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Public Service Corporation
(a subsidiary of WPS resources corporation)
600 North Adams Street
P.O. Box 19002
Green Bay, WI 54307-9002
1.800.450.7260

April 23, 1998

10 CFR 50.36a(a)(2)

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Radioactive Effluent Release Report January - December, 1997

Enclosed please find a copy of the Kewaunee Nuclear Power Plant Radioactive Effluent Release Report for January through December, 1997. This report is submitted to meet the requirements of Technical Specification 6.9.b.2.

Sincerely,

M L Marchi

Mark L. Marchi
Manager - Nuclear Business Group

DFS/jmf

Enc.

cc - US NRC Senior Resident Inspector
US NRC Region III

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50-305 KEWAUNEE POWER PLANT WPSC

RADIOACTIVE EFFLUENT RELEASE REPORT
JANUARY - DECEMBER, 1997
REC'D W/LTR DTD ~~12/31/97~~...9804280075
4/23/98

KEWAUNEE NUCLEAR POWER PLANT

RADIOACTIVE
EFFLUENT RELEASE REPORT

JANUARY - DECEMBER 1997

WISCONSIN PUBLIC SERVICE CORPORATION
WISCONSIN POWER & LIGHT COMPANY
MADISON GAS & ELECTRIC COMPANY

DOCKET 50-305

KEWAUNEE NUCLEAR POWER PLANT

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

January 1 - December 31, 1997

Wisconsin Public Service Corporation
Green Bay, Wisconsin
March 27, 1998

Table of Contents

0.0 SUMMARY

During 1997 all solid, liquid, and gaseous radioactive effluents from the Kewaunee Nuclear Plant were well below regulatory limits. For individual effluent streams , the quarterly limit most closely approached was:

GASEOUS:	Ingestion Pathway-Organ	Total Body	
	Quarterly Limit (mRems)	7.5	
	Actual Dose (mRems)	0.00005541	(4th Quarter)
	% of Specification	0.0007388	
LIQUID:	Ingestion Pathway-Organ	GI-LLI	
	Quarterly Limit (mRems)	5	
	Actual Dose (mRems)	0.01252	(4th Quarter)
	% of Limit	0.25	
SOLID:	No upper limit for solid radioactive waste applies.		
	Cubic Meters Shipped	18.4 m^3 (650 ft^3)	

1.0 INTRODUCTION

This report is being submitted in accordance with the requirements of Kewaunee Technical Specifications, Section 6.9.b.2 and the Offsite Dose Calculation Manual, Section 3/4.6. It includes data from all effluent releases made from January 1 - December 31, 1997. The report contains summaries of the gaseous and liquid releases made to the environment including the quantity, characterization, time duration and calculated radiation dose at the site boundary resulting from these releases. The report also includes a summation of solid waste disposal, revisions to the Process Control Program and the Offsite Dose Calculation Manual, and addresses the cumulative meteorological data.

1.1 Effluent Dose Limits

Specifications are set to insure that offsite doses are maintained as low as reasonably achievable while still allowing for practical and dependable operation of the Kewaunee Plant.

The Kewaunee Offsite Dose Calculation Manual (ODCM) describes the methodology and parameters used in:

1.) The calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints.

2.) The calculation of radioactive liquid and gaseous concentrations, dose rates and cumulative quarterly and annual doses. The ODCM methodology is acceptable for use in demonstrating compliance with 10 CFR 20.106; 10 CFR 20.1101(b); 10 CFR 50, Appendix I; and 40 CFR 190.

2.0 GASEOUS EFFLUENTS

2.1 Lower Limits of Detection (LLD) for Gaseous Effluents

Gaseous radioactive effluents are released in both the continuous mode and the batch mode. The auxiliary building stack is sampled continuously for particulates, halogens and Strontium by an "off-line" sample train. This stack is also grab-sampled daily for gaseous gamma emitters. Batch releases are sampled prior to release for principal gaseous and particulate gamma emitters, halogens and tritium.

The LLD's for gascous radioanalyses, as listed in Table 4.4 of the Kewaunee ODCM are:

Analysis	LLD (μCi/ml)
Gaseous Gamma Emitters	1.00 E-04
Iodine 131	3.00 E-12
Particulate Gamma Emitters	1.00 E-11
Particulate Gross Alpha	1.00 E-11
Strontium 89, 90	1.00 E-11
Noble Gases, Gross Beta or Gamma	1.00 E-06

The nominal "a priori" LLD values are shown below.

Isotope	a priori LLD (μCi/ml)
a. Gaseous emissions:	
Kr-87	1.17E-07
Kr-88	7.48E-08
Xe-133	7.75E-08
Xe-133m	2.97E-07
Xe-135	2.46E-08
Xe-138	9.58E-08

b. Particulate emissions:

Mn-54	1.39E-13
Fe-59	1.51E-13
Co-58	3.64E-13
Co-60	3.82E-13
Zn-65	1.66E-13
Mo-99	1.49E-13
Cs-134	2.78E-13
Cs-137	1.61E-13
Ce-141	2.07E-13
Ce-144	1.99E-12

c. Other identifiable gamma emitters:

Ar-41	3.93E-08
Kr-85	7.82E-05
Kr-85m	3.52E-08
Kr-89	2.60E-06
Xe-127	3.56E-08
Xe-131m	2.41E-06
Xe-135m	5.16E-08
Xe-137	1.10E-06
I-131	1.39E-13

d. Composite particulate samples:

Sr-89	1 E-14
Sr-90	1 E-14
Gross Alpha	1.00 E-14

These "a priori" LLDs represent the capabilities of the counting systems in use, not an after the fact "a posteriori" limit for a particular measurement.

2.2 Gaseous Batch Release Statistics

The following is a summation of all gaseous batch releases made during 1997.

Number of batch releases..........................9

Total time for all batch releases (min)........... 5204.0

Maximum time for a batch release (min)............ 845.0

Average time for a batch release (min)............ 578.2

Minimum time for a batch release (min)............ 42.0

2.3 Gaseous Effluent Data

The following table 2.1 presents a quarterly summation of the total activity released and average release rates of four categories of gaseous effluents. Table 2.2 lists the quarterly sums of individual gaseous radionuclides released by continuous and batch modes. Table 2.3 is essentially the same data. but is presented as monthly summations. Table 2.4 presents the dose limits for gaseous effluents, and the calculated doses this year from gaseous effluents.

Table 2.1
Annual Radioactive Effluent Release Report 1997
Gaseous Effluents - Summation of all Releases

Fission and Activation Gases	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Total Activity Released (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Average Release Rate (µCi/sec)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Iodines				
Total Activity Released (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Average Release Rate (µCi/sec)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Particulates				
Total Activity Released (Ci)	9.917E-006	8.833E-006	3.511E-006	5.789E-006
Average Release Rate (µCi/sec)	1.261E-006	1.123E-006	4.466E-007	7.362E-007
Gross Alpha Released (Ci)	1.644E-007	8.572E-008	0.000E+000	3.332E-008
Tritium				
Total Activity Released (Ci)	4.117E-001	2.177E-001	9.869E-001	1.567E+000
Average Release Rate (µCi/sec)	5.236E-002	2.770E-002	1.255E-001	1.993E-001

Tahle 2.2
Annual Radioactive Effluent Release Report 1997
Gaseous Effluents

Nuclides Released (Ci)
Continuous Mode

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Fission Gases				
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Iodines				
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Particulates				
Co-60	8.848E-007	8.833E-006	3.511E-006	5.789E-006
Sr-89	6.218E-006	0.000E+000	0.000E+000	0.000E+000
Sr-90	2.814E-006	0.000E+000	0.000E+000	0.000E+000
Total	9.917E-006	8.833E-006	3.511E-006	5.789E-006

Table 2.2(cont)
Annual Radioactive Effluent Release Report 1997
Gaseous Effluents

Nuclides Released (Ci)
Batch Mode

Fission Gases				
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Iodines				
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Particulates				
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3A
Annual Radioactive Effluent Release Report 1997
1st Quarter Gaseous Release
Total of all Releases

Noble Gases (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	January	February	March	Total
Co-60	8.848E-007	0.000E+000	0.000E+000	8.848E-007
Sr-89	6.218E-006	0.000E+000	0.000E+000	6.218E-006
Sr-90	2.814E-006	0.000E+000	0.000E+000	2.814E-006
Total	9.917E-006	0.000E+000	0.000E+000	9.917E-006

Halogens (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3A (Con't)
Annual Radioactive Effluent Release Report 1997
1st Quarter Gaseous Release
Total of all Releases

Summary	January	February	March	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	9.917E-006	0.000E+000	0.000E+000	9.917E-006
Total Tritium (Ci)	4.117E-001	0.000E+000	0.000E+000	4.117E-001
Total Particulate Gross Alpha (Ci)	9.107E-008	3.821E-008	3.512E-008	1.644E-007

Table 2.3A (Con't)
Annual Radioactive Effluent Release Report 1997
2nd Quarter Gaseous Release
Total of all Releases

Noble Gases (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	April	May	June	Total
Co-60	0.000E+000	3.008E-006	5.824E-006	8.833E-006
Total	0.000E+000	3.008E-006	5.824E-006	8.833E-006

Halogens (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3A (Con't)
Annual Radioactive Effluent Release Report 1997
2nd Quarter Gaseous Release
Total of all Releases

Summary	April	May	June	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	3.008E-006	5.824E-006	8.833E-006
Total Tritium (Ci)	0.000E+000	2.126E-001	5.140E-003	2.177E-001
Total Particulate Gross Alpha (Ci)	2.565E-008	0.000E+000	6.007E-008	8.572E-008

Table 2.3A (con't)
Annual Radioaetive Effluent Release Report 1997
3rd Quarter Gaseous Release
Total of all Releases

Noble Gases (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	July	August	September	Total
Co-60	3.511E-006	0.000E+000	0.000E+000	3.511E-006
Total	3.511E-006	0.000E+000	0.000E+000	3.511E-006

Halogens (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3A (Con't)
Annual Radioactive Effluent Release Report 1997
3rd Quarter Gaseous Release
Total of all Releases

Summary	July	August	September	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	3.511E-006	0.000E+000	0.000E+000	3.511E-006
Total Tritium (Ci)	0.000E+000	3.662E-001	6.206E-001	9.869E-001
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3A (Con't)
Annual Radioactive Effluent Release Report 1997
4th Quarter Gaseous Release
Total of all Releases

Noble Gases (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	October	November	December	Total
Co-60	0.000E+000	5.789E-006	0.000E+000	5.789E-006
Total	0.000E+000	5.789E-006	0.000E+000	5.789E-006

Halogens (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3A (Con't)
Annual Radioactive Effluent Release Report 1997
4th Quarter Gaseous Release
Total of all Releases

Summary	October	November	December	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	5.789E-006	0.000E+000	5.789E-006
Total Tritium (Ci)	3.897E-001	6.884E-001	4.890E-001	1.567E+000
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	3.332E-008	3.332E-008

Table 2.3B
Annual Radioactive Effluent Release Report 1997
1st Quarter Gaseous Release
Continuous Mode Only

Noble Gases (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	January	February	March	Total
Co-60	8.848E-007	0.000E+000	0.000E+000	8.848E-007
Sr-89	6.218E-006	0.000E+000	0.000E+000	6.218E-006
Sr-90	2.814E-006	0.000E+000	0.000E+000	2.814E-006
Total	9.917E-006	0.000E+000	0.000E+000	9.917E-006

Halogens (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3B (Con't)
Annual Radioactive Effluent Release Report 1997
1st Quarter Gaseous Release
Continuous Mode Only

Summary	January	February	March	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	9.917E-006	0.000E+000	0.000E+000	9.917E-006
Total Tritium (Ci)	4.117E-001	0.000E+000	0.000E+000	4.117E-001
Total Particulate Gross Alpha (Ci)	9.107E-008	3.821E-008	3.512E-008	1.644E-007

Table 2.3B (Con't)
Annual Radioactive Effluent Release Report 1997
2nd Quarter Gaseous Release
Continuous Mode Only

Noble Gases (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	April	May	June	Total
Co-60	0.000E+000	3.008E-006	5.824E-006	8.833E-006
Total	0.000E+000	3.008E-006	5.824E-006	8.833E-006

Halogens (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3B (Con't)
Annual Radioactive Effluent Release Report 1997
2nd Quarter Gaseous Release
Continuous Mode Only

Summary	April	May	June	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	3.008E-006	5.824E-006	8.833E-006
Total Tritium (Ci)	0.000E+000	2.126E-001	0.000E+000	2.126E-001
Total Particulate Gross Alpha (Ci)	2.565E-008	0.000E+000	6.007E-008	8.572E-008

Table 2.3B (con't)
Annual Radioactive Effluent Release Report 1997
3rd Quarter Gaseous Release
Continuous Mode Only

Noble Gases (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	July	August	September	Total
Co-60	3.511E-006	0.000E+000	0.000E+000	3.511E-006
Total	3.511E-006	0.000E+000	0.000E+000	3.511E-006

Halogens (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3B (Con't)
Annual Radioactive Effluent Release Report 1997
3rd Quarter Gaseous Release
Continuous Mode Only

Summary	July	August	September	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	3.511E-006	0.000E+000	0.000E+000	3.511E-006
Total Tritium (Ci)	0.000E+000	3.662E-001	6.206E-001	9.869E-001
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3B (Con't)
Annual Radioactive Effluent Release Report 1997
4th Quarter Gaseous Release
Continuous Mode Only

Noble Gases (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	October	November	December	Total
Co-60	0.000E+000	5.789E-006	0.000E+000	5.789E-006
Total	0.000E+000	5.789E-006	0.000E+000	5.789E-006

Halogens (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3B (Con't)
Annual Radioactive Effluent Release Report 1997
4th Quarter Gaseous Release
Continuous Mode Only

Summary	October	November	December	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	5.789E-006	0.000E+000	5.789E-006
Total Tritium (Ci)	3.897E-001	6.884E-001	4.831E-001	1.561E+000
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	3.332E-008	3.332E-008

Table 2.3C
Annual Radioactive Effluent Release Report 1997
1st Quarter Gaseous Release
Batch Mode Only

Noble Gases (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Halogens (Curies)

Isotope	January	February	March	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (Con't)
Annual Radioactive Effluent Release Report 1997
1st Quarter Gaseous Release
Batch Mode Only

Summary	January	February	March	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Tritium (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (Con't)
Annual Radioactive Effluent Release Report 1997
2nd Quarter Gaseous Release
Batch Mode Only

Noble Gases (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Halogens (Curies)

Isotope	April	May	June	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (Con't)
Annual Radioactive Effluent Release Report 1997
2nd Quarter Gaseous Release
Batch Mode Only

Summary	April	May	June	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Tritium (Ci)	0.000E+000	0.000E+000	5.140E-003	5.140E-003
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (con't)
Annual Radioactive Effluent Release Report 1997
3rd Quarter Gaseous Release
Batch Mode Only

Noble Gases (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Halogens (Curies)

Isotope	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (Con't)
Annual Radioactive Effluent Release Report 1997
3rd Quarter Gaseous Release
Batch Mode Only

Summary	July	August	September	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Tritium (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (Con't)
Annual Radioactive Effluent Release Report 1997
4th Quarter Gaseous Release
Batch Mode Only

Noble Gases (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Particulates (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Halogens (Curies)

Isotope	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.3C (Con't)
Annual Radioactive Effluent Release Report 1997
4th Quarter Gaseous Release
Batch Mode Only

Summary	October	November	December	Total
Total Noble Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Halogens (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Total Tritium (Ci)	0.000E+000	0.000E+000	5.894E-003	5.894E-003
Total Particulate Gross Alpha (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 2.4
Annual Radioactive Effluent Release Report 1997
Dose From Gaseous Effluents

The offsite dose limits from radioactive materials in gaseous effluents are specified in Section 3/4.4 of the Kewaunee ODCM and can be summarized as follows:

Limit	Whole Body Gamma	Skin Beta	Organ
Quarterly	5.0 mRad	10.0 mRad	7.5 mRem
Annual	10.0 mRad	20.0 mRad	15.0 mRem

The total release of gaseous effluents during each quarter of 1997 was within limits. The following offsite doses were calculated using equations 2.7, 2.8, and 2.11 from the Kewaunee ODCM. Calculated offsite doses versus quarterly limits are shown below:

	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
1. Gamma-Whole Body				
Specification (mRads)	5.000E+000	5.000E+000	5.000E+000	5.000E+000
Actual Dose (mRads)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
% of Specification	0.000E+000	0.000E+000	0.000E+000	0.000E+000
2. Beta-Skin				
Specification (mRads)	1.000E+001	1.000E+001	1.000E+001	1.000E+001
Actual Dose (mRads)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
% of Specification	0.000E+000	0.000E+000	0.000E+000	0.000E+000
3. Ingestion Pathway-Organ				
Specification (mRems)	7.500E+000	7.500E+000	7.500E+000	7.500E+000
Actual Dose (mRems)	4.082E-005	3.863E-005	3.438E-005	5.541E-005
% of Specification	5.443E-004	5.151E-004	4.584E-004	7.388E-004
	Bone	GI-LLI	GI-LLI	GI-LLI

Table 2.4 (Con't)
Annual Radioactive Effluent Release Report 1997
Dose From Gaseous Effluents

In addition, the cumulative annual offsite doses for the period January 1 - December 31, 1997 versus the ODCM annual limits were:

	Annual
1. Gamma-Whole Body	
Specification (mRads)	1.000E+001
Actual Dose (mRads)	0.000E+000
% of Specification	0.000E+000
2. Beta-Skin	
Specification (mRads)	2.000E+001
Actual Dose (mRads)	0.000E+000
% of Specification	0.000E+000
3. Ingestion Pathway-Organ	
Specification (mRems)	1.500E+001
Actual Dose (mRems)	1.485E-004
% of Specification	9.898E-004
TBody	

3.0 LIQUID EFFLUENTS

3.1 Lower Limits of Detection (LLD) for Liquid Effluents

Liquid radioactive effluents are released as both batch releases and continuous releases. Each batch is sampled prior to release and analyzed for gamma emitters and tritium. A fraction of each sample is retained for a monthly proportional composite which is then analyzed for Gross Alpha, Strontium 89, Strontium 90 and Iron 55.

The LLD's for liquid batch release radioanalyses, as listed in Table 4.3 of the Kewaunee Nuclear Power Plant Off-Site Dose Calculation Manual, are:

Analysis	LLD (µCi/ml)
Principal Gamma Emitters	1.00 E-06
Iodine 131	1.00 E-06
Tritium	1.00 E-05
Gross Alpha	5.00 E-07
Strontium 89, 90	5.00 E-08
Iron 55	1.00 E-06

The actual obtained "a priori" LLD values for batch releases are shown below.

Isotope	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average a priori LLD (µCi/ml)
Mn-54	6.59E-08	6.80E-10	6.80E-10	6.80E-10	1.70E-08
Fe-59	1.46E-09	1.49E-09	1.49E-09	1.49E-10	1.15E-09
Co-58	6.47E-08	9.46E-08	6.69E-08	6.69E-10	5.67E-08
Co-60	9.63E-08	9.77E-10	1.25E-07	9.77E-10	5.58E-08
Zn-65	1.64E-09	1.68E-09	1.68E-09	1.68E-09	1.67E-09
Mo-99	4.66E-09	4.83E-09	4.83E-09	4.83E-09	4.79E-09
Cs-134	1.92E-07	5.36E-10	5.36E-10	5.36E-10	4.84E-08
Cs-137	1.35E-07	9.60E-08	1.06E-07	6.63E-10	8.44E-08
Ce-141	5.47E-07	1.08E-07	3.80E-08	3.80E-10	1.73E-07
Ce-144	3.46E-07	1.71E-09	6.73E-07	4.52E-07	3.68E-07
I-131	3.96E-08	4.57E-08	7.16E-08	4.13E-08	4.96E-08
H-3	3.41E-06	3.61E-06	4.19E-06	4.44E-06	3.91E-06
Sr-89	1.47E-08	1.53E-08	1.26E-08	1.14E-08	1.35E-08
Sr-90	1.07E-08	7.60E-09	7.63E-09	7.13E-09	8.28E-09
Gross Alpha	3.27E-08	1.12E-08	3.97E-08	1.02E-08	2.34E-08
Fe-55	6.03E-07	6.07E-07	7.03E-07	6.83E-07	6.49E-07

Continuous liquid releases are grab sampled weekly and analyzed for principal gamma emitters. A fraction of each weekly sample is retained for a monthly proportional composite which is then analyzed for Tritium, Gross Alpha, Strontium 89, Strontium 90 and Iron 55.

The LLD's for liquid continuous release radioanalyses, as listed in Table 4.3 of the Kewaunee Nuclear Power Plant Off-Site Dose Calculation Manual, are:

Analysis	LLD (μCi/ml)
Principal Gamma Emitters	5.00 E-07
Iodine 131	1.00 E-06
Tritium	1.00 E-05
Gross Alpha	5.00 E-07
Strontium 89, 90	5.00 E-08
Iron 55	1.00 E-06

The actual obtained "a priori" LLD values for continuous releases are shown below.

Isotope	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average a priori LLD (μCi/ml)
Mn-54	2.49E-08	1.13E-08	2.27E-08	3.59E-08	2.37E-08
Fe-59	2.43E-08	2.48E-08	2.48E-10	2.48E-10	1.24E-08
Co-58	1.36E-08	1.11E-08	3.86E-08	3.68E-08	2.50E-08
Co-60	3.21E-08	1.63E-10	3.78E-08	2.82E-08	2.46E-08
Zn-65	2.74E-10	6.25E-08	2.80E-08	2.80E-10	2.28E-08
Mo-99	3.47E-07	8.09E-10	2.63E-07	8.09E-10	1.53E-07
Cs-134	8.57E-11	2.66E-08	3.60E-08	8.94E-11	1.57E-08
Cs-137	1.06E-10	2.71E-08	4.38E-08	2.45E-08	2.39E-08
Ce-141	1.53E-08	3.80E-08	3.89E-08	2.91E-08	3.03E-08
Ce-144	6.02E-08	8.05E-08	2.84E-10	1.44E-07	7.12E-08
I-131	3.39E-08	3.65E-08	1.38E-08	1.89E-08	2.58E-08
H-3	3.41E-06	3.61E-06	4.19E-06	4.44E-06	3.91E-06
Sr-89	9.53E-09	1.52E-08	1.09E-08	9.77E-09	1.14E-08
Sr-90	6.40E-09	7.18E-09	6.83E-09	6.30E-09	6.68E-09
Gross Alpha	7.63E-09	8.45E-09	8.47E-09	7.98E-09	8.13E-09
Fe-55	5.95E-07	6.98E-07	7.08E-07	6.63E-07	6.66E-07

3.2 **Liquid Batch Rclease Statistics**

The following is a summation of all liquid batch releases made during 1997.

Release Type	Number	Gallons Released
A SGBT Monitor Tk.	9	80473.0
B SGBT Monitor Tk.	2	17475.0
A CVC Monitor	6	37870.0
B CVC Monitor	6	38570.0
miscellaneous	1	300.0
Both WCTs	90	165260.0

Total time for all batch releases............ 23193.0 Min.

Maximum time for a batch release............. 1100.0 Min.

Minimum time for a batch release............. 32.0 Min.

Average time for a batch release............. 203.4 Min.

3.3 **Liquid Effluent Data**

The following Table 3.1 presents a quarterly summation of the total activity released and average concentration for all liquid effluents. It also presents the gross alpha activity released, volume of waste released and volume of dilution water used. Tables 3.2 and 3.3 are monthly summations of the same information in Table 3.1. Table 3.2 contains the quantity of the individual isotopes released to the unrestricted area for batch releases. Table 3.3 presents a monthly summation of gross radioactivity, tritium, gross alpha and isotopic activity for the secondary blowdown and leakage releases. It also presents the monthly total volume for these releases and dilution volumes. Table 3.4 presents the doses from liquid effluents for each quarter and the calculated doses this year from liquid effluents.

TABLE 3.1
Annual Radioactive Efflucnt Release Report 1997
Liquid Effluents - Summation of all Releases

	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Fission and Activation Products				
Total Release Excluding H3 and Dissolved Gases (Ci)	8.137E-003	1.873E-002	8.072E-003	1.576E-002
Average Concentration (µCi/ml)	9.450E-010	5.461E-010	4.408E-011	1.208E-010
Tritium				
Total Release (Ci)	2.072E+000	4.837E+000	5.681E+000	4.147E+001
Average Concentration (µCi/ml)	2.406E-007	1.411E-007	3.102E-008	3.177E-007
% of Tech. Spec. Limit(3.0E-3 µCi/ml)	8.021E-003	4.702E-003	1.034E-003	1.059E-002
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Average Concentration (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
% of Tech. Spec. Limit(2.0E-4 µCi/ml)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Volume of Waste Released				
Batch (liters)	3.277E+005	5.009E+005	1.844E+005	2.739E+005
Continuous (liters)	4.039E+006	1.074E+007	3.686E+007	3.109E+007
Total (liters)	4.367E+006	1.124E+007	3.704E+007	3.136E+007
Volume of Dilution Water				
Batch (liters)	1.050E+009	2.508E+009	2.252E+009	4.899E+009
Continuous (liters)	7.560E+009	3.178E+010	1.809E+011	1.256E+011
Total (liters)	8.610E+009	3.429E+010	1.831E+011	1.305E+011

TABLE 3.2A
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

	January	February	March	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	5.386E-003	2.709E-003	2.904E-005	8.124E-003
Avg. Conc. (µCi/ml)	1.504E-008	4.401E-009	3.772E-010	
Tritium				
Total Release (Ci)	2.552E-001	1.661E-001	1.651E+000	2.072E+000
Avg. Conc. (µCi/ml)	7.128E-007	2.699E-007	2.144E-005	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	1.188E+005	1.221E+005	8.676E+004	3.277E+005
Volume of Dilution Water				
(liters)	3.580E+008	6.155E+008	7.700E+007	1.050E+009

TABLE 3.2A (Con't)
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

Isotope (Ci)	January	February	March	Total
H-3	2.552E-001	1.661E-001	1.651E+000	2.072E+000
Mn-54	1.558E-006	2.028E-006	1.124E-006	4.710E-006
Fe-55	6.180E-004	5.128E-004	0.000E+000	1.131E-003
Co-58	2.752E-003	1.115E-003	1.083E-005	3.877E-003
Co-60	1.017E-003	4.183E-004	1.709E-005	1.452E-003
Ag-110m	1.473E-004	0.000E+000	0.000E+000	1.473E-004
Sb-124	1.494E-004	0.000E+000	0.000E+000	1.494E-004
Sb-125	5.949E-004	1.040E-004	0.000E+000	6.990E-004
Cs-137	1.057E-004	5.573E-004	0.000E+000	6.630E-004
Total	2.606E-001	1.688E-001	1.651E+000	2.080E+000

TABLE 3.2B
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

	April	May	June	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	1.692E-003	3.570E-005	1.509E-002	1.682E-002
Avg. Conc. (µCi/ml)	7.262E-009	3.464E-010	6.949E-009	
Tritium				
Total Release (Ci)	1.201E-001	3.887E-004	4.716E+000	4.837E+000
Avg. Conc. (µCi/ml)	5.156E-007	3.771E-009	2.172E-006	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	1.254E+005	1.256E+005	2.499E+005	5.009E+005
Volume of Dilution Water				
(liters)	2.330E+008	1.031E+008	2.172E+009	2.508E+009

TABLE 3.2B (Con't)
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

Isotope (Ci)	April	May	June	Total
H-3	1.201E-001	3.887E-004	4.716E+000	4.837E+000
Mn-54	0.000E+000	0.000E+000	8.553E-005	8.553E-005
Fe-55	3.136E-004	0.000E+000	6.497E-003	6.811E-003
Co-58	9.674E-004	1.458E-005	3.796E-004	1.362E-003
Co-60	2.065E-004	2.112E-005	5.575E-004	7.851E-004
Ag-110m	2.044E-004	0.000E+000	7.569E-003	7.774E-003
I-131	0.000E+000	0.000E+000	9.153E-007	9.153E-007
Total	1.218E-001	4.244E-004	4.732E+000	4.854E+000

TABLE 3.2C
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

	July	August	September	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	4.535E-003	1.120E-003	2.417E-003	8.072E-003
Avg. Conc. (µCi/ml)	5.516E-009	1.779E-009	3.023E-009	
Tritium				
Total Release (Ci)	2.183E+000	8.550E-001	2.643E+000	5.681E+000
Avg. Conc. (µCi/ml)	2.655E-006	1.357E-006	3.306E-006	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	7.880E+004	5.675E+004	4.884E+004	1.844E+005
Volume of Dilution Water				
(liters)	8.222E+008	6.299E+008	7.995E+008	2.252E+009

TABLE 3.2C (Con't)
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

Isotope (Ci)	July	August	September	Total
H-3	2.183E+000	8.550E-001	2.643E+000	5.681E+000
Mn-54	8.728E-006	0.000E+000	0.000E+000	8.728E-006
Fe-55	1.024E-003	3.632E-004	1.416E-003	2.804E-003
Co-57	2.152E-006	0.000E+000	0.000E+000	2.152E-006
Co-58	8.179E-004	6.773E-005	2.864E-004	1.172E-003
Co-60	5.118E-004	8.213E-005	3.228E-004	9.167E-004
Nb-95	1.659E-005	0.000E+000	0.000E+000	1.659E-005
Zr-95	9.527E-006	0.000E+000	0.000E+000	9.527E-006
Ag-110m	2.144E-003	6.073E-004	3.915E-004	3.143E-003
Total	2.188E+000	8.561E-001	2.645E+000	5.689E+000

TABLE 3.2D
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

	October	November	December	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	7.839E-003	6.247E-003	1.678E-003	1.576E-002
Avg. Conc. (µCi/ml)	3.277E-009	9.399E-009	9.112E-010	
Tritium				
Total Release (Ci)	1.615E+001	3.773E+000	2.155E+001	4.147E+001
Avg. Conc. (µCi/ml)	6.750E-006	5.676E-006	1.170E-005	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	1.305E+005	4.798E+004	9.540E+004	2.739E+005
Volume of Dilution Water				
(liters)	2.392E+009	6.647E+008	1.842E+009	4.899E+009

TABLE 3.2D (Con't)
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Batch Releases

Isotope (Ci)	October	November	December	Total
H-3	1.615E+001	3.773E+000	2.155E+001	4.147E+001
Fe-55	5.612E-004	4.318E-004	2.480E-004	1.241E-003
Co-58	5.058E-005	1.310E-004	0.000E+000	1.816E-004
Co-60	2.698E-004	3.140E-004	9.657E-005	6.804E-004
Sr-90	1.436E-006	0.000E+000	0.000E+000	1.436E-006
Ag-110m	6.956E-003	5.371E-003	1.331E-003	1.366E-002
Cs-137	0.000E+000	0.000E+000	3.333E-006	3.333E-006
Total	1.616E+001	3.779E+000	2.155E+001	4.149E+001

TABLE 3.3A
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Continuous Releases

	January	February	March	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	0.000E+000	1.321E-005	0.000E+000	1.321E-005
Avg. Conc. (μCi/ml)	0.000E+000	3.154E-012	0.000E+000	
Tritium				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (μCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (μCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (μCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	2.116E+006	1.297E+006	6.267E+005	4.039E+006
Volume of Dilution Water				
(liters)	1.369E+009	4.190E+009	2.001E+009	7.560E+009

TABLE 3.3A (Con't)

Annual Radioactive Effluent Release Rcport 1997

Liquid Effluents - Continuous Releases

Isotope (Ci)	January	February	March	Total
Co-58	0.000E+000	7.793E-006	0.000E+000	7.793E-006
Co-60	0.000E+000	5.421E-006	0.000E+000	5.421E-006
Total	0.000E+000	1.321E-005	0.000E+000	1.321E-005

TABLE 3.3B
Annual Radioactive Efflucnt Release Report 1997
Liquid Effluents - Continuous Releases

	April	May	June	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	1.958E-005	0.000E+000	1.888E-003	1.908E-003
Avg. Conc. (µCi/ml)	1.896E-011	0.000E+000	6.333E-011	
Tritium				
Total Release (Ci)	0.000E+000	0.000E+000	1.769E-004	1.769E-004
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	5.935E-012	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	5.949E+005	6.167E+005	9.529E+006	1.074E+007
Volume of Dilution Water				
(liters)	1.033E+009	9.366E+008	2.981E+010	3.178E+010

TABLE 3.3B (Con't)
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Continuous Releases

Isotope (Ci)	April	May	June	Total
H-3	0.000E+000	0.000E+000	1.769E-004	1.769E-004
Mn-54	0.000E+000	0.000E+000	4.444E-005	4.444E-005
Co-58	0.000E+000	0.000E+000	4.491E-004	4.491E-004
Co-60	1.958E-005	0.000E+000	1.395E-003	1.414E-003
Total	1.958E-005	0.000E+000	2.065E-003	2.085E-003

TABLE 3.3C
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Continuous Releases

	July	August	September	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Tritium				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	1.301E+007	1.143E+007	1.241E+007	3.686E+007
Volume of Dilution Water				
(liters)	4.788E+010	6.759E+010	6.541E+010	1.809E+011

TABLE 3.3C (Con't)
Annual Radioactive Effluent Releasc Report 1997
Liquid Effluents - Continuous Releases

Isotope (Ci)	July	August	September	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

TABLE 3.3D
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Continuous Releases

	October	November	December	Total
Gross Radioactivity				
Total Release Excluding H3 and Dissolved Gases (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Tritium				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Dissolved Gases				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Gross Alpha Activity				
Total Release (Ci)	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Avg. Conc. (µCi/ml)	0.000E+000	0.000E+000	0.000E+000	
Volume of Waste Released				
(liters)	9.003E+006	9.261E+006	1.283E+007	3.109E+007
Volume of Dilution Water				
(liters)	5.914E+010	3.271E+010	3.380E+010	1.256E+011

TABLE 3.3D (Con't)
Annual Radioactive Effluent Release Report 1997
Liquid Effluents - Continuous Releases

Isotope (Ci)	October	November	December	Total
Total	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Table 3.4
Annual Radioactivc Effluent Report 1997
Dose From Liquid Effluents

The dose to a member of the public from total liquid radioactive releases for each quarter was below the ODCM limits of 1.5 mrems to the total body and less than or equal to 5 mrems to any organ. Additionally, the dose to a member of the public from total liquid radioactive releases for the year was below the ODCM limits of 3 mrems to the total body and less than or equal to 10 mrems to any organ.

Instantaneous release concentrations are limited by the individual radionuclide concentrations established in 10 CFR 20, Appendix B, for unrestricted areas. During the report period, none of the isotopes released exceed the concentrations specified in Appendix B. The following offsite doses were calculated using equation 1.5 from the Kewaunee ODCM.

Organ 1st Qtr Dose	Dose Total mRem	Quarterly Limit mRem	Percent of Limit
Total Body	6.092E-003	1.5	0.41
Bone	5.920E-003	5.0	0.12
Liver	8.868E-003	5.0	0.18
Thyroid	9.561E-004	5.0	0.02
Kidney	3.544E-003	5.0	0.07
Lung	1.949E-003	5.0	0.04
GI-LLI	2.042E-003	5.0	0.04

Organ 2nd Qtr Dose	Dose Total mRem	Quarterly Limit mRem	Percent of Limit
Total Body	1.192E-004	1.5	0.01
Bone	3.364E-004	5.0	0.01
Liver	2.889E-004	5.0	0.01
Thyroid	3.668E-005	5.0	0.00
Kidney	3.801E-005	5.0	0.00
Lung	1.650E-004	5.0	0.00
GI-LLI	5.063E-004	5.0	0.01

Table 3.4 (Con't)
Annual Radioactive Effluent Report 1997
Dose From Liquid Effluents

Organ 3rd Qtr Dose	Dose Total mRem	Quarterly Limit mRem	Percent of Limit
Total Body	3.952E-005	1.5	0.00
Bone	2.500E-005	5.0	0.00
Liver	4.606E-005	5.0	0.00
Thyroid	2.191E-005	5.0	0.00
Kidney	2.236E-005	5.0	0.00
Lung	3.147E-005	5.0	0.00
GI-LLI	7.247E-004	5.0	0.01

Organ 4th Qtr Dose	Dose Total mRem	Quarterly Limit mRem	Percent of Limit
Total Body	2.798E-004	1.5	0.02
Bone	5.095E-005	5.0	0.00
Liver	2.942E-004	5.0	0.01
Thyroid	2.426E-004	5.0	0.00
Kidney	2.560E-004	5.0	0.01
Lung	2.523E-004	5.0	0.01
GI-LLI	4.015E-004	5.0	0.01

Calculated Dose This Year

Organ	Dose Total mRem	Quarterly Limit mRem	Percent of Limit
Total Body	6.531E-003	3.0	0.22
Bone	6.333E-003	10.0	0.06
Liver	9.497E-003	10.0	0.09
Thyroid	1.257E-003	10.0	0.01
Kidney	3.861E-003	10.0	0.04
Lung	2.398E-003	10.0	0.02
GI-LLI	3.675E-003	10.0	0.04

4.0 UNPLANNED RELEASES

No unplanned releases were made from the Kewaunee Plant during 1997.

The January-June 1991 Semi-Annual Effluent Release Report described an unplanned release which occurred on April 25, 1991. As reported in the 1996 Annual Effluent Release Report, WPSC will continue to provide status updates in the Annual Effluent Release Reports until the incident is resolved and corrective actions are completed.

The need to replace WG-301 and WG-302 is currently being reanalyzed due to the exorbitant cost of replacement valves and the fact that the leakage problem has already been corrected by installing WG-309. Any additional requirements for remote isolation of WG-309 per NUREG-0578 and NUREG-0737 have been researched and no prior NRC commitments were identified. Following a 10 CFR 50.59 review to address the addition of valve WG-309 into the Waste Gas System, it is anticipated that Design Change No. 2349 for WG-301 and WG-302 replacement will be cancelled. Barring any complications, these actions should resolve and wrap up this longstanding issue by mid 1998.

5.0 METEOROLOGICAL DATA

Meteorological data for 1997 is retained on file at the Kewaunee Nuclear Power Plant. The data on file includes a continuous strip chart recording and a 15-minute interval listing of wind speed, wind direction and atmospheric stability. This is more conservative than the requirements of ODCM Section 3/4.6. See Appendix A for missing meteorological data and the joint frequency distribution tables.

6.0 SOLID WASTE DISPOSAL

Table 6.1 is a summation of solid wastes shipped during 1997. Presented are the types of wastes, major nuclide composition, disposition of the wastes and shipping containers used.

The containers utilized at Kewaunee Nuclear Power Plant have the following volumes:

High Integrity Container (HIC)	158 ft^3
LSA Box (B-25)	98 ft^3
Compactor Boxes	50 ft^3
DOT-17H Drum	7.5 ft^3

A composite sample from the 1993 dewatered resin shipments was analyzed by a contractor for transuranic nuclides. The results showed an average transuranic concentration of 4.24 E-2 nanocuries/gram, well within the disposal site limit of 10 nanocuries/gram.

Table 6.1 contains the radionuclide content (curies) and percent abundance for each type of waste.

Table 6.1
Annual Radioactive Effluent Report 1997
Solid Waste and Irradiated Fuel Shipments

Isotopes denoted by an asterisk (*) in Table 6.1 are correlated values.

A. Solid Waste Shipped Off-Site for Burial or Disposal
(Not Irradiated Fuel - m^3 is actual waste volume not burial volume)

1. Type of Waste		Unit	Quantity
a.	Dewatered resin	m^3	None
	Container: HIC	Ci	None
b.	Dewatered filter media	m^3	None
	Container: HIC	Ci	None
c.	DAW (Compactible)	m^3	7.08E+00
	Container: Compactor Box	Ci	7.94E-01
d.	DAW (Non-Compactible)	m^3	None
	Container: Compactor Box	Ci	None

Average Transuranics shipped (all shipments): 0.00E+00 nCi/g

2. Estimate of Major Nuclide by Composition (By Type of Waste)		%	Ci
a.	Dewatered resin	None	None
b.	Dewatered filter media	None	None
c.	DAW (Compactible)	100%	7.94E-01
	Co-60	1.85E+01	1.47E-01
	***Fe-55**	***5.98E+01***	***4.75E-01***
	Ni-63	2.11E+01	1.68E-01
	Tc-99	5.10E-01	4.02E-03
d.	DAW (Non-Compactible)	None	None

3. Solid Waste Disposition

a.	Date of Shipment	Mode of Transportation	Destination
	12/22/97	CNSI Van	Barnwell, SC

B. Irradiated Fuel Shipments

No irradiated fuel shipments were made from the Kewaunee Nuclear Power Plant during the year of 1997.

7.0 PROGRAM REVISIONS

In accordance with Technical Specifications 6.18.b.3 and 6.19.a, the revisions to the Process Control Program, Offsite Dose Calculation Manual and radioactive waste treatment systems are listed below.

7.1 Offsite Dose Calculation Manual

The Offsite Dose Calculation Manual (ODCM) was revised during this report period. A complete copy of Revision 8 of the ODCM is included as a part of this report.

7.2 Major Cbanges to the Radioactive Liquid, Gaseous and Solid Waste Treatment Systems

Major changes to the radioactive liquid, gaseous or solid waste systems are submitted in the annual Updated Final Safety Analysis Report consistent with Technical Specification 6.19.

8.0 REPORTABLE OCCURRENCES

There were two reportable occurrences in 1997. The first was the planned and monitored release of low level radioactive caustic soda from a release path not described in the ODCM. The second involved long-term operability of process radiation monitors R-16 (Containment Fan Coil Water Monitor) and R-20 (Service Water Monitor).

The first reportable occurrence is the disposal of caustic soda from the Internal Containment Spray (ICS) system caustic additive standpipe. Plant staff decided to replace the caustic additive standpipe caustic soda because of the age of the caustic soda. The caustic soda had been in the standpipe for 23 years and had some discoloration. The caustic soda concentration was within specification. The evaluation, performed under the Kewaunee Assessment Process (KAP) as KAP-0493, supported caustic soda replacement but raised a question regarding the potential for low level radioactivity in the displaced caustic soda. The standpipe was sampled and found to contain detectable low level radioactivity. Caustic soda (Sodium Hydroxide) is routinely disposed of via the plant Waste Neutralizing Tank (WNT) using a simple acid-base neutralization. The WNT is a previously unevaluated release path. In order to use the WNT release path, it was evaluated as if it were to be a change to the ODCM but since this was a one-time evolution, no formal change was made to the ODCM. Should this release path need to be used again, inclusion in the ODCM will be considered. General Nuclear Procedure (GNP)1.19.30 "Disposal of Slightly Radioactive 30% NaOH Using the Waste Neutralizing Tank", was developed for this release. GNP 1.19.30 considered the ODCM and environmental pollution criterion. On February 12th and 13th 1997, 300 gallons of slightly contaminated caustic soda containing 0.000415 curies of Cesium-137 was released. The radiological impact of 0.00476 mrem to the liver was documented under SP 32A-136, "Radiological Liquid Discharges (Batch Mode)."

The second issue, R-16 and R-20, involves section 3.1.b of the ODCM. R-16 and R-20 were declared administratively Out-of-Service on April 2, 1997, because of a concern regarding reverse flow through the monitors. The sample delivery system and not the actual monitor operation was in question. An assessment of the issue was performed under Kewaunee Assessment Process (KAP) number KAP-0721. Later, a concern over backflow from R-16 into R-20 complicated the issue, so KAP-1061 was issued to evaluate this issue. The issues, and KAPs, are related. Efforts to understand and resolve the complicated reverse and backflow issues delayed returning the monitors to service in a timely manner (more than 30 days). The ODCM states;

> *"With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.1. Exert best efforts to return the instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the operability was not corrected in a timely manner."*

The delay in resolution is due to the complexity of the issues, the extreme operational conditions under which the monitors must be available, and the time required for the design of corrective options to address the issues under the assumed operational constrains. Plant design modification (DC-2873) is underway to correct these issues. Upon completion of DC-2873, the radiation monitors will be returned to service. This is expected to occur by mid-1998.

Appendix A

Kewaunee Nuclear Power Plant

1997 Meteorological Data

Missing Meteorological Data

First Quarter:	83 Hours
Second Quarter:	424.5 Hours
Third Quarter:	259 Hours
Fourth Quarter:	6.5 Hours

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

First Quater 1997 Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	3.5	0.5	7.75	15.75	23	2.5	0	53
NNE	0	0	7.25	18.25	14.25	1	0	40.75
NE	1.75	0.5	5.75	13.5	12.25	2	0	35.75
ENE	0	0.5	6.25	12.5	11.25	2.75	0	33.25
E	0	1.25	7.5	5.75	6	12.5	3	36
ESE	0	0.5	10.75	13.25	4.5	2.25	0	31.25
SE	0	0.25	4	9.75	8.5	2.75	0	25.25
SSE	0	0	5.75	10	20.5	22	4.25	62.5
S	0	0.75	4.75	9.75	7.25	7.75	3	33.25
SSW	0	0	5.25	11.5	5	0	0	21.75
SW	0	0.75	3.25	9.75	6.25	5	0.25	25.25
WSW	0	0.25	5	15.75	7.25	0	0	28.25
W	0	0	7	29	28.25	21.5	0.25	86
WNW	0.25	0.25	6.5	19.5	34.25	17.75	0	78.5
NW	5	0.5	11.25	15.25	6.5	1.5	0	40
NNW	6	1.25	8.5	22	9.25	0.25	0	47.25
TOTAL	16.5	7.25	106.5	231.25	204.25	101.5	10.75	678

First Quater 1997 Stabitity Class B

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0.25	4.25	1.75	0.75	0.25	0	7.25
NNE	0	0.25	4.5	2	3.5	1.25	1	12.5
NE	0.25	0.75	1	1	4.5	1	0	8.5
ENE	0	0	0.5	1.5	3.25	1.25	0	6.5
E	0	0	0	1.25	0	0	0	1.25
ESE	0	0	0.25	2.25	0.25	0	0	2.75
SE	0	0.5	0	1.5	0.5	0	0	2.5
SSE	0	0.25	1.75	4.75	4.25	3.25	1.5	15.75
S	0	0.25	4	4.5	1	1.25	0	11
SSW	0	0	3.25	2.75	2.25	0	0	8.25
SW	0	0	1	4	1.25	0.25	0.75	7.25
WSW	0	0	0.75	2.75	1	0	0	4.5
W	0	0	4.5	2.75	5	2	0	14.25
WNW	0	0	0.5	7.75	5	0.5	0	13.75
NW	0.5	0	1	3	1.75	0.75	0	7
NNW	2.75	0	2.25	3.75	3.25	0	0	12
Total	3.5	2.25	29.5	47.25	37.5	11.75	3.25	135

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

First Quater 1997 Stabitity Class C

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	1.75	4.25	9.75	7.75	1	0	24.5
NNE	0	0.25	2	6	2.75	0	0	11
NE	0	0	1.25	1.5	2.75	0	0	5.5
ENE	0	0	0.5	3.75	1.75	0	0	6
E	0	0.75	0.25	1.25	0	0	0	2.25
ESE	0.5	0	0.5	1	0.5	0	0	2.5
SE	0	0	0.25	0.75	3.25	0	0	4.25
SSE	0	0.25	1.75	2.25	4	2.25	0.25	10.75
S	0	0.25	1.75	4.25	5.5	2.5	0	14.25
SSW	0	0	3.5	7.5	2.25	0	0	13.25
SW	0	0	1.5	2.75	0	0	0	4.25
WSW	0	0	0.25	3.75	1	0	0	5
W	0	0.25	1.25	8.25	11	0.25	0	21
WNW	0	0.25	1.75	6.25	11	1	0	20.25
NW	3.25	0.25	1.5	0.5	1	2	0	8.5
NNW	3.75	1	1	5.75	6.75	0.5	0	18.75
Total	7.5	5	23.25	65.25	61.25	9.5	0.25	172

First Quater 1997 Stabitity Class D

Wind Direction	CALM	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0.25	2.75	8.75	8.5	4.75	5.5	1.25	31.75
NNE	0	0.5	8.25	4.25	5.5	3.25	0	21.75
NE	0	0.75	6.25	4.5	2.25	0.75	0	14.5
ENE	0	1.25	4.75	2.5	1.75	1.5	0.5	12.25
E	0	0	2	0.75	0	0.75	0	3.5
ESE	0.25	0	0.75	0.25	0	0	0	1.25
SE	0	0	1.75	1.25	2.75	0	0	5.75
SSE	0	0	0.75	4.25	5	1	0	11
S	0	1	5.75	9.75	8.75	1.75	0	27
SSW	0	1.5	22	13.25	7.5	0	0	44.25
SW	0	1.5	11	11.75	1	0.75	0.25	26.25
WSW	0	0.25	5	9.5	2.25	0	0	17
W	0	1.5	5.75	25.75	27	7.75	0	67.75
WNW	1.25	0.75	11.5	26	69	14.75	0.25	123.5
NW	4.25	0.5	7.75	16	8	3	0	39.5
NNW	1.5	1	6.5	27.25	10.75	1.75	0	48.75
Total	7.5	13.25	108.5	165.5	156.25	42.5	2.25	495.75

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

First Quater 1997 Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	1	2	6.25	4.75	1	1.5	0	16.5
NNE	0	0	2.75	2.25	3.25	0	0	8.25
NE	0	0.25	1.5	0	2.25	0	0	4
ENE	0	0.5	1.25	0	5	2.5	0	9.25
E	0	0.25	1	0	0.75	1	0	3
ESE	0	0.5	2.25	0	0	0	0	2.75
SE	0	0	1.5	1.5	0	0	0	3
SSE	0	1	1	0	0	0.5	0.25	2.75
S	0	1.25	3.25	3.5	0	1.25	0	9.25
SSW	0	1.5	10.75	17.5	0	0	0	29.75
SW	0	0.75	9.75	6.25	5.5	3.5	0	25.75
WSW	0	1	7	12.25	8.75	5.5	0.25	34.75
W	0	0.25	5.5	11.5	21.25	6.25	0	44.75
WNW	2.25	0.5	4	26.25	18.5	1	0	52.5
NW	1.75	1	5.5	8.25	1.75	1.25	0.25	19.75
NNW	2.25	1	5.5	6.5	0	0	0	15.25
Total	7.25	11.75	68.75	100.5	68	24.25	0.75	281.25

First Quater 1997 Stability Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0.5	0.5	0.5	2.75	0	0	0	4.25
NNE	0	1.25	0.5	0.75	0	0	0	2.5
NE	0.25	0	2.75	0.25	0	0	0	3.25
ENE	0	0.5	0.75	1.25	1.25	0	0	3.75
E	0	0	0.5	2.25	0	0	0	2.75
ESE	0	0	0	1.5	0	0	0	1.5
SE	0	0.25	0	0	0.25	0	0	0.5
SSE	0	0.75	0.5	1.25	0	0	0	2.5
S	0	0.5	2.5	2	0	0	0	5
SSW	0	1.5	8.25	2.5	0.75	0	0	13
SW	0	1.5	11.5	9	1.25	1.5	0	24.75
WSW	0.25	1.25	8.5	6.5	0.75	0	0	17.25
W	0	0.25	3.25	11.25	2.5	0	0	17.25
WNW	1.5	1.5	4.75	14.25	4	0	0	26
NW	3.25	0	8.75	8.25	0.25	0	0	20.5
NNW	0.25	0	3	5	0	0	0	8.25
Total	6	9.75	56	68.75	11	1.5	0	153

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

First Quater 1997 Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	1	2.5	0	0	0	3.5
NNE	0	0	0	0.25	0	0	0	0.25
NE	0	0.5	1.5	0	0	0	0	2
ENE	0	0.25	1.5	0	0	0	0	1.75
E	0	1	2.75	0	0	0	0	3.75
ESE	0	0.25	1.5	0	0	0	0	1.75
SE	0	1	1	0	0	0	0	2
SSE	0	0	1.75	1.25	0	0	0	3
S	0	0.5	4.75	1.75	0	0	0	7
SSW	0	1	3.25	1.5	0	0	0	5.75
SW	0	0.5	9.5	6	0	0	0	16
WSW	0	1	11.5	18	4	0	0	34.5
W	0	1.5	5	21.5	3.75	0	0	31.75
WNW	0	0.75	15.25	12	2.25	0	0	30.25
NW	0	0	9.5	0.75	0	0	0	10.25
NNW	0.25	0	3	5.25	0	0	0	8.5
Total	0.25	8.25	72.75	70.75	10	0	0	162

Second Quarter 1997 Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	2.5	9.5	6.25	0.25	0	18.5
NNE	0	0.25	4.5	33.5	13	5.5	1.75	58.5
NE	0	0	13.75	27.25	4.5	3.25	0	48.75
ENE	0	0.5	7	8	2.5	0	0	18
E	0	0.25	6.5	2.5	0.5	0	0	9.75
ESE	0	1.75	10.25	1.5	0	0	0	13.5
SE	0	1.25	6.75	2.5	0.75	0	0	11.25
SSE	0	0.5	12.25	10	2.5	0	0	25.25
S	0	0	3.25	10.25	3.5	0	0	17
SSW	0	0.5	1	5.25	1.25	0.25	0	8.25
SW	0	0	1.25	3.5	2.75	1.75	5.5	14.75
WSW	0	0.25	1.75	5	5.75	3	3.75	19.5
W	0	0.25	1.75	4.5	2.75	3.25	7.5	20
WNW	0	0	3.75	8.75	4.75	3.5	1.75	22.5
NW	0.25	0	3	12	22	0.75	0.5	38.5
NNW	0	0.25	2	15.25	5.5	8.25	0.5	31.75
Total	0.25	5.75	81.25	159.25	78.25	29.75	21.25	375.75

Second Quarter 1997 Stabitity Class B

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	1.5	2	0.5	0	0	4
NNE	0	0	1.75	11	4.75	0.75	4	22.25
NE	0	0	2	1.5	0.5	0	0	4
ENE	0	0	1	0.75	0.25	0	0	2
E	0	0	1	0	0.25	0	0	1.25
ESE	0	0.25	0.5	0	0	0	0	0.75
SE	0	0.25	0.25	0.5	0	0	0	1
SSE	0	0.25	3.25	1	0	0	0	4.5
S	0	0	1	1.5	1	0	0	3.5
SSW	0	0.25	1.5	0.5	0	0	0	2.25
SW	0	0.25	0.25	0	0	0	0	0.5
WSW	0	0	0	0	0.25	0	1	1.25
W	0	0	0	0	0.25	0.5	1.75	2.5
WNW	0	0	0	0.5	1.25	0	0.5	2.25
NW	0	0	0	1.5	0.25	0	0	1.75
NNW	0	0	0	2.5	3.5	1	0	7
Total	0	1.25	14	23.25	12.75	2.25	7.25	60.75

Second Quarter 1997 Stabitity Class C

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	1.25	1.5	1	0	0.25	4
NNE	0	0	1.5	3.75	0	0.25	4.5	10
NE	0	0.25	2	6	0.25	0	0	8.5
ENE	0	0	1.25	1.5	0	0	0	2.75
E	0	0	0.75	0	0	0	0	0.75
ESE	0	0	0.5	0	0	0	0	0.5
SE	0	0	1.75	1	0.25	0	0	3
SSE	0	0	4	0.75	0	0	0	4.75
S	0	0.25	2.25	1.5	0	0	0	4
SSW	0	0.25	1.5	1.25	0.75	0	0	3.75
SW	0	1	0.25	1	0.5	0.25	0	3
WSW	0	0.75	0.25	1	2.25	0.5	0	4.75
W	0	0	0	2.5	1	0.25	1	4.75
WNW	0	0	0.25	1.25	2.75	1	0	5.25
NW	0	0	0	1	3.25	0.5	0	4.75
NNW	0	0.75	0	2.25	4.5	0.25	0	7.75
Total	0	3.25	17.5	26.25	16.5	3	5.75	72.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Second Quarter 1997 Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0.25	0.5	5.75	7	0.75	0.5	3.25	18
NNE	0	0.5	7.25	27	14.25	1.5	1	51.5
NE	0	1	10.25	15.75	2.5	0	0.25	29.75
ENE	0	1	5.75	8.25	1.5	0	0	16.5
E	0	1.75	6.5	3.5	0.5	0	0	12.25
ESE	0	1.75	5.25	2.25	0	0	0	9.25
SE	0	2	5	0.5	0	0	0	7.5
SSE	0.25	2.75	6.25	2.25	1.5	1	0.5	14.5
S	0	1	5.5	6	4.5	1	0	18
SSW	0	0.25	6.25	9.25	8	0.25	0	24
SW	0	0.5	2	4	2.75	1	0	10.25
WSW	0.25	0	2.5	2.75	1.5	1.5	0.25	8.75
W	0	0.25	1	2.75	3.25	3.25	4	14.5
WNW	0	0.25	1.25	2.5	9.5	2	1.5	17
NW	0	0.25	0.75	3	4.75	0.5	0	9.25
NNW	0	0	4.25	10.5	3.25	5.5	2.25	25.75
Total	0.75	13.75	75.5	107.25	58.5	18	13	286.75

Second Quarter 1997 Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	6	1.5	5.5	2.75	0.5	0	0	16.25
NNE	0	1	10.75	22.5	9	5.75	0	49
NE	0	2.25	10.75	8.75	0.75	0	0	22.5
ENE	0	2.5	5	3	0.25	0	0	10.75
E	0	2.75	6.5	1.75	0	0	0	11
ESE	0.5	2.25	3.75	1	0	0	0	7.5
SE	0	2.5	3	1	0	0	0	6.5
SSE	0	4	5.25	4.25	1.75	1.25	0.25	16.75
S	0	3.75	17.75	9.25	4	0.25	0	35
SSW	0	2	22.5	13.25	4	0	0	41.75
SW	0	2.25	4	3	2.5	0.25	0.25	12.25
WSW	0	2.25	1.5	1.25	1	0	0	6
W	0	1.25	2.75	2	0.75	1.5	0	8.25
WNW	0	0	1	4.5	2	0	0	7.5
NW	0	1.25	2.75	5	0.5	0	0	9.5
NNW	0	0.75	3	7.5	0.5	0	0	11.75
Total	6.5	32.25	105.75	90.75	27.5	9	0.5	272.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Second Quarter 1997 Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	1	7.5	2.25	0	0	0.25	11
NNE	0	0.25	6.75	13.5	6.75	0.25	0	27.5
NE	0	2	8.5	4.5	0.25	0	0	15.25
ENE	0	0	4.75	1	0.25	0	0	6
E	0	1.25	3.5	1.5	0	0	0	6.25
ESE	0	0.75	3.25	0.5	0	0	0	4.5
SE	0	1.75	5.25	0.5	0	0	0	7.5
SSE	0	3.25	6.5	7.5	5.5	0.25	0	23
S	0	1.5	18.5	9	5	0.75	0	34.75
SSW	0	2.5	18.75	6	0.5	0.25	0	28
SW	0	2.5	4.25	1.5	0.25	0.25	0	8.75
WSW	0	1.25	2.25	2	0.25	0	0	5.75
W	0	1.5	1.25	3.5	0.5	0	0	6.75
WNW	0	0.5	2	5.25	0	0	0	7.75
NW	0	0.75	2	3.25	0	0	0	6
NNW	0	2.25	5.75	5.5	0	0	0	13.5
Total	0	23	100.75	67.25	19.25	1.75	0.25	212.25

Second Quarter 1997 Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0.75	5	12	0.75	0	0	0	18.5
NNE	0	2.5	11	8	4.75	0	0	26.25
NE	0	3	15.5	8.5	0.5	0	0	27.5
ENE	0	1.75	9	1	1.75	0	0	13.5
E	0	4.75	6	6.5	2	0	0	19.25
ESE	0	3.75	7.5	2.25	0	0	0	13.5
SE	0	2.75	11	1	0	0	0	14.75
SSE	0	4	28.25	22.75	8.75	0.5	0	64.25
S	0	4.25	38.25	30.5	7.5	0.25	0.25	81
SSW	0	7.75	36.75	1.75	0	0	0	46.25
SW	0	5.5	31	4.5	0.25	0	0	41.25
WSW	0	2.5	15.5	9.5	0.25	0	0	27.75
W	0	2.25	9.75	8.5	0	0.5	0	21
WNW	0	3.75	8.75	9.25	0	0.5	0	22.25
NW	0	3	8.25	7	0	0	0	18.25
NNW	0.25	7.5	15.5	1	0	0	0	24.25
Total	1	64	264	122.75	25.75	1.75	0.25	479.5

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Third Quarter 1997 Stability Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0.75	0	5	15.75	7.75	0.25	0	29.5
NNE	0	0.5	7	30	5.75	0	0	43.25
NE	0	0.75	16.75	20.5	0.5	0	0	38.5
ENE	0	0.5	12.25	4.5	2	0	0	19.25
E	0	0.75	14.5	7	0.5	0	0	22.75
ESE	0	0.5	17.5	5.25	1	0	0	24.25
SE	0	0.25	8.5	3.75	3	0	0	15.5
SSE	0	0	4.25	6	1.25	0	0	11.5
S	0	0.25	4.5	0.5	1	0	0.25	6.5
SSW	0	0.25	1.5	2.25	2.25	0	0	6.25
SW	0	0	1	7.5	5.75	0.25	0	14.5
WSW	0	0	7.25	14.5	10.5	2.25	1.5	36
W	0	0.5	5.75	25.25	4.25	1	0.5	37.25
WNW	0	0.25	4.25	12.25	4.75	0	0	21.5
NW	0	1.25	4.5	9.75	4.5	0	0	20
NNW	0	0.5	5.5	22.75	9.75	0	0	38.5
Total	0.75	6.25	120	187.5	64.5	3.75	2.25	385

Third Quarter 1997 Stability Class B

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	1.25	0.25	0.5	5	1.5	1.25	0	9.75
NNE	0	0.5	2.75	10.75	4	0	0	18
NE	0	0.5	4.5	0.25	0.5	0	0	5.75
ENE	0	0.5	1.75	0.25	0.75	0	0	3.25
E	0	1	1.25	0.75	0	0	0	3
ESE	0	0	0.75	0.25	0	0	0	1
SE	0	0.25	0.5	2.25	1.75	0.25	0	5
SSE	0	0	0.75	2.75	1.25	0.25	0	5
S	0	0.25	0.5	1.25	0.25	0	0	2.25
SSW	0	0.5	0	1.25	0.75	0.5	0	3
SW	0	0	1.5	0.5	0	0	0	2
WSW	0	0.5	2.25	3	0	0.5	0.5	6.75
W	0	0	0.5	2.75	0.5	0	0	3.75
WNW	0	0.5	1.75	1.25	1.5	0	0	5
NW	0	0	0.75	4	0.25	0	0	5
NNW	0	0.5	1	2	0.5	0	0	4
Total	1.25	5.25	21	38.25	13.5	2.75	0.5	82.5

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Third Quarter 1997 Stability Class C

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	2.25	5.75	2.75	0.5	0	11.25
NNE	0	0	1.5	9	1.5	0	0	12
NE	0	0	2	7.5	0	0	0	9.5
ENE	0	0	0.75	1	0	0	0	1.75
E	0	0	3.5	0.75	0	0	0	4.25
ESE	0	0.25	1	0.25	0	0	0	1.5
SE	0	0	4.5	1.75	0	0	0	6.25
SSE	0	0.25	2.25	3	3.5	0	0	9
S	0	0	1.25	1.75	1.75	0	0	4.75
SSW	0	0.25	2	0.75	0	0.5	0	3.5
SW	0	0	0.75	0.75	0.75	0	0	2.25
WSW	0	0.25	0.5	0.5	1.25	0.75	0	3.25
W	0	0.25	0.25	1.5	0.25	0.25	0	2.5
WNW	0	0	0.75	1.75	1	0	0	3.5
NW	0	0.5	2	2.75	1	0	0	6.25
NNW	0	0.25	3	3.25	0.25	0	0	6.75
Total	0	2	28.25	42	14	2	0	88.25

Third Quarter 1997 Stability Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	1.75	1.25	6.25	13.75	4.75	0.25	0	28
NNE	0	1.5	6.5	23	14.25	0.5	0	45.75
NE	0	2	10.75	9.5	3	0	0	25.25
ENE	0	1.5	11.5	4.5	0.25	0	0	17.75
E	0	1.25	13.75	3.75	0.5	0	0	19.25
ESE	0	1.5	7.5	2.5	1.25	0	0	12.75
SE	0	1.25	10	3.75	6.5	0.25	0	21.75
SSE	0	1.5	12.25	10.25	7	0	0	31
S	0	0.5	16.5	12.75	0.75	0	0	30.5
SSW	0	1.25	9	3.5	1.5	0	0	15.25
SW	0	1.5	1.25	3	4	0	0	9.75
WSW	0	0	2	9.5	7.25	2.25	0	21
W	0	0.25	2.75	9.25	10.5	1.5	0.25	24.5
WNW	0	0.75	3	8.25	4.5	0	0	16.5
NW	0	0.5	10	10	0	0	0	20.5
NNW	0	1.25	9	7.5	0.75	0	0	18.5
Total	1.75	17.75	132	134.75	66.75	4.75	0.25	358

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Third Quarter 1997 Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	20.5	0.5	10.5	11	1	0.25	0	43.75
NNE	0.25	0.25	2.5	10.5	3.5	0.25	0	17.25
NE	0	1	4.75	5.25	2.5	0	0	13.5
ENE	0	1	0.75	0.25	0.5	0	0	2.5
E	0	0.25	1.75	0.25	0.25	0	0	2.5
ESE	0	0.5	4	0	0	0	0	4.5
SE	0	1	3.5	3.75	2	0.25	0	10.5
SSE	0	2.5	9.75	9.25	7.75	0.25	0	29.5
S	0	2.5	23.5	16	0	0	0	42
SSW	0	1	18.5	6.25	1.5	0	0	27.25
SW	0	1.25	10.75	10.25	6	0	0	28.25
WSW	0	0	5.25	12.75	3.25	0.5	0	21.75
W	0	0.25	3.75	13.5	9.5	3	0	30
WNW	0	0.75	6	12.5	2.25	0	0	21.5
NW	0.25	2	9.5	3	0	0	0	14.75
NNW	0	2	16.25	8.5	0.5	0	0	27.25
Total	21	16.75	131	123	40.5	4.5	0	336.75

Third Quarter 1997 Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	2.5	0.25	4.5	1.75	0	0	0	9
NNE	0	0.5	3.25	7.75	0.75	0	0	12.25
NE	0	0	1.25	6.25	0	0	0	7.5
ENE	0	0	0.75	0.75	0	0	0	1.5
E	0	0.25	1.25	0	0	0	0	1.5
ESE	0	1.75	2.75	0	0	0	0	4.5
SE	0.25	1	2.5	1.5	2.75	0	0.25	8.25
SSE	0	4	11	7.75	9.75	0.25	0.25	33
S	0	6.5	14.75	5.25	0.75	0	0	27.25
SSW	0	4.75	10.25	3.5	0.25	0	0	18.75
SW	0	0.75	5.25	4.75	1.25	0	0	12
WSW	0.75	1.25	4.75	4.75	1.25	0	0	12.75
W	0	0.5	2.75	10.5	0.25	0.75	0	14.75
WNW	0	2	5.5	1.25	1.5	0	0	10.25
NW	0.25	2.25	8.5	2	0	0	0	13
NNW	0.25	0.25	13.25	6	0	0.25	0	20
Total	4	26	92.25	63.75	18.5	1.25	0.5	206.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Third Quarter 1997 Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	12.25	0	4.5	0.25	0	0	0	17
NNE	0	0.25	0.25	1	0	0	0	1.5
NE	0	0.25	0.75	3.25	0	0	0	4.25
ENE	0.25	0.5	1	0.75	0	0	0	2.5
E	0	2	0.75	0	0	0.25	0	3
ESE	0.25	1.5	2	0	0	0	0	3.75
SE	0	3.75	3.5	1.25	0.25	0	0	8.75
SSE	0.25	4.75	14.25	17	2.25	0	0	38.5
S	0	8.5	35.75	17.5	0.5	0	0	62.25
SSW	0	14.25	29.25	4.25	0	0	0	47.75
SW	0	13.5	33.75	1.5	0	0	0	48.75
WSW	0	8	45.25	8	0	0	0	61.25
W	0	3	34.75	24	0.5	0	0	62.25
WNW	0	4.75	33.25	5.25	0	0	0	43.25
NW	0	6	38.25	0.75	0	0	0	45
NNW	0	5.5	36.25	0.75	0	0	0	42.5
Total	13	76.5	313.5	85.5	3.5	0.25	0	492.25

Fourth Quarter 1997 Stability Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0.5	5.5	7.5	2.75	0	0	16.25
NNE	0	0	3.25	10.75	6.75	0.25	0.25	21.25
NE	0	0.5	1.25	4	3.75	2	0.25	11.75
ENE	0	0.5	4	8	15	11	0.75	39.25
E	0	0.25	6.75	9	7	7.75	1	31.75
ESE	0	0.25	7	8.25	2	0	0	17.5
SE	0	1.25	3.25	7.5	7.75	0	0	19.75
SSE	0	1.25	4.25	4.25	4.25	0.25	0	14.25
S	0	0	4	2	4.25	0.5	0	10.75
SSW	0	0.25	3	7.25	1	0.5	0.25	12.25
SW	0	0.25	5.25	8.5	8	1.25	0.25	23.5
WSW	0	1	3.25	13.25	17.75	4.5	0	39.75
W	0	0.75	7.75	26	14	1	0	49.5
WNW	0	0.5	8.5	25.5	15.5	0.75	0	50.75
NW	0	0.25	11.5	15.25	8.5	0.5	0	36
NNW	0	0.75	13.25	21.25	6.5	0.25	0	42
Total	0	8.25	91.75	178.25	124.75	30.5	2.75	436.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Fourth Quarter 1997 Stabitity Class B

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	3.25	9	0.5	0	0	12.75
NNE	0	0	0.75	3	4.75	1.25	1.75	11.5
NE	0	0	0.75	2	2.25	1	0	6
ENE	0	0	0.25	0	0.25	1.75	0	2.25
E	0	0.25	0.5	6.5	4.5	0	0	11.75
ESE	0	0.25	0.5	4.25	0.75	0	0	5.75
SE	0	0	2.25	3.25	1.25	0	0	6.75
SSE	0	0.75	1.75	2.25	2	0	0	6.75
S	0	0	0.75	1	0	0	0	1.75
SSW	0	0	0.25	2	0	0	0	2.25
SW	0	1	0.75	0.25	0	0.5	0	2.5
WSW	0	0.25	0.25	2.75	2	0.5	0	5.75
W	0	0	1	3.75	1.75	0	0	6.5
WNW	0	0.5	0.25	4.5	1.25	0	0	6.5
NW	0	0.5	2.25	3.75	0.5	0	0	7
NNW	0	0	1.75	7.25	0.25	0	0	9.25
Total	0	3.5	17.25	55.5	22	5	1.75	105

Fourth Quarter 1997 Stabitity Class C

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0	2.25	5.25	2.75	0	0	10.25
NNE	0	0	0.5	3.25	2.5	1	0	7.25
NE	0	0	0.5	1	2	1.5	0.25	5.25
ENE	0	0.25	1	0.25	1	0.25	0	2.75
E	0	0.75	3.5	2.25	2.5	0	0	9
ESE	0	1	4.25	3.25	0	0	0	8.5
SE	0	0.25	4	1.5	0.5	0	0	6.25
SSE	0	0	1.5	0.75	0	0	0	2.25
S	0	1.5	0.25	0.5	0	0	0	2.25
SSW	0	0.25	0.5	3.5	0.5	0	0	4.75
SW	0	0.75	0.75	1.75	0.5	0.5	0.25	4.5
WSW	0	0.5	1.75	2.25	1.25	0.75	0	6.5
W	0	0	0.5	2.25	2.25	0.25	0	5.25
WNW	0	0.25	0.5	5	2	0	0	7.75
NW	0	0	1.25	4.5	0.5	0	0	6.25
NNW	0	0.5	2.25	5	1.5	0	0	9.25
Total	0	6	25.25	42.25	19.75	4.25	0.5	98

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Fourth Quarter 1997 Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	2	11.25	46.5	16.5	0.25	0	76.5
NNE	0	1	3.5	9.5	4.25	1.5	0	19.75
NE	0	0	9.5	8.5	3	0	0	21
ENE	0	0.25	3.25	7.25	1.75	0.25	0	12.75
E	0	0.5	3.25	3.5	0.5	0	0	7.75
ESE	0	1	3.75	1.25	0.5	0	0	6.5
SE	0	0.75	2	2	1.25	0	0	6
SSE	0	0	0.75	1.75	0.5	0	0	3
S	0	0.75	2.25	4.25	3.75	0.75	0.25	12
SSW	0	0.75	11	16.5	2	0.5	0	30.75
SW	0	0.25	5.75	10.75	2.5	0.5	1	20.75
WSW	0	0.5	7.5	12.5	5.5	1.75	0	27.75
W	0	1.25	14	27.75	24.25	6.5	0.5	74.25
WNW	0	2.25	20.75	37.75	35.5	1.5	0	97.75
NW	0	2.75	20.5	14.75	0.5	0	0	38.5
NNW	0	1.75	18.25	39.25	5.25	0	0	64.5
Total	0	15.75	137.25	243.75	107.5	13.5	1.75	519.5

Fourth Quarter 1997 Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	1.25	1.5	6.5	7.5	3	0.75	0	20.5
NNE	0	0.5	2.25	0.75	2.5	0	0	6
NE	0	1.75	2.5	1.25	0.25	0	0	5.75
ENE	0	0.5	2	1	0	0	0	3.5
E	0	0.25	0.25	0.75	0	0	0	1.25
ESE	0	0.75	1.25	0	0	0	0	2
SE	0	0.25	2.25	0.25	0	0	0	2.75
SSE	0	1.5	1	4	0.5	0.25	0	7.25
S	0	0.5	3.75	15.75	8.5	0.75	0	29.25
SSW	0	1.75	16.75	13.5	2.75	0.25	0	35
SW	0	1.75	7.5	12.75	1	0.5	0	23.5
WSW	0	0.25	13	9.75	10	8.75	0	41.75
W	0	4.25	12.75	13.25	8.25	3.5	1	43
WNW	0	2.25	17.75	38.75	12.5	0	0	71.25
NW	0	1.25	14.25	18.75	1.5	0	0	35.75
NNW	0	2	11.5	13.25	3	0	0	29.75
Total	1.25	21	115.25	151.25	53.75	14.75	1	358.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction

Fourth Quarter 1997 Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	2.25	4.25	3.75	1.25	0	0	11.5
NNE	0	0.75	0.5	1.5	0	0	0	2.75
NE	0	1.75	0.25	0.25	0	0	0	2.25
ENE	0	0.25	1.5	0.25	0	0	0	2
E	0	0	0.75	0	0	0	0	0.75
ESE	0	0.5	0.25	0	0	0	0	0.75
SE	0	0	1.75	0	0	0	0	1.75
SSE	0	0.25	2	2	2	3	0.5	9.75
S	0	0.25	10.25	11.25	8.75	0.5	0	31
SSW	0	3.25	24.5	6.75	0.25	0	0	34.75
SW	0	2.75	13.75	15.25	4.25	0	0	36
WSW	0.25	1	10.75	12.25	1.75	0.25	0	26.25
W	0.25	2	12.75	12.5	8.75	0	0	36.25
WNW	0	1.5	18.25	23.25	1.5	0	0	44.5
NW	0	2.75	16	6.75	0	0	0	25.5
NNW	0	2.75	12.5	10.5	0.75	0	0	26.5
Total	0.5	22	130	106.25	29.25	3.75	0.5	292.25

Fourth Quarter 1997 Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0.25	1.5	3.25	0	0	0	0	5
NNE	0	1	0.5	1.25	0	0	0	2.75
NE	0	1.25	1.75	0.75	0	0	0	3.75
ENE	0	1.25	1.5	0	0	0	0	2.75
E	0	1.25	1	0	0	0	0	2.25
ESE	0	0.75	0.5	0.25	0	0	0	1.5
SE	0.25	3.5	4	2.5	0.25	0	0	10.5
SSE	0	2.5	17.25	17.25	15	2	1	55
S	0	5.25	14.75	11.25	3	0.25	0	34.5
SSW	0.25	4	15	0.5	0	0	0	19.75
SW	0	6	37	10.5	0.25	0	0	53.75
WSW	0	6.5	31	11.25	0	0	0	48.75
W	0	6	21.5	24.25	0.25	0	0	52
WNW	0.25	10	25	19.25	0.75	0	0	55.25
NW	0	6.25	21.75	2.75	0	0	0	30.75
NNW	0.25	3.5	8.5	1.75	0	0	0	14
Total	1.25	60.5	204.25	103.5	19.5	2.25	1	392.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Gaseous Batch Release Number 97-001
Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0	2	0.25	0	0	2.25
WSW	0	0	0	1.25	0	0	0	1.25
Total	0	0	0	3.25	0.25	0	0	3.5

Gaseous Batch Release Number 97-002
Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
NE	0	0	0.25	0.25	0	0	0	0.5
ESE	0	0	0	0.25	0	0	0	0.25
S	0	0	0	0.25	0	0	0	0.25
WNW	0	0	0.25	0	0	0	0	0.25
NW	0	0	0.25	0	0	0	0	0.25
Total	0	0	0.75	0.75	0	0	0	1.5

Stabitity Class B

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
ENE	0	0	0.25	0	0	0	0	0.25
ESE	0	0	0.25	0	0	0	0	0.25
SE	0	0.25	0	0	0	0	0	0.25
Total	0	0.25	0.5	0	0	0	0	0.75

Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
NNE	0	0	0	0.25	0	0	0	0.25
NE	0	0	0.25	0.75	0	0	0	1
ENE	0	0	0	0.25	0	0	0	0.25
Total	0	0	0.25	1.25	0	0	0	1.5

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
NNE	0	0	0.25	0.75	0	0	0	1
NE	0	0	0.5	1	0	0	0	1.5
E	0	0	0.25	0	0	0	0	0.25
SE	0	0.25	0	0	0	0	0	0.25
SSE	0	0.25	0	0	0	0	0	0.25
NNW	0	0	0.75	0	0	0	0	0.75
Total	0	0.5	1.75	1.75	0	0	0	4

Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0.25	0.25	0	0	0	0	0.5
NNE	0	0	0.25	1	0	0	0	1.25
NE	0	0	0.25	0.5	0	0	0	0.75
ENE	0	0	0	0.25	0	0	0	0.25
SE	0	0.25	0	0	0	0	0	0.25
NNW	0	0	0.5	0	0	0	0	0.5
Total	0	0.5	1.25	1.75	0	0	0	3.5

Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
N	0	0.25	0	0	0	0	0	0.25
NNE	0	0.25	0	0.5	0	0	0	0.75
NE	0	0.5	0.5	0	0	0	0	1
ENE	0	0	0.5	0.25	0	0	0	0.75
Total	0	1	1	0.75	0	0	0	2.75

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Gaseous Batch Release Numebr 97-003
Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0	1	0	0	0	1
Total	0	0	0	1	0	0	0	1

Gaseous Batch Release Numebr 97-004

There is no meteorological data available for release number 97-004; 10.75 hour duration.

Gaseous Batch Release Numebr 97-005
Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
ENE	0	0	0.25	0	0	0	0	0.25
E	0	0	0.25	0	0	0	0	0.25
ESE	0	0	0.25	0.25	0	0	0	0.5
SE	0	0	0.25	0.25	0	0	0	0.5
SSE	0	0	0.5	1.5	0	0	0	2
Total	0	0	1.5	2	0	0	0	3.5

Stabitity Class C

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
E	0	0	0.25	0	0	0	0	0.25
SE	0	0	1	0	0	0	0	1
Total	0	0	1.25	0	0	0	0	1.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
ENE	0	0	0.25	0	0	0	0	0.25
E	0	0	0.25	0.5	0	0	0	0.75
SSE	0	0	0	0.25	0	0	0	0.25
S	0	0	0.5	0.25	0	0	0	0.75
SSW	0	0	1.5	0	0	0	0	1.5
SW	0	0	0.25	0	0	0	0	0.25
Total	0	0	2.75	1	0	0	0	3.75

Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SSE	0	0	0	0.5	0	0	0	0.5
S	0	0	0	0.25	0	0	0	0.25
Total	0	0	0	0.75	0	0	0	0.75

Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SSW	0	0	0.25	0	0	0	0	0.25
Total	0	0	0.25	0	0	0	0	0.25

Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0.25	0	0	0	0	0.25
WSW	0	0	3	0	0	0	0	3
W	0	0	0.5	0	0	0	0	0.5
Total	0	0	3.75	0	0	0	0	3.75

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Gaseous Batch Relase Number 97-006
Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0	0.5	0	0	0	0.5
Total	0	0	0	0.5	0	0	0	0.5

Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0	1	0.25	0	0	1.25
Total	0	0	0	1	0.25	0	0	1.25

Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SSW	0	0	0.75	0.25	0	0	0	1
SW	0	0	1.5	0.5	0	0	0	2
Total	0	0	2.25	0.75	0	0	0	3

Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SSW	0	0	0.5	0	0	0	0	0.5
Total	0	0	0.5	0	0	0	0	0.5

Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SSW	0	0	0.75	0	0	0	0	0.75
SW	0	0	1.25	0	0	0	0	1.25
WSW	0	0	3	0	0	0	0	3
W	0	0	0.25	0	0	0	0	0.25
Total	0	0	5.25	0	0	0	0	5.25

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Gaseous Batch Release Number 97-007
Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0.25	0	0	0	0	0.25
WSW	0	0	1.5	0.5	0	0	0	2
W	0	0	0.75	7.25	0	0	0	8
WNW	0	0	0	0.25	0	0	0	0.25
Total	0	0	2.5	8	0	0	0	10.5

Gaseous Batch Release Number 97-08

Stabitity Class A

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
WSW	0	0	0	2	0.25	0	0	2.25
W	0	0	0.25	2.25	0	0	0	2.5
WNW	0	0	0	0.75	0	0	0	0.75
NW	0	0	0.25	0	0	0	0	0.25
Total	0	0	0.5	5	0.25	0	0	5.75

Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
WSW	0	0	0.5	0	0	0	0	0.5
Total	0	0	0.5	0	0	0	0	0.5

Stabitity Class E

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0.25	0	0	0	0	0.25
WSW	0	0	0.75	0	0	0	0	0.75
Total	0	0	1	0	0	0	0	1

Kewaunee Nuclear Power Plant Meteorological Data
January 1997 to December 1997
Wind Speed Hourly Average vs. Direction
Gaseous Batch Release Summary Data

Stabitity Class F

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	0.5	0	0	0	0	0.5
Total	0	0	0.5	0	0	0	0	0.5

Stabitity Class G

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
SW	0	0	3.25	0.5	0	0	0	3.75
WSW	0	0	2.75	0	0	0	0	2.75
Total	0	0	6	0.5	0	0	0	6.5

Gaseous Batch Release Number 97-009

Stabitity Class D

Wind Direction	Calm	1-3	4-7	8-12	13-18	19-24	>24	Total
W	0	0	3.75	1.75	0	0	0	5.5
WNW	0	0	2.5	2.25	0	0	0	4.75
NW	0	0	0.25	0.5	0	0	0	0.75
Total	0	0	6.5	4.5	0	0	0	11

Appendix B

Kewaunee Nuclear Power Plant

1997 Offsite Dose Calculation Manual Changes

January 6. 1997 Evaluated, but not implemented

October 20, 1997 Revision 8

KEWAUNEE NUCLEAR POWER PLANT

OFF-SITE DOSE CALCULATION MANUAL

Revision temporary change in support of GNP 1.19.30 & KAP0493

Date 1/6/97 PORC Mtg #97-001

Reviewed by C. A. Schrock 1-6-97
Plant Operations Review Committee/Date

Approved by 12/20/96
Superintendent - Plant Radiation Protection/Date

Approved by 12/20/96
Superintendent - Plant Radiochemistry/Date

Approved by 1-3-97
Licensing Director/Date

RETURN TO DAVE [illegible]

SECOND LEVEL REVIEW REPORT

DATE 12-17-96

RESPONSIBLE PERSON Dennis Rozell

TO GW Holmes

SECOND LEVEL REVIEWER(S)

Please perform a Second Level Review for KAP 0493/E per GNP 4.3.1. The review is to cover the following.

SAFETY REVIEW
10 CFR 50.59 EVALUATION

Second Level Review method used ***(circle one)*****:**

[✓ Design Review] Alternate Calculations Qualification Testing

Reference material used: NAD 5.13, SP 32A-136, ODCM Sections 1 & 3, table 3.1
USAR 11.1
[✓ GNP 4.3.1]
NEP 4.8, Attachment 1 (Design Inputs)

The items reviewed correctly reflect the applicable design criteria and the requirements of the SR and, if applicable, SER. Upon resolution of the following recommendations, the design change may be put in service.

Recommendations ***(if applicable)*****:**

1) Make it clear that a release path without continuous monitoring is an acceptable path as long as the controls in ODCM Table 3.1 and SP 32A-136 are in place.
2) Prepare and process this change analagous to an ODCM change.
3) Clarify that this SR & SE only covers discharge of the WNT - not the process of draining the standpipe and XFer of the caustic.

GW Holmes 12/17/96
REVIEWER'S SIGNATURE(S)/DATE

Resolution of Recommendations by RP:

COMMENTS INCORPORATED

Dennis Rozell 12-20-96
RESPONSIBLE PERSON/DATE

SAFETY REVIEW

IDENTIFICATION NO. KAP0493/GNP 1.19.30

This form documents a Safety Review has been performed as required by the OQAP and 10CFR50.59(a)(1).

Answer the following:	*CIRCLE ONE*
1. Is this a change in the facility or procedures as described in the USAR or does this conduct tests or experiments not described in the USAR?	[✓ YES] / NO
2. Does this involve a change in the Technical Specifications?	YES / [✓ NO]

IF THE ANSWER TO QUESTION 1 IS YES, A SAFETY EVALUATION REPORT DOCUMENTED ON Form GNP 4.3.1-3 IS REQUIRED. IF THE ANSWER TO QUESTION 2 IS YES, APPLICATION FOR A LICENSE AMENDMENT IS REQUIRED PER NEP 5.1.

The basis for these conclusions are: *(attach pages as necessary)*

12-16-96

RESPONSIBLE PERSON/DATE

12/16/96-

SAFETY EVALUATION REPORT

IDENTIFICATION NO. KAP0493 / GNP 1.19.30

The objective of this document is to perform the evaluation required per 10CFR50.59(a)(2).

ANSWER THE FOLLOWING:	*CIRCLE ONE*
1. Could the change increase the probability of occurrence of an accident previously evaluated in the USAR?	YES / [✓ NO]
2. Could the change increase the consequences of an accident previously evaluated in the USAR?	YES / [✓ NO]
3. Could the change increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the USAR?	YES / [✓ NO]
4. Could the change increase the consequences of a malfunction of equipment important to safety previously evaluated in the USAR?	YES / [✓ NO]
5. Could the change create the possibility of an accident of a different type than any previously evaluated in the USAR?	YES / [✓ NO]
6. Could the change create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the USAR?	YES / [✓ NO]
7. Could the change reduce the margin of safety as defined in the basis for any Technical Specification?	YES / [✓ NO]

The basis for these conclusions are attached.

NOTE: Identification of question answers using the question number on the attached pages is acceptable.

IF THE ANSWER TO ANY OF THE ABOVE QUESTIONS IS YES, APPLICATION FOR PRIOR NRC APPROVAL MUST BE MADE PER NEP 5.1.

Dennis 12-16-96

RESPONSIBLE PERSON/DATE

12/16/96

Safety Review for Sodium Hydroxide Release via the Waste Neutralizing Tank
(KAP 0493 and GNP 1.19.30)

The subject of this safety review is the release of slightly radioactive Sodium Hydroxide (NaOH) from the Internal Containment Spray Caustic Additive Standpipe, through a release path not currently identified in the Offsite Dose Calculation Manual (ODCM). This is a single non-routine evolution based on the need to dispose of approximately 300 gallons of slightly radioactive 30% NaOH. A sample of NaOH was removed from the standpipe, sampled, and found to contain ~1.3×10^{-6} µCi/ml gross gamma radioactivity and ~3.5×10^{-4} µCi/ml Tritium radioactivity.

The issue under review is the use of a previously unidentified release path. The new release path will be evaluated as if it were a change to the ODCM, however, since this is a one-time evolution there will be no formal changes made to the ODCM.

1.) Is this a change in the facility as described in the USAR or does this conduct tests or experiments not described in the USAR? YES

USAR, section 11.1 describes liquid waste releases and states that all liquid waste releases are continuously monitored for gross radioactivity. The Offsite Dose Calculation Manual (ODCM) implements the USAR requirements from section 11.1 and describes the approved release paths for all radioactive effluent releases.

The proposed evolution is a change to the facility as described in the USAR because the release will be through a previously unevaluated release path and it will be made without continuous radiation monitoring.

A determination was made as a part of the attached Safety Evaluation (and attached calculation),and as required by NAD 5.13, that this proposed evolution will maintain the level of radioactivity effluent control required by 10 CFR 20.106, 40 CFR 190, 10 CFR 50.36a, and Appendix I to 10 CFR Part 50 and that this proposed evolution will not adversely impact the accuracy or reliability of effluent dose or setpoint calculations.

2.) Does this involve a change in the technical specifications? NO

Plant Technical Specifications TS 6.16 and TS 6.18 require the existence of the ODCM (see TS Amendment 104) and specifies compliance with federal rules defining dose to the public. The ODCM defines the methodology used to satisfy these rules. Changes to the ODCM are controlled using NAD 5.13, reviewed using the GNP 4.3.1 Safety Review process, and do not constitute a Technical Specification (TS) change.

Therefore, the proposed evolution, analyzed as an ODCM change, does not involve a change to the Technical Specifications.

Safety Evaluation for Sodium Hydroxide Release via the Waste Neutralizing Tank (KAP 0493 and GNP 1.19.30)

1.) Could the change increase the probability of occurrence of an accident previously evaluated in the USAR?

No. This change does not affect a structure, system, or component that initiates an accident analyzed in the USAR. This change identifies a new radioactive release path to the environment and is analogous to an ODCM revision. The NaOH will be removed from the caustic additive standpipe and transferred into 55-gallon drums for temporary storage and transportation. The NaOH will be neutralized in the Waste Neutralizing Tank (WNT) and then released to the lake through the circulating water system. None of these systems, structures, or components involved with this process are safety related or have been identified as capable of initiating an accident in the USAR.

2.) Could the change increase the consequences of an accident previously evaluated in the USAR?

No. Since the process does not involve any equipment associated with an analyzed accident, no increase in consequences are possible.

The accidental release of recycle or waste liquid is one of the accidents described in the USAR (14.2.2). It involves the release of radioactive liquids due to the rupture or leaking of system pipe lines or storage tanks in the Auxiliary Building. The USAR analysis was performed due to potential high activity in fluids captured in the Auxiliary Building. Because of the low quantity of radioactivity in the NaOH as evidenced in #5 below, any accidental release of the NaOH is bounded by the analyzed event in the USAR 14.2.2.

3.) Could the change increase the probability of a malfunction of equipment important to safety previously evaluated in the USAR?

No. The equipment involved with this process does not impact safety (see #1 above). The equipment involved are the WNT, the WNT mixer and transfer pump, the 6 inch circulating water standpipe, the circulating water pump, and circulating water system.

4.) Could the change increase the consequences of a malfunction of equipment important to safety previously evaluated in the USAR?

No. This Safety Evaluation does not address the concern of draining the caustic additive standpipe, only the release of the slightly radioactive liquid through a release path not currently listed in the ODCM.

The equipment involved in this process (see #3) does not impact safety and is not required to mitigate the consequences of an accident.

5.) Could the change create the possibility of an accident of a different type than any previously evaluated in the USAR?

No. The radioactivity due to this release is expected to be ~1.3×10^{-6} µCi/ml gross gamma radioactivity and ~3.5×10^{-4} µCi/ml Tritium. An associated dose for this release of ~1.8×10^{-4} mrem Total Body and ~2.7×10^{-4} mrem organ (liver) has been calculated using ODCM methodology. This is significantly less than the ODCM limits of 1.5 mrem Total Body quarterly dose and 5 mrem maximum quarterly organ dose. These doses are quite low and will have a minimum impact on the cumulative quarterly and annual doses. The dose calculation assumes the total activity present in the NaOH is released instantaneously. No dilution in the WNT is assumed, although it will occur through the neutralization and release process. A minimum of one service water pump, with a minimal flow of 5000 gpm, will be operating during this evolution.

The release path from the WNT to the circulating water system (see attached drawing) does not have an in-line continuous radiation monitor, or an automatic isolation valve, as described in the USAR section 11.1. SP 32A-136 controls liquid releases and provides contingency actions, consistent with the ODCM, for releases made without an operable continuous in-line radiation monitor. These contingency actions of redundant sampling, independent verification of the release rate calculation, and independent verification of the release flow path will be implemented for this evolution.

The slight amount of radioactivity in the NaOH has been quantified and determined as negligible. The consequence of this radioactivity reaching the environment, via any release mechanism, has been evaluated and is negligible. Use of this described release path, in accordance with approved methodology for liquid releases without continuous in-line radiation monitoring or automatic isolation functions, is acceptable.

6.) Could the change create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the USAR?

No. The equipment involved with this process (see #3) does not impact safety and is not required to mitigate the consequences of an accident. The solution will be neutralized in the WNT, then released directly to the lake through the circulating water system. No other installed equipment in the plant will be involved in this process.

7.) Could the change reduce the margin of safety as defined in the basis for any Technical Specification?

No. The release flowpath, as described, will be reviewed according to NAD 5.13 as if it were to be included as an ODCM change, but because this is a one-time evaluation, the ODCM will not be revised. The release under discussion will be performed and quantified according to approved plant procedures and processes and will be included in the annual effluent release report. This is consistent with other releases made through the release paths currently described in the ODCM. There is no reduction in any margin of safety in the basis of the ODCM, USAR, or Technical Specifications.

The final mixture will conform to the WPDES constraints for pH, Oil and Grease, and Suspended Solids.

Due to the low radioactivity in the NaOH, it is anticipated that no special precautions will be necessary to protect personnel during this evolution. Current ALARA practices and chemical handling practices will ensure that the ODCM limits are not exceeded and that all personnel are protected.

SP 32A-136

12/18/96 TECHNICAL SPECIFICATION COMPLIANCE Permit # 02-0003

Status: Pre Release Tank = miscellaneous

ase Rate Calculations

Estimated R-18 reading (CPM) is: 3.11E+03

R18 Setpoint	3.22E+06 CPM
R18 Sensitivity	1.00E+08 CPM per µCi/ml
R18 Background	3.00E+03 CPM
Total MPC Fraction	1.62E-01
Total Gamma Concentration	1.13E-06 µCi/ml
SW Flow Rate	5000 GPM

Based on these parameters, the release rate of 300.00 GPM
does NOT exceed limits of Technical Specification

The system calculated maximum release rate is 3.09E+04 GPM
The calculated setpoint for this release is 4.59E+04 CPM

RNING:

The calculated setpoint is LESS THAN the system R18 setpoint

ALARA Limits:

Gross Gamma Concentration (diluted): 6.78E-08 µCi/ml
Tritium Concentration (diluted): 2.13E-05 µCi/ml

Gamma Concentration ALARA limit of 2.0E-8 uCi/ml is exceeded
Tritium Concentration ALARA limit of 5.0E-6 uCi/ml is exceeded

DOSE ANALYSIS

Dose analysis based on a release volume of 300.00 gal
and a dilution flow rate of 5000 GPM
Quarter is 4 based on SAMPLE date of ~~12/13/02~~ 12/13/96
Quarter and year to date totals are as of ~~12/13/02~~ 12/13/96

Dose Information in mrem

	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Release:	1.95E-04	2.67E-04	1.75E-04	1.10E-07	9.07E-05	3.02E-05	7.43E-06
QTD:	1.95E-04	2.67E-04	1.75E-04	1.10E-07	9.07E-05	3.02E-05	7.43E-06
YTD:	1.95E-04	2.67E-04	1.75E-04	1.10E-07	9.07E-05	3.02E-05	7.43E-06
Projected Quarterly	2.40E-04	3.29E-04	2.16E-04	1.36E-07	1.11E-04	3.72E-05	9.14E-06

Quarterly Total Body Dose	1.75E-04 is within	ODCM 3.3.2.a limit of	1.50	mrem
Annual Total Body Dose	1.75E-04 is within	ODCM 3.3.2.b limit of	3.00	mrem
Projected Total Body Dose	2.16E-04 is within	ODCM 3.3.3 limit of	0.18	mrem

rterly Max Organ Dose	2.67E-04 Liver	is within	ODCM 3.3.2.a limit of	5.00	mrem
ual Max Organ Dose	2.67E-04 Liver	is within	ODCM 3.3.2.b limit of	10.00	mrem
Projected Max Organ Dose	3.29E-04 Liver	is within	ODCM 3.3.3 limit of	0.62	mrem

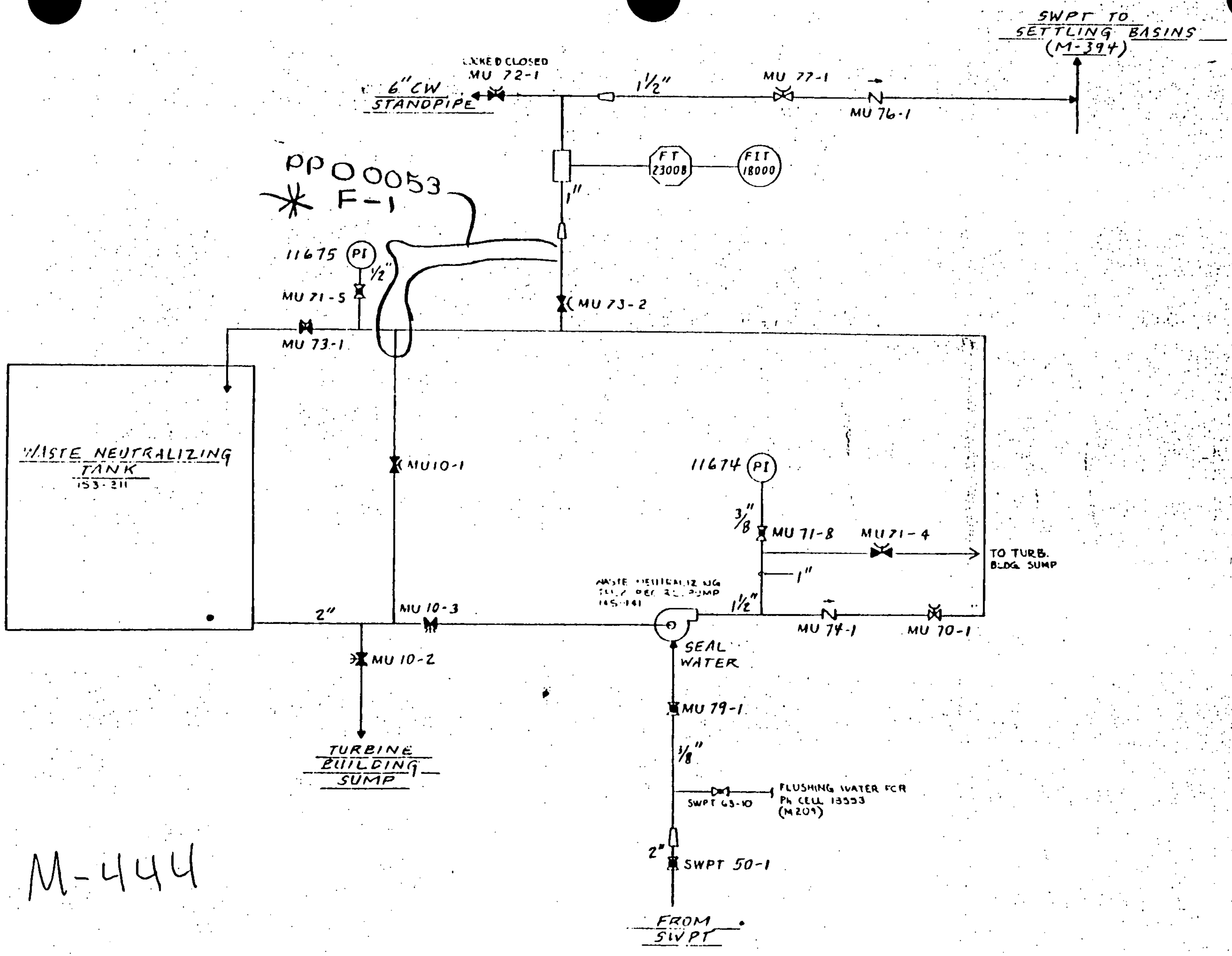
12/18/96

SP 32A-136
Permit # 02-0003
miscellaneous

RADIONUCLIDE ANALYSIS

Nuclide	Conc µCi/ml	Activity Ci	MPC µCi/ml	Conc/MPC
* H-3	3.54E-04	4.02E-04	3.00E-03	1.18E-01
Co-60	4.70E-07	5.33E-07	3.00E-05	1.57E-02
Sb-125	1.19E-07	1.35E-07	1.00E-04	1.19E-03
Cs-137	5.42E-07	6.16E-07	2.00E-05	2.71E-02
Subtotal	3.55E-04	4.03E-04		1.62E-01
Composite Sample for this period not found				
Total	3.55E-04	4.03E-04		1.62E-01

* - Non-Gamma Emitter


SWPT TO
SETTLING BASINS
(M-394)
LOCKED CLOSED
MU 72-1
6" CW
STANDPIPE
1½"
MU 77-1
MU 76-1
FT
2300B
FIT
18000
1"
PP00053
F-1
11675
PI
½"
MU 71-5
MU 73-2
MU 73-1
WASTE NEUTRALIZING
TANK
153-211
MU10-1
11674
PI
3/8"
MU 71-8
MU71-4
TO TURB.
BLDG. SUMP
1"
WASTE NEUTRALIZING
PUMP
145-141
1½"
2"
MU 10-3
MU 74-1
MU 70-1
SEAL
WATER
MU 10-2
MU 79-1
TURBINE
BUILDING
SUMP
3/8"
SWPT 63-10
FLUSHING WATER FOR
Ph CELL 13553
(M209)
2"
SWPT 50-1
FROM
SWPT

M-444

KEWAUNEE NUCLEAR POWER PLANT

OFFSITE DOSE CALCULATION MANUAL (ODCM)

Revision 8
October 20, 1997

Reviewed By: Charles A. Schrock Date: 10/20/97
Plant Operations Review Committee

Approved By: Date: 10-27-97
Nuclear Licensing Director

Approved By: Date: 10/20/97
Superintendent - Plant Radiation Protection

Approved By: Date: 10/20/97
Superintendent - Plant Radiochemistry

KEWAUNEE NUCLEAR POWER PLANT

OFFSITE DOSE CALCULATION MANUAL (ODCM)

Revision 8
October 20, 1997

Abstract

This document has been developed in accordance with the Wisconsin Public Service Corporation (WPSC) commitment made by letter dated August 21, 1984 (from D. C. Hintz to S. A. Varga). It provides the current methodologies and parameters to be used in the calculation of offsite doses due to radioactive gaseous and liquid effluents and gaseous and liquid effluent monitoring alarm/trip setpoints for the Kewaunee Nuclear Power Plant. To develop this document, WPSC contracted the J. Stewart Bland Consultants, Inc. of Maryland; however, rigorous review and final acceptance of this document has been provided by WPSC. Implementation of this document is the responsibility of WPSC.

December 18, 1984

KEWAUNEE NUCLEAR POWER PLANT
OFFSITE DOSE CALCULATION MANUAL

Table of Contents

KEWAUNEE NUCLEAR POWER PLANT
OFFSITE DOSE CALCULATION MANUAL

Table of Contents (con't)

KEWAUNEE NUCLEAR POWER PLANT
OFFSITE DOSE CALCULATION MANUAL

Table of Contents (con't)

KEWAUNEE NUCLEAR POWER PLANT
OFFSITE DOSE CALCULATION MANUAL

Introduction

The Kewaunee Offsite Dose Calculation Manual (ODCM) describes the methodology and parameters used in: 1) the calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints; and 2) the calculation of radioactive liquid and gaseous concentrations, dose rates and cumulative quarterly and yearly doses. The methodology stated in this manual is acceptable for use in demonstrating compliance with 10 CFR 20.106, 10 CFR 50, Appendix I and 40 CFR 190. Note that 10 CFR 20 was revised in its entirety, effective 1/1/94. Note also that 10 CFR 50, Appendix I, which is the basis for the ODCM was not revised at that time. The NRC has determined that it is acceptable for licensees to retain their existing level of effluent control as implementing the ALARA requirement after January 1, 1994, without submitting individual requests for amending their technical specifications to comply with new 10 CFR 20.1101(b). Therefore, the instantaneous release rate limits, which are specified by reference to the values in Appendix B will continue to be the values in Appendix B prior to revision, until the technical specifications are changed. The calculational methodology contained in this manual will continue to be based on the pre-1994 version of 10 CFR 20 until further notice.

More conservative calculational methods and/or conditions (e.g., location and/or exposure pathways) expected to yield higher computed doses than appropriate for the maximally exposed person may be assumed in the dose evaluations.

The ODCM will be maintained at the station for use as a reference guide and training document of accepted methodologies and calculations. Changes will be made to the ODCM calculational methodologies and parameters as is deemed necessary to assure reasonable conservatism in keeping with the principles of 10 CFR 50.36a and Appendix I for demonstrating radioactive effluents are ALARA.

Definitions

1. ACTION

ACTION shall be that part of a specification which prescribes remedial measures required under designated conditions.

2. GASEOUS RADWASTE TREATMENT SYSTEM

A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting off-gases from the primary coolant system and providing for delay or holdup for the purpose of reducing the total radioactivity released to the environment.

3. INSTRUMENTATION SURVEILLANCE

   a. CHANNEL CHECK

   b. CHANNEL FUNCTIONAL TEST

   c. CHANNEL CALIBRATION

   d. SOURCE CHECK

As defined in the Technical Specifications.

4. MEMBER(S) OF THE PUBLIC

MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, its contractors or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant.

5. OPERABLE-OPERABILITY

As defined in the Technical Specifications.

6. PURGE - PURGING

PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other OPERATING condition, in such a manner that replacement air or gas is required to purify the confinement.

7. RADIOLOGICAL ENVIRONMENTAL MONITORING MANUAL (REMM)

The REMM shall contain the current methodology and parameters used in the conduct of the radiological environmental monitoring program.

8. SITE BOUNDARY

The SITE BOUNDARY shall be that line beyond which the land is neither owned, nor leased, nor otherwise controlled by the licensee.

9. UNRESTRICTED AREA

An UNRESTRICTED AREA shall be 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, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.

10. VENTILATION EXHAUST TREATMENT SYSTEM

A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Feature atmospheric cleanup systems (i.e., Auxiliary Building special ventilation, Shield Building ventilation, spent fuel pool ventilation) are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

1.0 Liquid Effluents

1.1 Radiation Monitoring Instrumentation and Controls

The liquid effluent monitoring instrumentation and controls installed at Kewaunee for controlling and monitoring normal radioactive material releases in accordance with 10 CFR 50, Appendix A, Criteria 60 and 64, are summarized as follows:

1) Alarm (and Automatic Termination) - R-18 provides this function on the liquid radwaste effluent line, R-19 on the Steam Generator blowdown.

2) Alarm (only) - R-20 and R-16 provide alarm functions for the Service Water discharges.

3) Composite Samples - Samples are collected weekly from the steam generator blowdown and analyzed by gamma spectroscopy. Samples are collected weekly from the Turbine Building Sump and analyzed by gamma spectroscopy. The weekly samples are composited for monthly tritium and gross alpha analyses and for quarterly Sr-89 and 90 analyses. During periods of identified primary-to-secondary leakage (with the secondary activity > 1.0E-05 μCi/ml), grab samples from the Turbine Building sump are collected daily and analyzed by gamma spectroscopy. These samples are composited for monthly tritium and gross alpha analyses and for quarterly Sr-89 and 90 analyses.

4) Liquid Tank Controls - All radioactive liquid tanks are located inside the Auxiliary Building and contain the suitable confinement systems and drains to prevent direct, unmonitored release to the environment. A liquid radioactive waste flow diagram with the applicable, associated radiation monitoring instrumentation and controls is presented as Figure 1.

1.2 Liquid Effluent Monitor Setpoint Determination

Per the requirements of Specification 3.1, alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the release concentration limits of Specification 3.3.1 are met (i.e., the concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2, for radionuclides and 2.0E-04 μCi/ml for dissolved or entrained noble gases). The following equation[1] must be satisfied to meet the liquid effluent restrictions:

---

[1] Adapted from NUREG-0133

$$c \le \frac{C\,(F+f)}{f} \tag{1.1}$$

where:

C = the effluent concentration limit of Specification 3.3.1 implementing the 10 CFR 20 MPC for the site, in μCi/ml

c = the setpoint, in μCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, which is inversely proportional to the volumetric flow of the effluent line and proportional to the volumetric flow of the dilution stream plus the effluent stream, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the unrestricted area

f = the flow rate at the radiation monitor location in volume per unit time, but in the same units as F, below

F = the dilution water flow rate as measured prior to the release point, in volume per unit time

[Note that if no dilution is provided, $c \le C$. Also, note that when (F) is large compared to (f), then $(F + f) \approx F$.]

1.2.1 <u>Liquid Effluent Monitors (Radwaste, Steam Generator Blowdown and Service Water)</u>. The setpoints for the liquid effluent monitors at the Kewaunee Nuclear Power Plant are determined by the following equations:

$$SP \le \frac{MPC_{e} \times SEN \times CW}{RR} + bkg \tag{1.2}$$

and

$$MPC_{e} = \frac{\sum C_i}{\sum \frac{C_i}{MPC_i}} \tag{1.3}$$

where:

SP = alarm setpoint corresponding to the maximum allowable release rate (cpm)

MPC_e = an effective MPC value for the mixture of radionuclides in the effluent stream (μCi/ml)

C_i = the concentration of radionuclide i in the liquid effluent (μCi)

MPC_i = the MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2 (μCi/ml)

SEN = the sensitivity value to which the monitor is calibrated (cpm per μCi/ml)

CW = the circulating water flow rate (dilution water flow) at the time of release (gal/min)

RR = the liquid effluent release rate (gal/min)

bkg = the background of the monitor (cpm)

The radioactivity monitor setpoint equation (1.2) remains valid during outages when the circulating water dilution is at its lowest. Reduction of the waste stream flow (RR) may be necessary during these periods to meet the discharge criteria. At its lowest value, CW will equal RR and equation (1.2) reverts to the following equation:

$$SP \le MPC_e \; x \; SEN + bkg \qquad (1.4)$$

1.2.2 Conservative Default Values. Conservative alarm setpoints may be determined through the use of generic, default parameters. Table 1.1 summarizes all current default values in use for Kewaunee. They are based upon the following:

a) substitution of the default effective MPC value of 1.0E-05 μCi/ml (refer to Appendix C for justification);

b) substitutions of the lowest operational circulating water flow, in gal/min; and,

c) substitutions of the highest effluent release rate, in gal/min.

1.3 Liquid Effluent Concentration Limits - 10 CFR 20

Specification 3.3.1 limits the concentration of radioactive material in liquid effluents (after dilution in the Circulating Water System) to less than the concentrations as specified in 10 CFR 20, Appendix B, Table II, Column 2 for radionuclides other than noble gases. Noble gases are limited to a diluted concentration of 2E-04 μCi/ml. Release rates are controlled and radiation monitor alarm setpoints are established to ensure that these concentration limits are not exceeded. In the event any liquid release results in an alarm setpoint being exceeded, an evaluation of compliance with the concentration limits of Specification 3.3.1 may be performed using the following equation:

$$\sum [(C_i \div MPC_i) \times (RR \div CW)] \leq 1$$

where:

C_i = concentration of radionuclide i in the undiluted liquid effluent (μCi/ml)

MPC_i = the MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2 (μCi/ml)

= 2E-04 μCi/ml for dissolved or entrained noble gases

RR = the liquid effluent release rate (gal/min)

CW = the circulating water flow rate (dilution water flow) at the time of the release (gal/min)

1.4 Liquid Effluent Dose Calculation - 10 CFR 50

Specification 3.3.2 limits the dose or dose commitment to members of the public from radioactive materials in liquid effluents from the Kewaunee Nuclear Power Plant to:

- during any calendar quarter;

≤ 1.5 mrem to total body

≤ 5.0 mrem to any organ

- during any calendar year;

≤ 3.0 mrem to total body

≤ 10.0 mrem to any organ.

Per Surveillance Requirement 4.3.2, the following calculational methods may be used for determining the dose or dose commitment due to the liquid radioactive effluents from Kewaunee.

$$D_o = \frac{1.67E\text{-}02 \times VOL}{CW} \times \sum (C_i \times A_{io}) \qquad (1.5)$$

where:

D_o = dose or dose commitment to organ o, including total body (mrem)

A_{io} = site-related ingestion dose commitment factor to the total body or any organ o for radionuclide i (mrem/hr per μCi/ml) (Table 1.2)

C_i = average concentration of radionuclide i, in undiluted liquid effluent representative of the volume VOL (μCi/ml)

VOL = volume of liquid effluent released (gal)

CW = average circulating water discharge rate during release period (gal/min)

1.67E-02 = conversion factor (hr/min)

The site-related ingestion dose/dose commitment factors (A_{io}) are presented in Table 1.2 and have been derived in accordance with guidance of NUREG-0133 by the equation:

$$A_{io} = 1.14E{+}05\ [(U_w + D_w) + (U_F \times BF_i)]\ DF_i \qquad (1.6)$$

where:

A_{io} = composite dose parameter for the total body or critical organ o of an adult for radionuclide i, for the fish ingestion and water consumption pathways (mrem/hr per μCi/ml)

1.14E+05 = conversion factor (pCi/μCi x ml/kg ÷ hr/yr)

U_w = adult water consumption (730 kg/yr)

D_w = dilution factor from the near field area within 1/4 mile of the release point to the nearest potable water intake for the

USAR [illegible]

adult water consumption (84[2], unitless)

U_F = adult fish consumption (21 kg/yr)

BF_i = bioaccumulation factor for radionuclide i in fish from Table 1.3 (pCi/kg per pCi/1)

DF_i = dose conversion factor for nuclide i for adults in preselected organ, o, from Table E-11 of Regulatory Guide 1.109, 1977 and NUREG 0172, 1977 (mrem/pCi)

The radionuclides included in the periodic dose assessment per the requirements of Specification 3.3.2 and Surveillance Requirement 4.3.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per Surveillance Requirement 4.3.1.1, Table 4.3.

Radionuclides requiring radiochemical analysis (e.g., Sr-89 and Sr-90) will be added to the dose analysis at a frequency consistent with the required minimum analysis frequency of Table 4.3.

In lieu of the individual radionuclide dose assessment as presented above, the following simplified dose calculational equation may be used for demonstrating compliance with the dose limits of Specification 3.3.2. (Refer to Appendix A for the derivation and justification for this simplified method.)

Total Body

$$D_{tb} = \frac{9.67E{+}03 \times VOL}{CW} \times \sum C_i \qquad (1.7)$$

Maximum Organ

$$D_{max} = \frac{1.18E{+}04 \times VOL}{CW} \times \sum C_i \qquad (1.8)$$

where:

C_i = average concentration of radionuclide i, in undiluted liquid effluent representative of the volume VOL (μCi/ml)

VOL = volume of liquid effluent released (gal)

CW = average circulating water discharge rate during release

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[2] Adapted from the Kewaunee Final Environmental Statement, Section V.

period (gal/min)

D_{tb} = conservatively evaluated total body dose (mrem)

D_{max} = conservatively evaluated maximum organ dose (mrem)

9.67E+03 = conversion factor (hr/min) and the conservative total body dose conversion factor (Cs-134, total body -- 5.79E+05 mrem/hr per μCi/ml)

1.18E+04 = conversion factor (hr/min) and the conservative maximum organ dose conversion factor (Cs-134, liver -- 7.09E+05 mrem/hr per μCi/ml)

1.5 Liquid Effluent Dose Projections

Specification 3.3.3 requires that the liquid radioactive waste processing system be used to reduce the radioactive material levels in the liquid waste prior to release when the quarterly projected doses exceed:

- 0.18 mrem to the total body, or
- 0.62 mrem to any organ.

The applicable liquid waste streams and processing systems are as delineated in Figure 1.

Dose projections are made at least once per 31 days by the following equations:

$$D_{tbp} = D_{tb}\ (91 \div d) \qquad (1.9)$$

$$D_{maxp} = D_{max}\ (91 \div d) \qquad (1.10)$$

where:

D_{tbp} = the total body dose projection for current calendar quarter (mrem)

D_{tb} = the total body dose to date for current calendar quarter as determined by equation (1.5) or (1.7) (mrem)

D_{maxp} = the maximum organ dose projection for current calendar quarter (mrem)

D_{max} = the maximum organ dose to date for current calendar quarter as determined by equation (1.5) or (1.8) (mrem)

d = the number of days to date for current calendar quarter

91 = the number of days in a calendar quarter

1.6 Onsite Disposal of Low-Level Radioactively Contaminated Waste Streams

During the normal operation of Kewaunee, the potential exists for in-plant process streams which are not normally radioactive to become contaminated with very low levels of radioactive materials. These waste streams are normally separated from the radioactive streams. However, due mainly to infrequent, minor system leaks, and anticipated operational occurrences, the potential exists for these systems to become slightly contaminated. At Kewaunee, the secondary system demineralizer resins, the service water pretreatment system sludges, the make-up water system resins, and the sewage treatment plant sludges are waste streams that have the potential to become contaminated at very low levels. During the yearly testing of a batch of pre-treatment sludge, it was found that approximately 15,000 cubic feet of sludge had been contaminated with Cs-137 and Co-60.

The potential radiation doses to members of the public from these onsite disposal methods are well below 1 mrem per year. This dose is in keeping with the guidelines of the National Council on Radiation Protection (NCRP) in their Report No. 91, in which the NCRP established a "negligible individual risk level" at a dose rate of 1 mrem per year.

It is for these type wastes that the NRC acknowledged in Information Notice No. 83-05 and 88-22 that the levels of radioactive material are so low that control and disposal as a radwaste are not warranted. The potential risks to man are negligible and the disposal costs as a radwaste are unwarranted and costly.

This waste material will be monitored and evaluated prior to disposal to ensure its radioactive material content is negligible. It shall then be disposed of in a normal conventional manner with records being maintained of all materials disposed of using these methods.

Approvals for specific alternate disposal methods are listed in Appendix E. Currently, only service water pretreatment (SWPT) facility lagoon sludge and sewage treatment plant sludge have been approved for disposal by land spreading.

1.7 Heating Boiler Blowdown Operation with Primary-to-Secondary Leak

During operation with a primary-to-secondary leak, the potential exists for nonradioactive systems to become contaminated. One such system is the heating system. Activity is transferred from the reactor coolant system into the secondary main steam system through the leak and then into the heating system. Heating boiler operation following operation with a primary-to-secondary leak will result in the heating boiler becoming contaminated.

When the heating boiler is operated, it must be periodically blown down to remove impurities which collect in the system. This blowdown is normally directed to the steam generator blowdown tank but can be diverted to the circulating water discharge. Either way, the blowdown becomes a release path for radioactivity to the environment. The heating boiler blowdown is sampled, using current plant procedures, whenever the primary-to-secondary leakage exceeds 10 gallons per day and the gross gamma activity or tritium activity exceeds 1.0E-05 μCi/ml. The results of these samples allows for the activity being released to the environment to be quantified. This is similar to the method used for the turbine building sump release path. The radioactive effluent limits of 10 CFR Part 20, 40 CFR 190, and Technical Specifications can therefore be maintained.

Figure 1
Liquid Radioactive Effluent Flow Diagram

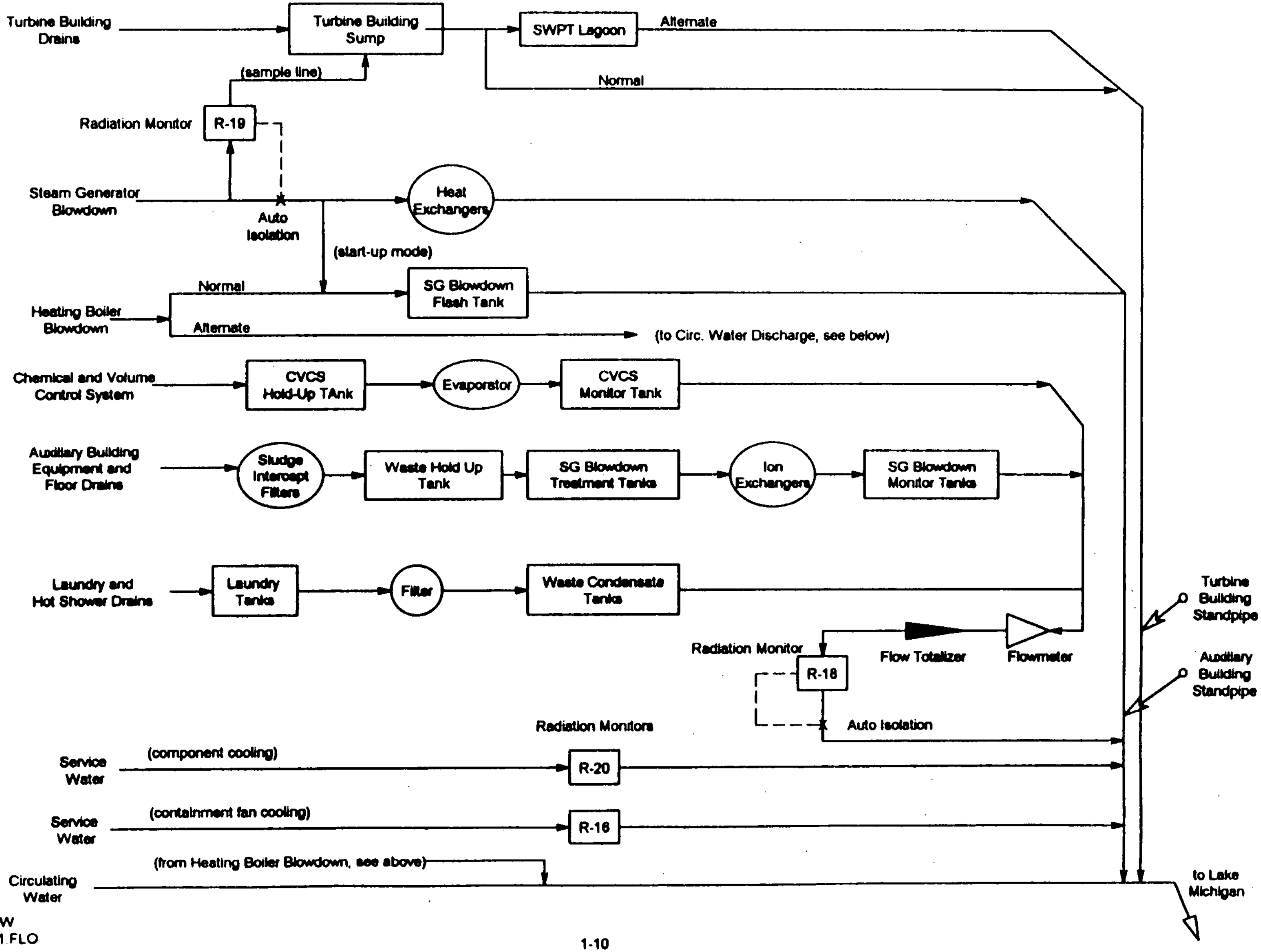

Table 1.1
Parameters for Liquid Alarm Setpoint Determinations

Parameter	Actual Value	Default Value*	Units	Comments
MPC_e	calculated	1.0E-05**	µCi/ml	Calculate for each batch to be released
C_i	measured	N/A	µCi/ml	Taken from gamma spectral analysis of liquid effluent
MPC_i	as determined	N/A	µCi/ml	Taken from 10 CFR 20, Appendix B, Table II, Col. 2
Sensitivity (SEN)				
R-18	as determined	1.0E+08	cpm per µCi/ml	Radwaste effluent
R-19	as determined	1.0E+08		Steam Generator blowdown
R-20	as determined	1.0E+08		Service Water - component cooling
R-16	as determined	9.8E+07		Service Water - Containment fan cooling
CW	as determined	2.58E+05	gpm	Circulating Water System default = winter, single CW pump
Release Rate (RR)				
R-18	as determined	8.0E+01	gpm	Determined prior to release; release rate can be adjusted for Technical Specification compliance
R-19	as determined	2.0E+02		Steam Generator A and B combined
R-20	as determined	5.0E+03		Service Water - component cooling
R-16	as determined	1.5E+03		Service Water - Containment fan cooling
background (bkg)				
R-18	as determined	2.0E+03	cpm	Nominal values only; actual values may be used in lieu of these reference values
R-19	as determined	8.0E+01		
R-20	as determined	6.0E+01		
R-16	as determined	8.0E+01		
Setpoint* (SP)				
R-18	calculated	3.22E+06 + bkg	cpm	Default alarm setpoints; more conservative values may be used as deem appropriate and desirable for assuring regulatory compliance and for maintianing releases ALARA.
R-19	calculated	1.29E+06 + bkg		
R-20	calculated	5.16E+04 + bkg		
R-16	calculated	1.69E+05 + bkg		
Setpoint* (SP) with no Circulating Water System flow, CW=0				
R-18	calculated	1.25E+05 + bkg	cpm	For outages with no Circulating Water System flow (CW=0) and a dilution flow as provided by the Service Water system of 10,000 gpm total.
R-19	calculated	5.00E+04 + bkg		
R-20	calculated	2.00E+03 + bkg		
R-16	calculated	6.53E+03 + bkg		

* Refer to Calculation # C10690 for the default setpoint calculation.
** Refer to Appendix C for derivation

Table 1.2
A_{io} Site Related Ingestion Dose Commitment Factors
(mrem/hr per μCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	-	3.30E-1	3.30E-1	3.30E-1	3.30E-1	3.30E-1	3.30E-1
C-14	3.13E+4	6.26E+3	6.26E+3	6.26E+3	6.26E+3	6.26E+3	6.26E+3
Na-24	4.09E+2	4.09E+2	4.09E+2	4.09E+2	4.09E+2	4.09E+2	4.09E+2
P-32	1.39E+6	8.62E+4	5.36E+4	-	-	-	1.56E+5
Cr-51	-	-	1.28E+0	7.63E-1	2.81E-1	1.69E+0	3.21E+2
Mn-54	-	4.38E+3	8.36E+2	-	1.30E+3	-	1.34E+4
Mn-56	-	1.10E+2	1.96E+1	-	1.40E+2	-	3.52E+3
Fe-55	6.61E+2	4.57E+2	1.06E+2	-	-	2.55E+2	2.62E+2
Fe-59	1.04E+3	2.45E+3	9.40E+2	-	-	6.85E+2	8.17E+3
Co-57	-	2.11E+1	3.51E+1	-	-	-	5.36E+2
Co-58	-	8.99E+1	2.02E+2	-	-	-	1.82E+3
Co-60	-	2.58E+2	5.70E+2	-	-	-	4.85E+3
Ni-63	3.13E+4	2.17E+3	1.05E+3	-	-	-	4.52E+2
Ni-65	1.27E+2	1.65E+1	7.52E+0	-	-	-	4.18E+2
Cu-64	-	1.01E+1	4.72E+0	-	2.53E+1	-	8.57E+2
Zn-65	2.32E+4	7.38E+4	3.33E+4	-	4.93E+4	-	4.65E+4
Zn-69	4.93E+1	9.43E+1	6.56E+0	-	6.13E+1	-	1.42E+1
Br-82	-	-	2.27E+3	-	-	-	2.61E+3
Br-83	-	-	4.05E+1	-	-	-	5.83E+1
Br-84	-	-	5.24E+1	-	-	-	4.12E-4
Br-85	-	-	2.15E+0	-	-	-	-
Rb-86	-	1.01E+5	4.71E+4	-	-	-	1.99E+4
Rb-88	-	2.90E+2	1.54E+2	-	-	-	4.00E-9
Rb-89	-	1.92E+2	1.35E+2	-	-	-	-
Sr-89	2.24E+4	-	6.44E+2	-	-	-	3.60E+3
Sr-90	5.52E+5	-	1.35E+5	-	-	-	1.59E+4
Sr-91	4.13E+2	-	1.67E+1	-	-	-	1.97E+3
Sr-92	1.57E+2	-	6.77E+0	-	-	-	3.10E+3
Y-90	5.85E-1	-	1.57E-2	-	-	-	6.21E+3
Y-91m	5.53E-3	-	2.14E-4	-	-	-	1.62E-2
Y-91	8.58E+0	-	2.29E-1	-	-	-	4.72E+3
Y-92	5.14E-2	-	1.50E-3	-	-	-	9.00E+2
Y-93	1.63E-1	-	4.50E-3	-	-	-	5.17E+3
Zr-95	2.70E-1	8.67E-2	5.87E-2	-	1.36E-1	-	2.75E+2
Zr-97	1.49E-2	3.01E-3	1.38E-3	-	4.55E-3	-	9.34E+2
Nb-95	4.47E+2	2.49E+2	1.34E+2	-	2.46E+2	-	1.51E+6
Nb-97	3.75E+0	9.48E-1	3.46E-1	-	1.11E+0	-	3.50E+3
Mo-99	-	1.07E+2	2.04E+1	-	2.43E+2	-	2.49E+2
Tc-99m	9.11E-3	2.58E-2	3.28E-1	-	3.91E-1	1.26E-2	1.52E+1
Tc-101	9.37E-3	1.35E-2	1.32E-1	-	2.43E-1	6.90E-3	-
Ru-103	4.61E+0	-	1.99E+0	-	1.76E+1	-	5.39E+2
Ru-105	3.84E-1	-	1.52E-1	-	4.96E+0	-	2.35E+2
Ru-106	6.86E+1	-	8.68E+0	-	1.32E+2	-	4.44E+3
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-

Table 1.2
A_{io} Site Related Ingestion Dose Commitment Factors
(mrem/hr per μCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.04E+0	9.62E-1	5.71E-1	-	1.89E+0	-	3.92E+2
Sb-124	9.48E+0	1.79E-1	3.76E+0	2.30E-2	-	7.38E+0	2.69E+2
Sb-125	6.06E+0	6.77E-2	1.44E+0	6.16E-3	-	4.67E+0	6.67E+1
Te-125m	2.57E+3	9.31E+2	3.44E+2	7.73E+2	1.04E+4	-	1.03E+4
Te-127m	6.49E+3	2.32E+3	7.91E+2	1.66E+3	2.64E+4	-	2.18E+4
Te-127	1.05E+2	3.79E+1	2.28E+1	7.81E+1	4.29E+2	-	8.32E+3
Te-129m	1.10E+4	4.11E+3	1.74E+3	3.79E+3	4.60E+4	-	5.55E+4
Te-129	3.01E+1	1.13E+1	7.33E+0	2.31E+1	1.27E+2	-	2.27E+1
Te-131m	1.66E+3	8.11E+2	6.76E+2	1.28E+3	8.22E+3	-	8.05E+4
Te-131	1.89E+1	7.89E+0	5.96E+0	1.55E+1	8.27E+1	-	2.67E+0
Te-132	2.42E+3	1.56E+3	1.47E+3	1.73E+3	1.50E+4	-	7.39E+4
I-130	2.79E+1	8.23E+1	3.25E+1	6.97E+3	1.28E+2	-	7.08E+1
I-131	1.54E+2	2.20E+2	1.26E+2	7.20E+4	3.76E+2	-	5.79E+1
I-132	7.49E+0	2.00E+1	7.01E+0	7.01E+2	3.19E+1	-	3.76E+0
I-133	5.24E+1	9.11E+1	2.78E+1	1.34E+4	1.59E+2	-	8.19E+1
I-134	3.91E+0	1.06E+1	3.80E+0	1.84E+2	1.69E+1	-	9.26E-3
I-135	1.63E+1	4.28E+1	1.58E+1	2.82E+3	6.86E+1	-	4.83E+1
Cs-134	2.98E+5	7.09E+5	5.79E+5	-	2.29E+5	7.61E+4	1.24E+4
Cs-136	3.12E+4	1.23E+5	8.86E+4	-	6.85E+4	9.39E+3	1.40E+4
Cs-137	3.82E+5	5.22E+5	3.42E+5	-	1.77E+5	5.89E+4	1.01E+4
Cs-138	2.64E+2	5.22E+2	2.59E+2	-	3.84E+2	3.79E+1	2.23E-3
Ba-139	1.02E+0	7.30E-4	3.00E-2	-	6.83E-4	4.14E-4	1.82E+0
Ba-140	2.15E+2	2.69E-1	1.41E+1	-	9.16E-2	1.54E-1	4.42E+2
Ba-141	4.98E-1	3.76E-4	1.68E-2	-	3.50E-4	2.13E-4	-
Ba-142	2.25E-1	2.31E-4	1.42E-2	-	1.95E-4	1.31E-4	-
La-140	1.52E-1	7.67E-2	2.03E-2	-	-	-	5.63E+3
La-142	7.79E-3	3.54E-3	8.82E-4	-	-	-	2.59E+1
Ce-141	3.17E-2	2.14E-2	2.43E-3	-	9.95E-3	-	8.19E+1
Ce-143	5.58E-3	4.13E+0	4.57E-4	-	1.82E-3	-	1.54E+2
Ce-144	1.65E+0	6.90E-1	8.87E-2	-	4.10E-1	-	5.58E+2
Pr-143	5.60E-1	2.25E-1	2.77E-2	-	1.30E-1	-	2.45E+3
Pr-144	1.83E-3	7.61E-4	9.31E-5	-	4.29E-4	-	-
Nd-147	3.83E-1	4.42E-1	2.65E-2	-	2.59E-1	-	2.12E+3
W-187	2.96E+2	2.47E+2	8.65E+1	-	-	-	8.10E+4
Np-239	2.97E-2	2.92E-3	1.61E-3	-	9.10E-3	-	5.98E+2

Table 1.3
Bioaccumulation Factors(BFi)
(pCi/kg per pCi/liter)*

Element	Freshwater Fish
H	9.0E-01
C	4.6E+03
Na	1.0E+02
P	3.0E+03
Cr	2.0E+02
Mn	4.0E+02
Fe	1.0E+02
Co	5.0E+01
Ni	1.0E+02
Cu	5.0E+01
Zn	2.0E+03
Br	4.2E+02
Rb	2.0E+03
Sr	3.0E+01
Y	2.5E+01
Zr	3.3E+00
Nb	3.0E+04
Mo	1.0E+01
Tc	1.5E+01
Ru	1.0E+01
Rh	1.0E+01
Ag	2.3E+00
Sb	1.0E+00
Te	4.0E+02
I	1.5E+01
Cs	2.0E+03
Ba	4.0E+00
La	2.5E+01
Ce	1.0E+00
Pr	2.5E+01
Nd	2.5E+01
W	1.2E+03
Np	1.0E+01

* Values in this Table are taken from Regulatory Guide 1.109 except for phosphorus which is adapted from NUREG/CR-1336 and silver and antimony which are taken from UCRL 50564, Rev. 1, October 1972.

2.0 Gaseous Effluents

2.1 Radiation Monitoring Instrumentation and Controls

The gaseous effluent monitoring instrumentation and controls at Kewaunee for controlling and monitoring normal radioactive material releases in accordance with 10 CFR 50, Appendix A, Criteria 60 and 64, are summarized as follows:

2.1.1 Waste Gas Holdup System - The vent header gases are collected by the waste gas holdup system. Gases may be recycled to provide cover gas for the CVCS hold-up tanks or held in the waste gas tanks for decay prior to release. Waste gas decay tanks are batch released after sampling and analysis. The tanks are discharged via the Auxiliary Building vent. R-13 and/or R-14 provide noble gas monitoring and automatic isolation.

2.1.2 Condenser Evacuation System - The air ejector discharge is monitored by R-15. Releases from this system are via the Auxiliary Building vent and are monitored by R-13 and/or R-14.

2.1.3 Containment Purge - Containment purge and ventilation is via the containment stack for the 36-inch RBV system but via the auxiliary building stack for the 2-inch vent and minipurge blower system. The stack radiation monitoring system consists of: a) a noble gas activity monitor providing alarm and automatic termination of release (R-12 and R-21); b) an iodine sampler; and c) a particulate sampler. Effluent flow rates are determined empirically as a function of fan operation (fan curves). Sampler flow rates are determined by flow rate instrumentation.

2.1.4 Auxiliary Building Vent - The Auxiliary Building vent receives discharges from the waste gas holdup system, condenser evacuation system, fuel storage area ventilation, Auxiliary Building radwaste processing area ventilation, 2-inch containment pressure relief purge/vent system, and Auxiliary Building general area. All effluents pass through the R-13 and/or R-14 channels which contain: a) a noble gas monitor; b) an iodine sampler; and c) a particulate sampler. The noble gas monitor provides auto isolation of any waste gas decay tank release and diverts other releases through the special ventilation system. Effluent flow rates are determined by installed flow measurement equipment or as a function of fan operation (fan curves). Sampler flow rates are determined by flow rate instrumentation.

2.1.5 Containment Mini-Purge/Vent System - Slight pressure buildup in containment is a recurring event resulting from normal operation of the plant. Prior to exceeding 2 psig in containment, this excess pressure is vented off. Air from containment is routed to the Auxiliary Building ventilation system via the Post LOCA hydrogen recombiner piping and then out through the Auxiliary Building vent stack. The system is also designed to allow a continuous supply of fresh air to be introduced into containment via a mini-blower to purge gases. An alarm of the Auxiliary Building vent stack monitor (R-13 or R-14) or the containment building airborne radioactivity monitors (R-11, R-12) provides automatic isolation.

A gaseous radioactive waste flow diagram with the applicable, associated radiation monitoring instrumentation and controls is presented as Figure 2.

2.2 Gaseous Effluent Monitor Setpoint Determination

2.2.1 Containment and Auxiliary Building Vent Monitor. Per the requirements of Specification 3.2, alarm setpoints shall be established for the gaseous effluent monitoring instrumentation to ensure that the release rate of noble gases does not exceed corresponding dose rate at the site boundary of 500 mrem/year to the total body or 3000 mrem/year to the skin. Based on a grab sample analysis of the applicable release (i.e., grab sample of the Containment vent or Auxiliary Building vent), the radiation monitoring alarm setpoints may be established by the following calculational method:

$$FRAC = [4.72E{+}02 \times X/Q \times VF \times \sum (C_i \times K_i)] \div 500 \qquad (2.1)$$

$$FRAC = [4.72E{+}02 \times X/Q \times VF \times \sum (C_i \times (L_i + 1.1\ M_i))] \div 3000 \qquad (2.2)$$

where:

FRAC	=	fraction of the allowable release rate based on the identified radionuclide concentrations and the release flow rate
X/Q	=	annual average meteorological dispersion to the controlling site boundary location (sec/m^3)
VF	=	ventilation system flow rate for the applicable release point and monitor (ft^3/min)
C_i	=	concentration of noble gas radionuclide i as determined by radioanalysis of grab sample (μCi/cm^3)
K_i	=	total body dose conversion factor for noble gas radionuclide i (mrem/yr per μCi/m^3, from Table 2.1)
L_i	=	beta skin dose conversion factor for noble gas radionuclide

i (mrem/yr per μCi/m^3, from Table 2.1)

M_i = gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per μCi/m^3, from Table 2.1)

1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad)

4.72E+02 = conversion factor (cm^3/ft^3 x min/sec)

500 = total body dose rate limit (mrem/yr)

3000 = skin dose rate limit (mrem/yr)

Based on the more limiting FRAC (i.e., higher value) as determined above, the alarm setpoint for the Containment and Auxiliary Building vent monitors at Kewaunee may be calculated:

$$SP = [\sum C_i \times SEN \div FRAC] + bkg \qquad (2.3)$$

where:

SP = alarm setpoint corresponding to the maximum allowable release rate (cpm)

SEN = monitor sensitivity (cpm per μCi/cm^3)

bkg = background of the monitor (cpm)

2.2.2 <u>Conservative Default Values</u>. A conservative alarm setpoint can be established, in lieu of the individual radionuclide evaluation based on the grab sample analysis, to eliminate the potential of periodically having to adjust the setpoint to reflect minor changes in radionuclide distribution and variations in release flow rate. The alarm setpoint may be conservatively determined by the default values presented in Table 2.2. These values are based upon:

- the maximum ventilation flow rate;
- a radionuclide distribution[3] comprised of 95% Xe-133, 2% Xe-135, 1% Xe-133m, 1% Kr-88 and 1% Kr-85; and
- an administrative multiplier of 0.5 to conservatively assure that any simultaneous releases do not exceed the maximum allowable release

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[3] Adopted from ANSI N237-1976/ANS-18.1, Source Term Specifications, Table 6.

rate.

For this radionuclide distribution, the alarm setpoint based on the total body dose rate is more restrictive than the corresponding setpoint based on the skin dose rate. The resulting conservative, default setpoints are presented in Table 2.2.

2.3 Gaseous Effluent Instantaneous Dose Rate Calculations - 10 CFR 20

2.3.1 Site Boundary Dose Rate - Noble Gases. Specification 3.4.1.a limits the dose rate at the site boundary due to noble gas releases to ≤ 500 mrem/yr to the total body, and ≤ 3000 mrem/yr to the skin. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event any gaseous releases from the station results in the alarm setpoints being exceeded, an evaluation of the unrestricted area dose rate resulting from the release may be performed using the following equations:

$$\dot{D}_{tb} = X/Q \times \sum (K_i \times \dot{Q}_i) \qquad (2.4)$$

and

$$\dot{D}_s = X/Q \times \sum((L_i + 1.1M_i) \times \dot{Q}_i) \qquad (2.5)$$

where:

$\dot{D}_{tb}$ = total body dose rate (mrem/yr)

$\dot{D}_s$ = skin dose rate (mrem/yr)

X/Q = atmospheric dispersion to the controlling site boundary (sec/m^3)

$\dot{Q}_i$ = average release rate of radionuclide i over the release period under evaluation (μCi/sec)

K_i = total body dose conversion factor for noble gas radionuclide i (mrem/yr per μCi/m^3, from Table 2.1)

L_i = beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per μCi/m^3, from Table 2.1)

M_i = gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per μCi/m^3, from Table 2.1)

1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad)

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2.3 may be used for evaluating the gaseous effluent dose rate.

2.3.2 Site Boundary Dose Rate - Radioiodine and Particulates. Specification 3.4.1.b limits the dose rate to ≤1500 mrem/yr to any organ for I-131, I-133, tritium and particulates with half-lives greater than 8 days. To demonstrate compliance with this limit, an evaluation is performed at a frequency no greater than that corresponding to the sampling and analysis time period for continuous releases (e.g., nominally once per 7 days) and for batch releases on the time period over which any batch release is to occur. The following equation may be used for the dose rate evaluation:

$$\dot{D}_o = X/Q \times \sum (R_i \times \dot{Q}_i) \tag{2.6}$$

where:

$\dot{D}_o$ = average organ dose rate over the sampling time period (mrem/yr)

X/Q = atmospheric dispersion to the controlling site boundary for the inhalation pathway (sec/m^3)

R_i = dose parameter for radionuclide i, (mrem/yr per μCi/m^3) for the child inhalation pathway from Table 2.6

Q_i = average release rate over the appropriate sampling period and analysis frequency for radionuclide i, I-131, I-133, tritium or other radionuclide in particulate form with half-life greater than 8 days (μCi/sec)

By substituting 1500 mrem/yr for $\dot{D}_o$ solving for $\dot{Q}_i$, an allowable release rate for I-131 can be determined. Based on the annual average meteorological dispersion (see Table 2.3) and the most limiting potential pathway, age group and organ (inhalation pathway, child thyroid – R_i = 1.62E+07 mrem/yr per μCi/m^3) the allowable release rate for I-131 is 6.43 μCi/sec. An added conservatism factor of 0.25 has been included in this calculation to account for any potential dose contribution from other radioactive particulate material. For a 7 day period which is the nominal sampling and analysis frequency for I-131, the cumulative allowable release is 3.9 Ci. Therefore, as long as the I-131 releases in any 7 day period do not exceed 3.9 Ci, no additional analyses are needed to verify compliance with the Specification 3.4.1.b limits on allowable release rate.

2.4 Gaseous Effluent Dose Calculations - 10 CFR 50

2.4.1 Unrestricted Area Dose - Noble Gases. Specification 3.4.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly dose limits of (≤ 5 mrad, gamma-air and ≤ 10 mrad, beta-air) and the calendar year limits (≤ 10 mrad, gamma-air and ≤ 20 mrad, beta-air). The following equations may be used to calculate the gamma-air and beta-air doses:

$$D_\gamma = 3.17E\text{-}08 \times X/Q \times \sum (M_i \times Q_i) \tag{2.7}$$

and

$$D_\beta = 3.17E\text{-}08 \times X/Q \times \sum (N_i \times Q_i) \tag{2.8}$$

where:

D_γ = air dose due to gamma emissions for noble gas radionuclides (mrad)

D_β = air dose due to beta emissions for noble gas radionuclides (mrad)

X/Q = atmospheric dispersion to the controlling site boundary (sec/m^3)

Q_i = cumulative release of noble gas radionuclide i over the period of interest (μCi)

M_i = air dose factor due to gamma emissions from noble gas radionuclide i (mrad/yr per $\mu Ci/m^3$ from Table 2.1)

N_i = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per $\mu Ci/m^3$, Table 2.1)

3.17E-08 = conversion factor (yr/sec)

In lieu of the individual noble gas radionuclide dose assessment as presented above, the following simplified dose calculational equation may be used for verifying compliance with the dose limits of Specification 3.4.2. (Refer to Appendix B for the derivation and justification for this simplified method.)

$$D\gamma = \frac{3.17E\text{-}08}{0.50} \times X/Q \times M_{eff} \times \sum Q_i \qquad (2.9)$$

and

$$D_\beta = \frac{3.17E\text{-}08}{0.50} \times X/Q \times N_{eff} \times \sum Q_i \qquad (2.10)$$

where:

M_{eff} = 5.3E+02 effective gamma-air dose factor (mrad/yr per $\mu Ci/m^3$)

N_{eff} = 1.1E+03 effective beta-air dose factor (mrad/yr per $\mu Ci/m^3$)

0.50 = conservatism factor

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2.3, may be used for the evaluation of the gamma-air and beta-air doses.

2.4.2 Unrestricted Area Dose - Radioiodine and Particulates. Per the requirements of Specification 3.4.3[illegible], a periodic assessment shall be performed to evaluate compliance with the quarterly dose limit ($\leq$7.5 mrem) and calendar year limit ($\leq$15 mrem) to any organ. The following equation may be used to evaluate the maximum organ dose due to releases of I-131, I-133, tritium and particulates with half-lives greater than 8 days:

$$D_{aop} = 3.17E\text{-}08 \times W \times SF_p \times \sum (R_i \times Q_i) \qquad (2.11)$$

where:

D_{aop} = dose or dose commitment for age group a to organ o, including the total body, via pathway p from I-131, I-133, tritium and radionuclides in particulate form with half-life greater than eight days (mrem)

W = atmospheric dispersion parameter to the controlling location(s) as identified in Table 2.3

X/Q = atmospheric dispersion for inhalation pathway and H-3 dose contribution via other pathways (sec/m^3)

D/Q = atmospheric deposition for vegetation, milk and ground plane exposure pathways (l/m^2)

R_i = dose factor for radionuclide i, (mrem/yr per μCi/m^3) or (m^2 - mrem/yr per μCi/sec) from Table 2.4 through 2.15 for each age group a and the applicable pathway p as identified in Table 2.3. Values for R_i were derived in accordance with the methods described in NUREG-0133.

Q_i = cumulative release over the period of interest for radionuclide i – I-131 or radioactive material in particulate form with halflife greater than 8 days (μCi).

SF_p = seasonal correction factor to account for the fraction of the period that the applicable exposure pathway does exist.

1) For milk and vegetation exposure pathways:

$$= \frac{\text{\# of months in the period that grazing occurs}}{\text{total \# of months in period}}$$

= 0.5 for annual calculations

2) For inhalation and ground plane exposure pathways: = 1.0

In lieu of the individual radionuclide (I-131 and particulates) dose assessment as presented above, the following simplified dose calculational equation may be used for verifying compliance with the dose limits of Specification 3.4.3.

$$D_{max} = 3.17E{-}08 \times W \times SF_p \times R_{I\text{-}131} \times \sum Q_i \qquad (2.12)$$

where:

D_{max} = maximum organ dose (mrem)

$R_{I\text{-}131}$ = I-131 dose parameter for the thyroid for the identified controlling pathway

= 1.05E+12, infant thyroid dose parameter with the grass-cow-milk pathway controlling (m^2 - mrem/yr per μCi/sec)

The ground plane exposure and inhalation pathways need not be considered when the above simplified calculational method is used because of the overall negligible contribution of these pathways to the total thyroid dose. It is recognized that for some particulate radionuclides (e.g. Co-60 and Cs-137), the ground plane exposure pathway may represent a higher dose contribution than either the vegetation or grass-cow-milk pathway. However, use of the I-131 thyroid dose parameter for all radionuclides will maximize the organ dose calculation, especially considering that no other radionuclide has a higher dose parameter for any organ via any pathway than I-131 for the thyroid via the grass-cow-milk pathway.

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Kewaunee as identified by the annual land-use census, see Specification 3.6.2. Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2.3.

2.5 Gaseous Effluent Dose Projection

Specification 3.4.4 requires that the Ventilation Exhaust Treatment System be used to reduce radioactive material levels prior to discharge when projected doses exceed one-half the annnal design objective rate in any calendar quarter, i.e., exceeding:

- 0.62 mrad/quarter, gamma air;
- 1.25 mrad/quarter, beta air; or
- 0.94 mrem/quarter, maximum organ.

The applicable gaseous release sources and processing systems are as delineated in Figure 2.

Dose projections are performed at least once per 31 days by the following equations:

$$D_{\gamma p} = D_{\gamma} \times (91 + d) \qquad (2.13)$$

$$D_{\beta p} = D_{\beta} \times (91 + d) \qquad (2.14)$$

$$D_{maxp} = D_{max} \times (91 + d) \qquad (2.15)$$

where:

$D_{\gamma p}$ = gamma air dose projection for current calendar quarter (mrad)

D_{γ} = gamma air dose to date for current calendar quarter as determined by equation (2.7) or (2.9) (mrad)

$D_{\beta p}$ = beta air dose projection for current calendar quarter (mrad)

D_{β} = beta air dose to date for current calendar quarter as determined by equation (2.8) or (2.10) (mrad)

D_{maxp} = maximum organ dose projection for current calendar quarter (mrem)

D_{max} = maximum organ dose to date for current calendar quarter as determined by equation (2.11) or (2.12) (mrem)

d = number of days to date in current calendar quarter

91 = number of days in a calendar quarter

2.6 Environmental Radiation Protection Standards 40 CFR 190

For the purpose of implementing Specification 3.5 on the EPA environmental radiation protection standard and Technical Specification 6.9.b.2 on reporting requirements, dose calculations may be performed using the above equations with the substitution of average or actual meteorological parameters for the period of interest and actual applicable pathways. Any exposure attributable to on-site sources will be evaluated based on the results of the environmental monitoring program (TLD measurements) or by calculational methods. NUREG-0543 describes acceptable methods for demonstrating compliance with 40 CFR Part 190 when radioactive effluents exceed the Appendix I portion of the specifications.

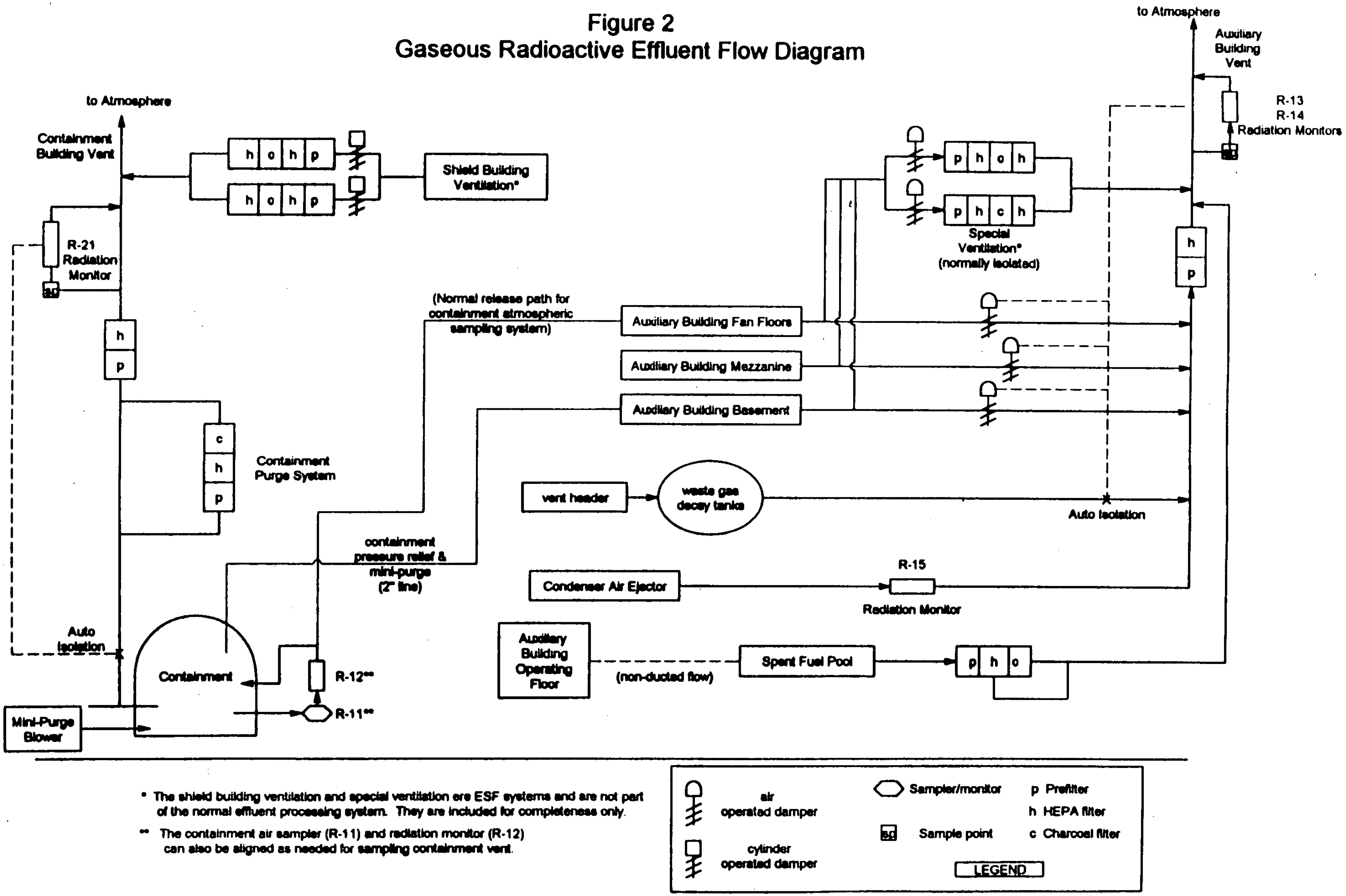
2.7 Incineration of Radioactively Contaminated Oil

During plant operation, radioactively contaminated oils are generated from various equipment operating in the plant. The largest source of contaminated oil is the reactor coolant pump lubricating oil which is periodically changed for preventive maintenance reasons. 10 CFR Part 20 allows licensees to incinerate radioactively contaminated oils on site provided that the total radioactive effluents from the facility conform to the requirements of 10 CFR Part 50, Appendix I.

Radioactively contaminated oil, which is designated for incineration, will be collected in containers which are uniquely serialized such that the contents can be identified and tracked. Each container will be sampled and analyzed for radioactivity. The isotopic concentrations will be recorded for each container.

The heating boiler will be utilized to incinerate the radioactively contaminated oil collected on site. A gaseous radwaste effluent dose calculation, as prescribed in Section 2.3 of the ODCM, will be performed to insure that the limits established by Specifications 3.4.1, 3.4.2 and 3.4.3 are not exceeded. Release of the activity is assumed to occur at the time the contaminated oil is transferred into the heating boiler fuel oil storage tank and will be accounted for using established plant procedures. This will be valid for an assumed release from the fuel oil storage tank vent, fill piping, or from the boiler exhaust stack. See Figure 3 for a description of the heating boiler fuel oil system.

Figure 2
Gaseous Radioactive Effluent Flow Diagram



* The shield building ventilation and special ventilation are ESF systems and are not part of the normal effluent processing system. They are included for completeness only.

** The containment air sampler (R-11) and radiation monitor (R-12) can also be aligned as needed for sampling containment vent.

Figure 3
Simplified Heating Boiler Fuel Oil Piping System

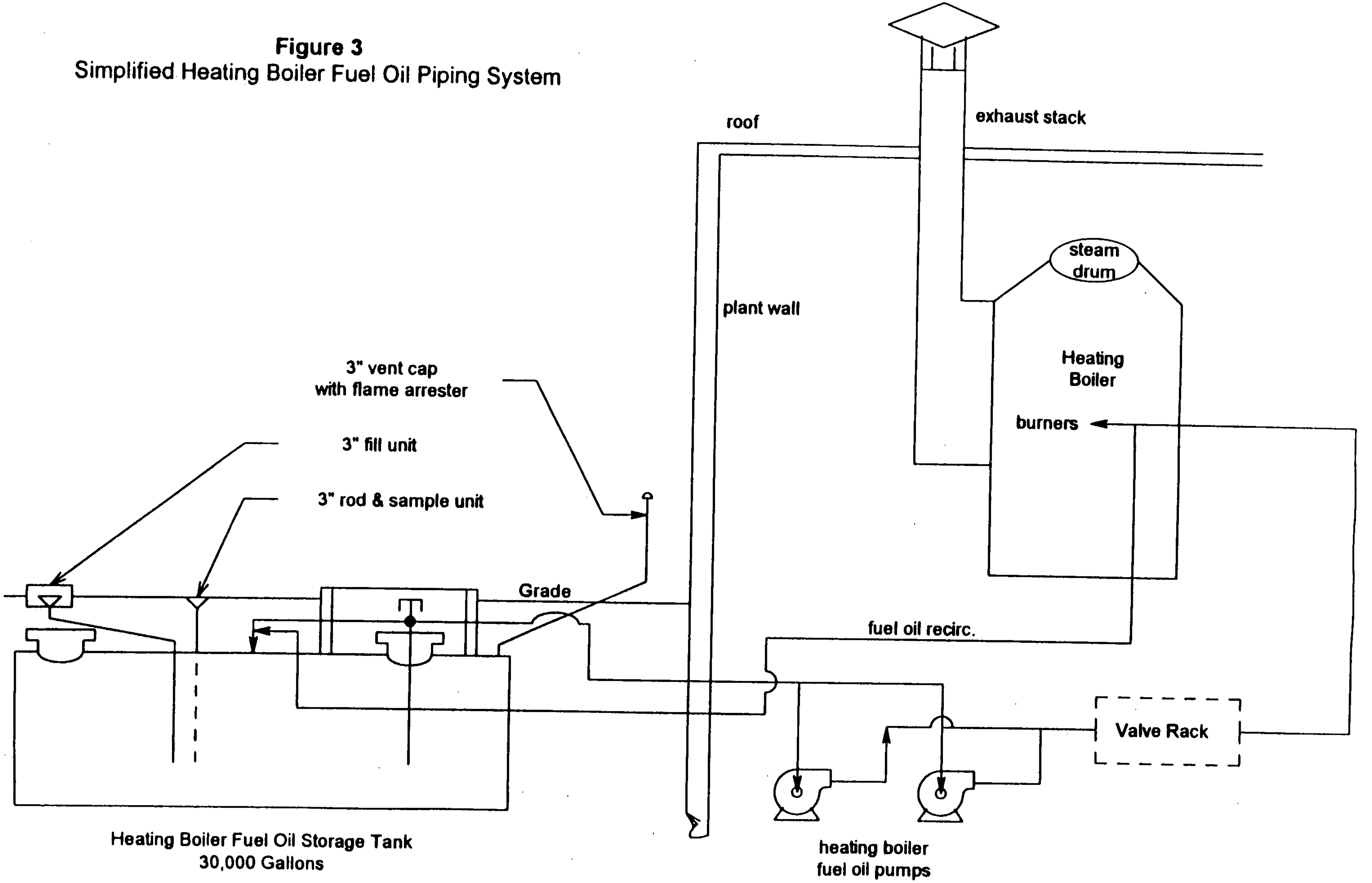


Table 2.1
Dose Factors for Noble Gases

Radionuclide	Total Body Dose Factor Ki (mrem/yr per µCi/m³)	Skin Dose Factor Li (mrem/yr per µCi/m³)	Gamma Air Dose Factor Mi (mrad/yr per µCi/m³)	Beta Air Dose Factor Ni (mrad/yr per µCi/m³)
Kr-83m	7.56E-02	-----	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

Table 2.2
Parameters for Gaseous Alarm Setpoint Determinations

Parameter	Actual Value	Default Value*	Units	Comments
X/Q	calculated	3.6E-06	sec/m^3	Licensing technical specification value
VF	fan curves	33,000 54,000	cfm	Containment -normal plus purge modes Auxiliary Building - normal operation
C_i	measured	N/A	μCi/m^3	
K_i	nuclide specific	N/A	mrem/yr per μCi/m^3	Values from Table 2.1
L_i	nuclide specific	N/A	mrem/yr per μCi/m^3	Values from Table 2.1
M_i	nuclide specific	N/A	mrem/yr per μCi/m^3	Values from Table 2.1
Sensitivity** (SEN)				
R-12	as determined	2.32E+07	cpm per μCi/cm^3	Containment
R-21		2.32E+07		Containment
R-13		2.32E+07		Auxiliary Building
R-14		2.32E+07		Auxiliary Building
background (bkg)				
R-12	as determined	4.0E+02	cpm	Nominal values only; actual values may be used in lieu of these reference values.
R-21		4.0E+01		
R-13		6.0E+02		
R-14		9.0E+02		
Setpoint* (SP)				
R-12	calculated	2.2E+05 + bkg	cpm	Default alarm setpoints; more conservative values may be used as deemed appropriate and desirable for ensuring reulatory compliance and for maintaining releases ALARA.
R-21	calculated	2.2E+05 + bkg		
R-13	calculated	1.3E+05 + bkg		
R-14	calculated	1.3E+05 + bkg		

* Refer to Calculation # C10690 for the default setpoint calculation.

** Conservatively based on Xe-133 sensitivity

Table 2.3
Controlling Locations, Pathways and Atmospheric Dispersion for Dose Calculations

			Atmospberic Dispersion	
Specification	**Location**	**Pathway(s)**	**X/Q (sec/m^3)**	**D/Q (1/m^3)**
3.4.1.a	site boundary (1300 m, N)	noble gases direct exposure	3.6E-06	N/A
3.4.1.b	site boundary (1300 m, N)	inhalation	3.6E-06	N/A
3.4.2	site boundary (1300 m, N)	gamma-air beta-air	3.6E-06	N/A
3.4.3	residence/dairy (1 mile W)	vegetation, milk and ground plane	5.6E-07	5.6E-09

Table 2.4
R_i Inhalation Pathway Dose Factors - ADULT
(mrem/yr per $\mu Ci/m^3$)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3
C-14	1.82E+4	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3
Na-24	1.02E+4	1.02E+4	1.02E+4	1.02E+4	1.02E+4	1.02E+4	1.02E+4
P-32	1.32E+6	7.71E+4	-	-	-	8.64E+4	5.01E+4
Cr-51	-	-	5.95E+1	2.28E+1	1.44E+4	3.32E+3	1.00E+2
Mn-54	-	3.96E+4	-	9.84E+3	1.40E+6	7.74E+4	6.30E+3
Mn-56	-	1.24E+0	-	1.30E+0	9.44E+3	2.02E+4	1.83E-1
Fe-55	2.46E+4	1.70E+4	-	-	7.21E+4	6.03E+3	3.94E+3
Fe-59	1.18E+4	2.78E+4	-	-	1.02E+6	1.88E+5	1.06E+4
Co-57	-	6.92E+2	-	-	3.70E+5	3.14E+4	6.71E+2
Co-58	-	1.58E+3	-	-	9.28E+5	1.06E+5	2.07E+3
Co-60	-	1.15E+4	-	-	5.97E+6	2.85E+5	1.48E+4
Ni-63	4.32E+5	3.14E+4	-	-	1.78E+5	1.34E+4	1.45E+4
Ni-65	1.54E+0	2.10E-1	-	-	5.60E+3	1.23E+4	9.12E-2
Cu-64	-	1.46E+0	-	4.62E+0	6.78E+3	4.90E+4	6.15E-1
Zn-65	3.24E+4	1.03E+5	-	6.90E+4	8.64E+5	5.34E+4	4.66E+4
Zn-69	3.38E-2	6.51E-2	-	4.22E-2	9.20E+2	1.63E+1	4.52E-3
Br-82	-	-	-	-	-	1.04E+4	1.35E+4
Br-83	-	-	-	-	-	2.32E+2	2.41E+2
Br-84	-	-	-	-	-	1.64E-3	3.13E+2
Br-85	-	-	-	-	-	-	1.28E+1
Rb-86	-	1.35E+5	-	-	-	1.66E+4	5.90E+4
Rb-88	-	3.87E+2	-	-	-	3.34E-9	1.93E+2
Rb-89	-	2.56E+2	-	-	-	-	1.70E+2
Sr-89	3.04E+5	-	-	-	1.40E+6	3.50E+5	8.72E+3
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Sr-91	6.19E+1	-	-	-	3.65E+4	1.91E+5	2.50E+0
Sr-92	6.74E+0	-	-	-	1.65E+4	4.30E+4	2.91E-1
Y-90	2.09E+3	-	-	-	1.70E+5	5.06E+5	5.61E+1
Y-91m	2.61E-1	-	-	-	1.92E+3	1.33E+0	1.02E-2
Y-91	4.62E+5	-	-	-	1.70E+6	3.85E+5	1.24E+4
Y-92	1.03E+1	-	-	-	1.57E+4	7.35E+4	3.02E-1
Y-93	9.44E+1	-	-	-	4.85E+4	4.22E+5	2.61E+0
Zr-95	1.07E+5	3.44E+4	-	5.42E+4	1.77E+6	1.50E+5	2.33E+4
Zr-97	9.68E+1	1.96E+1	-	2.97E+1	7.87E+4	5.23E+5	9.04E+0
Nb-95	1.41E+4	7.82E+3	-	7.74E+3	5.05E+5	1.04E+5	4.21E+3
Nb-97	2.22E-1	5.62E-2	-	6.54E-2	2.40E+3	2.42E+2	2.05E-2
Mo-99	-	1.21E+2	-	2.91E+2	9.12E+4	2.48E+5	2.30E+1
Tc-99m	1.03E-3	2.91E-3	-	4.42E-2	7.64E+2	4.16E+3	3.70E-2
Tc-101	4.18E-5	6.02E-5	-	1.08E-3	3.99E+2	-	5.90E-4

Table 2.4
R_i Inhalation Pathway Dose Factors - ADULT
(mrem/yr per $\mu Ci/m^3$)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	1.53E+3	-	-	5.83E+3	5.05E+5	1.10E+5	6.58E+2
Ru-105	7.90E-1	-	-	1.02E+0	1.10E+4	4.82E+4	3.11E-1
Ru-106	6.91E+4	-	-	1.34E+5	9.36E+6	9.12E+5	8.72E+3
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.08E+4	1.00E+4	-	1.97E+4	4.63E+6	3.02E+5	5.94E+3
Sb-124	3.12E+4	5.89E+2	7.55E+1	-	2.48E+6	4.06E+5	1.24E+4
Sb-125	5.34E+4	5.95E+2	5.40E+1	-	1.74E+6	1.01E+5	1.26E+4
Te-125m	3.42E+3	1.58E+3	1.05E+3	1.24E+4	3.14E+5	7.06E+4	4.67E+2
Te-127m	1.26E+4	5.77E+3	3.29E+3	4.58E+4	9.60E+5	1.50E+5	1.57E+3
Te-127	1.40E+0	6.42E-1	1.06E+0	5.10E+0	6.51E+3	5.74E+4	3.10E-1
Te-129m	9.76E+3	4.67E+3	3.44E+3	3.66E+4	1.16E+6	3.83E+5	1.58E+3
Te-129	4.98E-2	2.39E-2	3.90E-2	1.87E-1	1.94E+3	1.57E+2	1.24E-2
Te-131m	6.99E+1	4.36E+1	5.50E+1	3.09E+2	1.46E+5	5.56E+5	2.90E+1
Te-131	1.11E-2	5.95E-3	9.36E-3	4.37E-2	1.39E+3	1.84E+1	3.59E-3
Te-132	2.60E+2	2.15E+2	1.90E+2	1.46E+3	2.88E+5	5.10E+5	1.62E+2
I-130	4.58E+3	1.34E+4	1.14E+6	2.09E+4	-	7.69E+3	5.28E+3
I-131	2.52E+4	3.58E+4	1.19E+7	6.13E+4	-	6.28E+3	2.05E+4
I-132	1.16E+3	3.26E+3	1.14E+5	5.18E+3	-	4.06E+2	1.16E+3
I-133	8.64E+3	1.48E+4	2.15E+6	2.58E+4	-	8.88E+3	4.52E+3
I-134	6.44E+2	1.73E+3	2.98E+4	2.75E+3	-	1.01E+0	6.15E+2
I-135	2.68E+3	6.98E+3	4.48E+5	1.11E+4	-	5.25E+3	2.57E+3
Cs-134	3.73E+5	8.48E+5	-	2.87E+5	9.76E+4	1.04E+4	7.28E+5
Cs-136	3.90E+4	1.46E+5	-	8.56E+4	1.20E+4	1.17E+4	1.10E+5
Cs-137	4.78E+5	6.21E+5	-	2.22E+5	7.52E+4	8.40E+3	4.28E+5
Cs-138	3.31E+2	6.21E+2	-	4.80E+2	4.86E+1	1.86E-3	3.24E+2
Ba-139	9.36E-1	6.66E-4	-	6.22E-4	3.76E+3	8.96E+2	2.74E-2
Ba-140	3.90E+4	4.90E+1	-	1.67E+1	1.27E+6	2.18E+5	2.57E+3
Ba-141	1.00E-1	7.53E-5	-	7.00E-5	1.94E+3	1.16E-7	3.36E-3
Ba-142	2.63E-2	2.70E-5	-	2.29E-5	1.19E+3	-	1.66E-3
La-140	3.44E+2	1.74E+2	-	-	1.36E+5	4.58E+5	4.58E+1
La-142	6.83E-1	3.10E-1	-	-	6.33E+3	2.11E+3	7.72E-2
Ce-141	1.99E+4	1.35E+4	-	6.26E+3	3.62E+5	1.20E+5	1.53E+3
Ce-143	1.86E+2	1.38E+2	-	6.08E+1	7.98E+4	2.26E+5	1.53E+1
Ce-144	3.43E+6	1.43E+6	-	8.48E+5	7.78E+6	8.16E+5	1.84E+5
Pr-143	9.36E+3	3.75E+3	-	2.16E+3	2.81E+5	2.00E+5	4.64E+2
Pr-144	3.01E-2	1.25E-2	-	7.05E-3	1.02E+3	2.15E-8	1.53E-3
Nd-147	5.27E+3	6.10E+3	-	3.56E+3	2.21E+5	1.73E+5	3.65E+2
W-187	8.48E+0	7.08E+0	-	-	2.90E+4	1.55E+5	2.48E+0
Np-239	2.30E+2	2.26E+1	-	7.00E+1	3.76E+4	1.19E+5	1.24E+1

Table 2.5
R_i Inhalation Pathway Dose Factors - TEEN
(mrem/yr per μCi/m³)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3
C-14	2.60E+4	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3
Na-24	1.38E+4	1.38E+4	1.38E+4	1.38E+4	1.38E+4	1.38E+4	1.38E+4
P-32	1.89E+6	1.10E+5	-	-	-	9.28E+4	7.16E+4
Cr-51	-	-	7.50E+1	3.07E+1	2.10E+4	3.00E+3	1.35E+2
Mn-54	-	5.11E+4	-	1.27E+4	1.98E+6	6.68E+4	8.40E+3
Mn-56	-	1.70E+0	-	1.79E+0	1.52E+4	5.74E+4	2.52E-1
Fe-55	3.34E+4	2.38E+4	-	-	1.24E+5	6.39E+3	5.54E+3
Fe-59	1.59E+4	3.70E+4	-	-	1.53E+6	1.78E+5	1.43E+4
Co-57	-	6.92E+2	-	-	5.86E+5	3.14E+4	9.20E+2
Co-58	-	2.07E+3	-	-	1.34E+6	9.52E+4	2.78E+3
Co-60	-	1.51E+4	-	-	8.72E+6	2.59E+5	1.98E+4
Ni-63	5.80E+5	4.34E+4	-	-	3.07E+5	1.42E+4	1.98E+4
Ni-65	2.18E+0	2.93E-1	-	-	9.36E+3	3.67E+4	1.27E-1
Cu-64	-	2.03E+0	-	6.41E+0	1.11E+4	6.14E+4	8.48E-1
Zn-65	3.86E+4	1.34E+5	-	8.64E+4	1.24E+6	4.66E+4	6.24E+4
Zn-69	4.83E-2	9.20E-2	-	6.02E-2	1.58E+3	2.85E+2	6.46E-3
Br-82	-	-	-	-	-	-	1.82E+4
Br-83	-	-	-	-	-	-	3.44E+2
Br-84	-	-	-	-	-	-	4.33E+2
Br-85	-	-	-	-	-	-	1.83E+1
Rb-86	-	1.90E+5	-	-	-	1.77E+4	8.40E+4
Rb-88	-	5.46E+2	-	-	-	2.92E-5	2.72E+2
Rb-89	-	3.52E+2	-	-	-	3.38E-7	2.33E+2
Sr-89	4.34E+5	-	-	-	2.42E+6	3.71E+5	1.25E+4
Sr-90	1.08E+8	-	-	-	1.65E+7	7.65E+5	6.68E+6
Sr-91	8.80E+1	-	-	-	6.07E+4	2.59E+5	3.51E+0
Sr-92	9.52E+0	-	-	-	2.74E+4	1.19E+5	4.06E-1
Y-90	2.98E+3	-	-	-	2.93E+5	5.59E+5	8.00E+1
Y-91m	3.70E-1	-	-	-	3.20E+3	3.02E+1	1.42E-2
Y-91	6.61E+5	-	-	-	2.94E+6	4.09E+5	1.77E+4
Y-92	1.47E+1	-	-	-	2.68E+4	1.65E+5	4.29E-1
Y-93	1.35E+2	-	-	-	8.32E+4	5.79E+5	3.72E+0
Zr-95	1.46E+5	4.58E+4	-	6.74E+4	2.69E+6	1.49E+5	3.15E+4
Zr-97	1.38E+2	2.72E+1	-	4.12E+1	1.30E+5	6.30E+5	1.26E+1
Nb-95	1.86E+4	1.03E+4	-	1.00E+4	7.51E+5	9.68E+4	5.66E+3
Nb-97	3.14E-1	7.78E-2	-	9.12E-2	3.93E+3	2.17E+3	2.84E-2
Mo-99	-	1.69E+2	-	4.11E+2	1.54E+5	2.69E+5	3.22E+1
Tc-99m	1.38E-3	3.86E-3	-	5.76E-2	1.15E+3	6.13E+3	4.99E-2
Tc-101	5.92E-5	8.40E-5	-	1.52E-3	6.67E+2	8.72E-7	8.24E-4

Table 2.5
R_i Inhalation Pathway Dose Factors - TEEN
(mrem/yr per μCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	2.10E+3	-	-	7.43E+3	7.83E+5	1.09E+5	8.96E+2
Ru-105	1.12E+0	-	-	1.41E+0	1.82E+4	9.04E+4	4.34E-1
Ru-106	9.84E+4	-	-	1.90E+5	1.61E+7	9.60E+5	1.24E+4
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.38E+4	1.31E+4	-	2.50E+4	6.75E+6	2.73E+5	7.99E+3
Sb-124	4.30E+4	7.94E+2	9.76E+1	-	3.85E+6	3.98E+5	1.68E+4
Sb-125	7.38E+4	8.08E+2	7.04E+1	-	2.74E+6	9.92E+4	1.72E+4
Te-125m	4.88E+3	2.24E+3	1.40E+3	-	5.36E+5	7.50E+4	6.67E+2
Te-127m	1.80E+4	8.16E+3	4.38E+3	6.54E+4	1.66E+6	1.59E+5	2.18E+3
Te-127	2.01E+0	9.12E-1	1.42E+0	7.28E+0	1.12E+4	8.08E+4	4.42E-1
Te-129m	1.39E+4	6.58E+3	4.58E+3	5.19E+4	1.98E+6	4.05E+5	2.25E+3
Te-129	7.10E-2	3.38E-2	5.18E-2	2.66E-1	3.30E+3	1.62E+3	1.76E-2
Te-131m	9.84E+1	6.01E+1	7.25E+1	4.39E+2	2.38E+5	6.21E+5	4.02E+1
Te-131	1.58E-2	8.32E-3	1.24E-2	6.18E-2	2.34E+3	1.51E+1	5.04E-3
Te-132	3.60E+2	2.90E+2	2.46E+2	1.95E+3	4.49E+5	4.63E+5	2.19E+2
I-130	6.24E+3	1.79E+4	1.49E+6	2.75E+4	-	9.12E+3	7.17E+3
I-131	3.54E+4	4.91E+4	1.46E+7	8.40E+4	-	6.49E+3	2.64E+4
I-132	1.59E+3	4.38E+3	1.51E+5	6.92E+3	-	1.27E+3	1.58E+3
I-133	1.22E+4	2.05E+4	2.92E+6	3.59E+4	-	1.03E+4	6.22E+3
I-134	8.88E+2	2.32E+3	3.95E+4	3.66E+3	-	2.04E+1	8.40E+2
I-135	3.70E+3	9.44E+3	6.21E+5	1.49E+4	-	6.95E+3	3.49E+3
Cs-134	5.02E+5	1.13E+6	-	3.75E+5	1.46E+5	9.76E+3	5.49E+5
Cs-136	5.15E+4	1.94E+5	-	1.10E+5	1.78E+4	1.09E+4	1.37E+5
Cs-137	6.70E+5	8.48E+5	-	3.04E+5	1.21E+5	8.48E+3	3.11E+5
Cs-138	4.66E+2	8.56E+2	-	6.62E+2	7.87E+1	2.70E-1	4.46E+2
Ba-139	1.34E+0	9.44E-4	-	8.88E-4	6.46E+3	6.45E+3	3.90E-2
Ba-140	5.47E+4	6.70E+1	-	2.28E+1	2.03E+6	2.29E+5	3.52E+3
Ba-141	1.42E-1	1.06E-4	-	9.84E-5	3.29E+3	7.46E-4	4.74E-3
Ba-142	3.70E-2	3.70E-5	-	3.14E-5	1.91E+3	-	2.27E-3
La-140	4.79E+2	2.36E+2	-	-	2.14E+5	4.87E+5	6.26E+1
La-142	9.60E-1	4.25E-1	-	-	1.02E+4	1.20E+4	1.06E-1
Ce-141	2.84E+4	1.90E+4	-	8.88E+3	6.14E+5	1.26E+5	2.17E+3
Ce-143	2.66E+2	1.94E+2	-	8.64E+1	1.30E+5	2.55E+5	2.16E+1
Ce-144	4.89E+6	2.02E+6	-	1.21E+6	1.34E+7	8.64E+5	2.62E+5
Pr-143	1.34E+4	5.31E+3	-	3.09E+3	4.83E+5	2.14E+5	6.62E+2
Pr-144	4.30E-2	1.76E-2	-	1.01E-2	1.75E+3	2.35E-4	2.18E-3
Nd-147	7.86E+3	8.56E+3	-	5.02E+3	3.72E+5	1.82E+5	5.13E+2
W-187	1.20E+1	9.76E+0	-	-	4.74E+4	1.77E+5	3.43E+0
Np-239	3.38E+2	3.19E+1	-	1.00E+2	6.49E+4	1.32E+5	1.77E+1

Table 2.6
R_i Inhalation Pathway Dose Factors - CHILD
(mrem/yr per $\mu Ci/m^3$)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3
C-14	3.59E+4	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3
Na-24	1.61E+4	1.61E+4	1.61E+4	1.61E+4	1.61E+4	1.61E+4	1.61E+4
P-32	2.60E+6	1.14E+5	-	-	-	4.22E+4	9.88E+4
Cr-51	-	-	8.55E+1	2.43E+1	1.70E+4	1.08E+3	1.54E+2
Mn-54	-	4.29E+4	-	1.00E+4	1.58E+6	2.29E+4	9.51E+3
Mn-56	-	1.66E+0	-	1.67E+0	1.31E+4	1.23E+5	3.12E-1
Fe-55	4.74E+4	2.52E+4	-	-	1.11E+5	2.87E+3	7.77E+3
Fe-59	2.07E+4	3.34E+4	-	-	1.27E+6	7.07E+4	1.67E+4
Co-57	-	9.03E+2	-	-	5.07E+5	1.32E+4	1.07E+3
Co-58	-	1.77E+3	-	-	1.11E+6	3.44E+4	3.16E+3
Co-60	-	1.31E+4	-	-	7.07E+6	9.62E+4	2.26E+4
Ni-63	8.21E+5	4.63E+4	-	-	2.75E+5	6.33E+3	2.80E+4
Ni-65	2.99E+0	2.96E-1	-	-	8.18E+3	8.40E+4	1.64E-1
Cu-64	-	1.99E+0	-	6.03E+0	9.58E+3	3.67E+4	1.07E+0
Zn-65	4.26E+4	1.13E+5	-	7.14E+4	9.95E+5	1.63E+4	7.03E+4
Zn-69	6.70E-2	9.66E-2	-	5.85E-2	1.42E+3	1.02E+4	8.92E-3
Br-82	-	-	-	-	-	-	2.09E+4
Br-83	-	-	-	-	-	-	4.74E+2
Br-84	-	-	-	-	-	-	5.48E+2
Br-85	-	-	-	-	-	-	2.53E+1
Rb-86	-	1.98E+5	-	-	-	7.99E+3	1.14E+5
Rb-88	-	5.62E+2	-	-	-	1.72E+1	3.66E+2
Rb-89	-	3.45E+2	-	-	-	1.89E+0	2.90E+2
Sr-89	5.99E+5	-	-	-	2.16E+6	1.67E+5	1.72E+4
Sr-90	1.01E+8	-	-	-	1.48E+7	3.43E+5	6.44E+6
Sr-91	1.21E+2	-	-	-	5.33E+4	1.74E+5	4.59E+0
Sr-92	1.31E+1	-	-	-	2.40E+4	2.42E+5	5.25E-1
Y-90	4.11E+3	-	-	-	2.62E+5	2.68E+5	1.11E+2
Y-91m	5.07E-1	-	-	-	2.81E+3	1.72E+3	1.84E-2
Y-91	9.14E+5	-	-	-	2.63E+6	1.84E+5	2.44E+4
Y-92	2.04E+1	-	-	-	2.39E+4	2.39E+5	5.81E-1
Y-93	1.86E+2	-	-	-	7.44E+4	3.89E+5	5.11E+0
Zr-95	1.90E+5	4.18E+4	-	5.96E+4	2.23E+6	6.11E+4	3.70E+4
Zr-97	1.88E+2	2.72E+1	-	3.89E+1	1.13E+5	3.51E+5	1.60E+1
Nb-95	2.35E+4	9.18E+3	-	8.62E+3	6.14E+5	3.70E+4	6.55E+3
Nb-97	4.29E-1	7.70E-2	-	8.55E-2	3.42E+3	2.78E+4	3.60E-2
Mo-99	-	1.72E+2	-	3.92E+2	1.35E+5	1.27E+5	4.26E+1
Tc-99m	1.78E-3	3.48E-3	-	5.07E-2	9.51E+2	4.81E+3	5.77E-2
Tc-101	8.10E-5	8.51E-5	-	1.45E-3	5.85E+2	1.63E+1	1.08E-3

Table 2.6
R_i Inhalation Pathway Dose Factors - CHILD
(mrem/yr per μCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	2.79E+3	-	-	7.03E+3	6.62E+5	4.48E+4	1.07E+3
Ru-105	1.53E+0	-	-	1.34E+0	1.59E+4	9.95E+4	5.55E-1
Ru-106	1.36E+5	-	-	1.84E+5	1.43E+7	4.29E+5	1.69E+4
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.69E+4	1.14E+4	-	2.12E+4	5.48E+6	1.00E+5	9.14E+3
Sb-124	5.74E+4	7.40E+2	1.26E+2	-	3.24E+6	1.64E+5	2.00E+4
Sb-125	9.84E+4	7.59E+2	9.10E+1	-	2.32E+6	4.03E+4	2.07E+4
Te-125m	6.73E+3	2.33E+3	1.92E+3	-	4.77E+5	3.38E+4	9.14E+2
Te-127m	2.49E+4	8.55E+3	6.07E+3	6.36E+4	1.48E+6	7.14E+4	3.02E+3
Te-127	2.77E+0	9.51E-1	1.96E+0	7.07E+0	1.00E+4	5.62E+4	6.11E-1
Te-129m	1.92E+4	6.85E+3	6.33E+3	5.03E+4	1.76E+6	1.82E+5	3.04E+3
Te-129	9.77E-2	3.50E-2	7.14E-2	2.57E-1	2.93E+3	2.55E+4	2.38E-2
Te-131m	1.34E+2	5.92E+1	9.77E+1	4.00E+2	2.06E+5	3.08E+5	5.07E+1
Te-131	2.17E-2	8.44E-3	1.70E-2	5.88E-2	2.05E+3	1.33E+3	6.59E-3
Te-132	4.81E+2	2.72E+2	3.17E+2	1.77E+3	3.77E+5	1.38E+5	2.63E+2
I-130	8.18E+3	1.64E+4	1.85E+6	2.45E+4	-	5.11E+3	8.44E+3
I-131	4.81E+4	4.81E+4	1.62E+7	7.88E+4	-	2.84E+3	2.73E+4
I-132	2.12E+3	4.07E+3	1.94E+5	6.25E+3	-	3.20E+3	1.88E+3
I-133	1.66E+4	2.03E+4	3.85E+6	3.38E+4	-	5.48E+3	7.70E+3
I-134	1.17E+3	2.16E+3	5.07E+4	3.30E+3	-	9.55E+2	9.95E+2
I-135	4.92E+3	8.73E+3	7.92E+5	1.34E+4	-	4.44E+3	4.14E+3
Cs-134	6.51E+5	1.01E+6	-	3.30E+5	1.21E+5	3.85E+3	2.25E+5
Cs-136	6.51E+4	1.71E+5	-	9.55E+4	1.45E+4	4.18E+3	1.16E+5
Cs-137	9.07E+5	8.25E+5	-	2.82E+5	1.04E+5	3.62E+3	1.28E+5
Cs-138	6.33E+2	8.40E+2	-	6.22E+2	6.81E+1	2.70E+2	5.55E+2
Ba-139	1.84E+0	9.84E-4	-	8.62E-4	5.77E+3	5.77E+4	5.37E-2
Ba-140	7.40E+4	6.48E+1	-	2.11E+1	1.74E+6	1.02E+5	4.33E+3
Ba-141	1.96E-1	1.09E-4	-	9.47E-5	2.92E+3	2.75E+2	6.36E-3
Ba-142	5.00E-2	3.60E-5	-	2.91E-5	1.64E+3	2.74E+0	2.79E-3
La-140	6.44E+2	2.25E+2	-	-	1.83E+5	2.26E+5	7.55E+1
La-142	1.30E+0	4.11E-1	-	-	8.70E+3	7.59E+4	1.29E-1
Ce-141	3.92E+4	1.95E+4	-	8.55E+3	5.44E+5	5.66E+4	2.90E+3
Ce-143	3.66E+2	1.99E+2	-	8.36E+1	1.15E+5	1.27E+5	2.87E+1
Ce-144	6.77E+6	2.12E+6	-	1.17E+6	1.20E+7	3.89E+5	3.61E+5
Pr-143	1.85E+4	5.55E+3	-	3.00E+3	4.33E+5	9.73E+4	9.14E+2
Pr-144	5.96E-2	1.85E-2	-	9.77E-3	1.57E+3	1.97E+2	3.00E-3
Nd-147	1.08E+4	8.73E+3	-	4.81E+3	3.28E+5	8.21E+4	6.81E+2
W-187	1.63E+1	9.66E+0	-	-	4.11E+4	9.10E+4	4.33E+0
Np-239	4.66E+2	3.34E+1	-	9.73E+1	5.81E+4	6.40E+4	2.35E+1

Table 2.7
R_i Inhalation Pathway Dose Factors - INFANT
(mrem/yr per $\mu Ci/m^3$)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2
C-14	2.65E+4	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3
Na-24	1.06E+4	1.06E+4	1.06E+4	1.06E+4	1.06E+4	1.06E+4	1.06E+4
P-32	2.03E+6	1.12E+5	-	-	-	1.61E+4	7.74E+4
Cr-51	-	-	5.75E+1	1.32E+1	1.28E+4	3.57E+2	8.95E+1
Mn-54	-	2.53E+4	-	4.98E+3	1.00E+6	7.06E+3	4.98E+3
Mn-56	-	1.54E+0	-	1.10E+0	1.25E+4	7.17E+4	2.21E-1
Fe-55	1.97E+4	1.17E+4	-	-	8.69E+4	1.09E+3	3.33E+3
Fe-59	1.36E+4	2.35E+4	-	-	1.02E+6	2.48E+4	9.48E+3
Co-57	-	6.51E+2	-	-	3.79E+5	4.86E+3	6.41E+2
Co-58	-	1.22E+3	-	-	7.77E+5	1.11E+4	1.82E+3
Co-60	-	8.02E+3	-	-	4.51E+6	3.19E+4	1.18E+4
Ni-63	3.39E+5	2.04E+4	-	-	2.09E+5	2.42E+3	1.16E+4
Ni-65	2.39E+0	2.84E-1	-	-	8.12E+3	5.01E+4	1.23E-1
Cu-64	-	1.88E+0	-	3.98E+0	9.30E+3	1.50E+4	7.74E-1
Zn-65	1.93E+4	6.26E+4	-	3.25E+4	6.47E+5	5.14E+4	3.11E+4
Zn-69	5.39E-2	9.67E-2	-	4.02E-2	1.47E+3	1.32E+4	7.18E-3
Br-82	-	-	-	-	-	-	1.33E+4
Br-83	-	-	-	-	-	-	3.81E+2
Br-84	-	-	-	-	-	-	4.00E+2
Br-85	-	-	-	-	-	-	2.04E+1
Rb-86	-	1.90E+5	-	-	-	3.04E+3	8.82E+4
Rb-88	-	5.57E+2	-	-	-	3.39E+2	2.87E+2
Rb-89	-	3.21E+2	-	-	-	6.82E+1	2.06E+2
Sr-89	3.98E+5	-	-	-	2.03E+6	6.40E+4	1.14E+4
Sr-90	4.09E+7	-	-	-	1.12E+7	1.31E+5	2.59E+6
Sr-91	9.56E+1	-	-	-	5.26E+4	7.34E+4	3.46E+0
Sr-92	1.05E+1	-	-	-	2.38E+4	1.40E+5	3.91E-1
Y-90	3.29E+3	-	-	-	2.69E+5	1.04E+5	8.82E+1
Y-91m	4.07E-1	-	-	-	2.79E+3	2.35E+3	1.39E-2
Y-91	5.88E+5	-	-	-	2.45E+6	7.03E+4	1.57E+4
Y-92	1.64E+1	-	-	-	2.45E+4	1.27E+5	4.61E-1
Y-93	1.50E+2	-	-	-	7.64E+4	1.67E+5	4.07E+0
Zr-95	1.15E+5	2.79E+4	-	3.11E+4	1.75E+6	2.17E+4	2.03E+4
Zr-97	1.50E+2	2.56E+1	-	2.59E+1	1.10E+5	1.40E+5	1.17E+1
Nb-95	1.57E+4	6.43E+3	-	4.72E+3	4.79E+5	1.27E+4	3.78E+3
Nb-97	3.42E-1	7.29E-2	-	5.70E-2	3.32E+3	2.69E+4	2.63E-2
Mo-99	-	1.65E+2	-	2.65E+2	1.35E+5	4.87E+4	3.23E+1
Tc-99m	1.40E-3	2.88E-3	-	3.11E-2	8.11E+2	2.03E+3	3.72E-2
Tc-101	6.51E-5	8.23E-5	-	9.79E-4	5.84E+2	8.44E+2	8.12E-4

Table 2.7
R_i Inhalation Pathway Dose Factors - INFANT
(mrem/yr per μCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	2.02E+3	-	-	4.24E+3	5.52E+5	1.61E+4	6.79E+2
Ru-105	1.22E+0	-	-	8.99E-1	1.57E+4	4.84E+4	4.10E-1
Ru-106	8.68E+4	-	-	1.07E+5	1.16E+7	1.64E+5	1.09E+4
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	9.98E+3	7.22E+3	-	1.09E+4	3.67E+6	3.30E+4	5.00E+3
Sb-124	3.79E+4	5.56E+2	1.01E+2	-	2.65E+6	5.91E+4	1.20E+4
Sb-125	5.17E+4	4.77E+2	6.23E+1	-	1.64E+6	1.47E+4	1.09E+4
Te-125m	4.76E+3	1.99E+3	1.62E+3	-	4.47E+5	1.29E+4	6.58E+2
Te-127m	1.67E+4	6.90E+3	4.87E+3	3.75E+4	1.31E+6	2.73E+4	2.07E+3
Te-127	2.23E+0	9.53E-1	1.85E+0	4.86E+0	1.03E+4	2.44E+4	4.89E-1
Te-129m	1.41E+4	6.09E+3	5.47E+3	3.18E+4	1.68E+6	6.90E+4	2.23E+3
Te-129	7.88E-2	3.47E-2	6.75E-2	1.75E-1	3.00E+3	2.63E+4	1.88E-2
Te-131m	1.07E+2	5.50E+1	8.93E+1	2.65E+2	1.99E+5	1.19E+5	3.63E+1
Te-131	1.74E-2	8.22E-3	1.58E-2	3.99E-2	2.06E+3	8.22E+3	5.00E-3
Te-132	3.72E+2	2.37E+2	2.79E+2	1.03E+3	3.40E+5	4.41E+4	1.76E+2
I-130	6.36E+3	1.39E+4	1.60E+6	1.53E+4	-	1.99E+3	5.57E+3
I-131	3.79E+4	4.44E+4	1.48E+7	5.18E+4	-	1.06E+3	1.96E+4
I-132	1.69E+3	3.54E+3	1.69E+5	3.95E+3	-	1.90E+3	1.26E+3
I-133	1.32E+4	1.92E+4	3.56E+6	2.24E+4	-	2.16E+3	5.60E+3
I-134	9.21E+2	1.88E+3	4.45E+4	2.09E+3	-	1.29E+3	6.65E+2
I-135	3.86E+3	7.60E+3	6.96E+5	8.47E+3	-	1.83E+3	2.77E+3
Cs-134	3.96E+5	7.03E+5	-	1.90E+5	7.97E+4	1.33E+3	7.45E+4
Cs-136	4.83E+4	1.35E+5	-	5.64E+4	1.18E+4	1.43E+3	5.29E+4
Cs-137	5.49E+5	6.12E+5	-	1.72E+5	7.13E+4	1.33E+3	4.55E+4
Cs-138	5.05E+2	7.81E+2	-	4.10E+2	6.54E+1	8.76E+2	3.98E+2
Ba-139	1.48E+0	9.84E-4	-	5.92E-4	5.95E+3	5.10E+4	4.30E-2
Ba-140	5.60E+4	5.60E+1	-	1.34E+1	1.60E+6	3.84E+4	2.90E+3
Ba-141	1.57E-1	1.08E-4	-	6.50E-5	2.97E+3	4.75E+3	4.97E-3
Ba-142	3.98E-2	3.30E-5	-	1.90E-5	1.55E+3	6.93E+2	1.96E-3
La-140	5.05E+2	2.00E+2	-	-	1.68E+5	8.48E+4	5.15E+1
La-142	1.03E+0	3.77E-1	-	-	8.22E+3	5.95E+4	9.04E-2
Ce-141	2.77E+4	1.67E+4	-	5.25E+3	5.17E+5	2.16E+4	1.99E+3
Ce-143	2.93E+2	1.93E+2	-	5.64E+1	1.16E+5	4.97E+4	2.21E+1
Ce-144	3.19E+6	1.21E+6	-	5.38E+5	9.84E+6	1.48E+5	1.76E+5
Pr-143	1.40E+4	5.24E+3	-	1.97E+3	4.33E+5	3.72E+4	6.99E+2
Pr-144	4.79E-2	1.85E-2	-	6.72E-3	1.61E+3	4.28E+3	2.41E-3
Nd-147	7.94E+3	8.13E+3	-	3.15E+3	3.22E+5	3.12E+4	5.00E+2
W-187	1.30E+1	9.02E+0	-	-	3.96E+4	3.56E+4	3.12E+0
Np-239	3.71E+2	3.32E+1	-	6.62E+1	5.95E+4	2.49E+4	1.88E+1

Table 2.8

R_i Vegetation Pathway Dose Factors - ADULT

(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3
C-14	8.97E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5
Na-24	2.76E+5	2.76E+5	2.76E+5	2.76E+5	2.76E+5	2.76E+5	2.76E+5
P-32	1.40E+9	8.73E+7	-	-	-	1.58E+8	5.42E+7
Cr-51	-	-	2.79E+4	1.03E+4	6.19E+4	1.17E+7	4.66E+4
Mn-54	-	3.11E+8	-	9.27E+7	-	9.54E+8	5.94E+7
Mn-56	-	1.61E+1	-	2.04E+1	-	5.13E+2	2.85E+0
Fe-55	2.09E+8	1.45E+8	-	-	8.06E+7	8.29E+7	3.37E+7
Fe-59	1.27E+8	2.99E+8	-	-	8.35E+7	9.96E+8	1.14E+8
Co-57	-	1.17E+7	-	-	-	2.97E+8	1.95E+7
Co-58	-	3.09E+7	-	-	-	6.26E+8	6.92E+7
Co-60	-	1.67E+8	-	-	-	3.14E+9	3.69E+8
Ni-63	1.04E+10	7.21E+8	-	-	-	1.50E+8	3.49E+8
Ni-65	6.15E+1	7.99E+0	-	-	-	2.03E+2	3.65E+0
Cu-64	-	9.27E+3	-	2.34E+4	-	7.90E+5	4.35E+3
Zn-65	3.17E+8	1.01E+9	-	6.75E+8	-	6.36E+8	4.56E+8
Zn-69	8.75E-6	1.67E-5	-	1.09E-5	-	2.51E-6	1.16E-6
Br-82	-	-	-	-	-	1.73E+6	1.51E+6
Br-83	-	-	-	-	-	4.63E+0	3.21E+0
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	2.19E+8	-	-	-	4.32E+7	1.02E+8
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	9.96E+9	-	-	-	-	1.60E+9	2.86E+8
Sr-90	6.05E+11	-	-	-	-	1.75E+10	1.48E+11
Sr-91	3.20E+5	-	-	-	-	1.52E+6	1.29E+4
Sr-92	4.27E+2	-	-	-	-	8.46E+3	1.85E+1
Y-90	1.33E+4	-	-	-	-	1.41E+8	3.56E+2
Y-91m	5.83E-9	-	-	-	-	1.71E-8	-
Y-91	5.13E+6	-	-	-	-	2.82E+9	1.37E+5
Y-92	9.01E-1	-	-	-	-	1.58E+4	2.63E-2
Y-93	1.74E+2	-	-	-	-	5.52E+6	4.80E+0
Zr-95	1.19E+6	3.81E+5	-	5.97E+5	-	1.21E+9	2.58E+5
Zr-97	3.33E+2	6.73E+1	-	1.02E+2	-	2.08E+7	3.08E+1
Nb-95	1.42E+5	7.91E+4	-	7.81E+4	-	4.80E+8	4.25E+4
Nb-97	2.90E-6	7.34E-7	-	8.56E-7	-	2.71E-3	2.68E-7
Mo-99	-	6.25E+6	-	1.41E+7	-	1.45E+7	1.19E+6
Tc-99m	3.06E+0	8.66E+0	-	1.32E+2	4.24E+0	5.12E+3	1.10E+2
Tc-101	-	-	-	-	-	-	-

Table 2.8
R_i Vegetation Pathway Dose Factors - ADULT
(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	4.80E+6	-	-	1.83E+7	-	5.61E+8	2.07E+6
Ru-105	5.39E+1	-	-	6.96E+2	-	3.30E+4	2.13E+1
Ru-106	1.93E+8	-	-	3.72E+8	-	1.25E+10	2.44E+7
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.06E+7	9.76E+6	-	1.92E+7	-	3.98E+9	5.80E+6
Sb-124	1.04E+8	1.96E+6	2.52E+5	-	8.08E+7	2.95E+9	4.11E+7
Sb-125	1.36E+8	1.52E+6	1.39E+5	-	1.05E+8	1.50E+9	3.25E+7
Te-125m	9.66E+7	3.50E+7	2.90E+7	3.93E+8	-	3.86E+8	1.29E+7
Te-127m	3.49E+8	1.25E+8	8.92E+7	1.42E+9	-	1.17E+9	4.26E+7
Te-127	5.76E+3	2.07E+3	4.27E+3	2.35E+4	-	4.54E+5	1.25E+3
Te-129m	2.55E+8	9.50E+7	8.75E+7	1.06E+9	-	1.28E+9	4.03E+7
Te-129	6.65E-4	2.50E-4	5.10E-4	2.79E-3	-	5.02E-4	1.62E-4
Te-131m	9.12E+5	4.46E+5	7.06E+5	4.52E+6	-	4.43E+7	3.72E+5
Te-131	-	-	-	-	-	-	-
Te-132	4.29E+6	2.77E+6	3.06E+6	2.67E+7	-	1.31E+8	2.60E+6
I-130	3.96E+5	1.17E+6	9.90E+7	1.82E+6	-	1.01E+6	4.61E+5
I-131	8.09E+7	1.16E+8	3.79E+10	1.98E+8	-	3.05E+7	6.63E+7
I-132	5.74E+1	1.54E+2	5.38E+3	2.45E+2	-	2.89E+1	5.38E+1
I-133	2.12E+6	3.69E+6	5.42E+8	6.44E+6	-	3.31E+6	1.12E+6
I-134	1.06E-4	2.88E-4	5.00E-3	4.59E-4	-	2.51E-7	1.03E-4
I-135	4.08E+4	1.07E+5	7.04E+6	1.71E+5	-	1.21E+5	3.94E+4
Cs-134	4.66E+9	1.11E+10	-	3.59E+9	1.19E+9	1.94E+8	9.07E+9
Cs-136	4.20E+7	1.66E+8	-	9.24E+7	1.27E+7	1.89E+7	1.19E+8
Cs-137	6.36E+9	8.70E+9	-	2.95E+9	9.81E+8	1.68E+8	5.70E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	2.95E-2	2.10E-5	-	1.96E-5	1.19E-5	5.23E-2	8.64E-4
Ba-140	1.29E+8	1.62E+5	-	5.49E+4	9.25E+4	2.65E+8	8.43E+6
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	1.97E+3	9.92E+2	-	-	-	7.28E+7	2.62E+2
La-142	1.40E-4	6.35E-5	-	-	-	4.64E-1	1.58E-5
Ce-141	1.96E+5	1.33E+5	-	6.17E+4	-	5.08E+8	1.51E+4
Ce-143	1.00E+3	7.42E+5	-	3.26E+2	-	2.77E+7	8.21E+1
Ce-144	3.29E+7	1.38E+7	-	8.16E+6	-	1.11E+10	1.77E+6
Pr-143	6.34E+4	2.54E+4	-	1.47E+4	-	2.78E+8	3.14E+3
Pr-144	-	-	-	-	-	-	-
Nd-147	3.34E+4	3.86E+4	-	2.25E+4	-	1.85E+8	2.31E+3
W-187	3.82E+4	3.19E+4	-	-	-	1.05E+7	1.12E+4
Np-239	1.42E+3	1.40E+2	-	4.37E+2	-	2.87E+7	7.72E+1

Table 2.9
R_i Vegetation Pathway Dose Factors - TEEN
(mrem/yr per μCi/m^3) for H-3 and C-14(m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3
C-14	1.45E+6	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5
Na-24	2.45E+5	2.45E+5	2.45E+5	2.45E+5	2.45E+5	2.45E+5	2.45E+5
P-32	1.61E+9	9.96E+7	-	-	-	1.35E+8	6.23E+7
Cr-51	-	-	3.44E+4	1.36E+4	8.85E+4	1.04E+7	6.20E+4
Mn-54	-	4.52E+8	-	1.35E+8	-	9.27E+8	8.97E+7
Mn-56	-	1.45E+1	-	1.83E+1	-	9.54E+2	2.58E+0
Fe-55	3.25E+8	2.31E+8	-	-	1.46E+8	9.98E+7	5.38E+7
Fe-59	1.81E+8	4.22E+8	-	-	1.33E+8	9.98E+8	1.63E+8
Co-57	-	1.79E+7	-	-	-	3.34E+8	3.00E+7
Co-58	-	4.38E+7	-	-	-	6.04E+8	1.01E+8
Co-60	-	2.49E+8	-	-	-	3.24E+9	5.60E+8
Ni-63	1.61E+10	1.13E+9	-	-	-	1.81E+8	5.45E+8
Ni-65	5.73E+1	7.32E+0	-	-	-	3.97E+2	3.33E+0
Cu-64	-	8.40E+3	-	2.12E+4	-	6.51E+5	3.95E+3
Zn-65	4.24E+8	1.47E+9	-	9.41E+8	-	6.23E+8	6.86E+8
Zn-69	8.19E-6	1.56E-5	-	1.02E-5	-	2.88E-5	1.09E-6
Br-82	-	-	-	-	-	-	1.33E+6
Br-83	-	-	-	-	-	-	3.01E+0
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	2.73E+8	-	-	-	4.05E+7	1.28E+8
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	1.51E+10	-	-	-	-	1.80E+9	4.33E+8
Sr-90	7.51E+11	-	-	-	-	2.11E+10	1.85E+11
Sr-91	2.99E+5	-	-	-	-	1.36E+6	1.19E+4
Sr-92	3.97E+2	-	-	-	-	1.01E+4	1.69E+1
Y-90	1.24E+4	-	-	-	-	1.02E+8	3.34E+2
Y-91m	5.43E-9	-	-	-	-	2.56E-7	-
Y-91	7.87E+6	-	-	-	-	3.23E+9	2.11E+5
Y-92	8.47E-1	-	-	-	-	2.32E+4	2.45E-2
Y-93	1.63E+2	-	-	-	-	4.98E+6	4.47E+0
Zr-95	1.74E+6	5.49E+5	-	8.07E+5	-	1.27E+9	3.78E+5
Zr-97	3.09E+2	6.11E+1	-	9.26E+1	-	1.65E+7	2.81E+1
Nb-95	1.92E+5	1.06E+5	-	1.03E+5	-	4.55E+8	5.86E+4
Nb-97	2.69E-6	6.67E-7	-	7.80E-7	-	1.59E-2	2.44E-7
Mo-99	-	5.74E+6	-	1.31E+7	-	1.03E+7	1.09E+6
Tc-99m	2.70E+0	7.54E+0	-	1.12E+2	4.19E+0	4.95E+3	9.77E+1
Tc-101	-	-	-	-	-	-	-

Table 2.9
R_I Vegetation Pathway Dose Factors - TEEN
(mrem/yr per μCi/m^3) for H-3 and C-14(m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	6.87E+6	-	-	2.42E+7	-	5.74E+8	2.94E+6
Ru-105	5.00E+1	-	-	6.31E+2	-	4.04E+4	1.94E+1
Ru-106	3.09E+8	-	-	5.97E+8	-	1.48E+10	3.90E+7
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.52E+7	1.44E+7	-	2.74E+7	-	4.04E+9	8.74E+6
Sb-124	1.55E+8	2.85E+6	3.51E+5	-	1.35E+8	3.11E+9	6.03E+7
Sb-125	2.14E+8	2.34E+6	2.04E+5	-	1.88E+8	1.66E+9	5.00E+7
Te-125m	1.48E+8	5.34E+7	4.14E+7	-	-	4.37E+8	1.98E+7
Te-127m	5.51E+8	1.96E+8	1.31E+8	2.24E+9	-	1.37E+9	6.56E+7
Te-127	5.43E+3	1.92E+3	3.74E+3	2.20E+4	-	4.19E+5	1.17E+3
Te-129m	3.67E+8	1.36E+8	1.18E+8	1.54E+9	-	1.38E+9	5.81E+7
Te-129	6.22E-4	2.32E-4	4.45E-4	2.61E-3	-	3.40E-3	1.51E-4
Te-131m	8.44E+5	4.05E+5	6.09E+5	4.22E+6	-	3.25E+7	3.38E+5
Te-131	-	-	-	-	-	-	-
Te-132	3.90E+6	2.47E+6	2.60E+6	2.37E+7	-	7.82E+7	2.32E+6
I-130	3.54E+5	1.02E+6	8.35E+7	1.58E+6	-	7.87E+5	4.09E+5
I-131	7.70E+7	1.08E+8	3.14E+10	1.85E+8	-	2.13E+7	5.79E+7
I-132	5.18E+1	1.36E+2	4.57E+3	2.14E+2	-	5.91E+1	4.87E+1
I-133	1.97E+6	3.34E+6	4.66E+8	5.86E+6	-	2.53E+6	1.02E+6
I-134	9.59E-5	2.54E-4	4.24E-3	4.01E-4	-	3.35E-6	9.13E-5
I-135	3.68E+4	9.48E+4	6.10E+6	1.50E+5	-	1.05E+5	3.52E+4
Cs-134	7.09E+9	1.67E+10	-	5.30E+9	2.02E+9	2.08E+8	7.74E+9
Cs-136	4.29E+7	1.69E+8	-	9.19E+7	1.45E+7	1.36E+7	1.13E+8
Cs-137	1.01E+10	1.35E+10	-	4.59E+9	1.78E+9	1.92E+8	4.69E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	2.77E-2	1.95E-5	-	1.84E-5	1.34E-5	2.47E-1	8.08E-4
Ba-140	1.38E+8	1.69E+5	-	5.75E+4	1.14E+5	2.13E+8	8.91E+6
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	1.80E+3	8.84E+2	-	-	-	5.08E+7	2.35E+2
La-142	1.28E-4	5.69E-5	-	-	-	1.73E+0	1.42E-5
Ce-141	2.82E+5	1.88E+5	-	8.86E+4	-	5.38E+8	2.16E+4
Ce-143	9.37E+2	6.82E+5	-	3.06E+2	-	2.05E+7	7.62E+1
Ce-144	5.27E+7	2.18E+7	-	1.30E+7	-	1.33E+10	2.83E+6
Pr-143	7.12E+4	2.84E+4	-	1.65E+4	-	2.34E+8	3.55E+3
Pr-144	-	-	-	-	-	-	-
Nd-147	3.63E+4	3.94E+4	-	2.32E+4	-	1.42E+8	2.36E+3
W-187	3.55E+4	2.90E+4	-	-	-	7.84E+6	1.02E+4
Np-239	1.38E+3	1.30E+2	-	4.09E+2	-	2.10E+7	7.24E+1

Table 2.10

R_i Vegetation Pathway Dose Factors - CHILD

(mrem/yr per μCi/m^3) for H-3 and C-14(m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3
C-14	3.50E+6	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5
Na-24	3.83E+5	3.83E+5	3.83E+5	3.83E+5	3.83E+5	3.83E+5	3.83E+5
P-32	3.37E+9	1.58E+8	-	-	-	9.30E+7	1.30E+8
Cr-51	-	-	6.54E+4	1.79E+4	1.19E+5	6.25E+6	1.18E+5
Mn-54	-	6.61E+8	-	1.85E+8	-	5.55E+8	1.76E+8
Mn-56	-	1.90E+1	-	2.29E+1	-	2.75E+3	4.28E+0
Fe-55	8.00E+8	4.24E+8	-	-	2.40E+8	7.86E+7	1.31E+8
Fe-59	4.01E+8	6.49E+8	-	-	1.88E+8	6.76E+8	3.23E+8
Co-57	-	2.99E+7	-	-	-	2.45E+8	6.04E+7
Co-58	-	6.47E+7	-	-	-	3.77E+8	1.98E+8
Co-60	-	3.78E+8	-	-	-	2.10E+9	1.12E+9
Ni-63	3.95E+10	2.11E+9	-	-	-	1.42E+8	1.34E+9
Ni-65	1.05E+2	9.89E+0	-	-	-	1.21E+3	5.77E+0
Cu-64	-	1.11E+4	-	2.68E+4	-	5.20E+5	6.69E+3
Zn-65	8.12E+8	2.16E+9	-	1.36E+9	-	3.80E+8	1.35E+9
Zn-69	1.51E-5	2.18E-5	-	1.32E-5	-	1.38E-3	2.02E-6
Br-82	-	-	-	-	-	-	2.04E+6
Br-83	-	-	-	-	-	-	5.55E+0
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	4.52E+8	-	-	-	2.91E+7	2.78E+8
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	3.59E+10	-	-	-	-	1.39E+9	1.03E+9
Sr-90	1.24E+12	-	-	-	-	1.67E+10	3.15E+11
Sr-91	5.50E+5	-	-	-	-	1.21E+6	2.08E+4
Sr-92	7.28E+2	-	-	-	-	1.38E+4	2.92E+1
Y-90	2.30E+4	-	-	-	-	6.56E+7	6.17E+2
Y-91m	9.94E-9	-	-	-	-	1.95E-5	-
Y-91	1.87E+7	-	-	-	-	2.49E+9	5.01E+5
Y-92	1.56E+0	-	-	-	-	4.51E+4	4.46E-2
Y-93	3.01E+2	-	-	-	-	4.48E+6	8.25E+0
Zr-95	3.90E+6	8.58E+5	-	1.23E+6	-	8.95E+8	7.64E+5
Zr-97	5.64E+2	8.15E+1	-	1.17E+2	-	1.23E+7	4.81E+1
Nb-95	4.10E+5	1.59E+5	-	1.50E+5	-	2.95E+8	1.14E+5
Nb-97	4.90E-6	8.85E-7	-	9.82E-7	-	2.73E-1	4.13E-7
Mo-99	-	7.83E+6	-	1.67E+7	-	6.48E+6	1.94E+6
Tc-99m	4.65E+0	9.12E+0	-	1.33E+2	4.63E+0	5.19E+3	1.51E+2
Tc-101	-	-	-	-	-	-	-

Table 2.10

R_i Vegetation Pathway Dose Factors - CHILD

(mrem/yr per μCi/m^3) for H-3 and C-14(m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	1.55E+7	-	-	3.89E+7	-	3.99E+8	5.94E+6
Ru-105	9.17E+1	-	-	8.06E+2	-	5.98E+4	3.33E+1
Ru-106	7.45E+8	-	-	1.01E+9	-	1.16E+10	9.30E+7
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	3.22E+7	2.17E+7	-	4.05E+7	-	2.58E+9	1.74E+7
Sb-124	3.52E+8	4.57E+6	7.78E+5	-	1.96E+8	2.20E+9	1.23E+8
Sb-125	4.99E+8	3.85E+6	4.62E+5	-	2.78E+8	1.19E+9	1.05E+8
Te-125m	3.51E+8	9.50E+7	9.84E+7	-	-	3.38E+8	4.67E+7
Te-127m	1.32E+9	3.56E+8	3.16E+8	3.77E+9	-	1.07E+9	1.57E+8
Te-127	1.00E+4	2.70E+3	6.93E+3	2.85E+4	-	3.91E+5	2.15E+3
Te-129m	8.54E+8	2.39E+8	2.75E+8	2.51E+9	-	1.04E+9	1.33E+8
Te-129	1.15E-3	3.22E-4	8.22E-4	3.37E-3	-	7.17E-2	2.74E-4
Te-131m	1.54E+6	5.33E+5	1.10E+6	5.16E+6	-	2.16E+7	5.68E+5
Te-131	-	-	-	-	-	-	-
Te-132	6.98E+6	3.09E+6	4.50E+6	2.87E+7	-	3.11E+7	3.73E+6
I-130	6.21E+5	1.26E+6	1.38E+8	1.88E+6	-	5.87E+5	6.47E+5
I-131	1.43E+8	1.44E+8	4.76E+10	2.36E+8	-	1.28E+7	8.18E+7
I-132	9.20E+1	1.69E+2	7.84E+3	2.59E+2	-	1.99E+2	7.77E+1
I-133	3.59E+6	4.44E+6	8.25E+8	7.40E+6	-	1.79E+6	1.68E+6
I-134	1.70E-4	3.16E-4	7.28E-3	4.84E-4	-	2.10E-4	1.46E-4
I-135	6.54E+4	1.18E+5	1.04E+7	1.81E+5	-	8.98E+4	5.57E+4
Cs-134	1.60E+10	2.63E+10	-	8.14E+9	2.92E+9	1.42E+8	5.54E+9
Cs-136	8.06E+7	2.22E+8	-	1.18E+8	1.76E+7	7.79E+6	1.43E+8
Cs-137	2.39E+10	2.29E+10	-	7.46E+9	2.68E+9	1.43E+8	3.38E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	5.11E-2	2.73E-5	-	2.38E-5	1.61E-5	2.95E+0	1.48E-3
Ba-140	2.77E+8	2.43E+5	-	7.90E+4	1.45E+5	1.40E+8	1.62E+7
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	3.23E+3	1.13E+3	-	-	-	3.15E+7	3.81E+2
La-142	2.32E-4	7.40E-5	-	-	-	1.47E+1	2.32E-5
Ce-141	6.35E+5	3.26E+5	-	1.43E+5	-	4.07E+8	4.84E+4
Ce-143	1.73E+3	9.36E+5	-	3.93E+2	-	1.37E+7	1.36E+2
Ce-144	1.27E+8	3.98E+7	-	2.21E+7	-	1.04E+10	6.78E+6
Pr-143	1.48E+5	4.46E+4	-	2.41E+4	-	1.60E+8	7.37E+3
Pr-144	-	-	-	-	-	-	-
Nd-147	7.16E+4	5.80E+4	-	3.18E+4	-	9.18E+7	4.49E+3
W-187	6.47E+4	3.83E+4	-	-	-	5.38E+6	1.72E+4
Np-239	2.55E+3	1.83E+2	-	5.30E+2	-	1.36E+7	1.29E+2

Table 2.11

R_i Grass-Cow-Milk Pathway Dose Factors - ADULT

(mrem/yr per $\mu Ci/m^3$) for H-3 and C-14(m^2 x mrem/yr per $\mu Ci/sec$) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2
C-14	3.63E+5	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4
Na-24	2.54E+6	2.54E+6	2.54E+6	2.54E+6	2.54E+6	2.54E+6	2.54E+6
P-32	1.71E+10	1.06E+9	-	-	-	1.92E+9	6.60E+8
Cr-51	-	-	1.71E+4	6.30E+3	3.80E+4	7.20E+6	2.86E+4
Mn-54	-	8.40E+6	-	2.50E+6	-	2.57E+7	1.60E+6
Mn-56	-	4.23E-3	-	5.38E-3	-	1.35E-1	7.51E-4
Fe-55	2.51E+7	1.73E+7	-	-	9.67E+6	9.95E+6	4.04E+6
Fe-59	2.98E+7	7.00E+7	-	-	1.95E+7	2.33E+8	2.68E+7
Co-57	-	1.28E+6	-	-	-	3.25E+7	2.13E+6
Co-58	-	4.72E+6	-	-	-	9.57E+7	1.06E+7
Co-60	-	1.64E+7	-	-	-	3.08E+8	3.62E+7
Ni-63	6.73E+9	4.66E+8	-	-	-	9.73E+7	2.26E+8
Ni-65	3.70E-1	4.81E-2	-	-	-	1.22E+0	2.19E-2
Cu-64	-	2.41E+4	-	6.08E+4	-	2.05E+6	1.13E+4
Zn-65	1.37E+9	4.36E+9	-	2.92E+9	-	2.75E+9	1.97E+9
Zn-69	-	-	-	-	-	-	-
Br-82	-	-	-	-	-	3.72E+7	3.25E+7
Br-83	-	-	-	-	-	1.49E-1	1.03E-1
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	2.59E+9	-	-	-	5.11E+8	1.21E+9
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	1.45E+9	-	-	-	-	2.33E+8	4.16E+7
Sr-90	4.68E+10	-	-	-	-	1.35E+9	1.15E+10
Sr-91	3.13E+4	-	-	-	-	1.49E+5	1.27E+3
Sr-92	4.89E-1	-	-	-	-	9.68E+0	2.11E-2
Y-90	7.07E+1	-	-	-	-	7.50E+5	1.90E+0
Y-91m	-	-	-	-	-	-	-
Y-91	8.60E+3	-	-	-	-	4.73E+6	2.30E+2
Y-92	5.42E-5	-	-	-	-	9.49E-1	1.58E-6
Y-93	2.33E-1	-	-	-	-	7.39E+3	6.43E-3
Zr-95	9.46E+2	3.03E+2	-	4.76E+2	-	9.62E+5	2.05E+2
Zr-97	4.26E-1	8.59E-2	-	1.30E-1	-	2.66E+4	3.93E-2
Nb-95	8.25E+4	4.59E+4	-	4.54E+4	-	2.79E+8	2.47E+4
Nb-97	-	-	-	-	-	5.47E-9	-
Mo-99	-	2.52E+7	-	5.72E+7	-	5.85E+7	4.80E+6
Tc-99m	3.25E+0	9.19E+0	-	1.40E+2	4.50E+0	5.44E+3	1.17E+2
Tc-101	-	-	-	-	-	-	-

Table 2.11

R_i Grass-Cow-Milk Pathway Dose Factors - ADULT

(mrem/yr per μCi/m^3) for H-3 and C-14(m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	1.02E+3	-	-	3.89E+3	-	1.19E+5	4.39E+2
Ru-105	8.57E-4	-	-	1.11E-2	-	5.24E-1	3.38E-4
Ru-106	2.04E+4	-	-	3.94E+4	-	1.32E+6	2.58E+3
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	5.83E+7	5.39E+7	-	1.06E+8	-	2.20E+10	3.20E+7
Sb-124	2.57E+7	4.86E+5	6.24E+4	-	2.00E+7	7.31E+8	1.02E+7
Sb-125	2.04E+7	2.28E+5	2.08E+4	-	1.58E+7	2.25E+8	4.86E+6
Te-125m	1.63E+7	5.90E+6	4.90E+6	6.63E+7	-	6.50E+7	2.18E+6
Te-127m	4.58E+7	1.64E+7	1.17E+7	1.86E+8	-	1.54E+8	5.58E+6
Te-127	6.72E+2	2.41E+2	4.98E+2	2.74E+3	-	5.30E+4	1.45E+2
Te-129m	6.04E+7	2.25E+7	2.08E+7	2.52E+8	-	3.04E+8	9.57E+6
Te-129	-	-	-	-	-	-	-
Te-131m	3.61E+5	1.77E+5	2.80E+5	1.79E+6	-	1.75E+7	1.47E+5
Te-131	-	-	-	-	-	-	-
Te-132	2.39E+6	1.55E+6	1.71E+6	1.49E+7	-	7.32E+7	1.45E+6
I-130	4.26E+5	1.26E+6	1.07E+8	1.96E+6	-	1.08E+6	4.96E+5
I-131	2.96E+8	4.24E+8	1.39E+11	7.27E+8	-	1.12E+8	2.43E+8
I-132	1.64E-1	4.37E-1	1.53E+1	6.97E-1	-	8.22E-2	1.53E-1
I-133	3.97E+6	6.90E+6	1.01E+9	1.20E+7	-	6.20E+6	2.10E+6
I-134	-	-	-	-	-	-	-
I-135	1.39E+4	3.63E+4	2.40E+6	5.83E+4	-	4.10E+4	1.34E+4
Cs-134	5.65E+9	1.34E+10	-	4.35E+9	1.44E+9	2.35E+8	1.10E+10
Cs-136	2.61E+8	1.03E+9	-	5.74E+8	7.87E+7	1.17E+8	7.42E+8
Cs-137	7.38E+9	1.01E+10	-	3.43E+9	1.14E+9	1.95E+8	6.61E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	4.70E-8	-	-	-	-	8.34E-8	1.38E-9
Ba-140	2.69E+7	3.38E+4		1.15E+4	1.93E+4	5.54E+7	1.76E+6
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	4.49E+0	2.26E+0	-	-	-	1.66E+5	5.97E-1
La-142	-	-	-	-	-	3.03E-8	-
Ce-141	4.84E+3	3.27E+3	-	1.52E+3	-	1.25E+7	3.71E+2
Ce-143	4.19E+1	3.09E+4	-	1.36E+1	-	1.16E+6	3.42E+0
Ce-144	3.58E+5	1.50E+5	-	8.87E+4	-	1.21E+8	1.92E+4
Pr-143	1.59E+2	6.37E+1	-	3.68E+1	-	6.96E+5	7.88E+0
Pr-144	-	-	-	-	-	-	-
Nd-147	9.42E+1	1.09E+2	-	6.37E+1	-	5.23E+5	6.52E+0
W-187	6.56E+3	5.48E+3	-	-	-	1.80E+6	1.92E+3
Np-239	3.66E+0	3.60E-1	-	1.12E+0	-	7.39E+4	1.98E-1

Table 2.12
R_i Grass-Cow-Milk Pathway Dose Factors - TEEN
(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2
C-14	6.70E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5
Na-24	4.44E+6	4.44E+6	4.44E+6	4.44E+6	4.44E+6	4.44E+6	4.44E+6
P-32	3.15E+10	1.95E+9	-	-	-	2.65E+9	1.22E+9
Cr-51	-	-	2.78E+4	1.10E+4	7.13E+4	8.40E+6	5.00E+4
Mn-54	-	1.40E+7	-	4.17E+6	-	2.87E+7	2.78E+6
Mn-56	-	7.51E-3	-	9.50E-3	-	4.94E-1	1.33E-3
Fe-55	4.45E+7	3.16E+7	-	-	2.00E+7	1.37E+7	7.36E+6
Fe-59	5.20E+7	1.21E+8	-	-	3.82E+7	2.87E+8	4.68E+7
Co-57	-	2.25E+6	-	-	-	4.19E+7	3.76E+6
Co-58	-	7.95E+6	-	-	-	1.10E+8	1.83E+7
Co-60	-	2.78E+7	-	-	-	3.62E+8	6.26E+7
Ni-63	1.18E+10	8.35E+8	-	-	-	1.33E+8	4.01E+8
Ni-65	6.78E-1	8.66E-2	-	-	-	4.70E+0	3.94E-2
Cu-64	-	4.29E+4	-	1.09E+5	-	3.33E+6	2.02E+4
Zn-65	2.11E+9	7.31E+9	-	4.68E+9	-	3.10E+9	3.41E+9
Zn-69	-	-	-	-	-	-	-
Br-82	-	-	-	-	-	-	5.64E+7
Br-83	-	-	-	-	-	-	1.91E-1
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	4.73E+9	-	-	-	7.00E+8	2.22E+9
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	2.67E+9	-	-	-	-	3.18E+8	7.66E+7
Sr-90	6.61E+10	-	-	-	-	1.86E+9	1.63E+10
Sr-91	5.75E+4	-	-	-	-	2.61E+5	2.29E+3
Sr-92	8.95E-1	-	-	-	-	2.28E+1	3.81E-2
Y-90	1.30E+2	-	-	-	-	1.07E+6	3.50E+0
Y-91m	-	-	-	-	-	-	-
Y-91	1.58E+4	-	-	-	-	6.48E+6	4.24E+2
Y-92	1.00E-4	-	-	-	-	2.75E+0	2.90E-6
Y-93	4.30E-1	-	-	-	-	1.31E+4	1.18E-2
Zr-95	1.65E+3	5.22E+2	-	7.67E+2	-	1.20E+6	3.59E+2
Zr-97	7.75E-1	1.53E-1	-	2.32E-1	-	4.15E+4	7.06E-2
Nb-95	1.41E+5	7.80E+4	-	7.57E+4	-	3.34E+8	4.30E+4
Nb-97	-	-	-	-	-	6.34E-8	-
Mo-99	-	4.56E+7	-	1.04E+8	-	8.16E+7	8.69E+6
Tc-99m	5.64E+0	1.57E+1	-	2.34E+2	8.73E+0	1.03E+4	2.04E+2
Tc-101	-	-	-	-	-	-	-

Table 2.12
R_i Grass-Cow-Milk Pathway Dose Factors - TEEN
(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	1.81E+3	-	-	6.40E+3	-	1.52E+5	7.75E+2
Ru-105	1.57E-3	-	-	1.97E-2	-	1.26E+0	6.08E-4
Ru-106	3.75E+4	-	-	7.23E+4	-	1.80E+6	4.73E+3
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	9.63E+7	9.11E+7	-	1.74E+8	-	2.56E+10	5.54E+7
Sb-124	4.59E+7	8.46E+5	1.04E+5	-	4.01E+7	9.25E+8	1.79E+7
Sb-125	3.65E+7	3.99E+5	3.49E+4	-	3.21E+7	2.84E+8	8.54E+6
Te-125m	3.00E+7	1.08E+7	8.39E+6	-	-	8.86E+7	4.02E+6
Te-127m	8.44E+7	2.99E+7	2.01E+7	3.42E+8	-	2.10E+8	1.00E+7
Te-127	1.24E+3	4.41E+2	8.59E+2	5.04E+3	-	9.61E+4	2.68E+2
Te-129m	1.11E+8	4.10E+7	3.57E+7	4.62E+8	-	4.15E+8	1.75E+7
Te-129	-	-	-	1.67E-9	-	2.18E-9	-
Te-131m	6.57E+5	3.15E+5	4.74E+5	3.29E+6	-	2.53E+7	2.63E+5
Te-131	-	-	-	-	-	-	-
Te-132	4.28E+6	2.71E+6	2.86E+6	2.60E+7	-	8.58E+7	2.55E+6
I-130	7.49E+5	2.17E+6	1.77E+8	3.34E+6	-	1.67E+6	8.66E+5
I-131	5.38E+8	7.53E+8	2.20E+11	1.30E+9	-	1.49E+8	4.04E+8
I-132	2.90E-1	7.59E-1	2.56E+1	1.20E+0	-	3.31E-1	2.72E-1
I-133	7.24E+6	1.23E+7	1.72E+9	2.15E+7	-	9.30E+6	3.75E+6
I-134	-	-	-	-	-	-	-
I-135	2.47E+4	6.35E+4	4.08E+6	1.00E+5		7.03E+4	2.35E+4
Cs-134	9.81E+9	2.31E+10	-	7.34E+9	2.80E+9	2.87E+8	1.07E+10
Cs-136	4.45E+8	1.75E+9	-	9.53E+8	1.50E+8	1.41E+8	1.18E+9
Cs-137	1.34E+10	1.78E+10	-	6.06E+9	2.35E+9	2.53E+8	6.20E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	8.69E-8	-	-	-	-	7.75E-7	2.53E-9
Ba-140	4.85E+7	5.95E+4	-	2.02E+4	4.00E+4	7.49E+7	3.13E+6
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	8.06E+0	3.96E+0	-	-	-	2.27E+5	1.05E+0
La-142	-	-	-	-	-	2.23E-7	-
Ce-141	8.87E+3	5.92E+3	-	2.79E+3	-	1.69E+7	6.81E+2
Ce-143	7.69E+1	5.60E+4	-	2.51E+1	-	1.68E+6	6.25E+0
Ce-144	6.58E+5	2.72E+5	-	1.63E+5	-	1.66E+8	3.54E+4
Pr-143	2.92E+2	1.17E+2	-	6.77E+1	-	9.61E+5	1.45E+1
Pr-144	-	-	-	-	-	-	-
Nd-147	1.81E+2	1.97E+2	-	1.16E+2	-	7.11E+5	1.18E+1
W-187	1.20E+4	9.78E+3	-	-	-	2.65E+6	3.43E+3
Np-239	6.99E+0	6.59E-1	-	2.07E+0	-	1.06E+5	3.66E-1

Table 2.13
R_i Grass-Cow-Milk Pathway Dose Factors - CHILD
(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3
C-14	1.65E+6	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5
Na-24	9.23E+6	9.23E+6	9.23E+6	9.23E+6	9.23E+6	9.23E+6	9.23E+6
P-32	7.77E+10	3.64E+9	-	-	-	2.15E+9	3.00E+9
Cr-51	-	-	5.66E+4	1.55E+4	1.03E+5	5.41E+6	1.02E+5
Mn-54	-	2.09E+7	-	5.87E+6	-	1.76E+7	5.58E+6
Mn-56	-	1.31E-2	-	1.58E-2	-	1.90E+0	2.95E-3
Fe-55	1.12E+8	5.93E+7	-	-	3.35E+7	1.10E+7	1.84E+7
Fe-59	1.20E+8	1.95E+8	-	-	5.65E+7	2.03E+8	9.71E+7
Co-57	-	3.84E+6	-	-	-	3.14E+7	7.77E+6
Co-58	-	1.21E+7	-	-	-	7.08E+7	3.72E+7
Co-60	-	4.32E+7	-	-	-	2.39E+8	1.27E+8
Ni-63	2.96E+10	1.59E+9	-	-	-	1.07E+8	1.01E+9
Ni-65	1.66E+0	1.56E-1	-	-	-	1.91E+1	9.11E-2
Cu-64	-	7.55E+4	-	1.82E+5	-	3.54E+6	4.56E+4
Zn-65	4.13E+9	1.10E+10	-	6.94E+9	-	1.93E+9	6.85E+9
Zn-69	-	-	-	-	-	2.14E-9	-
Br-82	-	-	-	-	-	-	1.15E+8
Br-83	-	-	-	-	-	-	4.69E-1
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	8.77E+9	-	-	-	5.64E+8	5.39E+9
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	6.62E+9	-	-	-	-	2.56E+8	1.89E+8
Sr-90	1.12E+11	-	-	-	-	1.51E+9	2.83E+10
Sr-91	1.41E+5	-	-	-	-	3.12E+5	5.33E+3
Sr-92	2.19E+0	-	-	-	-	4.14E+1	8.76E-2
Y-90	3.22E+2	-	-	-	-	9.15E+5	8.61E+0
Y-91m	-	-	-	-	-	-	-
Y-91	3.91E+4	-	-	-	-	5.21E+6	1.04E+3
Y-92	2.46E-4	-	-	-	-	7.10E+0	7.03E-6
Y-93	1.06E+0	-	-	-	-	1.57E+4	2.90E-2
Zr-95	3.84E+3	8.45E+2	-	1.21E+3	-	8.81E+5	7.52E+2
Zr-97	1.89E+0	2.72E-1	-	3.91E-1	-	4.13E+4	1.61E-1
Nb-95	3.18E+5	1.24E+5	-	1.16E+5	-	2.29E+8	8.84E+4
Nb-97	-	-	-	-	-	1.45E-6	-
Mo-99	-	8.29E+7	-	1.77E+8	-	6.86E+7	2.05E+7
Tc-99m	1.29E+1	2.54E+1	-	3.68E+2	1.29E+1	1.44E+4	4.20E+2
Tc-101	-	-	-	-	-	-	-

Table 2.13
R_i Grass-Cow-Milk Pathway Dose Factors - CHILD
(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	4.29E+3	-	-	1.08E+4	-	1.11E+5	1.65E+3
Ru-105	3.82E-3	-	-	3.36E-2	-	2.49E+0	1.39E-3
Ru-106	9.24E+4	-	-	1.25E+5	-	1.44E+6	1.15E+4
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	2.09E+8	1.41E+8	-	2.63E+8	-	1.68E+10	1.13E+8
Sb-124	1.09E+8	1.41E+8	2.40E+5	-	6.03E+7	6.79E+8	3.81E+7
Sb-125	8.70E+7	1.41E+6	8.06E+4	-	4.85E+7	2.08E+8	1.82E+7
Te-125m	7.38E+7	2.00E+7	2.07E+7	-	-	7.12E+7	9.84E+6
Te-127m	2.08E+8	5.60E+7	4.97E+7	5.93E+8	-	1.68E+8	2.47E+7
Te-127	3.06E+3	8.25E+2	2.12E+3	8.71E+3	-	1.20E+5	6.56E+2
Te-129m	2.72E+8	7.61E+7	8.78E+7	8.00E+8	-	3.32E+8	4.23E+7
Te-129	-	-	-	2.87E-9	-	6.12E-8	-
Te-131m	1.60E+6	5.53E+5	1.14E+6	5.35E+6	-	2.24E+7	5.89E+5
Te-131	-	-	-	-	-	-	-
Te-132	1.02E+7	4.52E+6	6.58E+6	4.20E+7	-	4.55E+7	5.46E+6
I-130	1.75E+6	3.54E+6	3.90E+8	5.29E+6	-	1.66E+6	1.82E+6
I-131	1.30E+9	1.31E+9	4.34E+11	2.15E+9	-	1.17E+8	7.46E+8
I-132	6.86E-1	1.26E+0	5.85E+1	1.93E+0	-	1.48E+0	5.80E-1
I-133	1.76E+7	2.18E+7	4.04E+9	3.63E+7	-	8.77E+6	8.23E+6
I-134	-	-	-	-	-	-	-
I-135	5.84E+4	1.05E+5	9.30E+6	1.61E+5	-	8.00E+4	4.97E+4
Cs-134	2.26E+10	3.71E+10	-	1.15E+10	4.13E+9	2.00E+8	7.83E+9
Cs-136	1.00E+9	2.76E+9	-	1.47E+9	2.19E+8	9.70E+7	1.79E+9
Cs-137	3.22E+10	3.09E+10	-	1.01E+10	3.62E+9	1.93E+8	4.55E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	2.14E-7	-	-	-	-	1.23E-5	6.19E-9
Ba-140	1.17E+8	1.03E+5	-	3.34E+4	6.12E+4	5.94E+7	6.84E+6
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	1.93E+1	6.74E+0	-	-	-	1.88E+5	2.27E+0
La-142	-	-	-	-	-	2.51E-6	-
Ce-141	2.19E+4	1.09E+4	-	4.78E+3	-	1.36E+7	1.62E+3
Ce-143	1.89E+2	1.02E+5	-	4.29E+1	-	1.50E+6	1.48E+1
Ce-144	1.62E+6	5.09E+5	-	2.82E+5	-	1.33E+8	8.66E+4
Pr-143	7.23E+2	2.17E+2	-	1.17E+2	-	7.80E+5	3.59E+1
Pr-144	-	-	-	-	-	-	-
Nd-147	4.45E+2	3.60E+2	-	1.98E+2	-	5.71E+5	2.79E+1
W-187	2.91E+4	1.72E+4	-	-	-	2.42E+6	7.73E+3
Np-239	1.72E+1	1.23E+0	-	3.57E+0	-	9.14E+4	8.68E-1

Table 2.14
R_i Grass-Cow-Milk Pathway Dose Factors - INFANT
(mrem/yr per μCi/m^3) for H-3 and C-14 (m^2 x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3
C-14	3.23E+6	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5
Na-24	1.61E+7	1.61E+7	1.61E+7	1.61E+7	1.61E+7	1.61E+7	1.61E+7
P-32	1.60E+11	9.42E+9	-	-	-	2.17E+9	6.21E+9
Cr-51	-	-	1.05E+5	2.30E+4	2.05E+5	4.71E+6	1.61E+5
Mn-54	-	3.89E+7	-	8.63E+6	-	1.43E+7	8.83E+6
Mn-56	-	3.21E-2	-	2.76E-2	-	2.91E+0	5.53E-3
Fe-55	1.35E+8	8.72E+7	-	-	4.27E+7	1.11E+7	2.33E+7
Fe-59	2.25E+8	3.93E+8	-	-	1.16E+8	1.88E+8	1.55E+8
Co-57	-	8.95E+6	-	-	-	3.05E+7	1.46E+7
Co-58	-	2.43E+7	-	-	-	6.05E+7	6.06E+7
Co-60	-	8.81E+7	-	-	-	2.10E+8	2.08E+8
Ni-63	3.49E+10	2.16E+9	-	-	-	1.07E+8	1.21E+9
Ni-65	3.51E+0	3.97E-1	-	-	-	3.02E+1	1.81E-1
Cu-64	-	1.88E+5	-	3.17E+5	-	3.85E+6	8.69E+4
Zn-65	5.55E+9	1.90E+10	-	9.23E+9	-	1.61E+10	8.78E+9
Zn-69	-	-	-	-	-	7.36E-9	-
Br-82	-	-	-	-	-	-	1.94E+8
Br-83	-	-	-	-	-	-	9.95E-1
Br-84	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-
Rb-86	-	2.22E+10	-	-	-	5.69E+8	1.10E+10
Rb-88	-	-	-	-	-	-	-
Rb-89	-	-	-	-	-	-	-
Sr-89	1.26E+10	-	-	-	-	2.59E+8	3.61E+8
Sr-90	1.22E+11	-	-	-	-	1.52E+9	3.10E+10
Sr-91	2.94E+5	-	-	-	-	3.48E+5	1.06E+4
Sr-92	4.65E+0	-	-	-	-	5.01E+1	1.73E-1
Y-90	6.80E+2	-	-	-	-	9.39E+5	1.82E+1
Y-91m	-	-	-	-	-	-	-
Y-91	7.33E+4	-	-	-	-	5.26E+6	1.95E+3
Y-92	5.22E-4	-	-	-	-	9.97E+0	1.47E-5
Y-93	2.25E+0	-	-	-	-	1.78E+4	6.13E-2
Zr-95	6.83E+3	1.66E+3	-	1.79E+3	-	8.28E+5	1.18E+3
Zr-97	3.99E+0	6.85E-1	-	6.91E-1	-	4.37E+4	3.13E-1
Nb-95	5.93E+5	2.44E+5	-	1.75E+5	-	2.06E+8	1.41E+5
Nb-97	-	-	-	-	-	3.70E-6	-
Mo-99	-	2.12E+8	-	3.17E+8	-	6.98E+7	4.13E+7
Tc-99m	2.69E+1	5.55E+1	-	5.97E+2	2.90E+1	1.61E+4	7.15E+2
Tc-101	-	-	-	-	-	-	-

Table 2.14
R_i Grass-Cow-Milk Pathway Dose Factors - INFANT
(mrem/yr per μCi/m³) for H-3 and C-14 (m² x mrem/yr per μCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
Ru-103	8.69E+3	-	-	1.81E+4	-	1.06E+5	2.91E+3
Ru-105	8.06E-3	-	-	5.92E-2	-	3.21E+0	2.71E-3
Ru-106	1.90E+5	-	-	2.25E+5	-	1.44E+6	2.38E+4
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	3.86E+8	2.82E+8	-	4.03E+8	-	1.46E+10	1.86E+8
Sb-124	2.09E+8	3.08E+6	5.56E+5	-	1.31E+8	6.46E+8	6.49E+7
Sb-125	1.49E+8	1.45E+6	1.87E+5	-	9.38E+7	1.99E+8	3.07E+7
Te-125m	1.51E+8	5.04E+7	5.07E+7	-	-	7.18E+7	2.04E+7
Te-127m	4.21E+8	1.40E+8	1.22E+8	1.04E+9	-	1.70E+8	5.10E+7
Te-127	6.50E+3	2.18E+3	5.29E+3	1.59E+4	-	1.36E+5	1.40E+3
Te-129m	5.59E+8	1.92E+8	2.15E+8	1.40E+9	-	3.34E+8	8.62E+7
Te-129	2.08E-9	-	1.75E-9	5.18E-9	-	1.66E-7	-
Te-131m	3.38E+6	1.36E+6	2.76E+6	9.35E+6	-	2.29E+7	1.12E+6
Te-131	-	-	-	-	-	-	-
Te-132	2.10E+7	1.04E+7	1.54E+7	6.51E+7	-	3.85E+7	9.72E+6
I-130	3.60E+6	7.92E+6	8.88E+8	8.70E+6	-	1.70E+6	3.18E+6
I-131	2.72E+9	3.21E+9	1.05E+12	3.75E+9	-	1.15E+8	1.41E+9
I-132	1.42E+0	2.89E+0	1.35E+2	3.22E+0	-	2.34E+0	1.03E+0
I-133	3.72E+7	5.41E+7	9.84E+9	6.36E+7	-	9.16E+6	1.58E+7
I-134	-	-	1.01E-9	-	-	-	-
I-135	1.21E+5	2.41E+5	2.16E+7	2.69E+5	-	8.74E+4	8.80E+4
Cs-134	3.65E+10	6.80E+10	-	1.75E+10	7.18E+9	1.85E+8	6.87E+9
Cs-136	1.96E+9	5.77E+9	-	2.30E+9	4.70E+8	8.76E+7	2.15E+9
Cs-137	5.15E+10	6.02E+10	-	1.62E+10	6.55E+9	1.88E+8	4.27E+9
Cs-138	-	-	-	-	-	-	-
Ba-139	4.55E-7	-	-	-	-	2.88E-5	1.32E-8
Ba-140	2.41E+8	2.41E+5	-	5.73E+4	1.48E+5	5.92E+7	1.24E+7
Ba-141	-	-	-	-	-	-	-
Ba-142	-	-	-	-	-	-	-
La-140	4.03E+1	1.59E+1	-	-	-	1.87E+5	4.09E+0
La-142	-	-	-	-	-	5.21E-6	-
Ce-141	4.33E+4	2.64E+4	-	8.15E+3	-	1.37E+7	3.11E+3
Ce-143	4.00E+2	2.65E+5	-	7.72E+1	-	1.55E+6	3.02E+1
Ce-144	2.33E+6	9.52E+5	-	3.85E+5	-	1.33E+8	1.30E+5
Pr-143	1.49E+3	5.59E+2	-	2.08E+2	-	7.89E+5	7.41E+1
Pr-144	-	-	-	-	-	-	-
Nd-147	8.82E+2	9.06E+2	-	3.49E+2	-	5.74E+5	5.55E+1
W-187	6.12E+4	4.26E+4	-	-	-	2.50E+6	1.47E+4
Np-239	3.64E+1	3.25E+0	-	6.49E+0	-	9.40E+4	1.84E+0

Table 2.15
R_i Ground Plane Pathway Dose Factors
(m^2 x mrem/yr per μCi/sec)

Nuclide	Any Organ
Sb-124	2.87E+9
Sb-125	6.49E+9
Te-125m	1.55E+6
Te-127m	9.17E+4
Te-127	3.00E+3
Te-129m	2.00E+7
Te-129	2.60E+4
Te-131m	8.03E+6
Te-131	2.93E+4
Te-132	4.22E+6
I-130	5.53E+6
I-131	1.72E+7
I-132	1.24E+6
I-133	2.47E+6
I-134	4.49E+5
I-135	2.56E+6
Cs-134	6.75E+9
Cs-136	1.49E+8
Cs-137	1.04E+10
Cs-138	3.59E+5
Ba-139	1.06E+5
Ba-140	2.05E+7
Ba-141	4.18E+4
Ba-142	4.49E+4
La-140	1.91E+7
La-142	7.36E+5
Ce-141	1.36E+7
Ce-143	2.32E+6
Ce-144	6.95E+7
Pr-143	-
Pr-144	1.83E+3
Nd-147	8.40E+6
W-187	2.36E+6
Np-239	1.71E+6

3/4 RADIOLOGICAL EFFLUENT SPECIFICATIONS AND SURVEILLANCE REQUIREMENTS

3/4.0 APPLICABILITY AND SURVEILLANCE REQUIREMENTS

SPECIFICATIONS

3.0.1 **Compliance with the specifications contained in the succeeding text is required during the conditions specified therein; except that upon failure to meet the specifications, the associated ACTION requirements shall be met.**

3.0.2 **Noncompliance with a Specification shall exist when its requirements and associated ACTION requirements are not met within the specified time intervals. If the Specification is restored prior to expiration of the specified time intervals, completion of the Action requirements is not required.**

3.0.3 **When a Specification is not met, except as provided in the associated ACTION requirements, reporting pursuant to TS 6.9.b.3 will be initiated.**

SURVEILLANCE REQUIREMENTS

4.0.1 **Surveillance Requirements shall be met during the conditions specified for individual Specifications unless otherwise stated in an individual Surveillance Requirement.**

4.0.2 **Each Surveillance Requirement shall be performed within the specified time interval with a maximum allowable extension not to exceed 25% of the surveillance interval.**

4.0.3 **Failure to perform a Surveillance Requirement within the specified time interval shall constitute a failure to meet the OPERABILITY requirements for a Specification. Exceptions to these requirements are stated in the individual Specification. Surveillance Requirements do not have to be performed on inoperable equipment.**

3/4.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

SPECIFICATIONS

3.1 The radioactive liquid effluent monitoring instrumentation channels shown in Table 3.1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the methodology in Section 1.0 of the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY

During release via the monitored pathway.

ACTION

a. With a redioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, without delay suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.1 . Exert best efforts to return the instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

SURVEILLANCE REQUIREMENTS

4.1 Each redioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.1.

BASIS

Radioactive Liquid Effluent Monitoring Instrumentation. The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The operability and use of this instrumentation is consistent with the appropriate requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

3/4.2 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

SPECIFICATIONS

3.2 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.2 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.4.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the methodology in section 2.0 of the ODCM.

APPLICABILITY

As shown in Table 3.2.

ACTION

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Specification, without delay suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.2. Exert best efforts to return the instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

SURVEILLANCE REQUIREMENTS

4.2 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.2.

BASIS

Radioactive Gaseous Effluent Monitoring Instrumentation - The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the release of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The operability and use of this instrumentation is consistent with the appropriate requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

3/4.3 LIQUID EFFLUENTS

CONCENTRATION

SPECIFICATIONS

3.3.1 The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2 x 10^{-4} uCi/ml total activity.

APPLICABILITY

During release via the monitored pathway.

ACTION

With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, without delay restore the concentration to within the above limits.

SURVEILLANCE REQUIREMENTS

4.3.1.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 4.3.

4.3.1.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits of specification 3.3.1.

BASIS

Concentration - This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR Part 20.1301 to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, <u>HASL-300</u> (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," <u>Anal. Chem. 40</u>, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report <u>ARH-SA-215</u> (June 1975).

DOSE

SPECIFICATIONS

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

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

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

APPLICABILITY

At all times.

ACTION

a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to Technical Specification (TS) 6.9.b.3, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that heve been taken to reduce the release and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS

4.3.2 Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM once per 31 days.

BASIS

Dose - This specification is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable". The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

LIQUID RADWASTE TREATMENT SYSTEM

SPECIFICATIONS

3.3.3 The liquid radwaste treatment system as described in the ODCM shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses, due to the liquid effluent, to UNRESTRICTED AREAS would exceed 0.18 mrem to the total body or 0.62 mrem to any organ in a calendar quarter.

APPLICABILITY

At all times.

ACTION

a. With radioactive liquid waste being discharged without treatment and in excess of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days pursuant to TS 6.9.b.3, a Special Report that includes the following information:

1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,
2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
3. Summary description of action(s) taken to prevent a recurrence.

SURVEILLANCE REQUIREMENTS

4.3.3 Doses due to liquid releases from the unit to UNRESTRICTED AREAS shall be projected once pec 31 days in accordance with the methodology and parameters in the ODCM.

BASIS

Liquid Radwaste Treatment System. This requirement that the appropriate portions of this system be used, when specified, provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

3/4.4 GASEOUS EFFLUENTS

DOSE RATE

SPECIFICATIONS

3.4.1 The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrems/yr to the total body and less than or equal to 3000 mrems/yr to the skin, and

b. For iodine-131, iodine-133, tritium, and for all radionuclides in particulate form with half lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ.

APPLICABILITY

At all times.

ACTION

a. With the dose rate(s) exceeding the above limits, without delay restore the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

4.4.1.1 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM.

4.4.1.2 The dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.4.

BASIS

Dose Rate - This specification is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents will be within the annual dose limits of 10 CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrems/yr to the total body or to less than or equal to 3000 mrems/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrems/year.

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

DOSE - NOBLE GASES

SPECIFICATIONS

3.4.2 The air dose due to noble gases released in gaseous effluents, to areas at and beyond the SITE BOUNDARY shall be limited to the following:

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

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

APPLICABILITY

At all times.

ACTION

a. With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to TS 6.9.b.3, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS

4.4.2 Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in the ODCM once per 31 days.

BASIS

Dose - Noble Gases. This specification is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIONUCLIDES IN PARTICULATE FORM

SPECIFICATIONS

3.4.3 The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the SITE BOUNDARY shall be limited to the following:

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

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

APPLICABILITY

At all times.

ACTION

a. With the calculated dose from the release of iodine-131, iodine-133, tritium, and radionuclides in particulate form with half lives greater than 8 days, in gaseous effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to TS 6.9.b.3, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS

4.4.3 Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half lives greater than 8 days shall be determined in accordance with the methodology and parameters in the ODCM once per 31 days.

BASIS

Dose - Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form - This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable". The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half lives greater than 8 days are dependent upon the existing radionuclide pathways to man, in areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

GASEOUS RADWASTE TREATMENT SYSTEM

SPECIFICATIONS

3.4.4 The GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent air doses due to gaseous effluent releases to areas at and beyond the SITE BOUNDARY would exceed 0.62 mrad for gamma rediation and 1.25 mrad for beta radiation in a calendar quarter. The VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases, to areas at and beyond the SITE BOUNDARY would exceed 0.94 mrem to any organ in a calendar quarter.

APPLICABILITY

At all times.

ACTION

a. With gaseous waste being discharged without treatment and in excess of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to TS 6.9.b.3, a Special Report that includes the following information:

1. Explanation of why gaseous radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoporability,

2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

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

SURVEILLANCE REQUIREMENTS

4.4.4 Doses due to gaseous releases from areas at and beyond the SITE BOUNDARY shall be projected once per 31 days in accordance with the methodology and parameters in the ODCM.

BASIS

Gaseous Radwaste Treatment System - The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable".

This specification implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

3/4.5 TOTAL DOSE

SPECIFICATIONS

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

APPLICABILITY

At all times.

ACTION

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification 3.3.2.a, 3.3.2.b, 3.4.2.a, 3.4.2.b, 3.4.3.a, or 3.4.3.b, calculations should be made including direct radiation contributions from the reactor unit to determine whether the above limits have been exceeded. If such is the case in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to TS 6.9.b.3, a special report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This special report as defined in 10 CFR 20.2203, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the special report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considerad a timely request, and a variance is granted until staff action on the request is complete.

SURVEILLANCE REQUIREMENTS

4.5.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Surveillance Requirements 4.3.2, 4.4.2, and 4.4.3 in accordance with the methodology and parameters in the ODCM.

4.5.2 Cumulative dose contributions from direct radiation from the reactor unit shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in Specification 3.5.a.

BASIS

Total Dose - This specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. It is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the reactor remains within twice the dose design objectives of Appendix I, and if direct radiation doses from the reactor are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.2203, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Specifications 3.3.1 and 3.4.1. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

3/4.6 REPORTING REQUIREMENTS

3/4.6.1 Radioactive Effluent Release Report

The Radioactive Effluent Release Report shall include the following:

a. A summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit following the format of Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974.

b. An annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.[3] This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit during the previous calendar year. The assumptions used in making these assessment, i.e., specific activity, exposure time and location, shall be included in these reports. The assessment of radiation doses shall be performed based on the calculational guidance, as presented in the ODCM.

c. An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cyclo sources, including doses from primary effluent pathways and direct radiation, the previous calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation.

d. A list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

e. Any changes made during the reporting period to the ODCM.

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[3] In lieu of submission with the annual Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

TABLE 3.1
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Instrument	Minimum Channels Operable	Action
1. Gross Radioactivity Monitors Providing Alarm and Automatic Termination of Release		
a. Liquid Radwaste Effluent Line (R-18)	1	1
b. Steam Generator Blowdown Effluent Line (R-19)	1	2
2. Gross Beta or Gamma Radioactivity Monitors Providing Alarm But Not Providing Automatic Termination of Release		
a. Service Water System Effluent Line (Component cooling, R-20)	1	3
b. Service Water System Effluent Line (Containment fan cooling, R-16)	1	3

ACTION 1 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Surveillance Requirement 4.3.1.1 and

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge line valving;

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 2 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are analyzed for gross radioactivity (beta or gamma) at a lower limit of detection of 1.0E-6 uCi/ml:

a. At least once per week with no indication of primary-to-secondary leakage; or

b. At least once per 24 hours with identified primary-to-secondary leakage (with secondary side activity > 1.0E-05 uCi/ml)

ACTION 3 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that, at least once per 12 hours, grab samples are collected and analyzed for gross radioactivity (beta or gamma) at a lower limit of detection of 1.0E-6 uCi/ml. (Note: Failure to complete sampling and analysis prior to 12 hours after the monitor is declared O.O.S. is a violation of this specification).

TABLE 3.2
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(PAGE 1 OF 2)

Instrument	Minimum Channels Operable	Applicability	Action
1. Noble Gas Activity Monitor			
a. R-13 or R-14	1	*	
- Waste Gas Holdup System (auto-isolation)			4
- Auxiliary Building Ventilation System			5
- Containment Purge 2" line (auto-isolation)			6
b. R-12 or R-21	1	*	
- Containment purge 36" duct (auto-isolation)			6
c. R-15	1	*	5
- Condenser Evacuation System			
2. Radioiodine & Particulate Samplers			
a. Containment Building vent (R-21)	1	*	7
b. Auxiliary Building vent (R-13 or R-14)	1	*	7
3. Sampler flow rate measuring devices			
a. Containment Building vent sampler (R-21)	1	*	8
b. Auxiliary Building vent sampler (R-13 or R-14)	1	*	8

* At all times

TABLE 3.2
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(PAGE 2 OF 2)

TABLE NOTATIONS

ACTION 4 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment provided that prior to initiating the release:

a. At least two independent samples of the tank's contents are analyzed, and
b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge valve lineup;

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 5 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours.

ACTION 6 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, immediately suspend PURGING of radioactive effluents via this pathway.

ACTION 7 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the affected pathway may continue provided samples are continuously collected with auxiliary sampling equipment as required in Table 4.4.

ACTION 8 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours.

TABLE 4.0
FREQUENCY NOTATION

Notation	Frequency[1]
S	Once per shift
St	Once per 12 hours
D	Once per 24 hours
W	Once per 7 days
M	Once per 31 days
Q	Once per 92 days
SA	Once per 184 days
R	Once per refueling cycle, not to exceed 18 months
P	Prior to each reactor startup if not done previous week
PR	Completed prior to each release
N.A.	Not applicable

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[1] A maximum extension not to exceed 25% of the surveillance interval.

TABLE 4.1
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional Test
1. Gross Radioactivity Monitors Providing Alarm and Automatic Termination of Release				
a. Liquid Radwaste Effluent Line (R-18)	D	PR	R	Q
b. Steam Generator Blowdown Effluent Line (R-19)	D	M	R	Q
2. Gross Beta or Gamma Radioactivity Monitors Providing Alarm But Not Providing Automatic Termination of Release				
a. Service Water System Effluent Line (Component cooling, R-20)	D	M	R	Q
b. Service Water System Effluent Line (Containment fan cooling, R-16)	D	M	R	Q

TABLE 4.2
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional Test	Modes In Which Surveillance Required
1. Noble Gas Activity Monitor					
a. R-13 or R-14					
Waste Gas Holdup System (auto-isolation)	PR	PR	R	Q	*
Auxiliary Building Ventilation System	D	M	R	Q	*
Containment Purge 2" line (auto-isolation)	D	M	R	Q	*
b. R-12 or R-21					
Containment purge 36" duct (auto-isolation)	D	PR	R	Q	*
c. R-15 Condenser Evacuation System	D	M	R	Q	*
2. Radioiodine Particulate Samplers					
a. Containment Building vent (R-21)	W	N.A.	N.A.	N.A.	*
b. Auxiliary Building vent (R-13 or R-14)	W	N.A.	N.A.	N.A.	*
3. Sampler Flow Rate Measuring Devices					
a. Containment Building vent sampler (R-21)	D	N.A.	R	Q	*
b. Auxiliary Building vent sampler (R-13 or R-14)	D	N.A.	R	Q	*

* At all times other than when the line is valved out and tagged.

TABLE 4.3
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
Page 1 of 2

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (uCi/ml)
A. Batch Waste Release Tanks[b]	PR Each Batch	PR Each Batch	Principal Gamma Emitters[e]	$1x10^{-6}$
			I-131	$1x10^{-6}$
	PR Each Batch	M Composite[d]	H-3 Gross Alpha	$1x10^{-5}$ $5x10^{-7}$
	PR Each Batch	Q Composite[d]	Sr-89, Sr-90 Fe-55	$5x10^{-8}$ $1x10^{-6}$
B. Continuous Releases[c] (SG Blowdown) (TB Sump[f])	W Grab Sample	W Grab Sample	Principal Gamma Emitters[c]	$5x10^{-7}$
			I-131	$1x10^{-6}$
	W Grab Sample	M Composito[f]	H-3 Gross Alpha	$1x10^{-5}$ $5x10^{-7}$
	W Grab Sample	Q Composite[f]	Sr-89, Sr-90 Fe-55	$5x10^{-8}$ $1x10^{-6}$

TABLE 4.3
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
Page 2 of 2

Table Notations

[a] The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a not count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a btank observation represents a "real" signal.

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

$$\text{LLD} = \frac{4.66\, s_b}{E * V * 2.22 \text{ X } 10^6 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the a priori lower limit of detection as defined above, as uCi per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and time of counting.

Typical 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 (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

[b] A batch release is the discharge of liquid wastes of a discrate volume. Prior to sampling for analysis, each batch shall be located, and then thoroughly mixed to ensure representative sampling.

[c] 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. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report pursuant to TS 6.9.b.2.

[d] A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released.

[e] A continuous release is the discharge of liquid wastes of a nondiscrete volume, e.g., from a volume of a system that has an input flow during the continuous release.

[f] As a minimum, the monthly and quarterly composite samples shall be comprised of weekly grab samples.

TABLE 4.3
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
Page 2 of 2

Table Notations

[a] During periods of identified primary-to-secondary leakage (with the secondary activity > 1.0E-05 uCi/ml), grab samples are collected daily and analyzed by gamma spectroscopy.

TABLE 4.4
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM
Page 1 of 2

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (uCi/ml)
A. Waste Gas Storage Tank	PR Each Tank Grab Sample	PR Each Tank	Principal Gamma Emitters[b]	$1x10^{-4}$
B. Containment PURGE	PR Each PURGE Grab Sample	PR Each Purge	Principal Gamma Emitters[b]	$1x10^{-4}$
C. Auxiliary Building and Containment Building Vent	M Grab Sample	M	Principal Gamma Emitters[b]	$1x10^{-4}$
	Continuous[c]	W Charcoal Sample	I-131	$3x10^{-12}$
	Continuous[c]	W Particulate Sample	Principal Gamma Emitter[b] (I-131, others)	$1x10^{-11}$
	Continuous[c]	M Composite Particulate Sample	Gross Alpha	$1x10^{-11}$
	Continuous[c]	Q Composite Particulate Sample	SR-89, SR-90	$1x10^{-11}$
	Continuous[c]	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	$1x10^{-6}$

TABLE 4.4
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM
Page 2 OF 2

Table Notations

[a] The LLD is defined, for purposes of these specifications, 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% 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:

$$\mathrm{LLD} = \frac{4.66\, s_b}{E * V * 2.22 \times 10^6 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the a priori lower limit of detection as defined above, as uCi per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and time of counting.

Typical 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 (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

[b] 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, and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report pursuant to TS 6.9.b.2.

[c] The ratio of the sample flow rate to the sampled flow stream flow rate shall be known (based on sampler and ventilation system flow measuring devices or periodic flow estimates) for the time period covered by each dose or dose rate calculation made in accordance with Specifications 3.4.1, 3.4.2, and 3.4.3.

APPENDIX A

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS - LIQUID RADIOACTIVE EFFLUENTS

APPENDIX A

Technical Basis for Effective Dose Factors - Liquid Effluent Releases

The radioactive liquid effluents for the fuel cycle years 1983, 1982 and 1981 were evaluated to determine the dose contribution of the radionuclide distribution. This analysis was performed to evaluate the use of a limited dose analysis for determining environmental doses, providing a simplified method of determining compliance with the dose limits of Specification 3.3.2. For the radionuclide distribution of effluents from the Kewaunee Nuclear Power Plant, the controlling organ is either the GI-LLI or the liver. The calculated GI-LLI dose is almost exclusively dictated by the Nb-95 releases; the liver dose is mostly a function of the Cs-134 and Cs-137 releases. The radionuclides, Co-58, Co-60, Sr-90, Cs-134 and Cs-137 contribute essentially all of the calculated total body dose. The results of this evaluation are presented in Table A-1.

For purposes of simplifying the details of the dose calculational process, it is conservative to identify a controlling, dose significant radionuclide and limit the calculational process to the use of the dose conversion factor for this nuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculational method that is simplified while also being conservative.

For the evaluation of the maximum organ dose, it is conservative to use the Cs-134 dose conversion factor (7.09E+05 mrem/hr per μCi/ml, liver). Only the reactor-generated radionuclide Nb-95 has a higher dose conversion factor (1.51E+06 mrem/hr per μCi/ml, GI-LLI). However, since Nb-95 releases are typically less than 5% of the total releases, it is conservative to use the Cs-134 factor. By this approach, the maximum organ dose will be routinely overestimated. For 1983, using this simplified conservative method would overestimate the maximum organ dose by a factor of 85; for 1982, the conservatism is a factor of 35; and for 1981, a factor of 21.

For the total body calculation, the Cs-134 dose factor (5.79E+05 mrem/hr per μCi/ml, total body) is the highest among the identified dominant nuclides. For 1981, using this simplified conservative dose calculational method would overestimate the total body dose by a factor of 26; for 1982, the conservatism is a factor of 50; and for 1983, a factor of 34.
For evaluating compliance with the dose limits of Specification 3.3.2 the following simplified equations may be used:

Total Body

$$D_{tb} = \frac{1.67E\text{-}02 \text{ x } VOL}{CW} \text{ x } A_{Cs\text{-}134,TB} \text{ x } \sum C_i \qquad \text{(A.1)}$$

where:

D_{tb} = dose to the total body (mrem)

$A_{Cs\text{-}134,TB}$ = 5.79E+05, total body ingestion dose conversion factor for Cs-134 (mrem/hr per μCi/ml)

VOL = volume of liquid effluent released (gal)

ΣC_i = total concentration of all radionuclides (μCi/ml)

CW = average circulating water discharge rate during release period (gal/min)

1.67E-02 = conversion factor (hr/min)

Substituting the value for the Cs-134 total body dose conversion factor, the equation simplifies to:

$$D_{tb} = \frac{9.67E{+}03 \times VOL}{CW} \times \sum C_i \qquad (A.2)$$

Maximum Organ

$$D_{max} = \frac{1.67E{-}02 \times VOL \times A_{Cs\text{-}134,L}}{CW} \times \sum C_i \qquad (A.3)$$

where:

D_{max} = maximum organ dose (mrem)

$A_{Cs\text{-}134,L}$ = 7.09E+05, liver ingestion dose conversion factor for Cs-134 (mrem/hr per μCi/ml)

Substituting the value for $A_{Cs\text{-}134,Liver}$, the equation simplifies to:

$$D_{max} = \frac{1.18E{+}04 \times VOL}{CW} \times \sum C_i \qquad (A.4)$$

Only the total body dose need be evaluated by this simplified method since it represents the more limiting (compared with the maximum organ dose) for demonstrating compliance with Specification 3.3.2.

Tritium is not included in the limited analysis dose assessment for liquid releases, because the potential dose resulting from normal reactor releases is negligible. The average annual tritium release from the Kewaunee Nuclear Plant to Lake Michigan is approximately 300 curies. The calculated total body dose from such a release is 1.36E-02 mrem/yr via the fish ingestion and drinking water pathways. This amounts to 0.45% of the design objective dose of 3 mrem/yr. Furthermore, the release of tritium is a function of operating time and power level and is essentially unrelated to radwaste system operation.

Appendix A

Table A-1
Adult Dose Contributions
Fish and Drinking Water Pathways

	1983-84 Fuel Cycle				1982-83 Fuel Cycle				1981-82 Fuel Cycle			
Radio-Nuclide	Release (Ci)	TB Dose Frac.	GI-LLI Dose Frac.	Liver Dose Frac.	Release (Ci)	TB Dose Frac.	GI-LLI Dose Frac.	Liver Dose Frac.	Release (Ci)	TB Dose Frac.	GI-LLI Dose Frac.	Liver Dose Frac.
Co-58	5.91E-01	0.01	0.02	*	2.27E-01	0.01	0.18	*	8.51E-01	0.01	0.37	*
Co-60	1.29E-01	*	0.01	*	2.36E-01	0.02	0.49	0.01	3.66E-01	0.01	0.43	*
Ag-110m	8.41E-02	*	*	*	1.57E-01	*	*	*	2.06E-02	*	*	*
Sb-124	9.46E-02	*	*	*	3.78E-03	*	*	*	2.88E-02	*	*	*
Sb-125	4.60E-02	*	*	*	8.06E-03	*	*	*	2.07E-02	*	*	*
Nb-95	3.91E-02	*	0.96	*	3.67E-04	*	0.24	*	N/D		*	*
Cs-137	3.24E-02	0.64	0.01	0.69	2.08E-02	0.94	0.09	0.96	5.53E-02	0.62	0.14	0.68
Cs-134	1.06E-02	0.35	*	0.31	4.52E-04	0.03	*	0.03	1.93E-02	0.37	0.06	0.32
Total	1.03E+00			6.53E-01				1.36E+00				

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*Less than 0.01

N/D = not detected

APPENDIX B

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS - GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX B

Technical Bases for Effective Dose Factors - Gaseous Radioactive Effluents

Overview

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific. These effective factors, which can be based on typical radionuclide distributions of releases, can be applied to the total radioactivity released to approximate the dose in the environment (i.e., instead of having to perform individual radionuclide dose analyses only a single multiplication (K_{eff}, M_{eff} or N_{eff}) times the total quantity of radioactive material released would be needed). This approach provides a reasenable estimate of the actual dose while eliminating the need for a detailed calculational technique.

Determination of Effective Dose Factors

Effective dose transfer factors are calculated by the following equations:

$$K_{eff} = \sum (K_i \times f_i) \qquad (B.1)$$

where:

K_{eff} = the effective total body dose factor due to gamma emissions from all noble gases released

K_i = the total body dose factor due to gamma emissions from each noble gas radionuclide i released

f_i = the fractional abundance of noble gas radionuclide i relative to the total noble gas activity

$$(L + 1.1\ M)_{eff} = \sum ((L_i + 1.1\ M_i) \times f_i) \qquad (B.2)$$

where:

$(L + 1.1\ M)_{eff}$ = the effective skin dose factor due to beta and gamma emissions from all noble gases released

$(L_i + 1.1\ M_i)$ = the skin dose factor due to beta and gamma emissions from each noble gas radionuclide i released

$$M_{eff} = \sum (M_i \times f) \qquad \text{(B.3)}$$

where:

M_{eff} = the effective air dose factor due to gamma emissions from all noble gases released

M_i = the air dose factor due to gamma emissions from each noble gas radionuclide i released

$$N_{eff} = \sum (N_i \times f) \qquad \text{(B.4)}$$

where:

N_{eff} = the effective air dose factor due to beta emissions from all noble gases released

N_i = the air dose factor due to beta emissions from each noble gas radionuclide i released

Normally, it would be expected that past radioactive effluent data would be used for the determination of the effective dose factors. However, the noble gas releases from Kewaunee have been maintained to such negligible quantities that the inherent variability in the data makes any meaningful evaluations difficult. For the years of 1981, 1982 and 1983, the total noble gas releases have been limited to 6 Ci for 1981, 56 Ci for 1982, and 167 Ci for 1983. Therefore, in order to provide a reasonable basis for the derivation of the effective noble gas dose factors, the primary coolant source term from ANSI N237-1976/ANS-18.1, "Source Term Specifications," has been used as representing a typical distribution. The effective dose factors as derived are presented in Table B-1.

Application

To provide an additional degree of conservatism, a factor of 0.50 is introduced into the dose calculational process when the effective dose transfer factor is used. This conservatism provides additional assurance that the evaluation of doses by the use of a single effective factor will not significantly underestimate any actual doses in the environment.

For evaluating compliance with the dose limits of Specification 3.4.2, the following simplified equations may be used:

$$D\gamma = \frac{3.17E\text{-}08}{0.50} \times X/Q \times M_{eff} \times \sum Q_i \qquad \text{(B.5)}$$

$$D_\beta = \frac{3.17E\text{-}08}{0.50} \times X/Q \times N_{eff} \times \sum Q_i \qquad \text{(B.6)}$$

where:

$D\gamma$ = air dose due to gamma emissions for the cumulative release of all noble gases (mrad)

D_β = air dose due to beta emissions for the cumulative release of all noble gases (mrad)

X/Q = atmospheric dispersion to the controlling site boundary (sec/m^3)

M_{eff} = 5.3E+02, effective gamma-air dose factor (mrad/yr per μCi/m^3)

N_{eff} = 1.1E+03, effective beta-air dose factor (mrad/yr per μCi/m^3)

Σ Qi = cumulative release for all noble gas radionuclides (μCi)

3.17E-08 = conversion factor (yr/sec)

0.50 = conservatism factor to account for the variability in the effluent data

Combining the constants, the dose calculational equations simplify to:

$$D\gamma = 3.5E\text{-}05 \times X/Q \times \sum Q_i \tag{B.7}$$

and

$$D_\beta = 7.0E\text{-}05 \times X/Q \times \sum Q_i \tag{B.8}$$

The effective dose factors are used on a very limited basis for the purpose of facilitating the timely assessment of radioactive effluent releases, particularly during periods of computer malfunction where a detailed dose assessment may be unavailable. Dose assessments using the detailed, radionuclide dependent calculation are performed at least annually for preparation of the Radioactive Effluent Reports. Comparisons can be performed at this time to assure that the use of the effective dose factors does not substantially underestimate actual doses.

APPENDIX B

Table B-1
Effective Dose Factors - Noble Gases

Radionuclide	f_i	Total Body Effective Dose Factor K_{eff} (mrem/yr per μCi/m^3)	Skin Effective Dose Factor $(L+1.1\ M)_{eff}$ (mrem/yr per μCi/m^3)
Noble Gases - Total Body and Skin			
Kr-85	0.01	--	1.4E+01
Kr-88	0.01	1.5E+02	1.9E+02
Xe-133m	0.01	2.5E+00	1.4E+01
Xe-133	0.9	3.0E+02	6.6E+02
Xe-135	0.02	3.6E+01	7.9E+01
TOTAL		4.8E+02	9.6E+02
Noble Gases - Air			
Radionuclide	**f_i**	**Gamma Air Effective Dose Factor M_{eff} (mrad/yr per μCi/m^3)**	**Beta Air Effective Dose Factor N_{eff} (mrad/yr per μCi/m^3)**
Kr-85	0.01	--	2.0E+01
Kr-88	0.01	1.5E+02	2.9E+01
Xe-133m	0.01	3.3E+00	1.5E+01
Xe-133	0.95	3.4E+02	1.0E+03
Xe-135	0.02	3.8E+01	4.9E+01
TOTAL		5.3E+02	1.1E+03

APPENDIX C

EVALUATION OF CONSERVATIVE, DEFAULT MPC VALUE FOR LIQUID EFFLUENTS

Appendix C

Evaluation of Conservative, Default MPC Value for Liquid Effluents

In accordance with the requirements of Specification 3.1 the radioactive liquid effluent monitors shall be operable with alarm setpoints established to ensure that the concentration of radioactive material at the discharge point does not exceed the MPC value of 10 CFR 20, Appendix B, Table II, Column 2. The determination of allowable radionuclide concentration and corresponding alarm setpoint is a function of the individual radionuclide distribution and corresponding MPC values.

In order to limit the need for routinely having to reestablish the alarm setpoints as a function of changing radionuclide distributions, a default alarm setpoint can be established. This default setpoint can be conservatively based on an evaluation of the radionuclide distribution of the liquid effluents from Kewaunee and the effective MPC value for this distribution.

The effective MPC value for a radionuclide distribution can be calculated by the equation:

$$MPC_e = \frac{\sum C_i}{\sum \frac{C_i}{MPC_i}} \tag{C.1}$$

where:

MPC_e = an effective MPC value for a mixture of radionuclide (μCi/ml)

C_i = concentration of radionuclide i in the mixture

MPC_i = the 10 CFR 20, Appendix B, Table II, Column 2 MPC value for radionuclide i (μCi/ml)

Based on the above equation and the radionuclide distribution in the effluents for past years from Kewaunee, an effective MPC value can be determined. Results are presented in Table C-1.

Based on the annual radionuclide distributions, the most limiting effective MPC was for the calendar year 1983, with a calculated value of 3.8E-05 μCi/ml. For conservatism in establishing the alarm setpoints, a default effective MPC value of 1.0E-05 μCi/ml was selected. The overall conservatism of this value is reaffirmed for future releases considering that 1.0E-05 μCi/ml is more restrictive than the individual MPC values for the principal fission and activation products of Co-58, Co-60 and Cs-137 and is only slightly higher than the 9.0E-06 μCi/ml MPC value for Cs-134.

In 1992, Table C-1 was updated to include data from 1984 through 1991. The default effective MPC value of 1.0E-05 μCi/ml previously established was reaffirmed as being a conservative value. Note that the 1984 through 1991 data includes more nuclides than previous years data.

Appendix C

Table C-1
Calculation of Effective MPC

		Activity Released (Ci)		
Nuclide	MPC (μCi/ml)	1976-1981 Avg.	1982	1983
Sr-89	3E-06	1.0E-03	3E-05	2E-04
Sr-90	3E-07	2.5E-04	5E-05	1.2E-04
Nb-95	1E-04	5.4E-03	2.4E-03	2.5E-03
I-131	3E-07	1.9E-02	–	3E-05
I-133	1E-06	7.4E-04	–	2E-05
Cs-136	6E-05	5.2E-04	–	–
Cs-137	2E-05	5.7E-02	4.7E-02	2.1E-02
Cs-138	–	1.2E-04	–	–
Ba-140	2E-05	4.5E-04	–	6E-06
Mn-54	1E-04	4.5E-02	9E-03	3.6E-03
Co-57	4E-04	3.1E-04	1.7E-04	1.8E-04
Co-58	9E-05	5.5E-01	8.1E-01	2.1E-01
Co-60	3E-05	1.6E-01	3.7E-01	2.0E-01
Sb-124	2E-05	3.4E-02	3E-02	3.8E-03
Sb-125	1E-04	3.4E-02	1.8E-02	8.4E-03
Cr-51	2E-03	4.6E-02	1E.02	2.8E-03
Ag-110m	3E05	4.3E-02	1.5E-01	7.2E-02
Na-24	3E-05	9.7E-03	1E-05	8.3E-04
Fe-59	5E-05	6.1E-04	4.4E-04	8E-05
Sn-113	8E-05	6.1E-04	1E-04	8E-05
Zr-95	6E-05	2.2E-03	8E-04	4E-04
Total		1.09	1.46	0.53
Ci		9.2E+04	3.2E+04	1.4E+04
MPCi				
MPC$_e$ (μCi/ml)		1.2E-05	4.6E-05	3.8E-05

Appendix C

Table C-1 (con't) - Calculation of Effective MPC

Nuclide	MPC (μCi/ml)	Activity Released (Ci)				
		1984	1985	1986	1987	1988
Na-24	3.0E-05	1.42E-03	6.90E-03	5.85E-04	6.16E-04	3.08E-04
Cr-51	2.0E-03	2.57E-03	2.94E-02	4.08E-02	2.02E-02	8.36E-03
Mn-54	1.0E-04	6.06E-03	8.53E-03	1.94E-03	3.37E-03	4.87E-03
Fe-55	8.0E-04	7.45E-03		5.24E-02	1.21E-01	7.23E-02
Mn-56	1.0E-04				8.38E-05	
Co-57	4.0E-04	9.47E-04	2.19E-04	1.01E-04	8.03E-05	3.55E-04
Co-58	9.0E-05	5.78E-01	2.69E-01	1.92E-01	1.86E-01	2.68E-01
Fe-59	5.0E-05	3.62E-04	3.36E-02	1.03E-02	5.02E-03	1.94E-02
Co-60	3.0E-05	1.03E-01	1.41E-01	6.32E-02	4.62E-02	6.22E-02
Ni-63	3.0E-05			2.24E-02		
Sr-89	3.0E-06	2.05E-03	1.40E-04		4.61E-05	6.77E-05
Sr-90	3.0E-07	2.59E-04	3.48E-05		1.54E-05	3.79E-06
Nb-95	1.0E-04	1.23E-03	1.83E-02	2.20E-03	5.32E-03	1.36E-05
Zr-95	6.0E-05	7.30E-04	1.05E-02	6.89E-04	2.36E-03	9.53E-04
Nb-97	1.0E-04	3.91E-02				
Zr-97	2.0E-05	3.55E-04				
Mo-99	4.0E-05					
Ru-103	8.0E-05					
Ag-110m	3.0E-05	8.33E-02	3.82E-02	2.97E-02	8.43E-02	2.32E-02
Sn-113	8.0E-05	1.77E-03	3.85E-03	1.27E-03	1.43E-03	7.88E-04
Sn-117m	3.0E-06					
Sb-122	3.0E-05				1.91E-04	4.48E-04
Sb-124	2.0E-05	9.51E-02	3.95E-02	2.74E-02	2.92E-02	1.52E-02
Sb-125	1.0E-04	4.73E-02	3.07E-02	1.83E-02	2.25E-02	1.15E-02
I-131	3.0E-07	4.44E-05	3.04E-04		1.31E-04	1.33E-03
I-132	8.0E-06			3.44E-05	1.88E-04	
I-133	1.0E-06	4.12E-03		3.64E-05	5.76E-04	2.62E-04
Cs-134	9.0E-06	1.31E-02	5.62E-03	6.51E-04	2.06E-04	1.75E-03
I-134	2.0E-05			1.40E-03		
I-135	4.0E-06				4.31E-04	2.60E-05
Cs-136	6.0E-05					1.92E-04
Cs-137	2.0E-05	2.04E-02	2.24E-02	3.63E-03	2.97E-03	7.91E-03
Cs-138	3.0E-06	8.01E-04				
Ce-139	3.0E-06	3.28E-07				
Ba-140	2.0E-03					
La-140	2.0E-05		7.32E-05	4.07E-05	2.09E-04	2.63E-05
Ce-144	1.0E-05		9.01E-06			
W-187	6.0E-05					
Total Activity (Ci)		1.01E+00	6.28E-01	4.23E-01	5.33E-01	4.83E-01
MPCe (μCi/ml)		4.39E-05	4.19E-05	5.24E-05	5.37E-05	3.94E-05

Appendix C

Table C-1 (con't) - Calculation of Effective MPC

Nuclide	MPC (μCi/ml)	Activity Released (Ci)		
		1989	1990	1991
Na-24	3.0E-05	5.12E-05	1.53E-05	3.58E-05
Cr-51	2.0E-03	9.59E-04	2.02E-02	1.38E-02
Mn-54	1.0E-04	5.75E-03	2.85E-03	2.34E-03
Fe-55	8.0E-04	1.54E-01	1.53E-02	4.07E-02
Mn-56	1.0E-04			
Co-57	4.0E-04	6.67E-04	4.16E-05	1.97E-04
Co-58	9.0E-05	4.58E-01	8.79E-02	1.01E-01
Fe-59	5.0E-05	4.18E-03	3.05E-03	3.68E-03
Co-60	3.0E-05	9.12E-02	3.36E-02	3.45E-02
Ni-63	3.0E-05			
Sr-89	3.0E-06			2.12E-06
Sr-90	3.0E-07			
Nb-95	1.0E-04	1.43E-02	5.73E-03	4.87E-03
Zr-95	6.0E-05	1.00E-02	3.97E-03	3.07E-03
Nb-97	1.0E-04			
Zr-97	2.0E-05	3.98E-04	1.17E-04	6.21E-05
Mo-99	4.0E-05	3.16E-07		
Ru-103	8.0E-05	6.95E-06		
Ag-110m	3.0E-05	6.12E-02	1.92E-02	1.31E-02
Sn-113	8.0E-05	4.38E-03	2.36E-03	1.93E-03
Sn-117m	3.0E-06			7.21E-05
Sb-122	3.0E-05	5.69E-02	1.53E-05	1.48E-04
Sb-124	2.0E-05	1.22E-02	1.90E-03	2.10E-03
Sb-125	1.0E-04	9.04E-03	2.47E-03	2.61E-03
I-131	3.0E-07	1.45E-03		
I-132	8.0E-06			
I-133	1.0E-06			
Cs-134	9.0E-06	7.47E-03	6.92E-04	1.49E-04
I-134	2.0E-05			
I-135	4.0E-06			
Cs-136	6.0E-05			
Cs-137	2.0E-05	6.25E-03	8.02E-04	1.95E-04
Cs-138	3.0E-06			
Ce-139	3.0E-06			
Ba-140	2.0E-05			
La-140	2.0E-05	2.49E-04		
Ce-144	1.0E-05			
W-187	6.0E-05	9.02E-04	6.87E-04	1.83E-04
Total Activity (Ci)		9.00E-01	2.01E-01	2.25E-01
MPCe (μCi/ml)		4.62E-05	6.16E-05	7.06E-05

APPENDIX D

Site Maps

Appendix D

Site Maps

Plant drawing A-408, "Radiological Survey Site Map" depicts the site area by illustrating the site boundary and the restricted areas. The area within the site boundary but outside the restricted area is considered the onsite unrestricted area. Plant drawing A-449, "Plan of Plant Area, Fence, Lighting, and CCTV Support Structure" shows the layout of the site buildings. Much of the land located within the unrestricted area is used for recreational or agricultural purposes. The pier, at the liquid discharge of the plant, is often occupied by fishermen. Occupancy factors for this location is estimated to be five fishermen per day. The pier is open to the public from 4 AM to 11 PM. Admittance hours are posted. The school forest is most often visited by the Kewaunee County school system for educational purposes. It is estimated that 250 students visit this area per year. The walking trails, softball diamond and the school forest are open to use by the general public. It is estimated that approximately 400-500 people use this area each year. The school forest is also used by area schools for cross country meets and area boy scout troops for overnight campouts.

Figure D-1 presents the locations and elevations of radioactive effluent release points at the plant. The plant drawings referenced above are not included as part of the ODCM but can be found in the plant drawing system.

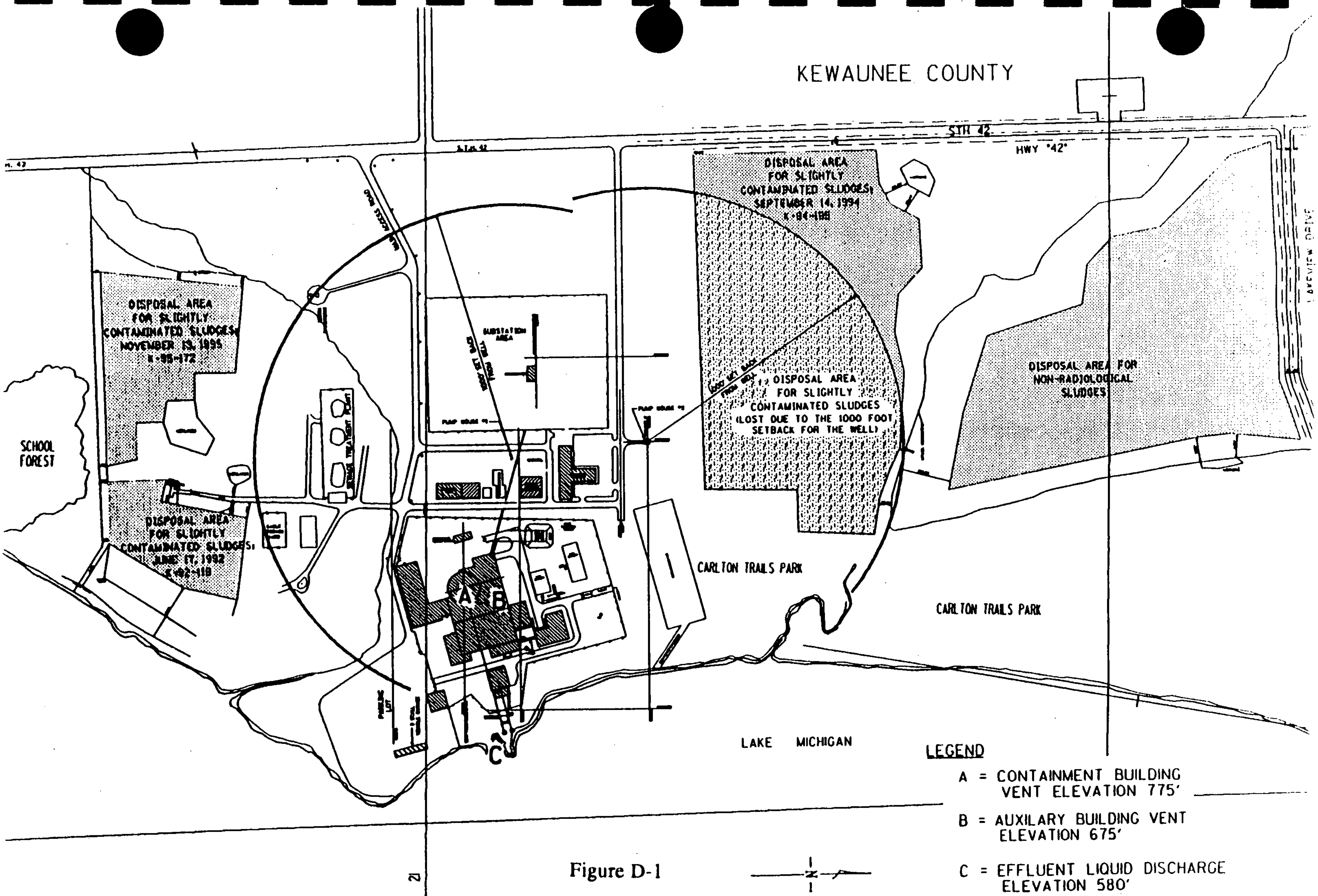
KEWAUNEE COUNTY
STH 42
HWY "42"
S.T.H. 42
MAIN ACCESS ROAD
SUBSTATION AREA
PUMP HOUSE #1
PUMP HOUSE #2
SEWAGE TREATMENT PLANT
DISPOSAL AREA FOR SLIGHTLY CONTAMINATED SLUDGES; NOVEMBER 13, 1995 K-95-172
DISPOSAL AREA FOR SLIGHTLY CONTAMINATED SLUDGES; JUNE 17, 1992 K-92-118
DISPOSAL AREA FOR SLIGHTLY CONTAMINATED SLUDGES; SEPTEMBER 14, 1994 K-94-188
1000 SET BACK FROM WELL
DISPOSAL AREA FOR SLIGHTLY CONTAMINATED SLUDGES (LOST DUE TO THE 1000 FOOT SETBACK FOR THE WELL)
DISPOSAL AREA FOR NON-RADIOLOGICAL SLUDGES
SCHOOL FOREST
CARLTON TRAILS PARK
CARLTON TRAILS PARK
LAKEVIEW DRIVE
LAKE MICHIGAN
PARKING LOT
A
B
C
N
21
20
LEGEND
A = CONTAINMENT BUILDING VENT ELEVATION 775'
B = AUXILARY BUILDING VENT ELEVATION 675'
C = EFFLUENT LIQUID DISCHARGE ELEVATION 580'

Figure D-1

APPENDIX E

Onsite Disposal of Low-Level Radioactively Contaminated Waste Streams

WPSC (414) 433-1598
TELECOPIER (414) 433-5544

NRC 91-148

EASYLINK 62891993

WISCONSIN PUBLIC SERVICE CORPORATION

600 North Adams • P O Box 19002 • Green Bay, WI 54307-9002

bcc - K M Barlow, MGE
N E Boys, WPL
Larry Nielsen, ANFC
D R Berg KNP
D A Bollom G6
R E Draheim KNP
K H Evers D2
M L Marchi KNP
D L Masarik KNP
J N Morrison D2
J R Mueller D2
D S Nalepka KNP
L A Nuthals D2 (NSRAC)
R P Pulec D2
J S Richmond D2
D J Ristau D2
D J Ropson KNP
DT Brown KNP
A J Ruege D2
C A Schrock KNP
C S Smoker KNP
C R Steinhardt D2
J J Wallace KNP
K H Weinhauer KNP
S F Wozniak D2
QA Vault KNP
TJ WEBB KNP

October 17, 1991

File

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Disposal of Low Level Radioactive Material

References:
1) Letter from K.H.Evers to Document Control Desk dated September 12, 1989
2) Letter from M.J.Davis to K.H.Evers dated February 13, 1990
3) Letter from L.Sridharon (WDNR) to M.Vandenbusch dated June 13, 1991

In reference 1, pursuant to the regulation of 10 CFR 20.302, Wisconsin Public Service Corporation (WPSC) requested authorization for the alternative disposal of very-low-level radioactive materials from the Kewaunee Nuclear Power Plant. In reference 2, the US NRC identified additional questions that needed to be addressed in order to complete their review. Attachment 1 provides our response to the questions.

WPSC requested the State of Wisconsin Department of Natural Resources (WDNR) to review the disposal options for the service water pretreatment lagoon sludges. In reference 3, the WDNR completed a review of the most appropriate on site disposal methods for the slightly contaminated service water pretreatment lagoon sludges. The two proposed methods that the WDNR evaluated included in-situ capping of the sludge in the wastewater treatment lagoon and on site landspreading. In Attachment 1, Appendix A, WPSC evaluated the on site landspreading application which is our preferred disposal method. WPSC does not intend to utilize the in-situ capping of the sludge in the lagoon at this time. However, in the letter the WDNR agreed that either disposal method was acceptable provided:

- if the material is to be left in the lagoon, it would be capped in accordance with Wisconsin State statutes.
- if the on site landspreading option is utilized, the material would be spread by either disking into the soil or by spiking into the ground.

WPSC will abide by the WDNR landspreading requirements which include locational and performance standards. Should there be any additional questions please feel free to contact a member of my staff.

Sincerely,

CA Schrock

C. A. Schrock
Manager - Nuclear Engineering

DJM/jms

Attach.

cc - US NRC - Region III
Mr. Patrick Castleman, US NRC

LIC\DJM\N492

ATTACHMENT 1

To

Letter from K. H. Evers (WPSC) to Document Control Desk (NRC)

Dated

October 17, 1991

References 1) Letter from K. H. Evers to Document Control Desk dated September 1, 1989.

NRC Question #1

On page 4 of your submittal, the average input to the Sewage Treatment System is approximately 11,000 gallons per day. In the Final Environmental Statement, this system is to be operated below its design capacity of 9,000 gallons per day. Discuss this deviation from the design capacity, and provide information to justify the higher output for this system.

WPSC Response

The original Sewage Treatment System installed at the Kewaunee Nuclear Power Plant (KNPP) was replaced in 1986 with a higher capacity system. The original system was designed for an onsite work force of around 150 people. It was a limited capacity aerobic treatment system which included the onsite lagoon for additional retention. Because of this limited capacity and more stringent conditions on system effluent to Lake Michigan, an aerobic digester system was installed, which has a higher capacity, and uses current technology.

The estimated input volume to the Sewage Treatment System used in the September 12, 1989 application was 11,000 gallons per day. This value was based on past operating data. The increase in influent from the original design basis included in the Final Environmental Statement is due mainly to an increase in the number of individuals and facilities (e.g., training and simulator building) located onsite. Design changes to the system were required to accommodate these new facilities.

The current volumes of sewage sludge were used as the basis for the potential dose analysis and corresponding radionuclide concentration limits. This increase has no significant effect on the dose modeling. (Refer to the response to NRC Question #2, below.)

NRC Question #2

Provide information regarding how the disposal plan assures that the annual dose to any exposed individual will be kept below 1 mrem per year.

WPSC Response

The dose pathway modeling used for determining the radioactive material concentration limits was based on NRC modeling. The computer code IMPACTS-BRC was used as the basis for calculating the potential doses from the alternative disposal methods. This modeling includes reasonable conservative exposure pathway scenarios for the various disposal methods.

Administrative controls will be established to ensure that the actual disposal of any slightly contaminated materials from KNPP are within the bounds of the evaluation. Samples from each of the waste streams will be collected and analyzed by gamma spectroscopy prior to release for disposal. A system lower limit of detection (LLD) of 5E-07 μCi/ml for the principal gamma emitting radionuclides will be required. This LLD ensures the identification of any contaminated materials at a fraction of the allowable concentration limits for the alternative disposal.

The results of these analyses will be used to ensure that any detectable levels of radioactive material are within the limits for alternative disposal. Any materials with levels of radioactive material above the concentration limits (and of plant origin) will be treated as a radioactive waste and appropriately controlled.

Records will be maintained to ensure that the cumulative disposal of any contaminated materials are maintained within the bounds of the evaluation. In addition to a comparison of the individual radionuclide concentration limits, a record of the total amount of radioactive material disposed of will be maintained. Cumulative totals will be maintained to ensure that the total activity does not exceed the quantity assumed in the derivation of the limits.

In developing the concentration limits presented in Table 1 of reference 1, it was assumed the total annual design basis volume of 27,000 ft^3 would be contaminated at the derived limit. The dose commitment from each radionuclide was individually evaluated as if it were the only radioactive material present. To determine if a mixture of radionuclides meets the limit, the sum-of-the-fractions rule should be applied (i.e., the sum of each radionuclide's concentration divided by its limiting concentration must be less than one).

The concentration limits of Table 1 of reference 1 also have an implied total activity limit. This limit is determined by multiplying the individual radionuclide concentration limit by the total estimated waste volume of 27,000 ft^3. These total activity limits are presented in Table A of this response, for each radionuclide individually. For a mixture of radionuclides, a total annual activity limit may be determined by normalizing the concentrations so that the sum-of-the-fractions for the mixture equals one (1). These resultant adjusted concentrations may be multiplied by the 27,000 ft^3 waste volume to determine the corresponding total activity limit of the mixture.

A Disposal Log will be maintained on a calendar year basis for all disposals of any very-low-level radioactive materials. The log will contain as a minimum the following information:

- Disposal location
- Description of waste
- Shipment/disposal date
- Waste volume
- Radionuclide concentrations (gamma emitters)
- Year-to-date radionuclide activity
- Year-to-date waste volume

In addition to the above Disposal Log, a record file will be kept for each individual disposal. This file will contain, as a minimum, the following information:

- Waste identification
- Sample gamma spectroscopy results
- Identified radionuclide concentrations and total activity

NRC Question #3

Revise Appendix B, Section A of your submittal, "Radiation Exposure During Transport," by adding the cumulative dose to the exposed population per reactor year for both the transportation worker and the general public (onlookers along route).

WPSC Response

The potential exposure to the general public (onlookers along route) is modeled by the IMPACTS-BRC code. As addressed in NUREG/CR-3585, this modeling is based on an integration of the source strength, an assumed population density along route and vehicular speed. For a conservative evaluation of the potential exposure to the general public from the transport of the KNPP waste, a population density of 610 persons/mi^2 was assumed. This value is conservative for the KNPP site area where the average population density is less than 53 persons/mi^2.. A transport distance of 45 miles was assumed. The IMPACTS-BRC modeling assumes five (5) tons of material are transported per shipment. For the assumed KNPP waste volume, this shipment weight translates into a total of 167 shipments per year. With a vehicular speed of 20 miles per hour, the resultant total population exposure time is 375 person-hours per year. At the concentration limits established for the alternative disposal, the potential onlooker doses during transport will be less than 0.01 person-rem_per year. For the modeling of the exposure to the transport worker, the IMPACTS-BRC model assumes two drivers per vehicle. As presented in the September 12, 1989 submittal, the maximum dose to the driver is less than 1 mrem per year (<0.001 rem/yr). Therefore, the total collective dose to the transport workers will be twice the individual dose, i.e., less than 0.002 person-rem. Including the population dose of <0.01 person-rem per year, the total collective dose to both the transport workers and the population is less than 0.02 person-rem (0.002 person-rem + 0.01 person-rem < 0.02 person-rem).

For the disposal of the existing 15,000 ft^3 of contaminated sludges, the population dose due to the transportation of the waste is calculated to be 0.0002 person-rem. The estimated collective exposure to the transport worker is 0.00007 person-rem. The total collective dose due to transport of the waste is 0.00027 person-rem.

Additional Potential Disposal Method

The Wisconsin Department of Natural Resources has requested Wisconsin Public Service to examine the feasibility of land application of the lagoon sludges in lieu of disposal in the Kewaunee County Landfill. Land application is also an option for the disposal of the sewage sludges. Therefore, WPS requests that the option for onsite disposal at the KNPP site by land application be included in the alternative disposal methods which was determined to be acceptable in our September 12, 1989 submittal.

The potential pathways of exposure as evaluated in the September 12, 1989 submittal conservatively bound any additional pathways of exposure that would result from onsite land spreading of the waste. Attachment A to this response provides an overview of the land spreading disposal method. Also, the pathways of exposure applicable to the onsite land application are evaluated; and a comparison to the controlling pathways and radionuclide concentrations as presented in the September 12, 1989 submittal are discussed. From a modeling standpoint, the two exposure scenarios , "Radiation Exposure During Transport" and "Radiation Exposure to Landfill Operator," appropriately characterize any potential exposure to workers involved with the land spreading of the waste. The other post-disposal exposure scenarios, "Intruder Scenario", "Intruder Well", and "Exposed Waste Scenario," as described in NUREG/CR-3585 (and as discussed in Appendix C of the submittal) reasonably bound any potential exposures from either ground waste migration or post-release from the Kewaunee site. In no case is there a higher potential for exposure from land application than the pathways and potential exposures that were used for the derivation of the limits for alternative disposal. Therefore, no revisions are needed to the radionuclide concentration limits proposed in the September 12, 1989 submittal to include the option for disposal by onsite land spreading of the waste.

Table A

Radionuclide Quantity Limits for Alternative Disposal

Nuclide	Limiting Concentration (μCi/ml)	Limiting Annual Quantity (Ci)
H-3	9.65E-04	0.7382
C-14	4.55E-05	0.0348
Cr-51	3.13E-04	0.2394
Mn-54	1.14E-05	0.0087
Fe-55	1.00E-02	7.6500
Fe-59	7.90E-06	0.0060
Co-58	1.16E-05	0.0089
Co-60	3.74E-06	0.0029
Ni-63	1.00E-02	7.6500
Sr-90	3.45E-03	2.6393
Zr-95	6.28E-06	0.0048
Nb-95	1.23E-05	0.0094
Mo-99	6.73E-05	0.0515
Tc-99	2.70E-04	0.2066
I-129	2.50E-06	0.0019
I-131	2.68E-05	0.0205
Cs-134	6.16E-06	0.0047
Cs-137	1.71E-05	0.0131
Ba-140	5.52E-05	0.0422
La-140	4.17E-06	0.0032
Transuranics		
TRU (T½ > 5 yrs)	8.91E-05	0.0682
Pu-241	2.85E-03	2.1803
Cm-242	1.00E-02	7.6500

Assumes annual quantity of KNPP wastes is 27,000 ft^3 or 7.65E8 mls.

Appendix A

Evaluation of Onsite Land Application for Alternative Disposal of Very-Low-Level Contaminated Materials

Overview

Land spreading of lagoon sludges onsite at the Kewaunee Nuclear Power Plant has been recommended by personnel from the Wisconsin Department of Natural Resources (DNR) as a desirable alternative to the use of the Kewaunee County Landfill for disposal. This method of disposal is also a recommended practice for disposing of sewage treatment facility sludges. Therefore, WPS requests that this disposal method be included in the options available for the alternative disposal of very-low-level radioactively contaminated materials from KNPP.

Description of Disposal Method

The disposal of KNPP sludges will be performed by beneficial land application to a dedicated disposal area located onsite at the Kewaunee Nuclear Power Plant. Typical methods of land spreading will be employed. KNPP sludges will be loaded onto appropriate vehicles (e.g., tanker truck, sludge spreader, etc.) and applied to the dedicated disposal area. The dedicated disposal area will be periodically plowed to a depth of 6 inches.

Onsite disposal of water treatment and sewage sludges are allowed by EPA and State of Wisconsin Department of Natural Resources with the criteria and limits for land spreading being specified by the potential use of the land. The two land use criteria are 1) Agricultural land that covers any lands upon which food crops are grown or animals are grazed for human consumption, and 2) Non-Agricultural land that covers lands which do not represent ingestion pathways to man. To be conservative, the Agricultural Land Application limits of sludge contaminants will be applied to the KNPP wastes even though the less restrictive Non-Agricultural Land Application sludge contamination limits are allowed. Therefore, no more than 50 metric tons of sludge per hectare will be applied to the dedicated disposal site. This limit will ensure that any land application will not exceed the bounds of the dose analysis as performed previously. In addition, other limitations as applied to land application by the State of Wisconsin Department of Natural Resources will be followed (e.g., control of runoff/erosion, proximity to wells/residences/surface water, etc.).

Applicable Pathways of Exposure

The pathways of exposure applicable for land spreading are not appreciably different from the pathways evaluated for the disposal methods at the Kewaunee County Landfill or the Green Bay Metropolitan Sewerage District facilities. The major exposure pathways are discussed below:

Direct Exposure to Workers

Any potential exposures to workers involved in the removal, transport and land spreading of the sludges are reasonably bound by the evaluation of the exposure to the transport worker in the September 12, 1989 submittal. The transport worker has been assumed to be exposed for 460 hours per year at one (1) meter from unshielded waste. For the land spreading of these wastes, it is estimated that the total exposure time for the removal and disposal of the lagoon sludges will require no longer than a three week period per year (i.e., 120 hours).

The potential exposure to a worker onsite after land spreading, has been estimated at no more that 100 hours per year. Such an individual would be involved in land maintenance activities, such as plowing and mowing. As modeled in the September 12, 1989 submittal, an exposure of 2000 hours per year to the landfill operator has been assumed. For this exposure, the KNPP materials are mixed with other landfill waste: a 1:13 mixing of KNPP materials to other waste is assumed. This mixing is not significantly different from the type of mixing that will occur in the field with the sludges being plowed into the soil to a depth of six (6) inches. With a land spreading of 50 metric tons per hectare per year, a mixing ratio of 1:30 will be achieved. Therefore, the resultant dose to the exposed worker would be less than the 1 mrem per year dose to the transport worker as evaluated in the September 12, 1989 submittal.

Post Disposal Exposure - Intruder Scenario

The IMPACTS-BRC model, as applied to the disposal of the KNPP waste, assumes a loss of institutional controls 10 years after closure of the site (See Appendix B of the September 12, 1989 submittal). An individual is assumed to reside in a house built on the disposal area. This individual receives a direct exposure (from the uncovered waste), an inhalation exposure (from resuspension), and an ingestion exposure (from growing ½ of his food crops). For modeling purposes, it is assumed that the waste is mixed at a ratio of 1:13 with other soils during the resident's construction process.

The onsite land application of KNPP waste will be limited by the Agricultural Land Application sludge concentrations even though the less restrictive Non-Agricultural Land Application sludge concentrations are applicable since a "dedicated land disposal" site will be used (i.e., no crops will be grown on the disposal site). Therefore, provided the KNPP waste does not exceed the Non-Agricultural maximum sludge concentrations for heavy metal or organic chemicals, unlimited application of waste to the dedicated land disposal site is allowed. However, to be conservative, the land application of KNPP wastes will be limited to 5 metric tons per hectare per year. The intruder scenario as evaluated in the September 12, 1989 submittal conservatively bounds this exposure pathway for the on-site land spreading.

Post Disposal - Intruder Well

The intruder well pathway for onsite land disposal is essentially the same as the intruder well pathway as evaluated by the IMPACTS-BRC model. It is conservatively assumed that the well is located at the edge of the disposal site. As modeled, locating the well at the disposal site edge in "downstream flow" direction maximizes the calculated hypothetical dose. (Additioual discussion of this modeling is presented in NUREG/CR-3585, Volume 2).

The potential dose for the intruder well scenario for the land spreading disposal would be less than 0.001 mrem per year. The modeling as presented in the September 12, 1989 submittal reasonably bounds any hypothetical well water exposure pathway.

In summary, the modeling of the exposure scenarios, as presented in the September 12, 1989 submittal, conservatively bounds the hypothetically exposures for the on-site land spreading. In no case is it likely that any individual, either on-site or off-site, will receive a dose in excess of 1 mrem per year from the disposal of the slightly contaminated materials.

K-42-114
Received
6-19-92

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

June 3, 1992

vg

Docket No. 50-305

MEMORANDUM FOR: John N Hannon, Director
Project Directorate III-3
Division of Reactor Projects - III/IV/V

FROM: Allen G. Hansen, Project Manager
Project Directorate III-3
Division of Reactor Projects - III/IV/V

SUBJECT: FORTHCOMING MEETING WITH WISCONSIN PUBLIC SERVICE CORPORATION (WPSC)

DATE & TIME: Thursday, June 18, 1992
1:30 to 4:00 pm

LOCATION: One White Flint North, Rockville, Maryland
Room 1F19

PURPOSE: To discuss WPSC progress on their Individual Plant Examination (Generic Letter 88-20)

PARTICIPANTS:*

NRC	WPSC
J. Hannon, NRR	P. Finnemore
A. Hansen, NRR	Others as designated
R. Hernan, NRR	
J. Flack, RES	
W. Beckner, NRR	
Others as designated	

Allen G. Hansen, Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV/V

cc: See next page

*Meetings between NRC technical staff and applicants or licensees are open for interested members of the public, petitioners, intervenors, or other parties to attend as observers pursuant to "Open Meeting Statement of NRC Staff Policy," 43 <u>Federal Register</u> 28058, 6/28/7B.

T A Hanson (MG&E)
J D Loock (WPL)
arry Nielsen (ANFC)
L Belant (NSRAC)
D A Bollom G6
K H Evers KNP
J P Giesler D2
M L Marchi KNP
D L Masarik KNP
R P Pulec D2 (2)
D J Ristau D2
A J Ruege D2
C A Schrock D2
C R Steinhardt D2
T J Webb KNP
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K-94-195
9/21/94

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 14, 1994

Mr. C. A. Schrock
Manager - Nuclear Engineering
Wisconsin Public Service Corporation
Post Office Box 19002
Green Bay, WI 54307-9002

SUBJECT: SAFETY EVALUATION FOR AN AMENDMENT TO AN APPROVED 10 CFR 20.302 APPLICATION FOR THE KEWAUNEE NUCLEAR PLANT (TAC NO. M89719)

Dear Mr. Schrock:

By letter dated June 23, 1994, as supplemented June 29, 1994, you requested approval to use another onsite area for the disposal of contaminated waste sludge in addition to the location approved by the NRC on June 17, 1992. The staff has completed its review of your request and finds that your proposal meets the radiological boundary conditions approved in the June 17, 1992, Safety Evaluation, and is therefore acceptable. The staff also finds that your proposal is in accordance with 10 CFR 20.2002 which replaced 20.302 on January 1, 1994.

This approval is granted provided that the enclosed Safety Evaluation is permanently incorporated into your Offsite Dose Calculation Manual (ODCM) as an Appendix, and that future modifications of these commitments are reported to the NRC.

Sincerely,

Richard J. Laufer

Richard J. Laufer, Acting Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure:
Safety Evaluation

cc w/enclosure:
see next page

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Larry Nielsen (ANFC)
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D E Cole KNP
K H Evers KNP
J P Giesler KNP

K A Hoops KNP
M L Marchi KNP
D L Masarik KNP
J N Morrison D1
L A Nuthals (NSRAC)
R P Pulec D2 (2)
C A Schrock D2

C S Smoker KNP
C R Steinhardt D2
C A Sternitzky KNP
T J Webb KNP
S F Wozniak D2
QA Vault KNP

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Chief Engineer
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO ONSITE DISPOSAL OF LOW-LEVEL RADIOACTIVELY CONTAMINATED WASTE SLUDGE

AT THE KEWAUNEE NUCLEAR POWER PLANT

WISCONSIN PUBLIC SERVICE CORPORATION
WISCONSIN POWER AND LIGHT COMPANY
MADISON GAS AND ELECTRIC COMPANY

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter dated June 23, 1994, and as supplemented on June 29, 1994, Wisconsin Public Service Corporation (the licensee) requested approval to use another onsite area for the disposal of contaminated waste sludge in addition to the location approved by the NRC on June 17, 1992.

2.0 EVALUATION

A Safety Evaluation (SE) dated June 17, 1992, approved the licensee's request pursuant to 10 CFR 20.302 for the disposal of 15,000 cubic feet of contaminated waste sludge by land application at the Kewaunee Nuclear Power Plant (KNPP) at a specific onsite location. The SE imposed the following boundary conditions:

1. The annual disposal must be less than a total activity of 0.2 mCi.
2. The whole body dose to the hypothetical maximally exposed individual must be less than 0.1 mrem/year.
3. The disposal must be the same site.

The site designated in the SE was an unused area adjacent to the onsite lagoon at the KNPP sewage treatment facility. In 1993, approximately 7500 cubic feet of the original 15,000 cubic feet of contaminated sludge was spread on that location. The licensee has now proposed to dispose of the remaining contaminated sludge at another onsite location northwest of the plant (see Attachment). The licensee has committed that the new disposal location will meet all the radiological boundary conditions contained in the SE for the 10 CFR 20.302 application approved on June 17, 1992. Additionally, the licensee has stated that this additional disposal site will meet all applicable Wisconsin Department of Natural Resources (WDNR) application requirements (i.e., sludge application rate and frequency of spreeding rate), in addition to WDNR landspreeding requirements regarding location and performance standards that were required at the original disposal site.

3.0 CONCLUSION

The staff finds the licensee's proposal to dispose of the low-level radioactive waste sludge in the additional onsite location to be within the radiological boundary conditions approved in the June 17, 1992, SE and is therefore acceptable. The staff also finds that your proposal is in accordance with 10 CFR 20.2002 which replaced 20.302 on January 1, 1994.

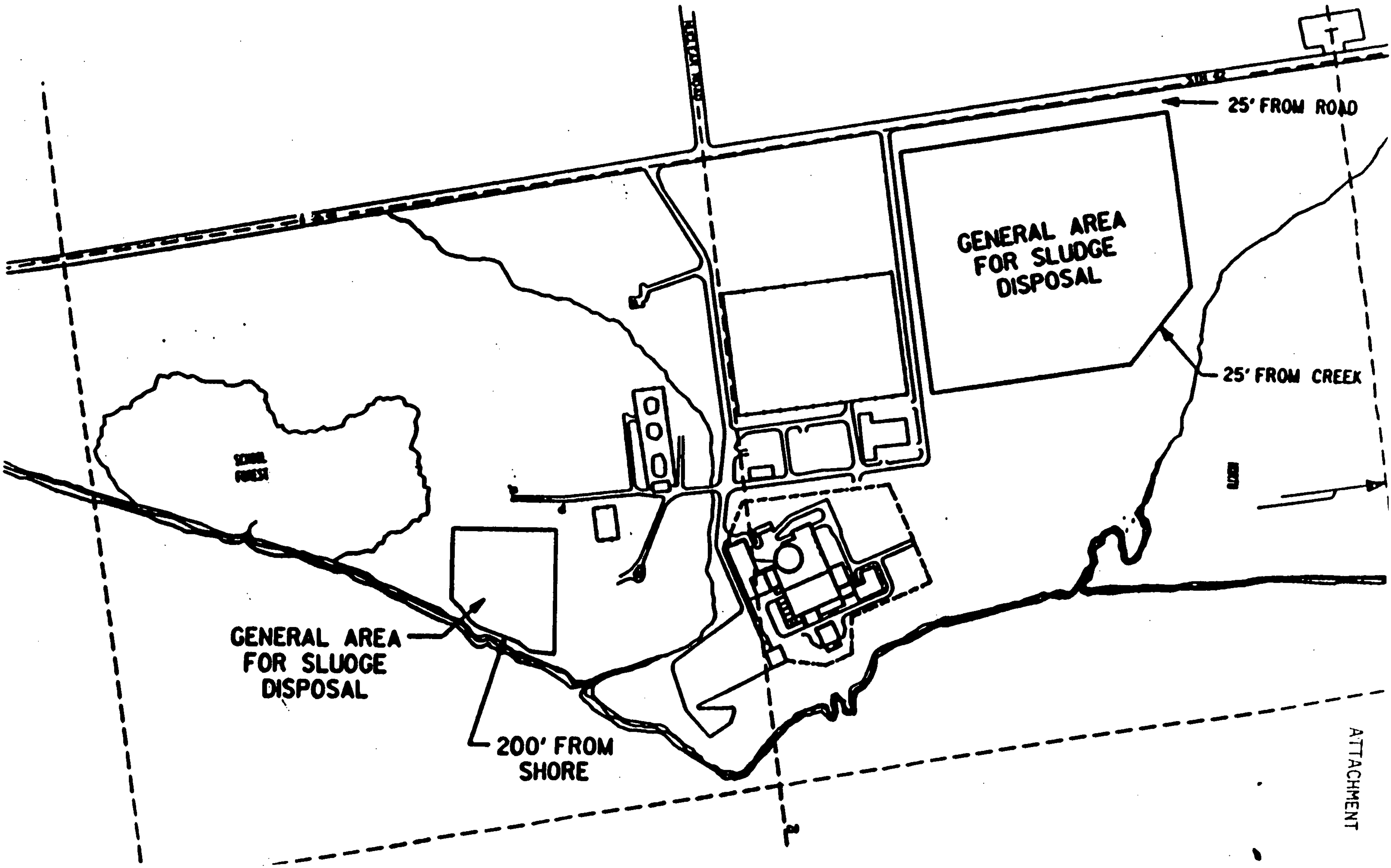
As stated in the NRC's June 17, 1992, approval of the licensee's 10 CFR 20.302 application, the licensee is required to permanently incorporate this modification into the Offsite Dose Calculation Manual as an Appendix, and that future modification of this commitment be reported to the NRC.

Principal Contributor: S. Klementowicz

Date: September 14, 1994

Attachment: KNPP Site Area Map

KEWAUNEE NUCLEAR POWER PLANT SITE AREA MAP



ATTACHMENT

K-95-172
Rec'd. 11-20-95

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 13, 1995

Mr. M. L. Marchi
Manager - Nuclear Business Group
Wisconsin Public Service Corporation
Post Office Box 19002
Green Bay, WI 54307-9002

SUBJECT: ALTERNATE DISPOSAL OF CONTAMINATED SEWAGE TREATMENT PLANT SLUDGE IN ACCORDANCE WITH 10 CFR 20.2002 (TAC NO. M93844)

Dear Mr. Marchi:

By letter dated October 17, 1995, as supplemented on November 3, 1995, you requested approval for the onsite disposal of contaminated sewage treatment sludge in accordance with 10 CFR 20.2002. This request was similar to a previous disposal request that was approved by the NRC on June 17, 1992.

The staff has completed its review of your request and finds that your proposal meets the radiological boundary conditions approved in the June 17, 1992, Safety Evaluation, and is therefore acceptable.

This approval is granted provided that the enclosed safety evaluation is permanently incorporated into you Offsite Dose Calculation Manual (ODCM) as an Appendix, and that future modifications of these commitments are reported to the NRC.

Sincerely,

Richard J. Laufer

Richard J. Laufer, Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure: Safety Evaluation

cc: See next page

NRC to WPSC LETTER DISTRIBUTION

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Larry Nielsen (ANFC)
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D E Day D1
K H Evers KNP
M L Marchi D2
J K Jubin (NSRAC)
R P Pulec KNP (3)
C A Schrock KNP
C S Smoker KNP
C R Steinhardt D2
CA Sternitzky KNP(Lic)
S F Wozniak D2
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Mr. M. L. Marchi
Wisconsin Public Service Corporation

Kewaunee Nuclear Power Plant

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO ONSITE DISPOSAL OF LOW-LEVEL RADIOACTIVELY CONTAMINATED SEWAGE TREATMENT SLUDGE AT THE KEWAUNEE NUCLEAR POWER PLANT

WISCONSIN PUBLIC SERVICE CORPORATION
WISCONSIN POWER AND LIGHT COMPANY
MADISON GAS AND ELECTRIC COMPANY

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter dated October 17, 1995, as supplemented on November 3, 1995, Wisconsin Public Service Corporation (the licensee) requested approval for the onsite disposal of contaminated sewage sludge similar to a previous disposal request that was approved by the NRC on June 17, 1992.

2.0 BACKGROUND

In a letter dated September 12, 1989, the licensee requested authorization for the alternate disposal of very-low-level radioactive material. In a Safety Evaluation (SE) dated June 17, 1992, the NRC approved the licensee's request pursuant to 10 CFR 20.302 (now 10 CFR 20.2002) for the disposal of 15,000 cubic feet of contaminated waste sludge by land application at the Kewaunee Nuclear Power Plant (KNPP) location. The SE imposed the following boundary conditions:

1. The annual disposal must be less than a total activity of 0.2 mCi.
2. The whole body dose to the hypothetical maximally exposed individual must be less than 0.1 mrem/year.
3. The disposal must be at the same site.

The licensee completed the disposal of the contaminated waste sludge discussed in the SE dated June 17, 1992. The licensee is now requesting authorization to dispose of additional contaminated waste sludge within the boundary conditions of the previously approved disposal.

3.0 EVALUATION

The licensee has proposed to dispose of approximately 6000 gallons (800 cubic feet) of sewage sludge similar to the material approved for disposal in the SE dated June 17, 1992. The principal radionuclides identified in the waste sludge and their activity based on measurements in May 1995 are: Co-58, 0.0009 mCi; Co-60, 0.0008 mCi; and Cr-51, 0.0006 mCi. The total combined activity is 0.0023 mCi. This activity is well below the boundary value of 0.2 mCi. Additionally, Cr-51 with it short half-life (27.7 day) will have undergone significant decay from its initial value of 0.0006 mCi.

The licensee has committed that the new disposal will meet all the radiological boundary conditions, on a cumulative basis, contained in the SE for the 10 CFR 20.302 application approved on June 17, 1992. Additionally, the licensee has stated that all applicable permits for this disposal have been obtained from the Wisconsin Department of Natural Resources.

4.0 CONCLUSION

The staff finds the licensee's proposal to dispose of the low-level radioactive waste sludge pursuant to 10 CFR 20.2002, on the licensee's site (see Attachment), is within the radiological boundary conditions approved in the June 17, 1992, SER and is therefore acceptable.

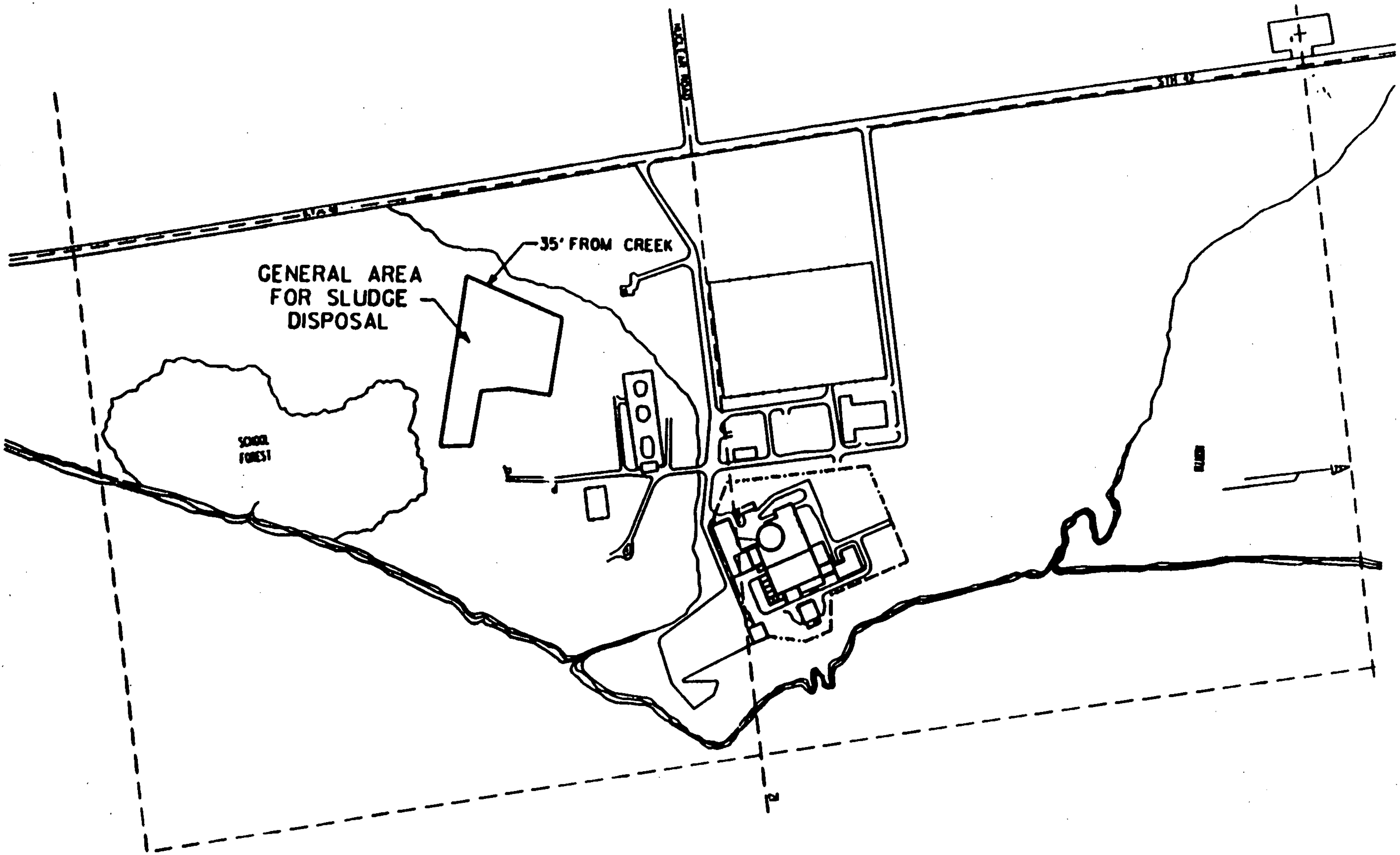
The licensee is required to permanently incorporate this modification into the Offsite Dose Calculation Manual as an Appendix, and to ensure that future modifications of these commitments are reported to the NRC.

Principal Contributor: S. Klementowicz

Date: November 13, 1995

Attachment: KNPP Site Area Map

KEWAUNEE NUCLEAR POWER PLANT SITE AREA MAP



ATTACHMENT

K-97-64
Rec'd 4-14-9

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 9, 1997

Mr. M. L. Marchi
Manager - Nuclear Business Group
Wisconsin Public Service Corporation
Post Office Box 19002
Green Bay, WI 54307-9002

SUBJECT: ONSITE DISPOSAL OF CONTAMINATED SLUDGE PURSUANT TO 10 CFR 20.2002 (TAC NO. M97411)

Dear Mr. Marchi:

By letter dated December 10, 1996, you requested that the U.S. Nuclear Regulatory Commission (NRC) review the applicability of a 10 CFR 20.203 (now 20.2002) application approved on June 17, 1992, for additional disposals of a similar nature.

The staff has completed its review of your request and agrees with your determination that the 10 CFR 20.203 application for onsite disposal of sludge contaminated with licensed radioactive material, which was approved on June 17, 1992, contains bounding conditions that are applicable for additional onsite disposals of a similar nature. A copy of the Safety Evaluation is enclosed.

Sincerely,

Richard J. Laufer

Richard J. Laufer, Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure: Safety Evaluation

cc: See next page

NRC to WPSC LETTER DISTRIBUTION

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K H Evers KNP
M L Marchi D2
JBennett KNP (NSRAC)
R P Pulec KNP (3)
C A Schrock KNP

C S Smoker KNP
C R Steinhardt D2
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO ONSITE DISPOSAL OF CONTAMINATED SLUDGE

AT THE KEWAUNEE NUCLEAR POWER PLANT

WISCONSIN PUBLIC SERVICE CORPORATION
WISCONSIN POWER AND LIGHT COMPANY
MADISON GAS AND ELECTRIC COMPANY

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter dated December 10, 1996, Wisconsin Public Service Corporation (the licensee) requested that the U.S. Nuclear Regulatory Commission (NRC) review its determination that NRC approval, pursuant to 10 CFR 20.2002, for the onsite disposal of contaminated sludge at the Kewaunee Nuclear Power Plant (KNPP) is not required, provided such disposals are conducted within the limits and bounding conditions approved by the NRC in its June 17, 1992, Safety Evaluation (SE).

2.0 BACKGROUND

In a letter dated September 12, 1989, the licensee requested authorization for the alternate disposal of sludge contaminated with licensed radioactive material. In an SE dated June 17, 1992, the NRC approved the licensee's request pursuant to 10 CFR 20.302 (new 10 CFR 20.2002) for the disposal of 15,000 cubic feet of contaminated waste sludge by land application at the KNPP location. The SE imposed boundary conditions as follows:

1. The annual disposal must be less than a total activity of 0.2 mCi;
2. The whole body dose to the hypothetical maximally exposed individual must be less than 0.1 mrem/year; and
3. The disposal must be at the same site.

The SE also stated that for any repetitive disposals, the licensee must reapply to the NRC when a particular disposal would exceed the boundary conditions.

3.0 EVALUATION

The licensee has determined that NRC approval for future onsite disposals of sludge contaminated with licensed radioactive material is not required provided the disposals comply with the limits and conditions of the SE issued on June 17, 1992. The licensee has also developed a sludge sampling and analysis procedure that implements the guidance contained in NRC Information

Notice 88-22. Specifically, the licensee's procedure will require the analysis of sludge samples using a detection system design and operating characteristics that yield a lower limit of detection for Co-58, Co-60, Cs-134, and Cs-137 consistent with measurements of environmental samples. The licensee has provided a site map (attached) that specifies the acceptable onsite disposal areas for the contaminated sludge.

4.0 CONCLUSION

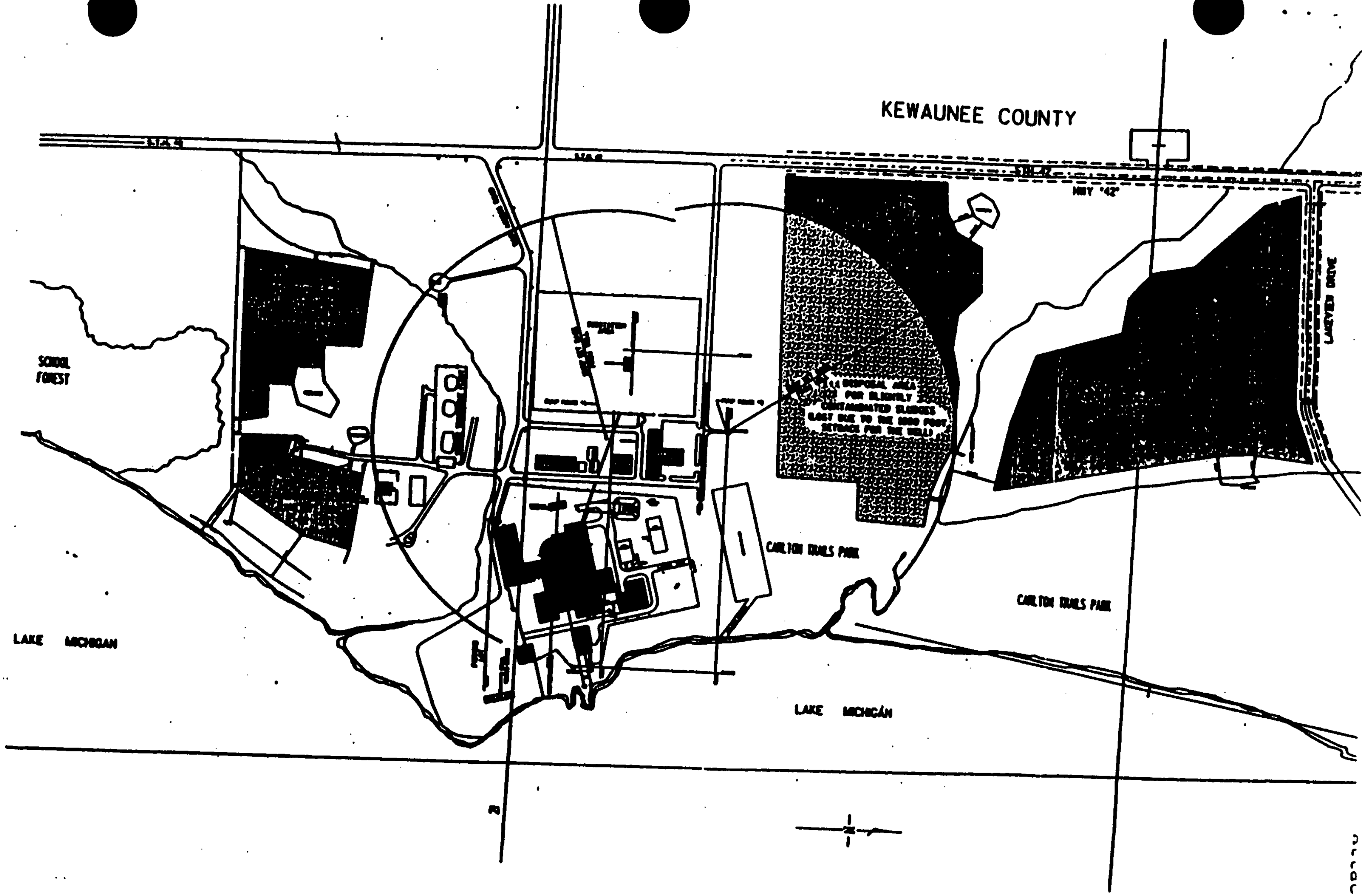
The staff agrees with the licensee's determination that additional onsite disposals of contaminated sludge, which are conducted within the bounding limits and conditions contained in the June 17, 1992, SE and within the areas specified in the attached site map, do not require specific NRC approval.

The licensee should permanently incorporate this Safety Evaluation into the Offsite Dose Calculation Manual as an Appendix.

Principal Contributor: S. Klementowicz

Date: April 9, 1997

Attachment: KNPP Site Map


KEWAUNEE COUNTY
STH 42
HWY "42"
LAKEVIEW DRIVE
SCHOOL FOREST
(1) DISPOSAL AREA FOR SLIGHTLY CONTAMINATED SLUDGES (LOST DUE TO THE 1000 FOOT SETBACK FOR THE WELL)
CARLTON TRAILS PARK
CARLTON TRAILS PARK
LAKE MICHIGAN
LAKE MICHIGAN