SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ P. O. Box 15830, Sacramento CA 95852-1830, (916) 452-3211
AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

MPC&D 01-031

February 28, 2001

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

Docket No. 50-312
Rancho Seco Nuclear Station
License No. DPR-54

2000 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

Attention: John Hickman

In accordance with 10 CFR 50.36a(a)(2) and Rancho Seco Permanently Defueled Technical Specification D6.9.3, the District submits the enclosed Rancho Seco Annual Radioactive Effluent Release Report for the period January 1 through December 31, 2000.

The analyses for strontium and gross alpha in liquid effluents are not yet completed. We will submit a revised report that includes the results of these analyses in approximately 60 days.

Members of your staff requiring additional information or clarification may contact Walter Partridge at (916) 732-4811.

Sincerely,

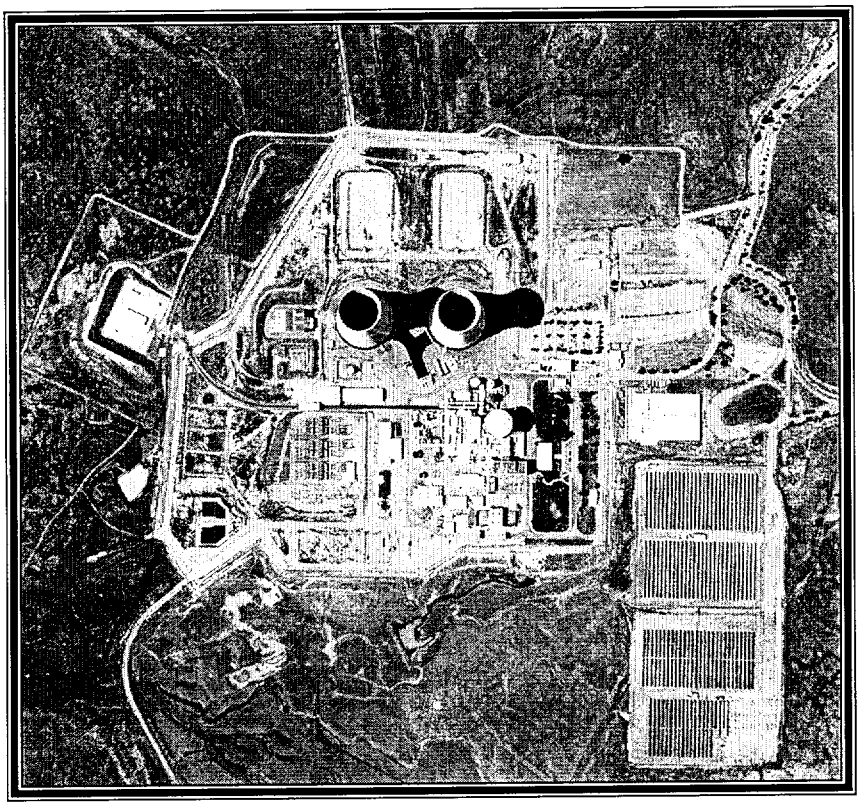
Steve J. Redeker
Manager, Plant Closure & Decommissioning

Attachment

cc w/atch: E.W. Merschoff, NRC, Region IV, Arlington

IE48

RANCHO SECO
NUCLEAR GENERATING STATION



LICENSE NUMBER DPR-54

ANNUAL
RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY – DECEMBER 2000

TABLE OF CONTENTS

ATTACHMENTS

1. Off-Site Dose Calculation Manual, Revision 12
2. Off-Site Dose Calculation Manual, Revision 13
3. Radiological Environmental Monitoring Program Manual, Revision 12

INTRODUCTION

Rancho Seco Nuclear Generating Station (RSNGS) Unit No. 1 is located in Sacramento County, California approximately 25 miles southeast of Sacramento and 26 miles north-northeast of Stockton. Rancho Seco Unit No. 1 began commercial operation on April 17, 1975. The single unit on the Rancho Seco site was a pressurized water reactor supplied by Babcock and Wilcox. The rated capacity was 963 gross megawatts electrical. Because of a public vote on June 6, 1989, the District shutdown the Rancho Seco Nuclear Generating Station and completed defueling operations on December 8, 1989.

This Annual Radioactive Effluent Release Report (ARERR) provides a summary of gaseous and liquid effluent releases made from Rancho Seco during the period January 1 through December 31, 2000. Also presented in this report is the projected radiological impact from these releases and a summary of solid radioactive waste shipments.

This report has been prepared by the Sacramento Municipal Utility District to meet the requirements of Rancho Seco Technical Specification D6.9.3 and Offsite Dose Calculation Manual (ODCM) Step 6.15. It is presented in accordance with the format of USNRC Regulatory Guide 1.21. The radiation doses reported in this ARERR are calculated for a hypothetical individual who receives the maximum possible exposure at or beyond the applicable Site Boundary.

Releases of radioactivity in gaseous and liquid effluents during this report period did not exceed the limits of 10 CFR 20 or the numerical guidelines of 10 CFR 50, Appendix I. A 40 CFR 190 dose evaluation is not required because radioactive effluent releases did not exceed twice the numerical guidelines of 10 CFR 50, Appendix I.

I. SUPPLEMENTAL INFORMATION

A. REGULATORY LIMITS & GUIDELINES FOR EFFLUENT RELEASES

1. Gaseous Effluents

a. Noble Gas dose rate limit at or beyond the Site Boundary for Gaseous Effluents (Offsite Dose Calculation Manual (ODCM) Technical Requirement 6.14.6):

500 mrem/year to the total body
3000 mrem/year to the skin

b. Noble Gas air dose limit at or beyond the Site Boundary for Gaseous Effluents (ODCM Technical Requirement 6.14.7, numerical guidelines of 10 CFR 50, Appendix I):

5 mrad per calendar quarter for gamma radiation
10 mrad per calendar quarter for beta radiation
10 mrad per calendar year for gamma radiation
20 mrad per calendar year for beta radiation

c. Dose rate limit at or beyond the Site Boundary for Gaseous Effluents for Tritium and radioactive material in particulate for with half-lives greater than 8 days (ODCM Technical Requirement 6.14.6):

1500 mrem/year to any organ

d. Dose commitment to a member of the public at or beyond the Site Boundary for Gaseous Effluents from Tritium and radioactive material in particulate form with half-lives greater than 8 days (ODCM Technical Requirement 6.14.8, numerical guidelines of 10 CFR 50, Appendix I):

7.5 mrem per calendar quarter to any organ
15 mrem per calendar year to any organ

2. Liquid Effluents

a. The concentration of radioactive material in liquid effluents released beyond the Site Boundary for Liquid Effluents shall not exceed the limits of 10 CFR 20, Appendix B, Table 2, Column 2. This applies to all radionuclides except dissolved or entrained noble gases (ODCM Technical Requirement 6.14.2).

b. Dose commitment to a member of the public at or beyond the Site Boundary for Liquid Effluents from radioactive materials in liquid effluents shall be limited to (ODCM Technical Requirement 6.14.3, numerical guidelines of 10 CFR 50, Appendix I):

1.5 mrem per calendar quarter to the total body
5 mrem per calendar quarter to any organ
3 mrem per calendar year to the total body
10 mrem per calendar year to any organ

B. MAXIMUM EFFLUENT CONCENTRATIONS

1. Gaseous Effluents

The concentrations listed in 10 CFR 20, Appendix B, Table 2, Column 1 (air) are not directly used in calculations for determining permissible gaseous effluent release rates. The annual dose limits of 10 CFR 20 for unrestricted areas are the doses associated with the concentrations of 10 CFR 20, Appendix B, Table 2, Column 1. ODCM Technical Requirement dose rate limits (mrem/yr) for gaseous effluents are provided to ensure that the dose rate from gaseous effluents at any time at the Site Boundary for Gaseous Effluents will be within the annual dose limits of 10 CFR 20 for unrestricted areas. These dose rate limits (listed above in part A) are used for determining permissible gaseous effluent release rates.

2. Liquid Effluents

The concentration values listed in 10 CFR 20, Appendix B, Table 2, Column 2 are used in calculations to determine permissible liquid discharge flow rates. The most conservative Maximum Effluent Concentration (MEC) value for each radionuclide detected in the liquid effluent sample (excluding dissolved or entrained noble gases) is used in the calculations.

C. MEASUREMENT METHODS FOR TOTAL RADIOACTIVITY

1. Fission and Activation Gases

Gamma Spectroscopy (HPGe)

Liquid Scintillation (H-3)

2. Particulates

Gamma Spectroscopy (HPGe)

Beta Proportional (Sr-90, gross beta)

Alpha Proportional (gross alpha)

3. Liquid Effluents

Gamma Spectroscopy (HPGe)

Liquid Scintillation (H-3)

Beta Proportional (Sr-90, gross beta)

Alpha Proportional (gross alpha)

NOTE: HPGe refers to Hyper-Pure Germanium

D. BATCH RELEASES (via monitored pathways)

1. Liquid (RHUT Releases)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
a. Number of batch releases	1	3	7	1
b. Total time period for batch releases (hours)	3.42	3.87	20.30	2.35
c. Maximum time period for a batch release (hours)	3.42	1.83	8.70	2.35
d. Average time period for a batch release (hours)	3.42	1.29	2.9	2.35
e. Minimum time period for a batch release (hours)	3.42	0.73	1.38	2.35
2. Liquid (Retention Basin Discharges)				
a. Number of batch releases	3	3	8	3
b. Total time period for batch releases (hours)	35.05	26.83	109.83	35.62
c. Maximum time period for a batch release (hours)	13.38	13.58	17.38	16.08
d. Average time period for a batch release (hours)	11.68	8.94	13.73	11.87
e. Minimum time period for a batch release (hours)	10.42	.25	6.2	6.37
f. Average stream flow during periods of release of effluent into a flowing stream (cfs)	20.3	18.2	17.5	17.4

NOTE: The Regenerant Holdup Tanks (RHUTs) are released to the Retention Basins. The Retention Basins are discharged offsite. All 10 CFR 50, Appendix I dose calculations are based on the RHUT releases. All 10 CFR 20 calculations are based on the Retention Basin discharges.

E. UNPLANNED RELEASES

This section describes unplanned releases of radioactivity in liquid and gaseous effluent.

Gaseous

None

Liquid

None

F. RADIOACTIVE EFFLUENT MONITORING INSTRUMENTATION INOPERABLE FOR GREATER THAN 30 DAYS

None

II. ESTIMATION OF ERROR

The methods for establishing error estimates included review of applicable station procedures, inspection of sampling equipment, engineering estimates, statistical applications, review of calibration setpoint data, and communication with plant personnel. The various sources of error (s) in reported values of gaseous effluents, liquid effluents, and solid waste are assumed to be independent, and thus the total error is calculated according to the formula:

$$\text{Total Error} = \sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2 \ldots + \sigma_i^2}$$

where: σ_i = relative error associated with component i

Sources of error for gaseous effluents include fan error (flow), grab sampling, collection, filter efficiency, counting, and calibration.

Sources of error for liquid effluents include RHUT volume, dilution water flow rate, grab sampling, counting, and calibration.

Sources of error for solid waste include offsite lab smear analysis, dose rate meter calibration, dose rate meter reading, computer program dose-to-curie calculation, sample volume measurement, gamma spec counting, gamma spec calibration, and waste volume determination.

III. GASEOUS EFFLUENTS

Table III-A, Gaseous Effluents - Summation of All Releases, provides a detailed summary of gaseous effluent releases per quarter. This table summarizes releases of fission and activation gases, particulates with half-lives greater than 8 days, and tritium. The methodology used to calculate the Percent of ODCM Technical Requirement limit is as follows:

$$\%\ \text{Tech Req Limit} = \frac{\sum_{i}\left[(F_i)(\text{Avg Rel Rate})(X/Q)(\text{Dose Factor})\right]}{(\text{Dose Rate Limit})} \times 100\%$$

where:

Fi = The fraction of the total number of Curies of nuclide i out of the total curies in that category for that quarter (unitless).

NOTE: F_i always equals 1.0 for H-3 because it is the only nuclide in the category.

$$\text{Avg Rel Rate} = \frac{(\text{Total Curies per category per quarter})\left(\frac{1\ E+06\ \mu Ci}{Ci}\right)}{(\#\ \text{seconds in the quarter})}$$

X/Q = A default dispersion factor determined to be conservative when compared to the use of actual data (sec/m3).

Dose Factor = The values derived for each nuclide i from NRC Regulatory Guide 1.109 (Ki, Li+1.1Mi, or Raij). [Units in (mrem/yr)/(μCi/m3)]

Dose Rate Limit = The Technical Requirement (i.e., Regulatory) limits for dose rate listed in Section I of this report (mrem/yr).

NOTE: Particulates with half-lives less than 8 days are not included in this calculation.

The methodology used to calculate the Estimated Total Error (%) in Table III-A is presented in Section II of this report.

Table III-B, Gaseous Effluents - Ground Level Releases, provides a complete quarterly summary of the amount of radioactivity (Ci) released per radionuclide in each quarter. Data from continuous and batch releases are provided for fission gases, particulates, and tritium. Data reported for batch releases results only from unplanned releases.

Table III-C, Gaseous Effluents - Typical Lower Limits of Detection, provides a listing of the typical lower limit of detection (LLD) concentrations in μCi/cc for various radionuclides.

Table III-D, Radiological Impact on Man Due to Gaseous Effluent Releases, provides a summary of calculated radiation doses delivered to a maximum exposed hypothetical individual at the Site Boundary for Gaseous Effluents (actual doses will be assessed in the 2000 Annual REMP Report). The maximum calculated organ dose, gamma air dose, and beta air dose are listed for each quarter along with an annual total. The direct radiation dose results, based on monitoring badge dosimetry, are also listed. Presented in this table for each category is a comparison versus ODCM Technical Requirement dose limits with the exception of direct radiation measurements.

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TABLE III-A

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error, %
A. Fission & Activation Gases (i.e. Noble Gases)						
1. Total Release	Ci	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	2.3 E+01
2. Average Release Rate for period	µCi/sec	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	
3. Percent of Tech Req limit	%	N/A	N/A	N/A	N/A	
B. Particulates						
1. Particulates with half-lives>8 days	Ci	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	2.3 E+01
2. Average Release Rate for period	µCi/sec	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	
3. Percent of Tech Req limit	%	N/A	N/A	N/A	N/A	
4. Gross Alpha radioactivity[1]	Ci	7.44E-08	1.29E-07	4.14E-08	1.10E-07	
C. Tritium						
1. Total Release	Ci	5.99E-01	4.42E-01	4.78E-01	2.23E-01	2.3 E+01
2. Average Release Rate for period	µCi/sec	7.62E-02	5.62E-02	6.01E-02	2.81E-02	
3. Percent of Tech Req limit	%	6.45E-04	4.76E-04	5.09E-04	2.38E-04	

[1] Gross alpha activity has been determined to be naturally occurring and not the result of the fuel cycle.

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TABLE III-B

GASEOUS EFFLUENTS - GROUND LEVEL RELEASES

		Continuous Mode			
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Fission Gases (i.e., Noble Gases)					
None		0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Particulates					
None					
3. Tritium					
H-3	Ci	5.99E-01	4.42E-01	4.78E-01	2.23E-01

TABLE III-C

GASEOUS EFFLUENTS - TYPICAL LOWER LIMITS OF DETECTION

RADIONUCLIDES		LLD (µCi/cc)
1.	Tritium (H-3)	2.27 E-10
2.	Fission & Activation Gases:	
	Krypton-85	3.47 E-06
3.	Particulates:	
	Manganese-54	2.08 E-12
	Cobalt-58	2.29 E-12
	Iron-59	5.89 E-12
	Cobalt-60	3.11 E-12
	Strontium-89	2.00 E-15
	Strontium-90	5.00 E-15
	Cesium-134	1.52 E-12
	Cesium-137	1.88 E-12
	Barium-140	3.06 E-12
	Cerium-141	1.15 E-12
	Cerium-144	3.69 E-12

TABLE III-D

RADIOLOGICAL IMPACT ON MAN DUE TO GASEOUS EFFLUENT RELEASES

CALCULATED RADIATION DOSES AT THE SITE BOUNDARY FOR GASEOUS EFFLUENTS:

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	2000 Annual
A. Tritium, Particulate						
1. Maximum Organ Dose	mrem	1.94E-02 (a)	1.43E-02 (a)	1.55E-02 (a)	7.25E-03 (a)	5.65E-02 (a)
Percent Tech Req limit	%	2.59E-01	1.91E-01	2.07E-01	9.67E-02	3.76E-01
B. Noble Gas						
1. Gamma Air Dose	mrad	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
Percent Tech Req limit	%	N/A	N/A	N/A	N/A	N/A
2. Beta Air Dose	mrad	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
Percent Tech Req limit	%	N/A	N/A	N/A	N/A	N/A
C. Direct Radiation						
1. Dose (Monitoring Badges)	mrem	0.00 E+00*	0.00 E+00*	0.00 E+00*	0.00 E+00*	0.00 E+00*
2. Percent of Tech Req limit	%	N/A	N/A	N/A	N/A	N/A

NOTE: The quarterly doses listed above were calculated using dose factors from GASPAR and default meteorological data for each quarter. Annual doses are the sum of quarterly doses.

(a) Child - All Except Bone

* None of the Indicator stations indicate significant radiation attributable to Plant operations.

IV. LIQUID EFFLUENTS

Table IV-A, Liquid Effluents - Summation of All Releases, provides a detailed summary of liquid effluent releases per quarter. This table summarizes releases of fission and activation products, tritium, dissolved and entrained gases, and gross alpha radioactivity. Also listed is the volume of waste released prior to dilution and the volume of dilution water used during each quarter.

The following methodology is used to calculate the Average Diluted Concentration and the Percent of ODCM Technical Requirement Limit in Table IV-A:

$$\%\ \text{Tech Req Limit} = \sum_{i}^{n}\left[\frac{C_i}{MEC_i}\right]$$

where: n = The total number of radionuclides identified

C_i = The average diluted concentration of radionuclide i

$$= \frac{(\text{Total Release per Category per Quarter in } \mu\text{Ci})}{(\text{Total Release Volume (part F in Table IV - A) in ml})}$$

MEC_i = The MEC of the i^{th} radionuclide, from 10 CFR 20, Appendix B, Table 2, Column 2

The methodology used to calculate the estimated total error in Table IV-A is presented in Section II of this report.

Table IV-B, Liquid Effluents, provides a complete quarterly summary of the amount of radioactivity (Ci) released per radionuclide in each quarter. Data is provided for fission and activation products, and for dissolved and entrained gases. Tritium and gross alpha are not included in this table (they are listed in Table IV-A). Since no continuous releases of liquid radioactive effluent are made from RSNGS, data is provided only for batch releases.

Table IV-C, Liquid Effluents - Typical Lower Limits of Detection, provides a listing of the typical lower limit of detection (LLD) concentrations in µCi/ml for various radionuclides.

Table IV-D, Radiological Impact on Man Due To Liquid Effluent Releases, provides a summary of calculated radiation doses delivered to a maximum exposed hypothetical individual at the Site Boundary for Liquid Effluents (actual doses will be assessed in the 2000 Annual REMP Report). The maximum calculated total body dose and organ dose are listed for each quarter along with an annual total. A comparison versus ODCM Technical Requirement dose limits is also presented.

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TABLE IV-A

LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error, %
A. Fission & Activation Products						
1. Total Release (not including tritium, gases, alpha)	Ci	2.24E-04	2.30E-04	5.93E-05	0.00E+00	2.3 E+01
2. Average diluted concentration during period	µCi/ml	4.97E-11	5.67E-11	1.50E-11	0.00E+00	
3. Percent of Tech Req limit	%	4.36E-03	5.28E-03	1.40E-03	0.00E+00	
B. Tritium						
1. Total Release	Ci	8.06E-02	5.23E-01	1.79E+00	2.49E-01	2.3 E+01
2. Average diluted concentration during period	µCi/ml	1.78E-08	1.29E-07	4.53E-07	6.37E-08	
3. Percent of Tech Req limit	%	1.78E-03	1.29E-02	4.53E-02	6.37E-03	
C. Dissolved and Entrained Gases (i.e., Noble Gases)						
1. Total Release	Ci	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	N/A
2. Average diluted concentration during period	µCi/ml	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	
D. Gross Alpha radioactivity						
1. Total Release	Ci	0.00 E+00	(1)	(1)	(1)	(1)
E. Volume of Waste Released						
Retention Basins (prior to dilution)	Liters	3.86 E+06	2.45 E+06	8.44 E+06	3.53 E+06	5.0 E+00
RHUTs (prior to dilution)	Liters	4.66 E+05	7.00 E+05	2.12 E+06	3.24 E+05	5.0 E+00
F. Volume of dilution water used during period	Liters	4.52E+09	4.05E+09	3.95E+09	3.91E+09	2.0 E+01

(1) Analytical results for Gross Alpha activity are not included in this report due to incomplete analysis.

TABLE IV-B

LIQUID EFFLUENTS

Nuclides Released		Batch Mode			
1. Fission and activation products (excluding tritium, gases alpha)	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Co-60	Ci	4.22E-05	2.45E-05	5.80E-06	0.00E+00
Sr-90	Ci	3.60E-07	(1)	(1)	(1)
Cs-134	Ci	2.86E-06	2.28E-06	0.00E+00	0.00E+00
Cs-137	Ci	1.79E-04	2.03E-04	5.35E-05	0.00E+00
Total (for quarter)	Ci	2.24E-04	2.30E-04	5.93E-05	0.00E+00
2. Dissolved and entrained gases					
None					

(1) Analytical results for Strontium activity are not included in this report due to incomplete analysis.

NOTE: No continuous releases of liquid radioactive effluent are made from Rancho Seco Nuclear Generating Station.

TABLE IV-C

LIQUID EFFLUENTS - TYPICAL LOWER LIMITS OF DETECTION

	RADIONUCLIDES	BATCH MODE: LLD (µCi/ml)
1.	Tritium (H-3)	2.60 E-06
2.	Particulates:	
	Manganese-54	2.11 E-09
	Iron-59	3.71 E-09
	Cobalt-57	2.12 E-09
	Cobalt-58	1.93 E-09
	Cobalt-60	1.98 E-09
	Zinc-65	4.34 E-09
	Strontium-90	5.00 E-10
	Ruthenium-106	1.79 E-08
	Silver-110m	1.94 E-09
	Antimony-125	5.78 E-09
	Cesium-134	1.93 E-09
	Cesium-136	2.23 E-09
	Cesium-137	2.30 E-09
	Barium-140	7.75 E-09
	Cerium-141	3.60 E-09
	Cerium-144	1.59 E-08
3.	Dissolved and Entrained Gases:	
	Krypton-85	4.87 E-07

TABLE IV-D

RADIOLOGICAL IMPACT ON MAN DUE TO LIQUID EFFLUENT RELEASES

CALCULATED RADIATION DOSE COMMITMENTS FOR LIQUID EFFLUENTS:

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	2000 Annual
A. Maximum Total Body Dose	mrem	4.77E-02 (a)	6.21E-02 (a)	2.79E-02 (a)	2.96E-03 (b)	1.39E-01 (a)
Percent Tech Req limit	%	3.18E+00	4.14E+00	1.86E+00	1.97E-01	4.65E+00
B. Maximum Organ Dose	mrem	1.01E-01 (c)	1.25E-01 (d)	5.31E-02 (d)	2.96E-03 (d)	2.76E-01 (d)
Percent Tech Req limit	%	2.01E+00	2.49E+00	1.06E+00	5.92E-02	2.76E+00

Note: The quarterly doses listed above were calculated using dose factors from LADTAP and the average dilution flow (cfs) for each respective quarter. Annual doses are the sum of quarterly doses.

(a) Adult
(b) Child
(c) Child - Bone
(d) Child - Liver

V. SOLID WASTE

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

1. Type of Waste:

	Volume (m^3)	Total Activity (Curies)	Est. Total Error (%)
A. Spent Resins, filter sludges, evaporator bottoms, etc.	3.77E+01	1.40E+00	2.5E+01
B. Dry compressible waste, contaminated equipment, etc	4.98E+02	3.12E+00	2.5E+01
C. Irradiated components, control rods, etc.	N/A	N/A	
D. Other	1.12E+01	1.47E-01	2.5E+01

2. Estimate of major nuclide composition Category A and Category B waste

	Category A		**Category B**	
Radionuclide	**Activity (Ci)**	**Percentage (%)**	**Activity (Ci)**	**Percentage (%)**
H-3	3.06E-02	2.19E+00	1.61E-02	5.17E-01
C-14	1.69E-02	1.21E+00	4.16E-02	1.33E+00
Fe-55	3.34E-02	2.39E+00	1.68E-01	5.39E+00
Co-60	2.98E-02	2.13E+00	2.02E-01	6.47E+00
Ni-63	3.11E-01	2.22E+01	1.34E+00	4.30E+01
Sr-90	3.85E-02	2.75E+00	5.32E-02	1.71E+00
Nb-94	5.05E-06	3.60E-04	6.01E-04	1.93E-02
Tc-99	0.00E+00	0.00E+00	4.48E-05	1.44E-03
Sb-125	1.21E-05	8.60E-04	2.22E-03	7.12E-02
Cs-134	5.62E-03	4.01E-01	5.68E-03	1.82E-01
Cs-137	9.28E-01	6.63E+01	1.28E+00	4.09E+01
Pu-238	1.45E-04	1.04E-02	2.82E-04	9.05E-03
Pu-239	1.08E-04	7.70E-03	2.47E-04	7.90E-03
Pu-241	5.72E-03	4.08E-01	1.20E-02	3.85E-01
Pu-242	5.83E-07	4.16E-05	7.37E-07	2.36E-05
Am-241	3.71E-04	2.65E-02	6.55E-04	2.10E-02
Cm-242	6.25E-10	4.46E-08	1.02E-06	3.27E-05
Cm-244	1.16E-04	8.31E-03	1.73E-04	5.54E-03

3. Estimate of major nuclide composition Category C and Category D waste

Radionuclide	Category C		Category D	
	Activity (Ci)	Percentage (%)	Activity (Ci)	Percentage (%)
H-3			9.05E-03	6.16E+00
C-14			2.20E-03	1.50E+00
Fe-55			1.37E-02	9.36E+00
Co-60			1.78E-02	1.21E+01
Ni-63			1.03E-01	6.99E+01
Sr-90			4.52E-05	3.08E-02
Nb-94			6.48E-05	4.41E-02
Tc-99			4.83E-06	3.29E-03
Sb-125			2.44E-04	1.66E-01
Cs-134			2.63E-06	1.79E-03
Cs-137			4.63E-04	3.15E-01
Pu-238			1.08E-05	7.36E-03
Pu-239			1.21E-05	8.21E-03
Pu-241			5.24E-04	3.57E-01
Pu-242			9.01E-10	6.13E-07
Am-241			2.04E-05	1.39E-02
Cm-242			1.22E-07	8.30E-05
Cm-244			2.88E-06	1.96E-03

4. Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
20	Highway	Envirocare of Utah, Inc.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments

None

ATTACHMENT 1

SCOPE OF REVISION:

1. Delete requirements for and references to Radiation Monitor R-15546A, Auxiliary Building Grade Level Vent from the ODCM. The Auxiliary Building Grade Level Vent System has been removed from service.
2. Add DQ 99-0061 to reference section.
3. Delete Auxiliary Boiler Vents/Reliefs and Miscellaneous Secondary System Steam Discharges from Gaseous Effluent pathway description. The Auxiliary Boiler and Secondary Steam System was removed from service several years ago and references to them in the ODCM were not taken out.
4. Revised Gaseous Effluent Partition Factor calculation to reflect Auxiliary Building Grade Level Vent removal from service.
5. Update appropriate tables and diagrams to reflect Auxiliary Building Grade Level Vent removal from service.
6. Update Atmospheric Dispersion and Deposition Parameters Table, Attachmet 4, to reflect 1998 Land Used Census.
7. Update Historical Liquid Source Term Table, Attachment 7, to reflect latest data.

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ATTACHMENTS

1.0 PURPOSE

The Off-site Dose Calculation Manual (ODCM) contains the methodology and parameters used in the calculation of off-site doses due to radioactive gaseous and liquid effluents. Also, the ODCM contains the methodology for determining effluent monitoring instrumentation alarm/trip setpoints. Methods are described for assessing compliance with the Technical Requirements in the ODCM as they apply to 10 CFR Parts 20.1301 and 20.1302, 10 CFR Part 50, Appendix I, and 40 CFR 190.10a for liquid and gaseous effluents. Additionally, the ODCM contains the Technical Requirements which provide the Specifications, Applicabilities, Actions, and Surveillance Requirements.

2.0 SCOPE

This procedure functions as a manual that provides the basis for development of detailed implementing procedures that address dose calculations for liquid/gaseous releases and monitor setpoints. Additionally, this manual provides the Technical Requirements that govern releases of liquid and gaseous radioactive releases off-site.

3.0 REFERENCES/COMMITMENT DOCUMENTS

3.1 Commitment Documents

3.1.1 Code of Federal Regulations, Title 10, Chapter 1, Parts 20, 50.36a and Part 50, Appendix I

3.1.2 Rancho Seco Permanently Defueled Technical Specifications (PDTS)

3.1.3 EPA 40 CFR Parts 302, 355 Reporting Requirements

3.1.4 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Plant Operations

3.2 Reference Documents

3.2.1 USNRC Regulatory Guide 1.109, Rev. 1, 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, October 1977

3.2.2 W. C. Burke, et. al., Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, NUREG-0133, USNRC:NRR, October 1978

3.2.3 ORNL, User's Manual for LADTAP II, NUREG/CR-1276, May 1980

3.2.4 D. L. Strange, et. al., LADTAP-II, Technical Reference and User Guide, NUREG/CR-4013, Pacific Northwest Laboratory, April 1986

3.2.5 Eckerman, K. F., et. al., User's Guide to GASPAR Code, NUREG-0597, USNRC:NRR, June 1980, in RSIC CCC-463

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

3.2.7 USNRC 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

3.2.8 USNRC Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants

3.2.9 REIMS Software Life Cycle Documents (Software Requirement Specification, Design Document, Acceptance Test Plan)

3.2.10 USNRC & Pacific Northwest Laboratory, TDMC Computer Code/Data Collections, XOQDOQ-82, Radiological Assessment Code System Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations

3.2.11 1992 Rancho Seco Land Use Census

12→← 3.2.12 RSNGS DSAR Chapters 11.1-11.5

12→← 3.2.13 RSNGS P&ID Drawing M-563, M-551, M-552

3.2.14 Pacific Northwest Laboratory, XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations

3.2.15 Congel, F. J., Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190), NUREG-0543, USNRC:NRR, February 1980

3.2.16 USNRC Generic Letter, 89-01, Dated January 31, 1989.

3.2.17 Rancho Seco REMP Manual

3.2.18 Engineering Calculation Z-RDM-I0279, Interim On-site Storage (IOS) Building Effluent Radiation Monitor (R15106) Setpoint Determination

3.2.19 PDQ 92-063

3.2.20 RP.312.I.14, Occupational Radiation Exposure Limits and Extensions

12→← 3.2.21 DQ 99-0061, 50.59 Rev. 1, Kurz probe flow out of tolerance.

4.0 DEFINITIONS

4.1 Member of the Public

Member of the Public means any individual except when that individual is receiving an occupational dose.

4.2 Occupational Dose

Occupational Dose means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.

4.3 Public Dose

Public Dose means the dose received by a Member of the Public from exposure to radiation and/or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. It does not include occupational dose or doses received from background radiation, as a patient from medical practices, or from voluntary participation in medical research programs.

4.4 Batch Release

A Liquid Batch Release for 10 CFR 50 Appendix I considerations is a transfer of a discrete volume of radioactive liquid from a RHUT to a retention basin. A Liquid Batch Release for 10 CFR 20 considerations is a transfer of a discrete volume of radioactive liquid from a retention basin to the Waste Water discharge canal (the Environmental Release Point).

A Gaseous Batch Release is the discharge of gaseous radioactive wastes of discrete volume. Batch releases for the gaseous pathway are no longer planned.

4.5 Continuous Release

A continuous radioactive gaseous release is the discharge of gaseous wastes of a non-discrete volume from a system that may have an input flow during the release. These include the Auxiliary
12→← Building Stack (ABS) and continuing Reactor Building purges.

Continuous radioactive liquid releases are not planned to be made from Rancho Seco Nuclear Generating Station (RSNGS).

4.6 Default Radionuclide Mix

A historical mixture of radionuclides that may be used to determine monitor setpoints.

4.7 Dilution Flow

The volume or volume rate of fluid (liquid or gas) which is added to a radiological release stream for the purpose of decreasing the instantaneous concentration of the stream.

4.8 Maximum Exposed (Hypothetical) Individual

The Maximum Exposed Individual is characterized as "maximum" with regard to food consumption, occupancy, and other usage or exposure pathway parameters in the vicinity of Rancho Seco that would represent an individual with habits greater than usually expected for the average of the population in general.

Maximum dose factor parameters will be determined using site specific data from the Land Use Census. If information needed to determine a parameter is not available, RG 1.109 parameters will be used. All dose factor parameters used are listed in Attachment 3.

4.9 RSNGS

Rancho Seco Nuclear Generating Station.

4.10 Site Boundaries

The Site Boundaries are defined by the drawings in Attachments 5 and 6.

4.11 Nuisance Pathways

(1) Secondary system gaseous pathways where the calculated dose totals contribute less than 5% of the annual limits and do not need to be tracked for dose calculational purposes unless secondary activity reaches a predetermined Action Level.

(2) Sources of trace levels of radioactivity in liquid effluents where the calculated dose totals contribute less than 1% of the annual limits and do not need to be tracked for dose calculational purposes. Trace levels are defined to be less than 1E-8 μCi/ml for the nuclides typically released from RSNGS. Examples include the oily water separator, plant effluent inlet, and storm drains.

4.12 Unplanned Release

The unexpected release of radioactive materials to unrestricted areas in gaseous and liquid effluent. All unplanned releases shall be discussed in the Annual Radiological Effluent Release Report (ARERR) to the NRC.

4.13 Miscellaneous Release

Release pathways which are considered planned but are not defined explicitly with monitoring requirements in this procedure. These pathways contribute a relatively small percentage (<5%) to the annual dose limits but shall be tracked for effluent activity accounting and dose calculation purposes. Miscellaneous releases shall not be reported in the ARERR as abnormal or unplanned releases. The IOS Building is an example of a Miscellaneous Release.

4.14 Safety Factor (SF)

A number greater than unity used in calculations to introduce greater conservatism (larger margin of safety) to offset various uncertainties in instrumentation and methods. Safety factors are set by Radiation Protection/Chemistry Supervision based on either analysis or professional judgment. Unless otherwise specified, the default value is two (2).

4.15 Liquid Effluent Radwaste Treatment System (LERTS)

The Liquid Effluent Radwaste Treatment System is a system designed to reduce the quantity of radioactive materials in liquid effluents by collecting liquid effluent and providing processing for the purpose of reducing the total radioactivity prior to its release to the environment.

4.16 Ventilation Exhaust Treatment System (VETS)

The Ventilation Exhaust Treatment System is the Reactor Building Purge Exhaust Filtering System and Auxiliary and Spent Fuel Building Filter Systems. These systems are designed and installed to reduce radioactive material in exhaust gases through HEPA filters for the purpose of removing 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 (ESF) atmospheric cleanup systems are not considered to be Ventilation Exhaust Treatment System components.

4.17 Instrument Surveillance

(1) Source Check

A source check is the qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.

(2) Channel Test

A channel test is the injection of an internal or external test signal into the channel to verify its proper response, including alarm and/or trip initiating action, where applicable.

(3) Instrument Channel Check

An instrument channel check is a verification of acceptable instrument performance by observation of its behavior and/or state; this verification includes comparison of output and/or state of independent channels measuring the same variable.

(4) Instrument Channel Calibration

An instrument channel calibration is a test, and adjustment (if necessary), to establish that the channel output responds with acceptable range and accuracy to known values of the parameter which the channel measures or an accurate simulation of these values. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip and shall be deemed to include the channel test.

4.18 Surveillance Intervals

The Surveillance Interval may be extended to a maximum of +25% to accommodate operations scheduling. The frequency notation (which follows the name of the Surveillance Interval in parenthesis) specified for the performance of Surveillance Requirements shall correspond to the Surveillance Intervals defined below.

(1) Shift (S): A time period covering at least once per twelve (12) hours.

(2) Daily (D): A time period spaced to occur at least once per twenty four (24) hours.

(3) Weekly (W): A time period spaced to occur at least once per seven (7) days.

(4) Monthly (M): A time period spaced to occur at least once per thirty one (31) days.

(5) Quarterly (Q): A time period spaced to occur at least once per ninety two (92) days.

(6) Semiannually (SA): A time period spaced to occur at least once per six (6) months.

(7) Annually (A): A time period spaced to occur at least once per twelve (12) months.

(8) Refueling Interval (R): A time period spaced to occur at least once per eighteen (18) months.

(9) Each Release (P): This surveillance will be completed prior to each release.

4.19 Radiological Effluent Information Management System (REIMS)

The computer software and database that tracks the volume and activity of released radioactive effluents. In addition, the software provides the basis for the permitting process, calculates dose to man, and summarizes data for inclusion into the ARERR.

4.20 Operable/Operability

A component or system is Operable when it is capable of performing it's intended function within the required range. The component or system shall be considered to have this capability when: (1) it satisfies the Specifications in Section 6.14, (2) it has been tested periodically in accordance with the Surveillance Requirement in Section 6.14 and has met its performance requirements, (3) the system has available its source of power, and (4) its required auxiliaries are maintained available and capable of performing their intended function.

5.0 RESPONSIBILITIES

5.1 Radiation Protection/Chemistry Superintendent

It is the responsibility of the RP/Chem Superintendent for the following:

1) ODCM Revisions and Reporting the Revisions in the Annual Radioactive Effluent Release Report (ARERR)
2) ARERR Preparation and Submittal
3) REIMS Database
4) LADTAP, GASPAR, and XOQDOQ Computer Program Verifications and Changes

5.2 PRC

The PRC is responsible for reviewing and accepting all changes to the ODCM with approval by the Plant Manager per Permanently Defueled Technical Specifications.

6.0 PROCEDURE

6.1 General Considerations

6.1.1 Liquid Effluent Pathways

Attachment 1 provides an information only simplified diagram of the liquid effluent produced by RSNGS. The liquid effluent discharge of RSNGS forms the headwaters of Clay Creek.

Dilution of the liquid effluent occurs off-site at the confluence of Clay and Hadselville Creeks, and of Hadselville and Laguna Creeks, and at the confluence of Laguna Creek and the Cosumnes River.

Planned radioactive liquid releases are directed through the A or B RHUTs to give reasonable assurance of compliance with 10 CFR 50 Appendix I prior to their discharge to the retention basins (North or South). Prior to discharge from the retention basins to the plant effluent (off-site), the discharge rate from the retention basins and the amount of dilution from Folsom South Canal are controlled to ensure compliance with the concentration requirements in 10 CFR 20.

6.1.2 Gaseous Effluent Pathways

Airborne radioactive material in the various rooms and systems at RSNGS is routed and discharged in airborne effluent as illustrated schematically in Attachment 2. The figure shows the functional arrangements of these streams, treatment and controls, radioactivity monitoring points, and effluent release points. Potential release pathways other than those specified in Attachment 2 have been identified. These release pathways are classified as NUISANCE pathways and include the following: 12→

1) Tank Atmospheric Vents

← Past experience has shown that the above release pathways do not contribute to the dose totals because of the small quantities released and the low concentration of radioactive materials. Therefore, Action Levels may be established for concentrations of radioactive material to trigger when the above routine gaseous effluent releases shall be evaluated for off-site dose impact. The Action Levels shall be based on levels that could contribute more than 5% to the most restrictive yearly dose limit. Action Levels shall be maintained through RSNGS procedures.

Unplanned releases shall be evaluated on a case by case basis.

The Interim On-site Storage (IOS) Building is a miscellaneous release.

6.1.3 Meteorological Data

The atmospheric dispersion (X/Q) and deposition (D/Q) factors used in calculations involving airborne effluent are conservative default values. The default X/Q value is 1.0E-4 sec/m^3, and the default D/Q value is 1.0E-6 m^{-2}. These factors should be used to determine monitor setpoints, assess compliance with the gaseous effluent requirements in Section 6.14, and calculate the gaseous effluent dose reported in the ARERR.

Attachment 4 contains dispersion and deposition factors calculated using actual meteorological data. These factors should not be used for dose calculations. They are presented for historical information only. The factors are based on a 10-year annual average of meteorological data taken from January 1978 to December 1987. The raw data was converted to X/Q and D/Q factors using the XOQDOQ computer program.

6.1.4 Boundaries

The Site Boundary for Gaseous Effluents as shown in Attachment 5 is for all calculations involving gaseous effluents. The Site Boundary for Liquid Effluents as shown in Attachment 6 is for all calculations involving liquid effluents. (Although the RHUTs are used as the dose accountability points for liquid effluents, the dose is considered to be received downstream of the boundary.)

6.1.5 40 CFR 190 Compliance

For the purposes of assessing compliance with 40 CFR 190, the MEMBER OF THE PUBLIC which received the most exposure may be determined using actual food consumption, actual occupancy rates, and dilution off-site from additional converging streams (verses assumptions used for a HYPOTHETICAL MAXIMUM EXPOSED INDIVIDUAL based on Land Use Census data).

6.1.6 Computers vs. Manual Calculations

Computer systems such as REIMS should be used for calculations in order to minimize error and hasten the release process. However, in the event computers are not available for calculations, manual pre-release calculations should be done based on the most historically restrictive receptor.

6.2 Liquid Monitor Setpoints

The High alarm setpoint for the Retention Basin Effluent Discharge Monitor (R15017A) is based upon preventing the limits of the Specification in Step 6.14.2 from being exceeded. When the high alarm level is reached, any effluent discharges in progress are terminated or diverted to the Retention Basins.

A SAFETY FACTOR is included in the setpoint calculations to incorporate a margin of conservatism.

When a batch release is not occurring or the calculated setpoint is so low that it will cause spurious alarms, the monitor setpoint should be set close to background without causing spurious alarms or as determined by Radiation Protection/Chemistry Supervision.

The conversion factor and setpoint calculations should be performed based on the same radionuclide mix.

6.2.1 Conversion Factors for R15017A

Provided here is the methodology to determine the conversion factor of counts per minute to microcuries per cubic centimeter for the Retention Basin Effluent Discharge Monitor (R15017A). The conversion factor is based on the monitor's efficiency for each nuclide and the abundance of the nuclide. The mix of isotopes used may be based on the historical mix provided in Attachment 7, current mix in the batch release, or as determined by Radiation Protection/Chemistry Supervision. The mix fraction shall be based on gamma emitting isotopes only.

The following equation shall be used to determine the conversion factor for R15017A:

$$CF = \left[\sum_i (f_i \times E_i)\right]^{-1}$$

Where:

$CF =$ µCi/cc per cpm
$f_i =$ Fraction of nuclide *i* to total activity of historical mix (Attachment 7) or batch mix

$E_i =$ Detector efficiency for nuclide *i* (cpm/µCi/cc) Attachment 8

6.2.2 High Alarm Setpoint for R15017A (µCi/ml)

$$\text{High Alarm } (\mu Ci / ml) = \frac{\sum_g C_g}{SF \times \sum_i \left(\frac{C_i}{MEC_i}\right)} + C_{bkgd}$$

Where:

C_g = The concentration of gamma-emitting nuclide *g* in µCi/ml.

C_i = The concentration of nuclide *i* in µCi/ml. This term includes non-gamma emitters

MEC_i = The MEC of radionuclide *i* from Appendix B to 10 CFR Part 20, Table 2, Column 2, in µCi/ml. The class with the most restrictive Effluent Concentration will be used for each isotope.

SF = A SAFETY FACTOR which may be applied to incorporate a margin of conservatism (SF ≥ 1). (Default = 2)

C_{bkg} = The background reading of the monitor (µCi/ml).

6.3 Maximum Effluent Concentrations in Liquid Effluents

The Maximum Effluent Concentration Fraction is calculated to determine compliance with 10 CFR 20 requirements and the Specification in Step 6.14.2. Radioactive liquid effluent discharges normally originate in the RHUTs and are discharged into a retention basin. Samples are collected and analyzed from each retention basin prior to discharge to ensure that compliance with the Specification in Step 6.14.2 can be achieved.

In addition, calculations to determine the minimum dilution water flow rate and maximum retention basin discharge flow rate to ensure compliance are provided in this section. Any combination of minimum dilution flow rate and maximum discharge flow rate which satisfy the Specification is acceptable.

6.3.1 Maximum Effluent Concentration Fraction (MECF)

Compliance with the Specification in Step 6.14.2 is anticipated when the MECF is less than or equal to 1.0. The MECF is calculated as follows:

$$MECF = \left[\sum_i \left(\frac{C_i}{MEC_i}\right)\right] \times \frac{F_r}{F_c + F_r}$$

Where:

MECF = The calculated fraction of Maximum Effluent Concentration in the radioactive liquid effluent discharged beyond the Site Boundary for Liquid Effluents (see Attachment 6).

C_i = The concentration (prior to dilution) of radionuclide *i* in the batch of liquid effluent in μCi/ml.

MEC_i = The MEC of radionuclide *i* from Appendix B to 10 CFR Part 20, Table 2, Column 2, in μCi/ml. The class with the most restrictive Effluent Concentration will be used for each isotope.

F_r = Discharge flow rate; the flow rate of the radioactive liquid batch release from the retention basin to the Waste Water Discharge Canal (Plant Effluent) in gpm.

F_c = The total available dilution water (Plant Effluent) flow rate at the time of discharge of the radioactive liquid effluent in gpm.

NOTE

$SF \times \Sigma_i(C_i/MEC_i)$ must be ≥ 1.0

6.3.2 Minimum Dilution Water Flow Rate (F_{cmin})

The minimum dilution water (Plant Effluent) flow rate (F_{cmin}) is calculated as follows:

$$F_{C_{min}} = F_r \times \left[\left(SF \times \sum_i \left\{\frac{C_i}{MEC_i}\right\}\right) - 1\right]$$

Where:

F_r = A fixed effluent discharge flow (gpm) (as required by specific release restrictions).

SF = A factor which may be applied to incorporate a margin of conservatism ($SF \geq 1$).

NOTE

$SF \times \Sigma_i(C_i/MEC_i)$ must be ≥ 1

6.3.3 Maximum Effluent Discharge Flow Rate (F_{rmax})

The maximum effluent discharge flow rate (F_{rmax}) is calculated as follows:

$$F_{r_{max}} = \frac{F_c}{\left[SF \times \sum_i \left(\frac{C_i}{MEC_i}\right)\right] - 1}$$

Where:

F_c = A fixed dilution water flow rate (gpm) (as required by specific release restrictions).

6.4 Liquid Dose Calculations

This section provides the methodology to demonstrate compliance with the Specification in Step 6.14.3.

Site specific organ dose factors for liquid effluents have been determined for the MAXIMUM EXPOSED INDIVIDUAL and are listed in Attachment 9. Dose factors (A_{ijap}) were derived using equations and methods in Regulatory Guide 1.109, Rev. 1 and LADTAP. The dose factor parameters used are listed in Attachment 3. As previously stated, site specific parameters should be used based on the Land Use Census in lieu of the values provided in RG 1.109 whenever possible.

The exposure pathways included in the A_{ijap} are those identified by the Land Use Census. The pathways considered for inclusion are:

- fresh water fish
- fresh water invertebrate
- river shoreline deposits
- milk from cows that eat fresh or stored forage irrigated with Clay Creek water
- meat from cows that eat fresh or stored forage irrigated with Clay Creek water
- vegetation

6.4.1 Liquid Effluent Dose Equation

$$D_{aj} = \frac{\sum_i \sum_p (Q_i \times A_{ijap})}{F}$$

Where:

D_{aj} = Annual calculated dose (50 year dose commitment) to the organ (or total body) ***j*** of a maximally exposed individual of age group ***a*** (mrem/yr).

Q_i = Activity of isotope ***i*** released during the year (Ci/yr).

A_{ijap} = Site specific dose factor for an organ (or total body) ***j*** for a person of age group ***a*** via pathway ***p*** due to isotope ***i*** (mrem-ft^3/Ci-sec).

F = Annual average discharge volumetric flow rate (effluent water plus dilution water) in ft^3/sec.

Because the dose rate varies linearly with activity release rate, the dose for a shorter period of time (mrem) may be calculated by substituting the activity released (Ci) during that period for Q_i in the above equation. However, volumetric flow rates should not be averaged over a period less than a calendar quarter. More conservative flow rates are acceptable.

6.5 Liquid Dose Projections

31-day dose projections are calculated to show compliance with the Specification in Step 6.14.4. Quarterly and Annual dose projections are calculated in compliance with the Specification in Step 6.14.11.

The following equations shall be used:

31-Day Projection:

$$D_{p31} = 31 \times \frac{D_{Yr}}{t_{Yr}}$$

Quarterly Projection:

$$D_{pQtr} = 91.3 \times \frac{D_{Qtr}}{t_{Qtr}}$$

Yearly Projection:

$$D_{pYr} = 365.25 \times \frac{D_{Yr}}{t_{Yr}}$$

Where:

D_{p31} = 31-day dose projection.

D_{Yr} = Cumulative annual dose to date.

t_{Yr} = Number of days into the year.

D_{pQtr} = Quarterly dose projection.

D_{Qtr} = Cumulative quarterly dose to date.

t_{Qtr} = Number of days into the quarter.

D_{pYr} = Annual dose projection.

6.6 Gaseous Monitor Setpoints

This step does not apply to the IOS Building vent monitor (R15106). The calculations used to determine the setpoints for this monitor are contained in Reference 3.2.18.

The Gaseous Effluent Radiation Monitors have the capability to monitor gaseous effluents over three general ranges (high, middle and low) using four channels. In the permanently defueled mode, the middle and high ranges (Channels 2 and 3) are no longer necessary, and are no longer used or maintained. Channels 1 and 4 both operate in the low range and are the monitor channels which are considered in this procedure.

The Specification in Step 6.14.5 states that the gaseous effluent monitors shall have their alarm/trip setpoints set to ensure the limits of the Specification in Step 6.14.6 are not exceeded. The conservative default atmospheric dispersion (X/Q) factor from Step 6.1.3 is used. Compliance with the dose rate limits for noble gases specified in Step 6.14.6 is demonstrated by setting each gaseous effluent monitor alarm/trip setpoint so that an alarm/trip will occur at or before the dose rate limit is reached.

A SAFETY FACTOR is included in the setpoint calculations to incorporate a margin of conservatism.

Maximum design flow rates for each release point will be used to calculate setpoints.

12→ 6.6.1 Conversion Factors for R15044 and R15045

Provided here is the methodology to determine the conversion factor of counts per minute to microcuries per cubic centimeter for the Auxiliary Building Stack Monitor (R15045) and Reactor Building Stack Monitor (R15044). The conversion factor is based on the monitor's efficiency of detection for each nuclide and the mix of the nuclide. The mix of isotopes used should be based on Kr-85, but may be based on the current mix in the continuous release, or as determined by Radiation Protection/Chemistry Supervision. The mix used for setpoint calculations and conversion factor calculations should be the same.

The following equation shall be used to determine the conversion factor for R15044 and ← R15045:

$$CF = \left[\sum_i (f_i \times E_i)\right]^{-1}$$

Where:

CF = µCi/cc per cpm

f_i = Fraction of nuclide *i* to total activity of the mix used

E_i = Detector efficiency for nuclide *i*, in cpm per µCi/cc, Attachment 10

6.6.2 Gaseous Effluent Flow Rates

Flow rates used in routine gaseous effluent calculations for the pathways listed below are conservative default values. These flow rates should be used to determine monitor setpoints, assess compliance with the gaseous effluent requirements in Section 6.14, and calculate the gaseous effluent dose reported in the ARERR.

Gaseous effluent release points and maximum design flow rates used at RSNGS are as follows:

Reactor Building Stack	74,000	CFM
12→← Auxiliary Building Stack	90,000	CFM
Interim On-site Storage Building Ventilation*	8,050	CFM

* The Interim On-site Storage (IOS) Building is not subject to continuous discharges of radioactivity. Because of the infrequency of a radioactive release, assessment will be done on each release according to administrative procedures.

6.6.3 Determination of Partition Factor (P_v)

12→ The Specification in Step 6.14.6 applies to the entire site, not just one vent or monitor. Consequently, the total release rate must be partitioned among the two major vents (ABS & RBS). For routine operations, the partition factor may be calculated by assuming that the effluent concentration is the same for all pathways and using a ratio of flow rates.

The total volume flow rate for the two vents is 164,000 CFM. Therefore:

$$P_{rbs} = \frac{74{,}000\ \text{CFM}}{164{,}000\ \text{CFM}} = 0.45$$

$$P_{abs} = \frac{90{,}000\ \text{CFM}}{164{,}000\ \text{CFM}} = 0.55$$

Radiation Protection/Chemistry Supervision may elect to use a different set of partition factors based on plant conditions. However, the sum of all the partition factors for the site must be less than or equal to unity (1).

← 6.6.4 Channel 4 Noble Gas Setpoint for R15044 and R15045 in µCi/sec

$$M_V = \frac{3000 \times P_V \times \sum_i C_i}{SF \times (X/Q) \times \sum_i \left[C_i \times (L_i + 1.1 \times M_i) \right]} + \text{Bkgd}$$

Where:

M_v	=	Monitor setpoint for vent ***v*** (i.e., RBS or ABS) in µCi/sec
3000	=	Step 6.14.6 Specification limit for skin dose rate in mrem/yr
P_v	=	Partition factor for vent ***v***, dimensionless, which distributes the total site release rate among the three vents
C_i	=	Concentration of isotope ***i*** in gaseous effluent in µCi/cc. The mix of isotopes used may be based on Kr-85, the current mix, or as determined by Radiation Protection/Chemistry Supervision.
SF	=	Safety Factor, dimensionless, (SF ≥ 1)
X/Q	=	A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.
L_i	=	A factor converting gamma radiation from noble gas radionuclide ***i*** to skin dose ($mrem-m^3/\mu Ci-yr$). See Attachment 11.
M_i	=	A factor converting gamma radiation from noble gas radionuclide ***i*** to air dose ($mrad-m^3/\mu Ci-yr$). See Attachment 11.
Bkgd	=	Monitor background reading in µCi/sec

12→← 6.6.5 Channel 1 Noble Gas Setpoint for R15044 and R15045 in µCi/cc

$$MC_v = \frac{MR_v}{472 \times F_v} + Bkgd$$

Where:

MC_v = Monitor setpoint for vent *v* based on concentration in µCi/cc

MR_v = Monitor setpoint for vent *v* based on release rate in µCi/sec excluding the background term. That is, $M_v - Bkgd$

F_v = Maximum design volumetric flow rate for vent *v* in CFM as indicated in Step 6.6.2.

472 = 28317 ml/ft^3 * 1 min/60 sec

Bkgd = Monitor background reading in µCi/cc

NOTE

Channel 1 does not cause any automatic terminations or audible alarms.

6.7 Maximum Effluent Concentrations (MECs) in Gaseous Effluents

In order to demonstrate compliance with 10 CFR 20.1301, which requires that the total MEC fraction not exceed 1 when averaged over an entire year, the calculation is included in the Annual Radioactive Effluent Release Report. In addition, a four hour reporting requirement exists when the total MEC fraction exceeds 20 when averaged over one hour per 10 CFR 50.72. The following provides guidance on how to perform this calculation.

Maximum Effluent Concentration Fraction (MECF) Equation

$$MECF = \sum_i \left(\frac{C_i}{MEC_i} \right) \times F \times 4.72E\text{-}4 \times X/Q \times TR$$

Where:

C_i = The concentration of nuclide *i* in mCi/cc.

F = Maximum design volumetric flow rate in CFM as indicated in 6.6.2.

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

MEC_i = The MEC for nuclide *i* from Appendix B to 10 CFR Part 20, Table 2, Column 2 (μCi/cc). The class with the most restrictive Effluent Concentration will be used for each isotope.

TR = If the time of release is less than one hour, then this value is the duration of the transient in minutes divided by sixty. Otherwise, the Time Ratio (TR) is one. Dimensionless.

4.72E-4 = The conversion factor in $min*m^3/sec*ft^3$.

6.8 Dose Rate Calculations

Compliance with the dose rate limits for noble gases in the Specification in Step 6.14.6 is demonstrated by setting each gaseous effluent monitor alarm setpoint so that an alarm will occur at or before either dose rate limit Specification in Step 6.14.6 is reached. In addition, the Specification in Step 6.14.6 provides a maximum limit on organ dose rate equivalent beyond the Site Boundary for Gaseous Effluents from tritium and all radioactive materials in particulate form with half-lives greater than 8 days. Compliance is determined by calculating the organ dose rate for the MAXIMUM EXPOSED INDIVIDUAL for the inhalation pathway only.

The dose rate due to noble gas is evaluated as follows:

Total Body:

$$\dot{D}_{tb} = (X/Q) \times \sum_v \sum_i (Q_{vi} \times K_i)$$

Skin:

$$\dot{D}_s = (X/Q) \times \sum_v \sum_i [Q_{vi} \times (L_i + 1.1M_i)]$$

Where:

D_{tb} = The total body dose rate from noble gases (mrem/yr)

D_s = The skin dose rate from noble gases (mrem/yr)

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

Q_{vi} = The release rate of noble gas radionuclide *i* from effluent vent *v* during the time of the release (μCi/sec)

K_i = A factor converting time integrated, ground-level concentration of noble gas radionuclide *i* to total body dose from its gamma radiation (mrem–m^3/μCi-yr). See Attachment 11.

L_i = A factor converting gamma radiation from noble gas radionuclide *i* to skin dose (mrem-m^3/μCi-yr). See Attachment 11.

M_i = A factor converting gamma radiation from noble gas radionuclide *i* to air dose (mrad-m^3/μCi-yr). See Attachment 11.

1.1 = A factor converting air dose from gamma radiation to skin dose equivalent (mrem/mrad)

The organ dose rate resulting from inhalation is calculated with the equation:

Organ:

$$\dot{D}O_{aj} = (X/Q) \times \sum_v \sum_i \left(Q_{vi} \times R_{aji}\right)$$

Where:

DO_{aj} = The dose commitment rate to organ *j* of a person in age group *a* (mrem/yr)

R_{aji} = The factor to convert air concentration of radionuclide *i* to organ *j* dose commitment rate of a person in age group *a* exposed by inhalation (mrem-m^3/μCi-yr). See Attachment 12.

Q_{vi} = The release rate of radionuclide *i* (not including Noble Gas nuclides), via effluent vent *v* during the time of the release (μCi/sec)

Exposure to dose rate factors, R_{aji}, for inhalation are derived by using equation 13 in RG 1.109, Rev. 1. Tables E-5, E-7, E-8, E-9, and E-10 are assumed to represent the Maximum Exposed Individual in the equation to derive R_{aji}.

6.9 Air Dose Calculations

The Surveillance Requirement in Step 6.14.7 requires cumulative dose to air from radioactive effluent noble gases to be determined in order to assess compliance with the Specification in Step 6.14.7. The air dose is evaluated in the sector of the maximum exposure at or beyond the Site Boundary for Gaseous Effluent.

Air dose from noble gas gamma radiation is calculated cumulatively with the equation:

$$D_g = 3.17E-8 \times \sum_v \left[(X/Q) \times \sum_i \sum_n (Q_{vni} \times M_i) \right]$$

Air dose from noble gas beta radiation is calculated cumulatively with the equation:

$$D_b = 3.17E-8 \times \sum_v \left[(X/Q) \times \sum_i \sum_n (Q_{vni} \times N_i) \right]$$

Where:

D_g = The noble gas gamma dose to air (mrad)

D_b = The noble gas beta dose to air (mrad)

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

M_i = A factor converting ground-level concentration to gamma radiation from noble gas radionuclide ***i*** to air dose ($mrad\text{-}m^3/\mu Ci\text{-}yr$)

N_i = A factor converting ground-level concentration to beta radiation from noble gas radionuclide ***i*** to air dose ($mrad\text{-}m^3/\mu Ci\text{-}yr$)

Q_{vni} = The quantity of each noble gas radionuclide ***i*** in batch ***n*** released via effluent stream ***v*** (μCi)

3.17E-8 = 1 yr/3.156E+7 sec

Factors M_i and N_i are 10^6 pCi/μCi times the values in RG 1.109, Rev. 1, Table B-1, Columns 4 and 2, respectively. The computer codes GASPAR and REIMS may be used to perform these calculations.

6.10 Organ Dose Calculations for Gaseous Effluents

The Surveillance Requirement in Step 6.14.8 requires the radiation dose or dose commitment to the Maximum Exposed (Hypothetical) Individual accumulated from exposure to tritium and radioactive materials in particulate form having half-lives greater than 8.0 days, that originate in effluent air, be determined at least every month. The radiation dose or dose commitment accumulated during a calendar quarter and a year may not exceed values stated in the Specification in Step 6.14.8.

A person may be exposed to effluent radioactive material of this type in air by inhalation or indirectly via environmental pathways that involve deposition onto vegetation and the ground. The exposure pathways evaluated will include the following:

p	Exposure Pathway
1	Air – inhalation
2	Deposition onto ground - irradiation
3	Deposition onto vegetation - ingestion
4	Deposition onto forage - cow - milk - ingestion
5	Deposition onto forage - meat animal - meat - ingestion
6	Deposition onto forage - goat - milk - ingestion

The equation used to calculate the dose commitment to the Maximum Exposed (Hypothetical) Individual from radionuclides other than tritium is:

$$D_{aj} = \sum_{p=1}\left[(X/Q)_p \times \sum_v\sum_i\left(Q_{vi} \times R_{ajip}\right)\right] + \sum_{p=2}^{6}\left[(D/Q)_p \times \sum_v\sum_i\left(Q_{vi} \times R_{aijp}\right)\right]$$

Where:

p = 1, i.e., air-inhalation, in the first term, and p = 2, 3, 4, 5, and 6 in the second term of the equation

i excludes H-3

D_{aj} = The dose commitment to organ *j* of a person in age group *a* (mrem)

Q_{vi} = The quantity of each radionuclide *i*, in particulate form having a half-life greater than 8.0 days, in air discharged via effluent stream *v* (μCi)

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

D/Q = A conservative default deposition factor. A Factor converting a ground-level or building wake discharge in air to deposition on land (m^{-2}). The D/Q value in Step 6.1.3 will be used.

R_{ajip} = A factor converting time integrated concentration of radionuclide *i* in air or deposited on vegetation and/or ground to radiation dose commitment to organ *j*, including total body, of a person in age group *a* who is exposed via pathway *p*.

When p=1, representing air-inhalation, R_{ajip} has units of mrem-m^3/μCi-yr. When p=2,3,4,5 or 6 in the second term of the equation above, representing pathways involving deposition, R_{ajip} has units of mrem-m^2-sec/yr-μCi. When the radionuclide is H-3, R_{ajip} has units of mrem-m^3/μCi-yr.

Tritium is assumed not to deposit onto vegetation or the ground. Hence, the concentration in vegetation is assumed to be related to the local atmospheric concentration as described in RG 1.109, Rev. 1, Appendix C. The dose commitment to the Maximum Exposed (Hypothetical) Individual from tritium in gaseous effluent is calculated with the equation:

$$D_{aj} = 3.17E-8 \times \sum_{p}\left[(X/Q)_p \times \sum_{v}(Q_{vi} \times R_{ajip})\right]$$

Where:

p = 1, 3, 4, 5, and 6

i includes H-3 only

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

3.17E-8 = years/sec

Other terms as defined above.

Dose factors R_{ajip} for RSNGS are derived using the equations and methods in RG 1.109, Rev. 1, Appendix C. Values of parameters in RG 1.109, Rev. 1, Table E-5 are assumed to represent the Maximum Exposed (Hypothetical) Individual unless Land Use Census data justify a different value. Any different values from default values will be justified and added as a table to the ODCM. Values of other parameters recommended in RG 1.109, Rev. 1, including those recommended in the absence of site-specific data, are used in the equations to derive the dose factors. (GASPAR or REIMS may be used to perform the calculations.)

6.11 Gas Dose Projections

31-Day Dose projections are calculated to show compliance with Step 6.14.9. Quarterly and Annual dose projections are calculated in compliance with the Specification in Step 6.14.11. The dose projection equations are the same as used for liquid per Step 6.5.

6.12 Fuel Cycle Dose

If a calculated dose exceeds twice the limit of the Specification in Step 6.14.3, 6.14.7, 6.14.8, or a level in Table 3 of the REMP Manual is exceeded, an assessment of compliance with the Specification in Step 6.14.10 must be made.

Liquid dose calculations shall be made using the general methodology of Step 6.4. Gas dose calculations shall be made using the general methodology of Steps 6.9 and 6.10. These methodologies are to be used as a guide and strict adherence is not required because the Fuel Cycle Dose Calculation is done to determine the actual dose received, not a hypothetical maximum. Therefore, parameters such as dilution beyond the site boundary and residential shielding may be factored into the calculation.

The total body and organ doses shall be the result of summing the individual contributions from liquid, gas, and direct radiation sources for the affected Member of the Public.

12→ Irradiation, i.e., exposure to an external source of radiation, directly from the RSNGS normally will be evaluated with the aid of environmental monitoring dosimetry. ←

6.13 EPA Reporting Requirements

If a calculated dose exceeds the Specification limit of Step 6.14.2, 6.14.3, 6.14.6, 6.14.7, or 6.14.8, an assessment of compliance with 40 CFR Parts 302 and 355, Reportable Quantity Adjustment - Radionuclides, must be made.

This involves determining the maximum quantity of radionuclides released in a 24 hour period and comparing the quantities to the values listed in 40 CFR 302 Appendix B. The "sum of the ratios" method shall be used to determine compliance. If the "sum of the ratios" is greater than one, the National Response Center shall be notified.

Since Rancho Seco's systems and procedures are set up to normally operate within the above limits, this condition is not expected to occur, therefore, specific implementation procedures to determine compliance are not required.

6.14 Technical Requirements

6.14.1 Liquid Effluent Monitoring Instrumentation

Specifications:

The radioactive liquid effluent monitoring instrumentation channels shown in Attachment 13 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Step 6.14.2 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with Step 6.2.

Applicability:

During releases via the retention basin effluent discharge.

Action:

1) With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits of Step 6.14.2 are met, immediately suspend the release of radioactive effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

2) With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the Action shown on Attachment 13.

Surveillance Requirements:

1) The maximum setpoint shall be determined in accordance with methodology as described in Step 6.2 and shall be recorded on the release permits.

2) Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the INSTRUMENT CHANNEL CHECK, SOURCE CHECK, INSTRUMENT CHANNEL CALIBRATION, AND CHANNEL TEST at the frequencies shown in Attachment 14.

3) Records shall be maintained in accordance with the Process Standards of all radioactive liquid effluent monitoring instrumentation alarm/trip setpoints. Maximum setpoints and calculations shall be available for review to ensure that the limits of Step 6.14.2 are met.

Bases:

During continuing operations leading to decontamination and decommissioning of the site, radioactively contaminated water will be processed, as necessary, to remove the activity according to the Process Control Program (PCP). After being processed as necessary, the water may be transferred to the 'A' and 'B' Regenerant Holdup Tanks (RHUTs). Pathways for water to reach the RHUTs are shown in Attachment 1, Liquid Effluent Flow Diagram. Administrative controls provide reasonable assurance that any waste water that is radioactive is processed through the RHUTs prior to their release.

Water which is in the 'A' and 'B' RHUTs is transferred to the North or South Retention Basin. The water in a Retention Basin is released off-site as a batch release. These releases are monitored by the Retention Basin Effluent Discharge Monitor.

Radioactive liquid effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of radioactive liquid effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the methodology contained in this manual to ensure that the alarm/trip will occur prior to exceeding the limits of Step 6.14.2. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

6.14.2 Maximum Effluent Concentrations in Liquid Effluents

Specifications:

The concentration of radioactive material released in liquid effluents at any time beyond the Site Boundary for Liquid Effluents (see Attachment 6) shall be limited to the concentrations specified in Appendix B to 10 CFR Part 20, Table 2, Column 2.

Applicability:

This is applicable at all times.

Action:

With the concentration of radioactive material released from the site to areas beyond the Site Boundary for Liquid Effluents exceeding the above Specifications, immediately restore concentration within the required limits and report the event in the next Annual Radioactive Effluent Release Report.

Surveillance Requirements:

The concentration of radioactive material at any time in liquid effluents released from the site to areas beyond the Site Boundary for Liquid Effluents shall be continuously monitored in accordance with Attachment 13.

The liquid effluent continuous monitor having provisions for automatic termination of liquid releases, as listed in Attachment 13, shall be used to limit the concentration of radioactive material released at any time from the site to areas beyond the Site Boundary for Liquid Effluents to the limits given in the above Specifications.

The radioactivity concentration of each Retention Basin to be discharged shall be determined prior to release by sampling and analysis in accordance with Attachment 15, Item A. The results of Retention Basin pre-release sample analyses shall be used with the calculational methods described in Step 6.3 to ensure that the concentration at the point of release is within the limits of the above Specification.

Bases:

This Specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site to areas beyond the Site Boundary For Liquid Effluents (see Attachment 6) will be less than the concentration levels specified in Appendix B to 10 CFR Part 20, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will result in exposures within the limits of 10 CFR Part 20.1301 to a MEMBER OF THE PUBLIC.

There are no continuous releases of radioactive material in liquid effluents from the plant. All radioactive liquid effluent releases from the plant are by batch method.

6.14.3 Liquid Dose Calculations

Specifications:

The dose or dose commitment to a MAXIMUM EXPOSED (HYPOTHETICAL) INDIVIDUAL from radioactive materials in liquid effluents released beyond the Site Boundary for Liquid Effluents (see Attachment 6) shall be limited to:

1) Less than or equal to 1.5 mrem to the total body and to less than or equal to 5.0 mrem to any organ during any calendar quarter; and,

2) Less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ during any calendar year.

Applicability:

At all times.

Action:

With the calculated dose or dose commitment from the release of radioactive materials in liquid effluents exceeding any of the above Specifications, prepare and submit to the Commission within 30 days a Special Report. This Report will identify the cause(s) for exceeding the limit(s) and define the corrective actions to be taken to reduce the releases of radioactive material in liquid effluents and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above Specifications.

Surveillance Requirements:

Cumulative dose assessments associated with the release of radioactive liquid effluent shall be determined by sampling and analysis in accordance with Attachment 15, Item B or Item C, and calculations performed in accordance with the methodology described in Step 6.4 at the following frequencies:

1) Prior to the initiation of a release of radioactive liquid effluent from the A or B RHUT; and,

2) Upon verification of monthly composite analysis results for radioactive liquid effluent released from the A and B RHUTs.

A dose tracking system and administrative dose limits shall be established and maintained. With the 31-day dose projection in excess of the limits in Step 6.14.4, adjust liquid effluent operating parameters to give reasonable assurance of compliance with the dose limits of this Specification (10 CFR 50, Appendix I dose guidelines) and maintain radioactive liquid releases as low as is reasonably achievable.

Bases:

ODCM Step 6.14.3 is provided to implement the requirements of Sections II.A, III.A, and IV.A of Appendix I, 10 CFR Part 50. This step implements the guides set forth in Section II.A of 10 CFR 50, 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 10 CFR 50, Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable." The dose calculation methodology in this manual implement the requirements in Section III.A of 10 CFR 50, Appendix I that conformance with the guides of 10 CFR 50, Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The equations specified in this manual 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. There is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in finished drinking water that are in excess of the requirements of 40 CFR 141.

The Lower Limits of Detection established in Attachment 15, Item B are based on an estimated maximum annual effluent outflow of 2 million gallons with a minimum annual average flow rate in the plant effluent stream of 6,000 gallons per minute. The RHUT pre-release and monthly composite Lower Limits of Detection equate to an off-site dose of less than 10 percent of the 10 CFR 50, Appendix I guidelines. These Lower Limits of Detection, along with the dose tracking system, give reasonable assurance that the dose limits prescribed in ODCM Step 6.14.3 (the 10 CFR 50, Appendix I dose guidelines) will be met.

6.14.4 Liquid Effluent Radwaste Treatment

Specifications:

The LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM shall be OPERABLE. The appropriate portions of the system shall be used to reduce the quantity of radioactive materials in liquid effluents prior to their discharge when projected doses due to the liquid effluent beyond the Site Boundary for Liquid Effluents (see Attachment 6), when averaged over 31 days, would exceed 0.25 mrem to the total body or 0.83 mrem to any organ (8.33% of the 10 CFR 50, Appendix I annual guidelines).

Applicability:

At all times.

Action:

With the LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM inoperable for more than 31 days or with radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days a Special Report which 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; and,

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:

Doses due to liquid releases to areas beyond the Site Boundary for Liquid Effluents shall be projected prior to each RHUT release in accordance with the methodology described in Step 6.5 when LIQUID EFFLUENT RADWASTE TREATMENT SYSTEMS are not being fully utilized. The installed LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM shall be considered OPERABLE by meeting the Specifications in Steps 6.14.2 and 6.14.3.

Bases:

The OPERABILITY of the LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used, when specified, provides reasonable assurance that the releases of radioactive materials in liquid effluents are maintained "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 objectives given in Section II.D of Appendix I to 10 CFR 50. The specified limits governing the use of appropriate portions of the LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM are the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

6.14.5 Gaseous Effluent Monitoring Instrumentation

Specifications:

The radioactive gaseous effluent monitoring instrumentation channels shown in Attachment 16 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Step 6.14.6 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the methodology contained in this procedure. Continuous samples of the gaseous effluent for radioactive particulate material shall be taken as indicated in Attachment 16.

Applicability:

This is applicable at all times.

Action:

1) With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits of Step 6.14.66 are met, immediately 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.

2) With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the Action shown in Attachment 16. Exert best efforts to return the instrument to OPERABLE status within 30 days and if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

Surveillance Requirements:

The maximum setpoints shall be determined by procedures implementing the methodology presented in this procedure and shall be recorded on release permits.

Each gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the INSTRUMENT CHANNEL CHECK, SOURCE CHECK, INSTRUMENT CHANNEL CALIBRATION, AND CHANNEL TEST at the frequencies shown in Attachment 17.

Records shall be maintained in accordance with the Process Standards of all radioactive gaseous effluent monitoring instrument alarm/trip setpoints. Maximum setpoints and setpoint calculations shall be available for review to ensure that the limits of Step 6.14.6 are met.

Bases:

The radioactive gaseous effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of radioactive gaseous effluents. The alarm/trip setpoints for these instruments, except for the Interim On-site Storage (IOS) Building vent monitor (R15106), shall be calculated in accordance with the methodology contained in this manual to ensure that the alarm/trip will occur prior to exceeding the limits of ODCM Step 6.14.6. The monitor setpoints for R15106 are set statistically high enough above background to prevent spurious alarms, yet stop potential radioactive releases when detected (Reference 3.2.18). The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

The IOS Building has a ventilation system which provides protection against radioactive airborne releases. Operation of the ventilation system produces a negative pressure in the building. During operation, the ventilation exhaust flow is continuously monitored for particulate activity. Upon an alarm, the exhaust duct closes and the supply and exhaust fans stop, minimizing any chance of an airborne release. Although no planned airborne radioactive releases are anticipated from this pathway, the ventilation exhaust monitor is included in Attachment 16.

Fuel Storage Building exhaust is directed to the Auxiliary Building Stack where the exhaust is filtered and monitored for any activity prior to release to the atmosphere.

6.14.6 Gaseous Dose Rates

Specifications:

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be limited to the following values:

1) The dose rate limit for noble gases shall be less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin; and,

2) The dose rate limit for tritium and for all radioactive materials in particulate form with half-lives greater than 8 days shall be less than or equal to 1500 mrem/yr to any organ.

Applicability:

This is applicable at all times.

Action:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the limit(s) specified and report the event in the next Annual Radioactive Effluent Release Report.

Surveillance Requirements:

The noble gas effluent continuous monitors, as listed in Attachment 16, shall use monitor setpoints to limit the dose rate in unrestricted areas to the limits in the above Specification.

In the event a noble gas effluent exceeds the setpoint of its monitor, an assessment of compliance with the Specification above shall be made in accordance with the methodology contained in this manual.

The release rate of radioactive materials, other than noble gases, in gaseous effluents shall be determined by obtaining representative samples and performing analyses in accordance with the sampling analyses program specified in Attachment 18.

The dose rate due to tritium and all radioactive material in particulate form with half-lives greater than 8 days, released in gaseous effluents, shall be determined to be within the limits of this Specification by using the results of the sampling and analysis program specified in Attachment 18 and the methodology described in Step 6.8.

Bases:

Step 6.14.6 is provided to ensure that the dose rate from gaseous effluents due to immersion or inhalation at any time at the Site Boundary for Gaseous Effluents (see Attachment 5) will be within the annual dose limits of 10 CFR Part 20 for MEMBERS OF THE PUBLIC. The annual dose limits are the doses associated with the concentrations of Appendix B to 10 CFR Part 20, Table 2, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of an individual at or beyond the Site Boundary for Gaseous Effluents to annual average concentrations exceeding the dose rate equivalent, on which the limits specified in Appendix B, Table 2 of 10 CFR Part 20 were derived. For individuals who may at times be within the Site Boundary for Gaseous Effluents, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the boundary. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the Site Boundary for Gaseous Effluents to less than or equal to 500 mrem/yr to the total body or to less than or equal to 3,000 mrem/yr to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a person of any age group via the inhalation pathway to less than or equal to 1,500 mrem/yr.

6.14.7 Gamma and Beta Air Dose

Specifications:

The air dose due to noble gases released in gaseous effluents to areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be limited to the following:

1) During any calendar quarter, to less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation; and,

2) During any calendar year, to less than or equal to 10 mrad for gamma radiation and to less than or equal to 20 mrad for beta radiation.

Applicability:

This is applicable at all times.

Action:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days a Special Report. This Report will identify the cause(s) for exceeding the limit(s) and define the corrective action(s) taken to reduce the release of radioactive noble gases on gaseous effluents, and the corrective action(s) to be taken to assure that subsequent releases will be in compliance with the above limits.

Surveillance Requirements:

Cumulative air dose contributions for the current calendar quarter and calendar year shall be determined in accordance with the methodology in Step 6.9 at least monthly.

Bases:

Step 6.14.7 is provided to implement the requirements of Sections II.B, III.A, and IV.A of Appendix I, 10 CFR Part 50. This step 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 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 an individual through the appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in this manual 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 equations in this manual provide for determining that the air doses at the Site Boundary for Gaseous Effluents (see Attachment 5) are based upon the historical average atmospheric conditions.

6.14.8 Gaseous Organ Dose

Specifications:

The dose or dose commitment to a MAXIMUM EXPOSED (HYPOTHETICAL) INDIVIDUAL from tritium and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents released to areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be limited to the following:

1) During any calendar quarter, to less than or equal to 7.5 mrem to any organ; and,

2) During any calendar year, to less than or equal to 15 mrem to any organ.

Applicability:

This is applicable at all times.

Action:

With the calculated dose or dose commitment from the release of tritium and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days a Special Report. This Report will identify the cause(s) for exceeding the limit and define the corrective actions to be taken to reduce the releases and the proposed corrective action(s) to be taken to assure that subsequent releases will be in compliance with the above annual limits.

Surveillance Requirements:

Cumulative dose contributions for the current calendar quarter and calendar year period shall be determined in accordance with the methodology described in Step 6.10 at least monthly.

Bases:

Step 6.14.8 is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Specifications are the guides set forth in Section II.C of 10 CFR 50, 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 10 CFR 50, Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." The calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of 10 CFR 50, Appendix I that conformance with the guides of 10 CFR 50, Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. For individuals who may at times be within the Site Boundary for Gaseous Effluents, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric dispersion factor above that for the boundary.

The calculational methods 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, "Calculating 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 estimating doses based upon the historical average atmospheric conditions.

The release rate specifications for radioactive materials in particulate form are dependent on the existing radionuclide pathways to man in areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5). The pathways which were examined in the development of these calculations are: (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.

6.14.9 Ventilation Exhaust Treatment System

Specifications:

The VENTILATION EXHAUST TREATMENT SYSTEM shall be OPERABLE. The installed VENTILATION EXHAUST TREATMENT SYSTEM shall be considered OPERABLE by meeting the Specifications in Steps 6.14.6, 6.14.7, and 6.14.86.

Also, the following two conditions shall not exist simultaneously:

1) Gaseous waste is being discharged without treatment, and;

2) The projected doses due to gaseous effluent releases from the site (see Attachment 5), when averaged over 31 days, would exceed 2% of the 10 CFR 50, Appendix I annual dose guidelines (0.3 mrem to any organ, or air doses of 0.2 mrad from gamma radiation or 0.4 mrad from beta radiation).

Applicability:

This is applicable at all times.

Action:

If both parts 1) and 2) of the Specification are satisfied, prepare and submit to the Commission within 30 days a Special Report pursuant to Technical Specification D6.9.7 which includes the following information:

a. Explanation of why gaseous radwaste was being discharged without treatment, and identification of the equipment or subsystems not OPERABLE and the reason for inoperability.

b. Action(s) taken to restore the inoperable equipment to OPERABLE STATUS.

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

Surveillance Requirements:

Doses due to gaseous releases to areas at and beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be projected at least once per 31 days in accordance with the methodology and parameters in Step 6.11.

Aerosol particulate testing will be performed on the HEPA filters in the Ventilation Exhaust Treatment Systems every 18 months, or after any work has been performed on the HEPA filter systems which could alter their integrity. For minor HEPA filter integrity repairs (up to ~ 0.1% of HEPA filter bank surface area), immediate testing is not required. HEPA filter integrity is ensured through visual observations and effluent sampling

Bases:

The OPERABILITY of the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems are available for use whenever gaseous effluents require treatment prior to release to the environment. 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 are maintained "as low as is reasonably achievable." Step 6.14.9 implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR 50, and the design objectives given in Section II.D of Appendix I to 10 CFR 50. The specified limits governing the use of appropriate portions of the systems and the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR 50, for gaseous effluents.

6.14.10 Fuel Cycle Dose

Specification:

The dose or dose commitment to any real MEMBER OF THE PUBLIC due to releases of radioactive material in gaseous and liquid effluents and to direct radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which is limited to less than or equal to 75 mrem) in a calendar year.

Applicability:

At all times.

Action:

1) With the calculated doses from the release of radioactive material in liquid or gaseous effluents exceeding twice the limits of Specifications in Steps 6.14.3, 6.14.7, 6.14.8 or exceeding the reporting levels in Table 3 of the REMP Manual, calculations shall be made including direct radiation contributions (including outside storage tanks, etc.) to determine whether the above specifications have been exceeded.

2) If the above limits have been exceeded, prepare and submit to the Commission within 30 days, 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 Part 20.2203(a)(4), 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, in a 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.

3) If the estimated dose(s) exceed the above limits, and if the release condition resulting in the violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provision of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

Surveillance Requirements:

Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with the Step 6.14.3, 6.14.7, and 6.14.8 Surveillance Requirements.

Cumulative dose contributions from direct radiation (including outside storage tanks, etc.) shall be determined in accordance with Step 6.12. This requirement is applicable only under the conditions set forth in the above Action statements.

Bases:

Step 6.14.10 is provided to meet the dose limitations of 40 CFR 190 that have been incorporated into 10 CFR 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant radioactive effluents exceed twice the numerical guides for design objective doses of 10 CFR 50, Appendix I or exceeds the reporting levels of the Radiological Environmental Monitoring Program. For the Rancho Seco site, it is unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the plant remains within twice the numerical guides for design objectives of 10 CFR 50, Appendix I and if direct radiation (outside storage tanks, etc.) is kept small. The Special Report will describe a course of action which should result in the limitation of the dose to a MEMBER OF THE PUBLIC for a calendar year to within the 40 CFR 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, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. If the dose to any MEMBER OF THE PUBLIC is evaluated to exceed the requirements of 40 CFR 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190 is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation which is part of the uranium fuel cycle.

6.14.11 Quarter/Annual Dose Projections

Specifications:

The projected dose contributions from liquid and gaseous effluents for the current calendar quarter and current calendar year shall be calculated according to the methodology in Steps 6.5 and 6.11 at least every 31 days.

Applicability:

At all times.

Action:

With the required dose calculations not being performed, best effort will be exerted to perform the calculations once the deficiency has been identified. Corrective actions will be taken and documented to prevent reoccurrence.

Surveillance Requirements

1) Liquid Effluents

Projected dose contributions shall be determined at least every 31 days.

2) Gaseous Effluents

Projected dose contributions shall be determined at least every 31 days.

Bases:

This step is provided to implement the requirement of Technical Specification D6.8.3.a.5. Dose projections provide a means of determining if current release practices will be within the dose limits of 10 CFR 50, Appendix I. Calculating projected dose totals every 31 days provides information which can be used to keep effluent releases "as low as is reasonably achievable".

Calculations performed during the first 15 days of the calendar year or calendar quarter will result in artificially high dose projections which provide no usable information.

6.15 Reports

6.15.1 Annual Radioactive Effluent Release Report (ARERR)

The ARERR covering the activities of the unit during the previous 12 months shall be submitted within 60 days after January 1 of each year. The report shall include the following:

(1) Summary of the quantities of radioactive liquid and gaseous effluents released from the unit.

(2) Summary of solid waste shipped from the unit.

(3) All unplanned releases of radioactive materials in gaseous and liquid effluents to unrestricted areas shall include a description of the event and equipment involved, cause(s), action(s) taken to prevent recurrence, and consequences.
(4) Dose or dose commitment assessments to ensure compliance with the specifications in 6.14.3, 6.14.7, and 6.14.8.

(5) Complete, legible copy of the entire ODCM and/or REMP Manual if changes occurred during the ARERR reporting period. The copy may be part of the ARERR or sent concurrently.

(6) The ARERR shall also include events described in 6.14.2, 6.14.5, and 6.14.6.

6.15.2 30 Day Reports

The following 30 day reports should be submitted if the criteria are met as stated in the following areas:

(1) 6.14.3 - Liquid Dose Calculations

(2) 6.14.4 - Liquid Dose Projections

(3) 6.14.7 - Gamma and Beta Air Dose

(4) 6.14.8 - Gaseous Organ Dose

(5) 6.14.9 - Gaseous Dose Projections

(6) 6.14.10 - Fuel Cycle Dose

7.0 RECORDS

The individual/packaged documents and related correspondence completed as a result of the performance or implementation of this procedure are records. They shall be transmitted to Records Management in accordance with RSAP-0601, Nuclear Records Management.

LIQUID EFFLUENT FLOW DIAGRAM

(This drawing is for information only)

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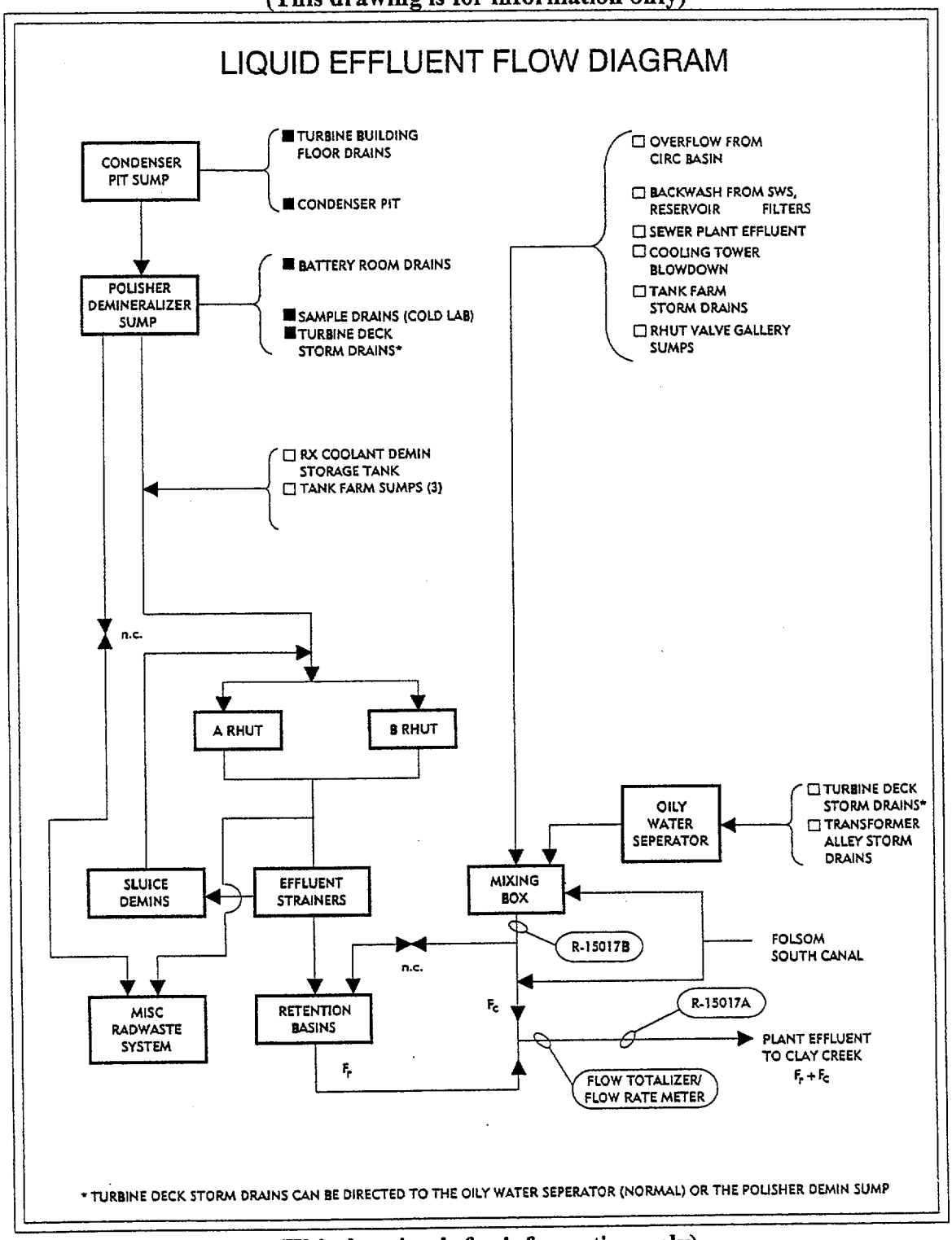

(This drawing is for information only)

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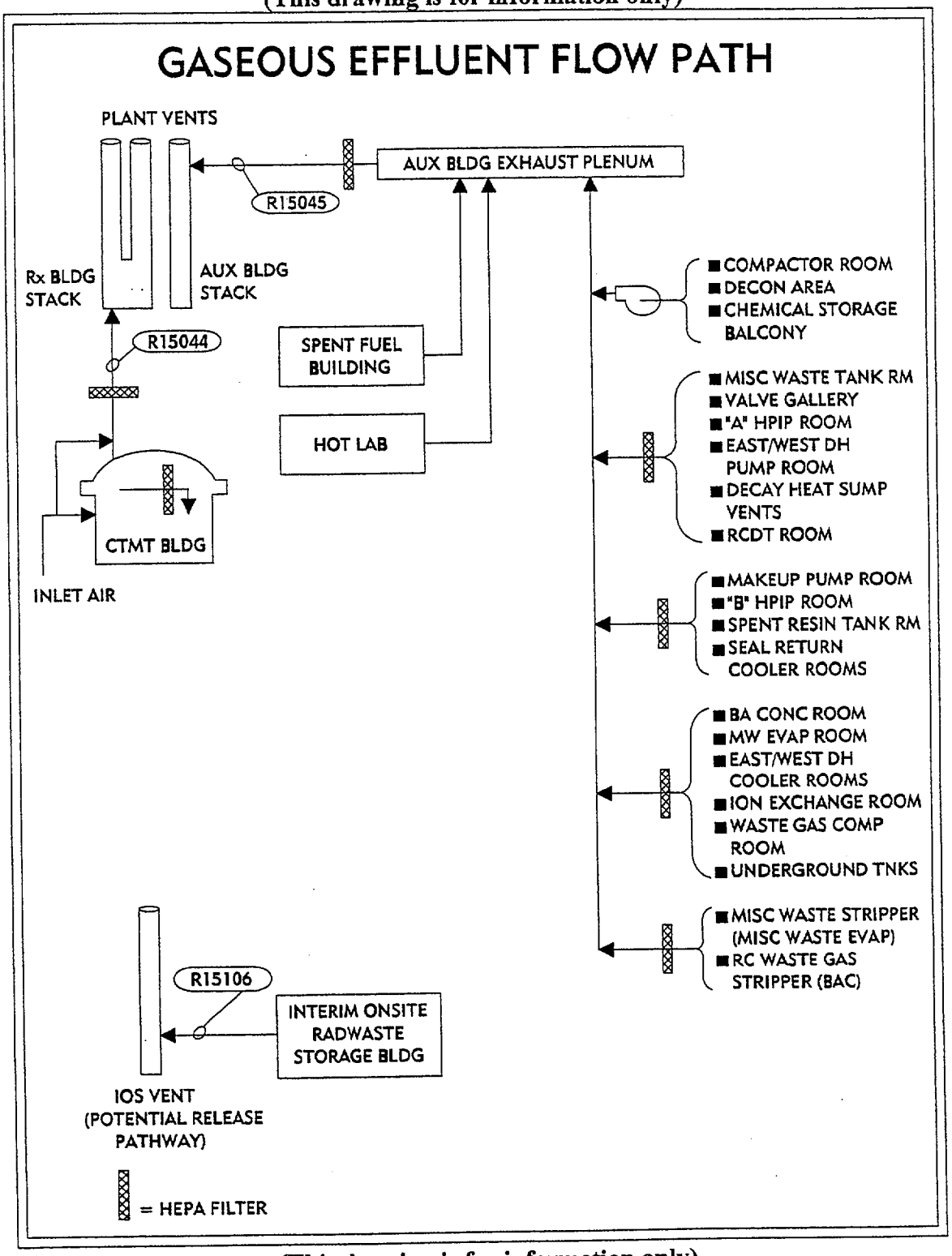
GASEOUS EFFLUENT FLOW DIAGRAM

(This drawing is for information only)

12→



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DOSE FACTOR PARAMETERS

CONSUMPTION AND USAGE PARAMETERS

PATHWAY	AGE	1.109 DEFAULT	RSNGS
Irrigated Stored Vegetables	Adult	520 kg/yr	520 kg/yr
	Teen	630 kg/yr	630 kg/yr
	Child	520 kg/yr	520 kg/yr
	Infant	0 kg/yr	0 kg/yr
Irrigated Fresh Vegetables	Adult	64 kg/yr	64 kg/yr
	Teen	42 kg/yr	42 kg/yr
	Child	26 kg/yr	26 kg/yr
	Infant	0 kg/yr	0 kg/yr
Irrigated Milk	Adult	310 kg/yr	310 kg/yr
	Teen	400 kg/yr	400 kg/yr
	Child	330 kg/yr	330 kg/yr
	Infant	330 kg/yr	330 kg/yr
Irrigated Meat & Poultry	Adult	110 kg/yr	110 kg/yr
	Teen	65 kg/yr	65 kg/yr
	Child	41 kg/yr	41 kg/yr
	Infant	0 kg/yr	0 kg/yr
Fish	Adult	21 kg/yr	21 kg/yr
	Teen	16 kg/yr	16 kg/yr
	Child	6.9 kg/yr	6.9 kg/yr
	Infant	0 kg/yr	0 kg/yr
Other Seafood Invertebrate (Crayfish)	Adult	5.0 kg/yr	6.9 kg/yr
	Teen	3.8 kg/yr	5.2 kg/yr
	Child	1.7 kg/yr	2.2 kg/yr
	Infant	0 kg/yr	0 kg/yr
Algae	Adult	None	0 kg/yr
	Teen	None	0 kg/yr
	Child	None	0 kg/yr
	Infant	None	0 kg/yr
Water Usage (Drinking Water)	Adult	730 l/yr	0 l/yr
	Teen	510 l/yr	0 l/yr
	Child	510 l/yr	0 l/yr
	Infant	330 l/yr	0 l/yr

DOSE FACTOR PARAMETERS (Continued)

CONSUMPTION AND USAGE PARAMETERS (continued)

PATHWAY	AGE	1.109 DEFAULT	RSNGS
Shoreline Recreation	Adult	12 hr/yr	200 hr/yr
	Teen	67 hr/yr	100 hr/yr
	Child	14 hr/yr	14 hr/yr
	Infant	0 hr/yr	0 hr/yr
Swimming	Adult	None	100 hr/yr
	Teen	None	100 hr/yr
	Child	None	14 hr/yr
	Infant	None	0 hr/yr
Boating	Adult	None	0 hr/yr
	Teen	None	0 hr/yr
	Child	None	0 hr/yr
	Infant	None	0 hr/yr
Inhalation	Adult	8000 m^3	8000 m^3
	Teen	8000 m^3	8000 m^3
	Child	3700 m^3	3700 m^3
	Infant	1400 m^3	1400 m^3

IRRIGATION RATES AND FRACTION OF IRRIGATION

	1.109 DEFAULT	RSNGS
Irrigation Rate	263 l/m^2/month	263 l/m^2/month
Time field has been irrigated prior to crop of interest	15 years	15 years
Fraction of the year field is irrigated	None	None
Fraction of animal water intake not obtained from the irrigation system (Irrigated Meat)	None	0
Fraction of animal water intake not obtained from the irrigation system (Irrigated Milk)	None	1

DOSE FACTOR PARAMETERS (Continued)

TRANSIT, TRANSFER, AND HOLDUP TIMES

	1.109 DEFAULT	RSNGS
Irrigated Stored Vegetables Holdup Time	1440 hrs	1440 hrs
Irrigated Fresh Vegetables Holdup Time	24 hrs	24 hrs
Irrigated Milk Holdup Time	48 hrs	48 hrs
Irrigated Meat Holdup Time	480 hrs	480 hrs
Transit Time From Time Of Sample To Time Of Release	None	72 hrs
Transit Time To Drinking Water	None	0 hrs

DILUTIONS

	1.109 DEFAULT	RSNGS
All Pathways	None	1 (None)
Shore-Width Factor	0.2	0.2

MISCELLANEOUS

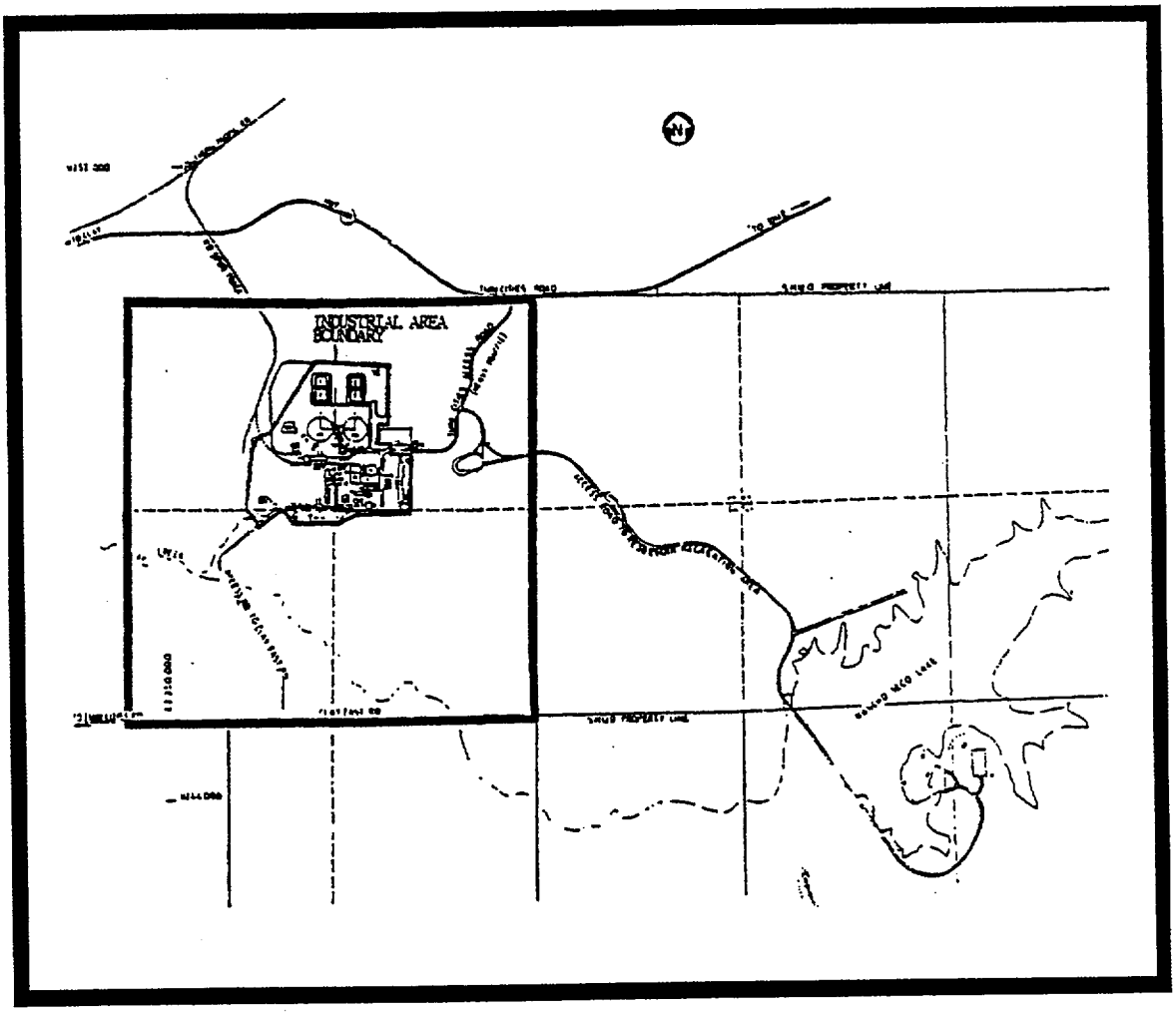
	1.109 DEFAULT	RSNGS
Fraction Of Leafy Vegetables Grown In Garden Of Interest	1.0	1.0
Fraction Of Produce Ingested Grown In Garden Of Interest	0.76	0.76
Crop Growing Time For Leafy Vegetables Ingested By Man	60 Days	30 Days
Crop Growing Time For Pasture Grass	30 Days	30 Days
Crop Yield For Leafy Vegetables Ingested By Man	2.0 kg/m^2	2.0 kg/m^2
Crop Yield For Pasture Grass	0.7 kg/m^2	2.0 kg/m^2

ATMOSPHERIC DISPERSION AND DEPOSITION PARAMETERS
GASEOUS EFFLUENT PATHWAYS
12→← 1998 CONTROLLING LOCATIONS**

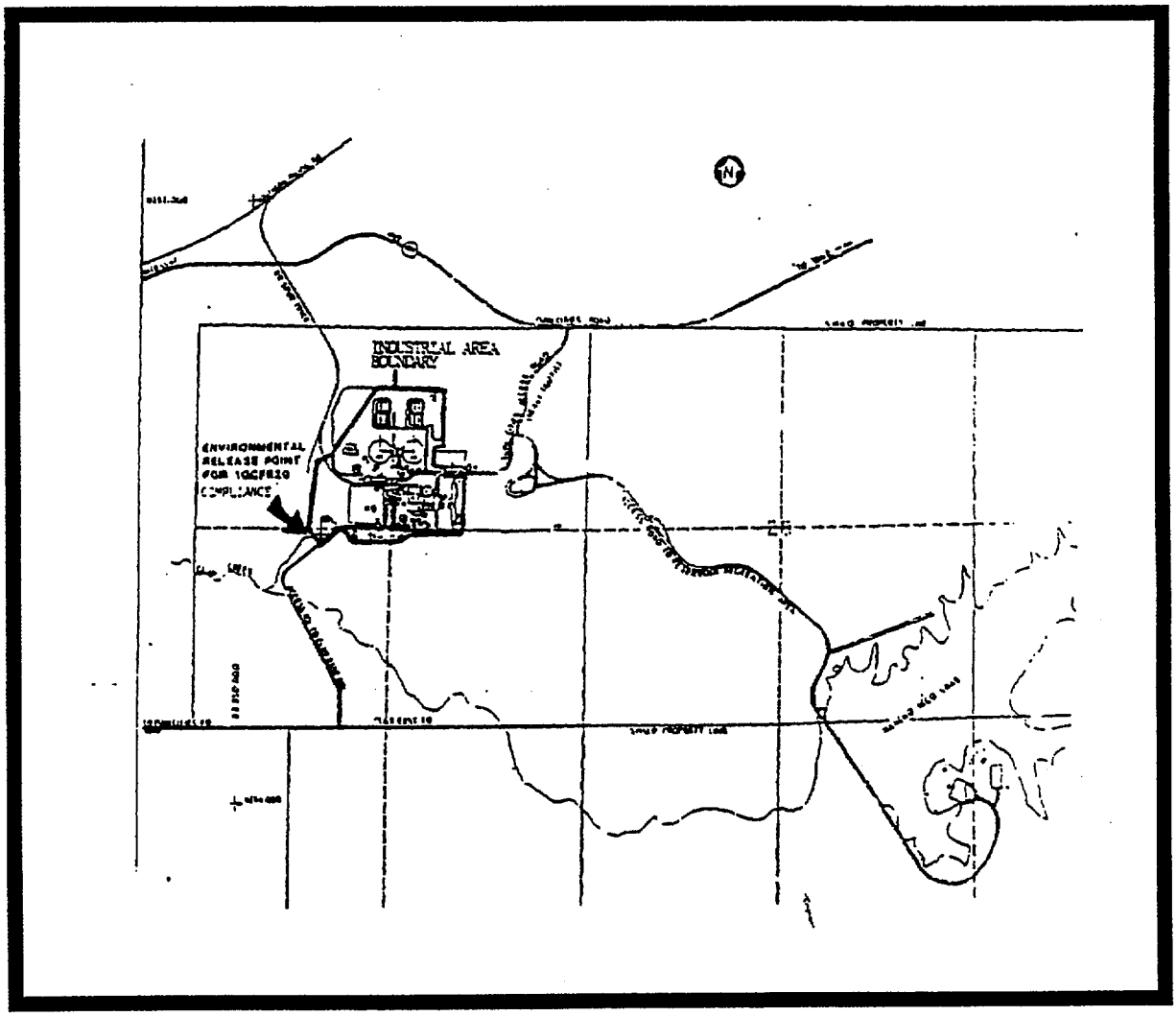
PATHWAY	DIRECTION	DISTANCE	X/Q* (sec/m^3)	D/Q* (m^{-2})
Inhalation	ENE	1038 M	8.1E-06	--
Ground	ENE	1038 M	--	4.8E-08
Vegetation	SSW	670 M	1.4E-05	2.8E-08
Cow Milk	ENE	1038 M	8.1E-06	4.8E-08
Meat Animal	S	195 M	1.2E-04	--
Meat Animal	SSE	198 M	--	3.4E-07
Goat Milk	SSW	2500 M	1.0E-06	1.7E-09
Site Boundary for Gaseous Effluents	NNW	670 M	2.1E-05	--

* Based on meteorological data from January 1978 to December 1987.
12→← ** Based on 1998 Land Use Census.

SITE BOUNDARY FOR GASEOUS EFFLUENTS



SITE BOUNDARY FOR LIQUID EFFLUENTS



HISTORICAL LIQUID SOURCE TERMS

12→

Nuclide	Ci (μCi/ml)	Of Gamma Emitters		Of All Nuclides	
		Relative %	Relative Fraction	Relative %	Relative Fraction
H-3	1.26E-04	n/a	n/a	100.00	1.00
Cs-137	8.20E-09	100.00	1.00	6.51E-03	6.51E-5
TOTAL	1.26E-04	100.00	1.00	100.00	1.00

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12→← Note: Based on Retention Basin Effluent History of Rancho Seco from January 1, 1995 through December 31, 1999

LIQUID MONITOR DETECTOR EFFICIENCIES

R15017A & R15017B*
(Detector Model RD-53)

Nuclide	Efficiency cpm/μCi/cc
MO-99	3.47 E+07
I-131	1.90 E+08
I-132	4.17 E+08
I-133	1.53 E+08
I-135	1.74 E+08
CS-134	3.25 E+08
CS-137	1.28 E+08
CR-51	1.85 E+07
MN-54	1.30 E+08
FE-59	1.26 E+08
CO-58	1.85 E+08
CO-60	2.40 E+08
ZN-65	6.49 E+07
SB-124	2.66 E+08
BA-140	8.98 E+07
LA-140	2.69 E+08
CE-141	7.68 E+07
CE-144	1.80 E+07

* From Calculation Z-RDM-I0261

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS

DOSE FACTOR TABLE: A(i) - Adult
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01
C-14	3.82E+05	7.63E+04	7.63E+04	7.63E+04	7.63E+04	7.63E+04	7.63E+04
NA-24	4.32E+01	4.32E+01	4.32E+01	4.32E+01	4.32E+01	4.32E+01	4.32E+01
P-32	4.07E+07	2.53E+06	1.57E+06	6.31E-02	6.31E-02	6.31E-02	4.58E+06
CR-51	3.08E+00	3.08E+00	8.89E+00	6.56E+00	4.36E+00	1.08E+01	1.46E+03
MN-54	8.23E+02	3.31E+05	6.38E+04	8.23E+02	9.90E+04	8.23E+02	1.01E+06
MN-56	0.00E+00	2.13E-04	3.79E-05	0.00E+00	2.70E-04	0.00E+00	6.79E-03
FE-55	1.18E+04	8.17E+03	1.91E+03	7.29E-04	7.29E-04	4.56E+03	4.69E+03
FE-59	1.47E+04	3.42E+04	1.32E+04	1.77E+02	1.77E+02	9.69E+03	1.14E+05
CO-58	2.36E+02	9.91E+02	1.93E+03	2.36E+02	2.36E+02	2.36E+02	1.55E+04
CO-60	1.26E+04	1.61E+04	2.02E+04	1.26E+04	1.26E+04	1.26E+04	7.73E+04
NI-63	3.42E+05	2.37E+04	1.15E+04	0.00E+00	0.00E+00	0.00E+00	4.95E+03
NI-65	8.65E-04	1.12E-04	5.13E-05	0.00E+00	0.00E+00	0.00E+00	2.85E-03
CU-64	8.90E-02	7.02E-01	3.77E-01	8.90E-02	1.64E+00	8.90E-02	5.24E+01
ZN-65	7.63E+04	2.42E+05	1.10E+05	4.46E+02	1.62E+05	4.46E+02	1.52E+05
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.84E-05	0.00E+00	0.00E+00	0.00E+00	6.98E-05
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	6.46E+00	1.21E+05	5.62E+04	6.46E+00	6.46E+00	6.46E+00	2.38E+04
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.01E+05	6.25E-02	5.75E+03	6.25E-02	6.25E-02	6.25E-02	3.22E+04
SR-90	5.71E+06	6.16E-03	1.53E+06	6.16E-03	6.16E-03	6.16E-03	3.26E+05
SR-91	5.59E+00	1.19E-01	3.40E-01	1.19E-01	1.19E-01	1.19E-01	2.62E+01
SR-92	5.95E-03	0.00E+00	2.58E-04	0.00E+00	0.00E+00	0.00E+00	1.18E-01
Y-90	3.15E+00	6.94E-02	1.52E-01	6.94E-02	6.94E-02	6.94E-02	3.27E+04
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.95E+02	6.82E-01	5.89E+00	6.82E-01	6.82E-01	6.82E-01	1.07E+05
Y-92	1.72E-05	4.24E-06	4.62E-06	4.24E-06	4.24E-06	4.24E-06	2.28E-01
Y-93	2.16E-02	1.61E-02	1.63E-02	1.61E-02	1.61E-02	1.61E-02	1.73E+02
ZR-95	1.82E+02	1.64E+02	1.62E+02	1.56E+02	1.69E+02	1.56E+02	2.67E+04
ZR-97	9.87E-01	9.83E-01	9.82E-01	9.82E-01	9.83E-01	9.82E-01	3.26E+02
NB-95	5.16E+02	3.27E+02	2.17E+02	8.92E+01	3.24E+02	8.92E+01	1.44E+06
MO-99	1.27E+00	3.04E+02	5.89E+01	1.27E+00	6.87E+02	1.27E+00	7.03E+02
TC-99M	8.23E-04	1.03E-03	4.74E-03	7.11E-04	5.51E-03	8.66E-04	1.88E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	6.76E+02	7.02E+01	3.31E+02	7.02E+01	2.38E+03	7.02E+01	7.08E+04
RU-105	9.35E-04	1.83E-04	4.80E-04	1.83E-04	9.91E-03	1.83E-04	4.60E-01
RU-106	1.61E+04	2.95E+02	2.30E+03	2.95E+02	3.08E+04	2.95E+02	1.02E+06
AG-110M	2.63E+03	2.59E+03	2.37E+03	2.06E+03	3.10E+03	2.06E+03	2.17E+05
TE-125M	1.86E+04	6.75E+03	2.49E+03	5.60E+03	7.57E+04	9.21E-01	7.43E+04
TE-127M	5.26E+04	1.88E+04	6.41E+03	1.34E+04	2.14E+05	5.57E-02	1.76E+05
TE-127	6.06E-01	2.18E-01	1.31E-01	4.49E-01	2.47E+00	1.62E-04	4.78E+01
TE-129M	7.19E+04	2.68E+04	1.14E+04	2.47E+04	3.00E+05	1.31E+01	3.62E+05
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	1.11E+03	5.44E+02	4.54E+02	8.58E+02	5.45E+03	5.64E+00	5.34E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	6.30E+03	4.07E+03	3.82E+03	4.50E+03	3.92E+04	3.73E+00	1.93E+05
I-130	3.14E+00	7.62E+00	3.51E+00	5.76E+02	1.14E+01	8.37E-01	6.68E+00
I-131	7.06E+02	1.00E+03	5.82E+02	3.24E+05	1.71E+03	1.47E+01	2.76E+02
I-132	1.60E-04	4.29E-04	1.50E-04	1.50E-02	6.83E-04	0.00E+00	8.05E-05
I-133	1.68E+01	2.84E+01	9.45E+00	4.01E+03	4.88E+01	1.13E+00	2.57E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	1.59E-01	4.14E-01	1.53E-01	2.73E+01	6.63E-01	8.91E-04	4.68E-01
CS-134	4.44E+05	1.05E+06	8.59E+05	4.03E+03	3.43E+05	1.16E+05	2.23E+04
CS-136	3.16E+04	1.24E+05	8.95E+04	1.15E+02	6.92E+04	9.59E+03	1.42E+04
CS-137	5.85E+05	7.98E+05	5.25E+05	6.06E+03	2.75E+05	9.54E+04	2.14E+04
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	4.90E+03	2.11E+01	3.35E+02	1.50E+01	1.71E+01	1.85E+01	1.01E+04
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.14E+00	3.92E+00	3.76E+00	3.71E+00	3.71E+00	3.71E+00	1.61E+04
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.29E-06
CE-141	1.87E+01	1.56E+01	9.66E+00	8.90E+00	1.20E+01	8.90E+00	2.54E+04
CE-143	1.93E+00	1.42E+02	1.76E+00	1.74E+00	1.81E+00	1.74E+00	5.24E+03
CE-144	8.99E+02	4.00E+02	8.76E+01	4.15E+01	2.54E+02	4.15E+01	2.90E+05
PR-143	7.38E+00	2.96E+00	3.66E-01	0.00E+00	1.71E+00	0.00E+00	3.23E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	9.62E+00	1.03E+01	5.27E+00	4.95E+00	8.11E+00	4.95E+00	2.59E+04
W-187	2.03E+01	1.72E+01	6.89E+00	1.35E+00	1.35E+00	1.35E+00	5.20E+03
NP-239	1.70E+00	1.56E+00	1.56E+00	1.55E+00	1.59E+00	1.55E+00	2.92E+03

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS (Continued)

DOSE FACTOR TABLE: A(i) - Teen
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.37E+01	1.37E+01	1.37E+01	1.37E+01	1.37E+01	1.37E+01
C-14	5.64E+05	1.13E+05	1.13E+05	1.13E+05	1.13E+05	1.13E+05	1.13E+05
NA-24	6.36E+01	6.36E+01	6.36E+01	6.36E+01	6.36E+01	6.36E+01	6.36E+01
P-32	4.44E+07	2.75E+06	1.72E+06	6.31E-02	6.31E-02	6.31E-02	3.73E+06
CR-51	1.82E+00	1.82E+00	8.10E+00	5.31E+00	3.19E+00	1.08E+01	1.06E+03
MN-54	4.20E+02	3.24E+05	6.45E+04	4.20E+02	9.69E+04	4.20E+02	6.63E+05
MN-56	0.00E+00	1.92E-04	3.43E-05	0.00E+00	2.43E-04	0.00E+00	1.26E-02
FE-55	1.37E+04	9.69E+03	2.26E+03	7.29E-04	7.29E-04	6.15E+03	4.19E+03
FE-59	1.55E+04	3.61E+04	1.40E+04	1.00E+02	1.00E+02	1.15E+04	8.53E+04
CO-58	1.28E+02	1.08E+03	2.32E+03	1.28E+02	1.28E+02	1.28E+02	1.33E+04
CO-60	6.35E+03	1.10E+04	1.69E+04	6.35E+03	6.35E+03	6.35E+03	6.71E+04
NI-63	4.50E+05	3.18E+04	1.53E+04	0.00E+00	0.00E+00	0.00E+00	5.06E+03
NI-65	8.19E-04	1.05E-04	4.77E-05	0.00E+00	0.00E+00	0.00E+00	5.67E-03
CU-64	8.55E-02	9.25E-01	4.80E-01	8.55E-02	2.21E+00	8.55E-02	6.52E+01
ZN-65	7.56E+04	2.62E+05	1.22E+05	2.29E+02	1.68E+05	2.29E+02	1.11E+05
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.93E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	4.10E+00	1.40E+05	6.56E+04	4.10E+00	4.10E+00	4.10E+00	2.07E+04
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.93E+05	5.64E-02	8.38E+03	5.64E-02	5.64E-02	5.64E-02	3.48E+04
SR-90	7.40E+06	6.16E-03	1.98E+06	6.16E-03	6.16E-03	6.16E-03	3.85E+05
SR-91	5.73E+00	1.16E-01	3.39E-01	1.16E-01	1.16E-01	1.16E-01	2.56E+01
SR-92	5.55E-03	0.00E+00	2.37E-04	0.00E+00	0.00E+00	0.00E+00	1.42E-01
Y-90	3.35E+00	6.87E-02	1.57E-01	6.87E-02	6.87E-02	6.87E-02	2.71E+04
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	2.46E+02	3.78E-01	6.97E+00	3.78E-01	3.78E-01	3.78E-01	1.01E+05
Y-92	1.64E-05	4.20E-06	4.55E-06	4.20E-06	4.20E-06	4.20E-06	3.35E-01
Y-93	2.13E-02	1.57E-02	1.59E-02	1.57E-02	1.57E-02	1.57E-02	1.70E+02
ZR-95	1.19E+02	9.67E+01	9.34E+01	8.62E+01	1.02E+02	8.62E+01	2.42E+04
ZR-97	9.41E-01	9.37E-01	9.37E-01	9.36E-01	9.38E-01	9.36E-01	2.63E+02
NB-95	4.73E+02	2.82E+02	1.75E+02	4.46E+01	2.75E+02	4.46E+01	1.02E+06
MO-99	6.36E-01	4.32E+02	8.28E+01	6.36E-01	9.87E+02	6.36E-01	7.73E+02
TC-99M	8.54E-04	1.13E-03	6.35E-03	6.98E-04	7.20E-03	9.40E-04	2.87E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	5.86E+02	3.51E+01	2.71E+02	3.51E+01	1.98E+03	3.51E+01	4.61E+04
RU-105	8.80E-04	1.81E-04	4.52E-04	1.81E-04	9.00E-03	1.81E-04	5.65E-01
RU-106	1.59E+04	1.48E+02	2.14E+03	1.48E+02	3.06E+04	1.48E+02	7.57E+05
AG-110M	1.87E+03	1.83E+03	1.53E+03	1.06E+03	2.53E+03	1.06E+03	2.17E+05
TE-125M	2.06E+04	7.42E+03	2.75E+03	5.75E+03	4.81E-01	4.81E-01	6.07E+04
TE-127M	5.93E+04	2.10E+04	7.05E+03	1.41E+04	2.40E+05	2.93E-02	1.48E+05
TE-127	6.53E-01	2.32E-01	1.41E-01	4.51E-01	2.64E+00	1.57E-04	5.04E+01
TE-129M	7.75E+04	2.88E+04	1.23E+04	2.50E+04	3.24E+05	7.70E+00	2.91E+05
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	1.18E+03	5.67E+02	4.74E+02	8.50E+02	5.86E+03	5.20E+00	4.51E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	6.58E+03	4.17E+03	3.92E+03	4.40E+03	4.00E+04	3.07E+00	1.32E+05
I-130	3.80E+00	9.45E+00	4.26E+00	7.06E+02	1.41E+01	8.08E-01	7.45E+00
I-131	9.72E+02	1.36E+03	7.33E+02	3.93E+05	2.33E+03	1.08E+01	2.77E+02
I-132	1.46E-04	3.81E-04	1.37E-04	1.29E-02	6.01E-04	0.00E+00	1.66E-04
I-133	2.27E+01	3.77E+01	1.22E+01	5.12E+03	6.54E+01	1.06E+00	2.88E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	1.85E-01	4.76E-01	1.77E-01	3.06E+01	7.52E-01	4.45E-04	5.28E-01
CS-134	5.04E+05	1.18E+06	5.50E+05	2.03E+03	3.77E+05	1.45E+05	1.67E+04
CS-136	3.27E+04	1.28E+05	8.62E+04	7.75E+01	6.99E+04	1.11E+04	1.04E+04
CS-137	6.99E+05	9.30E+05	3.26E+05	3.03E+03	3.18E+05	1.26E+05	1.62E+04
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-06
BA-140	5.34E+03	1.64E+01	3.53E+02	9.87E+00	1.21E+01	1.43E+01	8.23E+03
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	2.30E+00	2.08E+00	1.91E+00	1.85E+00	1.85E+00	1.85E+00	1.27E+04
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-05
CE-141	1.69E+01	1.30E+01	6.05E+00	5.15E+00	8.84E+00	5.15E+00	2.25E+04
CE-143	1.79E+00	1.48E+02	1.61E+00	1.59E+00	1.66E+00	1.59E+00	4.41E+03
CE-144	1.20E+03	5.10E+02	8.47E+01	2.12E+01	3.13E+02	2.12E+01	2.97E+05
PR-143	7.98E+00	3.18E+00	3.97E-01	0.00E+00	1.85E+00	0.00E+00	2.62E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	7.72E+00	8.17E+00	2.82E+00	2.47E+00	5.82E+00	2.47E+00	2.06E+04
W-187	2.17E+01	1.79E+01	7.11E+00	1.26E+00	1.26E+00	1.26E+00	4.51E+03
NP-239	1.50E+00	1.36E+00	1.35E+00	1.34E+00	1.39E+00	1.34E+00	2.41E+03

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS (Continued)

DOSE FACTOR TABLE: A(i) - Child
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01
C-14	1.28E+06	2.56E+05	2.56E+05	2.56E+05	2.56E+05	2.56E+05	2.56E+05
NA-24	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02
P-32	5.74E+07	2.69E+06	2.21E+06	8.84E-03	8.84E-03	8.84E-03	1.59E+06
CR-51	2.54E-01	2.54E-01	7.95E+00	4.52E+00	1.42E+00	8.05E+00	4.08E+02
MN-54	5.88E+01	2.53E+05	6.74E+04	5.88E+01	7.10E+04	5.88E+01	2.12E+05
MN-56	0.00E+00	2.51E-04	5.68E-05	0.00E+00	3.04E-04	0.00E+00	3.64E-02
FE-55	2.40E+04	1.27E+04	3.94E+03	1.02E-04	1.02E-04	7.19E+03	2.35E+03
FE-59	2.21E+04	3.58E+04	1.78E+04	1.40E+01	1.40E+01	1.04E+04	3.72E+04
CO-58	1.79E+01	1.28E+03	3.88E+03	1.79E+01	1.79E+01	1.79E+01	7.38E+03
CO-60	8.89E+02	7.51E+03	2.04E+04	8.89E+02	8.89E+02	8.89E+02	3.76E+04
NI-63	1.02E+06	5.48E+04	3.48E+04	0.00E+00	0.00E+00	0.00E+00	3.69E+03
NI-65	1.52E-03	1.43E-04	8.35E-05	0.00E+00	0.00E+00	0.00E+00	1.75E-02
CU-64	1.20E-02	1.27E+00	7.70E-01	1.20E-02	3.05E+00	1.20E-02	5.89E+01
ZN-65	9.53E+04	2.54E+05	1.58E+05	3.21E+01	1.60E+05	3.21E+01	4.46E+04
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	9.58E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	5.74E-01	1.61E+05	9.88E+04	5.74E-01	5.74E-01	5.74E-01	1.03E+04
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	6.48E+05	7.90E-03	1.85E+04	7.90E-03	7.90E-03	7.90E-03	2.51E+04
SR-90	1.47E+07	8.62E-04	3.93E+06	8.62E-04	8.62E-04	8.62E-04	2.97E+05
SR-91	1.04E+01	1.62E-02	4.06E-01	1.62E-02	1.62E-02	1.62E-02	2.28E+01
SR-92	1.02E-02	0.00E+00	4.09E-04	0.00E+00	0.00E+00	0.00E+00	1.93E-01
Y-90	4.28E+00	9.62E-03	1.24E-01	9.62E-03	9.62E-03	9.62E-03	1.22E+04
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	4.49E+02	5.29E-02	1.21E+01	5.29E-02	5.29E-02	5.29E-02	5.98E+04
Y-92	2.31E-05	0.00E+00	1.23E-06	0.00E+00	0.00E+00	0.00E+00	6.50E-01
Y-93	1.05E-02	2.20E-03	2.43E-03	2.20E-03	2.20E-03	2.20E-03	1.24E+02
ZR-95	8.32E+01	2.77E+01	2.60E+01	1.21E+01	3.45E+01	1.21E+01	1.63E+04
ZR-97	1.40E-01	1.32E-01	1.32E-01	1.31E-01	1.33E-01	1.31E-01	1.90E+02
NB-95	5.20E+02	2.06E+02	1.49E+02	6.25E+00	1.94E+02	6.25E+00	3.70E+05
MO-99	8.90E-02	7.01E+02	1.73E+02	8.90E-02	1.50E+03	8.90E-02	5.80E+02
TC-99M	4.34E-04	7.58E-04	1.10E-02	9.77E-05	9.69E-03	4.33E-04	3.76E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.02E+03	4.92E+00	3.96E+02	4.92E+00	2.57E+03	4.92E+00	2.63E+04
RU-105	1.31E-03	2.53E-05	4.90E-04	2.53E-05	1.13E-02	2.53E-05	8.35E-01
RU-106	3.18E+04	2.07E+01	3.98E+03	2.07E+01	4.29E+04	2.07E+01	4.94E+05
AG-110M	1.79E+03	1.26E+03	1.04E+03	1.48E+02	2.22E+03	1.48E+02	1.32E+05
TE-125M	3.04E+04	8.25E+03	4.06E+03	8.54E+03	6.73E-02	6.73E-02	2.94E+04
TE-127M	9.30E+04	2.50E+04	1.10E+04	2.22E+04	2.65E+05	4.10E-03	7.53E+04
TE-127	8.94E-01	2.41E-01	1.92E-01	6.19E-01	2.54E+00	2.20E-05	3.49E+01
TE-129M	1.09E+05	3.05E+04	1.70E+04	3.52E+04	3.21E+05	1.08E+00	1.33E+05
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-06
TE-131M	1.48E+03	5.13E+02	5.46E+02	1.05E+03	4.96E+03	7.28E-01	2.08E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	8.15E+03	3.61E+03	4.36E+03	5.26E+03	3.35E+04	4.30E-01	3.63E+04
I-130	6.36E+00	1.27E+01	6.62E+00	1.39E+03	1.90E+01	1.13E-01	6.02E+00
I-131	2.06E+03	2.07E+03	1.18E+03	6.84E+05	3.40E+03	1.51E+00	1.86E+02
I-132	2.60E-04	4.78E-04	2.20E-04	2.22E-02	7.32E-04	0.00E+00	5.63E-04
I-133	4.65E+01	5.74E+01	2.18E+01	1.06E+04	9.56E+01	1.49E-01	2.32E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	3.79E-01	6.82E-01	3.23E-01	6.04E+01	1.05E+00	6.24E-05	5.20E-01
CS-134	7.61E+05	1.25E+06	2.64E+05	2.85E+02	3.87E+05	1.39E+05	7.02E+03
CS-136	4.14E+04	1.14E+05	7.37E+04	1.09E+01	6.06E+04	9.05E+03	4.01E+03
CS-137	1.12E+06	1.07E+06	1.59E+05	4.25E+02	3.50E+05	1.26E+05	7.15E+03
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.51E-05
BA-140	8.64E+03	8.95E+00	5.05E+02	1.38E+00	3.85E+00	5.89E+00	4.38E+03
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	8.30E-01	4.59E-01	3.27E-01	2.59E-01	2.59E-01	2.59E-01	5.56E+03
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-04
CE-141	2.04E+01	1.05E+01	2.18E+00	7.21E-01	5.03E+00	7.21E-01	1.23E+04
CE-143	4.85E-01	1.42E+02	2.44E-01	2.23E-01	2.83E-01	2.23E-01	2.08E+03
CE-144	2.39E+03	7.51E+02	1.30E+02	2.97E+00	4.17E+02	2.97E+00	1.95E+05
PR-143	1.11E+01	3.33E+00	5.51E-01	0.00E+00	1.80E+00	0.00E+00	1.20E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	7.38E+00	6.04E+00	7.88E-01	3.47E-01	3.47E+00	3.47E-01	9.02E+03
W-187	2.65E+01	1.58E+01	7.17E+00	1.77E-01	1.77E-01	1.77E-01	2.19E+03
NP-239	4.00E-01	2.03E-01	1.99E-01	1.88E-01	2.32E-01	1.88E-01	1.13E+03

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS (Continued)

DOSE FACTOR TABLE: A(i) - Infant
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01
C-14	5.80E+05	1.24E+05	1.24E+05	1.24E+05	1.24E+05	1.24E+05	1.24E+05
NA-24	1.76E+02	1.76E+02	1.76E+02	1.76E+02	1.76E+02	1.76E+02	1.76E+02
P-32	9.00E+05	5.29E+04	3.49E+04	0.00E+00	0.00E+00	0.00E+00	1.22E+04
CR-51	0.00E+00	0.00E+00	7.82E-01	5.10E-01	1.12E-01	9.93E-01	2.28E+01
MN-54	0.00E+00	1.68E+02	3.82E+01	0.00E+00	3.73E+01	0.00E+00	6.18E+01
MN-56	0.00E+00	1.22E-06	0.00E+00	0.00E+00	1.05E-06	0.00E+00	1.11E-04
FE-55	5.61E+02	3.63E+02	9.69E+01	0.00E+00	0.00E+00	1.77E+02	4.61E+01
FE-59	1.04E+03	1.81E+03	7.14E+02	0.00E+00	0.00E+00	5.36E+02	8.66E+02
CO-58	0.00E+00	1.08E+02	2.70E+02	0.00E+00	0.00E+00	0.00E+00	2.70E+02
CO-60	0.00E+00	3.81E+02	8.99E+02	0.00E+00	0.00E+00	0.00E+00	9.06E+02
NI-63	1.72E+05	1.06E+04	5.97E+03	0.00E+00	0.00E+00	0.00E+00	5.29E+02
NI-65	1.47E-04	1.66E-05	7.56E-06	0.00E+00	0.00E+00	0.00E+00	1.27E-03
CU-64	0.00E+00	2.29E+00	1.06E+00	0.00E+00	3.87E+00	0.00E+00	4.70E+01
ZN-65	3.02E+04	1.03E+05	4.77E+04	0.00E+00	5.02E+04	0.00E+00	8.74E+04
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.15E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.14E+05	5.65E+04	0.00E+00	0.00E+00	0.00E+00	2.92E+03
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	5.77E+04	0.00E+00	1.66E+03	0.00E+00	0.00E+00	0.00E+00	1.19E+03
SR-90	3.91E+05	0.00E+00	1.05E+05	0.00E+00	0.00E+00	0.00E+00	7.22E+03
SR-91	4.01E+00	0.00E+00	1.45E-01	0.00E+00	0.00E+00	0.00E+00	4.75E+00
SR-92	1.84E-04	0.00E+00	6.83E-06	0.00E+00	0.00E+00	0.00E+00	1.98E-03
Y-90	4.55E-03	0.00E+00	1.22E-04	0.00E+00	0.00E+00	0.00E+00	6.28E+00
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	3.32E-01	0.00E+00	8.83E-03	0.00E+00	0.00E+00	0.00E+00	2.38E+01
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.31E-04
Y-93	3.06E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-01
ZR-95	3.06E-02	7.45E-03	5.28E-03	0.00E+00	8.03E-03	0.00E+00	3.71E+00
ZR-97	4.31E-05	7.40E-06	3.38E-06	0.00E+00	7.46E-06	0.00E+00	4.72E-01
NB-95	2.81E+00	1.16E+00	6.70E-01	0.00E+00	8.31E-01	0.00E+00	9.78E+02
MO-99	0.00E+00	1.38E+03	2.69E+02	0.00E+00	2.06E+03	0.00E+00	4.55E+02
TC-99M	5.61E-04	1.16E-03	1.49E-02	0.00E+00	1.25E-02	6.05E-04	3.36E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	4.08E-02	0.00E+00	1.37E-02	0.00E+00	8.50E-02	0.00E+00	4.97E-01
RU-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-06	0.00E+00	8.25E-05
RU-106	8.40E-01	0.00E+00	1.05E-01	0.00E+00	9.94E-01	0.00E+00	6.38E+00
AG-110M	1.81E+03	1.32E+03	8.74E+02	0.00E+00	1.89E+03	0.00E+00	6.85E+04
TE-125M	8.48E+02	2.83E+02	1.15E+02	2.85E+02	0.00E+00	0.00E+00	4.04E+02
TE-127M	2.62E+03	8.69E+02	3.17E+02	7.57E+02	6.45E+03	0.00E+00	1.06E+03
TE-127	9.61E-02	3.22E-02	2.07E-02	7.82E-02	2.34E-01	0.00E+00	2.02E+00
TE-129M	3.05E+03	1.05E+03	4.70E+02	1.17E+03	7.63E+03	0.00E+00	1.82E+03
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	2.87E+01	1.16E+01	9.55E+00	2.34E+01	7.96E+01	0.00E+00	1.95E+02
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.41E+02	6.98E+01	6.51E+01	1.03E+02	4.36E+02	0.00E+00	2.58E+02
I-130	8.92E+00	1.96E+01	7.88E+00	2.20E+03	2.16E+01	0.00E+00	4.21E+00
I-131	3.07E+03	3.61E+03	1.59E+03	1.19E+06	4.22E+03	0.00E+00	1.29E+02
I-132	1.30E-05	2.64E-05	9.41E-06	1.24E-03	2.95E-05	0.00E+00	2.14E-05
I-133	6.99E+01	1.02E+02	2.98E+01	1.85E+04	1.20E+02	0.00E+00	1.72E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	4.23E-01	8.41E-01	3.07E-01	7.54E+01	9.38E-01	0.00E+00	3.04E-01
CS-134	1.55E+05	2.89E+05	2.92E+04	0.00E+00	7.43E+04	3.05E+04	7.84E+02
CS-136	1.05E+04	3.08E+04	1.15E+04	0.00E+00	1.23E+04	2.51E+03	4.67E+02
CS-137	2.32E+05	2.71E+05	1.92E+04	0.00E+00	7.27E+04	2.94E+04	8.47E+02
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	1.28E+03	1.28E+00	6.61E+01	0.00E+00	3.05E-01	7.88E-01	3.15E+02
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.05E-04	1.20E-04	3.09E-05	0.00E+00	0.00E+00	0.00E+00	1.41E+00
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	2.07E-01	1.26E-01	1.49E-02	0.00E+00	3.89E-02	0.00E+00	6.52E+01
CE-143	3.20E-03	2.12E+00	2.42E-04	0.00E+00	6.18E-04	0.00E+00	1.24E+01
CE-144	9.82E+00	4.02E+00	5.50E-01	0.00E+00	1.62E+00	0.00E+00	5.63E+02
PR-143	7.86E-03	2.94E-03	3.90E-04	0.00E+00	1.09E-03	0.00E+00	4.15E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	4.81E-03	4.94E-03	3.02E-04	0.00E+00	1.90E-03	0.00E+00	3.13E+00
W-187	5.55E-01	3.86E-01	1.33E-01	0.00E+00	0.00E+00	0.00E+00	2.27E+01
NP-239	2.51E-04	2.24E-05	1.27E-05	0.00E+00	4.47E-05	0.00E+00	6.48E-01

GASEOUS MONITOR DETECTOR EFFICIENCIES

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R15044 and R15045
(Detector Model RD-52)

Nuclide	Efficiency* cpm/μCi/cc
KR-83M	0.0
KR-85M	7.30 E+07
KR-85	7.19 E+07
KR-87	8.70 E+07
KR-88	8.70 E+07
KR-89	8.70 E+07
KR-90	8.70 E+07
XE-131M	0.0
XE-133M	0.0
XE-133	2.94 E+07
XE-135M	0.0
XE-135	7.75 E+07
XE-137	8.70 E+07
XE-138	8.70 E+07
AR-41	7.80 E+07

* From Calculation Z-RDM-I0261

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS

FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

	Dose to People†		Dose to Air‡	
	Gamma-Body	Beta-Skin	Gamma	Beta
Nuclide	K(i)	L(i)	M(i)	N(i)
AR-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03
KR-83M	7.56E-02	0.00E+00	1.93E+01	2.88E+02
KR-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
KR-85M	1.17E+03	1.46E+03	1.23E+03	1.97E+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-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
XE-133M	2.51E+02	9.94E+02	3.27E+02	1.48E+03
XE-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
XE-135M	3.12E+03	7.11E+02	3.36E+03	7.39E+02
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

† -- mrem/yr per $\mu Ci/m^3$

‡ -- mrad/yr per $\mu Ci/m^3$

ORGAN DOSE FACTORS FOR GASEOUS EFFLUENTS

DOSE FACTOR TABLE: R(i) - Adult, inhalation

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
FE-55	2.46E+04	1.70E+04	3.95E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.35E+04
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.59E+04	0.00E+00	8.88E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
CS-136	3.91E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
CS-137	4.79E+05	6.21E+05	4.28E+05	0.00E+00	2.23E+05	7.52E+04	8.40E+03
BA-140	3.91E+04	4.91E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.27E+03	3.62E+05	1.20E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05

DOSE FACTOR TABLE: R(i) - Teen, inhalation,

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
FE-55	3.35E+04	2.39E+04	5.55E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.67E+04
SR-89	4.35E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
ZR-95	1.46E+05	4.59E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
I-131	3.55E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
I-133	1.22E+04	2.05E+04	6.23E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
CS-134	5.03E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
CS-137	6.71E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
BA-140	5.47E+04	6.71E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
CE-144	4.89E+06	2.02E+06	2.63E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05

ORGAN DOSE FACTORS FOR GASEOUS EFFLUENTS (Continued)

DOSE FACTOR TABLE: R(i) - Child, inhalation

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.13E+03	1.13E+03	1.13E+03	1.13E+03	1.13E+03	1.13E+03
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
FE-59	2.07E+04	3.35E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.27E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.96E+05	1.63E+04
SR-89	6.00E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.44E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
I-131	4.81E+04	4.81E+04	2.73E+04	1.63E+07	7.88E+04	0.00E+00	2.84E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.31E+05	1.21E+05	3.85E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-144	6.77E+06	2.12E+06	3.62E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05

DOSE FACTOR TABLE: R(i) - Infant, inhalation

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
CR-51	0.00E+00	0.00E+00	8.95E+01	5.76E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.54E+04	4.99E+03	0.00E+00	4.99E+03	1.00E+06	7.06E+03
FE-55	1.97E+04	1.18E+04	3.33E+03	0.00E+00	0.00E+00	8.70E+04	1.10E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.03E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
I-131	3.80E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.85E+06	1.48E+05

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Instrument	Minimum Number of Channels Operable	Action
1. Gross Radioactivity Monitors Providing Automatic Termination of Release		
Retention Basin Effluent Discharge Monitor (R15017A)	1	With the monitor inoperable, effluent releases may be resumed provided that prior to initiating a release from the retention basin: 1) At least two independent samples are analyzed in accordance with Step 6.14.2. 2) 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 the pathway. Exert best efforts to return the monitor to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperable monitor was not restored in a timely manner.
2. Flow Measurement Devices		
Waste Water Flow Rate and Totalizer (FIRQ95108)	1	With the flow measurement device inoperable, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours during retention basin releases by a level device in the discharge stream.
Retention Basin Discharge Flow Rate (FI95001)	1	With the flow rate measurement device inoperable, effluent releases via this pathway may continue provided that the Retention Basin discharge flow rate is estimated using the Waste Water Flow Rate instrument.

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Instrument	Instrument Channel Check	Source Check	Instrument Channel Calibration	Channel Test
1. Gross Radioactivity Monitors Providing Alarm and Automatic Termination Isolation				
Retention Basin Effluent Discharge Monitor (R15017A)	D(1)	P	R(2)	Q(3)
2. Flow Monitors				
Waste Water Flow Rate and Totalizer (FIRQ95108)	D(4)	N/A	R	Q
Retention Basin Discharge Flow Rate (FI95001)	D(4)	N/A	R	Q

Table Notation

(1) During releases via this pathway, a check shall be performed at least once per 24 hours. Normally, checks are automatically performed once every eight (8) hours.

(2) The Instrument Channel Calibration for radioactivity measurement instrumentation shall be performed using one or more reference standards.

(3) The Channel Test shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exist:

A. Instrumentation indicates measured levels above the alarm/trip setpoint.

B. Circuit failure.

C. Instrument indicates a downscale failure.

D. Instrument controls not set in operate mode.

(4) The Instrument Channel Check shall consist of verifying indication of flow during periods of release. The Instrument Channel Check shall be made at least once daily on any day in which batch releases are made.

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity	Lower Limit of Detection (LLD)[a] (µCi/ml)
A. Retention Basin (N/S)[b]	Each Batch P	Each Batch P	Mn-54, Co-60, Zn-65, Cs-134, Cs-137, Ce-144	3.00 E-07
			H-3	1.00 E-05
B. Regenerant Holdup Tank (A/B)[c,d] Standard Release Scenario[f]	Each Batch P	Each Batch P	Mn-54, Co-60	4.00 E-09
			Zn-65	6.00 E-09
			Cs-134, Cs-137	3.00 E-09
			Ce-144	6.00 E-08
			H-3	1.00 E-05
	Each Batch P	Composite[e] M	Sr-90	1.00 E-09
			Gross Alpha	1.00 E-07
C. Regenerant Holdup Tank (A/B)[c,d] Rapid Release Scenario[f]	Each Batch P	Each Batch P	Mn-54, Co-60, Zn-65, Cs-134, Cs-137	2.00 E-08
			Ce-144	6.00 E-08
			H-3	1.00 E-05
	Each Batch P	Composite[e] M	Mn-54, Co-60	4.00 E-09
			Zn-65	6.00 E-09
			Cs-134, Cs-137	3.00 E-09
			Sr-90	1.00 E-09
			Gross Alpha	1.00 E-07

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
(Continued)

Table Notation

(a) 1. The Lower Limits of Detection (LLDs) for the radionuclides presented in this table are the smallest concentrations (expressed in microcuries per milliliter) which are required to be detected, if present, in order to achieve compliance with the limits of Step 6.14.3 (10 CFR 50, Appendix I) for a RHUT transfer to a retention basin and assurance of compliance with the limits of Step 6.14.2 (10 CFR 20, Appendix B, Table 2, Column 2) for a Retention Basin Discharge.

2. The LLD of a radioanalysis system is that value which will indicate the presence or absence of radioactivity in a sample when the probability of a false positive and of a false negative determination is stated. The probabilities of the false positive and false negative are taken as equal at 0.05. The general equation for estimating the maximum LLD in microcuries per milliliter is given by the following:

$$LLD = \frac{2.71/t_s + 3.29 \times S_b}{(3.70\ E+04)(Y \times E \times V)e^{(-\lambda t_c)}}$$

Where:

2.71 = factor to account for Poisson statistics at very low background count rates

3.29 = two times the constant used to establish the one sided 0.95 confidence interval

3.70 E+04 = disintegrations/second/microcurie

Y = yield of radiochemical process, i.e., the product of all factors such as emission fraction, chemical yield, etc.

E = counting efficiency (count/disintegrations)

V = sample volume (milliliters)

λ = the radioactive decay constant for the particular nuclide ($seconds^{-1}$)

t_c = the elapsed time from midpoint of collection to the midpoint of counting

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM (Continued)

Table Notation (Continued)

S_b = the standard deviation of the background counting rate

$$S_b = \left(\frac{B}{t_b t_s} + \frac{B}{t_b^2} \right)^{0.5}$$

Where:

B = background counts

t_b = background counting interval (seconds)

t_s = sample counting interval (seconds)

3. The LLD is defined as an a priori (before the fact) estimate and is not to be calculated for each sample analyzed on an a posteriori (after the fact) basis.

(b) A batch release is the discharge of liquid wastes of discrete volume from the north or south Retention Basin. The Retention Basins are the maximum permissible concentration accountability points for 10 CFR 20, Appendix B compliance.

(c) A RHUT will be isolated and its contents thoroughly mixed to assure representative sampling prior to transferring the contents to a Retention Basin. The A and B RHUTs are the dose equivalent accountability points for 10 CFR 50, Appendix I compliance.

(d) Isotopic peaks which are measurable and identifiable from a RHUT sample analysis shall be reported and included in ODCM evaluations. Nuclides which are not observed in the analysis shall be reported as "less than" the nuclide's a posteriori minimum detectable concentration and shall not be reported as being present. The "less than" results shall be considered "zero" for the purposes of ODCM evaluations; however, if a nuclide is measured and identified at a value less than the Attachment 15 LLD value, it shall be reported and entered in ODCM evaluations.

(e) A composite sample shall be obtained by mixing liquid aliquot volumes in proportion to the volume of liquid released from each RHUT. Preparation of the composite is identical no matter which release scenario, or combination of scenarios, was used to release the RHUTs. If any RHUT which is part of the composite was released using the Rapid Release Scenario, the composite will be analyzed according to the Rapid Release Scenario.

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM (Continued)

Table Notation (Continued)

(f) Release of each RHUT may proceed along either of two separate scenarios depending on operational requirements. Normally, the Standard Release Scenario will be used for RHUT releases. The Rapid Release Scenario will be used when operational requirements dictate expediting the release process. In either scenario, the sample must eventually be analyzed to an LLD level which equates to an off-site dose of less that 10 percent of the 10 CFR 50, Appendix I guidelines. Preparation of the Monthly Composite is independent of the scenario used to release each RHUT during a calendar month: the composite must be prepared for either scenario, only the analysis requirements differ. These Lower Limits of Detection for either or both scenario may change as the maximum annual effluent outflow or the minimum annual average flow rate in the plant effluent stream changes.

1. Standard Release Scenario. This scenario uses the lower LLDs on a pre-release basis, resulting in correspondingly longer analysis intervals. In this scenario, the monthly composite does not need to be analyzed for gamma emitters. The pre-release and post–release (monthly composite) LLDs equate to an off-site dose of less than 10 percent of the 10 CFR 50, Appendix I guidelines.

2. Rapid Release Scenario. This scenario allows the use of higher LLDs for pre-release dose calculations, resulting in correspondingly shorter analysis intervals. The pre-release LLDs equate to an off-site dose of less than 20 percent of the 10 CFR 50, Appendix I guidelines. The post–release (monthly composite) LLDs equate to an off-site dose of less than 10 percent of the 10 CFR 50, Appendix I guidelines. H-3 and Ce-144 analyses are specifically required only on a pre-release basis. The LLDs for H-3 and Ce-144 are required for the pre-release analysis only, however, these LLDs were included in the determination of post-release LLDs which meet the 10 percent criteria.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Instrument	Minimum Number of Channels Operable	Action
1. Reactor Building Stack		
a. Noble Gas Activity Monitor providing alarm and automatic termination of release.	1	With the monitor channel alarm/trip setpoint less conservative than the setpoint calculated as described in Step 6.6, immediately suspend the release or declare the channel inoperable. With the monitor inoperable, effluent releases via this pathway may continue provided grab samples are taken at least daily and these samples are analyzed in accordance with Attachment 18. Increase grab sample frequency as necessary during unusual plant conditions.
b. Particulate Sampler	1	With the collection device inoperable, effluent releases via this pathway may continue provided continuous samples are taken within 1 hour after the monitor is declared inoperable and these samples are analyzed in accordance with Attachment 18*.
c. Sampler Flow Rate Measurement Device	1	With the flow rate device inoperable, effluent releases via this pathway may continue provided the flow rate is estimated and recorded daily.

* Interruption of continuous sampling is allowed for periods not to exceed 1 hour.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Continued)

Instrument	Minimum Number of Channels Operable	Action
2. Auxiliary Building Stack		
a. Noble Gas Activity Monitor	1	With the monitor alarm/trip setpoint less conservative than the setpoint calculated as described in Step 6.6, immediately suspend the release or declare the channel inoperable. With the monitor inoperable, effluent releases via this pathway may continue provided grab samples are taken at least daily (every 12 hours during fuel handling activities) and these samples are analyzed in accordance with Attachment 18. Increase grab sample frequency as necessary during unusual plant conditions.
b. Particulate Sampler	1	With the collection device inoperable, effluent releases via this pathway may continue provided continuous samples are taken within 1 hour after the monitor is declared inoperable and these samples are analyzed in accordance with Attachment 18*.
c. Sampler Flow Rate Measurement Device	1	With the flow rate device inoperable, effluent releases via this pathway may continue provided the flow rate is estimated and recorded daily.

* Interruption of continuous sampling is allowed for periods not to exceed 1 hour.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Continued)

Instrument	Minimum Number of Channels Operable	Action
12→← 3. IOS Building Vent		
a. Particulate Monitor	1	With the monitor inoperable, ventilation flow shall be halted or continuous particulate samples shall be taken in accordance with Attachment 18, Section D, for particulate samples.

* Interruption of continuous sampling is allowed for periods not to exceed 1 hour.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Instrument	Instrument Channel Check	Source Check	Instrument Channel Calibration	Channel Test
1. Reactor Building Stack				
a. Noble Gas Activity Monitor	D	M(4)	R(3)	Q(1)
b. Particulate Sampler	W	NA	NA	NA
c. Sampler Monitor Flow Rate Measurement Device	D	NA	R	Q
2. Auxiliary Building Stack				
a. Noble Gas Activity Monitor	D	M	R(3)	Q
b. Particulate Sampler	W	NA	NA	NA
c. Sampler Monitor Flow Rate Measurement Device	D	NA	R	Q
12→← 3. IOS Building Vent				
a. Particulate Sampler	M	NA	R	SA

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS (Continued)

Table Notation

(1) The CHANNEL TEST shall also demonstrate that automatic termination of the purge and control room alarm annunciation occurs if any of the following conditions exist:

- Instrument indicates measured levels above the alarm/trip setpoint.
- Circuit failure.
- Instrument indicates a downscale failure.
- Instrument controls not set in operate mode.

(2) The CHANNEL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exist:

- Instrument indicate measured levels above the alarm/trip setpoint.
- Circuit failure.
- Instrument indicates a downscale failure.
- Instrument controls not set in operate mode.

(3) The INSTRUMENT CHANNEL CALIBRATION shall be performed using one or more reference standards.

(4) A check shall be performed prior to each release and monthly during periods of continuous purging.

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

12→

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/ml)
A. Reactor Building Stack	M Grab Sample	M	Kr-85	1.00 E-04
			H-3	1.00 E-06
	Continuous	M Particulate Sample	Principal Gamma Emitters[c]	1.00 E-11
	Continuous	M Particulate Sample	Gross Alpha[e]	1.00 E-11
			Sr-90[d]	1.00 E-11
	Continuous	Continuous (Noble Gas Monitor)	Noble Gases, Gross Beta and Gamma	1.00 E-04 as Xe-133
B. Auxiliary Building Stack	M[b] Grab Sample	M	Kr-85	1.00 E-04
			H-3	1.00 E-06
	Continuous	M Particulate Sample	Principal Gamma Emitters[c]	1.00 E-11
	Continuous	M Particulate Sample	Gross Alpha[e]	1.00 E-11
			Sr-90[d]	1.00 E-11
	Continuous	Continuous (Noble Gas Monitor)	Noble Gases, Gross Beta and Gamma	1.00 E-04 as Xe-133

←

Table Notation

(a) 1. The Lower Limits of Detection (LLDs) for the radionuclides presented in this table are the smallest concentration (expressed in microcuries per unit volume) which are required to be detected, if present, in order to achieve compliance with the limits of the Specifications in Steps 6.14.6, 6.14.7, and 6.14.8.

2. The LLD of a radioanalysis system is that value which will indicate the presence or absence of radioactivity in a sample when the probability of a false positive and of a false negative determination is stated. The probabilities of the false positive and false negative are taken as equal at 0.05. The general equation for estimating the maximum LLD in microcuries per milliliter is given by the following:

$$LLD = \frac{2.71/t_s + 3.29 \times S_b}{(3.70\,E+04)(Y \times E \times V)e^{(-\lambda t_c)}}$$

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM
(Continued)

Where:

2.71 = factor to account for Poisson statistics at very low background count rates

3.29 = two times the constant used to establish the one sided 0.95 confidence interval

3.70 E+04 = disintegrations/second/microcurie

Y = yield of radiochemical process, i.e., the product of all factors such as emission fraction, chemical yield, etc.

E = counting efficiency (count/disintegrations)

V = sample volume (milliliters)

λ = the radioactive decay constant for the particular nuclide ($seconds^{-1}$)

t_c = the elapsed time from midpoint of collection to the midpoint of counting

S_b = the standard deviation of the background counting rate

$$S_b = \left(\frac{B}{t_b t_s} + \frac{B}{t_b^2} \right)^{0.5}$$

Where:

B = background counts

t_b = background counting interval (seconds)

t_s = sample counting interval (seconds)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM (Continued)

Table Notation (Continued)

3. The LLD is defined as an a priori (before the fact) estimate and is not to be calculated for each sample analyzed on an a posteriori (after the fact) basis.

(b) Tritium grab samples shall be taken at least once per seven days from the ventilation exhaust from the auxiliary building stack anytime fuel is in the spent fuel pool and the pool temperature exceeds 110°F. Below 110°F there is essentially no evaporation from this source.

(c) Principal gamma emitters for which the LLD applies are: Kr-85 for gaseous samples and Mn-54, Co-60, Zn-65, Cs-134, Cs-137, and Ce-144 for particulate samples. This does not mean only these nuclides will be detected and reported. Other peaks that are measurable and identifiable shall be reported in the Annual Radioactive Effluent Release Report, pursuant to Step 6.15.1. All peaks which are measurable and identifiable shall be reported and entered into the ODCM evaluations. Nuclides which are not observed for the analysis shall be reported as "less than" the nuclide's a posteriori minimum detectable concentration and shall not be reported as being present. The "less than" results shall be considered "zero" for the ODCM evaluations; however, if a nuclide is measured and identified at a value less than the Attachment 18 LLD value, it shall be reported and entered into ODCM evaluations.

(d) A gross beta analysis is performed on a monthly basis for each environmental release particulate sample. If any one of these samples indicates greater than 1.0E-11 µCi/cc gross beta Sr-90 activity, then an analysis will be performed on those samples exceeding this value.

(e) A gross alpha analysis is performed on a monthly basis for each environmental release particulate sample. This fulfills the requirements of performing a monthly composite.

ODCM REVISION REVIEW REQUIREMENTS

ODCM REVISION REVIEW REQUIREMENTS

Whenever the ODCM is revised, no matter what the changes are, several reviews must be performed. These reviews must also be documented. The documentation is often included as an attachment to the 50.59 Safety Determination. This form lists the minimum reviews and documentation required for each change. Initial each requirement as it is completed. Sign the bottom of the form when all review requirements are completed.

Initials

I. Determination that the level of control of radioactive effluents is being maintained.

This determination is made by review of the following documents:

- 10 CFR 20.1301 and 20.1302
- 10 CFR 50.36a
- Appendix I to 10 CFR 50
- 40 CFR 190

_____

II. Determination that the change(s) will not adversely affect the accuracy or reliability of effluent dose calculations or effluent monitor setpoint determinations.

This determination is made by directly reviewing each change to the ODCM. Although each change must be evaluated, changes that directly involve calculations should be more carefully considered. _____

III. Supporting information.

Full justification including analyses and evaluations to support the change(s) must be included in the review and approval package. _____

IV. Notification of NRC.

The NRC is notified of all changes to the ODCM by including a complete, legible copy as part of, or concurrent with, the Annual Radioactive Effluent Release Report (ARERR). To ensure inclusion in the ARERR a CTS item should be initiated whenever the ODCM is revised. _____

V. Implementing Documents.

The following documents should be reviewed for impact whenever the ODCM is revised:

- CAP-0008, Offsite Releases of Radioactivity in Liquid Effluents
- CAP-0009, Offsite Releases of Radioactivity in Liquid Effluents
- CAP-0013, Preparation of the Annual Radioactive Effluent Release Report
- CHM-5107, Compositing of Liquid Samples
- CHM-5109, Effluent Monitor Alarm Response Procedure

_____

VI. Multidiscipline Review

Ensure all areas that may be affected by the revision, or have an interest in the changes made in the revision, are included in the multidiscipline review. Areas that are affected by the ODCM and could be included in this review are: Technical Services, Surveillance Scheduler, Quality Assurance, Licensing, and Operations. _____

All Reviews Complete: _____ _____
Reviewer Signature Date

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ATTACHMENT 2

SCOPE OF REVISION:

1. Changed default flow rate for Auxiliary Building Stack from 90,000 cfm to 66,000 cfm.
2. Update Partition Factor to refelct change in ABS flow rate.
3. In reference section, corrected year of Land Use Census from 1992 to 1998.
4. Corrected page numbering in Attachment 15.

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ATTACHMENTS

1.0 PURPOSE

The Off-site Dose Calculation Manual (ODCM) contains the methodology and parameters used in the calculation of off-site doses due to radioactive gaseous and liquid effluents. Also, the ODCM contains the methodology for determining effluent monitoring instrumentation alarm/trip setpoints. Methods are described for assessing compliance with the Technical Requirements in the ODCM as they apply to 10 CFR Parts 20.1301 and 20.1302, 10 CFR Part 50, Appendix I, and 40 CFR 190.10a for liquid and gaseous effluents. Additionally, the ODCM contains the Technical Requirements which provide the Specifications, Applicabilities, Actions, and Surveillance Requirements.

2.0 SCOPE

This procedure functions as a manual that provides the basis for development of detailed implementing procedures that address dose calculations for liquid/gaseous releases and monitor setpoints. Additionally, this manual provides the Technical Requirements that govern releases of liquid and gaseous radioactive releases off-site.

3.0 REFERENCES/COMMITMENT DOCUMENTS

3.1 Commitment Documents

3.1.1 Code of Federal Regulations, Title 10, Chapter 1, Parts 20, 50.36a and Part 50, Appendix I

3.1.2 Rancho Seco Permanently Defueled Technical Specifications (PDTS)

3.1.3 EPA 40 CFR Parts 302, 355 Reporting Requirements

3.1.4 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Plant Operations

3.2 Reference Documents

3.2.1 USNRC Regulatory Guide 1.109, Rev. 1, 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, October 1977

3.2.2 W. C. Burke, et. al., Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, NUREG-0133, USNRC:NRR, October 1978

3.2.3 ORNL, User's Manual for LADTAP II, NUREG/CR-1276, May 1980

3.2.4 D. L. Strange, et. al., LADTAP-II, Technical Reference and User Guide, NUREG/CR-4013, Pacific Northwest Laboratory, April 1986

3.2.5 Eckerman, K. F., et. al., User's Guide to GASPAR Code, NUREG-0597, USNRC:NRR, June 1980, in RSIC CCC-463

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

3.2.7 USNRC 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

3.2.8 USNRC Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants

3.2.9 REIMS Software Life Cycle Documents (Software Requirement Specification, Design Document, Acceptance Test Plan)

3.2.10 USNRC & Pacific Northwest Laboratory, TDMC Computer Code/Data Collections, XOQDOQ-82, Radiological Assessment Code System Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations

3.2.11 1998 Rancho Seco Land Use Census

3.2.12 RSNGS DSAR Chapters 11.1-11.5

3.2.13 RSNGS P&ID Drawing M-563, M-551, M-552

3.2.14 Pacific Northwest Laboratory, XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations

3.2.15 Congel, F. J., Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190), NUREG-0543, USNRC:NRR, February 1980

3.2.16 USNRC Generic Letter, 89-01, Dated January 31, 1989.

3.2.17 Rancho Seco REMP Manual

3.2.18 Engineering Calculation Z-RDM-I0279, Interim On-site Storage (IOS) Building Effluent Radiation Monitor (R15106) Setpoint Determination

3.2.19 PDQ 92-063

3.2.20 RP.312.I.14, Occupational Radiation Exposure Limits and Extensions

3.2.21 DQ 99-0061, 50.59 Rev. 1, Kurz probe flow out of tolerance.

3.2.22 DQ-99-0053, SP.625A failed due to excessive system flow.

4.0 DEFINITIONS

4.1 Member of the Public

Member of the Public means any individual except when that individual is receiving an occupational dose.

4.2 Occupational Dose

Occupational Dose means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.

4.3 Public Dose

Public Dose means the dose received by a Member of the Public from exposure to radiation and/or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. It does not include occupational dose or doses received from background radiation, as a patient from medical practices, or from voluntary participation in medical research programs.

4.4 Batch Release

A Liquid Batch Release for 10 CFR 50 Appendix I considerations is a transfer of a discrete volume of radioactive liquid from a RHUT to a retention basin. A Liquid Batch Release for 10 CFR 20 considerations is a transfer of a discrete volume of radioactive liquid from a retention basin to the Waste Water discharge canal (the Environmental Release Point).

A Gaseous Batch Release is the discharge of gaseous radioactive wastes of discrete volume. Batch releases for the gaseous pathway are no longer planned.

4.5 Continuous Release

A continuous radioactive gaseous release is the discharge of gaseous wastes of a non-discrete volume from a system that may have an input flow during the release. These include the Auxiliary Building Stack (ABS) and continuing Reactor Building purges.

Continuous radioactive liquid releases are not planned to be made from Rancho Seco Nuclear Generating Station (RSNGS).

4.6 Default Radionuclide Mix

A historical mixture of radionuclides that may be used to determine monitor setpoints.

4.7 Dilution Flow

The volume or volume rate of fluid (liquid or gas) which is added to a radiological release stream for the purpose of decreasing the instantaneous concentration of the stream.

4.8 Maximum Exposed (Hypothetical) Individual

The Maximum Exposed Individual is characterized as "maximum" with regard to food consumption, occupancy, and other usage or exposure pathway parameters in the vicinity of Rancho Seco that would represent an individual with habits greater than usually expected for the average of the population in general.

Maximum dose factor parameters will be determined using site specific data from the Land Use Census. If information needed to determine a parameter is not available, RG 1.109 parameters will be used. All dose factor parameters used are listed in Attachment 3.

4.9 RSNGS

Rancho Seco Nuclear Generating Station.

4.10 Site Boundaries

The Site Boundaries are defined by the drawings in Attachments 5 and 6.

4.11 Nuisance Pathways

(1) Secondary system gaseous pathways where the calculated dose totals contribute less than 5% of the annual limits and do not need to be tracked for dose calculational purposes unless secondary activity reaches a predetermined Action Level.

(2) Sources of trace levels of radioactivity in liquid effluents where the calculated dose totals contribute less than 1% of the annual limits and do not need to be tracked for dose calculational purposes. Trace levels are defined to be less than 1E-8 μCi/ml for the nuclides typically released from RSNGS. Examples include the oily water separator, plant effluent inlet, and storm drains.

4.12 Unplanned Release

The unexpected release of radioactive materials to unrestricted areas in gaseous and liquid effluent. All unplanned releases shall be discussed in the Annual Radiological Effluent Release Report (ARERR) to the NRC.

4.13 Miscellaneous Release

Release pathways which are considered planned but are not defined explicitly with monitoring requirements in this procedure. These pathways contribute a relatively small percentage (<5%) to the annual dose limits but shall be tracked for effluent activity accounting and dose calculation purposes. Miscellaneous releases shall not be reported in the ARERR as abnormal or unplanned releases. The IOS Building is an example of a Miscellaneous Release.

4.14 Safety Factor (SF)

A number greater than unity used in calculations to introduce greater conservatism (larger margin of safety) to offset various uncertainties in instrumentation and methods. Safety factors are set by Radiation Protection/Chemistry Supervision based on either analysis or professional judgment. Unless otherwise specified, the default value is two (2).

4.15 Liquid Effluent Radwaste Treatment System (LERTS)

The Liquid Effluent Radwaste Treatment System is a system designed to reduce the quantity of radioactive materials in liquid effluents by collecting liquid effluent and providing processing for the purpose of reducing the total radioactivity prior to its release to the environment.

4.16 Ventilation Exhaust Treatment System (VETS)

The Ventilation Exhaust Treatment System is the Reactor Building Purge Exhaust Filtering System and Auxiliary and Spent Fuel Building Filter Systems. These systems are designed and installed to reduce radioactive material in exhaust gases through HEPA filters for the purpose of removing 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 (ESF) atmospheric cleanup systems are not considered to be Ventilation Exhaust Treatment System components.

4.17 Instrument Surveillance

(1) Source Check

A source check is the qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.

(2) Channel Test

A channel test is the injection of an internal or external test signal into the channel to verify its proper response, including alarm and/or trip initiating action, where applicable.

(3) Instrument Channel Check

An instrument channel check is a verification of acceptable instrument performance by observation of its behavior and/or state; this verification includes comparison of output and/or state of independent channels measuring the same variable.

(4) Instrument Channel Calibration

An instrument channel calibration is a test, and adjustment (if necessary), to establish that the channel output responds with acceptable range and accuracy to known values of the parameter which the channel measures or an accurate simulation of these values. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip and shall be deemed to include the channel test.

4.18 Surveillance Intervals

The Surveillance Interval may be extended to a maximum of +25% to accommodate operations scheduling. The frequency notation (which follows the name of the Surveillance Interval in parenthesis) specified for the performance of Surveillance Requirements shall correspond to the Surveillance Intervals defined below.

(1) Shift (S): A time period covering at least once per twelve (12) hours.

(2) Daily (D): A time period spaced to occur at least once per twenty four (24) hours.

(3) Weekly (W): A time period spaced to occur at least once per seven (7) days.

(4) Monthly (M): A time period spaced to occur at least once per thirty one (31) days.

(5) Quarterly (Q): A time period spaced to occur at least once per ninety two (92) days.

(6) Semiannually (SA): A time period spaced to occur at least once per six (6) months.

(7) Annually (A): A time period spaced to occur at least once per twelve (12) months.

(8) Refueling Interval (R): A time period spaced to occur at least once per eighteen (18) months.

(9) Each Release (P): This surveillance will be completed prior to each release.

4.19 Radiological Effluent Information Management System (REIMS)

The computer software and database that tracks the volume and activity of released radioactive effluents. In addition, the software provides the basis for the permitting process, calculates dose to man, and summarizes data for inclusion into the ARERR.

4.20 Operable/Operability

A component or system is Operable when it is capable of performing it's intended function within the required range. The component or system shall be considered to have this capability when: (1) it satisfies the Specifications in Section 6.14, (2) it has been tested periodically in accordance with the Surveillance Requirement in Section 6.14 and has met its performance requirements, (3) the system has available its source of power, and (4) its required auxiliaries are maintained available and capable of performing their intended function.

5.0 RESPONSIBILITIES

5.1 Radiation Protection/Chemistry Superintendent

It is the responsibility of the RP/Chem Superintendent for the following:

1) ODCM Revisions and Reporting the Revisions in the Annual Radioactive Effluent Release Report (ARERR)
2) ARERR Preparation and Submittal
3) REIMS Database

4) LADTAP, GASPAR, and XOQDOQ Computer Program Verifications and Changes

5.2 PRC

The PRC is responsible for reviewing and accepting all changes to the ODCM with approval by the Plant Manager per Permanently Defueled Technical Specifications.

6.0 PROCEDURE

6.1 General Considerations

6.1.1 Liquid Effluent Pathways

Attachment 1 provides an information only simplified diagram of the liquid effluent produced by RSNGS. The liquid effluent discharge of RSNGS forms the headwaters of Clay Creek.

Dilution of the liquid effluent occurs off-site at the confluence of Clay and Hadselville Creeks, and of Hadselville and Laguna Creeks, and at the confluence of Laguna Creek and the Cosumnes River.

Planned radioactive liquid releases are directed through the A or B RHUTs to give reasonable assurance of compliance with 10 CFR 50 Appendix I prior to their discharge to the retention basins (North or South). Prior to discharge from the retention basins to the plant effluent (off-site), the discharge rate from the retention basins and the amount of dilution from Folsom South Canal are controlled to ensure compliance with the concentration requirements in 10 CFR 20.

6.1.2 Gaseous Effluent Pathways

Airborne radioactive material in the various rooms and systems at RSNGS is routed and discharged in airborne effluent as illustrated schematically in Attachment 2. The figure shows the functional arrangements of these streams, treatment and controls, radioactivity monitoring points, and effluent release points. Potential release pathways other than those specified in Attachment 2 have been identified. These release pathways are classified as NUISANCE pathways and include the following:

1) Tank Atmospheric Vents

Past experience has shown that the above release pathways do not contribute to the dose totals because of the small quantities released and the low concentration of radioactive materials. Therefore, Action Levels may be established for concentrations of radioactive material to trigger when the above routine gaseous effluent releases shall be evaluated for off-site dose impact. The Action Levels shall be based on levels that could contribute more than 5% to the most restrictive yearly dose limit. Action Levels shall be maintained through RSNGS procedures.

Unplanned releases shall be evaluated on a case by case basis.

The Interim On-site Storage (IOS) Building is a miscellaneous release.

6.1.3 Meteorological Data

The atmospheric dispersion (X/Q) and deposition (D/Q) factors used in calculations involving airborne effluent are conservative default values. The default X/Q value is 1.0E-4 sec/m^3, and the default D/Q value is 1.0E-6 m^{-2}. These factors should be used to determine monitor setpoints, assess compliance with the gaseous effluent requirements in Section 6.14, and calculate the gaseous effluent dose reported in the ARERR.

Attachment 4 contains dispersion and deposition factors calculated using actual meteorological data. These factors should not be used for dose calculations. They are presented for historical information only. The factors are based on a 10-year annual average of meteorological data taken from January 1978 to December 1987. The raw data was converted to X/Q and D/Q factors using the XOQDOQ computer program.

6.1.4 Boundaries

The Site Boundary for Gaseous Effluents as shown in Attachment 5 is for all calculations involving gaseous effluents. The Site Boundary for Liquid Effluents as shown in Attachment 6 is for all calculations involving liquid effluents. (Although the RHUTs are used as the dose accountability points for liquid effluents, the dose is considered to be received downstream of the boundary.)

6.1.5 40 CFR 190 Compliance

For the purposes of assessing compliance with 40 CFR 190, the MEMBER OF THE PUBLIC which received the most exposure may be determined using actual food consumption, actual occupancy rates, and dilution off-site from additional converging streams (verses assumptions used for a HYPOTHETICAL MAXIMUM EXPOSED INDIVIDUAL based on Land Use Census data).

6.1.6 Computers vs. Manual Calculations

Computer systems such as REIMS should be used for calculations in order to minimize error and hasten the release process. However, in the event computers are not available for calculations, manual pre-release calculations should be done based on the most historically restrictive receptor.

6.2 Liquid Monitor Setpoints

The High alarm setpoint for the Retention Basin Effluent Discharge Monitor (R15017A) is based upon preventing the limits of the Specification in Step 6.14.2 from being exceeded. When the high alarm level is reached, any effluent discharges in progress are terminated or diverted to the Retention Basins.

A SAFETY FACTOR is included in the setpoint calculations to incorporate a margin of conservatism.

When a batch release is not occurring or the calculated setpoint is so low that it will cause spurious alarms, the monitor setpoint should be set close to background without causing spurious alarms or as determined by Radiation Protection/Chemistry Supervision.

The conversion factor and setpoint calculations should be performed based on the same radionuclide mix.

6.2.1 Conversion Factors for R15017A

Provided here is the methodology to determine the conversion factor of counts per minute to microcuries per cubic centimeter for the Retention Basin Effluent Discharge Monitor (R15017A). The conversion factor is based on the monitor's efficiency for each nuclide and the abundance of the nuclide. The mix of isotopes used may be based on the historical mix provided in Attachment 7, current mix in the batch release, or as determined by Radiation Protection/Chemistry Supervision. The mix fraction shall be based on gamma emitting isotopes only.

The following equation shall be used to determine the conversion factor for R15017A:

$$CF = \left[\sum_i (f_i \times E_i)\right]^{-1}$$

Where:

$CF =$ µCi/cc per cpm

$f_i =$ Fraction of nuclide ***i*** to total activity of historical mix (Attachment 7) or batch mix

$E_i =$ Detector efficiency for nuclide ***i*** (cpm/µCi/cc) Attachment 8

6.2.2 High Alarm Setpoint for R15017A (µCi/ml)

$$\text{High Alarm } (\mu Ci / ml) = \frac{\sum_g C_g}{SF \times \sum_i \left(\frac{C_i}{MEC_i}\right)} + C_{bkgd}$$

Where:

C_g = The concentration of gamma-emitting nuclide ***g*** in µCi/ml.

C_i = The concentration of nuclide ***i*** in µCi/ml. This term includes non-gamma emitters

MEC_i = The MEC of radionuclide ***i*** from Appendix B to 10 CFR Part 20, Table 2, Column 2, in µCi/ml. The class with the most restrictive Effluent Concentration will be used for each isotope.

SF = A SAFETY FACTOR which may be applied to incorporate a margin of conservatism (SF ≥ 1). (Default = 2)

C_{bkg} = The background reading of the monitor (µCi/ml).

6.3 Maximum Effluent Concentrations in Liquid Effluents

The Maximum Effluent Concentration Fraction is calculated to determine compliance with 10 CFR 20 requirements and the Specification in Step 6.14.2. Radioactive liquid effluent discharges normally originate in the RHUTs and are discharged into a retention basin. Samples are collected and analyzed from each retention basin prior to discharge to ensure that compliance with the Specification in Step 6.14.2 can be achieved.

In addition, calculations to determine the minimum dilution water flow rate and maximum retention basin discharge flow rate to ensure compliance are provided in this section. Any combination of minimum dilution flow rate and maximum discharge flow rate which satisfy the Specification is acceptable.

6.3.1 Maximum Effluent Concentration Fraction (MECF)

Compliance with the Specification in Step 6.14.2 is anticipated when the MECF is less than or equal to 1.0. The MECF is calculated as follows:

$$MECF = \left[\sum_i \left(\frac{C_i}{MEC_i}\right)\right] \times \frac{F_r}{F_c + F_r}$$

Where:

MECF = The calculated fraction of Maximum Effluent Concentration in the radioactive liquid effluent discharged beyond the Site Boundary for Liquid Effluents (see Attachment 6).

C_i = The concentration (prior to dilution) of radionuclide *i* in the batch of liquid effluent in μCi/ml.

MEC_i = The MEC of radionuclide *i* from Appendix B to 10 CFR Part 20, Table 2, Column 2, in μCi/ml. The class with the most restrictive Effluent Concentration will be used for each isotope.

F_r = Discharge flow rate; the flow rate of the radioactive liquid batch release from the retention basin to the Waste Water Discharge Canal (Plant Effluent) in gpm.

F_c = The total available dilution water (Plant Effluent) flow rate at the time of discharge of the radioactive liquid effluent in gpm.

NOTE

$SF \times \Sigma_i(C_i/MEC_i)$ must be ≥ 1.0

6.3.2 Minimum Dilution Water Flow Rate (F_{cmin})

The minimum dilution water (Plant Effluent) flow rate (F_{cmin}) is calculated as follows:

$$F_{c_{min}} = F_r \times \left[\left(SF \times \sum_i \left\{ \frac{C_i}{MEC_i} \right\} \right) - 1 \right]$$

Where:

F_r = A fixed effluent discharge flow (gpm) (as required by specific release restrictions).

SF = A factor which may be applied to incorporate a margin of conservatism ($SF \geq 1$).

NOTE

$SF \times \Sigma_i(C_i/MEC_i)$ must be ≥ 1

6.3.3 Maximum Effluent Discharge Flow Rate (F_{rmax})

The maximum effluent discharge flow rate (F_{rmax}) is calculated as follows:

$$F_{r_{max}} = \frac{F_c}{\left[SF \times \sum_i \left(\frac{C_i}{MEC_i} \right) \right] - 1}$$

Where:

F_c = A fixed dilution water flow rate (gpm) (as required by specific release restrictions).

6.4 Liquid Dose Calculations

This section provides the methodology to demonstrate compliance with the Specification in Step 6.14.3.

Site specific organ dose factors for liquid effluents have been determined for the MAXIMUM EXPOSED INDIVIDUAL and are listed in Attachment 9. Dose factors (A_{ijap}) were derived using equations and methods in Regulatory Guide 1.109, Rev. 1 and LADTAP. The dose factor parameters used are listed in Attachment 3. As previously stated, site specific parameters should be used based on the Land Use Census in lieu of the values provided in RG 1.109 whenever possible.

The exposure pathways included in the A_{ijap} are those identified by the Land Use Census. The pathways considered for inclusion are:

- fresh water fish
- fresh water invertebrate
- river shoreline deposits
- milk from cows that eat fresh or stored forage irrigated with Clay Creek water
- meat from cows that eat fresh or stored forage irrigated with Clay Creek water
- vegetation

6.4.1 Liquid Effluent Dose Equation

$$D_{aj} = \frac{\sum_i \sum_p (Q_i \times A_{ijap})}{F}$$

Where:

D_{aj} = Annual calculated dose (50 year dose commitment) to the organ (or total body) ***j*** of a maximally exposed individual of age group ***a*** (mrem/yr).

Q_i = Activity of isotope ***i*** released during the year (Ci/yr).

A_{ijap} = Site specific dose factor for an organ (or total body) ***j*** for a person of age group ***a*** via pathway ***p*** due to isotope ***i*** (mrem-ft^3/Ci-sec).

F = Annual average discharge volumetric flow rate (effluent water plus dilution water) in ft^3/sec.

Because the dose rate varies linearly with activity release rate, the dose for a shorter period of time (mrem) may be calculated by substituting the activity released (Ci) during that period for Q_i in the above equation. However, volumetric flow rates should not be averaged over a period less than a calendar quarter. More conservative flow rates are acceptable.

6.5 Liquid Dose Projections

31-day dose projections are calculated to show compliance with the Specification in Step 6.14.4. Quarterly and Annual dose projections are calculated in compliance with the Specification in
Step 6.14.11.

The following equations shall be used:

31-Day Projection:

$$D_{p31} = 31 \times \frac{D_{Yr}}{t_{Yr}}$$

Quarterly Projection:

$$D_{pQtr} = 91.3 \times \frac{D_{Qtr}}{t_{Qtr}}$$

Yearly Projection:

$$D_{pYr} = 365.25 \times \frac{D_{Yr}}{t_{Yr}}$$

Where:

D_{p31} = 31-day dose projection.

D_{Yr} = Cumulative annual dose to date.

t_{Yr} = Number of days into the year.

D_{pQtr} = Quarterly dose projection.

D_{Qtr} = Cumulative quarterly dose to date.

t_{Qtr} = Number of days into the quarter.

D_{pYr} = Annual dose projection.

6.6 Gaseous Monitor Setpoints

This step does not apply to the IOS Building vent monitor (R15106). The calculations used to determine the setpoints for this monitor are contained in Reference 3.2.18.

The Gaseous Effluent Radiation Monitors have the capability to monitor gaseous effluents over three general ranges (high, middle and low) using four channels. In the permanently defueled mode, the middle and high ranges (Channels 2 and 3) are no longer necessary, and are no longer used or maintained. Channels 1 and 4 both operate in the low range and are the monitor channels which are considered in this procedure.

The Specification in Step 6.14.5 states that the gaseous effluent monitors shall have their alarm/trip setpoints set to ensure the limits of the Specification in Step 6.14.6 are not exceeded. The conservative default atmospheric dispersion (X/Q) factor from Step 6.1.3 is used. Compliance with the dose rate limits for noble gases specified in Step 6.14.6 is demonstrated by setting each gaseous effluent monitor alarm/trip setpoint so that an alarm/trip will occur at or before the dose rate limit is reached.

A SAFETY FACTOR is included in the setpoint calculations to incorporate a margin of conservatism.

Maximum design flow rates for each release point will be used to calculate setpoints.

6.6.1 Conversion Factors for R15044 and R15045

Provided here is the methodology to determine the conversion factor of counts per minute to microcuries per cubic centimeter for the Auxiliary Building Stack Monitor (R15045) and Reactor Building Stack Monitor (R15044). The conversion factor is based on the monitor's efficiency of detection for each nuclide and the mix of the nuclide. The mix of isotopes used should be based on Kr-85, but may be based on the current mix in the continuous release, or as determined by Radiation Protection/Chemistry Supervision. The mix used for setpoint calculations and conversion factor calculations should be the same.

The following equation shall be used to determine the conversion factor for R15044 and R15045:

$$CF = \left[\sum_i (f_i \times E_i)\right]^{-1}$$

Where:

CF = µCi/cc per cpm

f_i = Fraction of nuclide *i* to total activity of the mix used

E_i = Detector efficiency for nuclide *i*, in cpm per µCi/cc, Attachment 10

6.6.2 Gaseous Effluent Flow Rates

Flow rates used in routine gaseous effluent calculations for the pathways listed below are conservative default values. These flow rates should be used to determine monitor setpoints, assess compliance with the gaseous effluent requirements in Section 6.14, and calculate the gaseous effluent dose reported in the ARERR.

Gaseous effluent release points and maximum design flow rates used at RSNGS are as follows:

Reactor Building Stack	74,000	CFM
Auxiliary Building Stack	66,000	CFM
Interim On-site Storage Building Ventilation*	8,050	CFM

* The Interim On-site Storage (IOS) Building is not subject to continuous discharges of radioactivity. Because of the infrequency of a radioactive release, assessment will be done on each release according to administrative procedures.

6.6.3 Determination of Partition Factor (P_v)

The Specification in Step 6.14.6 applies to the entire site, not just one vent or monitor. Consequently, the total release rate must be partitioned among the two major vents (ABS & RBS). For routine operations, the partition factor may be calculated by assuming that the effluent concentration is the same for all pathways and using a ratio of flow rates.

The total volume flow rate for the two vents is 140,000 CFM. Therefore:

$$P_{rbs} = \frac{74{,}000\ \text{CFM}}{140{,}000\ \text{CFM}} = 0.53$$

$$P_{abs} = \frac{66{,}000\ \text{CFM}}{140{,}000\ \text{CFM}} = 0.47$$

Radiation Protection/Chemistry Supervision may elect to use a different set of partition factors based on plant conditions. However, the sum of all the partition factors for the site must be less than or equal to unity (1).

6.6.4 Channel 4 Noble Gas Setpoint for R15044 and R15045 in µCi/sec

$$M_V = \frac{3000 \times P_V \times \sum_i C_i}{SF \times (X/Q) \times \sum_i \left[C_i \times (L_i + 1.1 \times M_i) \right]} + \text{Bkgd}$$

Where:

M_v	=	Monitor setpoint for vent *v* (i.e., RBS or ABS) in µCi/sec
3000	=	Step 6.14.6 Specification limit for skin dose rate in mrem/yr
P_v	=	Partition factor for vent *v*, dimensionless, which distributes the total site release rate among the two vents
C_i	=	Concentration of isotope *i* in gaseous effluent in µCi/cc. The mix of isotopes used may be based on Kr-85, the current mix, or as determined by Radiation Protection/Chemistry Supervision.
SF	=	Safety Factor, dimensionless, (SF ≥ 1)
X/Q	=	A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.
L_i	=	A factor converting gamma radiation from noble gas radionuclide *i* to skin dose (mrem–m^3/µCi–yr). See Attachment 11.
M_i	=	A factor converting gamma radiation from noble gas radionuclide *i* to air dose (mrad–m^3/µCi–yr). See Attachment 11.
Bkgd	=	Monitor background reading in µCi/sec

6.6.5 Channel 1 Noble Gas Setpoint for R15044 and R15045 in µCi/cc

$$MC_v = \frac{MR_v}{472 \times F_v} + Bkgd$$

Where:

MC_v = Monitor setpoint for vent *v* based on concentration in µCi/cc

MR_v = Monitor setpoint for vent *v* based on release rate in µCi/sec excluding the background term. That is, M_v – Bkgd

F_v = Maximum design volumetric flow rate for vent *v* in CFM as indicated in Step 6.6.2.

472 = 28317 ml/ft^3 * 1 min/60 sec

Bkgd = Monitor background reading in µCi/cc

NOTE

Channel 1 does not cause any automatic terminations or audible alarms.

6.7 Maximum Effluent Concentrations (MECs) in Gaseous Effluents

In order to demonstrate compliance with 10 CFR 20.1301, which requires that the total MEC fraction not exceed 1 when averaged over an entire year, the calculation is included in the Annual Radioactive Effluent Release Report. In addition, a four hour reporting requirement exists when the total MEC fraction exceeds 20 when averaged over one hour per 10 CFR 50.72. The following provides guidance on how to perform this calculation.

Maximum Effluent Concentration Fraction (MECF) Equation

$$MECF = \sum_i \left(\frac{C_i}{MEC_i} \right) \times F \times 4.72E\text{-}4 \times X/Q \times TR$$

Where:

C_i = The concentration of nuclide ***i*** in mCi/cc.

F = Maximum design volumetric flow rate in CFM as indicated in 6.6.2.

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

MEC_i = The MEC for nuclide ***i*** from Appendix B to 10 CFR Part 20, Table 2, Column 2 (µCi/cc). The class with the most restrictive Effluent Concentration will be used for each isotope.

TR = If the time of release is less than one hour, then this value is the duration of the transient in minutes divided by sixty. Otherwise, the Time Ratio (TR) is one. Dimensionless.

4.72E-4 = The conversion factor in $min*m^3/sec*ft^3$.

6.8 Dose Rate Calculations

Compliance with the dose rate limits for noble gases in the Specification in Step 6.14.6 is demonstrated by setting each gaseous effluent monitor alarm setpoint so that an alarm will occur at or before either dose rate limit Specification in Step 6.14.6 is reached. In addition, the Specification in Step 6.14.6 provides a maximum limit on organ dose rate equivalent beyond the Site Boundary for Gaseous Effluents from tritium and all radioactive materials in particulate form with half-lives greater than 8 days. Compliance is determined by calculating the organ dose rate for the MAXIMUM EXPOSED INDIVIDUAL for the inhalation pathway only.

The dose rate due to noble gas is evaluated as follows:

Total Body:

$$\dot{D}_{tb} = (X/Q) \times \sum_{v}\sum_{i}\left(Q_{vi} \times K_i\right)$$

Skin:

$$\dot{D}_{s} = (X/Q) \times \sum_{v}\sum_{i}\left[Q_{vi} \times \left(L_i + 1.1M_i\right)\right]$$

Where:

D_{tb} = The total body dose rate from noble gases (mrem/yr)

D_s = The skin dose rate from noble gases (mrem/yr)

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

Q_{vi} = The release rate of noble gas radionuclide ***i*** from effluent vent ***v*** during the time of the release (μCi/sec)

K_i = A factor converting time integrated, ground-level concentration of noble gas radionuclide ***i*** to total body dose from its gamma radiation ($mrem–m^3/\mu Ci$-yr). See Attachment 11.

L_i = A factor converting gamma radiation from noble gas radionuclide ***i*** to skin dose ($mrem-m^3/\mu Ci$-yr). See Attachment 11.

M_i = A factor converting gamma radiation from noble gas radionuclide ***i*** to air dose ($mrad-m^3/\mu Ci$-yr). See Attachment 11.

1.1 = A factor converting air dose from gamma radiation to skin dose equivalent (mrem/mrad)

The organ dose rate resulting from inhalation is calculated with the equation:

Organ:

$$\dot{D}O_{aj} = (X/Q) \times \sum_{v}\sum_{i}\left(Q_{vi} \times R_{aji}\right)$$

Where:

DO_{aj} = The dose commitment rate to organ ***j*** of a person in age group ***a*** (mrem/yr)

R_{aji} = The factor to convert air concentration of radionuclide ***i*** to organ ***j*** dose commitment rate of a person in age group ***a*** exposed by inhalation (mrem-m^3/μCi-yr). See Attachment 12.

Q_{vi} = The release rate of radionuclide ***i*** (not including Noble Gas nuclides), via effluent vent ***v*** during the time of the release (μCi/sec)

Exposure to dose rate factors, R_{aji}, for inhalation are derived by using equation 13 in RG 1.109, Rev. 1. Tables E-5, E-7, E-8, E-9, and E-10 are assumed to represent the Maximum Exposed Individual in the equation to derive R_{aji}.

6.9 Air Dose Calculations

The Surveillance Requirement in Step 6.14.7 requires cumulative dose to air from radioactive effluent noble gases to be determined in order to assess compliance with the Specification in Step 6.14.7. The air dose is evaluated in the sector of the maximum exposure at or beyond the Site Boundary for Gaseous Effluent.

Air dose from noble gas gamma radiation is calculated cumulatively with the equation:

$$D_g = 3.17E\text{-}8 \times \sum_{v}\left[(X/Q) \times \sum_{i}\sum_{n}(Q_{vni} \times M_i)\right]$$

Air dose from noble gas beta radiation is calculated cumulatively with the equation:

$$D_b = 3.17E\text{-}8 \times \sum_{v}\left[(X/Q) \times \sum_{i}\sum_{n}(Q_{vni} \times N_i)\right]$$

Where:

D_g = The noble gas gamma dose to air (mrad)

D_b = The noble gas beta dose to air (mrad)

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

M_i = A factor converting ground-level concentration to gamma radiation from noble gas radionuclide ***i*** to air dose (mrad-m^3/μCi-yr)

N_i = A factor converting ground-level concentration to beta radiation from noble gas radionuclide ***i*** to air dose (mrad-m^3/μCi-yr)

Q_{vni} = The quantity of each noble gas radionuclide ***i*** in batch ***n*** released via effluent stream ***v*** (μCi)

3.17E-8 = 1 yr/3.156E+7 sec

Factors M_i and N_i are 10^6 pCi/μCi times the values in RG 1.109, Rev. 1, Table B-1, Columns 4 and 2, respectively. The computer codes GASPAR and REIMS may be used to perform these calculations.

6.10 Organ Dose Calculations for Gaseous Effluents

The Surveillance Requirement in Step 6.14.8 requires the radiation dose or dose commitment to the Maximum Exposed (Hypothetical) Individual accumulated from exposure to tritium and radioactive materials in particulate form having half-lives greater than 8.0 days, that originate in effluent air, be determined at least every month. The radiation dose or dose commitment accumulated during a calendar quarter and a year may not exceed values stated in the Specification in Step 6.14.8.

A person may be exposed to effluent radioactive material of this type in air by inhalation or indirectly via environmental pathways that involve deposition onto vegetation and the ground. The exposure pathways evaluated will include the following:

p	Exposure Pathway
1	Air – inhalation
2	Deposition onto ground - irradiation
3	Deposition onto vegetation - ingestion
4	Deposition onto forage - cow - milk - ingestion
5	Deposition onto forage - meat animal - meat - ingestion
6	Deposition onto forage - goat - milk - ingestion

The equation used to calculate the dose commitment to the Maximum Exposed (Hypothetical) Individual from radionuclides other than tritium is:

$$D_{aj} = \sum_{p=1}\left[(X/Q)_p \times \sum_v \sum_i \left(Q_{vi} \times R_{ajip}\right)\right] + \sum_{p=2}^{6}\left[(D/Q)_p \times \sum_v \sum_i \left(Q_{vi} \times R_{aijp}\right)\right]$$

Where:

p = 1, i.e., air-inhalation, in the first term, and p = 2, 3, 4, 5, and 6 in the second term of the equation

i excludes H-3

D_{aj} = The dose commitment to organ ***j*** of a person in age group ***a*** (mrem)

Q_{vi} = The quantity of each radionuclide ***i***, in particulate form having a half-life greater than 8.0 days, in air discharged via effluent stream ***v*** (μCi)

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

D/Q = A conservative default deposition factor. A Factor converting a ground-level or building wake discharge in air to deposition on land (m^{-2}). The D/Q value in Step 6.1.3 will be used.

R_{ajip} = A factor converting time integrated concentration of radionuclide ***i*** in air or deposited on vegetation and/or ground to radiation dose commitment to organ ***j***, including total body, of a person in age group ***a*** who is exposed via pathway ***p***.

When p=1, representing air-inhalation, R_{ajip} has units of mrem-m^3/μCi-yr. When p=2,3,4,5 or 6 in the second term of the equation above, representing pathways involving deposition, R_{ajip} has units of mrem-m^2-sec/yr-μCi. When the radionuclide is H-3, R_{ajip} has units of mrem-m^3/μCi-yr.

Tritium is assumed not to deposit onto vegetation or the ground. Hence, the concentration in vegetation is assumed to be related to the local atmospheric concentration as described in RG 1.109, Rev. 1, Appendix C. The dose commitment to the Maximum Exposed (Hypothetical) Individual from tritium in gaseous effluent is calculated with the equation:

$$D_{aj} = 3.17E-8 \times \sum_{p}\left[(X/Q)_p \times \sum_{v}\left(Q_{vi} \times R_{ajip}\right)\right]$$

Where:

p = 1, 3, 4, 5, and 6

i includes H-3 only

X/Q = A conservative default atmospheric dispersion factor for a ground level release to a sector at or beyond the Site Boundary for Gaseous Effluents in sec/m^3. The default value in Step 6.1.3 will be used.

3.17E-8 = years/sec

Other terms as defined above.

Dose factors R_{ajip} for RSNGS are derived using the equations and methods in RG 1.109, Rev. 1, Appendix C. Values of parameters in RG 1.109, Rev. 1, Table E-5 are assumed to represent the Maximum Exposed (Hypothetical) Individual unless Land Use Census data justify a different value. Any different values from default values will be justified and added as a table to the ODCM. Values of other parameters recommended in RG 1.109, Rev. 1, including those recommended in the absence of site-specific data, are used in the equations to derive the dose factors. (GASPAR or REIMS may be used to perform the calculations.)

6.11 Gas Dose Projections

31-Day Dose projections are calculated to show compliance with Step 6.14.9. Quarterly and Annual dose projections are calculated in compliance with the Specification in Step 6.14.11. The dose projection equations are the same as used for liquid per Step 6.5.

6.12 Fuel Cycle Dose

If a calculated dose exceeds twice the limit of the Specification in Step 6.14.3, 6.14.7, 6.14.8, or a level in Table 3 of the REMP Manual is exceeded, an assessment of compliance with the Specification in Step 6.14.10 must be made.

Liquid dose calculations shall be made using the general methodology of Step 6.4. Gas dose calculations shall be made using the general methodology of Steps 6.9 and 6.10. These methodologies are to be used as a guide and strict adherence is not required because the Fuel Cycle Dose Calculation is done to determine the actual dose received, not a hypothetical maximum. Therefore, parameters such as dilution beyond the site boundary and residential shielding may be factored into the calculation.

The total body and organ doses shall be the result of summing the individual contributions from liquid, gas, and direct radiation sources for the affected Member of the Public.

Irradiation, i.e., exposure to an external source of radiation, directly from the RSNGS normally will be evaluated with the aid of environmental monitoring dosimetry.

6.13 EPA Reporting Requirements

If a calculated dose exceeds the Specification limit of Step 6.14.2, 6.14.3, 6.14.6, 6.14.7, or 6.14.8, an assessment of compliance with 40 CFR Parts 302 and 355, Reportable Quantity Adjustment - Radionuclides, must be made.

This involves determining the maximum quantity of radionuclides released in a 24 hour period and comparing the quantities to the values listed in 40 CFR 302 Appendix B. The "sum of the ratios" method shall be used to determine compliance. If the "sum of the ratios" is greater than one, the National Response Center shall be notified.

Since Rancho Seco's systems and procedures are set up to normally operate within the above limits, this condition is not expected to occur, therefore, specific implementation procedures to determine compliance are not required.

6.14 Technical Requirements

6.14.1 Liquid Effluent Monitoring Instrumentation

Specifications:

The radioactive liquid effluent monitoring instrumentation channels shown in Attachment 13 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of
Step 6.14.2 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with Step 6.2.

Applicability:

During releases via the retention basin effluent discharge.

Action:

1) With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits of
Step 6.14.2 are met, immediately suspend the release of radioactive effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

2) With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the Action shown on Attachment 13.

Surveillance Requirements:

1) The maximum setpoint shall be determined in accordance with methodology as described in Step 6.2 and shall be recorded on the release permits.

2) Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the INSTRUMENT CHANNEL CHECK, SOURCE CHECK, INSTRUMENT CHANNEL CALIBRATION, AND CHANNEL TEST at the frequencies shown in Attachment 14.

3) Records shall be maintained in accordance with the Process Standards of all radioactive liquid effluent monitoring instrumentation alarm/trip setpoints. Maximum setpoints and calculations shall be available for review to ensure that the limits of Step 6.14.2 are met.

Bases:

During continuing operations leading to decontamination and decommissioning of the site, radioactively contaminated water will be processed, as necessary, to remove the activity according to the Process Control Program (PCP). After being processed as necessary, the water may be transferred to the 'A' and 'B' Regenerant Holdup Tanks (RHUTs). Pathways for water to reach the RHUTs are shown in Attachment 1, Liquid Effluent Flow Diagram. Administrative controls provide reasonable assurance that any waste water that is radioactive is processed through the RHUTs prior to their release.

Water which is in the 'A' and 'B' RHUTs is transferred to the North or South Retention Basin. The water in a Retention Basin is released off-site as a batch release. These releases are monitored by the Retention Basin Effluent Discharge Monitor.

Radioactive liquid effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of radioactive liquid effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the methodology contained in this manual to ensure that the alarm/trip will occur prior to exceeding the limits of Step 6.14.2. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

6.14.2 Maximum Effluent Concentrations in Liquid Effluents

Specifications:

The concentration of radioactive material released in liquid effluents at any time beyond the Site Boundary for Liquid Effluents (see Attachment 6) shall be limited to the concentrations specified in Appendix B to 10 CFR Part 20, Table 2, Column 2.

Applicability:

This is applicable at all times.

Action:

With the concentration of radioactive material released from the site to areas beyond the Site Boundary for Liquid Effluents exceeding the above Specifications, immediately restore concentration within the required limits and report the event in the next Annual Radioactive Effluent Release Report.

Surveillance Requirements:

The concentration of radioactive material at any time in liquid effluents released from the site to areas beyond the Site Boundary for Liquid Effluents shall be continuously monitored in accordance with Attachment 13.

The liquid effluent continuous monitor having provisions for automatic termination of liquid releases, as listed in Attachment 13, shall be used to limit the concentration of radioactive material released at any time from the site to areas beyond the Site Boundary for Liquid Effluents to the limits given in the above Specifications.

The radioactivity concentration of each Retention Basin to be discharged shall be determined prior to release by sampling and analysis in accordance with Attachment 15, Item A. The results of Retention Basin pre-release sample analyses shall be used with the calculational methods described in Step 6.3 to ensure that the concentration at the point of release is within the limits of the above Specification.

Bases:

This Specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site to areas beyond the Site Boundary For Liquid Effluents (see Attachment 6) will be less than the concentration levels specified in Appendix B to 10 CFR Part 20, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will result in exposures within the limits of 10 CFR Part 20.1301 to a MEMBER OF THE PUBLIC.

There are no continuous releases of radioactive material in liquid effluents from the plant. All radioactive liquid effluent releases from the plant are by batch method.

6.14.3 Liquid Dose Calculations

Specifications:

The dose or dose commitment to a MAXIMUM EXPOSED (HYPOTHETICAL) INDIVIDUAL from radioactive materials in liquid effluents released beyond the Site Boundary for Liquid Effluents (see Attachment 6) shall be limited to:

1) Less than or equal to 1.5 mrem to the total body and to less than or equal to 5.0 mrem to any organ during any calendar quarter; and,

2) Less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ during any calendar year.

Applicability:

At all times.

Action:

With the calculated dose or dose commitment from the release of radioactive materials in liquid effluents exceeding any of the above Specifications, prepare and submit to the Commission within 30 days a Special Report. This Report will identify the cause(s) for exceeding the limit(s) and define the corrective actions to be taken to reduce the releases of radioactive material in liquid effluents and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above Specifications.

Surveillance Requirements:

Cumulative dose assessments associated with the release of radioactive liquid effluent shall be determined by sampling and analysis in accordance with Attachment 15, Item B or Item C, and calculations performed in accordance with the methodology described in
Step 6.4 at the following frequencies:

1) Prior to the initiation of a release of radioactive liquid effluent from the A or B RHUT; and,

2) Upon verification of monthly composite analysis results for radioactive liquid effluent released from the A and B RHUTs.

A dose tracking system and administrative dose limits shall be established and maintained. With the 31-day dose projection in excess of the limits in Step 6.14.4, adjust liquid effluent operating parameters to give reasonable assurance of compliance with the dose limits of this Specification (10 CFR 50, Appendix I dose guidelines) and maintain radioactive liquid releases as low as is reasonably achievable.

Bases:

ODCM Step 6.14.3 is provided to implement the requirements of Sections II.A, III.A, and IV.A of Appendix I, 10 CFR Part 50. This step implements the guides set forth in Section II.A of 10 CFR 50, 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 10 CFR 50, Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable." The dose calculation methodology in this manual implement the requirements in Section III.A of 10 CFR 50, Appendix I that conformance with the guides of 10 CFR 50, Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The equations specified in this manual 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. There is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in finished drinking water that are in excess of the requirements of 40 CFR 141.

The Lower Limits of Detection established in Attachment 15, Item B are based on an estimated maximum annual effluent outflow of 2 million gallons with a minimum annual average flow rate in the plant effluent stream of 6,000 gallons per minute. The RHUT pre-release and monthly composite Lower Limits of Detection equate to an off-site dose of less than 10 percent of the 10 CFR 50, Appendix I guidelines. These Lower Limits of Detection, along with the dose tracking system, give reasonable assurance that the dose limits prescribed in ODCM Step 6.14.3 (the 10 CFR 50, Appendix I dose guidelines) will be met.

6.14.4 Liquid Effluent Radwaste Treatment

Specifications:

The LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM shall be OPERABLE. The appropriate portions of the system shall be used to reduce the quantity of radioactive materials in liquid effluents prior to their discharge when projected doses due to the liquid effluent beyond the Site Boundary for Liquid Effluents (see Attachment 6), when averaged over 31 days, would exceed 0.25 mrem to the total body or 0.83 mrem to any organ (8.33% of the 10 CFR 50, Appendix I annual guidelines).

Applicability:

At all times.

Action:

With the LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM inoperable for more than 31 days or with radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days a Special Report which 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; and,

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:

Doses due to liquid releases to areas beyond the Site Boundary for Liquid Effluents shall be projected prior to each RHUT release in accordance with the methodology described in Step 6.5 when LIQUID EFFLUENT RADWASTE TREATMENT SYSTEMS are not being fully utilized. The installed LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM shall be considered OPERABLE by meeting the Specifications in Steps 6.14.2 and 6.14.3.

Bases:

The OPERABILITY of the LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used, when specified, provides reasonable assurance that the releases of radioactive materials in liquid effluents are maintained "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 objectives given in Section II.D of Appendix I to 10 CFR 50. The specified limits governing the use of appropriate portions of the LIQUID EFFLUENT RADWASTE TREATMENT SYSTEM are the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

6.14.5 Gaseous Effluent Monitoring Instrumentation

Specifications:

The radioactive gaseous effluent monitoring instrumentation channels shown in Attachment 16 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Step 6.14.6 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the methodology contained in this procedure. Continuous samples of the gaseous effluent for radioactive particulate material shall be taken as indicated in Attachment 16.

Applicability:

This is applicable at all times.

Action:

1) With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits of Step 6.14.66 are met, immediately 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.

2) With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the Action shown in Attachment 16. Exert best efforts to return the instrument to OPERABLE status within 30 days and if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

Surveillance Requirements:

The maximum setpoints shall be determined by procedures implementing the methodology presented in this procedure and shall be recorded on release permits.

Each gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the INSTRUMENT CHANNEL CHECK, SOURCE CHECK, INSTRUMENT CHANNEL CALIBRATION, AND CHANNEL TEST at the frequencies shown in Attachment 17.

Records shall be maintained in accordance with the Process Standards of all radioactive gaseous effluent monitoring instrument alarm/trip setpoints. Maximum setpoints and setpoint calculations shall be available for review to ensure that the limits of Step 6.14.6 are met.

Bases:

The radioactive gaseous effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of radioactive gaseous effluents. The alarm/trip setpoints for these instruments, except for the Interim On-site Storage (IOS) Building vent monitor (R15106), shall be calculated in accordance with the methodology contained in this manual to ensure that the alarm/trip will occur prior to exceeding the limits of ODCM Step 6.14.6. The monitor setpoints for R15106 are set statistically high enough above background to prevent spurious alarms, yet stop potential radioactive releases when detected (Reference 3.2.18). The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

The IOS Building has a ventilation system which provides protection against radioactive airborne releases. Operation of the ventilation system produces a negative pressure in the building. During operation, the ventilation exhaust flow is continuously monitored for particulate activity. Upon an alarm, the exhaust duct closes and the supply and exhaust fans stop, minimizing any chance of an airborne release. Although no planned airborne radioactive releases are anticipated from this pathway, the ventilation exhaust monitor is included in Attachment 16.

Fuel Storage Building exhaust is directed to the Auxiliary Building Stack where the exhaust is filtered and monitored for any activity prior to release to the atmosphere.

6.14.6 Gaseous Dose Rates

Specifications:

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be limited to the following values:

1) The dose rate limit for noble gases shall be less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin; and,

2) The dose rate limit for tritium and for all radioactive materials in particulate form with half-lives greater than 8 days shall be less than or equal to 1500 mrem/yr to any organ.

Applicability:

This is applicable at all times.

Action:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the limit(s) specified and report the event in the next Annual Radioactive Effluent Release Report.

Surveillance Requirements:

The noble gas effluent continuous monitors, as listed in Attachment 16, shall use monitor setpoints to limit the dose rate in unrestricted areas to the limits in the above Specification.

In the event a noble gas effluent exceeds the setpoint of its monitor, an assessment of compliance with the Specification above shall be made in accordance with the methodology contained in this manual.

The release rate of radioactive materials, other than noble gases, in gaseous effluents shall be determined by obtaining representative samples and performing analyses in accordance with the sampling analyses program specified in Attachment 18.

The dose rate due to tritium and all radioactive material in particulate form with half-lives greater than 8 days, released in gaseous effluents, shall be determined to be within the limits of this Specification by using the results of the sampling and analysis program specified in Attachment 18 and the methodology described in Step 6.8.

Bases:

Step 6.14.6 is provided to ensure that the dose rate from gaseous effluents due to immersion or inhalation at any time at the Site Boundary for Gaseous Effluents (see Attachment 5) will be within the annual dose limits of 10 CFR Part 20 for MEMBERS OF THE PUBLIC. The annual dose limits are the doses associated with the concentrations of Appendix B to 10 CFR Part 20, Table 2, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of an individual at or beyond the Site Boundary for Gaseous Effluents to annual average concentrations exceeding the dose rate equivalent, on which the limits specified in Appendix B, Table 2 of 10 CFR Part 20 were derived. For individuals who may at times be within the Site Boundary for Gaseous Effluents, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the boundary. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the Site Boundary for Gaseous Effluents to less than or equal to 500 mrem/yr to the total body or to less than or equal to 3,000 mrem/yr to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a person of any age group via the inhalation pathway to less than or equal to 1,500 mrem/yr.

6.14.7 Gamma and Beta Air Dose

Specifications:

The air dose due to noble gases released in gaseous effluents to areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be limited to the following:

1) During any calendar quarter, to less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation; and,

2) During any calendar year, to less than or equal to 10 mrad for gamma radiation and to less than or equal to 20 mrad for beta radiation.

Applicability:

This is applicable at all times.

Action:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days a Special Report. This Report will identify the cause(s) for exceeding the limit(s) and define the corrective action(s) taken to reduce the release of radioactive noble gases on gaseous effluents, and the corrective action(s) to be taken to assure that subsequent releases will be in compliance with the above limits.

Surveillance Requirements:

Cumulative air dose contributions for the current calendar quarter and calendar year shall be determined in accordance with the methodology in Step 6.9 at least monthly.

Bases:

Step 6.14.7 is provided to implement the requirements of Sections II.B, III.A, and IV.A of Appendix I, 10 CFR Part 50. This step 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 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 an individual through the appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in this manual 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 equations in this manual provide for determining that the air doses at the Site Boundary for Gaseous Effluents (see Attachment 5) are based upon the historical average atmospheric conditions.

6.14.8 Gaseous Organ Dose

Specifications:

The dose or dose commitment to a MAXIMUM EXPOSED (HYPOTHETICAL) INDIVIDUAL from tritium and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents released to areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be limited to the following:

1) During any calendar quarter, to less than or equal to 7.5 mrem to any organ; and,

2) During any calendar year, to less than or equal to 15 mrem to any organ.

Applicability:

This is applicable at all times.

Action:

With the calculated dose or dose commitment from the release of tritium and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days a Special Report. This Report will identify the cause(s) for exceeding the limit and define the corrective actions to be taken to reduce the releases and the proposed corrective action(s) to be taken to assure that subsequent releases will be in compliance with the above annual limits.

Surveillance Requirements:

Cumulative dose contributions for the current calendar quarter and calendar year period shall be determined in accordance with the methodology described in Step 6.10 at least monthly.

Bases:

Step 6.14.8 is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Specifications are the guides set forth in Section II.C of 10 CFR 50, 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 10 CFR 50, Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." The calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of 10 CFR 50, Appendix I that conformance with the guides of 10 CFR 50, Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. For individuals who may at times be within the Site Boundary for Gaseous Effluents, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric dispersion factor above that for the boundary.

The calculational methods 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, "Calculating 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 estimating doses based upon the historical average atmospheric conditions.

The release rate specifications for radioactive materials in particulate form are dependent on the existing radionuclide pathways to man in areas at or beyond the Site Boundary for Gaseous Effluents (see Attachment 5). The pathways which were examined in the development of these calculations are: (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.

6.14.9 Ventilation Exhaust Treatment System

Specifications:

The VENTILATION EXHAUST TREATMENT SYSTEM shall be OPERABLE. The installed VENTILATION EXHAUST TREATMENT SYSTEM shall be considered OPERABLE by meeting the Specifications in Steps 6.14.6, 6.14.7, and 6.14.86.

Also, the following two conditions shall not exist simultaneously:

1) Gaseous waste is being discharged without treatment, and;

2) The projected doses due to gaseous effluent releases from the site (see Attachment 5), when averaged over 31 days, would exceed 2% of the 10 CFR 50, Appendix I annual dose guidelines (0.3 mrem to any organ, or air doses of 0.2 mrad from gamma radiation or 0.4 mrad from beta radiation).

Applicability:

This is applicable at all times.

Action:

If both parts 1) and 2) of the Specification are satisfied, prepare and submit to the Commission within 30 days a Special Report pursuant to Technical Specification D6.9.7 which includes the following information:

a. Explanation of why gaseous radwaste was being discharged without treatment, and identification of the equipment or subsystems not OPERABLE and the reason for inoperability.

b. Action(s) taken to restore the inoperable equipment to OPERABLE STATUS.

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

Surveillance Requirements:

Doses due to gaseous releases to areas at and beyond the Site Boundary for Gaseous Effluents (see Attachment 5) shall be projected at least once per 31 days in accordance with the methodology and parameters in Step 6.11.

Aerosol particulate testing will be performed on the HEPA filters in the Ventilation Exhaust Treatment Systems every 18 months, or after any work has been performed on the HEPA filter systems which could alter their integrity. For minor HEPA filter integrity repairs (up to ~ 0.1% of HEPA filter bank surface area), immediate testing is not required. HEPA filter integrity is ensured through visual observations and effluent sampling

Bases:

The OPERABILITY of the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems are available for use whenever gaseous effluents require treatment prior to release to the environment. 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 are maintained "as low as is reasonably achievable." Step 6.14.9 implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR 50, and the design objectives given in Section II.D of Appendix I to 10 CFR 50. The specified limits governing the use of appropriate portions of the systems and the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR 50, for gaseous effluents.

6.14.10 Fuel Cycle Dose

Specification:

The dose or dose commitment to any real MEMBER OF THE PUBLIC due to releases of radioactive material in gaseous and liquid effluents and to direct radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which is limited to less than or equal to 75 mrem) in a calendar year.

Applicability:

At all times.

Action:

1) With the calculated doses from the release of radioactive material in liquid or gaseous effluents exceeding twice the limits of Specifications in Steps 6.14.3, 6.14.7, 6.14.8 or exceeding the reporting levels in Table 3 of the REMP Manual, calculations shall be made including direct radiation contributions (including outside storage tanks, etc.) to determine whether the above specifications have been exceeded.

2) If the above limits have been exceeded, prepare and submit to the Commission within 30 days, 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 Part 20.2203(a)(4), 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, in a 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.

3) If the estimated dose(s) exceed the above limits, and if the release condition resulting in the violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provision of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

Surveillance Requirements:

Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with the Step 6.14.3, 6.14.7, and 6.14.8 Surveillance Requirements.

Cumulative dose contributions from direct radiation (including outside storage tanks, etc.) shall be determined in accordance with Step 6.12. This requirement is applicable only under the conditions set forth in the above Action statements.

Bases:

Step 6.14.10 is provided to meet the dose limitations of 40 CFR 190 that have been incorporated into 10 CFR 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant radioactive effluents exceed twice the numerical guides for design objective doses of 10 CFR 50, Appendix I or exceeds the reporting levels of the Radiological Environmental Monitoring Program. For the Rancho Seco site, it is unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the plant remains within twice the numerical guides for design objectives of 10 CFR 50, Appendix I and if direct radiation (outside storage tanks, etc.) is kept small. The Special Report will describe a course of action which should result in the limitation of the dose to a MEMBER OF THE PUBLIC for a calendar year to within the 40 CFR 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, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. If the dose to any MEMBER OF THE PUBLIC is evaluated to exceed the requirements of 40 CFR 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190 is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation which is part of the uranium fuel cycle.

6.14.11 Quarter/Annual Dose Projections

Specifications:

The projected dose contributions from liquid and gaseous effluents for the current calendar quarter and current calendar year shall be calculated according to the methodology in Steps 6.5 and 6.11 at least every 31 days.

Applicability:

At all times.

Action:

With the required dose calculations not being performed, best effort will be exerted to perform the calculations once the deficiency has been identified. Corrective actions will be taken and documented to prevent reoccurrence.

Surveillance Requirements

1) Liquid Effluents

Projected dose contributions shall be determined at least every 31 days.

2) Gaseous Effluents

Projected dose contributions shall be determined at least every 31 days.

Bases:

This step is provided to implement the requirement of Technical Specification D6.8.3.a.5. Dose projections provide a means of determining if current release practices will be within the dose limits of 10 CFR 50, Appendix I. Calculating projected dose totals every 31 days provides information which can be used to keep effluent releases "as low as is reasonably achievable".

Calculations performed during the first 15 days of the calendar year or calendar quarter will result in artificially high dose projections which provide no usable information.

6.15 Reports

6.15.1 Annual Radioactive Effluent Release Report (ARERR)

The ARERR covering the activities of the unit during the previous 12 months shall be submitted within 60 days after January 1 of each year. The report shall include the following:

(1) Summary of the quantities of radioactive liquid and gaseous effluents released from the unit.

(2) Summary of solid waste shipped from the unit.

(3) All unplanned releases of radioactive materials in gaseous and liquid effluents to unrestricted areas shall include a description of the event and equipment involved, cause(s), action(s) taken to prevent recurrence, and consequences.
(4) Dose or dose commitment assessments to ensure compliance with the specifications in 6.14.3, 6.14.7, and 6.14.8.

(5) Complete, legible copy of the entire ODCM and/or REMP Manual if changes occurred during the ARERR reporting period. The copy may be part of the ARERR or sent concurrently.

(6) The ARERR shall also include events described in 6.14.2, 6.14.5, and 6.14.6.

6.15.2 30 Day Reports

The following 30 day reports should be submitted if the criteria are met as stated in the following areas:

(1) 6.14.3 - Liquid Dose Calculations

(2) 6.14.4 - Liquid Dose Projections

(3) 6.14.7 - Gamma and Beta Air Dose

(4) 6.14.8 - Gaseous Organ Dose

(5) 6.14.9 - Gaseous Dose Projections

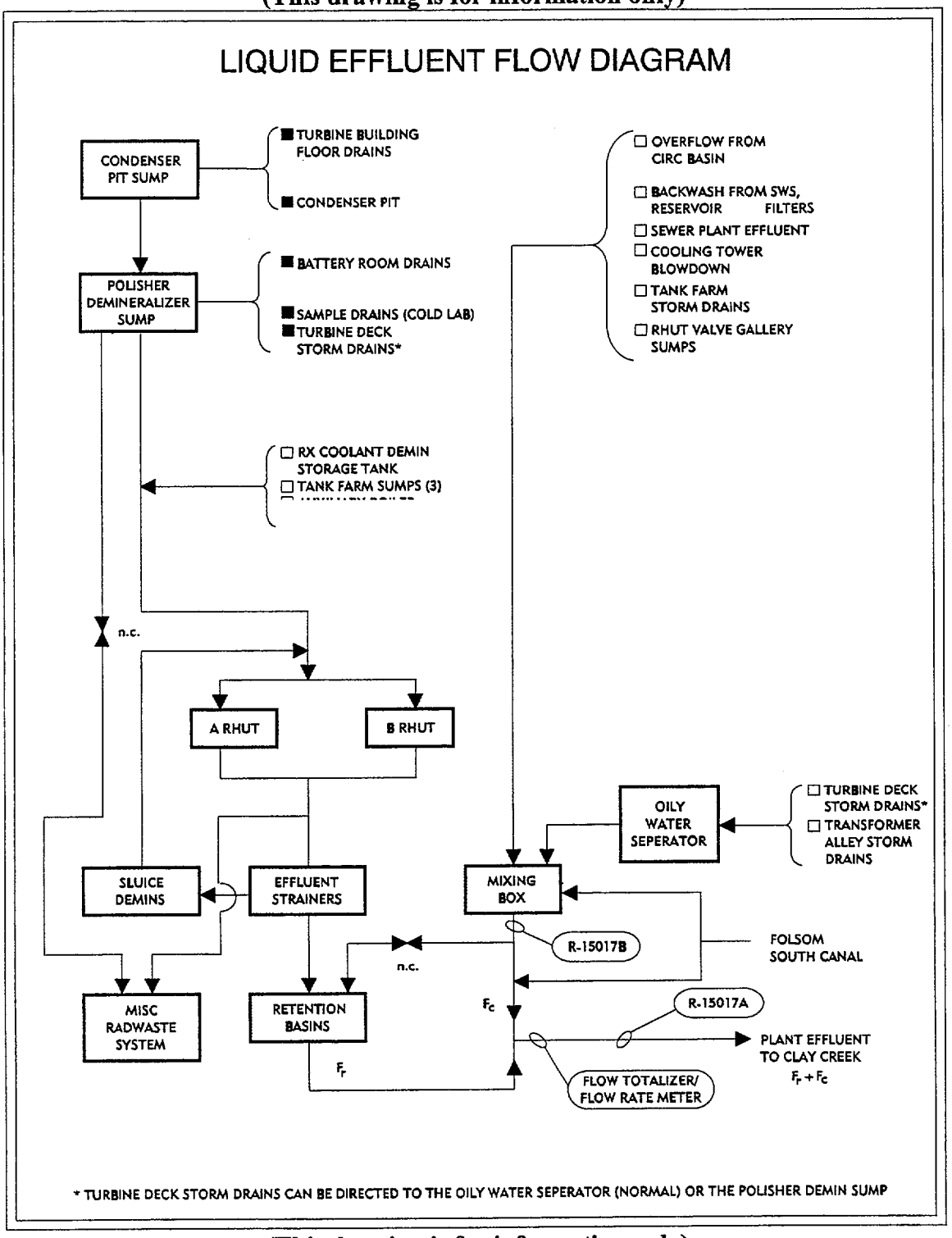
(6) 6.14.10 - Fuel Cycle Dose

7.0 RECORDS

The individual/packaged documents and related correspondence completed as a result of the performance or implementation of this procedure are records. They shall be transmitted to Records Management in accordance with RSAP-0601, Nuclear Records Management.

LIQUID EFFLUENT FLOW DIAGRAM

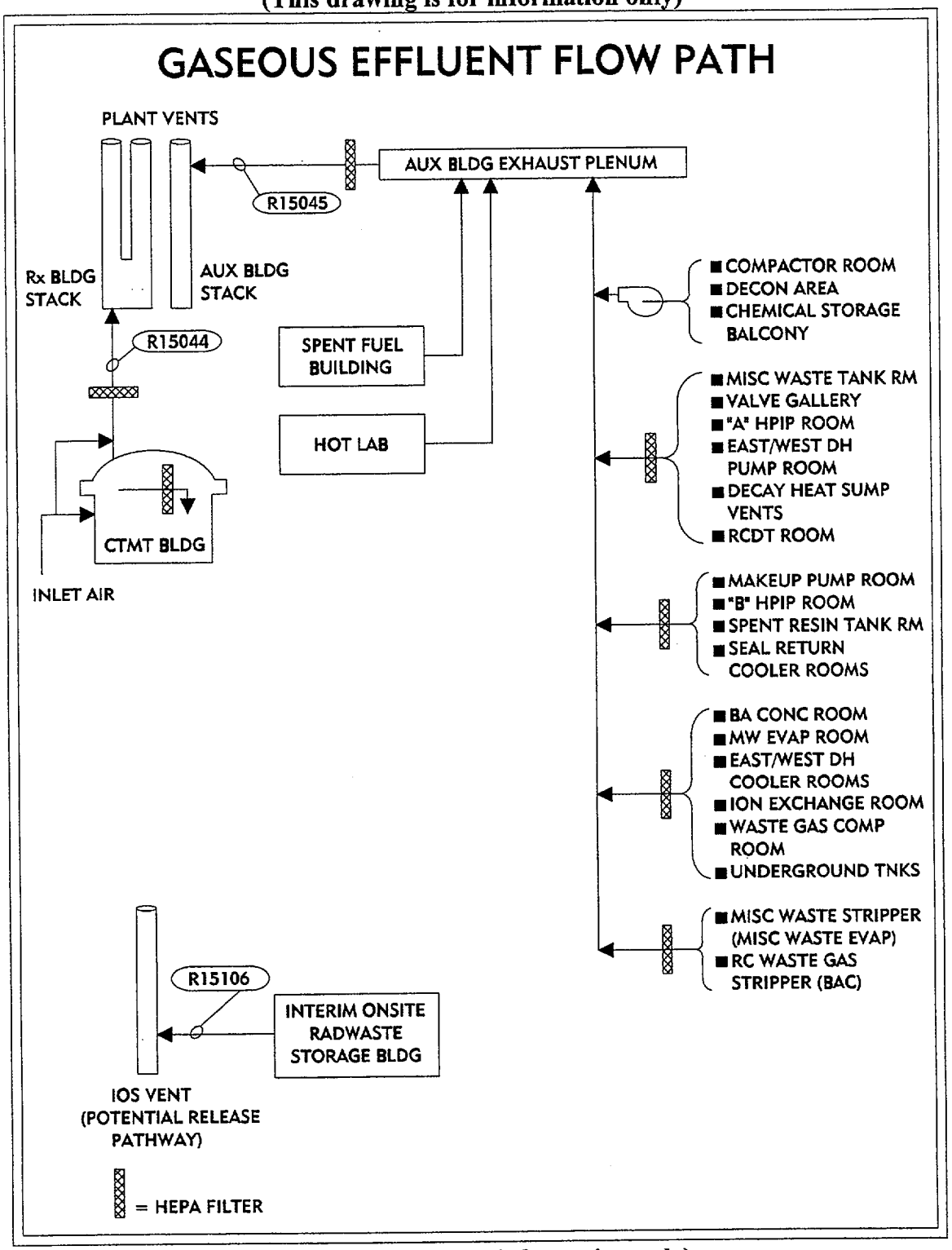
(This drawing is for information only)



(This drawing is for information only)

GASEOUS EFFLUENT FLOW DIAGRAM

(This drawing is for information only)



(This drawing is for information only)

DOSE FACTOR PARAMETERS

CONSUMPTION AND USAGE PARAMETERS

PATHWAY	AGE	1.109 DEFAULT	RSNGS
Irrigated Stored Vegetables	Adult	520 kg/yr	520 kg/yr
	Teen	630 kg/yr	630 kg/yr
	Child	520 kg/yr	520 kg/yr
	Infant	0 kg/yr	0 kg/yr
Irrigated Fresh Vegetables	Adult	64 kg/yr	64 kg/yr
	Teen	42 kg/yr	42 kg/yr
	Child	26 kg/yr	26 kg/yr
	Infant	0 kg/yr	0 kg/yr
Irrigated Milk	Adult	310 kg/yr	310 kg/yr
	Teen	400 kg/yr	400 kg/yr
	Child	330 kg/yr	330 kg/yr
	Infant	330 kg/yr	330 kg/yr
Irrigated Meat & Poultry	Adult	110 kg/yr	110 kg/yr
	Teen	65 kg/yr	65 kg/yr
	Child	41 kg/yr	41 kg/yr
	Infant	0 kg/yr	0 kg/yr
Fish	Adult	21 kg/yr	21 kg/yr
	Teen	16 kg/yr	16 kg/yr
	Child	6.9 kg/yr	6.9 kg/yr
	Infant	0 kg/yr	0 kg/yr
Other Seafood Invertebrate (Crayfish)	Adult	5.0 kg/yr	6.9 kg/yr
	Teen	3.8 kg/yr	5.2 kg/yr
	Child	1.7 kg/yr	2.2 kg/yr
	Infant	0 kg/yr	0 kg/yr
Algae	Adult	None	0 kg/yr
	Teen	None	0 kg/yr
	Child	None	0 kg/yr
	Infant	None	0 kg/yr
Water Usage (Drinking Water)	Adult	730 l/yr	0 l/yr
	Teen	510 l/yr	0 l/yr
	Child	510 l/yr	0 l/yr
	Infant	330 l/yr	0 l/yr

DOSE FACTOR PARAMETERS (Continued)

CONSUMPTION AND USAGE PARAMETERS (continued)

PATHWAY	AGE	1.109 DEFAULT	RSNGS
Shoreline Recreation	Adult	12 hr/yr	200 hr/yr
	Teen	67 hr/yr	100 hr/yr
	Child	14 hr/yr	14 hr/yr
	Infant	0 hr/yr	0 hr/yr
Swimming	Adult	None	100 hr/yr
	Teen	None	100 hr/yr
	Child	None	14 hr/yr
	Infant	None	0 hr/yr
Boating	Adult	None	0 hr/yr
	Teen	None	0 hr/yr
	Child	None	0 hr/yr
	Infant	None	0 hr/yr
Inhalation	Adult	8000 m^3	8000 m^3
	Teen	8000 m^3	8000 m^3
	Child	3700 m^3	3700 m^3
	Infant	1400 m^3	1400 m^3

IRRIGATION RATES AND FRACTION OF IRRIGATION

	1.109 DEFAULT	RSNGS
Irrigation Rate	263 l/m^2/month	263 l/m^2/month
Time field has been irrigated prior to crop of interest	15 years	15 years
Fraction of the year field is irrigated	None	None
Fraction of animal water intake not obtained from the irrigation system (Irrigated Meat)	None	0
Fraction of animal water intake not obtained from the irrigation system (Irrigated Milk)	None	1

DOSE FACTOR PARAMETERS (Continued)

TRANSIT, TRANSFER, AND HOLDUP TIMES

	1.109 DEFAULT	RSNGS
Irrigated Stored Vegetables Holdup Time	1440 hrs	1440 hrs
Irrigated Fresh Vegetables Holdup Time	24 hrs	24 hrs
Irrigated Milk Holdup Time	48 hrs	48 hrs
Irrigated Meat Holdup Time	480 hrs	480 hrs
Transit Time From Time Of Sample To Time Of Release	None	72 hrs
Transit Time To Drinking Water	None	0 hrs

DILUTIONS

	1.109 DEFAULT	RSNGS
All Pathways	None	1 (None)
Shore-Width Factor	0.2	0.2

MISCELLANEOUS

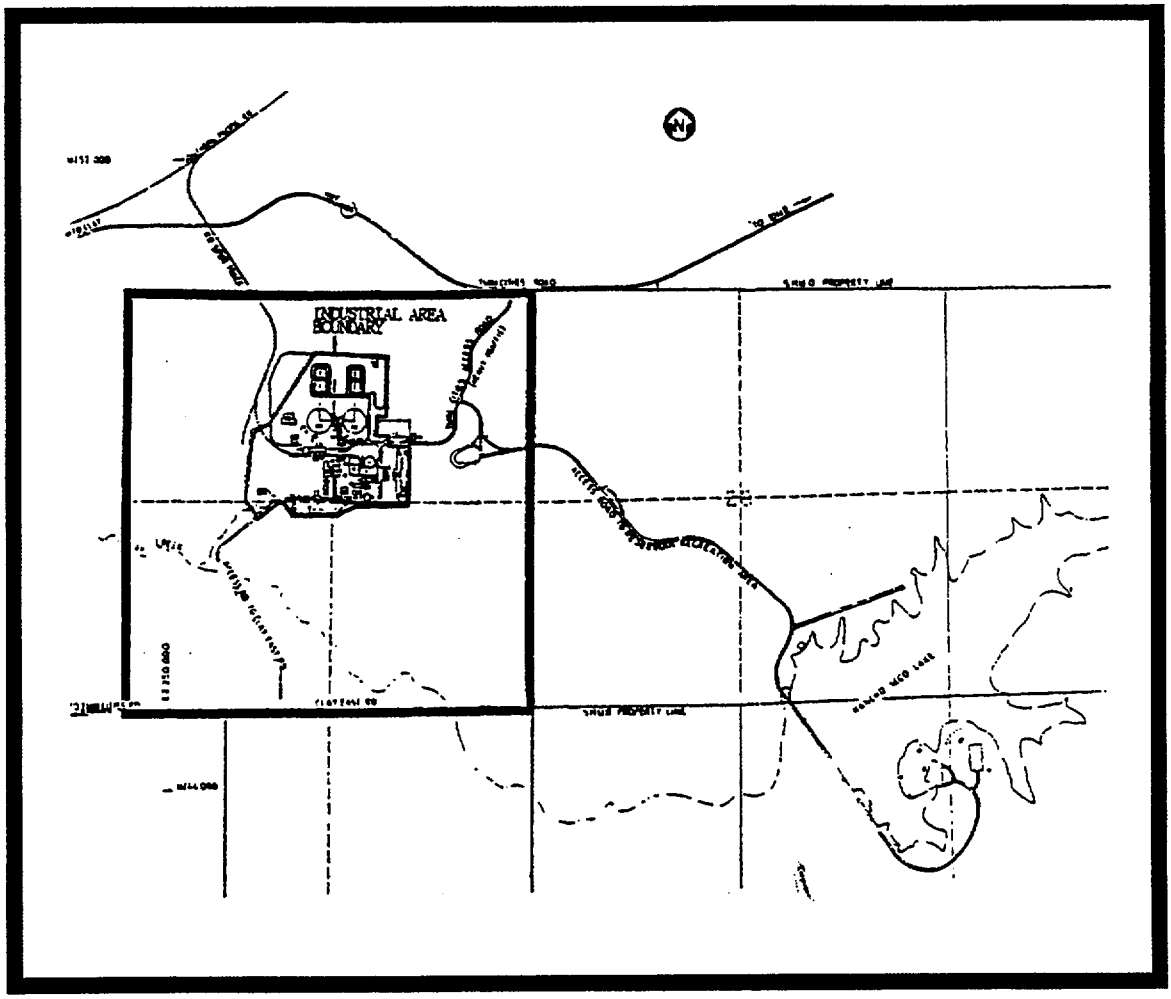
	1.109 DEFAULT	RSNGS
Fraction Of Leafy Vegetables Grown In Garden Of Interest	1.0	1.0
Fraction Of Produce Ingested Grown In Garden Of Interest	0.76	0.76
Crop Growing Time For Leafy Vegetables Ingested By Man	60 Days	30 Days
Crop Growing Time For Pasture Grass	30 Days	30 Days
Crop Yield For Leafy Vegetables Ingested By Man	2.0 kg/m^2	2.0 kg/m^2
Crop Yield For Pasture Grass	0.7 kg/m^2	2.0 kg/m^2

ATMOSPHERIC DISPERSION AND DEPOSITION PARAMETERS
GASEOUS EFFLUENT PATHWAYS
1998 CONTROLLING LOCATIONS**

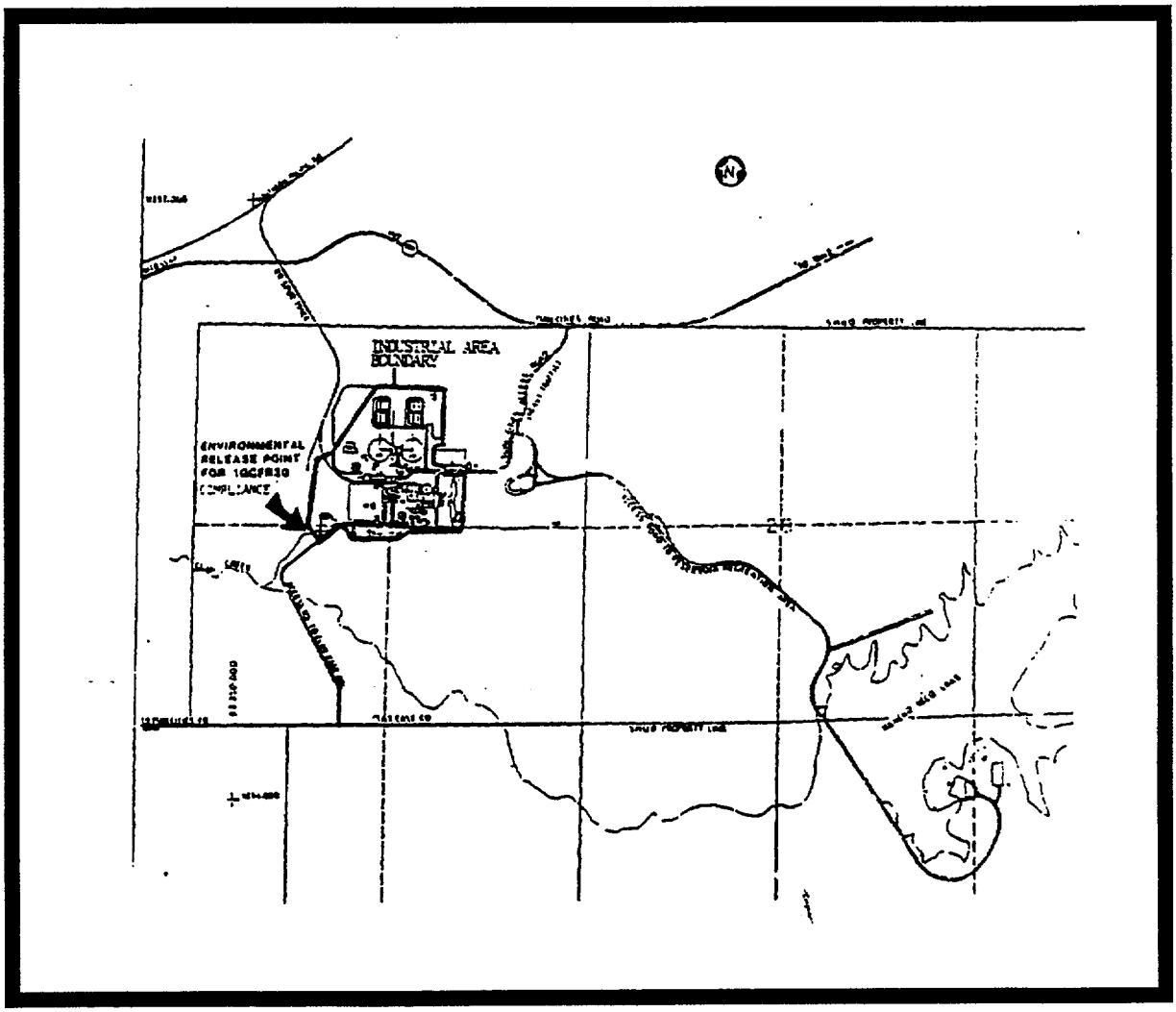
PATHWAY	DIRECTION	DISTANCE	X/Q* (sec/m^3)	D/Q* (m^{-2})
Inhalation	ENE	1038 M	8.1E-06	--
Ground	ENE	1038 M	--	4.8E-08
Vegetation	SSW	670 M	1.4E-05	2.8E-08
Cow Milk	ENE	1038 M	8.1E-06	4.8E-08
Meat Animal	S	195 M	1.2E-04	--
Meat Animal	SSE	198 M	--	3.4E-07
Goat Milk	SSW	2500 M	1.0E-06	1.7E-09
Site Boundary for Gaseous Effluents	NNW	670 M	2.1E-05	--

* Based on meteorological data from January 1978 to December 1987.
** Based on 1998 Land Use Census.

SITE BOUNDARY FOR GASEOUS EFFLUENTS



SITE BOUNDARY FOR LIQUID EFFLUENTS



HISTORICAL LIQUID SOURCE TERMS

Nuclide	Ci (μCi/ml)	Of Gamma Emitters		Of All Nuclides	
		Relative %	Relative Fraction	Relative %	Relative Fraction
H-3	1.26E-04	n/a	n/a	100.00	1.00
Cs-137	8.20E-09	100.00	1.00	6.51E-03	6.51E-5
TOTAL	1.26E-04	100.00	1.00	100.00	1.00

Note: Based on Retention Basin Effluent History of Rancho Seco from January 1, 1995 through December 31, 1999

LIQUID MONITOR DETECTOR EFFICIENCIES

R15017A & R15017B*
(Detector Model RD-53)

Nuclide	Efficiency cpm/μCi/cc
MO-99	3.47 E+07
I-131	1.90 E+08
I-132	4.17 E+08
I-133	1.53 E+08
I-135	1.74 E+08
CS-134	3.25 E+08
CS-137	1.28 E+08
CR-51	1.85 E+07
MN-54	1.30 E+08
FE-59	1.26 E+08
CO-58	1.85 E+08
CO-60	2.40 E+08
ZN-65	6.49 E+07
SB-124	2.66 E+08
BA-140	8.98 E+07
LA-140	2.69 E+08
CE-141	7.68 E+07
CE-144	1.80 E+07

* From Calculation Z-RDM-I0261

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS

DOSE FACTOR TABLE: A(i) - Adult
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01
C-14	3.82E+05	7.63E+04	7.63E+04	7.63E+04	7.63E+04	7.63E+04	7.63E+04
NA-24	4.32E+01	4.32E+01	4.32E+01	4.32E+01	4.32E+01	4.32E+01	4.32E+01
P-32	4.07E+07	2.53E+06	1.57E+06	6.31E-02	6.31E-02	6.31E-02	4.58E+06
CR-51	3.08E+00	3.08E+00	8.89E+00	6.56E+00	4.36E+00	1.08E+01	1.46E+03
MN-54	8.23E+02	3.31E+05	6.38E+04	8.23E+02	9.90E+04	8.23E+02	1.01E+06
MN-56	0.00E+00	2.13E-04	3.79E-05	0.00E+00	2.70E-04	0.00E+00	6.79E-03
FE-55	1.18E+04	8.17E+03	1.91E+03	7.29E-04	7.29E-04	4.56E+03	4.69E+03
FE-59	1.47E+04	3.42E+04	1.32E+04	1.77E+02	1.77E+02	9.69E+03	1.14E+05
CO-58	2.36E+02	9.91E+02	1.93E+03	2.36E+02	2.36E+02	2.36E+02	1.55E+04
CO-60	1.26E+04	1.61E+04	2.02E+04	1.26E+04	1.26E+04	1.26E+04	7.73E+04
NI-63	3.42E+05	2.37E+04	1.15E+04	0.00E+00	0.00E+00	0.00E+00	4.95E+03
NI-65	8.65E-04	1.12E-04	5.13E-05	0.00E+00	0.00E+00	0.00E+00	2.85E-03
CU-64	8.90E-02	7.02E-01	3.77E-01	8.90E-02	1.64E+00	8.90E-02	5.24E+01
ZN-65	7.63E+04	2.42E+05	1.10E+05	4.46E+02	1.62E+05	4.46E+02	1.52E+05
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.84E-05	0.00E+00	0.00E+00	0.00E+00	6.98E-05
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	6.46E+00	1.21E+05	5.62E+04	6.46E+00	6.46E+00	6.46E+00	2.38E+04
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.01E+05	6.25E-02	5.75E+03	6.25E-02	6.25E-02	6.25E-02	3.22E+04
SR-90	5.71E+06	6.16E-03	1.53E+06	6.16E-03	6.16E-03	6.16E-03	3.26E+05
SR-91	5.59E+00	1.19E-01	3.40E-01	1.19E-01	1.19E-01	1.19E-01	2.62E+01
SR-92	5.95E-03	0.00E+00	2.58E-04	0.00E+00	0.00E+00	0.00E+00	1.18E-01
Y-90	3.15E+00	6.94E-02	1.52E-01	6.94E-02	6.94E-02	6.94E-02	3.27E+04
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.95E+02	6.82E-01	5.89E+00	6.82E-01	6.82E-01	6.82E-01	1.07E+05
Y-92	1.72E-05	4.24E-06	4.62E-06	4.24E-06	4.24E-06	4.24E-06	2.28E-01
Y-93	2.16E-02	1.61E-02	1.63E-02	1.61E-02	1.61E-02	1.61E-02	1.73E+02
ZR-95	1.82E+02	1.64E+02	1.62E+02	1.56E+02	1.69E+02	1.56E+02	2.67E+04
ZR-97	9.87E-01	9.83E-01	9.82E-01	9.82E-01	9.83E-01	9.82E-01	3.26E+02
NB-95	5.16E+02	3.27E+02	2.17E+02	8.92E+01	3.24E+02	8.92E+01	1.44E+06
MO-99	1.27E+00	3.04E+02	5.89E+01	1.27E+00	6.87E+02	1.27E+00	7.03E+02
TC-99M	8.23E-04	1.03E-03	4.74E-03	7.11E-04	5.51E-03	8.66E-04	1.88E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	6.76E+02	7.02E+01	3.31E+02	7.02E+01	2.38E+03	7.02E+01	7.08E+04
RU-105	9.35E-04	1.83E-04	4.80E-04	1.83E-04	9.91E-03	1.83E-04	4.60E-01
RU-106	1.61E+04	2.95E+02	2.30E+03	2.95E+02	3.08E+04	2.95E+02	1.02E+06
AG-110M	2.63E+03	2.59E+03	2.37E+03	2.06E+03	3.10E+03	2.06E+03	2.17E+05
TE-125M	1.86E+04	6.75E+03	2.49E+03	5.60E+03	7.57E+04	9.21E-01	7.43E+04
TE-127M	5.26E+04	1.88E+04	6.41E+03	1.34E+04	2.14E+05	5.57E-02	1.76E+05
TE-127	6.06E-01	2.18E-01	1.31E-01	4.49E-01	2.47E+00	1.62E-04	4.78E+01
TE-129M	7.19E+04	2.68E+04	1.14E+04	2.47E+04	3.00E+05	1.31E+01	3.62E+05
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	1.11E+03	5.44E+02	4.54E+02	8.58E+02	5.45E+03	5.64E+00	5.34E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	6.30E+03	4.07E+03	3.82E+03	4.50E+03	3.92E+04	3.73E+00	1.93E+05
I-130	3.14E+00	7.62E+00	3.51E+00	5.76E+02	1.14E+01	8.37E-01	6.68E+00
I-131	7.06E+02	1.00E+03	5.82E+02	3.24E+05	1.71E+03	1.47E+01	2.76E+02
I-132	1.60E-04	4.29E-04	1.50E-04	1.50E-02	6.83E-04	0.00E+00	8.05E-05
I-133	1.68E+01	2.84E+01	9.45E+00	4.01E+03	4.88E+01	1.13E+00	2.57E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	1.59E-01	4.14E-01	1.53E-01	2.73E+01	6.63E-01	8.91E-04	4.68E-01
CS-134	4.44E+05	1.05E+06	8.59E+05	4.03E+03	3.43E+05	1.16E+05	2.23E+04
CS-136	3.16E+04	1.24E+05	8.95E+04	1.15E+02	6.92E+04	9.59E+03	1.42E+04
CS-137	5.85E+05	7.98E+05	5.25E+05	6.06E+03	2.75E+05	9.54E+04	2.14E+04
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	4.90E+03	2.11E+01	3.35E+02	1.50E+01	1.71E+01	1.85E+01	1.01E+04
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.14E+00	3.92E+00	3.76E+00	3.71E+00	3.71E+00	3.71E+00	1.61E+04
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.29E-06
CE-141	1.87E+01	1.56E+01	9.66E+00	8.90E+00	1.20E+01	8.90E+00	2.54E+04
CE-143	1.93E+00	1.42E+02	1.76E+00	1.74E+00	1.81E+00	1.74E+00	5.24E+03
CE-144	8.99E+02	4.00E+02	8.76E+01	4.15E+01	2.54E+02	4.15E+01	2.90E+05
PR-143	7.38E+00	2.96E+00	3.66E-01	0.00E+00	1.71E+00	0.00E+00	3.23E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	9.62E+00	1.03E+01	5.27E+00	4.95E+00	8.11E+00	4.95E+00	2.59E+04
W-187	2.03E+01	1.72E+01	6.89E+00	1.35E+00	1.35E+00	1.35E+00	5.20E+03
NP-239	1.70E+00	1.56E+00	1.56E+00	1.55E+00	1.59E+00	1.55E+00	2.92E+03

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS (Continued)

DOSE FACTOR TABLE: A(i) - Teen
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.37E+01	1.37E+01	1.37E+01	1.37E+01	1.37E+01	1.37E+01
C-14	5.64E+05	1.13E+05	1.13E+05	1.13E+05	1.13E+05	1.13E+05	1.13E+05
NA-24	6.36E+01	6.36E+01	6.36E+01	6.36E+01	6.36E+01	6.36E+01	6.36E+01
P-32	4.44E+07	2.75E+06	1.72E+06	6.31E-02	6.31E-02	6.31E-02	3.73E+06
CR-51	1.82E+00	1.82E+00	8.10E+00	5.31E+00	3.19E+00	1.08E+01	1.06E+03
MN-54	4.20E+02	3.24E+05	6.45E+04	4.20E+02	9.69E+04	4.20E+02	6.63E+05
MN-56	0.00E+00	1.92E-04	3.43E-05	0.00E+00	2.43E-04	0.00E+00	1.26E-02
FE-55	1.37E+04	9.69E+03	2.26E+03	7.29E-04	7.29E-04	6.15E+03	4.19E+03
FE-59	1.55E+04	3.61E+04	1.40E+04	1.00E+02	1.00E+02	1.15E+04	8.53E+04
CO-58	1.28E+02	1.08E+03	2.32E+03	1.28E+02	1.28E+02	1.28E+02	1.33E+04
CO-60	6.35E+03	1.10E+04	1.69E+04	6.35E+03	6.35E+03	6.35E+03	6.71E+04
NI-63	4.50E+05	3.18E+04	1.53E+04	0.00E+00	0.00E+00	0.00E+00	5.06E+03
NI-65	8.19E-04	1.05E-04	4.77E-05	0.00E+00	0.00E+00	0.00E+00	5.67E-03
CU-64	8.55E-02	9.25E-01	4.80E-01	8.55E-02	2.21E+00	8.55E-02	6.52E+01
ZN-65	7.56E+04	2.62E+05	1.22E+05	2.29E+02	1.68E+05	2.29E+02	1.11E+05
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.93E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	4.10E+00	1.40E+05	6.56E+04	4.10E+00	4.10E+00	4.10E+00	2.07E+04
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.93E+05	5.64E-02	8.38E+03	5.64E-02	5.64E-02	5.64E-02	3.48E+04
SR-90	7.40E+06	6.16E-03	1.98E+06	6.16E-03	6.16E-03	6.16E-03	3.85E+05
SR-91	5.73E+00	1.16E-01	3.39E-01	1.16E-01	1.16E-01	1.16E-01	2.56E+01
SR-92	5.55E-03	0.00E+00	2.37E-04	0.00E+00	0.00E+00	0.00E+00	1.42E-01
Y-90	3.35E+00	6.87E-02	1.57E-01	6.87E-02	6.87E-02	6.87E-02	2.71E+04
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	2.46E+02	3.78E-01	6.97E+00	3.78E-01	3.78E-01	3.78E-01	1.01E+05
Y-92	1.64E-05	4.20E-06	4.55E-06	4.20E-06	4.20E-06	4.20E-06	3.35E-01
Y-93	2.13E-02	1.57E-02	1.59E-02	1.57E-02	1.57E-02	1.57E-02	1.70E+02
ZR-95	1.19E+02	9.67E+01	9.34E+01	8.62E+01	1.02E+02	8.62E+01	2.42E+04
ZR-97	9.41E-01	9.37E-01	9.37E-01	9.36E-01	9.38E-01	9.36E-01	2.63E+02
NB-95	4.73E+02	2.82E+02	1.75E+02	4.46E+01	2.75E+02	4.46E+01	1.02E+06
MO-99	6.36E-01	4.32E+02	8.28E+01	6.36E-01	9.87E+02	6.36E-01	7.73E+02
TC-99M	8.54E-04	1.13E-03	6.35E-03	6.98E-04	7.20E-03	9.40E-04	2.87E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	5.86E+02	3.51E+01	2.71E+02	3.51E+01	1.98E+03	3.51E+01	4.61E+04
RU-105	8.80E-04	1.81E-04	4.52E-04	1.81E-04	9.00E-03	1.81E-04	5.65E-01
RU-106	1.59E+04	1.48E+02	2.14E+03	1.48E+02	3.06E+04	1.48E+02	7.57E+05
AG-110M	1.87E+03	1.83E+03	1.53E+03	1.06E+03	2.53E+03	1.06E+03	2.17E+05
TE-125M	2.06E+04	7.42E+03	2.75E+03	5.75E+03	4.81E-01	4.81E-01	6.07E+04
TE-127M	5.93E+04	2.10E+04	7.05E+03	1.41E+04	2.40E+05	2.93E-02	1.48E+05
TE-127	6.53E-01	2.32E-01	1.41E-01	4.51E-01	2.64E+00	1.57E-04	5.04E+01
TE-129M	7.75E+04	2.88E+04	1.23E+04	2.50E+04	3.24E+05	7.70E+00	2.91E+05
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	1.18E+03	5.67E+02	4.74E+02	8.50E+02	5.86E+03	5.20E+00	4.51E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	6.58E+03	4.17E+03	3.92E+03	4.40E+03	4.00E+04	3.07E+00	1.32E+05
I-130	3.80E+00	9.45E+00	4.26E+00	7.06E+02	1.41E+01	8.08E-01	7.45E+00
I-131	9.72E+02	1.36E+03	7.33E+02	3.93E+05	2.33E+03	1.08E+01	2.77E+02
I-132	1.46E-04	3.81E-04	1.37E-04	1.29E-02	6.01E-04	0.00E+00	1.66E-04
I-133	2.27E+01	3.77E+01	1.22E+01	5.12E+03	6.54E+01	1.06E+00	2.88E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	1.85E-01	4.76E-01	1.77E-01	3.06E+01	7.52E-01	4.45E-04	5.28E-01
CS-134	5.04E+05	1.18E+06	5.50E+05	2.03E+03	3.77E+05	1.45E+05	1.67E+04
CS-136	3.27E+04	1.28E+05	8.62E+04	7.75E+01	6.99E+04	1.11E+04	1.04E+04
CS-137	6.99E+05	9.30E+05	3.26E+05	3.03E+03	3.18E+05	1.26E+05	1.62E+04
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-06
BA-140	5.34E+03	1.64E+01	3.53E+02	9.87E+00	1.21E+01	1.43E+01	8.23E+03
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	2.30E+00	2.08E+00	1.91E+00	1.85E+00	1.85E+00	1.85E+00	1.27E+04
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-05
CE-141	1.69E+01	1.30E+01	6.05E+00	5.15E+00	8.84E+00	5.15E+00	2.25E+04
CE-143	1.79E+00	1.48E+02	1.61E+00	1.59E+00	1.66E+00	1.59E+00	4.41E+03
CE-144	1.20E+03	5.10E+02	8.47E+01	2.12E+01	3.13E+02	2.12E+01	2.97E+05
PR-143	7.98E+00	3.18E+00	3.97E-01	0.00E+00	1.85E+00	0.00E+00	2.62E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	7.72E+00	8.17E+00	2.82E+00	2.47E+00	5.82E+00	2.47E+00	2.06E+04
W-187	2.17E+01	1.79E+01	7.11E+00	1.26E+00	1.26E+00	1.26E+00	4.51E+03
NP-239	1.50E+00	1.36E+00	1.35E+00	1.34E+00	1.39E+00	1.34E+00	2.41E+03

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS (Continued)

DOSE FACTOR TABLE: A(i) - Child
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01
C-14	1.28E+06	2.56E+05	2.56E+05	2.56E+05	2.56E+05	2.56E+05	2.56E+05
NA-24	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02
P-32	5.74E+07	2.69E+06	2.21E+06	8.84E-03	8.84E-03	8.84E-03	1.59E+06
CR-51	2.54E-01	2.54E-01	7.95E+00	4.52E+00	1.42E+00	8.05E+00	4.08E+02
MN-54	5.88E+01	2.53E+05	6.74E+04	5.88E+01	7.10E+04	5.88E+01	2.12E+05
MN-56	0.00E+00	2.51E-04	5.68E-05	0.00E+00	3.04E-04	0.00E+00	3.64E-02
FE-55	2.40E+04	1.27E+04	3.94E+03	1.02E-04	1.02E-04	7.19E+03	2.35E+03
FE-59	2.21E+04	3.58E+04	1.78E+04	1.40E+01	1.40E+01	1.04E+04	3.72E+04
CO-58	1.79E+01	1.28E+03	3.88E+03	1.79E+01	1.79E+01	1.79E+01	7.38E+03
CO-60	8.89E+02	7.51E+03	2.04E+04	8.89E+02	8.89E+02	8.89E+02	3.76E+04
NI-63	1.02E+06	5.48E+04	3.48E+04	0.00E+00	0.00E+00	0.00E+00	3.69E+03
NI-65	1.52E-03	1.43E-04	8.35E-05	0.00E+00	0.00E+00	0.00E+00	1.75E-02
CU-64	1.20E-02	1.27E+00	7.70E-01	1.20E-02	3.05E+00	1.20E-02	5.89E+01
ZN-65	9.53E+04	2.54E+05	1.58E+05	3.21E+01	1.60E+05	3.21E+01	4.46E+04
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	9.58E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	5.74E-01	1.61E+05	9.88E+04	5.74E-01	5.74E-01	5.74E-01	1.03E+04
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	6.48E+05	7.90E-03	1.85E+04	7.90E-03	7.90E-03	7.90E-03	2.51E+04
SR-90	1.47E+07	8.62E-04	3.93E+06	8.62E-04	8.62E-04	8.62E-04	2.97E+05
SR-91	1.04E+01	1.62E-02	4.06E-01	1.62E-02	1.62E-02	1.62E-02	2.28E+01
SR-92	1.02E-02	0.00E+00	4.09E-04	0.00E+00	0.00E+00	0.00E+00	1.93E-01
Y-90	4.28E+00	9.62E-03	1.24E-01	9.62E-03	9.62E-03	9.62E-03	1.22E+04
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	4.49E+02	5.29E-02	1.21E+01	5.29E-02	5.29E-02	5.29E-02	5.98E+04
Y-92	2.31E-05	0.00E+00	1.23E-06	0.00E+00	0.00E+00	0.00E+00	6.50E-01
Y-93	1.05E-02	2.20E-03	2.43E-03	2.20E-03	2.20E-03	2.20E-03	1.24E+02
ZR-95	8.32E+01	2.77E+01	2.60E+01	1.21E+01	3.45E+01	1.21E+01	1.63E+04
ZR-97	1.40E-01	1.32E-01	1.32E-01	1.31E-01	1.33E-01	1.31E-01	1.90E+02
NB-95	5.20E+02	2.06E+02	1.49E+02	6.25E+00	1.94E+02	6.25E+00	3.70E+05
MO-99	8.90E-02	7.01E+02	1.73E+02	8.90E-02	1.50E+03	8.90E-02	5.80E+02
TC-99M	4.34E-04	7.58E-04	1.10E-02	9.77E-05	9.69E-03	4.33E-04	3.76E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.02E+03	4.92E+00	3.96E+02	4.92E+00	2.57E+03	4.92E+00	2.63E+04
RU-105	1.31E-03	2.53E-05	4.90E-04	2.53E-05	1.13E-02	2.53E-05	8.35E-01
RU-106	3.18E+04	2.07E+01	3.98E+03	2.07E+01	4.29E+04	2.07E+01	4.94E+05
AG-110M	1.79E+03	1.26E+03	1.04E+03	1.48E+02	2.22E+03	1.48E+02	1.32E+05
TE-125M	3.04E+04	8.25E+03	4.06E+03	8.54E+03	6.73E-02	6.73E-02	2.94E+04
TE-127M	9.30E+04	2.50E+04	1.10E+04	2.22E+04	2.65E+05	4.10E-03	7.53E+04
TE-127	8.94E-01	2.41E-01	1.92E-01	6.19E-01	2.54E+00	2.20E-05	3.49E+01
TE-129M	1.09E+05	3.05E+04	1.70E+04	3.52E+04	3.21E+05	1.08E+00	1.33E+05
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-06
TE-131M	1.48E+03	5.13E+02	5.46E+02	1.05E+03	4.96E+03	7.28E-01	2.08E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	8.15E+03	3.61E+03	4.36E+03	5.26E+03	3.35E+04	4.30E-01	3.63E+04
I-130	6.36E+00	1.27E+01	6.62E+00	1.39E+03	1.90E+01	1.13E-01	6.02E+00
I-131	2.06E+03	2.07E+03	1.18E+03	6.84E+05	3.40E+03	1.51E+00	1.86E+02
I-132	2.60E-04	4.78E-04	2.20E-04	2.22E-02	7.32E-04	0.00E+00	5.63E-04
I-133	4.65E+01	5.74E+01	2.18E+01	1.06E+04	9.56E+01	1.49E-01	2.32E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	3.79E-01	6.82E-01	3.23E-01	6.04E+01	1.05E+00	6.24E-05	5.20E-01
CS-134	7.61E+05	1.25E+06	2.64E+05	2.85E+02	3.87E+05	1.39E+05	7.02E+03
CS-136	4.14E+04	1.14E+05	7.37E+04	1.09E+01	6.06E+04	9.05E+03	4.01E+03
CS-137	1.12E+06	1.07E+06	1.59E+05	4.25E+02	3.50E+05	1.26E+05	7.15E+03
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.51E-05
BA-140	8.64E+03	8.95E+00	5.05E+02	1.38E+00	3.85E+00	5.89E+00	4.38E+03
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	8.30E-01	4.59E-01	3.27E-01	2.59E-01	2.59E-01	2.59E-01	5.56E+03
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-04
CE-141	2.04E+01	1.05E+01	2.18E+00	7.21E-01	5.03E+00	7.21E-01	1.23E+04
CE-143	4.85E-01	1.42E+02	2.44E-01	2.23E-01	2.83E-01	2.23E-01	2.08E+03
CE-144	2.39E+03	7.51E+02	1.30E+02	2.97E+00	4.17E+02	2.97E+00	1.95E+05
PR-143	1.11E+01	3.33E+00	5.51E-01	0.00E+00	1.80E+00	0.00E+00	1.20E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	7.38E+00	6.04E+00	7.88E-01	3.47E-01	3.47E+00	3.47E-01	9.02E+03
W-187	2.65E+01	1.58E+01	7.17E+00	1.77E-01	1.77E-01	1.77E-01	2.19E+03
NP-239	4.00E-01	2.03E-01	1.99E-01	1.88E-01	2.32E-01	1.88E-01	1.13E+03

ORGAN DOSE FACTORS FOR LIQUID EFFLUENTS (Continued)

DOSE FACTOR TABLE: A(i) - Infant
Units are mrem/hr per μCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01
C-14	5.80E+05	1.24E+05	1.24E+05	1.24E+05	1.24E+05	1.24E+05	1.24E+05
NA-24	1.76E+02	1.76E+02	1.76E+02	1.76E+02	1.76E+02	1.76E+02	1.76E+02
P-32	9.00E+05	5.29E+04	3.49E+04	0.00E+00	0.00E+00	0.00E+00	1.22E+04
CR-51	0.00E+00	0.00E+00	7.82E-01	5.10E-01	1.12E-01	9.93E-01	2.28E+01
MN-54	0.00E+00	1.68E+02	3.82E+01	0.00E+00	3.73E+01	0.00E+00	6.18E+01
MN-56	0.00E+00	1.22E-06	0.00E+00	0.00E+00	1.05E-06	0.00E+00	1.11E-04
FE-55	5.61E+02	3.63E+02	9.69E+01	0.00E+00	0.00E+00	1.77E+02	4.61E+01
FE-59	1.04E+03	1.81E+03	7.14E+02	0.00E+00	0.00E+00	5.36E+02	8.66E+02
CO-58	0.00E+00	1.08E+02	2.70E+02	0.00E+00	0.00E+00	0.00E+00	2.70E+02
CO-60	0.00E+00	3.81E+02	8.99E+02	0.00E+00	0.00E+00	0.00E+00	9.06E+02
NI-63	1.72E+05	1.06E+04	5.97E+03	0.00E+00	0.00E+00	0.00E+00	5.29E+02
NI-65	1.47E-04	1.66E-05	7.56E-06	0.00E+00	0.00E+00	0.00E+00	1.27E-03
CU-64	0.00E+00	2.29E+00	1.06E+00	0.00E+00	3.87E+00	0.00E+00	4.70E+01
ZN-65	3.02E+04	1.03E+05	4.77E+04	0.00E+00	5.02E+04	0.00E+00	8.74E+04
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.15E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.14E+05	5.65E+04	0.00E+00	0.00E+00	0.00E+00	2.92E+03
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	5.77E+04	0.00E+00	1.66E+03	0.00E+00	0.00E+00	0.00E+00	1.19E+03
SR-90	3.91E+05	0.00E+00	1.05E+05	0.00E+00	0.00E+00	0.00E+00	7.22E+03
SR-91	4.01E+00	0.00E+00	1.45E-01	0.00E+00	0.00E+00	0.00E+00	4.75E+00
SR-92	1.84E-04	0.00E+00	6.83E-06	0.00E+00	0.00E+00	0.00E+00	1.98E-03
Y-90	4.55E-03	0.00E+00	1.22E-04	0.00E+00	0.00E+00	0.00E+00	6.28E+00
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	3.32E-01	0.00E+00	8.83E-03	0.00E+00	0.00E+00	0.00E+00	2.38E+01
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.31E-04
Y-93	3.06E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-01
ZR-95	3.06E-02	7.45E-03	5.28E-03	0.00E+00	8.03E-03	0.00E+00	3.71E+00
ZR-97	4.31E-05	7.40E-06	3.38E-06	0.00E+00	7.46E-06	0.00E+00	4.72E-01
NB-95	2.81E+00	1.16E+00	6.70E-01	0.00E+00	8.31E-01	0.00E+00	9.78E+02
MO-99	0.00E+00	1.38E+03	2.69E+02	0.00E+00	2.06E+03	0.00E+00	4.55E+02
TC-99M	5.61E-04	1.16E-03	1.49E-02	0.00E+00	1.25E-02	6.05E-04	3.36E-01
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	4.08E-02	0.00E+00	1.37E-02	0.00E+00	8.50E-02	0.00E+00	4.97E-01
RU-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-06	0.00E+00	8.25E-05
RU-106	8.40E-01	0.00E+00	1.05E-01	0.00E+00	9.94E-01	0.00E+00	6.38E+00
AG-110M	1.81E+03	1.32E+03	8.74E+02	0.00E+00	1.89E+03	0.00E+00	6.85E+04
TE-125M	8.48E+02	2.83E+02	1.15E+02	2.85E+02	0.00E+00	0.00E+00	4.04E+02
TE-127M	2.62E+03	8.69E+02	3.17E+02	7.57E+02	6.45E+03	0.00E+00	1.06E+03
TE-127	9.61E-02	3.22E-02	2.07E-02	7.82E-02	2.34E-01	0.00E+00	2.02E+00
TE-129M	3.05E+03	1.05E+03	4.70E+02	1.17E+03	7.63E+03	0.00E+00	1.82E+03
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	2.87E+01	1.16E+01	9.55E+00	2.34E+01	7.96E+01	0.00E+00	1.95E+02
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.41E+02	6.98E+01	6.51E+01	1.03E+02	4.36E+02	0.00E+00	2.58E+02
I-130	8.92E+00	1.96E+01	7.88E+00	2.20E+03	2.16E+01	0.00E+00	4.21E+00
I-131	3.07E+03	3.61E+03	1.59E+03	1.19E+06	4.22E+03	0.00E+00	1.29E+02
I-132	1.30E-05	2.64E-05	9.41E-06	1.24E-03	2.95E-05	0.00E+00	2.14E-05
I-133	6.99E+01	1.02E+02	2.98E+01	1.85E+04	1.20E+02	0.00E+00	1.72E+01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	4.23E-01	8.41E-01	3.07E-01	7.54E+01	9.38E-01	0.00E+00	3.04E-01
CS-134	1.55E+05	2.89E+05	2.92E+04	0.00E+00	7.43E+04	3.05E+04	7.84E+02
CS-136	1.05E+04	3.08E+04	1.15E+04	0.00E+00	1.23E+04	2.51E+03	4.67E+02
CS-137	2.32E+05	2.71E+05	1.92E+04	0.00E+00	7.27E+04	2.94E+04	8.47E+02
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	1.28E+03	1.28E+00	6.61E+01	0.00E+00	3.05E-01	7.88E-01	3.15E+02
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.05E-04	1.20E-04	3.09E-05	0.00E+00	0.00E+00	0.00E+00	1.41E+00
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	2.07E-01	1.26E-01	1.49E-02	0.00E+00	3.89E-02	0.00E+00	6.52E+01
CE-143	3.20E-03	2.12E+00	2.42E-04	0.00E+00	6.18E-04	0.00E+00	1.24E+01
CE-144	9.82E+00	4.02E+00	5.50E-01	0.00E+00	1.62E+00	0.00E+00	5.63E+02
PR-143	7.86E-03	2.94E-03	3.90E-04	0.00E+00	1.09E-03	0.00E+00	4.15E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	4.81E-03	4.94E-03	3.02E-04	0.00E+00	1.90E-03	0.00E+00	3.13E+00
W-187	5.55E-01	3.86E-01	1.33E-01	0.00E+00	0.00E+00	0.00E+00	2.27E+01
NP-239	2.51E-04	2.24E-05	1.27E-05	0.00E+00	4.47E-05	0.00E+00	6.48E-01

GASEOUS MONITOR DETECTOR EFFICIENCIES

R15044 and R15045
(Detector Model RD-52)

Nuclide	Efficiency* cpm/μCi/cc
KR-83M	0.0
KR-85M	7.30 E+07
KR-85	7.19 E+07
KR-87	8.70 E+07
KR-88	8.70 E+07
KR-89	8.70 E+07
KR-90	8.70 E+07
XE-131M	0.0
XE-133M	0.0
XE-133	2.94 E+07
XE-135M	0.0
XE-135	7.75 E+07
XE-137	8.70 E+07
XE-138	8.70 E+07
AR-41	7.80 E+07

* From Calculation Z-RDM-I0261

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS

FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

	Dose to People†		Dose to Air‡	
	Gamma-Body	Beta-Skin	Gamma	Beta
Nuclide	K(i)	L(i)	M(i)	N(i)
AR-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03
KR-83M	7.56E-02	0.00E+00	1.93E+01	2.88E+02
KR-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
KR-85M	1.17E+03	1.46E+03	1.23E+03	1.97E+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-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
XE-133M	2.51E+02	9.94E+02	3.27E+02	1.48E+03
XE-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
XE-135M	3.12E+03	7.11E+02	3.36E+03	7.39E+02
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

† -- mrem/yr per $\mu Ci/m^3$

‡ -- mrad/yr per $\mu Ci/m^3$

ORGAN DOSE FACTORS FOR GASEOUS EFFLUENTS

DOSE FACTOR TABLE: R(i) - Adult, inhalation

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
FE-55	2.46E+04	1.70E+04	3.95E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.35E+04
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.59E+04	0.00E+00	8.88E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
CS-136	3.91E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
CS-137	4.79E+05	6.21E+05	4.28E+05	0.00E+00	2.23E+05	7.52E+04	8.40E+03
BA-140	3.91E+04	4.91E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.27E+03	3.62E+05	1.20E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05

DOSE FACTOR TABLE: R(i) - Teen, inhalation,

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
FE-55	3.35E+04	2.39E+04	5.55E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.67E+04
SR-89	4.35E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
ZR-95	1.46E+05	4.59E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
I-131	3.55E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
I-133	1.22E+04	2.05E+04	6.23E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
CS-134	5.03E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
CS-137	6.71E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
BA-140	5.47E+04	6.71E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
CE-144	4.89E+06	2.02E+06	2.63E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05

ORGAN DOSE FACTORS FOR GASEOUS EFFLUENTS (Continued)

DOSE FACTOR TABLE: R(i) - Child, inhalation

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	1.13E+03	1.13E+03	1.13E+03	1.13E+03	1.13E+03	1.13E+03
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
FE-59	2.07E+04	3.35E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.27E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.96E+05	1.63E+04
SR-89	6.00E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.44E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
I-131	4.81E+04	4.81E+04	2.73E+04	1.63E+07	7.88E+04	0.00E+00	2.84E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.31E+05	1.21E+05	3.85E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-144	6.77E+06	2.12E+06	3.62E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05

DOSE FACTOR TABLE: R(i) - Infant, inhalation

Units are mrem/yr per $\mu Ci/m^3$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	Gitract
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
CR-51	0.00E+00	0.00E+00	8.95E+01	5.76E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.54E+04	4.99E+03	0.00E+00	4.99E+03	1.00E+06	7.06E+03
FE-55	1.97E+04	1.18E+04	3.33E+03	0.00E+00	0.00E+00	8.70E+04	1.10E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.03E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
I-131	3.80E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.85E+06	1.48E+05

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Instrument	Minimum Number of Channels Operable	Action
1. Gross Radioactivity Monitors Providing Automatic Termination of Release		
Retention Basin Effluent Discharge Monitor (R15017A)	1	With the monitor inoperable, effluent releases may be resumed provided that prior to initiating a release from the retention basin: 1) At least two independent samples are analyzed in accordance with Step 6.14.2. 2) 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 the pathway. Exert best efforts to return the monitor to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperable monitor was not restored in a timely manner.
2. Flow Measurement Devices		
Waste Water Flow Rate and Totalizer (FIRQ95108)	1	With the flow measurement device inoperable, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours during retention basin releases by a level device in the discharge stream.
Retention Basin Discharge Flow Rate (FI95001)	1	With the flow rate measurement device inoperable, effluent releases via this pathway may continue provided that the Retention Basin discharge flow rate is estimated using the Waste Water Flow Rate instrument.

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Instrument	Instrument Channel Check	Source Check	Instrument Channel Calibration	Channel Test
1. Gross Radioactivity Monitors Providing Alarm and Automatic Termination Isolation				
Retention Basin Effluent Discharge Monitor (R15017A)	D(1)	P	R(2)	Q(3)
2. Flow Monitors				
Waste Water Flow Rate and Totalizer (FIRQ95108)	D(4)	N/A	R	Q
Retention Basin Discharge Flow Rate (FI95001)	D(4)	N/A	R	Q

Table Notation

(1) During releases via this pathway, a check shall be performed at least once per 24 hours. Normally, checks are automatically performed once every eight (8) hours.

(2) The Instrument Channel Calibration for radioactivity measurement instrumentation shall be performed using one or more reference standards.

(3) The Channel Test shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exist:

A. Instrumentation indicates measured levels above the alarm/trip setpoint.

B. Circuit failure.

C. Instrument indicates a downscale failure.

D. Instrument controls not set in operate mode.

(4) The Instrument Channel Check shall consist of verifying indication of flow during periods of release. The Instrument Channel Check shall be made at least once daily on any day in which batch releases are made.

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity	Lower Limit of Detection (LLD)[a] (μCi/ml)
A. Retention Basin (N/S)[b]	Each Batch P	Each Batch P	Mn-54, Co-60, Zn-65, Cs-134, Cs-137, Ce-144	3.00 E-07
			H-3	1.00 E-05
B. Regenerant Holdup Tank (A/B)[c,d] Standard Release Scenario[f]	Each Batch P	Each Batch P	Mn-54, Co-60	4.00 E-09
			Zn-65	6.00 E-09
			Cs-134, Cs-137	3.00 E-09
			Ce-144	6.00 E-08
			H-3	1.00 E-05
	Each Batch P	Composite[e] M	Sr-90	1.00 E-09
			Gross Alpha	1.00 E-07
C. Regenerant Holdup Tank (A/B)[c,d] Rapid Release Scenario[f]	Each Batch P	Each Batch P	Mn-54, Co-60, Zn-65, Cs-134, Cs-137	2.00 E-08
			Ce-144	6.00 E-08
			H-3	1.00 E-05
	Each Batch P	Composite[e] M	Mn-54, Co-60	4.00 E-09
			Zn-65	6.00 E-09
			Cs-134, Cs-137	3.00 E-09
			Sr-90	1.00 E-09
			Gross Alpha	1.00 E-07

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
(Continued)

Table Notation

(a) 1. The Lower Limits of Detection (LLDs) for the radionuclides presented in this table are the smallest concentrations (expressed in microcuries per milliliter) which are required to be detected, if present, in order to achieve compliance with the limits of Step 6.14.3 (10 CFR 50, Appendix I) for a RHUT transfer to a retention basin and assurance of compliance with the limits of Step 6.14.2 (10 CFR 20, Appendix B, Table 2, Column 2) for a Retention Basin Discharge.

2. The LLD of a radioanalysis system is that value which will indicate the presence or absence of radioactivity in a sample when the probability of a false positive and of a false negative determination is stated. The probabilities of the false positive and false negative are taken as equal at 0.05. The general equation for estimating the maximum LLD in microcuries per milliliter is given by the following:

$$LLD = \frac{2.71/t_s + 3.29 \times S_b}{(3.70\ E+04)(Y \times E \times V)e^{(-\lambda t_c)}}$$

Where:

2.71	=	factor to account for Poisson statistics at very low background count rates
3.29	=	two times the constant used to establish the one sided 0.95 confidence interval
3.70 E+04	=	disintegrations/second/microcurie
Y	=	yield of radiochemical process, i.e., the product of all factors such as emission fraction, chemical yield, etc.
E	=	counting efficiency (count/disintegrations)
V	=	sample volume (milliliters)
λ	=	the radioactive decay constant for the particular nuclide ($seconds^{-1}$)
t_c	=	the elapsed time from midpoint of collection to the midpoint of counting

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM (Continued)

Table Notation (Continued)

S_b = the standard deviation of the background counting rate

$$S_b = \left(\frac{B}{t_b t_s} + \frac{B}{t_b^2} \right)^{0.5}$$

Where:

B = background counts

t_b = background counting interval (seconds)

t_s = sample counting interval (seconds)

3. The LLD is defined as an a priori (before the fact) estimate and is not to be calculated for each sample analyzed on an a posteriori (after the fact) basis.

(b) A batch release is the discharge of liquid wastes of discrete volume from the north or south Retention Basin. The Retention Basins are the maximum permissible concentration accountability points for 10 CFR 20, Appendix B compliance.

(c) A RHUT will be isolated and its contents thoroughly mixed to assure representative sampling prior to transferring the contents to a Retention Basin. The A and B RHUTs are the dose equivalent accountability points for 10 CFR 50, Appendix I compliance.

(d) Isotopic peaks which are measurable and identifiable from a RHUT sample analysis shall be reported and included in ODCM evaluations. Nuclides which are not observed in the analysis shall be reported as "less than" the nuclide's a posteriori minimum detectable concentration and shall not be reported as being present. The "less than" results shall be considered "zero" for the purposes of ODCM evaluations; however, if a nuclide is measured and identified at a value less than the Attachment 15 LLD value, it shall be reported and entered in ODCM evaluations.

(e) A composite sample shall be obtained by mixing liquid aliquot volumes in proportion to the volume of liquid released from each RHUT. Preparation of the composite is identical no matter which release scenario, or combination of scenarios, was used to release the RHUTs. If any RHUT which is part of the composite was released using the Rapid Release Scenario, the composite will be analyzed according to the Rapid Release Scenario.

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM (Continued)

Table Notation (Continued)

(f) Release of each RHUT may proceed along either of two separate scenarios depending on operational requirements. Normally, the Standard Release Scenario will be used for RHUT releases. The Rapid Release Scenario will be used when operational requirements dictate expediting the release process. In either scenario, the sample must eventually be analyzed to an LLD level which equates to an off-site dose of less that 10 percent of the 10 CFR 50, Appendix I guidelines. Preparation of the Monthly Composite is independent of the scenario used to release each RHUT during a calendar month: the composite must be prepared for either scenario, only the analysis requirements differ. These Lower Limits of Detection for either or both scenario may change as the maximum annual effluent outflow or the minimum annual average flow rate in the plant effluent stream changes.

1. Standard Release Scenario. This scenario uses the lower LLDs on a pre-release basis, resulting in correspondingly longer analysis intervals. In this scenario, the monthly composite does not need to be analyzed for gamma emitters. The pre-release and post–release (monthly composite) LLDs equate to an off-site dose of less than 10 percent of the 10 CFR 50, Appendix I guidelines.

2. Rapid Release Scenario. This scenario allows the use of higher LLDs for pre-release dose calculations, resulting in correspondingly shorter analysis intervals. The pre-release LLDs equate to an off-site dose of less than 20 percent of the 10 CFR 50, Appendix I guidelines. The post–release (monthly composite) LLDs equate to an off-site dose of less than 10 percent of the 10 CFR 50, Appendix I guidelines. H-3 and Ce-144 analyses are specifically required only on a pre-release basis. The LLDs for H-3 and Ce-144 are required for the pre-release analysis only, however, these LLDs were included in the determination of post-release LLDs which meet the 10 percent criteria.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Instrument	Minimum Number of Channels Operable	Action
1. Reactor Building Stack		
a. Noble Gas Activity Monitor providing alarm and automatic termination of release.	1	With the monitor channel alarm/trip setpoint less conservative than the setpoint calculated as described in Step 6.6, immediately suspend the release or declare the channel inoperable. With the monitor inoperable, effluent releases via this pathway may continue provided grab samples are taken at least daily and these samples are analyzed in accordance with Attachment 18. Increase grab sample frequency as necessary during unusual plant conditions.
b. Particulate Sampler	1	With the collection device inoperable, effluent releases via this pathway may continue provided continuous samples are taken within 1 hour after the monitor is declared inoperable and these samples are analyzed in accordance with Attachment 18*.
c. Sampler Flow Rate Measurement Device	1	With the flow rate device inoperable, effluent releases via this pathway may continue provided the flow rate is estimated and recorded daily.

* Interruption of continuous sampling is allowed for periods not to exceed 1 hour.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Continued)

Instrument	Minimum Number of Channels Operable	Action
2. Auxiliary Building Stack		
a. Noble Gas Activity Monitor	1	With the monitor alarm/trip setpoint less conservative than the setpoint calculated as described in Step 6.6, immediately suspend the release or declare the channel inoperable. With the monitor inoperable, effluent releases via this pathway may continue provided grab samples are taken at least daily (every 12 hours during fuel handling activities) and these samples are analyzed in accordance with Attachment 18. Increase grab sample frequency as necessary during unusual plant conditions.
b. Particulate Sampler	1	With the collection device inoperable, effluent releases via this pathway may continue provided continuous samples are taken within 1 hour after the monitor is declared inoperable and these samples are analyzed in accordance with Attachment 18*.
c. Sampler Flow Rate Measurement Device	1	With the flow rate device inoperable, effluent releases via this pathway may continue provided the flow rate is estimated and recorded daily.

* Interruption of continuous sampling is allowed for periods not to exceed 1 hour.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Continued)

Instrument	Minimum Number of Channels Operable	Action
3. IOS Building Vent		
a. Particulate Monitor	1	With the monitor inoperable, ventilation flow shall be halted or continuous particulate samples shall be taken in accordance with Attachment 18, Section D, for particulate samples.

* Interruption of continuous sampling is allowed for periods not to exceed 1 hour.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Instrument	Instrument Channel Check	Source Check	Instrument Channel Calibration	Channel Test
1. Reactor Building Stack				
a. Noble Gas Activity Monitor	D	M(4)	R(3)	Q(1)
b. Particulate Sampler	W	NA	NA	NA
c. Sampler Monitor Flow Rate Measurement Device	D	NA	R	Q
2. Auxiliary Building Stack				
a. Noble Gas Activity Monitor	D	M	R(3)	Q
b. Particulate Sampler	W	NA	NA	NA
c. Sampler Monitor Flow Rate Measurement Device	D	NA	R	Q
3. IOS Building Vent				
a. Particulate Sampler	M	NA	R	SA

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS (Continued)

Table Notation

(1) The CHANNEL TEST shall also demonstrate that automatic termination of the purge and control room alarm annunciation occurs if any of the following conditions exist:

- Instrument indicates measured levels above the alarm/trip setpoint.
- Circuit failure.
- Instrument indicates a downscale failure.
- Instrument controls not set in operate mode.

(2) The CHANNEL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exist:

- Instrument indicate measured levels above the alarm/trip setpoint.
- Circuit failure.
- Instrument indicates a downscale failure.
- Instrument controls not set in operate mode.

(3) The INSTRUMENT CHANNEL CALIBRATION shall be performed using one or more reference standards.

(4) A check shall be performed prior to each release and monthly during periods of continuous purging.

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (µCi/ml)
A. Reactor Building Stack	M Grab Sample	M	Kr-85	1.00 E-04
			H-3	1.00 E-06
	Continuous	M Particulate Sample	Principal Gamma Emitters[c]	1.00 E-11
	Continuous	M Particulate Sample	Gross Alpha[e]	1.00 E-11
			Sr-90[d]	1.00 E-11
	Continuous	Continuous (Noble Gas Monitor)	Noble Gases, Gross Beta and Gamma	1.00 E-04 as Xe-133
B. Auxiliary Building Stack	M[b] Grab Sample	M	Kr-85	1.00 E-04
			H-3	1.00 E-06
	Continuous	M Particulate Sample	Principal Gamma Emitters[c]	1.00 E-11
	Continuous	M Particulate Sample	Gross Alpha[e]	1.00 E-11
			Sr-90[d]	1.00 E-11
	Continuous	Continuous (Noble Gas Monitor)	Noble Gases, Gross Beta and Gamma	1.00 E-04 as Xe-133

Table Notation

(a) 1. The Lower Limits of Detection (LLDs) for the radionuclides presented in this table are the smallest concentration (expressed in microcuries per unit volume) which are required to be detected, if present, in order to achieve compliance with the limits of the Specifications in Steps 6.14.6, 6.14.7, and 6.14.8.

2. The LLD of a radioanalysis system is that value which will indicate the presence or absence of radioactivity in a sample when the probability of a false positive and of a false negative determination is stated. The probabilities of the false positive and false negative are taken as equal at 0.05. The general equation for estimating the maximum LLD in microcuries per milliliter is given by the following:

$$LLD = \frac{2.71/t_s + 3.29 \times S_b}{(3.70\,E+04)(Y \times E \times V)e^{(-\lambda t_c)}}$$

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM
(Continued)

Where:

2.71	=	factor to account for Poisson statistics at very low background count rates
3.29	=	two times the constant used to establish the one sided 0.95 confidence interval
3.70 E+04	=	disintegrations/second/microcurie
Y	=	yield of radiochemical process, i.e., the product of all factors such as emission fraction, chemical yield, etc.
E	=	counting efficiency (count/disintegrations)
V	=	sample volume (milliliters)
λ	=	the radioactive decay constant for the particular nuclide (seconds^{-1})
t_c	=	the elapsed time from midpoint of collection to the midpoint of counting

S_b = the standard deviation of the background counting rate

$$S_b = \left(\frac{B}{t_b t_s} + \frac{B}{t_b^2} \right)^{0.5}$$

Where:

B	=	background counts
t_b	=	background counting interval (seconds)
t_s	=	sample counting interval (seconds)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM (Continued)

Table Notation (Continued)

3. The LLD is defined as an a priori (before the fact) estimate and is not to be calculated for each sample analyzed on an a posteriori (after the fact) basis.

(b) Tritium grab samples shall be taken at least once per seven days from the ventilation exhaust from the auxiliary building stack anytime fuel is in the spent fuel pool and the pool temperature exceeds 110°F. Below 110°F there is essentially no evaporation from this source.

(c) Principal gamma emitters for which the LLD applies are: Kr-85 for gaseous samples and Mn-54, Co-60, Zn-65, Cs-134, Cs-137, and Ce-144 for particulate samples. This does not mean only these nuclides will be detected and reported. Other peaks that are measurable and identifiable shall be reported in the Annual Radioactive Effluent Release Report, pursuant to Step 6.15.1. All peaks which are measurable and identifiable shall be reported and entered into the ODCM evaluations. Nuclides which are not observed for the analysis shall be reported as "less than" the nuclide's a posteriori minimum detectable concentration and shall not be reported as being present. The "less than" results shall be considered "zero" for the ODCM evaluations; however, if a nuclide is measured and identified at a value less than the Attachment 18 LLD value, it shall be reported and entered into ODCM evaluations.

(d) A gross beta analysis is performed on a monthly basis for each environmental release particulate sample. If any one of these samples indicates greater than 1.0E-11 µCi/cc gross beta Sr-90 activity, then an analysis will be performed on those samples exceeding this value.

(e) A gross alpha analysis is performed on a monthly basis for each environmental release particulate sample. This fulfills the requirements of performing a monthly composite.

ODCM REVISION REVIEW REQUIREMENTS

ODCM REVISION REVIEW REQUIREMENTS

Whenever the ODCM is revised, no matter what the changes are, several reviews must be performed. These reviews must also be documented. The documentation is often included as an attachment to the 50.59 Safety Determination. This form lists the minimum reviews and documentation required for each change. Initial each requirement as it is completed. Sign the bottom of the form when all review requirements are completed.

Initials

I. Determination that the level of control of radioactive effluents is being maintained.

This determination is made by review of the following documents:

- 10 CFR 20.1301 and 20.1302
- 10 CFR 50.36a
- Appendix I to 10 CFR 50
- 40 CFR 190

_____

II. Determination that the change(s) will not adversely affect the accuracy or reliability of effluent dose calculations or effluent monitor setpoint determinations.

This determination is made by directly reviewing each change to the ODCM. Although each change must be evaluated, changes that directly involve calculations should be more carefully considered. _____

III. Supporting information.

Full justification including analyses and evaluations to support the change(s) must be included in the review and approval package. _____

IV. Notification of NRC.

The NRC is notified of all changes to the ODCM by including a complete, legible copy as part of, or concurrent with, the Annual Radioactive Effluent Release Report (ARERR). To ensure inclusion in the ARERR a CTS item should be initiated whenever the ODCM is revised. _____

V. Implementing Documents.

The following documents should be reviewed for impact whenever the ODCM is revised:

- CAP-0008, Offsite Releases of Radioactivity in Liquid Effluents
- CAP-0009, Offsite Releases of Radioactivity in Liquid Effluents
- CAP-0013, Preparation of the Annual Radioactive Effluent Release Report
- CHM-5107, Compositing of Liquid Samples
- CHM-5109, Effluent Monitor Alarm Response Procedure

_____

VI. Multidiscipline Review

Ensure all areas that may be affected by the revision, or have an interest in the changes made in the revision, are included in the multidiscipline review. Areas that are affected by the ODCM and could be included in this review are: Technical Services, Surveillance Scheduler, Quality Assurance, Licensing, and Operations. _____

All Reviews Complete: _____ _____
Reviewer Signature Date

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ATTACHMENT 3

LEAD DEPARTMENT:
RP/ CHEMISTRY

EFFECTIVE DATE:
11-13-00

REVISION SUMMARY:

1. Revised section 1.0 to include ISFSI Technical Specification bases for dose limits, administrative controls, and pathway analysis.

2. Editorial change to revise reference to "thermoluminesence dosimeter" to "monitoring device". This was overlooked in the last revision as a generic change.

3. Added ISFSI Technical Specification to Section 9.0 as a reference

4. Increased number of monitoring badges from 24 to 25, in Table 1, Item 2, Direct Radiation, to reflect addition of ISFSI monitoring badges added in an earlier revision.

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0.0 POLICY

The Sacramento Municipal Utility District (SMUD) and the Rancho Seco Nuclear Station recognize their responsibility to comply with the Technical Specifications (10 CFR 50 and 10 CFR 72) and the applicable regulations, codes, standards and industry-wide criteria for establishing and maintaining a viable Radiological Environmental Monitoring Program. We are committed to operating the Rancho Seco Nuclear Station in such a manner that will assure proper radiation protection to all employees, contractors and the general public. To this end, we have committed to performing an environmental sampling program, which meets the intent of the applicable regulations while providing an accurate assessment of the radiological environment in and around the environs of the Rancho Seco site.

1.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM BASES

The Sacramento Municipal Utility District and the Rancho Seco Nuclear Station have instituted a Radiological Environmental Monitoring Program (REMP) which this manual serves to implement. The REMP is based upon the information contained in Title 10 of the Code of Federal Regulations, Part 20, Section 1302 (10 CFR 20.1302). That Regulatory basis and associated guidelines have been the foundation of the REMP and its programmatic elements which:

1. Provide the technological basis of, and the instruction for, monitoring the site and environs for radioactivity of all sources, including:

    a. naturally occurring background

    b. releases during normal operations

    c. operational occurrences and postulated accidents

    d. weapons testing and major nuclear accidents, which contribute to detectable radioactivity in the environs.

1. Ensures the annual dose equivalent to any real individual located outside the Independent Spent Fuel Storage Installation (ISFSI) controlled area does not exceed the annual dose limits in 10 CFR 72.104(a).

3. Provide the means to verify the radiological effluent control program of the Rancho Seco Nuclear Station.

4. Meet minimum limits for detecting radioactive isotopes in samples collected from the environs or direct measurements in the field.

5. Provide measurements of radiation and radioactive materials in those exposure pathways, (i.e., liquid, gaseous, and direct radiation), and for those radionuclides, (i.e., cesium, and cobalt), which lead to the highest potential radiation exposure of individuals resulting from station operation.

This Manual contains the minimum requirements for the conduct of the Rancho Seco Radiological Environmental Monitoring Program (REMP). The requirements are consistent with USNRC regulations, the Branch Technical Position (BTP), Radiological Effluent Technical Specifications (RETS) for PWRs (NUREG-0472), the Rancho Seco Permanently Defueled Technical Specifications (PDTS), and the ISFSI Technical Specifications as Administrative Controls.

2.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION

The Radiological Environmental Monitoring Program is under the cognizance of the Nuclear Plant Closure Manager, with the responsibility for the administration and oversight of the program assigned to the Radiation Protection/ Chemistry Superintendent (RP/ Chem Superintendent).

The design of the program is consistent with the intent of Title 10 Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation" Section 1302. To implement these requirements, the Permanently Defueled Technical Specifications, ISFSI Technical Specifications, Off-site Dose Calculation Manual, Health Physics Implementing Procedures, and Surveillance Procedures have been developed. The implementing procedures address specific areas in the program that require direct attention for completion.

2.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM PARAMETERS

The monitoring and sampling aspects of the program are:

- Identification of the effluent release pathways,
- Identification of the human exposure pathways,
- Identification of the land usage parameters by the population within a two mile radius of the site.

Three principal release pathways at Rancho Seco Nuclear Station are:

Gaseous Effluents:
Discharges from the Reactor Building Stack and the Auxiliary Building Stack.

Liquid Effluents:
Discharges which are released from the retention basins via the waste water disposal system [Regenerant Hold Up Tanks (RHUT) A and B].

Direct Radiation:
Radiation that emanates from the ISFSI, plant systems, or radioactive material contained within tanks or other containers, which are within the site boundary to humans outside of the site boundary.

The pathways to human exposure to radioactive materials in the effluent release pathways from Rancho Seco are:

Gaseous

- Inhalation of airborne radioactive material by humans, or by animals that inhale and retain the material in animal products that are consumed by humans, i.e., meat or milk.
- Consumption of radioactive particulate material which, although carried by air currents, is deposited onto or is taken up by water sources or plants consumed by humans, or by animals that provide products that are consumed by humans, i.e., milk or meat.
- Exposure from being immersed in air containing radioactive materials as a gas and/ or particulates.
- Exposure to the direct radiation from radioactive materials that have been deposited onto surfaces from airborne releases.

Liquid

- Drinking of water from the release pathway by humans, or by animals that are a food source for humans.
- The consumption of fish or other animals that have eaten fish or shellfish taken from water within the liquid release pathway.
- The consumption of products of animals that have eaten vegetation that has been irrigated with water from the release pathway.
- The consumption by humans of fruit or vegetation grown in soil irrigated with water from the release pathway.

Direct Radiation

- The exposure to radiation emitted from radioactive materials within the Rancho Seco site boundary. Sources include, but are not limited to, the Borated Water Storage Tank, Demineralized Reactor Coolant Storage Tank, the Interim Onsite Storage Building (IOSB), and the Independent Spent Fuel Storage Installation (ISFSI).

- The exposure from being immersed in the release pathway water, to radiation emanating from material contained in the water.

2.2 ANALYSIS OF EXPOSURE PATHWAYS

Exposure pathways are analyzed through a systematic process, which identifies a sample medium or organism that is found in the effluent pathways. Usage factors are determined that will suitably represent biological concentration, retention or uptake which may ultimately represent a contribution to human exposure. The pathways to human exposure are evaluated through the analysis of data obtained from the performance of a land use census. The performance of the land use census is required by the Permanently Defueled Technical Specifications Section D6.8.3b.2. The analysis of the effluent and exposure pathways enables the selection of sampling and monitoring locations that fall into one of two classes, those which are, and those which are not, influenced by effluent pathways. Those in the pathways are referred to as indicator locations. Several of the unaffected locations are selected to represent baseline or control locations.

Indicator locations provide data from the surrounding environment that may be influenced by the operation of the plant because they are nearby, downwind or downstream in the release pathway. Such data can be used to calculate doses to verify compliance with 40 CFR 190, using methodology contained in the ODCM. [This is referred to as the MEMBER OF THE PUBLIC. The MEMBER OF THE PUBLIC is defined as any individual except when that individual is receiving an occupational dose. A MEMBER OF THE PUBLIC who, based upon the land use census, is expected to receive the maximum off-site dose to real individuals, may be used to calculate doses to demonstrate compliance with 40 CFR 190.]

Control sample locations are to provide data that should not be influenced by the operations of Rancho Seco. These locations are selected based upon the distance from the plant, being upwind, or upstream of the release pathways. Data from these locations help discriminate between Rancho Seco releases and other natural or manmade events that may impact human exposure.

At Rancho Seco, potentially radioactive liquid effluent is discharged into Clay Creek. A continuous flow of Folsom South Canal water is released above the discharge point. The continuous minimum flow and the liquid effluent release are the major effluent release pathway, and thus the exposure pathway for the station during normal operations. Prior to the minimum release rate being established, Clay Creek was a seasonal stream, formed as the confluence of three and one half square miles of drainage runoff upstream of the site. The now continuous flow of Clay Creek intersects Hadselville Creek north and west of California State Highway 104. Hadselville Creek intersects Laguna Creek just east of the Folsom South Canal. Laguna Creek flows into the Cosumnes River approximately 20 miles from Rancho Seco.

Hadselville and Laguna Creeks are also seasonal streams and also receive irrigation runoff during periods when irrigation is used. These streams are the major release pathways for liquid effluents from the site.

The gaseous pathway analysis is related to the land use census. This pathway is not confined by creek banks, but is subject to the meteorological conditions during the time of the release. While not a significant release or exposure pathway, weekly air sampling is performed to determine the dose due to radioactive gaseous releases.

The direct radiation exposure pathway is measured with the use of monitoring devices, which monitor continuously and passively. The dose is integrated over three months to accumulate a statistically significant exposure. The vast majority of the dose integrated by these devices is delivered from primordial elements in the geological surface of the Earth, which contain naturally radioactive elements. A smaller fraction of the dose is delivered by cosmic radiation, which has penetrated the Earth's atmosphere.

3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING

The REMP shall be conducted AT ALL TIMES as specified in Table 1

3.1 With the REMP not being conducted as specified in Table 1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report (AREOR) required by Section 8.1, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions or seasonal unavailability.

3.2 With the level of radioactivity in an environmental sampling medium exceeding the Reporting Level of Table 3 when averaged over any calendar quarter, in addition to complying with the requirements of Section 5.0, FUEL CYCLE DOSE, prepare and submit to the Commission within 30 days after the level of radioactivity has been determined, a Special Report which includes an evaluation of any release conditions, environmental factors or other aspects which caused the Reporting Levels to be exceeded. This report will define corrective actions to reduce emissions such that potential exposures will meet the 10 CFR 50, Appendix I dose guidelines. When more than one of the radionuclides in Table 3 are detected in the sampling medium, the Special Report shall be submitted if the Reporting Level fraction summation equals or exceeds unity (1.0).

When radionuclides other than those in Table 3 are detected and are the result of plant effluents, this Special Report shall be submitted if the potential annual dose to an individual is greater than or equal to the calendar year guidelines of 10 CFR 50, Appendix I. This Special Report is not required if the measured level of radioactivity was not the result of plant effluents; however, the condition shall be reported and described in the AREOR.

3.3 With fresh vegetation samples unavailable from any of the sample locations required by Table 1, identify the cause of the unavailability of samples and the locations for obtaining replacement samples in the next AREOR. The locations from which samples were unavailable may then be deleted from Table 6 provided the locations from which the replacement samples were obtained are added to Table 6 as replacement locations, if available.

3.4 The radiological environmental monitoring samples shall be collected per Table 1 from the locations shown in Table 6. These samples shall be analyzed to the requirements of Table 1 and Table 2.

3.5 The flow measuring devices on the environmental air monitors used for sampling the Table 1 AIRBORNE EXPOSURE PATHWAY shall be subject to a MONTHLY function check and shall be calibrated ONCE EVERY 12 MONTHS.

3.6 The REMP required by Section 1.0 provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides, which lead to the highest potential radiation exposures of individuals resulting from the Station operation. This monitoring program thereby implements Section IV.B.2 of Appendix I to 10 CFR 50 and supplements the REMP by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and Off-site Dose Calculation Manual (ODCM) modeling of the environmental exposure pathways.

Guidance for Section 3.0 was provided by References 9.12 and 9.29. REMP changes may be initiated based on operational experience and changes in the regional population or agricultural practices. The detection capabilities required by Table 2 are state of the art for routine environmental measurements in industrial laboratories. The LLDs for drinking water meet the requirements of 40 CFR 141.

4.0 LAND USE CENSUS

A Land Use Census shall be conducted biennially and shall identify the location of the nearest milk animal, the nearest residence and the nearest garden of greater than 500 square feet producing fresh leafy vegetation in each of the 16 meteorological sectors within a distance of two (2) miles. The location of the nearest milk animal is not required if the Offsite Dose Calculation Manual (ODCM) dose calculations are using conservative dose factors which assume the presence of milk animals within the vicinity of Rancho Seco Nuclear Station. Vegetation sampling may be performed at the Station Site Boundary in lieu of the garden census.

The Land Use Census shall also include information relevant to the liquid effluent pathway and gaseous effluent pathway such that the ODCM and the REMP Manual can be kept current with existing environmental and societal use of land surrounding Rancho Seco.

4.1 The Land Use Census shall be conducted biennially by using methods that will provide the best results, such as door-to-door survey, aerial survey, or by consulting local agriculture authorities The Land Use Census, or portions thereof, shall be conducted during the appropriate time of the year to provide the best results. The results of the Land Use Census shall be included in the AREOR covering the census year as required by Section 8.1.2.

4.2 With the Land Use Census identifying a location(s) which yields a calculated dose or dose commitment greater than the values currently being calculated in the ODCM for compliance with 10 CFR 50, Appendix I, identify the new location(s) in the next AREOR.

4.3 With the Land Use Census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with Section 3.0, Radiological Environmental Monitoring, add the new location(s) to Table 6 within 30 days or submit a Special Report to the Commission that identifies the cause(s) for exceeding these requirements and the proposed corrective actions for precluding recurrence.

The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s) [via the same exposure pathway] may be deleted from Table 6 after October 31 of the census year. Identify the new location(s) in the next AREOR including a revised figure(s) and table for the REMP Manual reflecting the new location(s).

4.4 The Section 4.0 requirements are provided to ensure that changes in the use of unrestricted areas are identified and that modifications to the REMP and the ODCM are made if required by the results of the Land Use Census. These requirements also satisfy the requirements of Section IV.B.3 of Appendix I to 10 CFR 50.

Restricting the Land Use Census to gardens of greater than 500 square feet provides assurance that significant exposure pathway via leafy vegetation consumption will be identified and monitored. Gardens of this size are the minimum required to produce the quantity (26 kg/ year) of leafy vegetation assumed (reference 9.14) to be consumed by a child. In specifying this minimum garden size, it was further assumed that 20 percent of the garden was used for growing broad leaf vegetation (e.g./ lettuce or cabbage) and that the productivity was two- (2) kg/ m^2.

In addition, by gathering information on the liquid effluent pathway and the gaseous effluent pathway, the Land Use Census provides assurance that proper radiological environmental monitoring and radioactive effluent controls are in place for the adequate protection of the health and safety of the general public.

5.0 FUEL CYCLE DOSE

The dose or dose commitment to any real MEMBER OF THE PUBLIC due to releases of radioactive material in gaseous and liquid effluents and to direct radiation from uranium fuel cycle sources shall AT ALL TIMES be limited to less than or equal to 25 mrem (total body or any organ), and 75 mrem (thyroid), in a calendar year.

5.1 With any of the Reporting Levels of Table 3 being exceeded, calculations shall be made to determine whether the Section 5.0 fuel cycle dose/dose commitment limits have been exceeded. Contributions from direct radiation sources (including outside storage tanks, etc.) shall be included in this calculation.

5.2 If the Section 5.0 limits have been exceeded, prepare and submit to the Commission within 30 days a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the Section 5.0 limits. This Special Report shall also include a schedule for achieving conformance with the Section 5.0 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, in a calendar year that includes the release(s) covered by this Special Report. This Special Report shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations.

5.3 If the estimated dose(s) exceeds Section 5.0 limits, and if the release condition resulting in the violation of 40 CFR 190 has not already been corrected, the Special Report shall also include a request for a variance in accordance with the provision of 40 CFR 190. Submittal of the Special Report is considered a timely request, and a variance is granted until USNRC staff action on the request is complete.

5.4 The Section 5.0 requirements are provided, in part, to meet the dose limitations of 40 CFR 190 that have been incorporated into 10 CFR 20. For the Rancho Seco site, it is unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the Station remains within twice the numerical guides for design objectives of 10 CFR 50, Appendix I and if direct radiation is kept small.

The Special Report will describe a course of action, which should result in the limitation of the dose to a MEMBER OF THE PUBLIC for a calendar year to within the 40 CFR 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, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of five (5) miles must be considered.

If the dose to any MEMBER OF THE PUBLIC is evaluated to exceed the requirements of 40 CFR 190, the Special Report along with a request for a variance (provided the release conditions resulting in violation of 40 CFR 190 have not already been corrected) is considered to be a timely request and fulfills the requirements of 40 CFR 190 until USNRC staff action is completed.

An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she receives an occupational dose.

6.0 INTERLABORATORY COMPARISON PROGRAM

The laboratory performing analyses of Table 6 samples pursuant to the requirements of Table 1 shall AT ALL TIMES participate in an Interlaboratory Comparison Program (ICP) approved by the Commission. The ICP approved by the Commission may not always supply tests for the analyses required by Table 6.

Since no Commission approved ICP exists for Monitoring Devices; the laboratory performing analyses of the REMP environmental monitoring devices shall AT ALL TIMES participate in a licensee approved comparison program.

6.1 With ICP analyses not being performed as required in Section 6.0, report the corrective actions taken to prevent a recurrence to the Commission in the AREOR as required by Section 8.1.

6.2 A summary of the results obtained, as a participant in the ICP shall be included in the AREOR as required by Section 8.1.

6.3 The requirement to participate in an ICP is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR 50.

7.0 DEFINITIONS

7.1 FORTNIGHTLY - Once per fourteen (14) days

7.2 INDUSTRIAL AREA - That portion of the Station property, access to which is controlled as described in the NRC approved Security Plan by security fencing, equipment and personnel.

7.3 SITE BOUNDARY - That line beyond which the land is neither owned, nor leased, nor otherwise controlled by the licensee.

7.4 RESTRICTED AREA - An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

7.5 CONTROLLED AREA - An area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

7.6 UNRESTRICTED AREA - An area, access to which is neither limited nor controlled by the licensee.

7.7 MEMBER(S) OF THE PUBLIC - Any individual except when that individual is receiving an occupational dose.

8.0 RADIOLOGICAL REPORT REQUIREMENTS

8.1 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)

8.1.1 An AREOR covering the operation of the Station during the previous calendar year shall be submitted to the USNRC prior to May 1 of each year in accordance with Permanently Defueled Technical Specification D6.9.2.3.

8.1.2 The AREOR shall include summaries and statistical evaluations of the results of the radiological environmental surveillance activities for the report period, including (as appropriate) a comparison with operational controls. The AREOR shall also include the results of the Land Use Census required by Section 4.0, LAND USE CENSUS. In the event a radionuclide concentration should be confirmed in excess of the Reporting Level in Table 3 by environmental measurements, the AREOR shall describe a planned course of corrective action.

8.1.3 The AREOR shall include summarized and tabulated results of all radiological environmental samples taken during the AREOR period. In the event that some results are not available for inclusion, the AREOR shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

8.1.4 The AREOR shall include a summary description of the REMP (including a map of all sampling locations keyed to a table giving distances and directions from the Reactor Building) and the results of participation in the Interlaboratory Comparison Program required by Section 6.0. The AREOR shall also include information related to Section 5.0, Fuel Cycle Dose.

8.2 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (ARERR)

Any changes made to the REMP MANUAL during the ARERR reporting period shall be included in that ARERR. The complete REMP manual, in its revised form, shall be submitted with the ARERR.

9.0 REFERENCES

The following documents pertain to the design and conduct of radiological environmental monitoring programs:

9.1 American National Standards Institute (ANSI), Performance, Testing and Procedural Specifications for Thermoluminesence Dosimetry (Environmental Applications), ANSI Standard N545 (1975).

9.2 American Nuclear Insurers and Mutual Atomic Energy Liability Underwriters (ANI/MAELU), Environmental Monitoring Programs, Information Bulletin 86-1 (1986).

9.3 ANI/MAELU, Engineering Inspection Criteria for Radiological Environmental Monitoring, Section 5.2, Revision 2.

9.4 ANI/MAELU, Nuclear Liability Insurance Records Retention, Information Bulletin 80-1 A, Rev. 2 (1986).

9.5 Committee on the Biological Effects of Ionizing Radiations (BEIR), The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: BEIR V Report (1990).

9.6 National Council on Radiation Protection (NCRP), A Handbook of Radioactivity Measurements Procedures, NCRP Report No. 58, Second Edition (1985).

9.7 NCRP, Radiological Assessment: Predicting the Transport, Bioaccumulation and Uptake by Man of Radionuclides Released to the Environment, NCRP Report No. 76 (1984).

9.8 USEPA, Environmental Standards for the Uranium Fuel Cycle, 40 CFR 190, Subpart B (1993).

9.9 USEPA, Upgrading Environmental Radiation Data, Health Physics Society Committee Report HPSR-1, EPA 520/1-80-012 (1980).

9.10 USNRC, Criterion 64 - Monitoring Radioactive Releases, 10 CFR 50, Appendix A (1993).

9.11 USNRC, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material In Light Water Cooled Nuclear Power Reactor Effluents, 10 CFR 50, Appendix I (1993).

9.12 USNRC, An Acceptable Radiological Environmental Monitoring Program, Branch Technical Position, Rev. 1 (November 1979).

9.13 USNRC, Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Off-site Dose Calculation Manual or the Process Control Program, Generic Letter 89-01 (January 31, 1989).

9.14 USNRC, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I, Regulatory Guide 1.109 (1977).

9.15 USNRC, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, Regulatory Guide 1.113 (1977).

9.16 USNRC, Measuring and Reporting of Radioactivity in the Environs of Nuclear Power Plants, Regulatory Guide 4.1 (1973).

9.17 USNRC, Preparation of Environmental Reports for Nuclear Power Stations, Regulatory Guide 4.2, Rev. 2 (1976).

9.18 USNRC, Performance. Testing and Procedural Specifications for Thermoluminesence Dosimetry: Environmental Applications," Regulatory Guide 4.13.

9.19 USNRC, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Regulatory Guide 4.15, Rev. 1 (1979).

9.20 USNRC, Radiological Assessment: A Textbook on Environmental Dose NUREG/CR-3332 (1983).

9.21 USNRC, Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements, NUREG/CR-4007 (1984).

9.22 USNRC, Radiological Effluent Technical Specifications for PWRs, NUREG-0472, Rev. 2 (July 1979).

9.23 USNRC, Radiological Monitoring by NRC Licensees for Routine Operations of Nuclear Facilities, NUREG-0475 (1978).

9.24 USNRC, Methods for Demonstrating LWR Compliance With the EPA Uranium Fuel Cycle Standard (40 CFR 190), NUREG-O543 (1980).

9.25 USNRC, Dose Limits for individual members of the public, 10 CFR 20.1301 (1993).

9.26 USNRC, Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the limits, 10 CFR 2O.2203 (1993).

9.27 Merril Eisenbud, Environmental Radioactivity From Natural, Industrial. and Military Sources, Third Edition (1987).

9.28 Rancho Seco Permanently Defueled Technical Specifications.

9.29 USNRC, Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station, NUREG/CR-0130 (June 1978)

9.30 USNRC, Air Sampling in the Workplace, Regulatory Guide 8.25, Rev. 1 (June 1992)

9.31 Rancho Seco Independent Spent Fuel Storage Installation Technical Specifications.

10.0 IDENTIFICATION CONVENTION FOR TABLE 6 SAMPLE LOCATIONS

Sampling and monitoring sites designated in Table 6 are identified using the following convention:

10.1 To establish the fact that the Table 6 samples originate from the Rancho Seco REMP, the letter "R" precedes every sample site designator.

10.2 The next two (2) letters are selected to identify SAMPLE TYPE. Refer to Table 4 for a listing of the SAMPLE TYPES and the associated two-letter abbreviation.

10.3 The numbers following the SAMPLE TYPE abbreviation reflect the straight-line distance (miles) to the sample site, referenced to the center of the Reactor Building.

10.4 Following the distance, a SECTOR DESIGNATOR letter is included to specify which of the 16 meteorological sectors the sample site is encompassed. Refer to Table 5 for a listing of the sector designators.

10.5 The final character in the sample site designation is the letter "O" or the letter "P". The letter "O" designates the sample as one being added to the REMP following Station initial criticality. The letter "P" designates the sample as one being added during the post operational period following the issuance of the Possession Only License.

10.6 The present identification convention has been selected in preference to the system originally used to identify samples and sites. Since it is desirable to retain the ability to identify, and continue to use data from, previously collected samples, the former identification convention is also shown parenthetically in Table 6.

11.0 REPORTING RESULTS OF RADIOLOGICAL ENVIRONMENTAL DATA

The requirements for reporting radiological environmental data are specified in Section 8.0 of this manual. Those subsections which require supporting data from the Radiological Environmental Monitoring Program address the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report. Special Reports are made specific in HPIP-2050, Radiological Environmental Monitoring Program Reports. Specified therein are conditions requiring special reports, and reporting requirements in days for submittal. This includes those calculations to provide rapid assurance of the degree of compliance with 10 CFR 50 Appendix I, and 40 CFR 190 calculations after releases of any origin.

12.0 SELECTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS

In conjunction with the data base established from the land use census, the requirements of the Permanently Defueled Technical Specifications, and the guidance described in Section 2.0 of this Manual, the selection of sampling and monitoring sites is performed. These selected locations provide at least the minimum number of locations specified in Table 1.

Data was gathered from the land use census, Lawrence Livermore National Laboratory Rancho Seco Study Reports, Oak Ridge National Laboratory Study Reports, and from additional sampling sites from which materials have been collected. The information gathered was used to determine indicator sites. Presently, a number of control sites have been selected and are not anticipated to be increased in number.

The second column of Table 6 identifies the Sample Class of a particular sample as either an Indicator (IND) or a Control (CON) Sample. Additional sample locations designated as Special (Spec) are used to perform initial radiological evaluations.

Environmental monitoring devices are placed in the environs around the site. These devices passively monitor radiation in the immediate environs. Data from monitoring devices is trended to establish variations, which are influenced by seasonal, meteorological, local and global sources. The monitoring devices will also respond to radiation in the effluents of the plant if they pass in near proximity. The data is included in each quarterly environmental report.

Sample locations for the collection of the flora and fauna are concentrated in the liquid effluent pathway to the West. Representative samples of all the pathways and suitable locations are established in all directions. Air samplers are distributed to achieve a sampling of air from major wind directions across the site.

The Radiological Environmental Monitoring Program maintains at least those minimum sampling locations and type of samples to meet the requirements listed in Table 1.

A site has been established for a vegetable garden. The garden is at the site boundary alongside Clay Creek, and irrigated with water from the effluent stream. This data is considered essential for comparisons to vegetation not irrigated with effluent stream water for determination of bioaccumulation for soil types common to the environs.

All of the environmental sample locations required for the Radiological Environmental Monitoring Program are designated in Table 6. Additional sampling locations are listed in HPIP-2070, REMP Routes and Sample Locations.

13.0 Radiological Environmental Monitoring Program (REMP) Manual Changes

As required by the Permanently Defueled Technical Specifications (PDTS) section D6.14.3, changes to the REMP manual shall be documented and the records of the reviews performed for the changes shall be retained as required by the PDTS section D6.10.2.o. The documentation shall contain sufficient information to support the change together with the appropriate analyses or evaluations justifying the change.

The documentation shall also contain a determination that the change will maintain the level of radioactive effluent control that is required by 10 CFR 20.1302, 40CFR190, 10 CFR 50.36a, and Appendix I to 10CFR50 and not adversely impact the accuracy or reliability of effluent dose or setpoint calculations.

Changes to the REMP manual shall become effective after review and acceptance by the PRC and approval by the Plant Manager.

Changes to the REMP manual shall be submitted to the Nuclear Regulatory Commission in the form of a complete, legible copy of the entire REMP Manual as a part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change to the REMP Manual was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changes, and shall indicate the date (e.g., month/ year) the change was implemented.

Table 1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/ or Sample	Number of Samples*	Sampling and Collection Frequency	Type and Frequency of Analysis
1. AIRBORNE	3	Continuous operation of sampler with sample collection as required by dust loading but at least once per week	Particulate sampler. Analyze for Gross Beta radioactivity at least 24 hours following filter change. Perform gamma isotopic analysis on each sample where gross beta activity is greater than 10 times the yearly mean of control samples for the same sample period. Perform gamma isotopic analysis on composite (by location) sample at least once per quarter.
2. DIRECT RADIATION	At least 25 locations with 2 monitoring devices at each location	At least once per quarter	Gamma dose. At least once per quarter
3. WATERBORNE			
a. Surface	2	Composite sample collected monthly	Gamma isotopic and tritium analysis of each composite
	3	Grab sample collected monthly	Gamma isotopic and tritium analysis of each sample
b. Runoff	1	Grab sample collected fortnightly	Gamma isotopic and tritium analysis of each sample

* Sample locations are shown in Table 6

Table 1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/ or Sample	Number of Samples*	Sampling and Collection Frequency	Type and Frequency of Analysis
3. WATERBORNE c. Ground	2	Grab sample collected quarterly	Gross Beta, Gamma isotopic, and Tritium analysis of each sample
d. Drinking	2	Grab sample collected monthly	Gross Beta, Gamma isotopic, and Tritium analysis of each sample.
e. Mud and Silt	2	At least quarterly. Sample collected of the top 3" of material 2 ft. from shoreline.	Gamma isotopic analysis of each sample.
4. INGESTION a. Fish	1	At least semiannually. At least one sample of either of the species listed in Table 6	Gamma isotopic analysis of the edible portion of each sample.
b. Food	1	At least semiannually. One sample of vegetable(s) as shown in Table 6	Gamma isotopic analysis of the edible portion of each sample.

* Sample locations are shown in Table 6

Table 2

MAXIMUM VALUES FOR THE LOWER LIMIT OF DETECTION, LLD [a,c]

Analysis	Water (pCi/ l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/ kg-wet)	Food Products (pCi/ kg-wet)	Mud and Silt (pCi/ kg-wet)
Gross Beta	4[b]	0.01			
H-3	2000 (1000[b])				
Mn-54	15		130		
Co-60	15		130		150[(e)]
Zn-65	30		260		
Cs-134	15 (10[b])	0.01[d]	130	60	150
Cs-137	18 (10[b])	0.01[d]	130	60	150

Table 2

MAXIMUM VALUES FOR THE LOWER LIMIT OF DETECTION, LLD [a,c]

[a] The Low Limit of Detection (LLD) values for the radionuclides presented in Table 2 are those recommended in Reference 9.12 (BTP) and Reference 9.22 (RETS).

The LLD of a radioanalysis system is that value which will indicate the presence or absence of radioactivity in a sample when the probability of a false position and of a false negative determination is stated. The probabilities of the false positive and false negative determinations are taken as equal to 0.05. The equation for estimating the maximum LLD is given by the following equation:

$$LLD = \frac{2.71/t_s + 3.29S_b}{3.7E - 2(YEV)\exp(-\lambda t_c)}$$, pCi/ l, pCi/kg-wet, or pCi/M^3

where:

2.71	=	factor to account for Poisson statistics at very low background count rate
3.29	=	twice the constant used to establish the one-sided 0.95 confidence interval
S_b	=	standard deviation of the background count rate
	=	$[B / (t_b t_s) + B / t_b^2]^{0.5}$
B	=	background counts
t_b	=	background count interval, sec
t_s	=	sample count interval, sec
3.7E-2	=	conversion factor, dis/ sec/ pCi
Y	=	radiochemical process yield (product of all factors such as abundance, chemical yield, etc.)
E	=	counting efficiency, cts/ dis
V	=	sample volume or mass, l or kg
λ	=	radioactive decay constant for the associate nuclide

Table 2

MAXIMUM VALUES FOR THE LOWER LIMIT OF DETECTION, LLD [a,d]

t_c = elapsed time from the midpoint of sample collection to the midpoint of counting, sec

The LLD is defined as an *a priori* (before the fact) estimate and is not to be calculated for each sample analyzed on an *a posteriori* (after the fact) basis.

Occasionally, unavoidably small sample sizes or other uncontrollable circumstances may result in *a priori* LLD values not being met. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

b LLD for Drinking Water samples from Reference 9.22 (RETS).

c Other peaks which are measurable and identifiable, together with the nuclides in Table 2, shall be identified and reported.

d Composite analysis LLD from Reference 9.22 (RETS) is shown; individual sample LLD is 0.05 pCi/m^3. This LLD (0.05 pCi/m^3) is a site specific value.

e LLD for Mud and Silt Co-60 is not required by Reference 9.22 (RETS). This value is consistent with the RETS required LLD for Cs-134 and Cs-137.

Table 3

REPORTING LEVELS FOR REMP MEASUREMENTS

Analysis	Water (pCi/ l)	Airborne Particulate or Gases (pCi/ m^3)	Fish (pCi/ kg-wet)	Food Products (pCi/ kg-wet)
H-3	20000[a]			
Mn-54	1000		30000	
Co-60	300		10000	
Zn-65	300		20000	
Cs-134	30	10	1000	1000
Cs-137	50	20	2000	2000
Gross Beta	40[b]	2[c]		

a Applies to water samples utilized for human consumption only. This value is as specified in 40 CFR 141.

b Gross Beta activity in water of ten times the yearly mean of the control samples is indicated as the level that gamma isotopic analysis should be performed on the individual sample [Reference 9.12 (BTP)]. Gamma isotopic analysis on each water sample is required by Table 1 and therefore this reporting requirement does not apply.

c Gross Beta activity in air of ten (10) times the yearly mean of the control samples is indicated as the level that Gamma Isotopic analysis should be performed on the individual sample. The value indicated is site specific.

Table 4

TWO LETTER DESIGNATION TO IDENTIFY THE TYPE OF SAMPLE [a]

Letter Designation	Type of Sample Represented
AG	Algae Sample
AS	Air Sample
FS	Fish Sample
LV	Garden Vegetation
MS	Mud & Silt (Sediment)
RW	Runoff Water
SW	Surface Water[b]
TL	Direct Radiation (Monitoring Badge)
WW	Ground (Well) Water
DW	Drinking Water
SL	Soil

a Additional letter designation may be added as sample designators if additional sample types are collected for analysis.

b The portion of precipitation on the land that ultimately reaches streams is considered to be surface water.

Table 5

SECTOR LETTER DESIGNATIONS USED IN SAMPLE IDENTIFICATION

Sector	Sector Degrees	True North Compass Sector
A	348.75 to 11.25	N
B	11.25 to 33.75	NNE
C	33.75 to 56.25	NE
D	56.25 to 78.75	ENE
E	78.75 to 101.25	E
F	101.25 to 123.75	ESE
G	123.75 to 146.25	SE
H	146.25 to 168.75	SSE
J	168.75 to 191.25	S
K	191.25 to 213.75	SSW
L	213.75 to 236.25	SW
M	236.25 to 258.75	WSW
N	258.75 to 281.25	W
P	281.25 to 303.75	WNW
Q	303.75 to 326.25	NW
R	326.25 to 348.75	NNW

Table 6

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Sample Identification (Former ID)	Sample Class	Collection Frequency	Location Identification
AIR (Particulates)			
RASO.1C0 (RAHO)	IND	Weekly	On Site (PAP Building Carport)
RASO.3MO	IND	Weekly	On Site (Effluent Discharge)
RASO.7EO	IND	Weekly	Meteorological Tower
RUNOFF WATER			
RRW0.6MO	IND	Biweekly	Site Boundary
SURFACE WATER			
RSWO.7NO	IND	Monthly	Water Sump
RSW1.3F0 (RSWC0)	IND	Monthly	Rancho Seco Reservoir
RSW3.7N0 (RSWB0)	CON	Monthly	Folsom South Canal (Composite Sample)
RSW1.8N0	IND	Monthly	Confluence of Clay and Hadselville Creeks
RSWO.3M0	IND	Monthly	Effluent Discharge (Composite Sample)

Table 6 (continued)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Sample Identification (Former ID)	Sample Class	Collection Frequency	Location Identification
GROUND (Well) WATER			
RWW0.3EO (RWWAO)	IND	Quarterly	Site Well
RWW0.8DO	CON	Quarterly	Marciel Ranch
DRINKING WATER			
RWD0.1GO	IND	Monthly	Industrial Area Drinking Water Source
RDW1.8FP	CON	Monthly	Rancho Seco Lake Drinking Water Source
MUD AND SILT (Sediment)			
RMS0.3MO	IND	Quarterly	Effluent Discharge
RMS0.6MO (RMSEO)	IND	Quarterly	Site Boundary
FISH*			
RFS0.6MO	IND	Semiannually	Clay Creek near the Site Boundary

NOTE: Include predator (e.g., bass, sunfish) or scavenger (e.g., catfish, sucker) species, as available.

* Other downstream locations may be substituted to meet sampling requirements.

Table 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Sample Identification (Former ID)	Sample Class	Collection Frequency	Location Identification	
GARDEN VEGETABLES				
RLV0.6MO	IND	Semiannually	Site Boundary Vegetable Irrigation Garden (vegetable samples, depending on availability)	
RLVXX.XX (RLVFO)	CON	Semiannually	Truck Farm, outside 5 mile radius. (locally grown vegetable samples, depending on availability)	
MONITORING DEVICE				
RTL0.3RO	IND	Quarterly	#1	Rancho Seco Site
RTLO.3CO	IND	Quarterly	#2	Rancho Seco Parking Lot
RTLO.3NO	IND	Quarterly	#3	Rancho Seco Site
RTL0.3LO	IND	Quarterly	#4	Rancho Seco Site
RTL0.3HO	IND	Quarterly	#5	Rancho Seco Site
RTL0.4FO	IND	Quarterly	#6	SMUD Photovoltaic Facility
RTL0.5CO	IND	Quarterly	#7	Rancho Seco Entrance
RTLO.6KO	IND	Quarterly	#11	Tokay Substation/ Clay East Rd.
RTL2.7MO	IND	Quarterly	#16	Tipling Residence
RTL8.2KO	CON	Quarterly	#17	Elliot Cemetery
RTL7.8CO	CON	Quarterly	#18	Sam Jaber Residence

Table 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Sample Identification (Former ID)	Sample Class	Collection Frequency		Location Identification
MONITORING DEVICE				
RTL1.8FO	IND	Quarterly	#19	Rancho Seco Lake
RTL1.5MO	IND	Quarterly	#20	Clay East Road & Kirkwood
RTL3.9KO	IND	Quarterly	#26	Borden Road
RTL7.4MO	CON	Quarterly	#30	Herald Fire Department
RTL3.7NO	IND	Quarterly	#31	Hobay Road
RTL3.8MO	IND	Quarterly	#33	Folsom South Canal Pumping Station
RTL1.9NO	IND	Quarterly	#35	Hadselville Creek and Plant Effluent Water
RTL1.7FO	IND	Quarterly	#43	Rancho Seco Reservoir
RTL1.4DO	IND	Quarterly	#46	Twin Cities Road (Highway 104)
RTL8.0PO	CON	Quarterly	#55	Colony Road
RTL0.8DO	IND	Quarterly	#63	Marciel Ranch
RTL0.6MO	IND	Quarterly	#65	Site Boundary Irrigated Garden
RTL0.3PO	IND	Quarterly	#68	West Fence, adjacent to ISFSI
RTL0.3NP	IND	Quarterly	#88	ISFSI outer Security fence, near inactive West Garden
RTL0.4NP	IND	Quarterly	#89	ISFSI outer Security fence, SW corner
RTL0.5NP	IND	Quarterly	#90	ISFSI outer Security fence, NW corner
RTL0.3QP	IND	Quarterly	#91	ISFSI outer Security fence, NE corner