.23E-05	2.11E-06
CS 138	5.52E-08	1.09E-07	5.40E-08	-	8.01E-08	7.91E-09	4.65E-13
BA 139	9.70E-08	6.91E-11	2.84E-09	-	6.46E-11	3.92E-11	1.72E-07
BA 140	2.03E-05	2.55E-08	1.33E-06	-	8.67E-09	1.46E-08	4.18E-05
BA 141	4.71E-08	3.56E-11	1.59E-09	-	3.31E-11	2.02E-11	2.22E-17
BA 142	2.13E-08	2.19E-11	1.34E-09	-	1.85E-11	1.24E-11	3.00E-26
LA 140	2.50E-09	1.26E-09	3.33E-10	-	-	-	9.25E-05
LA 142	1.28E-10	5.82E-11	1.45E-11	-	-	-	4.25E-07
CE 141	9.36E-09	6.33E-09	7.18E-10	-	2.94E-09	-	2.42E-05
CE 143	1.65E-09	1.22E-06	1.35E-10	-	5.37E-10	-	4.56E-05
CE 144	4.88E-07	2.04E-07	2.62E-08	-	1.21E-07	-	1.65E-04
PR 143	9.20E-09	3.69E-09	4.56E-10	-	2.13E-09	-	4.03E-05
PR 144	3.01E-11	1.25E-11	1.53E-12	-	7.05E-12	-	4.33E-18
ND 147	6.29E-09	7.27E-09	4.35E-10	-	4.25E-09	-	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	-	-	-	2.82E-05
NP 239	1.19E-09	1.17E-10	6.45E-11	-	3.65E-10	-	2.40E-05

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	-	-	-	2.32E-05
CR 51	-	-	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	-	5.90E-06	1.17E-06	-	1.76E-06	-	1.21E-05
MN 56	-	1.58E-07	2.81E-08	-	2.00E-07	-	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	-	-	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	-	-	4.32E-06	3.24E-05
CO 58	-	9.72E-07	2.24E-06	-	-	-	1.34E-05
CO 60	-	2.81E-06	6.33E-06	-	-	-	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	-	-	-	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	-	-	-	5.19E-06
CU 64	-	1.15E-07	5.41E-08	-	2.91E-07	-	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	-	1.28E-05	-	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	-	1.83E-08	-	5.16E-08
BR 83	-	-	5.74E-08	-	-	-	LT E-24
BR 84	-	-	7.22E-08	-	-	-	LT E-24
BR 85	-	-	3.05E-09	-	-	-	LT E-24
RB 86	-	2.98E-05	1.40E-05	-	-	-	4.41E-06
RB 88	-	8.52E-08	4.54E-08	-	-	-	7.30E-15
RB 89	-	5.50E-08	3.89E-08	-	-	-	8.43E-17
SR 89	4.40E-04	-	1.26E-05	-	-	-	5.24E-05
SR 90	8.30E-03	-	2.05E-03	-	-	-	2.33E-04
SR 91	8.07E-06	-	3.21E-07	-	-	-	3.66E-05
SR 92	3.05E-06	-	1.30E-07	-	-	-	7.77E-05
Y 90	1.37E-08	-	3.69E-10	-	-	-	1.13E-04
Y 91M	1.29E-10	-	4.93E-12	-	-	-	6.09E-09
Y 91	2.01E-07	-	5.39E-09	-	-	-	8.24E-05
Y 92	1.21E-09	-	3.50E-11	-	-	-	3.32E-05
Y 93	3.83E-09	-	1.05E-10	-	-	-	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	-	1.91E-08	-	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	-	7.11E-10	-	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	-	4.42E-09	-	1.95E-05
MO 99	-	6.03E-06	1.15E-06	-	1.38E-05	-	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	-	1.38E-08	5.14E-10	6.08E-07

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	3.60E-10	5.12E-10	5.03E-09	-	9.26E-09	3.12E-10	8.75E-17
RU 103	2.55E-07	-	1.09E-07	-	8.99E-07	-	2.13E-05
RU 105	2.18E-08	-	8.46E-09	-	2.75E-07	-	1.76E-05
RU 106	3.92E-06	-	4.94E-07	-	7.56E-06	-	1.88E-04
AG 110M	2.05E-07	1.94E-07	1.18E-07	-	3.70E-07	-	5.45E-05
TE 125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	-	-	1.13E-05
TE 127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	-	2.41E-05
TE 127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	-	1.22E-05
TE 129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	-	6.12E-05
TE 129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	-	2.45E-07
TE 131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	-	9.39E-05
TE 131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	-	2.29E-09
TE 132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	-	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	-	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	-	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	-	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	-	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	-	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	-	1.74E-06
CS 134	8.37E-05	1.97E-04	9.14E-05	-	6.26E-05	2.39E-05	2.45E-06
CS 136	8.59E-06	3.38E-05	2.27E-05	-	1.84E-05	2.90E-06	2.72E-06
CS 137	1.12E-04	1.49E-04	5.19E-05	-	5.07E-05	1.97E-05	2.12E-06
CS 138	7.76E-08	1.49E-07	7.45E-08	-	1.10E-07	1.28E-08	4.76E-11
BA 139	1.39E-07	9.78E-11	4.05E-09	-	9.22E-11	6.74E-11	1.24E-06
BA 140	2.84E-05	3.48E-08	1.83E-06	-	1.18E-08	2.34E-08	4.38E-05
BA 141	6.71E-08	5.01E-11	2.24E-09	-	4.65E-11	3.43E-11	1.43E-13
BA 142	2.99E-08	2.99E-11	1.84E-09	-	2.53E-11	1.99E-11	9.18E-20
LA 140	3.48E-09	1.71E-09	4.55E-10	-	-	-	9.28E-05
LA 142	1.79E-10	7.95E-11	1.98E-11	-	-	-	2.42E-06
CE 141	1.33E-08	8.88E-09	1.02E-09	-	4.18E-09	-	2.54E-05
CE 143	2.35E-09	1.71E-06	1.91E-10	-	7.67E-10	-	5.14E-05
CE 144	6.96E-07	2.88E-07	3.74E-08	-	1.72E-07	-	1.75E-04
PR 143	1.31E-08	5.23E-09	6.52E-10	-	3.04E-09	-	4.31E-05
PR 144	4.30E-11	1.76E-11	2.18E-12	-	1.01E-11	-	4.74E-14
ND 147	9.38E-09	1.02E-08	6.11E-10	-	5.99E-09	-	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	-	-	-	3.22E-05
NP 239	1.76E-09	1.66E-10	9.22E-11	-	5.21E-10	-	2.67E-05

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

Page 1 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.25E-04	3.86E-05	3.18E-05	-	-	-	2.28E-05
CR 51	-	-	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	-	1.07E-05	2.85E-06	-	3.00E-06	-	8.98E-06
MN 56	-	3.34E-07	7.54E-08	-	4.04E-07	-	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	-	-	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	-	-	7.74E-06	2.78E-05
CO 58	-	1.80E-06	5.51E-06	-	-	-	1.05E-05
CO 60	-	5.29E-06	1.56E-05	-	-	-	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	-	-	-	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	-	-	-	2.56E-05
CU 64	-	2.45E-07	1.48E-07	-	5.92E-07	-	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	-	2.30E-05	-	6.41E-06
[illegible] 69	4.38E-08	6.33E-08	5.85E-09	-	3.84E-08	-	3.99E-06
BR 83	-	-	1.71E-07	-	-	-	LT E-24
BR 84	-	-	1.98E-07	-	-	-	LT E-24
BR 85	-	-	9.12E-09	-	-	-	LT E-24
RB 86	-	6.70E-05	4.12E-05	-	-	-	4.31E-06
RB 88	-	1.90E-07	1.32E-07	-	-	-	9.32E-09
RB 89	-	1.17E-07	1.04E-07	-	-	-	1.02E-09
SR 89	1.32E-03	-	3.77E-05	-	-	-	5.11E-05
SR 90	1.70E-02	-	4.31E-03	-	-	-	2.29E-04
SR 91	2.40E-05	-	9.06E-07	-	-	-	5.30E-05
SR 92	9.03E-06	-	3.62E-07	-	-	-	1.71E-04
Y 90	4.11E-08	-	1.10E-09	-	-	-	1.17E-04
Y 91M	3.8[illegible]-10	-	1.39E-11	-	-	-	7.48E-07
Y 91	6.[illegible]-07	-	1.61E-08	-	-	-	8.02E-05
Y 92	3.60E-09	-	1.03E-10	-	-	-	1.04E-04
Y 93	1.14E-08	-	3.13E-10	-	-	-	1.70E-04
ZR 95	1.16E-07	2.55E-08	2.27E-08	-	3.65E-08	-	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	-	1.45E-09	-	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	-	8.23E-09	-	1.62E-05
[illegible] 99	-	1.33E-05	3.29E-06	-	2.84E-05	-	1.10E-05
[illegible] 99M	9.23E-10	1.81E-09	3.00E-08	-	2.63E-08	9.19E-10	1.03E-06

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	1.07E-09	1.12E-09	1.42E-08	-	1.91E-08	5.92E-10	3.56E-09
RU 103	7.31E-07	-	2.81E-07	-	1.84E-06	-	1.89E-05
RU 105	6.45E-08	-	2.34E-08	-	5.67E-07	-	4.21E-05
RU 106	1.17E-05	-	1.46E-06	-	1.58E-05	-	1.82E-04
AG 110M	5.39E-07	3.64E-07	2.91E-07	-	6.78E-07	-	4.33E-05
TE 125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	-	-	1.10E-05
TE 127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	-	2.34E-05
TE 127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	-	1.84E-05
TE 129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	-	5.94E-05
TE 129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	-	8.34E-06
TE 131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	-	1.01E-04
TE 131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	-	4.36E-07
TE 132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	-	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	-	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	-	1.54E-06
[illegible] 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	-	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	-	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	-	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	-	2.40E-06
CS 134	2.34E-04	3.84E-04	8.10E-05	-	1.19E-04	4.27E-05	2.07E-06
CS 136	2.35E-05	6.46E-05	4.18E-05	-	3.44E-05	5.13E-06	2.27E-06
CS 137	3.27E-04	3.13E-04	4.62E-05	-	1.02E-04	3.67E-05	1.96E-06
CS 138	2.28E-07	3.17E-07	2.01E-07	-	2.23E-07	2.40E-08	1.46E-07
BA 139	4.14E-07	2.21E-10	1.20E-08	-	1.93E-10	1.30E-10	2.39E-05
BA 140	8.31E-05	7.28E-08	4.85E-06	-	2.37E-08	4.34E-08	4.21E-05
BA 141	2.00E-07	1.12E-10	6.51E-09	-	9.69E-11	6.58E-10	1.14E-07
BA 142	8.74E-08	6.29E-11	4.88E-09	-	5.09E-11	3.70E-11	1.14E-09
LA 140	1.01E-08	3.53E-09	1.19E-09	-	-	-	9.84E-05
LA 142	5.24E-10	1.67E-10	5.23E-11	-	-	-	3.31E-05
CE 141	3.97E-08	1.98E-08	2.94E-09	-	8.68E-09	-	2.47E-05
CE 143	6.99E-09	3.79E-06	5.49E-10	-	1.59E-09	-	5.55E-05
CE 144	2.08E-06	6.52E-07	1.11E-07	-	3.61E-07	-	1.70E-04
PR 143	3.93E-08	1.18E-08	1.95E-09	-	6.39E-09	-	4.24E-05
PR 144	1.29E-10	3.99E-11	6.49E-12	-	2.11E-11	-	8.59E-08
[illegible] 147	2.79E-08	2.26E-08	1.75E-09	-	1.24E-08	-	3.58E-05
[illegible] 187	4.29E-07	2.54E-07	1.14E-07	-	-	-	3.57E-05
NP 239	5.25E-09	3.77E-10	2.65E-10	-	1.09E-09	-	2.79E-05

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	-	-	-	2.30E-05
CR 51	-	-	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	-	1.99E-05	4.51E-06	-	4.41E-06	-	7.31E-06
MN 56	-	8.18E-07	1.41E-07	-	7.03E-07	-	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	-	-	4.36E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	-	-	1.59E-05	2.57E-05
CO 58	-	3.60E-06	8.98E-06	-	-	-	8.97E-06
CO 60	-	1.08E-05	2.55E-05	-	-	-	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	-	-	-	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	-	-	-	4.05E-05
CU 64	-	6.09E-07	2.82E-07	-	1.03E-06	-	1.25E-05
ZN 65	1.84E-05	6.31E-05	2.91E-05	-	3.06E-05	-	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	-	6.98E-08	-	1.37E-05
BR 83	-	-	3.63E-07	-	-	-	LT E-24
BR 84	-	-	3.82E-07	-	-	-	LT E-24
BR 85	-	-	1.94E-08	-	-	-	LT E-24
RB 86	-	1.70E-04	8.40E-05	-	-	-	4.35E-06
RB 88	-	4.98E-07	2.73E-07	-	-	-	4.85E-07
RB 89	-	2.86E-07	1.97E-07	-	-	-	9.74E-08
SR 89	2.51E-03	-	7.20E-05	-	-	-	5.16E-05
SR 90	1.85E-02	-	4.71E-03	-	-	-	2.31E-04
SR 91	5.00E-05	-	1.81E-06	-	-	-	5.92E-05
SR 92	1.92E-05	-	7.13E-07	-	-	-	2.07E-04
Y 90	8.69E-08	-	2.33E-09	-	-	-	1.20E-04
Y 91M	8.10E-10	-	2.76E-11	-	-	-	2.70E-06
Y 91	1.13E-06	-	3.01E-08	-	-	-	8.10E-05
Y 92	7.65E-09	-	2.15E-10	-	-	-	1.46E-04
Y 93	2.43E-08	-	6.62E-10	-	-	-	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	-	5.41E-08	-	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	-	2.56E-09	-	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	-	1.24E-08	-	1.46E-05
MO 99	-	3.40E-05	6.63E-06	-	5.08E-05	-	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	-	4.26E-08	2.07E-09	1.15E-06

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.27E-09	2.86E-09	2.83E-08	-	3.40E-08	1.56E-09	4.86E-07
RU 103	1.48E-06	-	4.95E-07	-	3.08E-06	-	1.80E-05
RU 105	1.36E-07	-	4.58E-08	-	1.00E-06	-	5.41E-05
RU 106	2.41E-05	-	3.01E-06	-	2.85E-05	-	1.83E-04
AG 110M	9.96E-07	7.27E-07	4.81E-07	-	1.04E-06	-	3.77E-05
TE 125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	-	-	1.11E-05
TE 127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	-	2.36E-05
TE 127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	-	2.10E-05
TE 129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	-	5.97E-05
TE 129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	-	2.27E-05
TE 131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	-	1.03E-04
TE 131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	-	7.11E-06
TE 132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	-	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	-	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	-	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	-	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	-	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	-	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	-	2.62E-06
CS 134	3.77E-04	7.03E-04	7.10E-05	-	1.81E-04	7.42E-05	1.91E-06
CS 136	4.59E-05	1.35E-04	5.04E-05	-	5.38E-05	1.10E-05	2.05E-06
CS 137	5.22E-04	6.11E-04	4.33E-05	-	1.64E-04	6.64E-05	1.91E-06
CS 138	4.81E-07	7.82E-07	3.79E-07	-	3.90E-07	6.09E-08	1.25E-06
BA 139	8.81E-07	5.84E-10	2.55E-08	-	3.51E-10	3.54E-10	5.58E-05
BA 140	1.71E-04	1.71E-07	8.81E-06	-	4.06E-08	1.05E-07	4.20E-05
BA 141	4.25E-07	2.91E-10	1.34E-08	-	1.75E-10	1.77E-10	5.19E-06
BA 142	1.84E-07	1.53E-10	9.06E-09	-	8.81E-11	9.26E-11	7.59E-07
LA 140	2.11E-08	8.32E-09	2.14E-09	-	-	-	9.77E-05
LA 142	1.10E-09	4.04E-10	9.67E-11	-	-	-	6.86E-05
CE 141	7.87E-08	4.80E-08	5.65E-09	-	1.48E-08	-	2.48E-05
CE 143	1.48E-08	9.82E-06	1.12E-09	-	2.86E-09	-	5.73E-05
CE 144	2.98E-06	1.22E-06	1.67E-07	-	4.93E-07	-	1.71E-04
PR 143	8.13E-08	3.04E-08	4.03E-09	-	1.13E-08	-	4.29E-05
PR 144	2.74E-10	1.06E-10	1.38E-11	-	3.84E-11	-	4.93E-06
ND 147	5.53E-08	5.68E-08	3.48E-09	-	2.19E-08	-	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	-	-	-	3.69E-05
NP 239	1.11E-08	9.93E-10	5.61E-10	-	1.98E-09	-	2.87E-05

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Page 1 of 2

Parameter Symbol	Definition	Values
f_g	Fraction of produce ingested grown in garden of interest.	0.76
f_ℓ	Fraction of leafy vegetables grown in garden of interest.	1.0
P	Effective surface density of soil (assumes a 15 cm plow layer, expressed in dry weight)	240 kg/m^2
r	Fraction of deposited activity retained on crops, leafy vegetables, or pasture grass.	0.25 1.0 (for iodines) 0.2 (for other particulates)
S_F	Attenuation factor accounting for shielding provided by residential structures.	0.7 (for maximum individuals) 0.5 (for general population)
t_b	Period of long-term buildup for activity in sediment or soil (nominally 15 yr).	1.31×10^5 hr
t_e	Period of crop, leafy vegetable, or pasture grass exposure during growing season.	720 hrs (30 days, for grass-cow-milk-man pathway) 1440 hrs (60 days for crop/ vegetation-man pathway)
t_f	Transport time from animal feed-milk-man provided by residential structures.	2 days (for max. individual) 4 days (for gen. population)
t_h	Time delay between harvest of vegetation or crops and ingestion. i) For ingestion of forage by animals	Zero (for pasture grass) 2160 hr (90 days for stored feed)

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Page 2 of 2

Parameter Symbol	Definition	Values
	ii) For ingestion of crops by man	24 hr (1 day, for leafy vegetables & max. individual) feed) 1440 hr (60 days for produce & maximum individual) 336 hr (14 days for general population)
t_p	Environmental transit time, release to receptor (add time from release to exposure individual) point to minimums shown for distribution)	12 hr (for max. 24 hr (for gen. population) 24 hr (for max. individual) 168 hr (7 days for population sport fish doses) 240 hr (10 days for population commercial fish doses)
t_s	Average time from slaughter of meat animal to consumption.	20 days
Y_V	Agricultural producitivity by unit area (measured in wet weight)	0.7 kg/m^2 (for grass-cow-milk man pathway) 2.0 kg/m^2 (for produce or leafy vegetables ingested by man)
W	Shore-width factor for river shoreline	0.2
λ_w	Rate constant for removal of activity on plant or leaf surfaces by weathering (corresponds to a 14-day half-life)	0.0021 hr^{-1}

Fort Calhoun Station
Unit No. 1

CH-ODCM-0001

CHEMISTRY PROCEDURE

Title: OFF-SITE DOSE CALCULATION MANUAL (ODCM)

FC-68 Number:	41437
Reason for Change:	Incorporate new monitor configuration for auxiliary building exhaust stack gas, in conjunction with Mod MR-FC-84-155.
Contact Person:	James Shipman

PART I

ADMINISTRATIVE SECTION

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PART IV

1.0 INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is the controlling document for the Fort Calhoun Station's (FCS) Radiological Effluent and Environmental Monitoring programs. The programs are necessary to ensure the requirements set forth in 10 CFR 20, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR 50, Appendix I. The document is subdivided into four sections as outlined below:

Part I, Introduction - consists of information necessary for the effective use of the ODCM.

Part II, Radiological Effluent Controls - consists of 5 separate sections including:

Section 1 Radiological Effluent Release Limits

Section 2 Radiological Effluent Release Requirements

Section 3 Radiological Effluent Sampling and Analysis Requirements

Section 4 Radiological Effluent Reporting Requirements

Section 5 Radiological Environmental Monitoring Requirements

Together these sections provide the controls used to permit radioactive material releases from the Fort Calhoun Station.

Part III, Radiological Effluent Radiation Monitor Calculation - provides radiation monitor setpoint calculations for the liquid and airborne release pathways.

Part IV, Radiological Effluent Monitoring Calculations - provides the methodology necessary to calculate doses to individuals as a result of radioactive airborne and liquid releases from Fort Calhoun.

The ODCM has been prepared in accordance with the guidance of Nuclear Regulatory Commissions Reg. Guide 1.109, Rev. 1.

The Radiological Effluent Controls Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Release Limits - All Sections

B. Radiological Effluent Release Requirements - All Sections

C. Radiological Effluent Sampling and Analysis Requirements - All Sections

D. Radiological Effluent Reporting Requirements - Sections 4.1 and 4.4

2.0 ADMINISTRATIVE

The Radiological Environmental Monitoring Program consists of the following sections in the Radiological Effluent Controls:

A. Radiological Effluent Reporting Requirements - Sections 4.2 and 4.3

B. Radiological Environmental Monitoring Requirements - All Sections

2.1 Responsibilities

2.1.1 Nuclear Operation Division Chemistry Department is responsible for the implementation and maintenance of the ODCM.

2.1.2 Nuclear Operation Division Operation Department is responsible for the compliance with the ODCM in the operation of Fort Calhoun Station.

2.2 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 Report in accordance with the requirements of Technical Specification 5.17.

3.0 METEOROLOGICAL DATA

The Annual Average χ/Q is utilized to determine the concentrations of radionuclides at the unrestricted area boundary. This dispersion factor coincides with the highest calculated annual average value for the Fort Calhoun Station. It is based on 3 years of Onsite Meteorological data and the MESODIF II plume trajectory model. This model conforms with the Nuclear Regulatory Commissions Regulatory Guide 1.111. The model employs the sector averaged equations that are utilized for long-term releases. This type of release (long term) is not dependent solely on atmospheric conditions for complying with 10 CFR 20 concentration limits at the unrestricted area boundary.

Real time meteorological data will be utilized in the preparation of the Annual Report. This data is used to calculate the joint frequency table and 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, GASPAR and LADTAP, conform with the Nuclear Regulatory Commissions Reg. Guide 1.109 and 1.21 for the reporting of doses due to routine radioactive effluent releases.

4.0 DEFINITIONS

Air Effluent Concentration (AEC)

Radionuclide limits listed in 10 CFR 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.

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.

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 20, Appendix B, Table 2, Column 2.

5.0 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 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.

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 is 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

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

Fort Calhoun Technical Specifications (Unit No. 1)

Updated Safety Analysis Report

Commitment Documents:

IMPLEMENTING STEP	COMMITMENT NUMBER (CID)	SOURCE DOCUMENT
Part II, 2.2.3.1 C.2	920102/01	FC-0133-92

PART II

RADIOLOGICAL EFFLUENT CONTROLS

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS

The limits and conditions for the controlled release of radioactive material in liquid and airborne effluents are to ensure that these releases result in concentrations that are within the limits specified in 10 CFR 20, and to ensure that releases of radioactive material to the environment be as low as reasonably achievable in conformance with 10 CFR 50.34a and 50.36a. To meet these criteria, the following requirements must be met for all radioactive liquid and airborne effluents from FCS:

1.1 Liquid Effluents

1.1.1 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 20 for liquid effluents at site discharge. For dissolved or entrained noble gases, the concentration shall be limited to 2.0 E-04 μCi/ml, total activity.

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.

1.1.2 Annual Design Objectives

1.1.2.1 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed <u>3</u> millirems to the <u>total body</u>.

1.1.2.2 The dose or dose commitment to an individual in unrestricted areas from radioactive materials in liquid effluents during any calendar year shall not exceed <u>10</u> millirems to <u>any organ</u>.

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.1.2.3 The radiation dose contributions from radioactive materials in liquid effluents released at site discharge shall be determined, in accordance with Part IV, Section 2.1, 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:

A. Make an investigation to identify the causes for such releases.

B. Define and initiate a program of action to reduce such releases to the design levels.

C. 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.

1.2 Airborne Effluents

1.2.1 The release rate of radioactive material in airborne effluents shall be controlled such that the instantaneous concentrations for these radionuclides do not exceed the values specified in 10 CFR 20 for airborne effluents at the unrestricted area boundary.

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.

1.2.2 Annual Design Objectives

1.2.2.1 The gamma air dose in unrestricted areas due to the release of noble gases in airborne effluents shall not exceed 10 millirads during any calendar year;

1.2.2.2 The beta air dose in unrestricted areas due to the release of noble gases in airborne effluents shall not exceed 20 millirads during any calendar year; and

1.0 RADIOACTIVE EFFLUENTS RELEASE LIMITS (Continued)

1.2.2.3 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 15 millirems from all exposure pathways during any calendar year.

1.2.2.4 The radiation dose contributions from radioactive materials in airborne effluents shall be determined, in accordance with the Part IV, section 2.2, on a quarterly basis. If the dose contribution, due to the cumulative release of airborne effluents averaged over a calendar quarter exceeds one-half of the annual design objectives, the following course of actions shall be taken:

A. Make an investigation to identify the cause for such release rates.

B. Define and initiate a program of action to reduce such releases to design levels.

C. 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.

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

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS

The requirements for the release of radioactive liquid and airborne effluents from FCS stated in this Section are to ensure that the limits of Section 1 will be met, as well as to allow for operational flexibility. When any of the requirements for release of radioactive effluents cannot be complied with, the release shall not be permitted to occur or it shall be immediately terminated, if it is in progress.

2.1 Liquid Effluent Releases

The equipment or subsystem(s) of the liquid radwaste treatment system as identified in the Part II, section 2.1, shall be operable. If the radioactive liquid effluents were discharged without treatment by one or more of the pieces of equipment or subsystem(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reasons for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1 Monitor and Hotel Waste Tanks

During release of radioactive liquid effluents, the following conditions shall be met:

2.1.1.1 There shall be sufficient dilution flow so that, at site discharge:

$$\sum_{i=1}^{n} C_i / wec_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

wec_i = 10 CFR 20, Appendix B, Table 2, Column 2 limits.

2.1.1.2 The overboard header effluent radiation monitor shall be set in accordance with Part III to alarm and automatically close the discharge valve prior to exceeding 10 CFR 20 limits at site discharge.

2.1.1.3 The liquid effluent radioactivity shall be continuously monitored during the release. If the effluent radiation monitor is inoperable, effluent releases may continue provided that: (prior to initiating a release)

A. At least two independent samples are analyzed in accordance with applicable chemistry procedures.

B. At least two qualified individuals independently verify the release rate calculations.

2.1.1.4 The liquid effluent radioactivity shall be continuously recorded during the release. If the process radiation monitor chart recorder is inoperable and the process radiation monitor is operable then effluent releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.1.5 The liquid effluent flow rate shall be continuously monitored and recorded during the release. If the flow rate recorder is inoperable, effluent releases may continue provided the flow rate is determined at least once per four hours during actual release.

2.1.2 Steam Generator

During the release of steam generator blowdown to the discharge tunnel, the following conditions shall be met:

2.1.2.1 There shall be sufficient dilution flow so that, at site discharge:

$$\sum_{i=1}^{n} C_i/wec_i \leq 1$$

where:

C_i = concentration of the i^{th} radionuclide in the liquid effluent at site discharge.

wec_i = 10 CFR 20, Appendix B, Table 2, Column 2 limit.

2.1.2.2 The steam generator blowdown radiation monitors shall be set in accordance with Part III to alarm and automatically close the blowdown isolation valves prior to exceeding 10 CFR 20 limits at site dishcarge.

2.1.2.3 The radioactivity for each blowdown line shall be continuously monitored by the blowdown radiation monitors and recorded.

A. If one of the two radiation monitors is inoperable, the activity for both blowdown lines shall be monitored by the operable radiation monitor within 2 hours of the declaration, by Shift Supervisor, of inoperability.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.1.2.3 B. If both radiation monitors are inoperable, steam generator liquid releases may continue provided grab samples are analyzed for principal gamma emitters at a sensitivity of 5.0E-07 μCi/ml and recorded at least daily when the specific activity of Steam Generator Blowdown is less than or equal to 0.01 μCi/gram dose equivalent I-131 and at least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 μCi/gram dose equivalent I-131.

2.1.2.4 The radioactivity for each blowdown line shall be continuously recorded. If the process radiation monitor chart recorder is not operational, Steam Generator releases may continue provided that the radioactivity level is recorded manually at least once per four hours during actual release.

2.2 Airborne Effluent Releases

The equipment or subsystem(s) of the gaseous radwaste treatment system as identified in Part III, Section 2.2, shall be operable. If the radioactive airborne effluents were discharged without treatment by one or more of the equipment or subsystems(s) identified in that section 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:

A. Identification of equipment or subsystem(s) not operable and reason for inoperability.

B. Action(s) taken to restore the inoperable equipment to operable status.

C. Summary description of action(s) taken to prevent a recurrence.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1 Auxiliary Building Exhaust Stack

2.2.1.1 During the ventilation of airborne effluents from the Auxiliary Building through the Auxiliary Building Exhaust Stack, the following conditions shall be met:

A. The Auxiliary Building Exhaust Stack Noble Gas Monitor, iodine sampler and particulate sampler, shall be operational, OR: 10/93

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 2).

2) If the Auxiliary Building Exhaust Stack iodine or particulate sampler(s) is/are 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 using auxiliary sample collection equipment is initiated within 2 hours of the declaration, by the Shift Supervisor, of inoperability in accordance with Table 2.

B. The Auxiliary Building Exhaust Stack Noble Gas Radiation Monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.1 C. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from the Auxiliary Building may continue provided that the radioactivity level is recorded manually at least once per four hours during the actual release.

D. The Auxiliary Building Exhaust Stack flowrate shall be monitored and recorded during ventilation of the Auxiliary Building. If the flowrate monitor or recorder is inoperable, ventilation may continue provided the flowrate is determined and recorded manually at least once per four hours.

2.2.1.2 During release of airborne effluents from containment pressure relief line to the Auxiliary Building Exhaust Stack, the following conditions shall be met:

10/93

A. The conditions set forth in Section 2.2.1.1 shall be met.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

C. At least one Auxiliary Building exhaust fan shall be in operation.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.2 D. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from containment may continue provided that the radioactivity level is recorded manually at least once per four hours during the actual release.

E. The containment flow rate shall be monitored and automatically recorded during the release. If the flow rate monitor or recorder is inoperable, releases from the containment may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.2.1.3 During release of gaseous radioactive effluent from Containment Penetration M72 or M74 (Integrated Leak Rate Test Depressurization Vent Path) to the Auxiliary Building Stack:

10/93

A. The conditions set forth in Section 2.2.1.1 shall be met.

B. Automatic release termination capability is not required provided manual isolation can be accomplished in accordance with the requirements of SS-ST-ILRT-0001.

2.2.1.4 During the release of airborne effluents from the containment purge line:

10/93

A. The conditions set forth in Section 2.2.1.1 shall be met.

B. A noble gas monitor shall monitor the containment building atmosphere.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.1.5 During the release of airborne effluents from the gaseous waste discharge header:

A. The Auxiliary Building Exhaust Stack noble gas monitor, iodine sampler and particulate sampler shall be operational, OR:

1) If the Auxiliary Building Exhaust Stack noble gas monitor is inoperable, effluent releases may continue provided that (prior to release):

a) At least two independent samples are analyzed in accordance with the applicable chemistry procedure.

b) At least two qualified individuals independently verify the release rate calculations.

B. The Auxiliary Building Exhaust Stack noble gas radiation monitor shall be set in accordance with Part III to alarm and automatically terminate the release prior to exceeding 10 CFR 20 limits at the unrestricted area boundary (see Part III, Figure 1).

C. At least one Auxiliary Building exhaust fan shall be in operation.

D. The Auxiliary Building Exhaust Stack airborne radioactivity shall be monitored and recorded during the release. If the process radiation monitor chart recorder is inoperable and the noble gas monitor is operable then releases from waste gas decay tanks may continue provided that the gaseous radioactivity level is recorded manually at least once per four hours during the actual release.

E. The waste gas discharge header flow rate shall be monitored and automatically recorded during releases. If the flow rate monitor or recorder is inoperable, releases may continue provided the flow rate is determined and recorded manually at least once per four hours during actual release.

2.0 RADIOACTIVE EFFLUENT RELEASE REQUIREMENTS (Continued)

2.2.2 Condenser Offgas

2.2.2.1 During power operation, the condenser air ejector 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 2)

2.2.3 Laboratory and Radioactive Waste Processing Building Stack

2.2.3.1 During the release of airborne effluents from the Laboratory and Radioactive Waste Processing Building (LRWPB) the following conditions shall be met:

A. The LRWPB noble gas monitor, iodine sampler and particulate sampler shall be operational, OR:

1) 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 and analyzed for principal gamma emitters.

[2)] If the iodine or particulate sampler(s) is/are 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, by the Shift Supervisor, of inoperability in accordance with Table 2.

B. The LRWPB noble gas radiation monitor shall be set in accordance with Part III to alarm at its predetermined setpoints.

C. The LRWPB Stack flow rate shall be monitored and recorded during ventilation of the LRWPB. If the flow rate monitor or recorder is inoperable, ventilation may continue provided the flow rate is determined and recorded manually at least once per four hours.

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS

The sampling and analysis requirements stated in this Section will provide reasonable assurance that radioactive materials present in the liquid and airborne effluents will be properly identified and accurately quantified. This information will serve as the basis for determining doses to individuals as a result of radioactive effluents from FCS.

Records shall be maintained and reports of the sampling and results of analyses shall be submitted to the Nuclear Regulatory Commission in accordance with Section 4 of these Controls. Sampling, analysis and operability testing will typically be documented on Surveillance Tests or on Release Permits or Summaries.

3.1 Liquid Effluents

3.1.1 Radioactive liquid effluent sampling and activity analyses shall be performed in accordance with Table 1. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration at the point of release is limited to 10 CFR 20 limits for unrestricted areas.

3.1.2 Prior to release of each batch of liquid effluent, the batch shall be mixed, sampled, and analyzed for principal gamma emitters. When operational or other limitations preclude specific gamma radionuclide analysis of each batch:

3.1.2.1 Gross radioactivity measurements shall be made to estimate the quantity and concentrations of radioactive materials released in the batch.

3.1.2.2 A weekly sample composite from proportional aliquots from each batch released during the week shall be analyzed for the principal gamma-emitting radionuclides.

3.1.3 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 II, Section 4.

3.1.4 The radiation monitors for liquid effluents shall have their operability tested in accordance with the requirements in Table 3, Item A.

3.1.5 Steam Generator blowdown effluent flowrates shall have their operability tested in accordance with the requirement in Table 3, Item D. 10/93

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.2 Airborne Effluents

3.2.1 Radioactive airborne effluent sampling and activity analyses shall be performed in accordance with Table 2. The results of these analyses shall be used with the calculational methods in Part IV of this manual to assure that the concentration of radioactive materials is limited to 10 CFR 20 limits at the unrestricted area boundary.

3.2.2 The radiation monitors/samplers for airborne effluents shall have their operability tested in accordance with the requirements in Table 3, Item B.

3.2.3 The Auxiliary Building Exhaust and the Laboratory Radioactive Waste Processing Building Exhaust Stack flowrates shall have their operability tested in accordance with the requirements in Table 3, Item D. 10/93

3.3 Lower Limit of Detection (LLD)

The lower limit of detection (LLD) for liquid and airborne effluent discharges, referenced in Part II, Tables 1 and 2, is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 * s_b}{E * V * D * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD = the lower limit of detection as defined above, in either picoCuries or microCuries, per unit mass or volume as a function of the value of D

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate, as counts per minute

E = the counting efficiency, as counts per disintegration

V = the sample size in units of mass or volume

D = 2.22E+06 of disintegrations per minute per microCurie or 2.22 disintegrations per minute per picoCurie

3.0 RADIOLOGICAL EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS (Continued)

3.3 Y = the fractional radiochemical yield, when applicable

λ = the radioactive decay constant for the particular radionuclide

Δt = the elapsed time for the plant effluent between the midpoint of sample collection and time of counting

Appropriate values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an A Priori limit representing the capability of a measurement system and not as a limit for a particular measurement.

LLD verifications will be performed on a periodic basis. This determination is to ensure that the counting system is able to detect levels of radiation at the LLD values for the specific type of analysis required by Tables 1 and 2. They will be performed with a blank (non-radioactive) sample in the same counting geometry as the actual sample.

4.0 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 1 are complied with. These reports will meet the requirements for documentation of radioactive effluents contained in 10 CFR 50.36a; Reg. Guide 1.21, Rev. 1; Reg. Guide 4.8, Table 1; and Reg. Guide 1.109, Rev. 1.

4.1 Annual Radioactive Effluent Release Report

A report covering the operation of the Fort Calhoun Station during the previous calender year shall be submitted within 90 days after January 1 of each year per the requirements of 10CFR 50.36a.

The radioactive effluent release report shall include 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.

The radioactive effluent release report shall include 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.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.1 The radioactive effluent release report shall include 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.

The radioactive effluent release report shall include any 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.

4.2 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:

4.2.1 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.

4.2.2 Interpretations and statistical evaluation of the results, including an assessment of the observed impacts of the plant operation and environment.

4.2.3 The results of participation in a NRC approved Interlaboratory Comparison Program.

4.2.4 The results of land use survey required by Part II, Section 5.4.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.2.5 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:

4.2.5.1 Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded.

4.2.5.2 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.

4.2.5.3 Purification system flow history starting 48 hours prior to the first sample in which the limit was exceeded.

4.2.5.4 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

4.2.5.5 The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

4.3 Non-Routine Report

If a confirmed measured radionuclide concentration in an environmental sampling medium averaged over any calendar quarter sampling period exceeds the reporting level referenced in Table 7, and if the radioactivity is attributable to plant operation, a written report shall be submitted to the Nuclear Regulatory Commission within 30 days from the end of the quarter.

The report shall include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the anomalous result.

4.0 RADIOACTIVE EFFLUENT REPORTING REQUIREMENTS (Continued)

4.4 EPA 40 CFR 190 Reporting Requirements

With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Part II, Sections 1.1.2, 1.2.2, or 1.3, based on quarterly and annual calculations, 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 190 standard. Otherwise, obtain a variance from the Commission to permit releases which exceed the 40 CFR 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.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

The requirements set forth in this Section will provide reasonable assurance that radioactive liquid and airborne effluent releases to the environment in and around Fort Calhoun Station are monitored and that any deviation of radiation levels above background will be identified.

5.1 Radiological environmental monitoring shall be conducted according to Table 4. 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 (Part II, Section 4.2).

5.2 If the level of radioactivity, from calculated doses, in the Annual Radiological Effluent Release Report leads to a higher exposure pathway to individuals, this pathway shall be added to the Radiological Environmental Monitoring Program.

5.3 If the level of radioactivity in an environmental sampling medium exceeds the reporting level specified in Table 7, a Non-routine Report shall be prepared and submitted to the Nuclear Regulatory Commission (Part II, Section 4.3). The detection capabilities of the equipment used for the analysis of Environmental Samples must meet the requirements of Table 6 for Lower Level of Detection (LLD).

5.4 A land use survey shall be conducted once per 24 months between the dates of June 1 and October 1. This 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 results of the land use survey shall be submitted to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report (Part II, Section 4.2). The survey shall be conducted under the following conditions:

5.4.1 Within a one-mile radius from the plant site, enumeration by door-to-door or equivalent counting techniques.

5.4.2 Within a five-mile radius, enumeration by using referenced information from county agricultural agents or other reliable sources.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING REQUIREMENTS

5.4.3 If it is learned from this survey that milk animals are present at a location which yields a calculated dose greater than from previously sampled location(s), the new location(s) shall be added to the monitoring program. The 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 is then added to the monitoring program. Also, any location(s) from which milk can no longer be obtained may be dropped and replaced if practicable from the monitoring program and the Nuclear Regulatory Commission shall be notified in the Annual Radiological Environmental Operating Report (Part II, Section 4.2).

5.4.4 Radiological Environmental Sampling locations and the media that is utilized for analysis are presented in Table 5. Details of the emergency TLD locations are contained in Emergency Preparedness Implementing Procedures.

5.5 Analyses shall be performed on radioactive materials as part of an Interlaboratory Comparison Program that has been approved by the Nuclear Regulatory Commission. The results of these analyses shall be included in the Annual Radiological Environmental Operating Report.

5.6 Deviations from the monitoring program, presented in this section and detailed in Table 4, are permitted if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of equipment, or if a person discontinues participation in the program and other legitimate reasons. If the equipment malfunctions, corrective actions will be complete as soon as practicable. If a person no longer supplies samples, a replacement will be made. All deviations from the sampling schedule will be described in the Annual Radiological Environmental Operating Report, pursuant to Part II, Section 4.2.

TABLE 1

Radioactive Liquid Effluent Sampling and Analysis

A. **Monitor & Hotel Waste Tanks Releases**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Each Batch	Principal Gamma Emitters(2)(3)	5.0 E-07
	I-131(2)	1.0 E-06
Monthly From One Batch	Dissolved Noble Gases(2) (Gamma Emitters)	1.0 E-05
Monthly Composite(7)	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite(7)	Sr-89, Sr-90	5.0 E-08

B. **Steam Generator Blowdown**

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Weekly Composite(7)	Principal Gamma Emitters(3)	5.0 E-07
	I-131(5)	1.0 E-06
Monthly	Dissolved Noble Gases (Gamma Emitters)	1.0 E-05
Monthly Composite(7)	H-3	1.0 E-05
	Gross α	1.0 E-07
Quarterly Composite(7)	Sr-89, Sr-90	5.0 E-08

TABLE 2

Radioactive Airborne Effluent Sampling and Analysis

A. Gas Decay Tank Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Prior to each release	Principal Gamma Emitters(4)	1.0 E-04

B. Containment Purge Releases or Containment

Pressure Relief Line Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Prior to each release	Principal Gamma Emitters(4)	1.0 E-04
Prior to each release	H-3	1.0 E-06

C. Condenser Air Ejector Releases

Sampling Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)(1)
Monthly(6)	Tritium (H-3)	1.0 E-06
Monthly	Principal Gamma Emitters(4)	1.0 E-04

TABLE 2
(Continued)

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

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

TABLES 1 and 2
(Continued)

NOTES:

(1) LLD is defined in Part II, Section 3.3.

(2) Gross Radioactivity is defined as the determination of radioactivity levels without regard to specific radionuclide identification and individual isotopic quantification.

(3) 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, Ce-141, and Ce-144.

(4) 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, Ce-141, Ce-144 for particulate emissions.

(5) 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 1.0 E-06 microCurie/milliliter.

(6) Required only when steam generator blowdown radioactivity for tritium (Table 1, Item B) exceeds 3.0 E-03 microCurie/milliliter.

(7) 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.

TABLE 3

Radiological Effluent and Environmental Instrumentation
Operability Test Requirements

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A. Liquid Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-054 A/B	X(2)	X	X	X	-
RM-055/55A	-	-	X	X	X

B. Gaseous Monitors	Daily Channel Check	Monthly Source Check	Quarterly Channel Func. Test	Refueling Calibration	Source Check Prior to Release
RM-043	X	X	X	X	-
RM-057	X	X	X	X	-
RM-062/62A(1)	X	X	X	X	X
RM-041/42 Sampler Flow Rate	X	-	-	X	-
RM-060 Sampler Flow Rate	X	-	-	X	-

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C. Envirnmntl. Monitors	Monthly Operations Check	Annual Air Flow Calibration
RM-035 → 039	X	X

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D. Effluent Flowrates	Daily Channel Check	Refueling Calibration
Steam Generator Blowdown Flowrate	X	X
Auxiliary Building Exhaust Stack Flowrate	X	X
Laboratory and Radioactive Waste Processing Building Exhaust Stack Flowrate	X	X

NOTES:

(1) RM-062A will be substituted for RM-062 when it is sampling the Auxiliary Building Exhaust Stack.

(2) Visual flowcheck daily

TABLE 4

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
1. Direct Radiation	A. Ten TLD indicator stations, one control station, total of 11.	Gamma dose	Quarterly
	B. An inner-ring of 16 stations, one in each meteorological sector in the general area of the unrestricted area boundary and within 2.5 miles.	Gamma dose during site Area and General Emergencies only.	Replaced Annually
	C. An outer-ring of 16 stations, 1 in each meteorological sector located outside of the inner-ring, but no more distant than approximately 5 miles(5).	Gamma dose during site Area and General Emergencies only.	Replaced Annually
2. Air Monitoring	A. Indicator Stations	1) Filter for Gross Beta(3)	Weekly
	1. 3 stations in the general area of th[illegible] unrestricted area bou[illegible]ry	2) Charcoal for I-131	Weekly
	2. City of Blair	3) Filter for Gamma Isotopic	Quarterly composite of wkly. fltrs.
	B. One background station	Same as A. above	
3. Water	A. Missouri River at nearest downstream drinking water intake.	Gamma Isotopic, H-3	Monthly composite for Gamma Isotopic Analysis
	B. Missouri River downstream near the mixing zone.		Quarterly composite for H-3 Analysis
	C. Missouri River upstream of plant intake (background).		
4. Milk(4)	A. Nearest family cow when available or one dairy farm within 5 miles.	Gamma Isotopic and I-131	Semimonthly grazing season (May to October)
	B. One dairy farm between 5 miles and 18.75 miles. (Background)		
5. Fish	A. Four fish samples within vicinity of plant discharge.	Gamma Isotopic	Once per season (May to October)
	B. One background sample upstream of plant discharge.		
6. Sediment	One sample from downstream area on the station side of the Missouri River.	Gamma Isotopic	Semiannually

TABLE 4
(Continued)

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Collection Site(1)	Types of Analysis(2)	Frequency
7. **Vegetables or Food Products**	A. One sample outside of 5 miles. (Background) B. One sample in the highest exposure pathway.	Gamma Isotopic	Once per season (May to October)

Notes:

(1) See Table 6 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) When milk samples are not available, a broad leaf vegetation or pasture grass sample shall be collected, when available.

(5) Details of the Emergency TLD Stations are contained in Emergency Preparedness Implementing Procedures.

TABLE 5

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from (north)	Airborne Particulate	Airborne Iodine	TLD	Surface Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
1	Onsite Station No. 1, 110-meter weather tower	0.5	293°	X	X	X					
2	Onsite Station No. 2, adjacent to old plant access road	0.6	208°	X	X	X					
3	Offsite Station No. 3, intersection of Hwy. 75 and farm access road	0.8	145°	X	X	X					
4	Blair OPPD office	3.0	303°	X	X	X					
5	EOF Building, North Omaha Power Station	17.5	157°	X	X	X					
6	Fort Calhoun City Hall	4.8	149°			X					
7	Fence around intake gate, Desoto Wildlife Refuge	2.0	101°			X					
8	Entrance to Plant Site from Hwy. 75	0.6	180°			X					
9	NW of Plant	1.0	310°			X					
10	WSW of Plant	0.7	250°			X					
11	SE of Plant	0.9	130°			X					
12	Met. Utilities Dist., Florence Treatment Plant North Omaha, NE	17.0	156°				X				
13	West bank Missouri River, downstream from reactor building	0.5	106°				X		X		
14	125' upstream from intake bldg., west bank of river	0.1	345°				X		X		

TABLE 5
(Continued)

Radiological Environmental Sampling Locations and Media

Location Number	Location Description	Distance From FCS Reactor Bldg. (miles)	Direction (Degrees from north)	Airborne Particulate	Airborne Iodine	TLD	Well Water	Fresh Milk	Bottom Sediment	Fish	Vegetation
15	Smith Farm[1]	1.9	133°				X				
16	OPPD Onsite Well[1]	0.1	154°				X				
17	Headquarters Bldg.,[1] Desoto Wildlife Refuge	3.1	53°				X				
18	Miller Farm[3] (Discontinued Milk)	0.8	206°								X
19	Flynn Dairy[2]	3.4	310°					X			
20	Mohr Dairy[1][2][3]	7.9	187°					X			X
21	Japp Dairy[2]	6.3	219°					X			
22	Fish Sampling Area - Missouri River	R.M. 645.0	-							X	
23	Fish Sampling Area - Missouri River	R.M. 666.0	-							X	
24	Legenhausen Farm (Discontinued)	0.7	207°								
25	Seltz Farm[2]	2.7	168°					X			
26	Vegetation[3] (High Expos. Pthwy. for Veg.)										X
27	Vegetation[3] (Background)										X

Notes:

(1) Sampling not required for pathway modeling, collections performed for additional information only.

(2) When a milk sample is not available at a location, a broad leaf vegetation sample will be collected at that location as a substitute.

(3) Vegetation sites chosen based on Land Use Survey and Semiannual Radioactive Effluent Release Report.

TABLE 6

Detection Capabilities for Environmental Sample Analysis(1)(2)(3)
Lower Limit of Detection (LLD)

Sample	Units	Gross Beta	H-3	Mn-54	Fe-59	Co-58, 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	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
Air Particulate or Gases	pCi/m^3	1.0E-02	--	--	--	--	--	--	--	7.0E-02	--	--	--
Sediment	pCi/kg (dry)	--	--	--	--	--	--	--	--	--	1.5E+02	1.8E+02	--
Grass or Broad Leaf Vegetation/ Vegetables	pCi/kg (wet)	--	--	--	--	--	--	--	--	6.0E+01	6.0E+01	8.0E+01	--

(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 Surveillance Report pursuant to Part II, Section 5.1.

(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, for purposes of these specifications, as the smallest concentration or radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22E{+}06 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

TABLE 7

Reporting Levels for Radioactivity Concentrations in Environmental Samples(1)

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	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
Air Particulate or Gases	pCi/m^3	--	--	--	--	--	--	--	--	9.0E-01	--	--	--
Grass or Broad Leaf Vegetation/ Vegetables	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:

$$\frac{\text{Concentration (1)}}{\text{Reporting Level (1)}} + \frac{\text{Concentration (2)}}{\text{Reporting Level (2)}} + \cdots \geq 1.0$$

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 II, Section 1.1 and 1.2. 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.

PART III

RADIOLOGICAL EFFLUENT RADIATION MONITOR CALCULATIONS

1.0 EFFLUENT MONITOR SETPOINTS

1.1 Liquid Effluents

There are two liquid discharge pathways to the Missouri River. These pathways originate with the radioactive liquid waste processing system (monitor or hotel tanks) and the steam generator blowdown system. Both of these pathways empty into the circulating water system which discharges to the Missouri River (see Figure 1). Figure 2 depicts the liquid discharge pathways and associated radiation monitors. Figure 3 depicts the methods of liquid effluent treatment. A detailed discussion of the liquid effluent treatment system is presented in Section 2.1.

The flowrate for dilution water varies with the number of circulating water pumps in service, the number of raw water pumps in service, and with the operation of the warm water recirculation. Some warm water from the condenser outlet is diverted from the circulating water discharge to upstream of the intake structure to help prevent ice from forming on the circulating water pump intakes during winter months. The varying dilution flowrate and utilization of warm water recirculation is accounted for in the dilution calculations for monitor tank and stream generation releases. 10/93 10/93

Alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the concentration of radioactive material released in liquid effluents at site discharge shall be less than the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2.

Cs-137 is the most abundant radionuclide in liquid effluent streams and is used to calibrate the liquid effluent monitors.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2 Liquid Effluent Radiation Monitors

1.2.1 Steam Generator Blowdown Monitors (RM-054A and B)

These process radiation detectors monitor the flow through the steam generator blowdown lines and automatically close the blowdown isolation valves if the monitor high alarm setpoint is reached. The high alarm setpoint calculations are based on controlling the discharge at 10 CFR 20 limits of 1.0E-06 μCi/ml at site discharge.

The following calculations for maximum concentration and alarm setpoints are valid when steam generator blowdown is the only liquid release pathway. For simultaneous radioactive liquid releases of steam generator blowdown and monitor tank discharge, refer to Section 1.5.1.

The maximum allowable concentration in the blowdown line is calculated as follows:

$$A_o = \frac{(1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o}$$

Where:

1.0E-06 μCi/ml = 10 CFR 20 Limit for unidentified radionuclides at site discharge (10 CFR 20, Appendix B, Note 2).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates may be used, as required.)

Y_o = Blowdown flow rate (gpm). (Normal blowdown flow rate is based on 2 transfer pumps with a design flow of 135 gpm each, 270 gpm total. Other flow rates may be used, as required.)

A_o = Maximum allowable blowdown concentration (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.1 The high alarm setpoint (CPM) =

$$.85\ [\ (S_f)\ (A_o) + B\ ]$$

Where:

.85 = Correction factor for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable blowdown line activity (μCi/ml).

B = Background (CPM).

Setpoints may be recalculated based on adjusted dilution flow and adjusted blowdown flow.

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified prior to automatic actuation of the blowdown isolation valves.

1.2.2 Overboard Discharge Header Monitor (RM-055 or RM-055A)

This process radiation monitor provides control of the waste monitor tank effluent by monitoring the overboard header prior to its discharge into the circulating water discharge tunnel. The concentration of activity at discharge is controlled below the 10 CFR 20 limit of 1.0E-06 μCi/ml at site discharge for unidentified isotopes by the high alarm setpoint which closes the overboard flow control valve.

The following calculations for maximum concentration and alarm setpoints are valid when Monitor Tank discharge is the only liquid release pathway. For simultaneous radioactive liquid releases of monitor tank discharge and steam generator blowdown, refer to Section 1.5.1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The maximum allowable concentration in the overboard discharge header is:

$$A_o = \frac{(1.0E\text{-}06\ \mu Ci/ml)\ \ (X_o)}{Y_o}$$

Where:

1.0E-06 μCi/ml= 10 CFR 20 Limit for unidentified radionuclides at site discharge (10 CFR 20, Appendix B, Note 2).

X_o = Total dilution flow in the discharge tunnel (gpm). (Normal flow is based on 1 circulating water pump at 120,000 gpm. Other flowrates such as raw water pump(s) may be used, as required.) 10/93

Y_o = Maximum monitor tank discharge flow rate (gpm). (Normal monitor tank maximum flow is 50 gpm. Other flow rates such as raw water pump(s) may be used, as required.) 10/93

A_o = Maximum allowable activity in discharge header (μCi/ml).

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.2.2 The high alarm setpoint (CPM) =

$.85\ [\ (S_f)\ (A_o) + B]$ 10/93

Where:

.85 = Correction factor for instrument meter error.

S_F = Detector sensitivity factor (CPM/μCi/ml). (Sensitivity based on Cs-137).

A_o = Maximum allowable concentrat.on in discharge header (μCi/ml).

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to automatic actuation of the overboard flow control valve.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.3 Airborne Effluents

The airborne effluent monitoring instrumentation for controlling and monitoring normal radioactive material releases in accordance with 10 CFR 20, Appendix B, Table 2, Column 1 limits at the unrestricted area boundary (see Figure 1), are summarized as follows:

A. Auxiliary Building - The Auxiliary Building Exhaust Stack receives discharges from the waste gas decay tanks, containment purge, containment vent systems and the auxiliary building ventilation system. Radiation Monitor RM-062 provides noble gas monitoring and iodine and particulate sampling for the Auxiliary Building Exhaust Stack. Backup noble gas monitoring is provided by RM-062A and backup iodine and particulate sampling is provided by RM-060. Ventilation Isolation Actuation Signal (VIAS) is actuated by exceeding a monitor's alarm setpoint. Actuation of VIAS will isolate releases from containment and waste gas decay tanks. The Auxiliary Building Exhaust fans will remain in operation. 10/93

B. Laboratory and Radioactive Waste Process-ing Building (LRWPB) - Noble gas monitoring is provided by Radiation Monitor RM-043. Particulate and Iodine sampling is provided by RM-041 and RM-042, respectively. These radiation monitors/samplers do not serve a control function. 10/93

C. Condenser Off-Gas Monitors - Noble gas activity is monitored by RM-057. The condenser off-gas is discharged directly to the environment. Exceeding the high alarm setpoint on RM-057 will activate isolation of main steam to the Auxiliary Steam System.

An airborne radioactive waste flow diagram with the applicable, associated radiation monitoring instrumentation and controls is presented as Figure 4. The airborne waste disposal system is presented in Figure 5. A detailed discussion of the airborne effluent treatment system is presented in Section 2.2.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4 Airborne Effluent Radiation Monitors

1.4.1 Auxiliary Building Exhaust Stack Noble Gas Activity Monitor (RM-062/RM-062A) 10/93

Either of these monitors may be used to measure the noble gas activity in the exhaust stack. The noble gas is monitored after passing through a particulate filter. The monitor controls airborne releases so that the 10 CFR 20 limit at the unrestricted area boundary of 5.0E-07 μCi/cc, based upon Xe-133, is not exceeded. The Ventilation Isolation Actuation Signal is initiated when the high alarm setpoint is reached.

The following calculations for maximum release rate and alarm setpoint are valid when Auxiliary Building Exhaust Stack is the only airborne release pathway. For simultaneous airborne releases from Auxiliary Building Exhaust Stack, Condenser Off-gas and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for stack airborne activity is calculated as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ sec/m^3)} \times (1.0E{+}06\ cc/m^3) = 1.0E{+}05\ \mu Ci/sec$$

Where:

5.0E-07 μCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m^3	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m^3	=	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ [\ \frac{(1.0E{+}05)\ (S_F)\ (60)}{(F_v)\ (28317)} + B\ ]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.1 Where:

.85 =	Correction for instrument meter error.
S_F =	Detector sensitivity factor (CPM/ μCi/cc). (Sensitivity based on Xe-133)
60 =	Conversion (seconds to minutes).
28317 =	Conversion factor (ft^3 to cc).
F_v =	Auxiliary Building Exhaust stack flow rate (SCFM). (Default maximum flow rate is 122500 cfm for 3 Auxiliary Building exhaust fans and 2 containment purge fans in operation. Other flow rates may be used, as required.)
B =	Background (CPM).

An alarm setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, prior to actuation of VIAS.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.2 Condenser Air Ejector Monitor (RM-057)

This monitor is located in the turbine building and monitors the condenser off-gas. The purpose of this monitor is to monitor the condenser off-gas discharges so that the 10 CFR 20 limit at the unrestricted area boundary of 5.0E-07 μCi/cc, based upon Xe-133, is not exceeded.

The following calculations for maximum release rate and alarm setpoint are valid when condenser off-gas is the only airborne release pathway. For simultaneous airborne releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for condenser air ejector monitor is as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ sec/m^3)} \times (1.0E{+}06\ cc/m^3) = 1.0E{+}05\ \mu Ci/sec$$

Where:

5.0E-07 μCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m^3	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m^3	=	Constant of unit conversion.

The high alarm setpoint (CPM):

$$Setpoint = .85\ [\ \frac{(1.0E{+}05)\ (S_F)\ (60)}{(F_v)\ (28317)} + B\ ]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.2 Where:

.85	=	Correction for instrument meter error.
S_F	=	Detector sensitivity factor (CPM/μCi/cc). (Sensitivity based on Xe-133)
60	=	Conversion (seconds to minutes).
28317	=	Conversion factor (ft^3 to cc).
F_v	=	Vent stack flow rate (SCFM). Default maximum flow rate is 4755 scfm (3 vacuum pumps in hogging mode. Other flow rates may be used, as required.)
B	=	Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified, allowing time for corrective actions prior to exceeding the alarm setpoint and tripping of the auxiliary steam supply valve, RCV-978.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.3 Laboratory and Radioactive Waste Processing Building Exhaust Stack Noble Gas Activity Monitor (RM-043)

RM-043 is located in the Radwaste Building and samples the LRWPB Exhaust Stack. The monitor alarm setpoint is based on the 10 CFR 20 limit for Xe-133 at the unrestricted area boundary.

The following calculations for maximum release rate and alarm setpoint are valid when the LRWPB Exhaust Stack is the only airborne release pathway. For simultaneous airborne releases from condenser off-gas, Auxiliary Building Exhaust Stack, and the LRWPB Exhaust Stack, refer to Section 1.5.2.

The maximum allowable release rate for RM-043 is as follows:

$$\frac{(5.0E\text{-}07\ \mu Ci/cc)}{(5.0E\text{-}06\ \sec/m^3)} \times (1.0E\text{+}06\,cc/m^3) = 1.0E\text{+}05\ \mu Ci/\sec$$

Where:

5.0E-07 μCi/cc	=	10 CFR 20 Limit at the unrestricted area boundary (based upon Xe-133).
5.0E-06 sec/m^3	=	Annual average dispersion factor at the unrestricted area boundary.
1.0E+06 cc/m^3	=	Constant of unit conversion.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.4.3 The high alarm setpoint (CPM):

$$Setpoint = .85\ \left[\ \frac{(1.0E{+}05)\ (S_F)\ (60)}{(F_V)\ \ (28317)} + B\ \right]$$

Where:

.85 = Correction for instrument meter error.

S_F = Detector sensitivity factor (CPM/µCi/cc). (Sensitivity based on XE-133)

60 = Conversion (seconds to minutes).

28317 = Conversion factor (ft^3 to cc).

F_v = LRWPB Exhaust stack flow rate (SCFM). (Default flow rate is 28700 cfm. Other flow rates may be used if required.

B = Background (CPM).

An alert setpoint will be chosen at a value below the alarm setpoint so that significant increases in activity will be identified.

This monitor alarms in the Control Room. There are no automatic control functions associated with the actuation of the alarm.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5 Simultaneous Release Pathways

1.5.1 Liquid Release Pathways

The liquid radiation monitors (RM054A and B, RM055, and RM055A) control liquid releases so that 10 CFR 20 limit of 1.0E-06 µCi/ml for unidentified isotopes at site discharge is not exceeded. There are two liquid release pathways that contribute to the concentration at site discharge. These are Steam Generator Blowdown and Monitor Tank Overboard Discharge Header. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.2 so that unrestricted area concentration limits are not exceeded.

The calculations for the alarm setpoints for the liquid effluent monitors will be adjusted as follows:

$$A_t = K_o A_o + K_1 A_1$$

$$A_T = \frac{K_o\ (1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_o} + \frac{K_1\ (1.0E\text{-}06\ \mu Ci/ml)\ (X_o)}{Y_1}$$

Where:

A_T = Sum of individual maximum allowable concentrations for Steam Generator and Monitor Tank prior to dilution for simultaneous liquid releases (µCi/ml)

A_o = Maximum allowable concentration in Steam Generator blowdown Line (µCi/ml)

A_1 = Maximum allowable concentration in Monitor Tank Discharge Line (µCi/ml)

K_o = Proportionality constant for Steam Generator (See Table 1)

K_1 = Proportionality constant for Monitor Tank (See Table 1)

X_o = Total dilution flow in Discharge Tunnel (GPM)

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.1 Where:

Y_o = Steam Generator Blowdown flowrate (GPM)

Y_1 = Monitor Tank Discharge flowrate (GPM)

The High Alarm Setpoint for Steam Generator Blowdown monitors, RM054A and B, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_o\ S_{Fo}\ A_o + B_o]$$

The High Alarm Setpoint for Monitor Tank Discharge monitors, RM055 and 55A, will then be:

$$Alarm\ Setpoint\ (CPM) = .85\ [K_1\ S_{F1}\ A_1 + B_1]$$

Where:

S_{Fo} = Detector Sensitivity factor for RM054A/B, CPM/(μCi/ml), based on Cs-137.

S_{F1} = Detector Sensitivity factor for RM055/55A, CPM/(μCi/ml), based on Cs-137.

A_o = Maximum allowable concentration in SG Blowdown line. (μCi/ml)

A_1 = Maximum allowable concentration in MT Discharge line. (μCi/ml)

B_o = RM054 A or B background countrate. (CPM)

B_1 = RM055 or 55A background countrate. (CPM)

Where:

K_o, K_1 = Proportionality constants. See Table 1.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Airborne Release Pathway

The noble gas radiation monitors (RM043, RM057, and RM062/RM062A) control airborne releases so that 10 CFR 20 limits of 5.0E-07 μCi/cc for noble gases at the unrestricted area boundary is not exceeded. There are three pathways that contribute to the concentration at the unrestricted area boundary. These are the Auxiliary Building Exhaust Stack, Condenser Off-gas, and the LRWPB Exhaust Stack. When more than one pathway is utilized for radioactive releases, it is necessary to adjust the alarm setpoints given in Section 1.4 to ensure that unrestricted area concentration limits are not exceeded. 10/93

The calculations for the alarm setpoints for the airborne effluent monitors will be adjusted as follows:

The maximum allowable release rates for simultaneous releases is: 10/93

$$Max.\ Release\ Rate = \sum_{i=1}^{3} K_i R_i = \sum_{i=1}^{3} K_i \frac{Conc_i}{\chi/Q}$$

Where:

R_1 = RM062/RM062A release rate (μCi/sec) 10/93
R_2 = RM057 release rate (μCi/sec) 10/93
R_3 = RM043 release rate (μCi/sec)
$K_1 \rightarrow K_3$= Proportionality constants. See Table 1.

$Conc_i$ = Radionuclide concentration for the monitor of interest.

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

10/93

1.5.2 The maximum release rate is then:

$$\left[\frac{K_1(5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \frac{K_2(5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} + \right.$$

$$\left. \frac{K_3(5.0E\text{-}07\ \mu Ci/cc)}{5.0E\text{-}06\ sec/m^3} \right] 1.0E{+}06\ \frac{cc}{m^3} = Max.\ Release\ Rate$$

The alarm setpoints for the noble gas monitors will then be:

$$RM062/62A = .85\ \left[K_1\ \frac{(1.0\ E{+}05)\ (S_F)(60)}{F_V\ (28317)} + B \right]$$

$$RM057 = .85\ \left[K_2\ \frac{(1.0\ E{+}05)\ (S_F)(60)}{(F_V)\ (28317)} + B \right]$$

$$RM043 = .85\ \left[K_3\ \frac{(1.0\ E{+}05)\ (S_F)(60)}{(F_V)\ (28317)} + B \right]$$

1.0 EFFLUENT MONITOR SETPOINTS (Continued)

1.5.2 Where:

.85	=	Correction factor for instrument meter error.
$K_1 \rightarrow K_3$	=	Proportionality constants. See Table 1. 10/93
S_F	=	Detector sensitivity factor.
F_V	=	Vent stack flowrate. (Condenser off-gas flowrate for RM057, LRWPB Exhaust stack flow rate for RM043, Auxiliary Building Exhaust Stack flow rate for RM62/62A). 10/93
B	=	Monitor background count rate.
60	=	Constant of unit conversion (60 sec/min).

TABLE 1

NOTE: The Fort Calhoun Station is capable of performing simultaneous airborne releases given that the sum of the Unrestricted Area Fraction Sum for all airborne releases remains less than or equal to 1.0.

A. Proportionally Constants for Simultaneous Airborne Releases.

1. Auxiliary Building Exhaust Stack

		Total 0.80	
K_1	Noble Gases	0.70	RM-062 or 062A
	Iodine/Particulate/Tritium	0.10	

Contributing Pathways:

a)	Auxiliary Building	0.10
b)	Containment Building	0.65
c)	Waste Gas Decay Tanks	0.05

2. Condenser/Air Ejector — Total 0.10

K_2	Noble Gases	0.05	RM-057
	Tritium	0.05	

Contributing Pathways:

a)	Condenser Off Gas	0.10

3. Laboratory and Radioactive Waste Building Exhaust Stack — Total 0.10

K_3	Noble Gases	0.05	RM-043
	Iodine/Particulate	0.05	

Contributing Pathways:

a)	Laboratory and Radioactive Waste Building Exhaust Stack	0.10
	Airborne Release Total	1.00

NOTE: The Fort Calhoun Station is capable of performing simultaneous liquid releases given that the sum of the Unrestricted Area Fraction Sum for all liquid releases remains less than or equal to 1.0.

B. Proportionally Constants for Simultaneous Liquid Releases.

1.	K_0	Steam Generator Releases	0.30	RM-054A/054B
2.	K_1	Waste Liquid Releases	0.70	RM-055A
		Liquid Release Total	1.00	

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.1 Liquid Radwaste Treatment System

The major equipment or subsystem(s) of the liquid radwaste treatment system are comprised of the waste filters, monitor tanks, and evaporator. This equipment, including associated pumps, valves and piping, is used in different combinations on an as-needed basis to process the liquid effluent to provide compliance with the as low as is reasonably achievable philosophy and the applicable section of 10 CFR Part 20. The liquid radwaste treatment system is described in Section 11.1.2 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405-M-100, M-9 and M-8.

A filtration/ion exchange (FIX) system may be utilized for processing liquid radwaste in the event the waste evaporator is not in service. 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 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 Part II, Section 2.1.

Every effort will be made to process all liquid waste, except from the hotel waste tanks, through the evaporator or FIX before entering the monitor tanks. If the radioactive liquid waste is discharged without processing and it appears that 1/2 of the annual objective will be exceeded during the calendar quarter, a special report shall be submitted to the Commission pursuant to Part II, Section 2.1.

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.

2.0 RADIOACTIVE WASTE TREATMENT SYSTEM

2.2 Airborne Radwaste Treatment 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, a special report shall be submitted to the Commission pursuant to Part II, Section 2.2.

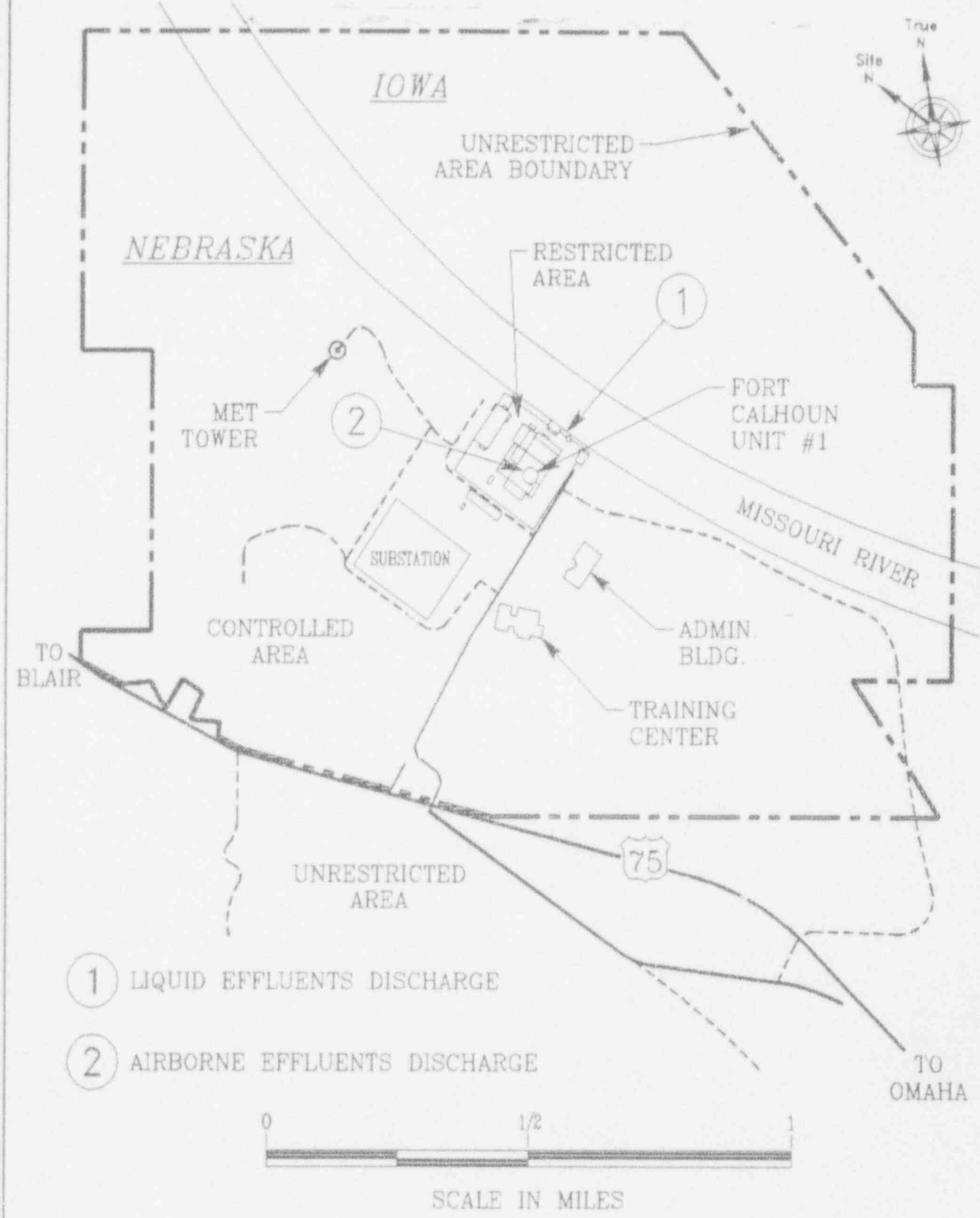
The radioactive effluents from the controlled access area of the auxiliary building are filtered by the HEPA filters in the auxiliary building ventilation system. If the radioactive effluents are discharged without the HEPA filters, a special report shall be submitted to the NRC pursuant to Part II, Section 2.2.

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 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 as per Part II, Section 2.2.

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, a special report shall be submitted to the Commission pursuant to Part II, Section 2.2.

The airborne radwaste treatment system is described in Section 11.1.3 of the USAR. For effluent release points and monitor locations refer to P&ID's 11405-M-1 and M-261.

Figure 1



EXCLUSION AND SITE BOUNDARY MAP

Figure 2

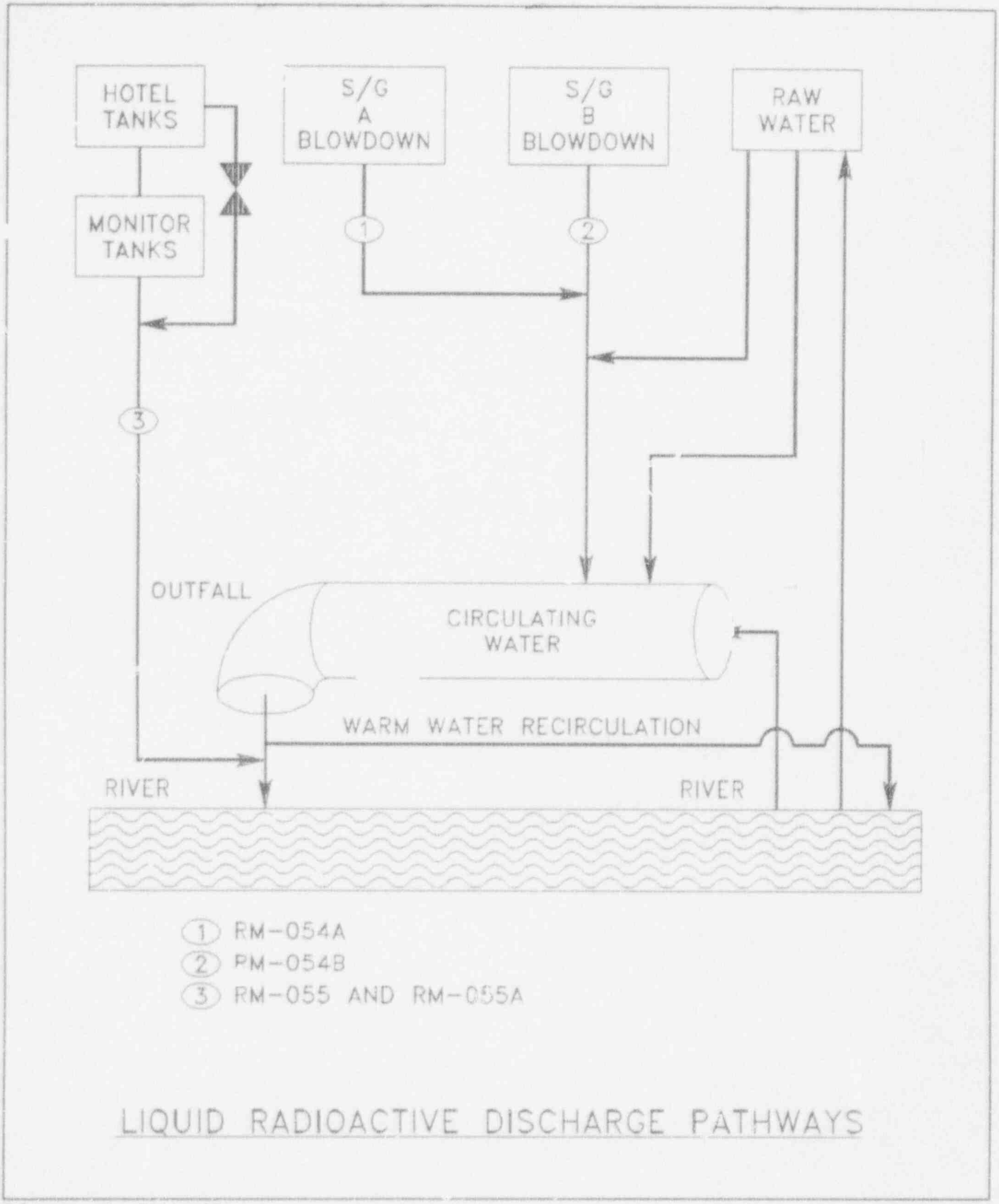
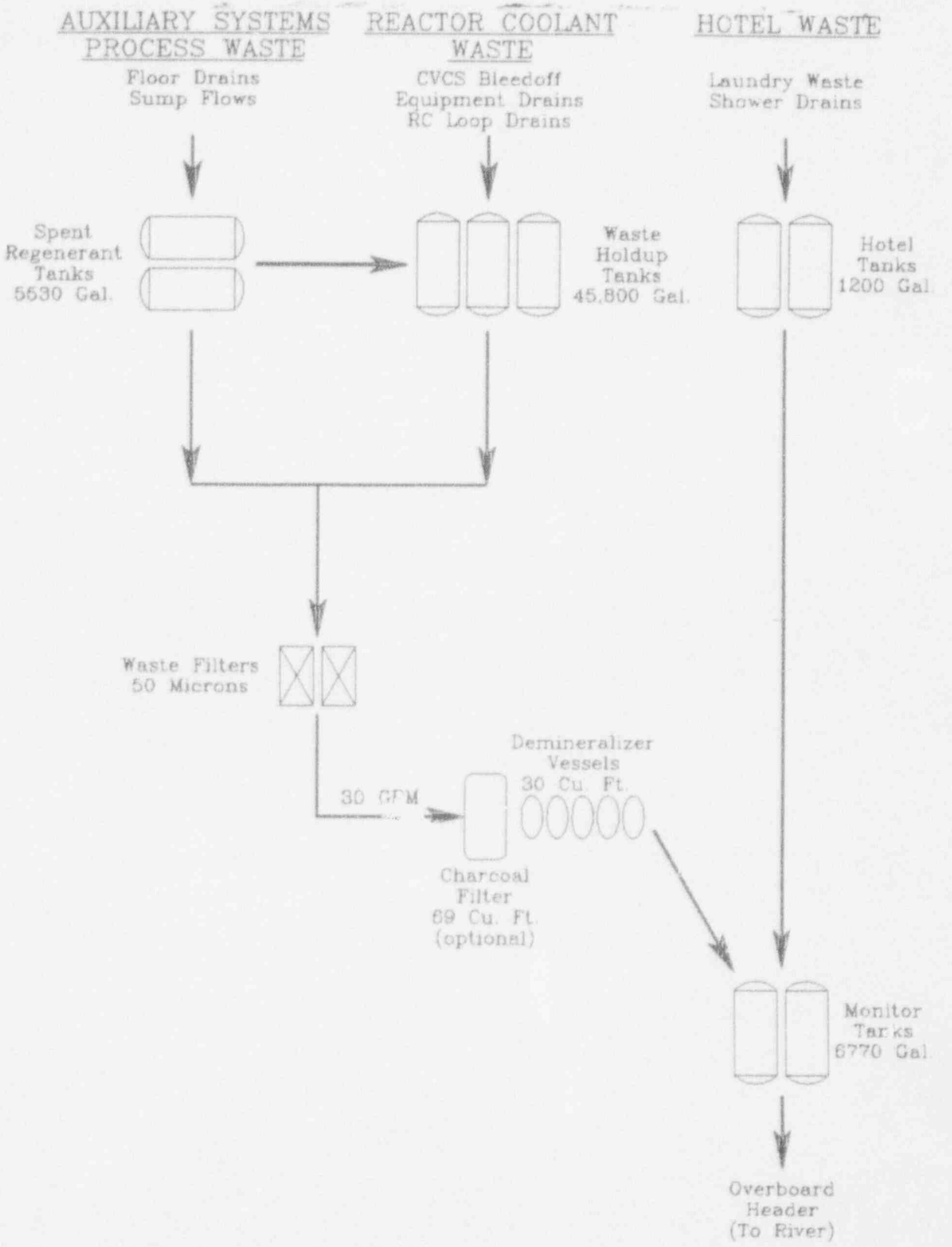


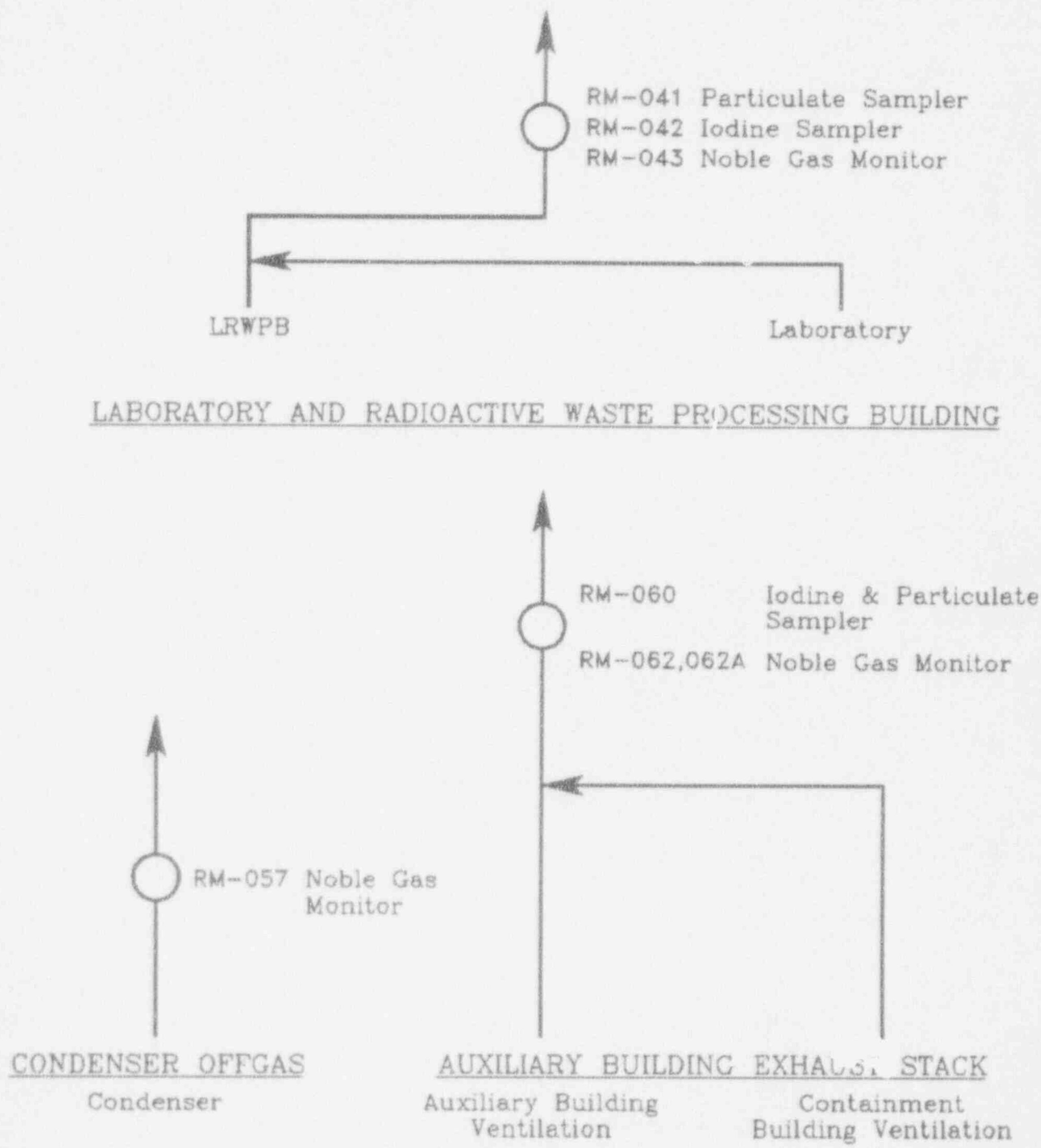
Figure 2 CH8915E

Figure 3



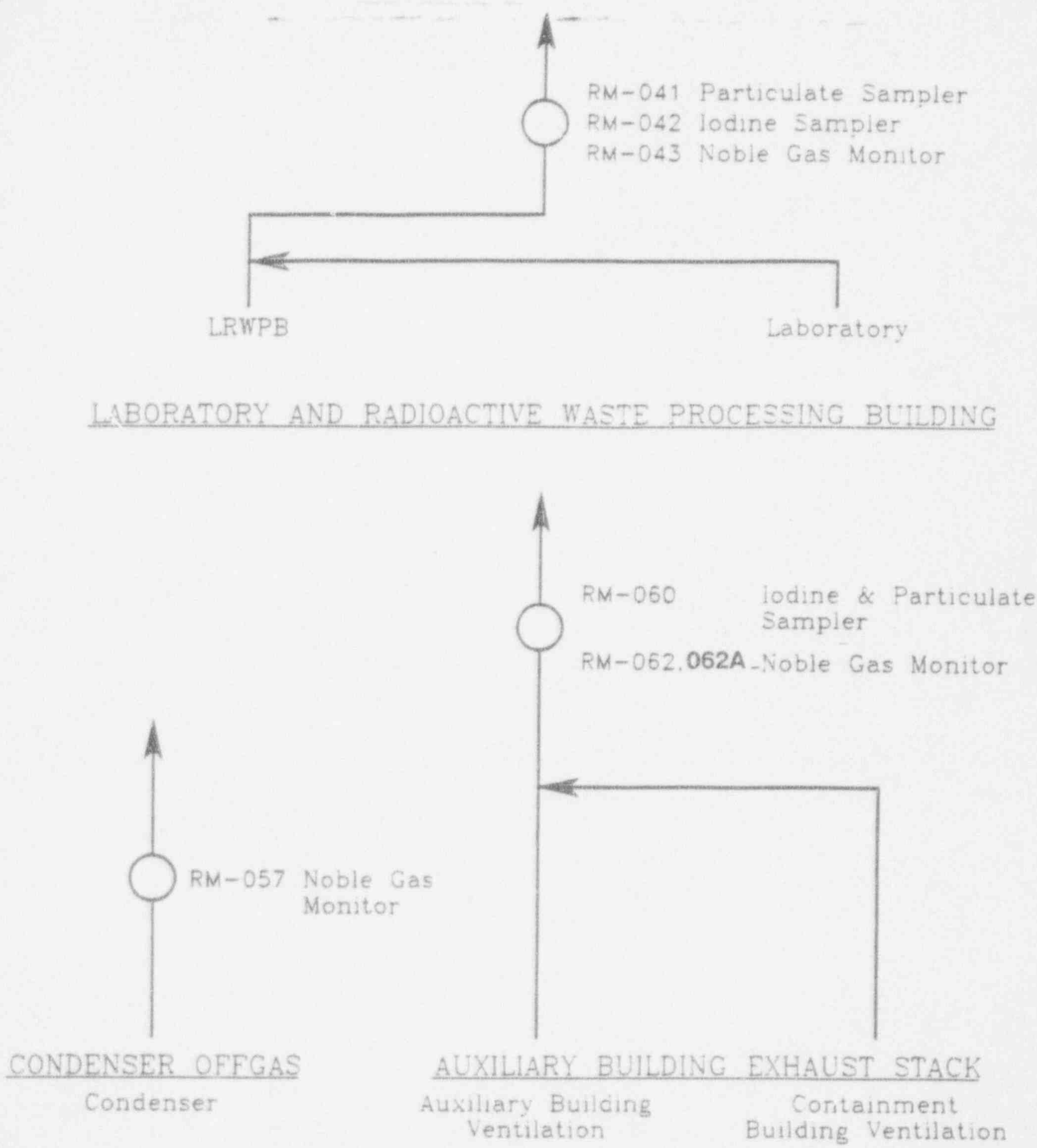
LIQUID RADIOACTIVE WASTE DISPOSAL SYSTEM

Figure 4



AIRBORNE EFFLUENT DISCHARGE PATHWAYS

Figure 4



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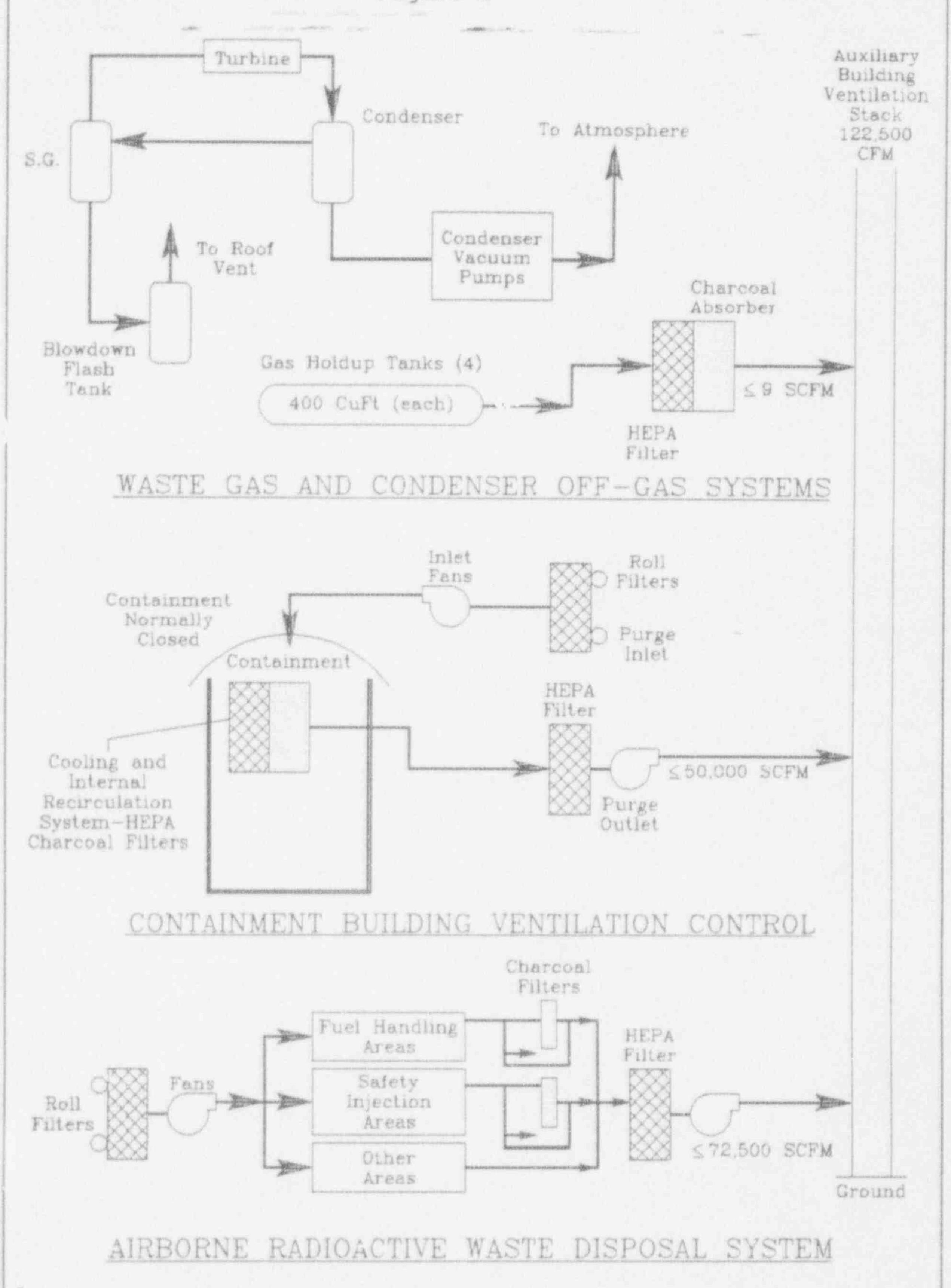
AIRBORNE EFFLUENT DISCHARGE PATHWAYS

Figure 5


Turbine
Condenser
S.G.
To Atmosphere
Auxiliary Building Ventilation Stack 122,500 CFM
Condenser Vacuum Pumps
To Roof Vent
Charcoal Absorber
Blowdown Flash Tank
Gas Holdup Tanks (4)
400 CuFt (each)
≤ 9 SCFM
HEPA Filter
WASTE GAS AND CONDENSER OFF-GAS SYSTEMS
Inlet Fans
Roll Filters
Containment Normally Closed
Purge Inlet
Containment
HEPA Filter
Cooling and Internal Recirculation System-HEPA Charcoal Filters
≤ 50,000 SCFM
Purge Outlet
CONTAINMENT BUILDING VENTILATION CONTROL
Charcoal Filters
Fuel Handling Areas
HEPA Filter
Fans
Roll Filters
Safety Injection Areas
Other Areas
≤ 72,500 SCFM
Ground
AIRBORNE RADIOACTIVE WASTE DISPOSAL SYSTEM

PART IV

RADIOLOGICAL EFFLUENT MONITORING CALCULATIONS

1.0 EFFLUENT CONCENTRATIONS

1.1 Liquid Effluent Concentrations

The concentration of radioactive material in liquid effluents (after dilution in the Circulating Water System) will be limited to the concentrations as specified in 10 CFR 20, Appendix B, Table 2, Column 2. For batch releases (Monitor and Hotel Waste Tanks and Steam Generators) and for continuous releases (Steam Generator Blowdown), the analyses will be performed in accordance with Part II, Table 1, and the concentration of each radionuclide at site discharge will be calculated, based on the following equation:

Radionuclide concentration at site discharge:

$$A_i = \frac{a_i f}{F + f}$$

$$\text{and} \sum_{i=1}^{n} A_i / wec_i \leq 1$$

Where:

A_i = concentration at site discharge for radionuclide, i, in μCi/ml.

a_i = concentration of radionuclide, i, in the undiluted effluent in μCi/ml.

f = undiluted effluent flowrate, in gpm.

F = total diluted effluent flowrate in gpm.

wec_i = water effluent concentration limit for radionuclide, i, per 10 CFR 20, Appendix B, Table 2, Column 2.

1.0 EFFLUENT CONCENTRATIONS

NOTE: In addition to the above defined method, Notes 1 through 4 of 10 CFR Part 20, Appendix B, will also be applicable.

1.2 Airborne Effluent Concentrations

The concentration at the unrestricted area boundary, due to airborne effluent releases, will be limited to less than Appendix B, Table 2, Column 1, values. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event an airborne effluent release from the station result in an alarm setpoint being exceeded, an evaluation of the unrestricted area boundary concentration resulting from the release will be performed:

To determine the concentration and air effluent concentration (aec) fraction summation at the unrestricted area boundary, the following equations will be used:

$$A_i = K_o Q_i (\chi/Q)$$

$$\text{and } \sum_{i=1}^{n} A_i/aec_i \leq 1$$

Where:

A_i = Concentration of radionuclide, i, at the unrestricted area boundary

K_o = Constant of unit conversion. ($1E\text{-}6m^3$ /cc)

aec_i = Air effluent concentration limit (10 CFR 20, Appendix B, Table 2, Column 1 value for radionuclide, i)

Q_i = The release rate of radionuclides i, in airborne effluents from all vent releases (in μCi/sec.)

(χ/Q) = 5E-6 sec/m^3. For all vent releases. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary

1.0 EFFLUENT CONCENTRATIONS

As appropriate, simultaneous releases from the Auxiliary Building Ventilation Stack, Laboratory and Radwaste Building Stack and condenser off gas will be considered in evaluating compliance with the release rate limits of 10 CFR 20. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. Historical annual average dispersion parameters, as presented in Table 3, may be used for evaluating the airborne effluent dose rate.

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding those more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding 10 CFR 20 limits. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based upon the above criteria, no further analyses are required for demonstrating compliance with 10 CFR 20.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS

2.1 Liquid Effluent Dose Calculations

Three pathways for human exposure to liquid releases from FCS to the Missouri River exists: 1) fish, 2) drinking water, and 3) Shoreline deposition. Fish are considered to be taken from the vicinity of the plant discharge. The drinking water for Omaha is located 19 miles downstream from FCS. The dilution factors for these pathways are derived from the Revised Environmental Report for FCS, (1974), (page 4-29 and 4-31). This report states that during Low-Low river conditions, the concentration at Omaha's water intake will be ≤14% of the concentration at discharge from FCS and will average 3%. This equates to a dilution factor of 7.14, which is used to calculate the maximum dose to an individual from liquid pathways and a dilution factor of 33.33, for calculating the average dose. All pathways combine to give the dose to an individual in unrestricted areas.

10 CFR 50, App. I restricts the dose to individuals in the unrestricted areas from radioactive materials in liquid effluents from the Fort Calhoun Station to the following limits:

- during any calendar quarter
  ≤1.5 mrem to total body
  ≤5.0 mrem to any organ and
- during any calendar year
  ≤ 3.0 mrem to total body
  ≤ 10.0 mrem to any organ

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 The following calculational methods shall be used for determining the dose or dose commitment from liquid effluents.

Doses from Liquid Effluent Pathways

A. POTABLE WATER

$$R_{apj} = 1100 \frac{U_{ap} M_p}{F} \sum_{i=1}^{n} Q_i D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in ℓ/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of withdrawal of drinking water, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/ sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

D_{aipj} = is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of water, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFF[illegible]T DOSE CALCULATIONS (Continued)

2.1 B. AQUATIC FOODS

$$R_{apj} = 1100 \frac{U_{ap} M_p}{F} \sum_{i=1}^{n} Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p)$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the intake rate for an individual of age group, a, associated with pathway, p, in kg/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of harvest of aquatic food, dimensionless. Table 3

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

B_{ip} = is the equilibrium bioaccumulation factor for radionuclide, i, in pathway, p, expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/liter), in (pCi/kg)/(pCi/liter). Table 2

D_{aipj} = is the dose factor specific to a given age group, a, radionuclide, i, pathway, p, and organ, j, which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi. Tables 12-15

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure. For internal dose, t_p is the total time elapsed between release of the radionuclides and ingestion of food, in hours. Table 16

1100 = Constant (pCi * yr * ft^3/Ci * sec * L)

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.1 C. SHORELINE DEPOSITS

$$R_{apj} = 110,000 \frac{U_{ap}M_pW}{F} \sum_{i=1}^{n} Q_iT_{ip}D_{aipj}[\exp(-\lambda_i t_p)][1-\exp(-\lambda_i t_b)]$$

Where:

R_{apj} = is the total annual dose to organ, j, of individuals of age group, a, from all of the radionuclides, i, in pathway, p, in mrem/yr.

U_{ap} = is a usage factor that specifies the exposure time for an individual of age group, a, associated with pathway, p, in hr/yr. Table 5

M_p = is the mixing ratio (reciprocal of the dilution factor) at the point of exposure, dimensionless. Table 3

W = is the shore-width factor, dimensionless. Table 16

F = is the flow rate of the liquid effluent, in ft^3/sec.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

T_{ip} = is the radioactive half life of radionuclide, i, in days.

D_{aipj} = is the dose factor specific radionuclide, i, which can be used to calculate the radiation dose from exposure to a given concentration of a radionu-clide in sediment, expressed as a ratio of the dose rate (in mrem/hr) and the areal radionuclide concentration (in pCi/m^2). Table 7

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}.

t_p = is the average transit time required for radionuclides to reach the point of exposure, in hours. Table 16

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours. Table 16

110,000 = Constant [(100 * pCi * yr * ft^3)/(* sec * L)]

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Airborne Effluent Dose Calculations

2.2.1 Noble Gas

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from noble gases in airborne effluents from the Fort Calhoun Station to the following limits:

- During any calendar quarter
  $\leq$5 mrad-gamma air dose
  $\leq$10 mrad-beta air dose

  and

- During any calendar year
  $\leq$10 mrad-gamma air dose
  $\leq$20 mrad-beta air dose

The following general equations shall be used to calculate the gamma-air and beta-air doses:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

Doses from Noble Gases

2.2 A. Annual Gamma/Beta Air Dose from All Other Noble Gas Releases

$$D^{\gamma}(r,\Theta) \text{ or } D^{\beta}(r,\Theta) = 3.17 \times 10^{4} \sum_{i=1}^{n} Q_i [\chi/Q]^D (r,\Theta) (DF_i^{\gamma} \text{ or } DF_i^{\beta})$$

Where:

$DF_i^{\gamma}, DF_i^{\beta}$ = are the gamma and beta air dose factors for a uniform semi-infinite cloud of radionuclide, i, in mrad-m^3/pCi-yr. Table 1

$D^{\gamma}(r,\Theta)$ or $D^{\beta}(r,\Theta)$ = are the annual gamma and beta air doses at distance r, in the sector at angle Θ, from the discharge point, in mrad/yr.

Q_i = is the annual release rate of radionuclide, i, in Ci/yr.

$[\chi/Q]^D(r,\Theta)$ = is the annual average gaseous dispersion factor at distance r, in the sector at angle θ, in sec/m^3. Table 3

3.17×10^4 = is the number of pci per ci divided by the number of seconds per year.

B. Annual Total Body Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = S_F \sum_{i=1}^{n} \chi_i (r,\Theta) DFB_i$$

Where:

DFB_i = is the total body dose factor for a semi-infinite cloud of the radionuclide, i, which includes the attenuation of 5 g/cm^2 of tissue, in mrem-m^3/pCi-yr. Table 1

$D_{\infty}^{T}(r,\Theta)$ = is the annual total body dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

$\chi_i(r,\Theta)$ = is the annual average ground-level concentration of radionuclide, i, at distance r, in the sector at angle Θ, in pCi/m^3. Table 3

S_F = Shielding Factor. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C. Annual Skin Dose from All Other Noble Gas Releases

$$D_{\infty}^{T}(r,\Theta) = 1.11\ S_F \sum_{i=1}^{n} \chi_i(r,\Theta)\, DF_i^{\gamma} + \sum_{i=1}^{n} \chi_i(r,\Theta)\, DFS_i$$

Where:

$D_{\infty}^{T}(r,\Theta)$ = is the annual skin dose due to immersion in a semi-infinite cloud at distance r, in the sector at angle Θ, in mrem/yr.

DFS_i = is the beta skin dose factor for a semiinfinite cloud of radionuclide, i, in mrem-m^3/pCi-yr. Table 1

1.11 = is the average ratio of tissue to air energy absorption coefficients.

2.2.2 Radioiodine, Tritium, and Particulates

10 CFR 50, App. I, restricts the dose to individuals in the unrestricted areas from radioactive materials in gaseous airborne from the Fort Calhoun Station to:

- During any calendar quarter
  $\leq$7.5 mrem to any organ

  and

- During any calendar year
  $\leq$15 mrem to any organ

The dose to an individual from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in airborne effluents released to unrestricted areas (See Part III, Figure 1) should be determined by the following expressions:

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 **NOTE:** In all cases, for releases of tritium, use the dispersion parameter for inhalation (χ/Q).

A. Annual Organ Dose from External Irradiation from Radioactivity Deposited on the Ground Plane

A.1 The ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined by:

$$C_i^G(r,\Theta) = \frac{[1.0x10^{12}]\ [\delta_i(r,\Theta)Q_i]}{\lambda_i}\ [1-\exp(^-\lambda_i t_b)]$$

Where:

C_i^G	=	is the ground plane concentration of the radionuclide, i, at distance r, in the sector at angle θ, from the release point, in pCi/m^2.
Q_i	=	is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.
t_b	=	is the time period over which the accumulation is evaluated, which is assumed to be 15 years (mid-point of plant operating life). Table 16
$\delta_i(r,\theta)$	=	is the annual average relative deposition of radionuclide, i, at distance r, in the sector at angle θ, considering depletion of the plume by deposition during transport, in m^{-2}. Table 3
λ_i	=	is the radiological decay constant for radionuclide, i, in yr^{-1}.
$1.0x10^{12}$	=	is the number of pCi per Ci

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 A.2 The annual organ dose is then calculated using the following equation:

$$D_j^G(r,\Theta) = 8760\ S_F \sum_{i=1}^{n} C_i^G(r,\Theta)\, DFG_{ij}$$

Where:

$C_i^G(r,\theta)$ = is the ground plane concentration of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2.

DFG_{ij} = is the open field ground plane dose conversion factor for organ, j, from radionuclide, i, in $mrem\text{-}m^2/pCi\text{-}hr$. Table 7

$D_j^G(r,\theta)$ = is the annual dose to the organ, j, at distance r, in the sector at angle θ, in mrem/yr.

S_F = is the shielding factor that accounts for the dose reduction due to shielding provided by residential structures during occupancy, dimensionless. Table 16

8760 = is the number of hours in a year

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 B. Annual Dose from Inhalation of Radionuclides in Air

B.1 The annual average airborne concentration of radionuclide, i, at distance r, in the sector at angle θ, with respect to the release point, may be determined as:

$$\chi_i(r,\theta) = 3.17 \times 10^4 Q_i [\chi/Q]^D (r,\theta)$$

Where:

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

$\chi_i(r,\theta)$ = is the annual average ground-level concentration of radionuclide, i, in air at distance r, in the sector at angle θ, in pCi/m^3.

$[\chi/Q]^D(r,\theta)$ = is the annual average atmosphere dispersion factor, in sec/m^3 (see R.G. 1.111). This includes depletion (for radioiodines and particulates) and radiological decay of the plume. Table 3

3.17×10^4 = is the number of pCi/Ci divided by the number of sec/yr.

B.2 The annual dose associated with inhalation of all radionuclides to organ, j, of an individual in age group, a, is then:

$$D^A_{ja}(r,\Theta) = R_a \sum_{i=1}^{n} \chi_i (r,\theta)\ DFA_{ija}$$

Where:

$D^A_{ja}(r,\theta)$ = is the annual dose to organ, j, of an individual in the age group, a, at distance r, in the sector at angle θ, due to inhalation, in mrem/yr.

R_a = is the annual air intake for individuals in the age group, a, in m^3/yr. Table 5

DFA_{ija} = is the inhalation dose factor for radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 8-11

2.0 <u>RADIOACTIVE EFFLUENT DOSE CALCULATIONS</u> (Continued)

2.2 C. Concentrations of Radionuclides in Foods and Vegetation from Atmospheric Releases

C.1 Parameters for Calculating Concentrations in Forage, Produce, and Leafy Vegetables, excluding Carbon-14 and Tritium

$$C_i^V(r,\theta) = d_i(r,\theta)\left[\frac{r[1-\exp(-\lambda_{Ei}t_e)]}{Y_v\lambda_{Ei}} + \frac{B_{iv}[1-\exp(-\lambda_i t_b)]}{P\lambda_i}\right]\exp(-\lambda_i t_h)$$

<u>Where</u>:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in and on vegetation at distance r, in the sector at angle θ, in pCi/kg.

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i, at distance r, in the sector at angle θ, in pCi/m^2 hr.

The deposition rate from the plume is defined by: (Reg. Guide 1.109, Rev. 1, Page 1.109-26, Equa. C-6)

$$d_i(r,\theta) = 1.1 \times 10^8 \delta_i(r,\theta) Q_i$$

<u>Where</u>:

$d_i(r,\theta)$ = is the deposition rate of radionuclide, i.

$\delta_i(r,\theta)$ = is the relative deposition of radionuclide, i, considering depletion and decay, in m^{-2} (see Regulatory Guide 1.111). Table 3

1.1×10^8 = is the number of pCi/Ci (10^{12}) divided by the number of hours per year (8760).

Q_i = is the annual release rate of radionuclide, i, to the atmosphere, in Ci/yr.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 For radioiodines, the model considers only the elemental fraction of the effluent:

$$d_i\ (r_1\ \theta) = 5.5 \times 10^7\ \delta_i\ (r_1\ \theta)\ Q_i$$

Where:

$d_i\ (r_1\ \theta)$ = The deposition rate of radioiodine, i.

5.5×10^7 = The number of pCi/Ci (10^{12}) divided by the number of hours per year (8760), then multiplied by the amount of radioiodine emissions considered to be nonelemental (0.5).

$\delta_i\ (r,\ \theta)$ = The relative deposition of radioiodine, i, considering depletion and decay, in m^{-2}. Table 3.

Q_i = The total (elemental and nonelemental) radioiodine, i, emission rate.

r = is the fraction of deposited activity retained on crops, dimensionless. Table 16

λ_{Ei} = is the effective removal rate constant for radionuclide, i, from crops, in hr^{-1}.

$\lambda_{Ei} = \lambda_i + \lambda_w$
$\lambda_w = 0.0021/hr$. Table 16

t_e = is the time period that crops are exposed to contamination during the growing season, in hours. Table 16

Y_v = is the agricultural productivity (yield) in kg (wet weight)/m^2. Table 16

B_{iv} = is the concentration factor for uptake of radionuclide, i, from soil by edible parts of crops, in pCi/ kg (wet weight) per pCi/kg dry soil. Table 4

λ_i = is the radiological decay constant of radionuclide, i, in hr^{-1}

t_b = is the period of time for which sediment or soil is exposed to the contaminated water, in hours (mid-point of plant life). Table 16

P = is the effective "surface density" for soil, in kg (dry soil)/m^2. Table 16

t_h = is the holdup time that represents the time interval between harvest and consumption of the food, in hours. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 Different values for the parameters t_c, Y_v, and t_h, may be used to allow the use of the Equation for different purposes: estimating concentrations in produce consumed by man; in leafy vegetables consumed by man; in forage consumed directly as pasture grass by dairy cows, beef cattle, or goats; and in forage consumed as stored feed by dairy cows, beef cattle or goats. See Table 16

C.2 Parameters for Calculating Radionuclide Concentration in Milk, excluding Carbon-14 and Tritium

C.2.1 Parameters for Calculating the Concentration of Radionuclide, i, in the Animal's Feed (Milk Cow, Beef Cow, and Goat)

$$C_i^V(r,\Theta) = f_p f_s C_i^P(r,\Theta) + (1 - f_p) C_i^S(r,\Theta) + f_p(1 - f_s) C_i^S(r,\Theta)$$

Where:

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

$C_i^P(r,\theta)$ = is the concentration of radionuclide, i, on pasture grass (calculated using Equation C.2.1 with t_h=0), in pCi/kg.

$C_i^S(r,\theta)$ = is the concentration of radionuclide, i, in stored feeds (calculated using Equation C.2.1 with t_h=90 days), in pCi/kg.

f_p = is the fraction of the year that animals graze on pasture. Table 16

f_s = is the fraction of daily feed that is pasture grass while the animal grazes on pasture. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.2.2 Parameters for Calculating Radionuclide Concentration in Cow and Goat Milk

$$C_i^M(r,\Theta) = F_m C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^M(r,\theta)$ = is the concentration of radionuclide, i, in milk, in pCi/liter.

$C_i^V(r,\theta)$ = is the concentration of radionuclide, i, in the animal's feed, in pCi/kg.

F_m = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each liter of milk, in days/liter. Table 4

Q_F = is the amount of feed consumed by the animal per day, in kg/day. Table 6

t_f = is the average transport time of the radionuclide, i, from the feed to the milk and to the receptor (a value of 2 days is assumed). Table 16

λ_i = is the radiological decay constant of radionuclide, i, in days^{-1}.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.3 Parameters for Calculating Radionuclide Concentration in Cow Meat, excluding Carbon-14 and Tritium

$$C_i^F(r,\Theta) = F_f C_i^V(r,\Theta) Q_F \exp(-\lambda_i t_f)$$

Where:

$C_i^F(r,\theta)$ = is the concentration of radionuclide, i, in meat, in pCi/liter.

F_f = is the average fraction of the animal's daily intake of radionuclide, i, which appears in each kilogram of flesh, in days/kilogram. Table 4

t_f = is the average time from slaughter to consumption. Table 16

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.4 Parameters for Calculating the Carbon-14 Concentrations in Vegetation

Carbon-14 is assumed to be released in oxide form (CO or CO_2). The concentration of Carbon-14 in vegetation is calculated by assuming that its ratio to the natural carbon in vegetation is the same as the ratio of Carbon-14 to natural carbon in the atmosphere surrounding the vegetation. Also, in the case of intermittent releases, such as from gaseous waste decay tanks, the parameter p is employed to account for the fractional equilibrium ratio achieved. The parameter, p, is defined as the ratio of the total annual release time (for Carbon-14 atmospheric releases) to the total annual time during which photosynthesis occurs (taken to be 4400 hrs), under the condition that the value of p should never exceed unity. For continuous Carbon-14 releases, p is taken to be unity. These considerations yield the following relationship:

$$C_{14}^{V}(r,\Theta) = 3.17 \times 10^{7} p Q_{14} [\chi/Q](r,\Theta)\ 0.11/0.16$$

$$= 2.2 \times 10^{7} p Q_{14} [\chi/Q](r,\Theta)$$

Where:

$C_{14}^{v}(r,\theta)$ = is the concentration of Carbon-14 in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

Q_{14} = is the annual release rate of Carbon 14, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

p = is the fractional equilibrium ratio, dimensionless. P=1 (Reg. Guide 1.109, Rev. 1, pg. 26).

0.11 = is the fraction of total plant mass that is natural carbon, dimensionless.

0.16 = is equal to the concentration of natural carbon in the atmosphere, in g/m^3.

3.17×10^7 = is equal to $(1.0 \times 10^{12}$ pci/ci$)(1.0 \times 10^3$ g/kg$)$ $(3.15 \times 10^7$ sec/yr$)$.

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 C.5 Parameters for Calculating Tritium Concentrations in Vegetation

The concentration of tritium in vegetation is calculated from its concentration in the air surrounding the vegetation.

$$C_T^V(r,\Theta) = 3.17 \times 10^7 Q_T[\chi/Q](r,\Theta)\ (.75)(0.5/H)$$

$$= 1.2 \times 10^7 Q_T[\chi/Q](r,\Theta)/H$$

Where:

$C_T^v(r,\theta)$ = is the concentration of Tritium in vegetation grown at distance r, in the sector at angle θ, in pCi/kg.

H = is the absolute humidity of the atmosphere at distance r, in the sector at angle θ, in g/m^3. H=8 gm/kg.

Q_T = is the annual release rate of Tritium, in Ci/yr.

$[\chi/Q](r,\theta)$ = is the atmospheric dispersion factor, in sec/m^3. Table 3

0.5 = is the ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless.

0.75 = is the fraction of total plant mass that is water, dimensionless.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D. Annual Dose from Atmospherically Released Radionuclides in Foods

D.1 The total annual dose to organ, j, of an individual in age group, a, resulting from ingestion of all radionuclides in produce, milk, and leafy vegetables is given by:

$$D_{ja}^{D}(r,\Theta) = \sum_{i} DFI_{ija}\left[U_a^V f_g C_i^V(r,\Theta) + U_a^m C_i^m(r,\Theta) + U_a^F C_i^F(r,\Theta) + U_a^L f_\ell C_i^L(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15.

$U_a^v, U_a^m,$ = are the ingestion rates of produce (non-leafy vegetables, fruits, and grains); milk, meat, and leafy U_a^F, U_a^L vegetables, respectively for individuals in age group, a. Table 5.

Values of F_g and f_ℓ are 0.76 and 1.0, respectively.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.1 Calculating the Ingested Dose from Leafy and Non-Leafy (produce) Vegetation for Radionuclide, i, to Each Organ, j, and Age Group, a

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_a^L f_l C_i^L(r,\Theta) + U_a^V f_g C_i^V(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, to organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in vegetation, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pci. Tables 12-15

U_a^L, U_a^V = are the ingestion rates of leafy vegetables and produce (non-leafy vegetables, fruits, and grains), for individuals in age group, a, in kg/yr. Table 5

C_i^L = is the concentration of radionuclide, i, in and on leafy vegetation, in pCi/kg.

C_i^V = is the concentration of radionuclide, i, in and on produce, in pCi/kg.

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.2 Calculation Determining the Ingested Dose from Cow Milk for Radionuclide, i, Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_{a}^{M}C_{i}^{M}(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r\ \theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in cow milk, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_{a}^{M} = is the ingestion rate of cow milk for individuals in age group, a, in ℓ/yr. Table 5

C_{i}^{M} = is the radionuclide concentration in cow milk, in pCi/kg. Equation C.2.2

2.0 RADIOACTIVE EFFLUENT DOSE CALCULATIONS (Continued)

2.2 D.1.3 Calculation Determining the Ingested Dose from Meat for Radionuclide, i, to Organ, j, and Age Group, a.

$$D_{ja}^{D}(r,\Theta) = DFI_{ija}\left[U_a^F C_i^F(r,\Theta)\right]$$

Where:

$D_{ja}^{D}(r,\theta)$ = is the annual dose from the ingestion of radionuclide, i, organ, j, of an individual in age group, a, from dietary intake of atmospherically released radionuclides in meat, in mrem/yr.

DFI_{ija} = is the dose conversion factor for the ingestion of radionuclide, i, organ, j, and age group, a, in mrem/pCi. Tables 12-15

U_a^F = is the ingestion rate of meat for individuals in age group, a in kg/yr. Table 5

C_i^F = is the radionuclide, i, concentration in meat, in pCi/ kg.

TABLE 1

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

Nuclide	β-air*(DF^{β}_{i})	β-Skin**(DFS_i)	γ-Air*(DF^{γ}_{i})	γ-Body**(DFB_i)
KR-83m	2.88E-04	--	1.93E-05	7.56E-08
KR-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03
KR-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05
KR-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03
KR-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02
KR-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02
KR-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03

* $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

** $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

*** 2.88E-04 = 2.88×10^{-4}

TABLE 2

BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)

FRESHWATER

Element	Fish	Invertebrate
H	9.0E-01	9.0E-01
C	4.6E+03	9.1E+03
NA	1.0E+02	2.0E+02
P	1.0E+05	2.0E+04
CR	2.0E+02	2.0E+03
MN	4.0E+02	9.0E+04
FE	1.0E+02	3.2E+03
CO	5.0E+01	2.0E+02
NI	1.0E+02	1.0E+02
CU	5.0E+01	4.0E+02
ZN	2.0E+03	1.0E+04
BR	4.2E+02	3.3E+02
RB	2.0E+03	1.0E+03
SP	3.0E+01	1.0E+02
Y	2.5E+01	1.0E+03
ZR	3.3E+00	6.7E+00
NB	3.0E+04	1.0E+02
MO	1.0E+01	1.0E+01
TC	1.5E+01	5.0E+00
RU	1.0E+01	3.0E+02
RH	1.0E+01	3.0E+02
TE	4.0E+02	6.1E+03
I	1.5E+01	5.0E+00
CS	2.0E+03	1.0E+03
BA	4.0E+00	2.0E+02
LA	2.5E+01	1.0E+03
CE	1.0E+00	1.0E+03
PR	2.5E+01	1.0E+03
ND	2.5E+01	1.0E+03
W	1.2E+03	1.0E+01
NP	1.0E+01	4.0E+02

TABLE 3

CONTROLLING LOCATIONS, PATHWAYS AND
ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS

Location	Pathway(s)	Controlling Age Group	Atmospheric Dispersion χ/Q ($\chi/Q(r,\theta)$) (sec/m³)	D/Q ($\delta(r,\theta)$) (1/m³)
Unrestricted Area Boundary	Noble Gases Direct Exposure	N/A	5.0E-06	N/A
Unrestricted Area Boundary	Inhalation	Child	5.0E-06	N/A
Unrestricted Area Boundary	Gamma-Air Beta-Air	N/A	5.0E-06	N/A
Miller Farm* 0.8 miles SSW	milk, ground plane, meat, inhalation, and vegetation	Child	5.0E-06	1.6E-08
Site Discharge	Liquid	N/A	Mixing Ratio, M_p	7.14
M.U.D. Intake	Liquid	N/A	Mixing Ratio, M_p	30.8

* Location is subject to change depending on the results of the Land Use survey performed annually in accordance with Part II, Section 5.4

TABLE 4

STABLE ELEMENT TRANSFER DATA

Element	B_{iv} Veg/Soil	F_m (Cow) Milk (d/λ)	F_f Meat (d/kg)
H	4.8E+00	1.0E-02	1.2E-02
C	5.5E+00	1.2E-02	3.1E-02
Na	5.2E-02	4.0E-02	3.0E-02
P	1.1E+00	2.5E-02	4.6E-02
Cr	2.5E-04	2.2E-03	2.4E-03
Mn	2.9E-02	2.5E-04	8.0E-04
Fe	6.6E-04	1.2E-03	4.0E-02
Co	9.4E-03	1.0E-03	1.3E-02
Ni	1.9E-02	6.7E-03	5.3E-02
Cu	1.2E-01	1.4E-02	8.0E-03
Zn	4.0E-01	3.9E-02	3.0E-02
Rb	1.3E-01	3.0E-02	3.1E-02
Sr	1.7E-02	8.0E-04	6.0E-04
Y	2.6E-03	1.0E-05	4.6E-03
Zr	1.7E-04	5.0E-06	3.4E-02
Nb	9.4E-03	2.5E-03	2.8E-01
Mo	1.2E-01	7.5E-03	8.0E-03
Tc	2.5E-01	2.5E-02	4.0E-01
Ru	5.0E-02	1.0E-06	4.0E-01
Rh	1.3E+01	1.0E-02	1.5E-03
Ag	1.5E-01	5.0E-02	1.7E-02
Te	1.3E+00	1.0E-03	7.7E-02
I	2.0E-02	6.0E-03	2.9E-03
Cs	1.0E-02	1.2E-02	4.0E-03
Ba	5.0E-03	4.0E-04	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04	1.2E-03
Pr	2.5E-03	5.0E-06	4.7E-03
Nd	2.4E-03	5.0E-06	3.3E-03
W	1.8E-02	5.0E-04	1.3E-03
Np	2.5E-03	5.0E-06	2.0E-04

TABLE 5

RECOMMENDED VALUES FOR U_{AP} TO BE USED FOR THE MAXIMUM EXPOSED INDIVIDUAL IN LIEU OF SITE SPECIFIC DATA

Pathway	Infant	Child	Teen	Adult
Fruits, vegetables, & grain (kg/yr)	-	520	630	520
Leafy vegetables (kg/yr)	-	26	42	64
Milk (ℓ/yr)	330	330	400	310
Meat & poultry (kg/yr)	-	41	65	110
Fish (fresh or salt) (kg/yr)	-	6.9	16	21
Other Seafood (kg/yr)	-	1.7	3.8	5
Drinking water (ℓ/yr)	330	510	510	730
Shoreline recreation (hr/yr)	-	14	67	12
Inhalation (m^3/yr)	1400	3700	8000	8000

TABLE 6

ANIMAL CONSUMPTION RATES

Animal	Q_F Feed or Forage [Kg/day (wet weigh)]	Q_{AW} Water (ℓ/day)
Milk Cow	50	60
Beef Cattle	50	50
Goats	6	8

TABLE 7

Page 1 of 2

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Nr-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08

TABLE 7
(Continued)

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EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	-	-	-	1.08E-05
CR 51	-	-	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN 54	-	4.95E-06	7.87E-07	-	1.23E-06	1.75E-04	9.67E-06
MN 56	-	1.55E-10	2.29E-11	-	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	-	-	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	-	-	1.27E-04	2.35E-05
CO 58	-	1.98E-07	2.59E-07	-	-	1.16E-04	1.33E-05
CO 60	-	1.44E-06	1.85E-06	-	-	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	-	-	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	-	-	7.00E-07	1.54E-06
CU 64	-	1.83E-10	7.69E-11	-	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	5.82E-06	-	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	-	5.27E-12	1.15E-07	2.04E-09
BR 83	-	-	3.01E-08	-	-	-	2.90E-08
BR 84	-	-	3.91E-08	-	-	-	2.05E-13
BR 85	-	-	1.60E-09	-	-	-	LT E-24
RB 86	-	1.69E-05	7.37E-06	-	-	-	2.08E-06
RB 88	-	4.84E-08	2.41E-08	-	-	-	4.18E-19
RB 89	-	3.20E-08	2.12E-08	-	-	-	1.16E-21
SR 89	3.80E-05	-	1.09E-06	-	-	1.75E-04	4.37E-05
SR 90	1.24E-02	-	7.62E-04	-	-	1.20E-03	9.02E-05
SR 91	7.74E-09	-	3.13E-10	-	-	4.56E-06	2.39E-05
SR 92	8.43E-10	-	3.64E-11	-	-	2.06E-06	5.38E-06
Y 90	2.61E-07	-	7.01E-09	-	-	2.12E-05	6.32E-05
Y 91M	3.26E-11	-	1.27E-12	-	-	2.40E-07	1.66E-10
Y 91	5.78E-05	-	1.55E-06	-	-	2.13E-04	4.81E-05
Y 92	1.29E-09	-	3.77E-11	-	-	1.96E-06	9.19E-06
Y 93	1.18E-08	-	3.26E-10	-	-	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	-	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	-	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	-	9.67E-07	6.31E-05	1.30E-05
MO 99	-	1.51E-08	2.87E-09	-	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	-	5.52E-12	9.55E-08	5.20E-07

TABLE 8
INHALATION DOSE FACTORS FOR ADULT
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	5.22E-15	7.52E-15	7.38E-14	-	1.35E-13	4.99E-08	1.36E-21
RU 103	1.91E-07	-	8.23E-08	-	7.29E-07	6.31E-05	1.38E-05
RU 105	9.88E-11	-	3.89E-11	-	1.27E-10	1.37E-06	6.02E-06
RU 106	8.64E-06	-	1.09E-06	-	1.67E-05	1.17E-03	1.14E-04
AG 110M	1.35E-06	1.25E-06	7.43E-07	-	2.46E-06	5.79E-04	3.78E-05
TE 125M	4.27E-07	1.98E-07	5.34E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE 127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE 127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE 129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE 129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE 131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE 131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE 132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	-	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	-	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	-	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	-	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	-	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	-	6.56E-07
CS 134	4.66E-05	1.06E-04	9.10E-05	-	3.59E-05	1.22E-05	1.30E-06
CS 136	4.88E-06	1.83E-05	1.38E-05	-	1.07E-05	1.50E-06	1.46E-06
CS 137	5.98E-05	7.76E-05	5.35E-05	-	2.78E-05	9.40E-06	1.05E-06
CS 138	4.14E-08	7.76E-08	4.05E-08	-	6.00E-08	6.07E-09	2.33E-13
BA 139	1.17E-10	8.32E-14	3.42E-12	-	7.78E-14	4.70E-07	1.12E-07
BA 140	4.88E-06	6.13E-09	3.21E-07	-	2.09E-09	1.59E-04	2.73E-05
BA 141	1.25E-11	9.41E-15	4.20E-13	-	8.75E-15	2.42E-07	1.45E-17
BA 142	3.29E-12	3.38E-15	2.07E-13	-	2.86E-15	1.49E-07	1.96E-26
LA 140	4.30E-08	2.17E-08	5.73E-09	-	-	1.70E-05	5.73E-05
LA 142	8.54E-11	3.88E-11	9.65E-12	-	-	7.91E-07	2.64E-07
CE 141	2.49E-06	1.69E-06	1.91E-07	-	7.83E-07	4.52E-05	1.50E-05
CE 143	2.33E-08	1.72E-08	1.91E-09	-	7.60E-09	9.97E-06	2.83E-05
CE 144	4.29E-04	1.79E-04	2.30E-05	-	1.06E-04	9.72E-04	1.02E-04
PR 143	1.17E-06	4.69E-07	5.80E-08	-	2.70E-07	3.51E-05	2.50E-05
PR 144	3.76E-12	1.56E-12	1.91E-13	-	8.81E-13	1.27E-07	2.69E-18
ND 147	6.59E-07	7.62E-07	4.56E-08	-	4.45E-07	2.76E-05	2.16E-05
W 187	1.06E-09	8.85E-10	3.10E-10	-	-	3.63E-06	1.94E-05
NP 239	2.87E-08	2.82E-09	1.55E-09	-	8.75E-09	4.70E-06	1.49E-05

TABLE 9

INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	-	-	-	1.16E-05
CR 51	-	-	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	-	6.39E-06	1.05E-06	-	1.59E-06	2.48E-04	8.35E-06
MN 56	-	2.12E-10	3.15E-11	-	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	-	-	1.55E-05	7.99E-07
FE 59	1.99E-06	4.62E-06	1.79E-06	-	-	1.91E-04	2.23E-05
CO 58	-	2.59E-07	3.47E-07	-	-	1.68E-04	1.19E-05
CO 60	-	1.89E-06	2.48E-06	-	-	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	-	-	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	-	-	1.17E-06	4.59E-06
CU 64	-	2.54E-10	1.06E-10	-	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.82E-06	1.67E-05	7.80E-06	-	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	-	7.53E-12	1.98E-07	3.56E-08
BR 83	-	-	4.30E-08	-	-	-	LT E-24
BR 84	-	-	5.41E-08	-	-	-	LT E-24
BR 85	-	-	2.29E-09	-	-	-	LT E-24
RB 86	-	2.38E-05	1.05E-05	-	-	-	2.21E-06
RB 88	-	6.82E-08	3.40E-08	-	-	-	3.65E-15
RB 89	-	4.40E-08	2.91E-08	-	-	-	4.22E-17
SR 89	5.43E-05	-	1.56E-06	-	-	3.02E-04	4.64E-05
SR 90	1.35E-02	-	8.35E-04	-	-	2.06E-03	9.56E-05
SR 91	1.10E-08	-	4.39E-10	-	-	7.59E-06	3.24E-05
SR 92	1.19E-09	-	5.08E-11	-	-	3.43E-06	1.49E-05
Y 90	3.73E-07	-	1.00E-08	-	-	3.66E-05	6.99E-05
Y 91M	4.63E-11	-	1.77E-12	-	-	4.00E-07	3.77E-09
Y 91	8.26E-05	-	2.21E-06	-	-	3.67E-04	5.11E-05
Y 92	1.84E-09	-	5.36E-11	-	-	3.35E-06	2.06E-05
Y 93	1.69E-08	-	4.65E-10	-	-	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	-	8.42E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	-	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	-	1.25E-06	9.39E-05	1.21E-05
MO 99	-	2.11E-08	4.03E-09	-	5.14E-08	1.92E-05	3.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	-	7.20E-12	1.44E-07	7.66E-07

TABLE 9
INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	7.40E-15	1.05E-14	1.03E-13	-	1.90E-13	8.34E-08	1.09E-16
RU 103	2.63E-07	-	1.12E-07	-	9.29E-07	9.79E-05	1.36E-05
RU 105	1.40E-10	-	5.42E-11	-	1.76E-10	2.27E-06	1.13E-05
RU 106	1.23E-05	-	1.55E-06	-	2.38E-05	2.01E-03	1.20E-04
AG 110M	1.73E-06	1.64E-06	9.99E-07	-	3.13E-06	8.44E-04	3.41E-05
TE 125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	-	6.70E-05	9.38E-06
TE 127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE 127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE 129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE 129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE 131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE 131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE 132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	-	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	-	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	-	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	-	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	-	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	-	8.69E-07
CS 134	6.28E-05	1.41E-04	6.86E-05	-	4.69E-05	1.83E-05	1.22E-06
CS 136	6.44E-06	2.42E-05	1.71E-05	-	1.38E-05	2.22E-06	1.36E-06
CS 137	8.38E-05	1.06E-04	3.89E-05	-	3.80E-05	1.51E-05	1.06E-06
CS 138	5.82E-08	1.07E-07	5.58E-08	-	8.28E-08	9.84E-09	3.38E-11
BA 139	1.67E-10	1.18E-13	4.87E-12	-	1.11E-13	8.08E-07	8.06E-07
BA 140	6.84E-06	8.38E-09	4.40E-07	-	2.85E-09	2.54E-04	2.86E-05
BA 141	1.78E-11	1.32E-14	5.93E-13	-	1.23E-14	4.11E-07	9.33E-14
BA 142	4.62E-12	4.63E-15	2.84E-13	-	3.92E-15	2.39E-07	5.99E-20
LA 140	5.99E-08	2.95E-08	7.82E-09	-	-	2.68E-05	6.09E-05
LA 142	1.20E-10	5.31E-11	1.32E-11	-	-	1.27E-06	1.50E-06
CE 141	3.55E-06	2.37E-06	2.71E-07	-	1.11E-06	7.67E-05	1.58E-05
CE 143	3.32E-08	2.42E-08	2.70E-09	-	1.08E-08	1.63E-05	3.19E-05
CE 144	6.11E-04	2.53E-04	3.28E-05	-	1.51E-04	1.67E-03	1.08E-04
PR 143	1.67E-06	6.64E-07	8.28E-08	-	3.86E-07	6.04E-05	2.67E-05
PR 144	5.37E-12	2.20E-12	2.72E-13	-	1.26E-12	2.19E-07	2.94E-14
ND 147	9.83E-07	1.07E-06	6.41E-08	-	6.28E-07	4.65E-05	2.28E-05
W 187	1.50E-09	1.22E-09	4.29E-10	-	-	5.92E-06	2.21E-05
NP 239	4.23E-08	3.99E-09	2.21E-09	-	1.25E-08	8.11E-06	1.65E-05

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	-	-	-	1.14E-05
CR 51	-	-	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	-	1.16E-05	2.57E-06	-	2.71E-06	4.26E-04	6.19E-06
MN 56	-	4.48E-10	8.43E-11	-	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	-	-	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	-	-	3.43E-04	1.91E-05
CO 58	-	4.79E-07	8.55E-07	-	-	2.99E-04	9.29E-06
CO 60	-	3.55E-06	6.12E-06	-	-	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	-	-	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	-	-	2.21E-06	2.27E-05
CU 64	-	5.39E-10	2.90E-10	-	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	-	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	-	1.58E-11	3.84E-07	2.75E-06
BR 83	-	-	1.28E-07	-	-	-	LT E-24
BR 84	-	-	1.48E-07	-	-	-	LT E-24
BR 85	-	-	6.84E-09	-	-	-	LT E-24
RB 86	-	5.36E-05	3.09E-05	-	-	-	2.16E-06
RB 88	-	1.52E-07	9.90E-08	-	-	-	4.66E-09
RB 89	-	9.33E-08	7.85E-08	-	-	-	5.11E-10
SR 89	1.62E-04	-	4.66E-06	-	-	5.83E-04	4.52E-05
SR 90	2.73E-02	-	1.74E-03	-	-	3.99E-03	9.28E-05
SR 91	3.28E-08	-	1.24E-09	-	-	1.44E-05	4.70E-05
SR 92	3.54E-09	-	1.42E-10	-	-	6.49E-06	6.55E-05
Y 90	1.11E-06	-	2.99E-08	-	-	7.07E-05	7.24E-05
Y 91M	1.37E-10	-	4.98E-12	-	-	7.60E-07	4.64E-07
Y 91	2.47E-04	-	6.59E-06	-	-	7.10E-04	4.97E-05
Y 92	5.50E-09	-	1.57E-10	-	-	6.46E-06	6.46E-05
Y 93	5.04E-08	-	1.38E-09	-	-	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	-	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	-	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	-	2.33E-06	1.66E-04	1.00E-05
MO 99	-	4.66E-08	1.15E-08	-	1.06E-07	3.66E-05	3.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	-	1.37E-11	2.57E-07	1.30E-06

TABLE 10
INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.19E-14	2.30E-14	2.91E-13	-	3.92E-13	1.58E-07	4.41E-09
RU 103	7.55E-07	-	2.90E-07	-	1.90E-06	1.79E-04	1.21E-05
RU 105	4.13E-10	-	1.50E-10	-	3.63E-10	4.30E-06	2.69E-05
RU 106	3.68E-05	-	4.57E-06	-	4.97E-05	3.87E-03	1.16E-04
AG 110M	4.56E-06	3.08E-06	2.47E-06	-	5.74E-06	1.48E-03	2.71E-05
TE 125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	-	1.29E-04	9.13E-06
TE 127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE 127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE 129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE 129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE 131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE 131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE 132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	-	1.38E-06
I 131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	-	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	-	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	-	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	-	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	-	1.20E-06
CS 134	1.76E-04	2.74E-04	6.07E-05	-	8.93E-05	3.27E-05	1.04E-06
CS 136	1.76E-05	4.62E-05	3.14E-05	-	2.58E-05	3.93E-06	1.13E-06
CS 137	2.45E-04	2.23E-04	3.47E-05	-	7.63E-05	2.81E-05	9.78E-07
CS 138	1.71E-07	2.27E-07	1.50E-07	-	1.68E-07	1.84E-08	7.29E-08
BA 139	4.98E-10	2.66E-13	1.45E-11	-	2.33E-13	1.56E-06	1.56E-05
BA 140	2.00E-05	1.75E-08	1.17E-06	-	5.71E-09	4.71E-04	2.75E-05
BA 141	5.29E-11	2.95E-14	1.72E-12	-	2.56E-14	7.89E-07	7.44E-08
BA 142	1.35E-11	9.73E-15	7.54E-13	-	7.87E-15	4.44E-07	7.41E-10
LA 140	1.74E-07	6.08E-08	2.04E-08	-	-	4.94E-05	6.10E-05
LA 142	3.50E-10	1.11E-10	3.49E-11	-	-	2.35E-06	2.05E-05
CE 141	1.06E-05	5.28E-06	7.83E-07	-	2.31E-06	1.47E-04	1.53E-05
CE 143	9.89E-08	5.37E-08	7.77E-09	-	2.26E-08	3.12E-05	3.44E-05
CE 144	1.83E-03	5.72E-04	9.77E-05	-	3.17E-04	3.23E-03	1.05E-04
PR 143	4.99E-06	1.50E-06	2.47E-07	-	8.11E-07	1.17E-04	2.63E-05
PR 144	1.61E-11	4.99E-12	8.10E-13	-	2.64E-12	4.23E-07	5.32E-08
ND 147	2.92E-06	2.36E-06	1.84E-07	-	1.30E-06	8.87E-05	2.22E-05
W 187	4.41E-09	2.61E-09	1.17E-09	-	-	1.11E-05	2.46E-05
NP 239	1.26E-07	9.04E-09	6.35E-09	-	2.63E-08	1.57E-05	1.73E-05

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.53E-05	-	-	-	1.15E-05
CR 51	-	-	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	-	1.81E-05	3.56E-06	-	3.56E-06	7.14E-04	5.04E-06
MN 56	-	1.10E-09	1.58E-10	-	7.86E-10	8.95E-06	5.12E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	-	-	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	-	-	7.25E-04	1.77E-05
CO 58	-	8.71E-07	1.30E-06	-	-	5.55E-04	7.95E-06
CO 60	-	5.73E-06	8.41E-06	-	-	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	-	-	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	-	-	5.80E-06	3.58E-05
CU 64	-	1.34E-09	5.53E-10	-	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	-	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	-	2.87E-11	1.05E-06	9.44E-06
BR 83	-	-	2.72E-07	-	-	-	LT E-24
BR 84	-	-	2.86E-07	-	-	-	LT E-24
BR 85	-	-	1.46E-08	-	-	-	LT E-24
RB 86	-	1.36E-04	6.30E-05	-	-	-	2.17E-06
RB 88	-	3.98E-07	2.05E-07	-	-	-	2.42E-07
RB 89	-	2.29E-07	1.47E-07	-	-	-	4.87E-08
SR 89	2.84E-04	-	8.15E-06	-	-	1.45E-03	4.57E-05
SR 90	2.92E-02	-	1.85E-03	-	-	8.03E-03	9.36E-05
SR 91	6.83E-08	-	2.47E-09	-	-	3.76E-05	5.24E-05
SR 92	7.50E-09	-	2.79E-10	-	-	1.70E-05	1.00E-04
Y 90	2.35E-06	-	6.30E-08	-	-	1.92E-04	7.43E-05
Y 91M	2.91E-10	-	9.90E-12	-	-	1.99E-06	1.68E-06
Y 91	4.20E-04	-	1.12E-05	-	-	1.75E-03	5.02E-05
Y 92	1.17E-08	-	3.29E-10	-	-	1.75E-05	9.04E-05
Y 93	1.07E-07	-	2.91E-09	-	-	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	-	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	-	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	-	3.37E-06	3.42E-04	9.05E-06
MO 99	-	1.18E-07	2.31E-08	-	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-13	2.06E-12	2.66E-11	-	2.22E-11	5.79E-07	1.45E-06

TABLE 11
INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	4.65E-14	5.88E-14	5.80E-13	-	6.99E-13	4.17E-07	6.03E-07
RU 103	1.44E-06	-	4.85E-07	-	3.03E-06	3.94E-04	1.15E-05
RU 105	8.74E-10	-	2.93E-10	-	6.42E-10	1.12E-05	3.46E-05
RU 106	6.20E-05	-	7.77E-06	-	7.61E-05	8.26E-03	1.17E-04
AG 110M	7.13E-06	5.16E-06	3.57E-06	-	7.80E-06	2.62E-03	2.36E-05
TE 125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	-	3.19E-04	9.22E-06
TE 127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE 127	1.59E-09	6.81E-10	3.40E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE 129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE 129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE 131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE 131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE 132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	-	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	-	7.56E-07
I 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	-	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	-	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	-	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	-	1.31E-06
CS 134	2.83E-04	5.02E-04	5.32E-05	-	1.36E-04	5.69E-05	9.53E-07
CS 136	3.45E-05	9.61E-05	3.78E-05	-	4.03E-05	8.40E-06	1.02E-06
CS 137	3.92E-04	4.37E-04	3.25E-05	-	1.23E-04	5.09E-05	9.53E-07
CS 138	3.61E-07	5.58E-07	2.84E-07	-	2.93E-07	4.67E-08	6.26E-07
BA 139	1.06E-09	7.03E-13	3.07E-11	-	4.23E-13	4.25E-06	3.64E-05
BA 140	4.00E-05	4.00E-08	2.07E-06	-	9.59E-09	1.14E-03	2.74E-05
BA 141	1.12E-10	7.70E-14	3.55E-12	-	4.64E-14	2.12E-06	3.39E-06
BA 142	2.84E-11	2.36E-14	1.40E-12	-	1.36E-14	1.11E-06	4.95E-07
LA 140	3.61E-07	1.43E-07	3.68E-08	-	-	1.20E-04	6.06E-05
LA 142	7.36E-10	2.69E-10	6.46E-11	-	-	5.87E-06	4.25E-05
CE 141	1.98E-05	1.19E-05	1.42E-06	-	3.75E-06	3.69E-04	1.54E-05
CE 143	2.09E-07	1.38E-07	1.58E-08	-	4.03E-08	8.30E-05	3.55E-05
CE 144	2.28E-03	8.65E-04	1.26E-04	-	3.84E-04	7.03E-03	1.06E-04
PR 143	1.00E-05	3.74E-06	4.99E-07	-	1.41E-06	3.09E-04	2.66E-05
PR 144	3.42E-11	1.32E-11	1.72E-12	-	4.80E-12	1.15E-06	3.06E-06
ND 147	5.67E-06	5.81E-06	3.57E-07	-	2.25E-06	2.30E-04	2.23E-05
W 187	9.26E-09	6.44E-09	2.23E-09	-	-	2.83E-05	2.54E-05
NP 239	2.65E-07	2.37E-08	1.34E-08	-	4.73E-08	4.25E-05	1.78E-05

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	-	-	-	2.17E-05
CR 51	-	-	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	-	4.57E-06	8.72E-07	-	1.36E-06	-	1.40E-05
MN 56	-	1.15E-07	2.04E-08	-	1.46E-07	-	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	-	-	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	-	-	2.85E-06	3.40E-05
CO 58	-	7.45E-07	1.67E-06	-	-	-	1.51E-05
CO 60	-	2.14E-06	4.72E-06	-	-	-	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	-	-	-	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	-	-	-	1.74E-06
CU 64	-	8.33E-08	3.91E-08	-	2.10E-07	-	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	-	1.03E-05	-	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	-	1.28E-08	-	2.96E-09
BR 83	-	-	4.02E-08	-	-	-	5.79E-08
BR 84	-	-	5.21E-08	-	-	-	4.09E-13
BR 85	-	-	2.14E-09	-	-	-	LT E-24
RB 86	-	2.11E-05	9.83E-06	-	-	-	4.16E-06
RB 88	-	6.05E-08	3.21E-08	-	-	-	8.36E-19
RB 89	-	4.01E-08	2.82E-08	-	-	-	2.33E-21
SR 89	3.08E-04	-	8.84E-06	-	-	-	4.94E-05
SR 90	7.58E-03	-	1.86E-03	-	-	-	2.19E-04
SR 91	5.67E-06	-	2.29E-07	-	-	-	2.70E-05
SR 92	2.15E-06	-	9.30E-08	-	-	-	4.26E-05
Y 90	9.62E-09	-	2.58E-10	-	-	-	1.02E-04
Y 91M	9.09E-11	-	3.52E-12	-	-	-	2.67E-10
Y 91	1.41E-07	-	3.77E-09	-	-	-	7.76E-05
Y 92	8.45E-10	-	2.47E-11	-	-	-	1.48E-05
Y 93	2.68E-09	-	7.40E-11	-	-	-	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	-	1.53E-08	-	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	-	5.12E-10	-	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	-	3.42E-09	-	2.10E-05
MO 99	-	4.31E-06	8.20E-07	-	9.76E-06	-	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	-	1.06E-08	3.42E-10	4.13E-07

TABLE 12
INGESTION DOSE FACTORS FOR ADULT
(mrem per pCi Ingested)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.54E-10	3.66E-10	3.59E-09	-	6.59E-09	1.87E-10	1.10E-21
RU 103	1.85E-07	-	7.97E-08	-	7.06E-07	-	2.16E-05
RU 105	1.54E-08	-	6.08E-09	-	1.99E-07	-	9.42E-06
RU 106	2.75E-06	-	3.48E-07	-	5.31E-06	-	1.78E-04
AG 110M	1.60E-07	1.48E-07	8.79E-08	-	2.91E-07	-	6.04E-05
TE 125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	-	1.07E-05
TE 127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	-	2.27E-05
TE 127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	-	8.68E-06
TE 129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	-	5.79E-05
TE 129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	-	2.37E-08
TE 131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	-	8.40E-05
TE 131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	-	2.79E-09
TE 132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	-	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	-	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	-	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	-	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	-	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	-	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	-	1.31E-06
CS 134	6.22E-05	1.48E-04	1.21E-04	-	4.79E-05	1.59E-05	2.59E-06
CS 136	6.51E-06	2.57E-05	1.85E-05	-	1.43E-05	1.96E-06	2.92E-06
CS 137	7.97E-05	1.09E-04	7.14E-05	-	3.70E-05	1.23E-05	2.11E-06
CS 138	5.52E-08	1.09E-07	5.40E-08	-	8.01E-08	7.91E-09	4.65E-13
BA 139	9.70E-08	6.91E-11	2.84E-09	-	6.46E-11	3.92E-11	1.72E-07
BA 140	2.03E-05	2.55E-08	1.33E-06	-	8.67E-09	1.46E-08	4.18E-05
BA 141	4.71E-08	3.56E-11	1.59E-09	-	3.31E-11	2.02E-11	2.22E-17
BA 142	2.13E-08	2.19E-11	1.34E-09	-	1.85E-11	1.24E-11	3.00E-26
LA 140	2.50E-09	1.26E-09	3.33E-10	-	-	-	9.25E-05
LA 142	1.28E-10	5.82E-11	1.45E-11	-	-	-	4.25E-07
CE 141	9.36E-09	6.33E-09	7.18E-10	-	2.94E-09	-	2.42E-05
CE 143	1.65E-09	1.22E-06	1.35E-10	-	5.37E-10	-	4.56E-05
CE 144	4.88E-07	2.04E-07	2.62E-08	-	1.21E-07	-	1.65E-04
PR 143	9.20E-09	3.69E-09	4.56E-10	-	2.13E-09	-	4.03E-05
PR 144	3.01E-11	1.25E-11	1.53E-12	-	7.05E-12	-	4.33E-18
ND 147	6.29E-09	7.27E-09	4.35E-10	-	4.25E-09	-	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	-	-	-	2.82E-05
NP 239	1.19E-09	1.17E-10	6.45E-11	-	3.65E-10	-	2.40E-05

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

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Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	-	-	-	2.32E-05
CR 51	-	-	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	-	5.90E-06	1.17E-06	-	1.76E-06	-	1.21E-05
MN 56	-	1.58E-07	2.81E-08	-	2.00E-07	-	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	-	-	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	-	-	4.32E-06	3.24E-05
CO 58	-	9.72E-07	2.24E-06	-	-	-	1.34E-05
CO 60	-	2.81E-06	6.33E-06	-	-	-	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	-	-	-	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	-	-	-	5.19E-06
CU 64	-	1.15E-07	5.41E-08	-	2.91E-07	-	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	-	1.28E-05	-	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	-	1.83E-08	-	5.16E-08
BR 83	-	-	5.74E-08	-	-	-	LT E-24
BR 84	-	-	7.22E-08	-	-	-	LT E-24
BR 85	-	-	3.05E-09	-	-	-	LT E-24
RB 86	-	2.98E-05	1.40E-05	-	-	-	4.41E-06
RB 88	-	8.52E-08	4.54E-08	-	-	-	7.30E-15
RB 89	-	5.50E-08	3.89E-08	-	-	-	8.43E-17
SR 89	4.40E-04	-	1.26E-05	-	-	-	5.24E-05
SR 90	8.30E-03	-	2.05E-03	-	-	-	2.33E-04
SR 91	8.07E-06	-	3.21E-07	-	-	-	3.66E-05
SR 92	3.05E-06	-	1.30E-07	-	-	-	7.77E-05
Y 90	1.37E-08	-	3.69E-10	-	-	-	1.13E-04
Y 91M	1.29E-10	-	4.93E-12	-	-	-	6.09E-09
Y 91	2.01E-07	-	5.39E-09	-	-	-	8.24E-05
Y 92	1.21E-09	-	3.50E-11	-	-	-	3.32E-05
Y 93	3.83E-09	-	1.05E-10	-	-	-	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	-	1.91E-08	-	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	-	7.11E-10	-	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	-	4.42E-09	-	1.95E-05
MO 99	-	6.03E-06	1.15E-06	-	1.38E-05	-	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	-	1.38E-08	5.14E-10	6.08E-07

TABLE 13
INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi Inhaled)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	3.60E-10	5.12E-10	5.03E-09	-	9.26E-09	3.12E-10	8.75E-17
RU 103	2.55E-07	-	1.09E-07	-	8.99E-07	-	2.13E-05
RU 105	2.18E-08	-	8.46E-09	-	2.75E-07	-	1.76E-05
RU 106	3.92E-06	-	4.94E-07	-	7.56E-06	-	1.88E-04
AG 110M	2.05E-07	1.94E-07	1.18E-07	-	3.70E-07	-	5.45E-05
TE 125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	-	-	1.13E-05
TE 127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	-	2.41E-05
TE 127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	-	1.22E-05
TE 129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	-	6.12E-05
TE 129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	-	2.45E-07
TE 131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	-	9.39E-05
TE 131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	-	2.29E-09
TE 132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	-	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	-	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	-	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	-	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	-	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	-	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	-	1.74E-06
CS 134	8.37E-05	1.97E-04	9.14E-05	-	6.26E-05	2.39E-05	2.45E-06
CS 136	8.59E-06	3.38E-05	2.27E-05	-	1.84E-05	2.90E-06	2.72E-06
CS 137	1.12E-04	1.49E-04	5.19E-05	-	5.07E-05	1.97E-05	2.12E-06
CS 138	7.76E-08	1.49E-07	7.45E-08	-	1.10E-07	1.28E-08	4.76E-11
BA 139	1.39E-07	9.78E-11	4.05E-09	-	9.22E-11	6.74E-11	1.24E-06
BA 140	2.84E-05	3.48E-08	1.83E-06	-	1.18E-08	2.34E-08	4.38E-05
BA 141	6.71E-08	5.01E-11	2.24E-09	-	4.65E-11	3.43E-11	1.43E-13
BA 142	2.99E-08	2.99E-11	1.84E-09	-	2.53E-11	1.99E-11	9.18E-20
LA 140	3.48E-09	1.71E-09	4.55E-10	-	-	-	9.28E-05
LA 142	1.79E-10	7.95E-11	1.98E-11	-	-	-	2.42E-06
CE 141	1.33E-08	8.88E-09	1.02E-09	-	4.18E-09	-	2.54E-05
CE 143	2.35E-09	1.71E-06	1.91E-10	-	7.67E-10	-	5.14E-05
CE 144	6.96E-07	2.88E-07	3.74E-08	-	1.72E-07	-	1.75E-04
PR 143	1.31E-08	5.23E-09	6.52E-10	-	3.04E-09	-	4.31E-05
PR 144	4.30E-11	1.76E-11	2.18E-12	-	1.01E-11	-	4.74E-14
ND 147	9.38E-09	1.02E-08	6.11E-10	-	5.99E-09	-	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	-	-	-	3.22E-05
NP 239	1.76E-09	1.66E-10	9.22E-11	-	5.21E-10	-	2.67E-05

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.25E-04	3.86E-05	3.18E-05	-	-	-	2.28E-05
CR 51	-	-	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	-	1.07E-05	2.85E-06	-	3.00E-06	-	8.98E-06
MN 56	-	3.34E-07	7.54E-08	-	4.04E-07	-	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	-	-	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	-	-	7.74E-06	2.78E-05
CO 58	-	1.80E-06	5.51E-06	-	-	-	1.05E-05
CO 60	-	5.29E-06	1.56E-05	-	-	-	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	-	-	-	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	-	-	-	2.56E-05
CU 64	-	2.45E-07	1.48E-07	-	5.92E-07	-	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	-	2.30E-05	-	6.41E-06
ZN 69	4.38E-08	6.33E-08	5.85E-09	-	3.84E-08	-	3.99E-06
BR 83	-	-	1.71E-07	-	-	-	LT E-24
BR 84	-	-	1.98E-07	-	-	-	LT E-24
BR 85	-	-	9.12E-09	-	-	-	LT E-24
RB 86	-	6.70E-05	4.12E-05	-	-	-	4.31E-06
RB 88	-	1.90E-07	1.32E-07	-	-	-	9.32E-09
RB 89	-	1.17E-07	1.04E-07	-	-	-	1.02E-09
SR 89	1.32E-03	-	3.77E-05	-	-	-	5.11E-05
SR 90	1.70E-02	-	4.31E-03	-	-	-	2.29E-04
SR 91	2.40E-05	-	9.06E-07	-	-	-	5.30E-05
SR 92	9.03E-06	-	3.62E-07	-	-	-	1.71E-04
Y 90	4.11E-08	-	1.10E-09	-	-	-	1.17E-04
Y 91M	3.82E-10	-	1.39E-11	-	-	-	7.48E-07
Y 91	6.02E-07	-	1.61E-08	-	-	-	8.02E-05
Y 92	3.60E-09	-	1.03E-10	-	-	-	1.04E-04
Y 93	1.14E-08	-	3.13E-10	-	-	-	1.70E-04
ZR 95	1.16E-07	2.55E-08	2.27E-08	-	3.65E-08	-	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	-	1.45E-09	-	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	-	8.23E-09	-	1.62E-05
MO 99	-	1.33E-05	3.29E-06	-	2.84E-05	-	1.10E-05
TC 99M	9.23E-10	1.81E-09	3.00E-08	-	2.63E-08	9.19E-10	1.03E-06

TABLE 14
INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi Ingested)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	1.07E-09	1.12E-09	1.42E-08	-	1.91E-08	5.92E-10	3.56E-09
RU 103	7.31E-07	-	2.81E-07	-	1.84E-06	-	1.89E-05
RU 105	6.45E-08	-	2.34E-08	-	5.67E-07	-	4.21E-05
RU 106	1.17E-05	-	1.46E-06	-	1.58E-05	-	1.82E-04
AG 110M	5.39E-07	3.64E-07	2.91E-07	-	6.78E-07	-	4.33E-05
TE 125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	-	-	1.10E-05
TE 127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	-	2.34E-05
TE 127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	-	1.84E-05
TE 129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	-	5.94E-05
TE 129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	-	8.34E-06
TE 131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	-	1.01E-04
TE 131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	-	4.36E-07
TE 132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	-	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	-	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	-	1.54E-06
I 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	-	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	-	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	-	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	-	2.40E-06
CS 134	2.34E-04	3.84E-04	8.10E-05	-	1.19E-04	4.27E-05	2.07E-06
CS 136	2.35E-05	6.46E-05	4.18E-05	-	3.44E-05	5.13E-06	2.27E-06
CS 137	3.27E-04	3.13E-04	4.62E-05	-	1.02E-04	3.67E-05	1.96E-06
CS 138	2.28E-07	3.17E-07	2.01E-07	-	2.23E-07	2.40E-08	1.46E-07
BA 139	4.14E-07	2.21E-10	1.20E-08	-	1.93E-10	1.30E-10	2.39E-05
BA 140	8.31E-05	7.28E-08	4.85E-06	-	2.37E-08	4.34E-08	4.21E-05
BA 141	2.00E-07	1.12E-10	6.51E-09	-	9.69E-11	6.58E-10	1.14E-07
BA 142	8.74E-08	6.29E-11	4.88E-09	-	5.09E-11	3.70E-11	1.14E-09
LA 140	1.01E-08	3.53E-09	1.19E-09	-	-	-	9.84E-05
LA 142	5.24E-10	1.67E-10	5.23E-11	-	-	-	3.31E-05
CE 141	3.97E-08	1.98E-08	2.94E-09	-	8.68E-09	-	2.47E-05
CE 143	6.99E-09	3.79E-06	5.49E-10	-	1.59E-09	-	5.55E-05
CE 144	2.08E-06	6.52E-07	1.11E-07	-	3.61E-07	-	1.70E-04
PR 143	3.93E-08	1.18E-08	1.95E-09	-	6.39E-09	-	4.24E-05
PR 144	1.29E-10	3.99E-11	6.49E-12	-	2.11E-11	-	8.59E-08
ND 147	2.79E-08	2.26E-08	1.75E-09	-	1.24E-08	-	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	-	-	-	3.57E-05
NP 239	5.25E-09	3.77E-10	2.65E-10	-	1.09E-09	-	2.79E-05

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Page 1 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	-	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	-	-	-	2.30E-05
CR 51	-	-	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	-	1.99E-05	4.51E-06	-	4.41E-06	-	7.31E-06
MN 56	-	8.18E-07	1.41E-07	-	7.03E-07	-	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	-	-	4.36E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	-	-	1.59E-05	2.57E-05
CO 58	-	3.60E-06	8.98E-06	-	-	-	8.97E-06
CO 60	-	1.08E-05	2.55E-05	-	-	-	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	-	-	-	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	-	-	-	4.05E-05
CU 64	-	6.09E-07	2.82E-07	-	1.03E-06	-	1.25E-05
ZN 65	1.84E-05	6.31E-05	2.91E-05	-	3.06E-05	-	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	-	6.98E-08	-	1.37E-05
BR 83	-	-	3.63E-07	-	-	-	LT E-24
BR 84	-	-	3.82E-07	-	-	-	LT E-24
BR 85	-	-	1.94E-08	-	-	-	LT E-24
RB 86	-	1.70E-04	8.40E-05	-	-	-	4.35E-06
RB 88	-	4.98E-07	2.73E-07	-	-	-	4.85E-07
RB 89	-	2.86E-07	1.97E-07	-	-	-	9.74E-08
SR 89	2.51E-03	-	7.20E-05	-	-	-	5.16E-05
SR 90	1.85E-02	-	4.71E-03	-	-	-	2.31E-04
SR 91	5.00E-05	-	1.81E-06	-	-	-	5.92E-05
SR 92	1.92E-05	-	7.13E-07	-	-	-	2.07E-04
Y 90	8.69E-08	-	2.33E-09	-	-	-	1.20E-04
Y 91M	8.10E-10	-	2.76E-11	-	-	-	2.70E-06
Y 91	1.13E-06	-	3.01E-08	-	-	-	8.10E-05
Y 92	7.65E-09	-	2.15E-10	-	-	-	1.46E-04
Y 93	2.43E-08	-	6.62E-10	-	-	-	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	-	5.41E-08	-	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	-	2.56E-09	-	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	-	1.24E-08	-	1.46E-05
MO 99	-	3.40E-05	6.63E-06	-	5.08E-05	-	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	-	4.26E-08	2.07E-09	1.15E-06

TABLE 15
INGESTION DOSE FACTORS FOR INFANT
(mrem per pCi Ingested)

Page 2 of 2

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TC 101	2.27E-09	2.86E-09	2.83E-08	-	3.40E-08	1.56E-09	4.86E-07
RU 103	1.48E-06	-	4.95E-07	-	3.08E-06	-	1.80E-05
RU 105	1.36E-07	-	4.58E-08	-	1.00E-06	-	5.41E-05
RU 106	2.41E-05	-	3.01E-06	-	2.85E-05	-	1.83E-04
AG 110M	9.96E-07	7.27E-07	4.81E-07	-	1.04E-06	-	3.77E-05
TE 125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	-	-	1.11E-05
TE 127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	-	2.36E-05
TE 127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	-	2.10E-05
TE 129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	-	5.97E-05
TE 129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	-	2.27E-05
TE 131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	-	1.03E-04
TE 131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	-	7.11E-06
TE 132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	-	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	-	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	-	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	-	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	-	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	-	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	-	2.62E-06
CS 134	3.77E-04	7.03E-04	7.10E-05	-	1.81E-04	7.42E-05	1.91E-06
CS 136	4.59E-05	1.35E-04	5.04E-05	-	5.38E-05	1.10E-05	2.05E-06
CS 137	5.22E-04	6.11E-04	4.33E-05	-	1.64E-04	6.64E-05	1.91E-06
CS 138	4.81E-07	7.82E-07	3.79E-07	-	3.90E-07	6.09E-08	1.25E-06
BA 139	8.81E-07	5.84E-10	2.55E-08	-	3.51E-10	3.54E-10	5.58E-05
BA 140	1.71E-04	1.71E-07	8.81E-06	-	4.06E-08	1.05E-07	4.20E-05
BA 141	4.25E-07	2.91E-10	1.34E-08	-	1.75E-10	1.77E-10	5.19E-06
BA 142	1.84E-07	1.53E-10	9.06E-09	-	8.81E-11	9.26E-11	7.59E-07
LA 140	2.11E-08	8.32E-09	2.14E-09	-	-	-	9.77E-05
LA 142	1.10E-09	4.04E-10	9.67E-11	-	-	-	6.86E-05
CE 141	7.87E-08	4.80E-08	5.65E-09	-	1.48E-08	-	2.48E-05
CE 143	1.48E-08	9.82E-06	1.12E-09	-	2.86E-09	-	5.73E-05
CE 144	2.98E-06	1.22E-06	1.67E-07	-	4.93E-07	-	1.71E-04
PR 143	8.13E-08	3.04E-08	4.03E-09	-	1.13E-08	-	4.29E-05
PR 144	2.74E-10	1.06E-10	1.38E-11	-	3.84E-11	-	4.93E-06
ND 147	5.53E-08	5.68E-08	3.48E-09	-	2.19E-08	-	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	-	-	-	3.69E-05
NP 239	1.11E-08	9.93E-10	5.61E-10	-	1.98E-09	-	2.87E-05

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Page 1 of 2

Parameter Symbol	Definition	Values
f_g	Fraction of produce ingested grown in garden of interest.	0.76
f_l	Fraction of leafy vegetables grown in garden of interest.	1.0
P	Effective surface density of soil (assumes a 15 cm plow layer, expressed in dry weight)	240 kg/m^2
r	Fraction of deposited activity retained on crops, leafy vegetables, or pasture grass.	0.25 1.0 (for iodines) 0.2 (for other particulates)
S_F	Attenuation factor accounting for shielding provided by residential structures.	0.7 (for maximum individuals) 0.5 (for general population)
t_b	Period of long-term buildup for activity in sediment or soil (nominally 15 yr).	1.31 x 10^5 hr
t_e	Period of crop, leafy vegetable, or pasture grass exposure during growing season.	720 hrs (30 days, for grass-cow-milk-man pathway) 1440 hrs (60 days for crop/vegetation-man pathway)
t_f	Transport time from animal feed-milk-man provided by residential structures.	2 days (for max. individual) 4 days (for gen. population)
t_h	Time delay between harvest of vegetation or crops and ingestion. i) For ingestion of forage by animals	Zero (for pasture grass) 2160 hr (90 days for stored feed)

TABLE 16
RECOMMENDED VALUES FOR OTHER PARAMETERS

Parameter Symbol	Definition	Values
	ii) For ingestion of crops by man	24 hr (1 day, for leafy vegetables & max. individual) feed) 1440 hr (60 days for produce & maximum individual) 336 hr (14 days for general population)
t_p	Environmental transit time, release to receptor (add time from release to exposure individual) point to minimums shown for distribution)	12 hr (for max. 24 hr (for gen. population) 24 hr (for max. individual) 168 hr (7 days for population sport fish doses) 240 hr (10 days for population commercial fish doses)
t_s	Average time from slaughter of meat animal to consumption.	20 days
Y_v	Agricultural productivity by unit area (measured in wet weight)	0.7 kg/m^2 (for grass-cow-milk man pathway) 2.0 kg/m^2 (for produce or leafy vegetables ingested by man)
W	Shore-width factor for river shoreline	0.2
λ_w	Rate constant for removal of activity on plant or leaf surfaces by weathering (corresponds to a 14-day half-life)	0.0021 hr^{-1}

RW-200

RADIOACTIVE MATERIALS CONTROL PROCEDURE

Title: PROCESS CONTROL PROGRAM

Setpoint/Procedure Form Number (FC-68):	40136
Reason for Change:	Remove references to burial in Washington and clear up references that no longer apply to OPPD, minor text changes to align program description with implementing procedures.
Contact Person:	Mark Breuer

PROCESS CONTROL PROGRAM

1.0 PURPOSE

To provide guidance and boundary conditions for preparation of specific procedures for processing, sampling, analyzing, packaging and shipping solid radioactive waste in accordance with State and Federal regulatory requirements and the Fort Calhoun Station Unit No. 1 Radiological Effluent Technical Specifications.

This program is applicable to the Fort Calhoun Station Unit No. 1 solid radwaste system. Wastes considered in this program are primary and radwaste liquid processing resins, oil and filters. Dry Active Waste is only included as it applies to assurance that packaged waste is suitable for shipment and burial in accordance with applicable State and Federal regulations. Concentrates and aqueous liquids are not considered due to the present decisions not to utilize the waste evaporator as a means for processing liquid wastes.

2.0 RESPONSIBILITIES

2.1 The Radioactive Waste Operations Supervisor is responsible for:

2.1.1 Maintenance of and compliance with this Process Control Program;

2.1.2 Record keeping and document control of shipping and processing data; and

2.1.3 Assuring Radwaste Personnel are appropriately trained and qualified to perform waste processing and packaging activities.

2.2 The Operations Supervisor is responsible for:

2.2.1 Providing trained personnel to operate appropriate radwaste process equipment; and

2.2.2 Defining those Operations positions which require training.

2.3 The Manager Training is responsible for:

2.3.1 Development and implementation of performance-based training for designated personnel in accordance with Training Division procedures.

2.4 All OPPD and OPPD contract personnel are responsible for:

2.4.1 Implementation of procedures and good practices so as to provide Quality Assurance and maintain exposures ALARA.

2.5 The Nuclear Quality Assurance Department is responsible for:

2.5.1 Establishment of a Quality Assurance Program addressing Radwaste processing and packaging; and

2.5.2 Performing audits of activities associated with this Process Control Program to assure compliance with the Quality Assurance Plan.

2.6 The Plant Review Committee is responsible for:

2.6.1 Reviewing and approving changes to this Process Control Program prior to implementation of the changes; and

2.6.2 Reviewing and approving engineering and safety evaluations performed in support of changes to this Process Control Program.

2.7 The Station Engineering Manager is responsible for:

2.7.1 Ensuring engineering and safety evaluations are performed for changes made to this Process Control Program; and

2.7.2 Submitting these evaluations to the Plant Review Committee for review and approval prior to implementation of the changes evaluated.

3.0 DEFINITIONS

3.1 Batch - An isolated quantity of feed waste to be processed having essentially constant physical and chemical characteristics. For the purpose of resin type wastes a batch is defined as the volume of resins in the Spent Resin Storage Tank or in a vendor supplied system intended to process a quantity of feed waste.

3.2 Operable - A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, 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).

3.3 Processing - Changing, modifying, and/or packaging plant generated radioactive waste into a form that is acceptable to a disposal facility.

3.4 Quality Assurance/Quality Control - As used in this document, "quality assurance" comprises those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.

3.5 Sampling Plan - A sampling program implemented to ensure that representative samples from the feed waste and the final waste form are obtained and tested for conformance with parameters stated in the Process Control Program and waste form acceptance criteria.

3.6 Low-Level Radioactive Waste (LLW) - Those low-level radioactive wastes containing source, special nuclear, or by-product material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste has the same meaning as in the Low-Level Waste policy Act, that is radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in Section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

3.7 Waste Container - A vessel of any shape, size, and composition used to contain the final processed waste.

3.8 Waste Form - Waste in a waste container acceptable for disposal at a licensed disposal facility.

3.9 Stability - As used in this program, STABILITY means structural stability. Stability requires that the waste form maintain its structural integrity under the expected disposal conditions.

3.10 Chelating Agent - For the purpose of this program CHELATING AGENTS are amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, picolanic acid and gluconic acid) as defined in 10CFR61.2.

4.0 APPARATUS

4.1 None.

5.0 PREREQUISITES

5.1 All personnel performing activities under the control of and described by this Process Control Program shall have been successfully trained and qualified to perform the described activities before actually performing the activities.

5.2 Procedures shall have been developed for implementation of this Process Control Program and shall be reviewed and approved by the Plant Review Committee prior to performing activities described and required by this Process Control Program.

6.0 PRECAUTIONS

6.1 None.

7.0 PROCEDURE

7.1 WASTE TYPES

7.1.1 Primary Resin

A. The contaminated waste product generated as a result of reactor water purification and demineralization, cation ion exchange, deborating ion exchange and spent fuel pool demineralization.

B. Waste consists of contaminated bead ion exchange resins at varying degrees of exhaustion, small concentrations of various solids, activated and non-activated corrosion products and fission products.

7.1.2 Radwaste Liquid Processing Resin

A. The contaminated waste product generated as a result of processing radwaste liquids using a demineralization system. This system may be vendor supplied.

B. Waste consists of contaminated bead ion exchange resins at varying degrees of exhaustion, small concentrations of various solids, activated and non-activated corrosion products and fission products.

7.1.3 Filters

A. The contaminated waste product generated as a result of liquid processing activities and the removal of cartridge elements from the processing systems. 2/93

B. Waste consists of contaminated mechanical filtration cartridges containing various amounts of particulate solids, corrosion products, activation and fission products.

7.1.4 Oil

A. The contaminated waste product generated as a result of leakage or intentional drainage and replacement of various plant component lubricating and/or control fluids.

B. Waste consists of contaminated oils and greases of various grades both synthetic and natural, in free form or containing various amounts of solid material.

7.1.5 Dry Active Waste

A. The contaminated waste product generated as a result of plant maintenance and repair and routine plant operations.

7.1.5 B. Waste generally consists of contaminated trash in the form of plastics, papers, wood, steel and cloth items with varying concentrations of corrosion, activation and fission products.

7.1.6 <u>Non-Standard Wastes</u>

A. The contaminated waste product generated as a result of non-routine plant operation, maintenance and or repair activities.

B. Waste consists of plant components, irradiated hardware and other specialty items contaminated with varying concentrations of corrosion, activation and fission products. The waste may also be those items which have become activated with contamination being a minimal fraction of the total radioactivity.

7.2 PROCESS DESCRIPTION

7.2.1 <u>Primary Resin</u>

A. Primary resins are obtained from the demineralizer filtration system, purification ion exchangers, the cation ion exchanger, the deborating ion exchanger and the spent fuel storage pool demineralizer.

B. The resins from the demineralizer filtration system are sluiced into a container for processing and shipment from the plant.

C. The resins from other sources and their sluice water are collected in the spent resin storage tank.

D. The contents of the spent resin storage tank are recirculated with sufficient liquid to keep resin flowing. Nitrogen gas is used to break up solid chunks during this recirculation process.

E. The contents of the tank are pumped into a disposable container within a shielded shipping cask or process shield after which the contents are processed and shipped from the plant.

7.2.1 F. Due to the infrequent need to dispose of spent primary resins (approximately every 2-3 years) the most efficient method of disposal is to use a vendor supplied processing system. A NRC approved container (e.g. high Integrity Container or HIC) or solidification process shall provide the required stability.

7.2.2 Radwaste Liquid Processing Resin

A. Radwaste liquids are processed using a demineralization system in lieu of using the installed plant evaporator system.

B. Radioactive liquids are normally transferred from the waste holdup tanks to the demineralization system using the waste holdup transfer pumps. Specific maintenance and/or decontamination activities may require the use of portable transfer pumps and hoses.

C. The processed liquids are directed to the monitor tanks to be analyzed and discharged to the Missouri River through the overboard discharge piping.

D. The depleted resins in the demineralization system vessels are sluiced from the demineralizer vessels into a container which will provide the required stability either through design (HIC) or by solidification.

E. Multiple sluices may be performed to fill the container.

F. Once the container is filled, processed and stabilized; the waste will be shipped for disposal.

7.2.3 Filters 2/93

A. Used filter cartridges originate from the purification filters, the waste filters, the spent fuel pool cooling system filter, ultrasonic cleaning unit, laundry machines and various other decontamination equipment.

7.2.3 B. Filters are removed from their respective system and permitted to drain excess liquids from the elements.

C. The filters are then transferred in a container for disposal. 2/93

(1) When stabilization is required, (i.e. Class B or C) the filters shall be disposed of in a HIC or shall be solidified.

7.2.4 <u>Oil</u>

A. Oil generated during operation and maintenance is collected in containers in appropriate approved areas of the plant.

B. The filled and labeled containers are sealed and moved to available areas for temporary storage. 2/93

C. Oils may be shipped off site to a contracted and licensed vendor for processing or incineration.

7.2.5 <u>Dry Active Waste</u>

A. Dry Active Wastes are collected from radiologically controlled areas throughout the plant. 2/93

B. The waste is sorted to remove reusable and wet items.

C. The contaminated waste material is then either compacted into metal 55 gallon drums in the waste baler, packaged in metal boxes, or placed into a seal/land container for shipment to a process facility. Contaminated waste will be disposed of by an approved burial site or processed (e.g. incinerated, etc.) by an approved vendor. 2/93

7.2.6 <u>Non-Standard Waste</u>

A. Reactor components and irradiated hardware are waste which are not routinely generated.

B. These types of non-standard waste will be handled on a case-by-case basis through the implementation of special procedures approved by the Plant Review Committee.

7.3 PROCESS CONTROL

7.3.1 Radioactive waste processing instrumentation and equipment shall be subject to formal calibration and preventative maintenance programs.

7.3.2 <u>Primary and Radwaste Liquid Processing Resin</u>

A. Primary resins will be transferred into containers for processing using plant installed and vendor supplied equipment.

B. Radwaste Liquid Processing will be performed using a vendor supplied system with transfer of depleted resins from the demineralizer vessels into a processing container by means of sluicing.

C. Primary and Radwaste Liquid Processing Resin dewatering will be performed using an NRC and PRC approved Process Control Program.

D. Referenced Radwaste Procedures controlling the processing, transfer and dewatering activities shall be observed.

E. The Process Control Program which specifically controls processing of the waste (i.e. the vendors PCP) shall identify the mechanisms and frequency of test/measurements used to verify stability and free standing liquid requirements are satisfied.

F. Successful completion of applicable portions of the vendor Process Control Program shall serve as an indicator of system operability.

7.3.2 G. Containers used for dewatering and packaging for disposal at the Barnwell disposal facility shall be approved for use and disposal by the South Carolina Department of Health and Environmental Control.

H. The vendor supplied system shall be operated in accordance with the system operating procedures and applicable station Radwaste Procedures.

I. Station to vendor interfacing is addressed in the Safety Evaluation for the processing and dewatering operations.

7.3.3 Filters

A. Filter processing is controlled by referenced Radwaste Procedures.

B. Filters requiring stability are packaged as described in Section 7.2.3. The containers and/or process used shall be approved by the South Carolina Department of Health and Control. 2/93

7.3.4 Oil

A. Processing of oil shall be performed in accordance with referenced Radwaste Procedures and applicable vendor procedures and topical reports for the methodology applied to the processing activity.

7.3.5 Dry Active Waste

A. Dry Active Waste is processed in accordance with referenced Radwaste Procedures.

7.3.6 Non-Standard Waste

A. Non-Standard Waste is processed in accordance with special Radwaste Procedures germane to the specific non-standard waste being processed.

7.4 PRODUCT CONTROL

7.4.1 A sample from each batch of waste shall be analyzed quantitatively for activity and isotopic identity as required in station procedures. If radionuclide distributions are shown to be consistent between similar batches, consideration may be given to decreasing the frequency of routine measurements. Frequency of sampling is as described in Radiation Protection Procedure RW-221, "10CFR61 Sampling". This constitutes the sampling plan.

7.4.2 Scaling factors for nuclides which are hard to identify are established for waste streams by using analyses performed and provided by an off-site vendor.

7.4.3 This frequency of sampling shall be raised or lowered based upon consideration of waste stream or radionuclide characteristics. Factors which would influence this consideration include the frequency of process vessel changeout or waste shipment, the difficulty (e.g. Costs, occupational exposures) in obtaining a representative sample of a particular waste stream, the variability of the radionuclide distribution within the waste stream over time, and the availability of analytical capability for particular radionuclides. If radionuclide distributions are shown to be consistent between similar batches, consideration may be given to decreasing the frequency of routine measurements. If onsite samples show a variation from presently used scaling factors by more than a factor of 10, samples will be sent offsite for analysis to establish new scaling factors.

7.4.4 Radionuclide concentrations and classification of future waste shipments are expected to be similar to those of previous shipments for each specific waste stream. Values are available from shipment manifest forms.

7.4.5 Administrative controls for preventing unsatisfactory waste forms from being released for shipment are described in referenced station procedures.

7.4.6 Referenced Radwaste Procedures ensure wastes shall have no detectable free standing liquids. No detectable free standing liquid is defined as low as practical but not more than 1% of the volume of the waste when the waste is in a disposable container designed to ensure stability or not more than 0.5% of the volume of the waste for waste processed in any other container.

7.4.7 Processed resin shall be sampled in accordance with regulatory guidance and referenced station procedures to verify that the free liquid content of the packaged product is within limits established by applicable regulatory agencies. Sampling and measurement of free liquid content shall be performed whenever process changes occur that may significantly alter system performance, until compliance with moisture content limits under these conditions can be demonstrated.

7.4.8 Each waste shipment shall be accompanied by a shipping manifest giving a physical description of the waste, the volume, the radionuclide identity and quantity, the total radioactivity, the principal chemical form and waste class, based on 10CFR61.55.

7.4.9 Sufficient analysis shall be performed to verify that the quality of waste forms prepared for disposal by vendor's onsite processing shall be similar to vendor's test results.

7.5 TRAINING

7.5.1 Processing of solid radioactive waste shall be performed by qualified and trained personnel.

7.5.2 Training records of processing personnel shall be maintained by the Training Division.

7.5.3 Training and qualification records for operators of mobile vendor processing units shall be maintained by the Radioactive Waste Operations Supervisor while the vendor is active on site. These records shall be sent to the Nuclear Records Management System after the vendor has completed work on site.

7.6 PROCEDURE CONTROL

7.6.1 On site processing of radioactive waste shall be performed in accordance with approved station procedures.

7.6.2 Processing of radioactive waste by onsite vendors shall be performed in accordance with applicable Process Control Programs, procedures and applicable NRC guidance.

7.6.3 Procedures for processing, containerization and transport of wastes shall ensure that specific DOT, 10CFR and burial site requirements are satisfied.

7.6.4 Process Control Programs for specific radwaste systems supplied by vendors for on site processing shall be presented to the Plant Review Committee for review and approval prior to use of the system.

7.7 RECORDS

7.7.1 Waste classification records, waste form records and other records required for the preparation of the Fort Calhoun Station Unit No. 1 Semiannual Radioactive Effluent Release Report shall be prepared and retained in accordance with the requirements of 10CFR20, 10CFR71, 49CFR170-178 and the Fort Calhoun Station Technical Specifications.

7.7.2 Records of processing data, test and analysis results and results of training, inspection and audits are retained in accordance with the Fort Calhoun Station Quality Assurance Plan and applicable station Administrative Procedures.

7.7.3 All certificates of compliance, licenses, criteria and regulations pertaining to processing, packaging, shipment and disposal of radioactive materials controlled under this Process Control Program shall be maintained in the most current status. OPPD, Fort Calhoun Station Unit No. 1 shall be currently registered, as necessary, to use applicable packagings.

7.7.4 Sufficient documentation shall be maintained to demonstrate compliance of solid radwaste processing with this Process Control Program.

7.8 QUALITY ASSURANCE

7.8.1 Quality Assurance shall be maintained as defined by the Fort Calhoun Station Quality Assurance Plan, Section 11.

7.8.2 The QA Plan shall ensure compliance with NRC and burial site criteria for waste classification and waste form.

7.8.3 Audits shall be conducted in accordance with NQA Audit Section Instructions.

7.8.4 The Topical Reports of vendor supplied radwaste processing systems shall undergo review either by the Radioactive Waste Operations Supervisor or the Supervisor-Radiation Protection. The review shall ensure the vendor supplied system will be compatible with plant operations and that the Topical report has been submitted to the NRC for review. The review shall be documented by a memo addressed to file.

7.8.5 Audits of a sampling of implementing procedures shall be performed at least once every 24 months. Procedures should be reviewed to ensure continual compliance with the requirements and process parameters of this Process Control Program.

7.8.6 Radioactive wastes not described within this document must be evaluated and approved for inclusion in this Process Control Program or in a vendor Process Control Program prior to processing.

7.9 REVISIONS

7.9.1 Changes or modifications made to design and/or operation of radioactive waste processing, treatment and/or packaging systems or activities, as described within this Process Control Program, shall require formal engineering evaluation and performance of a safety evaluation in accordance with 10CFR50.59 and USNRC IE Circular No. 80-18. 2/93

7.9.2 Changes made to this Process Control Program and supporting engineering and safety evaluations shall be reviewed and approved by the Plant review Committee prior to implementing the changes.

7.9.3 Changes to the Process Control Program approved by the Plant Review Committee shall be submitted to the Nuclear Engineer-In-Charge of Licensing, for input to the Semi-Annual Radioactive Effluent Release Report.

8.0 REFERENCES

8.1 Radiation Protection Procedure RW-201, "Control of Containers"

8.2 Radiation Protection Procedure RW-202, "Collection/Sorting/Segregation of Dry Active Waste (DAW)"

8.3 Radiation Protection Procedure RW-203, "Compacting Dry Active Waste (DAW)"

8.4 Radiation Protection Procedure RW-204, "Packaging Non-Compactable Dry Active Waste"

8.5 Radiation Protection Procedure RW-206, "Transfer of Spent Primary Resin to Disposal Containers"

8.6 Radiation Protection Procedure RW-207, "Operation of the Fix Radwaste Liquid Processing System"

8.7 Radiation Protection Procedure RW-208, "Transfer of Spent Fix System Resin to Disposal Containers"

8.8 Radiation Protection Procedure RW-209, "Dewatering Spent Radwaste Liquid Processing Resin and Primary Resin In Disposal Containers"

8.9 Radiation Protection Procedure RW-211, "Storage of Filters From Radwaste Systems" 2/93

8.10 Radiation Protection Procedure RW-212, "Loading HIC Overpacks" 2/93

8.11 Radiation Protection Procedure RW-214, "Collection Of Oils"

8.12 Radiation Protection Procedure RW-215, "Processing of Contaminated Oils"

8.13 Radiation Protection Procedure RW-216, "Testing of Sorbent Materials"

8.14 Radiation Protection Procedure RW-218, "10CFR61 Classification"

8.15 Radiation Protection Procedure RW-221, "10CFR61 Sampling"

8.16 49CFR Parts 170 through 178

8.17 10CFR Parts 20, 50, 61, and 71

8.18 USNRC IE Circular No. 80-18 2/93

8.19 USNRC Low Level Waste Licensing Branch; Technical Position on Radioactive Waste Classification, Current Revision 2/93

8.20 USNRC Low Level Waste Licensing Branch; Technical Position on Waste Form, Current Revision 2/93

8.21 South Carolina Department of Health and Environmental Control Radioactive Material License No. 097, Current Revision 2/93

8.22 Barnwell Special Nuclear Material License No. 12-13536-01, issued to Chem-Nuclear Systems, Inc.

8.23 Barnwell Site Disposal Criteria, (Chem-Nuclear Systems, Inc.) November 1982 2/93

8.24 Current Vendor Processing Topical Report

8.25 Current Vendor Operating Procedures as referenced in RW-207 2/93

8.26 FCS Quality Assurance Plan, Section 11.1 and 11.2

8.27 Fort Calhoun Station Unit No. 1, Updated Safety Analysis Report

8.28 Fort Calhoun Station Unit No. 1 Technical Specifications Sections 2.9.2, 3.12.2, and 5.9.4

9.0 ATTACHMENTS

None

Fort Calhoun Station
Unit No. 1

RW-200

RADIOACTIVE MATERIALS CONTROL PROCEDURE

Title: PROCESS CONTROL PROGRAM

Setpoint/Procedure
Form Number (FC-68): 38585

Reason for Change: Incorporate 10 CFR 20 changes.

Contact Person: Mark Puckett

PROCESS CONTROL PROGRAM

1.0 PURPOSE

To provide guidance and boundary conditions for preparation of specific procedures for processing, sampling, analyzing, packaging and shipping solid radioactive waste in accordance with State and Federal regulatory requirements. 7/93

This program is applicable to the Fort Calhoun Station Unit No. 1 solid radwaste system. Wastes considered in this program are primary and radwaste liquid processing resins, oil and filters. Dry Active Waste is only included as it applies to assurance that packaged waste is suitable for shipment and burial in accordance with applicable State and Federal regulations. Concentrates and aqueous liquids are not considered due to the present decisions not to utilize the waste evaporator as a means for processing liquid wastes.

2.0 RESPONSIBILITIES

2.1 The Radioactive Waste Operations Supervisor is responsible for:

2.1.1 Maintenance of and compliance with this Process Control Program;

2.1.2 Record keeping and document control of shipping and processing data; and

2.1.3 Assuring Radwaste Personnel are appropriately trained and qualified to perform waste processing and packaging activities.

2.2 The Operations Supervisor is responsible for:

2.2.1 Providing trained personnel to operate appropriate radwaste process equipment; and

2.2.2 Defining those Operations positions which require training.

2.3 The Manager Training is responsible for:

2.3.1 Development and implementation of performance-based training for designated personnel in accordance with Training Division procedures.

2.4 All OPPD and OPPD contract personnel are responsible for:

2.4.1 Implementation of procedures and good practices so as to provide Quality Assurance and maintain exposures ALARA.

2.5 The Nuclear Quality Assurance Department is responsible for:

2.5.1 Establishment of a Quality Assurance Program addressing Radwaste processing and packaging; and

2.5.2 Performing audits of activities associated with this Process Control Program to assure compliance with the Quality Assurance Plan.

2.6 The Plant Review Committee is responsible for:

2.6.1 Reviewing and approving changes to this Process Control Program prior to implementation of the changes; and

2.6.2 Reviewing and approving engineering and safety evaluations performed in support of changes to this Process Control Program.

2.7 The Station Engineering Manager is responsible for:

2.7.1 Ensuring engineering and safety evaluations are performed for changes made to this Process Control Program; and

2.7.2 Submitting these evaluations to the Plant Review Committee for review and approval prior to implementation of the changes evaluated.

3.0 DEFINITIONS

3.1 Batch - An isolated quantity of feed waste to be processed having essentially constant physical and chemical characteristics. For the purpose of resin type wastes a batch is defined as the volume of resins in the Spent Resin Storage Tank or in a vendor supplied system intended to process a quantity of feed waste.

3.2 Operable - A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, 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).

3.3 Processing - Changing, modifying, and/or packaging plant generated radioactive waste into a form that is acceptable to a disposal facility.

3.4 Quality Assurance/Quality Control - As used in this document, "quality assurance" comprises those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.

3.5 Sampling Plan - A sampling program implemented to ensure that representative samples from the feed waste and the final waste form are obtained and tested for conformance with parameters stated in the Process Control Program and waste form acceptance criteria.

3.6 Low-Level Radioactive Waste (LLW) - Those low-level radioactive wastes containing source, special nuclear, or by-product material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste has the same meaning as in the Low-Level Waste policy Act, that is radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in Section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

3.7 Waste Container - A vessel of any shape, size, and composition used to contain the final processed waste.

3.8 Waste Form - Waste in a waste container acceptable for disposal at a licensed disposal facility.

3.9 Stability - As used in this program, STABILITY means structural stability. Stability requires that the waste form maintain its structural integrity under the expected disposal conditions.

3.10 Chelating Agent - For the purpose of this program CHELATING AGENTS are amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, picolanic acid and gluconic acid) as defined in 10CFR61.2.

4.0 APPARATUS

None

5.0 PREREQUISITES

5.1 All personnel performing activities under the control of and described by this Process Control Program shall have been successfully trained and qualified to perform the described activities before actually performing the activities.

5.2 Procedures shall have been developed for implementation of this Process Control Program and shall be reviewed and approved by the Plant Review Committee prior to performing activities described and required by this Process Control Program.

6.0 PRECAUTIONS

None

7.0 PROCEDURE

7.1 WASTE TYPES

7.1.1 Primary Resin

A. The contaminated waste product generated as a result of reactor water purification and demineralization, cation ion exchange, deborating ion exchange and spent fuel pool demineralization.

B. Waste consists of contaminated bead ion exchange resins at varying degrees of exhaustion, small concentrations of various solids, activated and non-activated corrosion products and fission products.

7.1.2 Radwaste Liquid Processing Resin

A. The contaminated waste product generated as a result of processing radwaste liquids using a demineralization system. This system may be vendor supplied.

B. Waste consists of contaminated bead ion exchange resins at varying degrees of exhaustion, small concentrations of various solids, activated and non-activated corrosion products and fission products.

7.1.3 Filters

A. The contaminated waste product generated as a result of liquid processing activities and the removal of cartridge elements from the processing systems.

B. Waste consists of contaminated mechanical filtration cartridges containing various amounts of particulate solids, corrosion products, activation and fission products.

7.1.4 Oil

A. The contaminated waste product generated as a result of leakage or intentional drainage and replacement of various plant component lubricating and/or control fluids.

B. Waste consists of contaminated oils and greases of various grades both synthetic and natural, in free form or containing various amounts of solid material.

7.1.5 Dry Active Waste

A. The contaminated waste product generated as a result of plant maintenance and repair and routine plant operations.

B. Waste generally consists of contaminated trash in the form of plastics, papers, wood, steel and cloth items with varying concentrations of corrosion, activation and fission products.

7.1.6 Non-Standard Wastes

A. The contaminated waste product generated as a result of non-routine plant operation, maintenance and or repair activities.

B. Waste consists of plant components, irradiated hardware and other specialty items contaminated with varying concentrations of corrosion, activation and fission products. The waste may also be those items which have become activated with contamination being a minimal fraction of the total radioactivity.

7.2 PROCESS DESCRIPTION

7.2.1 Primary Resin

A. Primary resins are obtained from the demineralizer filtration system, purification ion exchangers, the cation ion exchanger, the deborating ion exchanger and the spent fuel storage pool demineralizer.

B. The resins from the demineralizer filtration system are sluiced into a container for processing and shipment from the plant.

C. The resins from other sources and their sluice water are collected in the spent resin storage tank.

7.2.1 D. The contents of the spent resin storage tank are recirculated with sufficient liquid to keep resin flowing. Nitrogen gas is used to break up solid chunks during this recirculation process.

E. The contents of the tank are pumped into a disposable container within a shielded shipping cask or process shield after which the contents are processed and shipped from the plant.

F. Due to the infrequent need to dispose of spent primary resins (approximately every 2-3 years) the most efficient method of disposal is to use a vendor supplied processing system. A NRC approved container (e.g. high Integrity Container or HIC) or solidification process shall provide the required stability.

7.2.2 <u>Radwaste Liquid Processing Resin</u>

A. Radwaste liquids are processed using a demineralization system in lieu of using the installed plant evaporator system.

B. Radioactive liquids are normally transferred from the waste holdup tanks to the demineralization system using the waste holdup transfer pumps. Specific maintenance and/or decontamination activities may require the use of portable transfer pumps and hoses.

C. The processed liquids are directed to the monitor tanks to be analyzed and discharged to the Missouri River through the overboard discharge piping.

D. The depleted resins in the demineralization system vessels are sluiced from the demineralizer vessels into a container which will provide the required stability either through design (HIC) or by solidification.

7.2.2 E. Multiple sluices may be performed to fill the container.

F. Once the container is filled, processed and stabilized; the waste will be shipped for disposal.

7.2.3 Filters

A. Used filter cartridges originate from the purification filters, the waste filters, the spent fuel pool cooling system filter, ultrasonic cleaning unit, laundry machines and various other decontamination equipment.

B. Filters are removed from their respective system and permitted to drain excess liquids from the elements.

C. The filters are then transferred in a container for disposal.

(1) When stabilization is required, (i.e. Class B or C) the filters shall be disposed of in a HIC or shall be solidified.

7.2.4 Oil

A. Oil generated during operation and maintenance is collected in containers in appropriate approved areas of the plant.

B. The filled and labeled containers are sealed and moved to available areas for temporary storage.

C. Oils may be shipped off site to a contracted and licensed vendor for processing or incineration.

7.2.5 Dry Active Waste

A. Dry Active Wastes are collected from radiologically controlled areas throughout the plant.

B. The waste is sorted to remove reusable and wet items.

7.2.5 C. The contaminated waste material is then either compacted into metal 55 gallon drums in the waste baler, packaged in metal boxes, or placed into a seal/land container for shipment to a process facility. Contaminated waste will be disposed of by an approved burial site or processed (e.g. incinerated, etc.) by an approved vendor.

7.2.6 Non-Standard Waste

A. Reactor components and irradiated hardware are waste which are not routinely generated.

B. These types of non-standard waste will be handled on a case-by-case basis through the implementation of special procedures approved by the Plant Review Committee.

7.3 PROCESS CONTROL

7.3.1 Radioactive waste processing instrumentation and equipment shall be subject to formal calibration and preventative maintenance programs.

7.3.2 Primary and Radwaste Liquid Processing Resin

A. Primary resins will be transferred into containers for processing using plant installed and vendor supplied equipment.

B. F waste Liquid Processing will be rformed using a vendor supplied ystem with transfer of depleted resins from the demineralizer vessels into a processing container by means of sluicing.

C. Primary and Radwaste Liquid Processing Resin dewatering will be performed using an NRC and PRC approved Process Control Program.

D. Referenced Radwaste Procedures controlling the processing, transfer and dewatering activities shall be observed.

7.3.2 E. The Process Control Program which specifically controls processing of the waste (i.e. the vendors PCP) shall identify the mechanisms and frequency of test/measurements used to verify stability and free standing liquid requirements are satisfied.

F. Successful completion of applicable portions of the vendor Process Control Program shall serve as an indicator of system operability.

G. Containers used for dewatering and packaging for disposal at the Barnwell disposal facility shall be approved for use and disposal by the South Carolina Department of Health and Environmental Control.

H. The vendor supplied system shall be operated in accordance with the system operating procedures and applicable station Radwaste Procedures.

I. Station to vendor interfacing is addressed in the Safety Evaluation for the processing and dewatering operations.

7.3.3 <u>Filters</u>

A. Filter processing is controlled by referenced Radwaste Procedures.

B. Filters requiring stability are packaged as described in Section 7.2.3. The containers and/or process used shall be approved by the South Carolina Department of Health and Control.

7.3.4 <u>Oil</u>

A. Processing of oil shall be performed in accordance with referenced Radwaste Procedures and applicable vendor procedures and topical reports for the methodology applied to the processing activity.

7.3.5 Dry Active Waste

A. Dry Active Waste is processed in accordance with referenced Radwaste Procedures.

7.3.6 Non-Standard Waste

A. Non-Standard Waste is processed in accordance with special Radwaste Procedures germane to the specific non-standard waste being processed.

7.4 PRODUCT CONTROL

7.4.1 A sample from each batch of waste shall be analyzed quantitatively for activity and isotopic identity as required in station procedures. If radionuclide distributions are shown to be consistent between similar batches, consideration may be given to decreasing the frequency of routine measurements. Frequency of sampling is as described in Radiation Protection Procedure RW-221, "10CFR61 Sampling". This constitutes the sampling plan.

7.4.2 Scaling factors for nuclides which are hard to identify are established for waste streams by using analyses performed and provided by an off-site vendor.

7.4.3 This frequency of sampling shall be raised or lowered based upon consideration of waste stream or radionuclide characteristics. Factors which would influence this consideration include the frequency of process vessel changeout or waste shipment, the difficulty (e.g. Costs, occupational exposures) in obtaining a representative sample of a particular waste stream, the variability of the radionuclide distribution within the waste stream over time, and the availability of analytical capability for particular radionuclides. If radionuclide distributions are shown to be consistent between similar batches, consideration may be given to decreasing the frequency of routine measurements. If onsite samples show a variation from presently used scaling factors by more than a factor of 10, samples will be sent offsite for analysis to establish new scaling factors.

7.4.4 Radionuclide concentrations and classification of future waste shipments are expected to be similar to those of previous shipments for each specific waste stream. Values are available from shipment manifest forms.

7.4.5 Administrative controls for preventing unsatisfactory waste forms from being released for shipment are described in referenced station procedures.

7.4.6 Referenced Radwaste Procedures ensure wastes shall have no detectable free standing liquids. No detectable free standing liquid is defined as low as practical but not more than 1% of the volume of the waste when the waste is in a disposable container designed to ensure stability or not more than 0.5% of the volume of the waste for waste processed in any other container.

7.4.7 Processed resin shall be sampled in accordance with regulatory guidance and referenced station procedures to verify that the free liquid content of the packaged product is within limits established by applicable regulatory agencies. Sampling and measurement of free liquid content shall be performed whenever process changes occur that may significantly alter system performance, until compliance with moisture content limits under these conditions can be demonstrated.

7.4.8 Each waste shipment shall be accompanied by a shipping manifest giving a physical description of the waste, the volume, the radionuclide identity and quantity, the total radioactivity, the principal chemical form and waste class, based on 10CFR61.55.

7.4.9 Sufficient analysis shall be performed to verify that the quality of waste forms prepared for disposal by vendor's onsite processing shall be similar to vendor's test results.

7.5 TRAINING

7.5.1 Processing of solid radioactive waste shall be performed by qualified and trained personnel.

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7.6.1 On site processing of radioactive waste shall be performed in accordance with approved station procedures.

7.6.2 Processing of radioactive waste by onsite vendors shall be performed in accordance with applicable Process Control Programs, procedures and applicable NRC guidance.

7.6.3 Procedures for processing, containerization and transport of wastes shall ensure that specific DOT, 10CFR and burial site requirements are satisfied.

7.6.4 Process Control Programs for specific radwaste systems supplied by vendors for on site processing shall be presented to the Plant Review Committee for review and approval prior to use of the system.

7.7 RECORDS

7.7.1 Waste classification records, waste form records and other records required for the preparation of the Fort Calhoun Station Unit No. 1 Annual Radioactive Effluent Release Report shall be prepared and retained in accordance with the requirements of 10CFR20, 10CFR71, 49CFR170-178 and the Fort Calhoun Station Technical Specifications. 7/93

7.7.2 Records of processing data, test and analysis results and results of training, inspection and audits are retained in accordance with the Fort Calhoun Station Quality Assurance Plan and applicable station Administrative Procedures.

7.7.3 All certificates of compliance, licenses, criteria and regulations pertaining to processing, packaging, shipment and disposal of radioactive materials controlled under this Process Control Program shall be maintained in the most current status. OPPD, Fort Calhoun Station Unit No. 1 shall be currently registered, as necessary, to use applicable packagings.

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7.8.1 Quality Assurance shall be maintained as defined by the Fort Calhoun Station Quality Assurance Plan, Section 11.

7.8.2 The QA Plan shall ensure compliance with NRC and burial site criteria for waste classification and waste form.

7.8.3 Audits shall be conducted in accordance with NQA Audit Section Instructions.

7.8.4 The Topical Reports of vendor supplied radwaste processing systems shall undergo review either by the Radioactive Waste Operations Supervisor or the Supervisor-Radiation Protection. The review shall ensure the vendor supplied system will be compatible with plant operations and that the Topical report has been submitted to the NRC for review. The review shall be documented by a memo addressed to file.

7.8.5 Audits of a sampling of implementing procedures shall be performed at least once every 24 months. Procedures should be reviewed to ensure continual compliance with the requirements and process parameters of this Process Control Program.

7.8.6 Radioactive wastes not described within this document must be evaluated and approved for inclusion in this Process Control Program or in a vendor Process Control Program prior to processing.

7.9 REVISIONS

7.9.1 Changes or modifications made to design and/or operation of radioactive waste processing, treatment and/or packaging systems or activities, as described within this Process Control Program, shall require formal engineering evaluation and performance of a safety evaluation in accordance with 10CFR50.59 and USNRC IE Circular No. 80-18.

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7.9.3 Changes to the Process Control Program approved by the Plant Review Committee shall be submitted to the Nuclear Engineer-In-Charge of Licensing, for input to the Annual Radioactive Effluent Release Report. 7/93

8.0 REFERENCES

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8.7 Radiation Protection Procedure RW-208, "Transfer of Spent Fix System Resin to Disposal Containers"

8.8 Radiation Protection Procedure RW-209, "Dewatering Spent Radwaste Liquid Processing Resin and Primary Resin In Disposal Containers"

8.9 Radiation Protection Procedure RW-211, "Storage of Filters From Radwaste Systems"

8.10 Radiation Protection Procedure RW-212, "Loading HIC Overpacks"

8.11 Radiation Protection Procedure RW-214, "Collection Of Oils"

8.12 Radiation Protection Procedure RW-215, "Processing of Contaminated Oils"

8.13 Radiation Protection Procedure RW-216, "Testing of Sorbent Materials"

8.14 Radiation Protection Procedure RW-218, "10CFR61 Classification"

8.15 Radiation Protection Procedure RW-221, "10CFR61 Sampling"

8.16 49CFR Parts 170 through 178

8.17 10CFR Parts 20, 50, 61, and 71

8.18 USNRC IE Circular No. 80-18

7/93

8.19 USNRC Low Level Waste Licensing Branch; Technical Position on Radioactive Waste Classification, Current Revision

8.20 USNRC Low Level Waste Licensing Branch; Technical Position on Waste Form, Current Revision

8.21 South Carolina Department of Health and Environmental Control Radioactive Material License No. 097, Current Revision

8.22 Barnwell Special Nuclear Material License No. 12-13536-01, issued to Chem-Nuclear Systems, Inc.

8.23 Barnwell Site Disposal Criteria, (Chem-Nuclear Systems, Inc.) November 1982

8.24 Current Vendor Processing Topical Report

8.25 Current Vendor Operating Procedures as referenced in RW-207

8.26 FCS Quality Assurance Plan, Section 11.1 and 11.2

8.27 Fort Calhoun Station Unit No. 1, Updated Safety Analysis Report

8.28 Fort Calhoun Station Unit No. 1 Technical Specifications Sections 5.18 and 5.9.4

9.0 <u>ATTACHMENTS</u>

None