

Offsite Dose Calculation Manual  
Revision 13

Peach Bottom Atomic Power Station  
Units 2 and 3

02.2008

Exelon Nuclear  
Docket Nos. 50-277 & 50-278

Table of Contents

- I. Purpose
- II. Instrument Setpoints
- III. Liquid Pathway Dose Calculations
  - A. Liquid Radwaste Release Flow Rate Determination
  - B. ODCMS 4.8.B.2.1
  - C. ODCMS 4.8.B.4.1
- IV. Gaseous Pathway Dose Calculations
  - A. ODCMS 4.8.C.1.1 and 4.8.C.1.2
  - B. ODCMS 4.8.C.2.1
  - C. ODCMS 4.8.C.3.1
  - D. ODCMS 4.8.C.5.1
  - E. Technical Requirements Manual Test Requirement (TR)  
3.5.3
  - F. ODCMS 4.8.C.7.1 and 4.8.C.7.2
- V. Nuclear Fuel Cycle Dose Assessment - 40 CFR 190 and  
10 CFR 72.104
  - A. ODCMS 4.8.D.1.1 and 4.8.D.1.2
- VI. Radiological Environmental Monitoring Program
  - A. ODCMS 4.8.E.1.1 and 4.8.E.1.2
- VII. Bases
- Appendix A Radioactive Effluents Control Program

## I. Purpose

The purpose of the Offsite Dose Calculation Manual is to establish methodologies and procedures for calculating doses to individuals in areas at and beyond the SITE BOUNDARY due to radioactive effluents from Peach Bottom Atomic Power Station. The results of these calculations are required to determine compliance with the requirements of Specification 5.5.4, "Radioactive Effluent Controls Program" of Appendix A to Operating Licenses DPR-44 and DPR-56, "Technical Specifications for Peach Bottom Atomic Power Station Units No. 2 and 3". The Radioactive Effluents Control Program is located in Appendix A of this Offsite Dose Calculation Manual and contains Offsite Dose Calculation Manual Specifications (ODCMS) and their associated Bases which implement the requirements of Technical Specification 5.5.4.

## II. Setpoint Determination for Liquid & Gaseous Monitors

### II.A Liquid Radwaste Activity Monitor Setpoint

02.2008 | A sketch of the Liquid Radwaste System is presented in Figure 4. Each tank of radioactive waste is sampled prior to release. A small liquid volume of this sample is analyzed for gross gamma activity in a NaI well counter. This NaI well counter activity is then converted to an equivalent liquid radwaste monitor reading.

$$\text{CPS (R/W Monitor)} = [\text{Net CPM/ml (well)} \times \text{Eff W/RW}] + \text{Background CPS}$$

Where:

$$\text{CPS (R/W Monitor)} = \text{liquid radwaste gross activity monitor reading in CPS}$$

$$\text{Net CPM/ml (well)} = \text{gross gamma activity for the radwaste sample tank [determined by the well counter]}$$

$$\text{Eff W/RW} = \text{conversion factor between well counter and liquid radwaste gross activity monitor [determined by calibrating both detectors with the same liquid radioactive source]}$$

$$\text{Background CPS} = \text{background reading of the liquid radwaste gross activity monitor in CPS}$$

Exceeding the expected response would indicate that an incorrect sample had been obtained for that release and the release is automatically stopped.

The alarm and trip pot setpoints for the liquid radwaste activity monitor are determined from a calibration curve for the alarm pot and trip pot. The alarm pot setting includes a factor of 1.25 to allow for analysis error, pot setting error, instrument error and calibration error. The trip pot setting includes a factor of 1.35 to allow for analysis error, pot setting error, instrument error and calibration error.

## II.B Liquid Radwaste Release Flowrate Setpoint Determination

The trip pot setpoint for the liquid radwaste release flowrate is determined by multiplying the liquid radwaste flowrate (from Section III.A) by 1.2 and using this value on the appropriate calibration curve for the discharge flow meter to be used. The Peach Bottom radwaste system has two flow monitors - high flow (5 to 300 gpm) and low flow (0.8 to 15 gpm). The factor of 1.2 allows for pot setting error and instrument error. The flow rate determination includes a margin of assurance which includes consideration of this error such that the instantaneous release limit of 10 CFR 20 is not exceeded.

## II.C Setpoint Determination for Gaseous Radwaste

02.2008 | A sketch of the Offgas Radwaste Treatment System is presented in Figure 2. Sketches of the Ventilation Treatment Systems for Units 2 and 3 are presented in Figures 3 and 4 respectively. The high and high-high alarm setpoints for the main stack radiation monitor, Unit 2 roof vent radiation monitor and Unit 3 roof vent radiation monitor are determined as follows:

02.2008 | High Alarm - the high alarm setpoint is set at approximately 3 x background.

02.2008 | High-High Alarm - the high-high alarm setpoint is set at a release rate from this vent of approximately 30% of the instantaneous release limit as specified in ODCMS 3.8.C.1.a for the most restrictive case (skin or total body) on an unidentified basis. To determine these setpoints, solve the gaseous effluent dose rate equations in section IV.A of the ODCM to determine what main stack release rate and roof vent release rate will produce a dose rate of 150 mrem/yr to the total body (30% of the limit of 500 mrem/yr) and a dose rate of 900 mrem/yr to the skin (30% of the limit of 3000 mrem/yr) from each release point. Using the highest (most restrictive) release rate for each release point determine monitor response required to produce this release rate assuming a normal vent flow rate and pressure correction factor. Set the high-high alarm for approximately this monitor response.

## II.D. Setpoint Determination for Gaseous Radwaste

### Flow Monitors

The alarm setpoint for the main stack flow monitor is as follows:

Low Flow Alarm - 10,000 CFM. - This setting ensures that the main stack minimum dilution flow as specified in ODCMS 3.8.C.4.a is maintained.

The alarm setpoints for the roof vent flow monitors are as follows:

Low Flow Alarm -  $1.5 \times 10^5$  cfm

High Flow Alarm -  $5.4 \times 10^5$  cfm

## III. Liquid Pathway Dose Calculations

### III.A Liquid Radwaste Release Flow Rate Determination

Peach Bottom Atomic Power Station Units 2 and 3 have one common discharge point for liquid releases. The following calculation assures that the radwaste release limits are met.

The flow rate of liquid radwaste released from the site to areas at and beyond the SITE BOUNDARY shall be such that the concentration of radioactive material after dilution shall be limited to 10 times the concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than noble gases and  $2E-4$   $\mu\text{Ci/ml}$  total activity concentration for all noble gases as specified in ODCMS 3.8.B.1. This methodology is consistent with the additional guidance the NRC provided to the industry during the implementation of the updated 10 CFR 20 which changed the criterion for controlling release rate based on Effective Concentration (EC) values in the updated 10 CFR 20 as opposed to the Maximum Permissible Concentration (MPC) values in the former 10 CFR 20.

Each tank of radioactive waste is sampled prior to release and is quantitatively analyzed for identifiable gamma emitters as specified in Table 4.8.B.1 of the ODCMS. While non-gamma emitters are not specifically addressed, the conservatism inherent in the calculation of the maximum permissible release rate are more than adequate to account for them. From this gamma isotopic analysis the maximum permissible release flow rate is determined as follows:

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Determine a Dilution Factor by:

$$\text{Dilution Factor} = \sum_i \frac{\mu\text{Ci} / \text{ml}_i}{10 \times \text{ECL}_i} \quad 1$$

$\mu\text{Ci} / \text{ml}_i$  = the activity of each identified gamma emitter in  $\mu\text{Ci}/\text{ml}$

$\text{ECL}_i$  = The effluent concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than noble gases or  $2 \times 10^{-4} \mu\text{Ci}/\text{ml}$  for noble gases.

Determine the Maximum Permissible Release Rate with this Dilution Factor by:

$$\text{Release Rate (gpm)} = \frac{A \times 2.0 \times 10^5}{B \times C \times \text{Dilution Factor}}$$

A = The number of circulating water pumps running which will provide dilution

$2.0 \times 10^5$  = the flow rate in gpm for each circulating water pump running

B = margin of assurance which includes consideration of the maximum error in the activity setpoint, the maximum error in the flow setpoint, and possible loss of 5 out of the 6 possible circulating water pumps during a release. The value used for B is 10.0.

C = concentration gradient factor. The value used for C is 5.0 for discharge canal water levels less than 104' and 3.0 for canal water levels greater than 104'. This just adds another factor of conservatism.

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### III.B ODCMS 4.8.B.2.1

Dose contributions from liquid effluents released to areas at and beyond the SITE BOUNDARY shall be calculated using the equation below. This dose calculation uses those appropriate radionuclides listed in Table III.A.1. These radionuclides account for virtually 100 percent of the total body dose and organ dose from liquid effluents.

The dose for each age group and each organ should be calculated to determine the maximum total body dose and organ dose for each quarter and the year, as appropriate. Cumulative dose files for quarterly and yearly doses should be maintained separately and the maximum total body and organ dose reported in each case. CM-1 NRC URI 88-33-01, T00353.

$$D_{\tau} = \sum_i \left[ A_{ir} \sum_{\ell=1}^m \Delta t_{\ell} C_{i\ell} F_{\ell} \right]$$

where:

- $D_{\tau}$  = The cumulative dose commitment to the total body or any organ,  $\tau$ , from liquid effluents for the total time period  $\sum_{\ell=1}^m \Delta t_{\ell}$ , in mrem.
- $\Delta t_{\ell}$  = The length of the  $\ell$ th time period over which  $C_{i\ell}$  and  $F_{\ell}$  are averaged for the liquid release, in hours.
- $C_{i\ell}$  = The average concentration of radionuclide,  $i$ , in undiluted liquid effluent during time period  $\Delta t_{\ell}$  from any liquid release, (determined by the effluent sampling analysis program, ODCMS Table 4.8.B.1), in  $\mu\text{Ci/ml}$ .
- $A_{ir}$  = The site related ingestion dose commitment factor to the total body or organ,  $\tau$ , for each radionuclide listed in Table III.A.1, in mrem-ml per hr- $\mu\text{Ci}$ . See Site Specific Data.\*\*
- $F_{\ell}$  = The near field average dilution factor for  $C_{i\ell}$  during any liquid effluent release. Defined as the ratio of the maximum undiluted liquid waste flow during release to the average flow through the discharge pathway.

### III.C ODCMS 4.8.B.4.1

Projected dose contributions from liquid effluents shall be calculated using the methodology described in section III.B.

\*\* See Note 1 in Bases

TABLE III.A.1LIQUID EFFLUENT INGESTION DOSE FACTORS  
(DECAY CORRECTED) $A_{it}$  DOSE FACTOR (MREM-ML PER HR- $\mu$ Ci)

<u>RADIO- NUCLIDE</u>	<u>TOTAL BODY</u>		
	<u>ADULT</u>	<u>TEEN</u>	<u>CHILD</u>
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	5.93E+04	6.49E+04	8.33E+04
02.2008 CR-51	1.49E+00	1.53E+00	1.69E+00
MN-54	9.82E+02	1.00E+03	1.08E+03
FE-55	1.31E+02	1.40E+02	1.96E+02
FE-59	1.14E+03	1.17E+03	1.36E+03
02.2008 CO-57	4.55E+01	4.71E+01	5.78E+01
CO-58	2.59E+02	2.62E+02	3.17E+02
CO-60	7.40E+02	7.48E+02	9.07E+02
ZN-65	3.87E+04	3.95E+04	4.16E+04
SR-89	8.83E+02	9.45E+02	1.48E+03
SR-90	1.88E+05	1.56E+05	1.72E+05
Y-91M	5.85E-13	6.14E-13	9.35E-14
Y-93	1.27E-03	1.34E-03	2.16E-03
NB-95	1.52E+02	1.56E+02	1.68E+02
NB-95M	no data	no data	no data
ZR-95	1.77E-01	1.72E-01	3.48E-01
02.2008 ZR-97	1.56E-03	1.56E-03	3.43E-03
MO-99	2.91E+01	3.01E+01	5.53E+01
TC-99M	3.33E-02	3.33E-02	4.93E-02
RU-103	3.57E+00	3.60E+00	5.97E+00
RU-105	1.73E-01	1.78E-01	3.16E-01
AG-110M	2.13E+00	2.04E+00	4.23E+00

02.2008	SN-113	no data	no data	no data
	TE-129M	2.01E+03	2.17E+03	2.79E+03
	TE-131M	4.57E+02	4.81E+02	5.74E+02
	TE-132	1.40E+03	1.44E+03	1.65E+03
02.2008	SB-124	6.33E+02	6.54E+02	7.54E+02
	SB-125	2.15E+02	2.51E+02	3.08E+02
	I-131	1.86E+02	1.79E+02	2.36E+02
	I-133	1.97E+01	2.03E+01	3.20E+01
02.2008	I-135	2.04E+00	2.06E+00	3.12E+00
	CS-134	6.74E+05	3.88E+05	1.49E+05
	CS-136	9.79E+04	9.15E+04	7.30E+04
	CS-137	3.98E+05	2.20E+05	8.49E+04
02.2008	CS-138	2.65E-09	2.78E-09	3.25E-09
02.2008	BA-139	5.01E-07	5.17E-07	1.18E-06
	BA-140	3.66E+01	3.62E+01	7.42E+01
	LA-140	1.92E-02	1.97E-02	2.78E-02
	LA-142	2.46E-08	2.52E-08	3.59E-08
02.2008	CE-141	1.45E-02	1.46E-02	3.86E-02
	CE-143	1.68E-03	1.69E-03	4.44E-03

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1  
LIQUID EFFLUENT INGESTION DOSE FACTORS  
(DECAY CORRECTED)

$A_{it}$  DOSE FACTOR (MREM-ML PER HR- $\mu$ Ci)

<u>RADIO- NUCLIDE</u>	<u>LIVER</u>		
	<u>ADULT</u>	<u>TEEN</u>	<u>CHILD</u>
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	9.55E+04	1.04E+05	1.01E+05
02.2008 CR-51	no data	no data	no data
MN-54	5.15E+03	5.06E+03	4.03E+03
FE-55	5.62E+02	6.01E+02	6.33E+02
FE-59	2.96E+03	3.02E+03	2.73E+03
02.2008 CO-57	2.74E+01	2.81E+01	2.86E+01
CO-58	1.16E+02	1.14E+02	1.04E+02
CO-60	3.35E+02	3.32E+02	3.07E+02
ZN-65	8.55E+04	8.46E+04	6.69E+04
SR-89	no data	no data	no data
SR-90	no data	no data	no data
Y-91M	no data	no data	no data
Y-93	no data	no data	no data
NB-95	2.83E+02	2.84E+02	2.35E+02
NB-95M	no data	no data	no data
ZR-95	2.61E-01	2.50E-01	3.91E-01
02.2008 ZR-97	8.43E-03	3.39E-03	5.82E-03
MO-99	1.53E+02	1.58E+02	2.23E+02
TC-99M	2.61E-03	2.57E-03	2.98E-03
RU-103	no data	no data	no data
RU-105	no data	no data	no data
AG-110M	3.58E+00	3.36E+00	5.30E+00

02.2008	SN-113	no data	no data	no data
	TE-129M	4.74E+03	5.09E+03	5.02E+03
	TE-131M	5.48E+02	5.77E+02	5.40E+02
	TE-132	1.48E+03	1.53E+03	1.36E+03
	SB-124	3.01E+01	3.09E+01	2.79E+01
02.2008	SB-125	9.57E+01	1.17E+01	1.04E+02
	I-131	3.25E+02	3.32E+02	4.16E+02
	I-133	6.48E+01	6.66E+01	8.45E+01
02.2008	I-135	5.52E+00	5.55E+00	1.63E+00
	CS-134	8.25E+05	8.36E+05	7.06E+05
	CS-136	1.36E+05	1.36E+05	1.13E+05
	CS-137	6.07E+05	6.32E+05	5.75E+05
	CS-138	5.34E-09	5.56E-09	5.12E-09
02.2008	BA-139	1.22E-08	1.25E-08	2.17E-08
	BA-140	7.00E-01	6.90E-01	1.11E+00
	LA-140	7.28E-02	7.40E-02	8.25E-02
	LA-142	9.89E-08	1.01E-07	1.15E-07
02.2008	CE-141	1.28E-01	1.27E-01	2.60E-01
	CE-143	1.52E+01	1.51E+01	3.07E+01

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1LIQUID EFFLUENT INGESTION DOSE FACTORS  
(DECAY CORRECTED) $A_{it}$  DOSE FACTOR (MREM-ML PER HR- $\mu$ Ci)

<u>RADIO- NUCLIDE</u>	<u>BONE</u>		
	<u>ADULT</u>	<u>TEEN</u>	<u>CHILD</u>
H-3	no data	no data	no data
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	2.38E+05	2.58E+05	3.35E+05
02.2008 CR-51	no data	no data	no data
MN-54	no data	no data	no data
FE-55	8.12E+02	8.47E+02	1.19E+03
FE-59	1.26E+03	1.30E+03	1.68E+03
02.2008 CO-57	no data	no data	no data
CO-58	no data	no data	no data
CO-60	no data	no data	no data
ZN-65	2.69E+04	2.43E+04	2.51E+04
SR-89	3.08E+04	3.30E+04	5.19E+04
SR-90	7.67E+05	6.31E+05	6.78E+05
Y-91M	1.51E-11	1.61E-11	2.57E-11
Y-93	4.58E-02	4.90E-02	7.77E-02
NB-95	5.08E+02	5.12E+02	6.04E+02
NB-95M	no data	no data	no data
02.2008 ZR-95	8.13E-01	7.94E-01	1.78E+00
ZR-97	1.69E-02	1.71E-02	4.03E-02
MO-99	no data	no data	no data
TC-99M	9.24E-04	9.22E-04	1.52E-03
RU-103	8.30E+00	8.43E+00	1.55E+01
RU-105	4.39E-01	4.59E-01	8.71E-01
AG-110M	3.87E+00	3.55E+00	7.84E+00

02.2008	SN-113	no data	no data	no data
	TE-129M	1.27E+04	1.37E+04	1.80E+04
	TE-131M	1.12E+03	1.21E+03	1.56E+03
	TE-132	2.29E+03	2.42E+03	3.07E+03
	SB-124	1.60E+03	1.68E+03	2.15E+03
	SB-125	4.75E+03	1.07E+03	1.39E+03
	I-131	2.28E+02	2.38E+02	4.13E+02
	I-133	3.72E+01	3.92E+01	6.84E+01
	I-135	2.11E+00	2.16E+00	3.66E+00
	CS-134	3.47E+05	3.55E+05	4.30E+05
	CS-136	3.45E+04	3.46E+04	4.10E+04
	CS-137	4.44E+05	4.75E+05	6.01E+05
02.2008	CS-138	2.70E-09	2.90E-09	3.68E-09
	BA-139	1.71E-05	1.77E-05	4.07E-05
	BA-140	5.57E+02	5.63E+02	1.27E+03
	LA-140	1.44E-01	1.51E-01	2.36E-01
	LA-142	2.18E-07	2.28E-07	3.94E-07
02.2008	CE-141	1.89E-01	1.90E-01	5.21E-01
	CE-143	2.06E-02	2.07E-02	5.66E-02

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1LIQUID EFFLUENT INGESTION DOSE FACTORS  
(DECAY CORRECTED) $A_{it}$  DOSE FACTOR (MREM-ML PER HR- $\mu$ Ci)

RADIO- NUCLIDE	KIDNEY		
	<u>ADULT</u>	<u>TEEN</u>	<u>CHILD</u>
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	no data	no data	no data
02.2008 CR-51	3.28E-01	3.35E-01	2.57E-01
MN-54	1.53E+03	1.51E+03	1.13E+03
FE-55	no data	no data	no data
FE-59	no data	no data	no data
02.2008 CO-57	no data	no data	no data
CO-58	no data	no data	no data
CO-60	no data	no data	no data
ZN-65	5.72E+04	5.41E+04	4.22E+04
SR-89	no data	no data	no data
SR-90	no data	no data	no data
Y-91M	no data	no data	no data
Y-93	no data	no data	no data
NB-95	2.79E+02	2.75E+02	2.21E+02
NB-95M	no data	no data	no data
ZR-95	4.09E-01	3.68E-01	5.60E-01
02.2008 ZR-97	5.14E-03	5.14E-03	8.35E-03
MO-99	3.46E+02	3.61E+02	4.77E+02
TC-99M	3.96E-02	3.83E-02	4.33E-02
RU-103	3.17E+01	2.97E+01	3.91E+01
RU-105	5.68E+00	5.78E+00	7.66E+00
AG-110M	7.04E+00	6.40E+00	9.86E+00

02.2008	SN-113	no data	no data	no data
	TE-129M	5.31E+04	5.74E+04	5.29E+04
	TE-131M	5.55E+03	6.01E+03	5.22E+03
	TE-132	1.43E+04	1.47E+04	1.27E+04
02.2008	SB-124	no data	no data	no data
	SB-125	no data	no data	no data
	I-131	5.57E+02	5.73E+02	6.82E+02
	I-133	1.12E+02	1.16E+02	1.41E+02
02.2008	I-135	8.86E+00	8.77E+00	1.01E+01
	CS-134	2.67E+05	2.66E+05	2.19E+05
	CS-136	7.57E+04	7.42E+04	6.00E+04
	CS-137	2.06E+05	2.15E+05	1.87E+05
	CS-138	3.92E-09	4.10E-09	3.60E-09
02.2008	BA-139	1.14E-08	1.18E-08	1.90E-08
	BA-140	2.38E-01	2.34E-01	3.62E-01
	LA-140	no data	no data	no data
	LA-142	no data	no data	no data
02.2008	CE-141	5.94E-02	5.98E-02	1.14E-01
	CE-143	6.70E-03	6.77E-03	1.29E-02

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1LIQUID EFFLUENT INGESTION DOSE FACTORS  
(DECAY CORRECTED) $A_{it}$  DOSE FACTOR (MREM-ML PER HR- $\mu$ Ci)

<u>RADIO- NUCLIDE</u>	<u>GI-LLI</u>		
	<u>ADULT</u>	<u>TEEN</u>	<u>CHILD</u>
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	1.73E+05	1.41E+05	5.98E+04
02.2008 CR-51	3.74E+02	2.57E+02	8.98E+01
MN-54	1.58E+04	1.04E+04	3.38E+03
FE-55	3.22E+02	2.60E+02	1.17E+02
FE-59	9.90E+03	7.15E+03	2.84E+03
02.2008 CO-57	6.94E+02	5.24E+02	2.34E+02
CO-58	2.35E+03	1.56E+03	6.04E+02
CO-60	6.30E+03	4.33E+03	1.70E+03
ZN-65	5.38E+04	3.58E+04	1.18E+04
SR-89	4.94E+03	3.93E+03	2.01E+03
SR-90	2.22E+04	1.77E+04	9.13E+03
Y-91M	4.44E-11	7.58E-10	5.03E-08
Y-93	1.45E+03	1.50E+03	1.18E+03
NB-95	1.72E+06	1.21E+06	4.35E+05
NB-95M	no data	no data	no data
ZR-95	8.27E+02	5.78E+02	4.08E+02
ZR-97	1.06E+03	9.19E+02	8.81E+02
02.2008 MO-99	3.54E+02	2.82E+02	1.85E+02
TC-99M	1.54E+00	1.69E+00	1.69E+00
RU-103	9.69E+02	7.04E+02	4.01E+02
RU-105	2.69E+02	3.70E+02	5.69E+02
AG-110M	1.46E+03	9.43E+02	6.30E+02

02.2008	SN-113	no data	no data	no data
	TE-129M	6.40E+04	5.15E+04	2.19E+04
	TE-131M	5.44E+04	4.63E+04	2.19E+04
	TE-132	7.02E+04	4.85E+04	1.37E+04
	SB-124	4.53E+04	3.38E+04	1.35E+04
02.2008	SB-125	5.93E+04	4.85E+04	2.13E+04
	I-131	8.58E+01	6.57E+01	3.70E+01
	I-133	5.82E+01	5.03E+01	3.40E+01
02.2008	I-135	6.24E+00	6.16E+00	5.03E+00
	CS-134	1.44E+04	1.04E+04	3.80E+03
	CS-136	1.55E+04	1.09E+04	3.96E+03
	CS-137	1.18E+04	9.00E+03	3.60E+03
	CS-138	2.28E-14	2.52E-12	2.36E-09
02.2008	BA-139	3.04E-05	1.58E-04	2.35E-03
	BA-140	1.15E+03	8.69E+02	6.43E+02
	LA-140	5.34E+03	4.25E+03	2.30E+03
	LA-142	7.22E-04	3.08E-03	2.27E-02
02.2008	CE-141	4.89E+02	3.63E+02	3.24E+02
	CE-143	5.69E+02	4.54E+02	4.49E+02

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

IV. Gaseous Pathway Dose CalculationsIV.A. ODCMS 4.8.C.1.1 and 4.8.C.1.2

The dose rate in areas at and beyond the SITE BOUNDARY due to radioactive materials released in gaseous effluents shall be determined by the expressions below:

IV.A.1 Noble Gases:

The dose rate from radioactive noble gas releases shall be determined by either of two methods. Method (a), the Gross Release Method, assumes that all noble gases released are the most limiting nuclide - Kr-88 for total body dose (vent and stack releases) and skin dose (vent releases) and Kr-87 for skin dose (stack releases). Method (b), the Isotopic Analysis Method, utilizes the results of noble gas analyses required by ODCMS 4.8.C.1.1.

## a. Gross Release Method

$$D_{TB} = V \dot{Q}_{NS} + K \left( \overline{\chi/Q} \right)_V \dot{Q}_{NV}$$

$$D_S = \left[ L_S \left( \overline{\chi/Q} \right)_S + 1.1B \right] \dot{Q}_{NS} + \left[ L_V + 1.1M \right] \left( \overline{\chi/Q} \right)_V \dot{Q}_{NV}$$

where:

The location is the site boundary, 1097m SSE from the vents. This location results in the highest calculated dose to an individual from noble gas releases.

$D_{TB}$  = total body dose rate, in mrem/yr.

$D_S$  = skin dose rate, in mrem/yr.

$V$  =  $4.72 \times 10^{-4}$  mrem/yr per  $\mu\text{Ci/sec}$ ; the constant for Kr-88 accounting for the gamma radiation from the elevated finite plume. This constant was developed using MARE program with plant specific inputs for PBAPS.

## IV.A.1.a (Cont'd)

- $\dot{Q}_{NS}$  = The gross release rate of noble gases from the stack determined by gross activity stack monitors averaged over one hour, in  $\mu\text{Ci}/\text{sec}$ .
- K =  $1.47 \times 10^4$  mrem/yr per  $\mu\text{Ci}/\text{m}^3$ ; the total body dose factor due to gamma emissions for Kr-88 (Reg. Guide 1.109, Table B-1).
- 12.2008 |  $(\overline{\chi/Q})_V$  =  $9.19 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY for all vent releases.
- $\dot{Q}_{NV}$  = The gross release rate of noble gases in gaseous effluents from vent releases determined by gross activity vent monitors averaged over one hour, in  $\mu\text{Ci}/\text{sec}$ .
- $L_V$  =  $2.37 \times 10^3$  mrem/yr per  $\mu\text{Ci}/\text{m}^3$ ; the skin dose factor due to beta emissions for Kr-88. (Reg. Guide 1.109, Table B-1).
- $L_S$  =  $9.73 \times 10^3$  mrem/yr per  $\mu\text{Ci}/\text{m}^3$ ; the skin dose factor due to beta emissions for Kr-87. (Reg. Guide 1.109, Table B-1).
- $(\overline{\chi/Q})_S$  =  $9.97 \times 10^{-8}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.
- B =  $1.74 \times 10^{-4}$  mrad/yr per  $\mu\text{Ci}/\text{sec}$ ; the constant for Kr-87 accounting for the gamma radiation from the elevated finite plume. This constant was developed using MARE program with plant specific inputs for PBAPS.
- M =  $1.52 \times 10^4$  mrad/yr per  $\mu\text{Ci}/\text{m}^3$ ; the air dose factor due to gamma emissions for Kr-88. (Reg. Guide 1.109, Table B-1).
- 1.1 = Unit conversion, converts air dose to skin dose, mrem/mrad.

## IV.A.1. b. Isotopic Analysis Method

$$D_{TB} = \sum_i \left( V_i \dot{Q}_{iS} + K_i \left( \overline{\chi/Q} \right)_V \dot{Q}_{iV} \right)$$

$$D_S = \sum_i \left[ \left( L_i \left( \overline{\chi/Q} \right)_S + 1.1B_i \right) \dot{Q}_{iS} + \left( L_i + 1.1M_i \right) \left( \overline{\chi/Q} \right)_V \dot{Q}_{iV} \right]$$

where:

The location is the site boundary, 1097m SSE from the vents. This location results in the highest calculated dose to an individual from noble gas releases.

$D_{TB}$  = total body dose rate, in mrem/yr.

$D_S$  = skin dose rate, in mrem/yr.

$V_i$  = The constant for each identified noble gas radionuclide for the gamma radiation from the elevated finite plume. The constants were developed using the MARE program with plant specific inputs for PBAPS. Values are listed on Table IV.A.1, in mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

$\dot{Q}_{iS}$  = The release rate of noble gas radionuclide, i, in gaseous effluents from the stack determined by isotopic analysis averaged over one hour, in  $\mu\text{Ci}/\text{sec}$ .

$K_i$  = The total body dose factor due to gamma emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrem/yr per  $\mu\text{Ci}/\text{m}^3$ .

12.2008 |  $\left( \overline{\chi/Q} \right)_V$  =  $9.19 \times 10^{-7} \text{ sec}/\text{m}^3$ ; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY for all vent releases.

$\dot{Q}_{iV}$  = The release rate of noble gas radionuclide, i, in gaseous effluents from all vent releases determined by isotopic analysis averaged over one hour, in  $\mu\text{Ci}/\text{sec}$ .

$L_i$  = The skin dose factor due to beta emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrem/yr per  $\mu\text{Ci}/\text{m}^3$ .

## IV.A.1.b (Cont'd)

- $(\overline{\chi/Q})_S$  =  $9.97 \times 10^{-8}$  sec/m<sup>3</sup>; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.
- $B_i$  = The constant for each identified noble gas radionuclide accounting for the gamma radiation from the elevated finite plume. The constants were developed using MARE program with plant specific inputs for PBAPS. Values are listed on Table IV.A.1, in mrad/yr per  $\mu\text{Ci}/\text{sec}$ .
- $M_i$  = The air dose factor due to gamma emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrad/yr per  $\mu\text{Ci}/\text{m}^3$ .
- 1.1 = Unit conversion, converts air dose to skin dose, mrem/mrad.

TABLE IV.A.1 - Constants for Isotopic Analysis Method  
(corrected for decay during transit)

{PRIVATE } Radionuclide	Plume-Air Dose Factor $B_i$ (mrad/yr per $\mu\text{Ci/sec}$ )	Total Body Dose Factor $K_i$ (mrem/yr per $\mu\text{Ci/m}^3$ )	Skin Dose Factor $L_i$ (mrem/yr per $\mu\text{Ci/m}^3$ )	Gamma Air Dose Factor $M_i$ (mrad/yr per $\mu\text{Ci/m}^3$ )	Beta Air Dose Factor $N_i$ (mrad/yr per $\mu\text{Ci/m}^3$ )	Plume-Body Dose Factor $V_i$ (mrem/yr per $\mu\text{Ci/sec}$ )
Kr-85m	4.02E-05	1.17E+03	1.46E+03	1.23E+03	1.97E+03	3.76E-05
Kr-87	1.74E-04	5.92E+03	9.73E+03	6.17E+03	1.03E+04	1.66E-04
Kr-88	4.90E-04	1.47E+04	2.37E+03	1.52E+04	2.93E+03	4.72E-04
Xe-133	1.19E-05	2.94E+02	3.06E+02	3.53E+02	1.05E+03	1.11E-05
Xe-133m	1.09E-05	2.51E+02	9.94E+02	3.27E+02	1.48E+03	1.01E-05
Xe-135	6.37E-05	1.81E+03	1.86E+03	1.92E+03	2.46E+03	5.95E-05
Xe-135m	6.61E-05	2.53E+03	5.76E+02	2.72E+03	5.99E+02	6.17E-05
Xe-138	1.52E-04	6.98E+03	3.26E+03	7.28E+03	3.75E+03	1.46E-04

The values  $K_i$ ,  $L_i$ ,  $M_i$ , and  $N_i$  are taken from Reg. Guide 1.109, Table B-1. The values  $B_i$  and  $V_i$  were developed using the MARE program with plant specific inputs for PBAPS.

IV.A.2 Iodine-131, iodine-133, tritium and radioactive materials in particulate form, other than noble gases, with half-lives greater than eight days:

The dose rate shall be determined for either of two critical organs and most restrictive age group. Child thyroid dose is limiting when iodine releases exceed 10 percent of the total release rates. The teenager lung dose is limiting when iodine is either not present or a small fraction of the total release.

When it is not clear which organ dose will be limiting, doses for both restrictive age group organs will be calculated and the limiting organ dose identified.

$$D = \sum_i P_i [W_S \dot{Q}_{iS} + W_V \dot{Q}_{iV} + W_V \dot{Q}_{iV}]$$

where:

The location is the site boundary, 1097m SSE from the vents.

- $D$  = dose rate to the critical organ most restrictive age group, in mrem/yr.
- $P_i$  = The dose parameter for radionuclides other than noble gases for the inhalation pathway. The dose factors are based on the critical organ, and most restrictive age group. All values are from Reg. Guide 1.109 (Tables E-5, E-8, E-9 and E-10). Values are listed on Table IV.A.2, in mrem/yr per  $\mu\text{Ci}/\text{m}^3$
- $W_S$  =  $1.03 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY from stack releases. (SSE boundary)
- $\dot{Q}_{iS}$  = The release rate of radionuclides; i, in gaseous effluents from the stack determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1) in  $\mu\text{Ci}/\text{sec}$ .
- $W_V$  =  $4.78 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY for all vent releases. (SSE boundary)

## IV.A.2. (Cont'd)

$\dot{Q}_{iv}$  = The release rate of radionuclide,  $i$ , in gaseous effluents from all vent releases, determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1) in  $\mu\text{Ci}/\text{sec}$ .

$q_{iv}$  = The release rate of radionuclide,  $i$ , in gaseous effluents from the auxiliary boiler stack releases, determined by the oil sampling and analysis program (ODCM Specification Table 4.8.C.1) in  $\mu\text{Ci}/\text{sec}$  as calculated below:

$$= \sum_i \frac{C_{iv} \times 3785 \times Z}{T}$$

where:

The location is the site boundary, 1097m SSE from the vents.

$C_{iv}$  = activity concentration measured in oil for nuclide,  $i$ , in  $\mu\text{Ci}/\text{ml}$ .

3785 = milliliters per gallon.

$Z$  = gallons of oil consumed.

$T$  = number of seconds used for release  
 Method (a) 60 second  
 Method (b) number of seconds used to burn oil for release.

TABLE IV.A.2  
Pi CONSTANTS FOR CRITICAL ORGAN FOR THE  
MOST RESTRICTIVE AGE GROUP

(mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

RADIONUCLIDE	INFANT THYROID DOSE FACTOR	INFANT LUNG DOSE FACTOR	CHILD THYROID DOSE FACTOR	TEENAGER LUNG DOSE FACTOR
H-3	6.47E+02	6.47E+02	1.13E+03	1.27E+03
C-14	5.31E+03	5.31E+03	6.73E+03	4.87E+03
NA-24	1.06E+04	1.06E+04	1.61E+04	1.38E+04
P-32	no data	no data	no data	no data
Cr-51	5.75E+01	1.28E+04	8.55+01	2.10E+04
MN-54	no data	1.00E+06	no data	1.98E+06
FE-55	no data	8.69E+04	no data	1.24E+05
MN-56	no data	1.25E+04	no data	1.52E+04
CO-58	no data	7.77E+05	no data	1.34E+06
FE-59	no data	1.02E+06	no data	1.53E+06
CO-60	no data	4.51E+06	no data	8.72E+06
NI-63	no data	2.09E+05	no data	3.07E+05
CU-64	no data	9.30E+03	no data	1.11E+04
NI-65	no data	8.12E+03	no data	9.36E+03
ZN-65	no data	6.47E+05	no data	1.24E+06
ZN-69	no data	1.47E+03	no data	1.58E+03
BR-83	no data	no data	no data	no data
BR-84	no data	no data	no data	no data
BR-85	no data	no data	no data	no data
BR-86	no data	no data	no data	no data
BR-88	no data	no data	no data	no data
BR-89	no data	no data	no data	no data

12.2008

	SR-89	no data	2.03E+06	no data	2.42E+06
	SR-90	no data	1.12E+07	no data	1.65E+07
	Y-90	no data	2.69E+05	no data	2.93E+05
	SR-91	no data	5.26E+04	no data	6.07E+04
	Y-91M	no data	2.79E+03	no data	3.20E+03
	Y-91	no data	2.45E+06	no data	2.94E+06
	SR-92	no data	2.38E+04	no data	2.74E+04
	Y-92	no data	2.45E+04	no data	2.68E+04
	Y-93	no data	7.64E+04	no data	8.32E+04
	NB-95	no data	4.79E+05	no data	7.51E+05
	ZR-95	no data	1.75E+06	no data	2.69E+06
	ZR-97	no data	1.10E+05	no data	1.30E+05
	MO-99	no data	1.35E+05	no data	1.54E+05
	TC-99M	no data	8.11E+02	no data	1.15E+03
	TC-101	no data	5.84E+02	no data	6.67E+02
	RU-103	no data	5.52E+05	no data	7.83E+05
	RU-105	no data	1.57E+04	no data	1.82E+04
	RU-106	no data	1.16E+07	no data	1.61E+07
12.2008	AG-110M	no data	3.67E+06	no data	6.75E+06
	TE-125M	1.62E+03	4.47E+05	1.92E+03	5.36E+05
	TE-127M	4.87E+03	1.31E+06	6.07E+03	1.66E+06
	TE-127	1.85E+00	1.04E+04	1.96E+00	1.12E+04
	TE-129M	5.47E+03	1.68E+06	6.33E+03	1.98E+06
	TE-129	6.75E-02	3.00E+03	7.14E-02	3.30E+03
	I-130	1.60E+06	no data	1.85E+06	no data
	I-131	1.48E+07	no data	1.62E+07	no data
	TE-131M	8.93E+01	1.99E+05	9.77E+01	2.38E+05
	TE-131	1.58E-02	2.06E+03	1.70E-02	2.34E+03

	I-132	1.69E+05	no data	1.94E+05	no data
	TE-132	2.79E+02	3.40E+05	3.18E+02	4.49E+05
	I-133	3.56E+06	no data	3.85E+06	0.00E+00
	CS-134	no data	7.97E+04	0.00E+00	1.46E+05
	I-134	4.45E+04	no data	5.07E+04	no data
	I-135	6.96E+05	no data	7.92E+05	no data
	CS-136	no data	1.18E+04	no data	1.78E+04
	CS-137	no data	7.13E+04	no data	1.21E+05
	CS-138	no data	6.54E+01	no data	7.87E+01
	BA-139	no data	5.95E+03	no data	6.46E+03
	BA-140	no data	1.60E+06	no data	2.03E+06
	LA-140	no data	1.68E+05	no data	2.14E+05
	BA-141	no data	2.97E+03	no data	3.29E+03
12.2008	CE-141	no data	5.17E+05	no data	6.14E+05
	BA-142	no data	1.55E+03	no data	1.91E+03
	LA-142	no data	8.22E+03	no data	1.02E+04
	CE-143	no data	1.16E+05	no data	1.30E+05
	PR-143	no data	4.33E+05	no data	4.83E+05
	CE-144	no data	9.84E+06	no data	1.34E+07
	PR-144	no data	1.61E+03	no data	1.75E+03
	ND-147	no data	3.22E+05	no data	3.72E+05
	W-187	no data	3.96E+04	no data	4.74E+04
	NP-239	no data	5.95E+04	no data	6.49E+04

IV.B. ODCMS 4.8.C.2.1

The air dose in areas at and beyond the SITE BOUNDARY due to noble gases released in gaseous effluents shall be determined by the expressions below.

The air dose shall be determined by either of two methods. Method (a), the Gross Release Method, assumes that all noble gases released are the most limiting nuclide - Kr-88 for gamma radiation and Kr-87 for beta radiation. Method (b), the Isotopic Analysis Method, utilizes the results of noble gas analyses required by ODCMS 4.8.C.1.1.

## IV.B.1 for gamma radiation:

## a. Gross Release Method

$$D_{\gamma} = 3.17 \times 10^{-8} \left[ M \left( \overline{\chi/Q} \right)_V \tilde{Q}_V + B \tilde{Q}_S \right]$$

where:

The location is the SITE BOUNDARY 1097m SSE from the vents. This location results in the highest calculated gamma air dose from noble gas releases.

$D_{\gamma}$  = gamma air dose, in mrad.

$3.17 \times 10^{-8}$  = years per second.

M =  $1.52 \times 10^4$  mrad/yr per  $\mu\text{Ci}/\text{m}^3$ ; the air dose factor due to gamma emissions for Kr-88. (Reg. Guide 1.109, Table B-1)

$\left( \overline{\chi/Q} \right)_V$  =  $9.19 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_V$  = The gross release of noble gas radionuclides in gaseous effluents from all vents, determined by gross activity vent monitors, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year as appropriate.

## IV.B.1. a (Cont'd)

$B$  =  $4.90 \times 10^{-4}$  mrad/year per  $\mu\text{Ci}/\text{sec}$ ; the constant for Kr-88 accounting for the gamma radiation from the elevated finite plume. The constant was developed using the MARE program with plant specific inputs for PBAPS.

$\tilde{Q}_S$  = The gross release of noble gas radionuclides in gaseous releases from the stack determined by gross activity stack monitor in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year as appropriate.

## b. Isotopic Analysis Method

$$D_\gamma = 3.17 \times 10^{-8} \sum_i \left[ M_i \left( \overline{\chi/Q} \right)_v \tilde{Q}_{iV} + B_i \tilde{Q}_{iS} \right]$$

where:

The location is the SITE BOUNDARY, 1097m SSE from the vents. This location results in the highest calculated gamma air dose from noble gas releases.

$D_\gamma$  = gamma air dose, in mrad.

$3.17 \times 10^{-8}$  = years per second.

$M_i$  = The air dose factor due to gamma emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrad/yr per  $\mu\text{Ci}/\text{m}^3$ .

$\left( \overline{\chi/Q} \right)_v$  =  $9.19 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_{iV}$  = The release of noble gas radionuclides,  $i$ , in gaseous effluents from all vents as determined by isotopic analysis, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

$B_i$  = The constant for each identified noble gas radionuclide accounting for the gamma radiation for the elevated finite plume. The constants were developed using the MARE program with plant specific inputs for PBAPS. Values are listed on Table IV.A.1, in mrad/yr per  $\mu\text{Ci}/\text{sec}$ .

## IV.B.1. b. (Cont'd)

$\tilde{Q}_{is}$  = The release of noble gas radionuclides, i, in gaseous effluents from the stack determined by isotopic analysis, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

## IV.B.2. for beta radiation:

## a. Gross Release Method

$$D_{\beta} = 3.17 \times 10^{-8} N \left[ \left( \overline{\chi/Q} \right)_V \tilde{Q}_V + \left( \overline{\chi/Q} \right)_S \tilde{Q}_S \right]$$

where:

The location is the SITE BOUNDARY 1097m SSE from the vents. This location results in the highest calculated gamma air dose from noble gas releases.

$D_{\beta}$  = beta air dose, in mrad.

$3.17 \times 10^{-8}$  = years per second.

$N$  =  $1.03 \times 10^4$  mrad/yr per  $\mu\text{Ci}/\text{m}^3$ ; the air dose factor due to beta emissions for Kr-87. (Reg. Guide 1.109, Table B-1)

12.2008

$\left( \overline{\chi/Q} \right)_V$  =  $9.19 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_V$  = The gross release of noble gas radionuclides in gaseous effluents from all vents determined by gross activity vent monitors, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

$\left( \overline{\chi/Q} \right)_S$  =  $9.97 \times 10^{-8}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_S$  = The gross release of noble gas radionuclides in gaseous releases from the stack determined by gross activity stack monitors, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

## IV.B.2. b. Isotopic Analysis Method

$$D_{\beta} = 3.17 \times 10^{-8} \sum_i N_i \left[ \left( \overline{\chi/Q} \right)_V \tilde{Q}_{iV} + \left( \overline{\chi/Q} \right)_S \tilde{Q}_{iS} \right]$$

$3.17 \times 10^{-8}$  = years per second.

$N_i$  = The air dose factor due to beta emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrad/yr per  $\mu\text{Ci}/\text{m}^3$ .

12.2008

$\left( \overline{\chi/Q} \right)_V$  =  $9.19 \times 10^{-7}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_{iV}$  = The release of noble gas radionuclide,  $i$ , in gaseous effluents from all vents as determined by isotopic analysis, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

$\left( \overline{\chi/Q} \right)_S$  =  $9.97 \times 10^{-8}$  sec/ $\text{m}^3$ ; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_{iS}$  = The release of noble gas radionuclide,  $i$ , in gaseous effluents from the stack as determined by isotopic analysis, in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

IV.C ODCMS 4.8.C.3.1

The dose to an individual from iodine-131, iodine-133, tritium and radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to areas at and beyond the SITE BOUNDARY.

The dose shall be determined for the limiting organ. Infant thyroid doses are dominating any time that either iodine-131 release rates are more than two (2) percent of total release rates or iodine-133 exceeds 25 percent of total release rates. In these cases only iodine-131 and iodine-133 are potentially significant.

For cases where there is no detectable iodine releases, doses shall be determined for infant bone and liver. Both bone and liver doses are calculated because the controlling dose is dependent upon the presence of strontium.

## IV.C (Continued)

When it is not clear whether thyroid, bone, or liver doses are controlling, all three shall be calculated and the limiting dose identified.

$$D = 3.17 \times 10^{-8} \sum_i F_e R_i \left[ W_S \tilde{Q}_{iS} + W_V \tilde{Q}_{iV} + W_W \tilde{Q}_{iW} \right]$$

where:

Location is the critical pathway dairy 1431m WSW from vents.

$D$  = limiting dose to the critical infant organ, from the milk, or inhalation, or ground plane pathways, in mrem.

$3.17 \times 10^{-8}$  = years per second.

$F_e$  = Fraction that is elemental (0.5 for iodines and 1.0 for all other elements).

$R_i$  = The dose factor for each identified radionuclide;  $i$ , in  $m^2$  (mrem/yr) per  $\mu\text{Ci}/\text{sec}$  except tritium, which is in mrem/yr per  $\mu\text{Ci}/m^3$ . The dose factors are for the critical individual organ for the most restrictive age group, infant. Values are listed in Table IV.C.1 for the ingestion pathway, Table IV.C.2 for the inhalation pathway, and Table IV.C.3 for the ground plane pathway. See Site Specific Data.\*\*

$W_S$  =  $8.78 \times 10^{-10}$  meters<sup>-2</sup>;  $(\overline{D/Q})$  for the food pathway for stack releases except tritium which uses a  $(\chi/Q)$  of  $8.78 \times 10^{-8}$  sec/m<sup>3</sup>.

$\tilde{Q}_{iS}$  = The release of radionuclide,  $i$ , in gaseous effluents from the stack determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1), in  $\mu\text{Ci}$ . Releases shall be cumulative over the calendar quarter or year, as appropriate.

$W_V$  =  $1.58 \times 10^{-9}$  meters<sup>-2</sup>;  $(\overline{D/Q})$  for the food pathway for vent releases except tritium which uses a  $(\chi/Q)$  of  $1.58 \times 10^{-7}$  sec/m<sup>3</sup>.

\*\* See Note 2 and 3 in Bases

## IV.C (Continued)

$\tilde{Q}_{iv}$  = The release of radionuclide,  $i$ , in gaseous effluents from the vents determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1) in  $\mu\text{Ci}$ . Release shall be cumulative over the calendar quarter or year, as appropriate.

$\tilde{q}_{iv}$  = The release of radionuclide,  $i$ , in gaseous effluents from the auxiliary boiler stack releases, determined by the oil sampling and analysis program (ODCMS Table 4.8.C.1) in  $\mu\text{Ci}$ . Release shall be cumulative over the calendar quarter or year, as appropriate.

TABLE IV.C.1

Ri CONSTANTS INGESTION PATHWAY $(m^2 \text{ (mrem/yr) per } \mu\text{Ci/sec})^*$ 

Radionuclide	Infant Bone	Infant Liver	Infant Thyroid	Infant Kidney	Infant Lung	Infant GI-LLI	Infant Skin	Infant T Body
H-3	no data	1.30E+03	1.30E+03	1.30E+03	1.30E+03	1.30E+03	no data	1.30E+03
C-14	1.26E+09	2.70E+08	2.70E+08	2.70E+08	2.70E+08	2.70E+08	no data	2.70E+08
NA-24	4.48E+06	4.48E+06	4.48E+06	4.48E+06	4.48E+06	4.48E+06	no data	4.48E+06
P-32	4.74E+10	2.79E+09	no data	no data	no data	6.41E+08	no data	1.84E+09
CR-51	no data	no data	3.35E+04	7.32E+03	6.51E+04	1.50E+06	no data	5.13E+04
MN-54	no data	1.93E+07	no data	4.28E+06	no data	7.09E+06	no data	4.38E+06
FE-55	7.09E+07	4.58E+07	no data	no data	2.24E+07	5.81E+06	no data	1.22E+07
MN-56	no data	9.24E-03	no data	7.94E-03	no data	8.39E-01	no data	1.59E-03
CO-58	no data	9.57E+06	no data	no data	no data	2.39E+07	no data	2.39E+07
FE-59	7.92E+07	1.38E+08	no data	no data	4.09E+07	6.61E+07	no data	5.45E+07
CO-60	no data	4.69E+07	no data	no data	no data	1.12E+08	no data	1.11E+08
NI-63	1.88E+10	1.17E+09	no data	no data	no data	5.80E+07	no data	6.54E+08
CU-64	no data	5.42E+04	no data	9.17E+04	no data	1.11E+06	no data	2.51E+04
NI-65	1.03E+00	1.16E-01	no data	no data	no data	8.85E+00	no data	5.29E-02
ZN-65	2.69E+09	9.22E+09	no data	4.47E+09	no data	7.78E+09	no data	4.25E+09
ZN-69	3.09E+04	5.56E+04	no data	2.31E+04	no data	4.54E+06	no data	4.14E+03
BR-83	no data	no data	no data	no data	no data	no data	no data	1.20E-01
BR-84	no data	no data	no data	no data	no data	no data	no data	1.64E-23
BR-85	no data	no data	no data	no data	no data	no data	no data	no data
RB-86	no data	6.69E+09	no data	no data	no data	1.71E+08	no data	3.31E+09
12.2008 RB-88	no data	5.60E-45	no data	no data	no data	5.45E-45	no data	3.07E-45
RB-89	no data	9.86E-53	no data	no data	no data	3.36E-53	no data	6.79E-53
SR-89	4.58E+09	no data	no data	no data	no data	9.42E+07	no data	1.31E+08
SR-90	6.55E+10	no data	no data	no data	no data	8.18E+08	no data	1.67E+10
Y-90	1.99E+02	no data	no data	no data	no data	2.74E+05	no data	5.33E+00
SR-91	7.94E+04	no data	no data	no data	no data	9.40E+04	no data	2.87E+03
Y-91M	1.66E-19	no data	no data	no data	no data	5.53E-16	no data	5.65E-21
Y-91	2.77E+04	no data	no data	no data	no data	1.98E+06	no data	7.37E+02
SR-92	1.36E+00	no data	no data	no data	no data	1.47E+01	no data	5.05E-02
Y-92	1.57E-04	no data	no data	no data	no data	3.01E+00	no data	4.43E-06
Y-93	6.31E-01	no data	no data	no data	no data	4.98E+03	no data	1.72E-02
NB-95	1.98E+05	8.16E+04	no data	5.85E+04	no data	6.89E+07	no data	4.72E+04
ZR-95	2.62E+03	6.40E+02	no data	6.89E+02	no data	3.19E+05	no data	4.54E+02
ZR-97	1.19E+00	2.04E-01	no data	2.05E-01	no data	1.30E+04	no data	9.31E-02
MO-99	no data	6.07E+07	no data	9.07E+07	no data	2.00E+07	no data	1.18E+07
TC-99M	8.04E+00	1.66E+01	no data	1.78E+02	8.67E+00	4.82E+03	no data	2.14E+02
TC-101	7.44E-60	9.38E-60	no data	1.11E-58	5.11E-60	1.59E-57	no data	9.28E-59
RU-103	2.97E+03	no data	no data	6.18E+03	no data	3.61E+04	no data	9.93E+02
RU-105	2.36E-03	no data	no data	1.73E-02	no data	9.38E-01	no data	7.94E-04
RU-106	9.54E+04	no data	no data	1.13E+05	no data	7.24E+05	no data	1.19E+04
AG-110M	1.87E+08	1.37E+08	no data	1.95E+08	no data	7.09E+09	no data	9.04E+07
SB-124	5.31E+07	7.81E+05	1.41E+05	no data	3.32E+07	1.64E+08	no data	1.64E+07
SB-125	5.23E+07	5.06E+05	6.55E+04	no data	3.03E+07	6.98E+07	no data	1.08E+07
TE-125M	5.68E+07	1.90E+07	1.91E+07	no data	no data	2.71E+07	no data	7.68E+06

12.2008

TE-127M	1.82E+08	6.03E+07	5.26E+07	4.48E+08	no data	7.34E+07	no data	2.20E+07
TE-127	1.85E+03	6.19E+02	1.50E+03	4.51E+03	no data	3.88E+04	no data	3.97E+02
TE-129M	1.84E+08	6.32E+07	7.08E+07	4.61E+08	no data	1.10E+08	no data	2.84E+07
TE-129	7.99E-10	2.76E-10	6.70E-10	1.99E-09	no data	6.39E-08	no data	1.87E-10
I-130	1.04E+06	2.28E+06	2.56E+08	2.51E+06	no data	4.89E+05	no data	9.17E+05
I-131	7.97E+08	9.39E+08	3.08E+11	1.10E+09	no data	3.35E+07	no data	4.13E+08
TE-131M	9.87E+05	3.97E+05	8.05E+05	2.73E+06	no data	6.69E+06	no data	3.28E+05
TE-131	1.03E-32	3.79E-33	9.15E-33	2.62E-32	no data	4.14E-31	no data	2.88E-33
I-132	3.66E-01	7.43E-01	3.48E+01	8.29E-01	no data	6.02E-01	no data	2.65E-01
TE-132	6.17E+06	3.05E+06	4.51E+06	1.91E+07	no data	1.13E+07	no data	2.85E+06
I-133	1.06E+07	1.54E+07	2.81E+09	1.81E+07	no data	2.61E+06	no data	4.52E+06
CS-134	1.90E+10	3.54E+10	no data	9.11E+09	3.73E+09	9.61E+07	no data	3.57E+09
I-134	4.81E-12	9.86E-12	2.30E-10	1.10E-11	no data	1.02E-11	no data	3.51E-12
I-135	3.21E+04	6.39E+04	5.73E+06	7.12E+04	no data	2.31E+04	no data	2.33E+04
CS-136	5.80E+08	1.71E+09	no data	6.80E+08	1.39E+08	2.59E+07	no data	6.37E+08
CS-137	2.77E+10	3.24E+10	no data	8.71E+09	3.53E+09	1.01E+08	no data	2.30E+09
CS-138	2.58E-23	4.20E-23	no data	2.09E-23	3.27E-24	6.71E-23	no data	2.04E-23
BA-139	1.26E-07	8.32E-11	no data	5.00E-11	5.04E-11	7.95E-06	no data	3.63E-09
BA-140	7.09E+07	7.09E+04	no data	1.68E+04	4.35E+04	1.74E+07	no data	3.65E+06
LA-140	1.18E+01	4.67E+00	no data	no data	no data	5.49E+04	no data	1.20E+00
BA-141	1.41E-45	9.65E-49	no data	5.80E-49	5.87E-49	1.72E-44	no data	4.44E-47
CE-141	1.42E+04	8.69E+03	no data	2.68E+03	no data	4.49E+06	no data	1.02E+03
BA-142	7.43E-80	6.18E-83	no data	3.56E-83	3.74E-83	3.07E-79	no data	3.66E-81
LA-142	4.99E-11	1.83E-11	no data	no data	no data	3.11E-06	no data	4.39E-12
CE-143	1.16E+02	7.70E+04	no data	2.24E+01	no data	4.49E+05	no data	8.78E+00
PR-143	4.38E+02	1.64E+02	no data	6.09E+01	no data	2.31E+05	no data	2.17E+01
CE-144	1.14E+06	4.68E+05	no data	1.89E+05	no data	6.55E+07	no data	6.40E+04
PR-144	1.70E-53	6.59E-54	no data	2.39E-54	no data	3.07E-49	no data	8.58E-55
ND-147	2.58E+02	2.65E+02	no data	1.02E+02	no data	1.68E+05	no data	1.63E+01
W-187	1.79E+04	1.24E+04	no data	no data	no data	7.31E+05	no data	4.30E+03
NP-239	1.06E+01	9.51E-01	no data	1.90E+00	no data	2.75E+04	no data	5.37E-01
NP-237	5.33E+07	3.53E+06	no data	1.41E+07	no data	1.83E+06	no data	2.33E+06
NP-238	1.02E+02	2.56E+00	no data	5.58E+00	no data	3.42E+04	no data	1.57E+00

\* Tritium  $R_1$  values in units of mrem/yr per  $\mu\text{Ci}/\text{m}^3$

TABLE IV.C.2  
 Ri CONSTANTS INHALATION PATHWAY  
 (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

Radionuclide	Infant Bone	Infant Liver	Infant Thyroid	Infant Kidney	Infant Lung	Infant GI-LLI	Infant Skin	Infant T Body
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	Skin	T Body
H-3	no data	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	no data	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	no data	5.31E+03
NA-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	no data	1.06E+04
P-32	2.03E+06	1.12E+05	no data	no data	no data	1.61E+04	no data	7.74E+04
CR-51	no data	no data	5.75E+01	1.32E+01	1.28E+04	3.57E+02	no data	8.95E+01
MN-54	no data	2.53E+04	no data	4.98E+03	1.00E+06	7.06E+03	no data	4.98E+03
FE-55	1.97E+04	1.18E+04	no data	no data	8.69E+04	1.10E+03	no data	3.33E+03
MN-56	no data	1.54E+00	no data	1.10E+00	1.25E+04	7.17E+04	no data	2.21E-01
CO-58	no data	1.22E+03	no data	no data	7.77E+05	1.11E+04	no data	1.82E+03
FE-59	1.36E+04	2.35E+04	no data	no data	1.02E+06	2.48E+04	no data	9.48E+03
CO-60	no data	8.02E+03	no data	no data	4.51E+06	3.19E+04	no data	1.18E+04
NI-63	3.39E+05	2.04E+04	no data	no data	2.09E+05	2.42E+03	no data	1.16E+04
CU-64	no data	1.88E+00	no data	3.98E+00	9.30E+03	1.50E+04	no data	7.74E-01
NI-65	2.39E+00	2.84E-01	no data	no data	8.12E+03	5.01E+04	no data	1.23E-01
ZN-65	1.93E+04	6.26E+04	no data	3.25E+04	6.47E+05	5.14E+04	no data	3.11E+04
ZN-69	5.39E-02	9.67E-02	no data	4.02E-02	1.47E+03	1.32E+04	no data	7.18E-03
BR-83	no data	no data	no data	no data	no data	no data	no data	3.81E+02
BR-84	no data	no data	no data	no data	no data	no data	no data	4.00E+02
BR-85	no data	no data	no data	no data	no data	no data	no data	2.04E+01
BR-86	no data	1.90E+05	no data	no data	no data	3.04E+03	no data	8.82E+04
BR-88	no data	5.57E+02	no data	no data	no data	3.39E+02	no data	2.87E+02
BR-89	no data	3.21E+02	no data	no data	no data	6.82E+01	no data	2.06E+02
SR-89	3.98E+05	no data	no data	no data	2.03E+06	6.40E+04	no data	1.14E+04
SR-90	4.09E+07	no data	no data	no data	1.12E+07	1.31E+05	no data	2.59E+06
Y-90	3.29E+03	no data	no data	no data	2.69E+05	1.04E+05	no data	8.82E+01
SR-91	9.56E+01	no data	no data	no data	5.26E+04	7.34E+04	no data	3.46E+00
Y-91M	4.07E-01	no data	no data	no data	2.79E+03	2.35E+03	no data	1.39E-02
Y-91	5.88E+05	no data	no data	no data	2.45E+06	7.03E+04	no data	1.57E+04
SR-92	1.05E+01	no data	no data	no data	2.38E+04	1.40E+05	no data	3.91E-01
Y-92	1.64E+01	no data	no data	no data	2.45E+04	1.27E+05	no data	4.61E-01
Y-93	1.50E+02	no data	no data	no data	7.64E+04	1.67E+05	no data	4.07E+00
NB-95	1.57E+04	6.43E+03	no data	4.72E+03	4.79E+05	1.27E+04	no data	3.78E+03
ZR-95	1.15E+05	2.79E+04	no data	3.11E+04	1.75E+06	2.17E+04	no data	2.03E+04
ZR-97	1.50E+02	2.56E+01	no data	2.59E+01	1.10E+05	1.40E+05	no data	1.17E+01
MO-99	no data	1.65E+02	no data	2.65E+02	1.35E+05	4.87E+04	no data	3.23E+01
TC-99M	1.40E-03	2.88E-03	no data	3.11E-02	8.11E+02	2.03E+03	no data	3.72E-02
TC-101	6.51E-05	8.23E-05	no data	9.79E-04	5.84E+02	8.44E+02	no data	8.12E-04
RU-103	2.02E+03	no data	no data	4.24E+03	5.52E+05	1.61E+04	no data	6.79E+02
RU-105	1.22E+00	no data	no data	8.99E-01	1.57E+04	4.84E+04	no data	4.10E-01
RU-106	8.68E+04	no data	no data	1.07E+05	1.16E+07	1.64E+05	no data	1.09E+04
AG-110M	9.98E+03	7.22E+03	no data	1.09E+04	3.67E+06	3.30E+04	no data	5.00E+03
TE-125M	4.76E+03	1.99E+03	1.62E+03	no data	4.47E+05	1.29E+04	no data	6.58E+02
TE-127M	1.67E+04	6.90E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04	no data	2.07E+03
TE-127	2.23E+00	9.53E-01	1.85E+00	4.86E+00	1.04E+04	2.44E+04	no data	4.89E-01
TE-129M	1.41E+04	6.09E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04	no data	2.23E+03
TE-129	7.88E-02	3.47E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04	no data	1.88E-02

12.2008

I-130	6.36E+03	1.39E+04	1.60E+06	1.53E+04	no data	1.99E+03	no data	5.57E+03
I-131	3.79E+04	4.44E+04	1.48E+07	5.18E+04	no data	1.06E+03	no data	1.96E+04
TE-131M	1.07E+02	5.50E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05	no data	3.63E+01
TE-131	1.74E-02	8.22E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03	no data	5.00E-03
I-132	1.69E+03	3.54E+03	1.69E+05	3.95E+03	no data	1.90E+03	no data	1.26E+03
TE-132	3.72E+02	2.37E+02	2.79E+02	1.04E+03	3.40E+05	4.41E+04	no data	1.76E+02
I-133	1.32E+04	1.92E+04	3.56E+06	2.24E+04	no data	2.16E+03	no data	5.60E+03
CS-134	3.96E+05	7.03E+05	no data	1.90E+05	7.97E+04	1.33E+03	no data	7.45E+04
I-134	9.21E+02	1.88E+03	4.45E+04	2.09E+03	no data	1.29E+03	no data	6.65E+02
I-135	3.86E+03	7.60E+03	6.96E+05	8.47E+03	no data	1.83E+03	no data	2.77E+03
CS-136	4.83E+04	1.35E+05	no data	5.64E+04	1.18E+04	1.43E+03	no data	5.29E+04
CS-137	5.49E+05	6.12E+05	no data	1.72E+05	7.13E+04	1.33E+03	no data	4.55E+04
CS-138	5.05E+02	7.81E+02	no data	4.10E+02	6.54E+01	8.76E+02	no data	3.98E+02
BA-139	1.48E+00	9.84E-04	no data	5.92E-04	5.95E+03	5.10E+04	no data	4.30E-02
BA-140	5.60E+04	5.60E+01	no data	1.34E+01	1.60E+06	3.84E+04	no data	2.90E+03
LA-140	5.05E+02	2.00E+02	no data	no data	1.68E+05	8.48E+04	no data	5.15E+01
BA-141	1.57E-01	1.08E-04	no data	6.50E-05	2.97E+03	4.75E+03	no data	4.97E-03
CE-141	2.77E+04	1.67E+04	no data	5.25E+03	5.17E+05	2.16E+04	no data	1.99E+03
BA-142	3.98E-02	3.30E-05	no data	1.90E-05	1.55E+03	6.93E+02	no data	1.96E-03
LA-142	1.03E+00	3.77E-01	no data	no data	8.22E+03	5.95E+04	no data	9.04E-02
CE-143	2.93E+02	1.93E+02	no data	5.64E+01	1.16E+05	4.97E+04	no data	2.21E+01
PR-143	1.40E+04	5.24E+03	no data	1.97E+03	4.33E+05	3.72E+04	no data	6.99E+02
CE-144	3.19E+06	1.21E+06	no data	5.38E+05	9.84E+06	1.48E+05	no data	1.76E+05
PR-144	4.79E-02	1.85E-02	no data	6.72E-03	1.61E+03	4.28E+03	no data	2.41E-03
ND-147	7.94E+03	8.13E+03	no data	3.15E+03	3.22E+05	3.12E+04	no data	5.00E+02
W-187	1.30E+01	9.02E+00	no data	no data	3.96E+04	3.56E+04	no data	3.11E+00
NP-239	3.71E+02	3.32E+01	no data	6.62E+01	5.95E+04	2.49E+04	no data	1.88E+01
U-232	3.60E+08	no data	no data	3.36E+07	2.09E+09	6.10E+04	no data	2.98E+007
U-233	7.62E+07	no data	no data	1.53E+07	4.98E+08	5.64E+04	no data	5.36E+06
U-234	7.31E+07	no data	no data	1.50E+07	4.89E+08	5.53E+04	no data	5.25E+06
U-235	7.01E+07	no data	no data	1.41E+07	4.59E+08	7.03E+04	no data	4.93E+06
U-236	7.01E+07	no data	no data	1.44E+07	4.69E+08	5.19E+04	no data	5.04E+06
U-237	4.55E+02	no data	no data	1.13E+03	1.28E+05	1.83E+04	no data	1.21E+02
U-238	6.71E+07	no data	no data	1.32E+07	4.28E+08	4.96E+04	no data	4.61E+06
NP-237	4.03E+09	2.39E+09	no data	1.08E+09	4.89E+08	7.14E+04	no data	1.76E+08
NP-238	3.74E+03	8.47E+02	no data	2.06E+02	1.29E+05	3.61E+04	no data	5.82E+01
PU-238	3.77E+09	2.35E+09	no data	6.50E+08	1.26E+09	6.57E+04	no data	1.78E+08
PU-239	4.10E+09	2.46E+09	no data	6.93E+08	1.19E+09	5.99E+04	no data	1.88E+08
PU-240	4.10E+09	2.45E+09	no data	6.92E+08	1.19E+09	6.10E+04	no data	1.88E+08
PU-241	1.18E+08	2.59E+07	no data	1.61E+07	1.07E+06	1.26E+03	no data	4.35E+06
PU-242	3.81E+09	2.37E+09	no data	6.68E+08	1.14E+09	5.88E+04	no data	1.81E+08
PU-244	4.44E+09	2.72E+09	no data	7.64E+08	1.31E+09	8.76E+04	no data	2.07E+08
AM-241	4.41E+09	2.73E+09	no data	1.11E+09	5.68E+08	6.69E+04	no data	1.83E+08
AM-242M	4.55E+09	2.60E+09	no data	1.12E+09	2.30E+08	8.41E+04	no data	1.89E+08
AM-243	4.34E+09	2.63E+09	no data	1.08E+09	5.39E+08	7.84E+04	no data	1.78E+08
CM-242	1.79E+08	1.21E+08	no data	2.37E+07	4.16E+08	7.14E+04	no data	7.98E+06
CM-243	3.46E+09	2.13E+09	no data	5.47E+08	5.94E+08	7.03E+04	no data	1.48E+08
CM-244	2.90E+09	1.78E+09	no data	4.49E+08	5.71E+08	6.80E+04	no data	1.24E+08
CM-245	4.51E+09	2.74E+09	no data	7.32E+08	5.49E+08	6.34E+04	no data	1.90E+08
CM-246	4.48E+09	2.74E+09	no data	7.32E+08	5.59E+08	6.23E+04	no data	1.90E+08
CM-247	4.35E+09	2.70E+09	no data	7.21E+08	5.49E+08	8.19E+04	no data	1.86E+08
CM-248	3.61E+10	2.23E+10	no data	5.94E+09	4.52E+09	1.32E+06	no data	1.54E+09
CF-252	3.32E+09	no data	no data	no data	1.92E+09	2.59E+05	no data	1.41E+08

TABLE IV.C.3  
Ri CONSTANTS GROUND PLANE PATHWAY  
(mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AG-110M	3.44E+09
AM-241	6.85E+08
AM-242M	9.61E+07
AM-243	5.03E+09
BA-139	1.06E+05
BA-140	2.05E+07
BA-141	4.18E+04
BA-142	4.49E+04
BR-83	4.87E+03
BR-84	2.03E+05
BR-85	no data
C-14	no data
CE-141	1.37E+07
CE-143	2.31E+06
CE-144	6.96E+07
CF-252	4.83E+10
CM-242	6.85E+05
CM-243	7.05E+09
CM-244	7.84E+06
CM-245	3.67E+09
CM-246	3.86E+06
CM-247	8.51E+09
CM-248	2.63E+10
CO-58	3.79E+08
CO-60	2.32E+10
CR-51	4.66E+06
CS-134	6.91E+09
CS-136	1.50E+08
CS-137	1.30E+10
CS-138	3.59E+05
CU-64	6.07E+05
FE-55	no data
FE-59	2.72E+08
H-3	no data
I-130	5.51E+06
I-131	1.73E+07
I-132	1.23E+06
I-133	2.45E+06
I-134	4.46E+05
I-135	2.52E+06
LA-140	1.92E+07
LA-142	7.60E+05
MN-54	1.38E+09
MN-56	9.04E+05
MO-99	3.99E+06
NA-24	1.19E+07
NB-95	1.37E+08
ND-147	8.40E+06

NI-63	
NI-65	2.97E+05
NP-237	5.42E+09
NP-238	4.53E+06
NP-239	1.71E+06
P-32	no data
PR-143	no data
PR-144	1.83E+03
PU-238	4.65E+06
PU-239	3.06E+06
PU-240	5.02E+06
PU-241	1.14E+07
PU-242	4.26E+06
PU-244	3.46E+09
RB-86	8.97E+06
RB-88	3.31E+04
RB-89	1.23E+05
RU-103	1.08E+08
RU-105	6.36E+05
RU-106	4.22E+08
SB-124	5.98E+08
SB-125	2.38E+09
SR-89	2.16E+04
SR-90	no data
SR-91	2.15E+06
SR-92	7.77E+05
TC-101	2.04E+04
TC-99M	1.84E+05
TE-125M	1.55E+06
TE-127	2.98E+03
TE-127M	9.17E+04
TE-129	2.62E+04
TE-129M	1.98E+07
TE-131	2.92E+04
TE-131M	8.03E+06
TE-132	4.23E+06
U-232	9.12E+06
U-233	8.90E+09
U-234	2.45E+06
U-235	1.24E+10
U-236	8.13E+04
U-237	5.16E+07
U-238	4.26E+08
W-187	2.36E+06
Y-90	4.49E+03
Y-91	1.07E+06
Y-91M	1.00E+05
Y-92	1.80E+05
Y-93	1.83E+05
ZN-65	7.46E+08
ZN-69	no data
ZR-95	2.45E+08
ZR-97	2.96E+06

IV.D ODCMS 4.8.C.5.1

The projected doses from releases of gaseous effluents to areas at and beyond the SITE BOUNDARY shall be calculated in accordance with the following sections of this manual:

- a. gamma air dose - IV.B.1
- b. beta air dose - IV.B.2
- c. organ dose - IV.C

The projected dose calculation shall be based on expected release from plant operation. The normal release pathways result in the maximum releases from the plant. Any alternative release pathways result in lower releases and, therefore, lower doses.

IV.E Technical Requirements Manual Test Requirement (TR) 3.5.3

IV.E.1 The recombiner hydrogen analyzers currently used at Peach Bottom are Whittaker Electrochemical type. (Analyzers 4083A and 4083B on Unit 2. Analyzers 5083A and 5083B on Unit 3.)

IV.E.2 The calibration gas for the Whittaker Analyzers is 2% Hydrogen, Balance Air.

IV.F ODCMS 4.8.C.7.1 and 4.8.C.7.2

IV.F.1 The dose rate in areas at and beyond the SITE BOUNDARY due to radioactive materials released in gaseous effluents from the incineration of waste oil from the auxiliary boilers shall be calculated by the equation in IV.A.2.

The dose rate from radioactive particulate release shall be determined by either of two methods. Method (a), total instantaneous release assumes that the total activity contained in the waste oil is released in the first minute of incineration. Method (b) uses the activity release over the entire time of incineration.

For normal operations, it is assumed that Method (a) will be used, since the total activity from the waste oil is expected to contribute an insignificant dose compared to the annual limits. However, in the event that the activity is significantly higher than administrative or regulatory limits, then Method (b) would be used because it is more accurate in calculating the dose rate.

Since the auxiliary boiler stacks are at approximately the same height as the reactor vents and discharge from the auxiliary boilers will also be heated, the use of the reactor vent D/Q value for the calculations is considered conservative.

IV.F.2 The dose to an individual from radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to areas at and beyond the SITE BOUNDARY from the incineration of contaminated waste oil from the auxiliary boiler stacks shall be calculated by the equation in IV.C.

V.A. ODCMS 4.8.D.1.1 and 4.8.D.1.2

V.A.1 ODCMS 4.8.D.1.1

02.2008 The total gaseous and liquid cumulative dose contributions are limited by ODCMS 3.8.D.1 to 3.0 mrem for whole body and critical organ, and 55 mrem for the thyroid to preserve assumptions set forth in the 10CFR72.212 report for the TN-68 spent fuel casks that are stored on the Independent Spent Fuel Storage (ISFSI) pad. Exceeding these action levels does not necessarily result in the overall 40CFR190 or 10CFR72.104 requirements not being met. Further calculations are required to determine compliance.

#### Whole Body

The whole body dose contribution from liquid and gaseous effluents shall be determined by the following method:

$$D_{WB} = D_{\tau} + D_{\gamma}$$

where:

$D_{WB}$  = whole body dose from liquid and gaseous effluents, in mrem.

$D_{\tau}$  = cumulative dose commitment to the total body from liquid effluents, in mrem (Determined by ODCM Section III.B).

$D_{\gamma}$  = gamma air dose, in mrad (Determined by ODCM Section IV.B, with mrad equivalent to mrem).

#### Critical organ(except thyroid)

The critical organ(except thyroid) dose contribution from liquid and gaseous effluents shall be determined by the following method:

$$D_{CO} = D_{\tau} + D_{\gamma} + D$$

where:

$D_{CO}$  = critical organ(except thyroid) dose from liquid and gaseous effluents, in mrem.

## V.A.1 (Continued)

$D_r$  = cumulative dose commitment to any organ from liquid effluents, in mrem (Determined by ODCM Section III.B).

$D_\gamma$  = gamma air dose, in mrad (Determined by ODCM Section IV.B, with mrad equivalent to mrem).

$D$  = limiting dose to the critical organ(except thyroid), in mrem (Determined by ODCM Section IV.C).

Thyroid

The thyroid dose contribution from gaseous effluents shall be determined by the following method:

$$D_{thy} = D_r + D_\gamma + D$$

where:

$D_{thy}$  = thyroid dose from gaseous effluents, in mrem.

$D_r$  = cumulative dose commitment to any organ from liquid effluents, in mrem (Determined by ODCM Section III.B).

$D_\gamma$  = gamma air dose, in mrad (Determined by ODCM Section IV.B, with mrad equivalent to mrem).

$D$  = limiting dose to the thyroid, in mrem (Determined by ODCM Section IV.C).

V.A.2 ODCMS 4.8.D.1.2

The cumulative dose from all sources(i.e. gas and liquid effluents and direct radiation) is calculated by summing the individual doses obtained in ODCMS 4.8.D.1.1 for whole body( $D_{WB}$ ), critical organ( $D_{CO}$ ) and thyroid( $D_{thy}$ ) with the TLD measured dose(mrem) minus the background dose.

Whole Body

The cumulative whole body dose from liquid, gas and direct radiation shall be determined by the following method:

$$D_{WB}^{Total} = D_{WB} + D_d$$

where:

$D_{WB}^{Total}$  = whole body dose equivalent from all sources, in mrem.

## V.A.2 (continued)

$D_{WB}$  = whole body dose from liquid and gaseous effluents, in mrem.

$D_D$  = Dose from direct radiation, in mrem(after subtracting background).

Critical Organ(except thyroid)

The cumulative critical organ(except thyroid) dose from liquid, gas and direct radiation shall be determined by the following method:

$$D_{CO}^{Total} = D_{CO} + D_D$$

where:

$D_{CO}^{Total}$  = critical organ(except thyroid) dose equivalent from all sources, in mrem.

$D_{CO}$  = critical organ(except thyroid) dose from liquid and gaseous effluents, in mrem.

$D_D$  = Dose from direct radiation, in mrem(after subtracting background).

Thyroid

The cumulative thyroid dose from gas and direct radiation shall be determined by the following method:

$$D_{Thy}^{Total} = D_{Thy} + D_D$$

where:

$D_{Thy}^{Total}$  = thyroid dose equivalent from all sources, in mrem.

$D_{Thy}$  = thyroid dose from gaseous effluents, in mrem.

$D_D$  = Dose from direct radiation, in mrem(after subtracting background).

The dose contribution is calculated at the discharge point for liquids and in the worst sector for gases. If necessary, the dose contribution from liquid and gas may be calculated for a real individual.

VI.A ODCMS 4.8.E.1.1 and 4.8.E.1.2

The radiological environment monitoring samples shall be collected pursuant to Table VII.A.1 from the locations shown on Figures VII.A.1, VII.A.2, and VII.A.3, and shall be analyzed pursuant to the requirements of Table VII.A.1.

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station  
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses	
<u>I. Direct Radiation</u>					
Site Boundary	1L	1,256 feet NE of site	TLD sites were chosen in accordance with Peach Bottom ODCMS Table 4.8.E.1 Item 1. Site Boundary stations all sectors except several along Conowingo Pond. These sectors are monitored by stations on the east side of Conowingo Pond. The 5 mile vicinity stations cover all sectors. The distant and special interest stations provide information in population centers and control locations.	Gamma Dose quarterly	
	1A	1,396 feet SE of site			
	2	4,661 feet SE of site			
	1I	2,851 feet SSE of site			
	1C	4,513 feet SSE of site			
	1J	3,755 feet S of site			
	1F	2,707 feet SSW of site			
	40	7,050 feet SW of site			
	1NN	2,547 feet WSW of site			
	1H	3,104 feet W of site			
	1G	3,173 feet WNW of site			
	1B	2,587 feet NW of site			
	1E	3,136 feet NNW of site			
	1K	4604 feet SW of site			
	Intermediate Distance	15			19,449 feet N of site
		22			13,230 feet NNE of site
		44			27,480 feet NE of site
32		15,213 feet ENE of site			
45		18,524 feet ENE of site			
14		10,397 feet E of site			
17		21,966 feet ESE of site			
31A		24,105 feet SE of site			
4K		45,721 feet SE of site			
23		5,276 feet SSE of site			
27		13,859 feet S of site			
48		25,772 feet SSW of site			
3A		19,114 feet SW of site			
49		20,673 feet WSW of site			
50		25,677 feet W of site			
51	20,511 feet WNW of site				
26	22,093 feet NW of site				
6B	30,538 feet NW of site				
42	21,954 feet NNW of site				

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station  
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
Distant and Special Interest	43	26,931 feet NNE of site		
	5	24,482 feet E of site		
	16	67,788 feet E of site		
	24	58,048 feet ESE of site		
	2B	3,768 feet SSE of site		
	46	23,483 feet SSE of site		
	47	22,153 feet S of site		
	18	51,413 feet W of site		
	19 C	106,354 feet WNW of site		
II.	<u>Airborne</u>			
Particulates	1Z	1,396 feet SE of site	Approximately 1 cfm continuous flow through glass fiber filter which is collected weekly.  These stations provide for coverage of the highest annual average ground level D/Q near the site boundary, the community with the highest annual average D/Q and a control location.	Gross beta analysis on each weekly sample. Gamma spectrometry shall be done when gross beta exceeds ten times the yearly mean of control station value.  Gross beta analysis done $\geq 24$ hr after sampling to allow for Radon and Thoron daughter decay.  Gamma Spec on quarterly composite by location.
	1B	2,587 feet NW of site		
	1C	4,513 feet SSE of site		
	3A	19,114 feet SW of site		
	5H2 C	162,565 feet NE of site		

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station  
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
Iodine	1Z	1,396 feet SE of site	A TEDA impregnated flow-through cartridge is connected to air sampler and is collected weekly at site filter change.	Iodine 131 weekly
	1B	2,587 feet NW of site		
	1C	4,513 feet SSE of site		
	3A	19,114 feet SW of site		
	5H2 C	162,565 feet NE of site		
III.	<u>Waterborne</u>			
Surface	1LL C	1,256 feet NE of site	Sample collected from a continuous water sampler, monthly. In event sampler is inoperable, grab samples will be collected each calendar day until sampler returned to service.	Gamma isotopic analysis monthly;  H-3 on quarterly composite
	1MM	5,470 feet SE of site		
Drinking	4L	45,721 feet SE of site	Sample collected from a continuous water sampler monthly. In event sampler is inoperable, weekly grab samples will be collected until sampler returned to service.	Gross beta and gamma isotopic monthly,  H-3 on quarterly composite
	6I C	30,337 feet NW of site		

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station  
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
Sediment	4J	7,346 feet SE of site	A sediment sample is taken down stream of discharge semi-annually.	Gamma isotopic analysis each sample
IV. <u>Ingestion</u>				
Milk	V C	32,736 feet W of site	Sample of fresh milk is collected from each farm biweekly when cows are on pasture (April through October), monthly at other times.	I-131 analyses on each sample
	J	5,119 feet W of site		
	R	4,694 feet WSW of site		Gamma isotopic analysis or Cs-134, -137 by chemical separation quarterly
	U	11,414 feet SSW of site		
Fish	4	7,162 feet SE of site	Two species of recreationally important fish (predator and bottom feeder) sampled in season or semiannually if not seasonal.	Gamma isotopic analyses on edible portions.
	6 C	57,347 feet NW of site		
Food Products	Two offsite locations of highest predicted annual average ground level D/Q and one location (15-30 km distance) in the least prevalent wind direction as determined using the results of the most recent annual Land use Survey.		Samples of three (3) different kinds of broad leaf vegetation monthly when available if milk sampling is not performed	Gamma isotopic and I-131 analysis

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C = Control Location

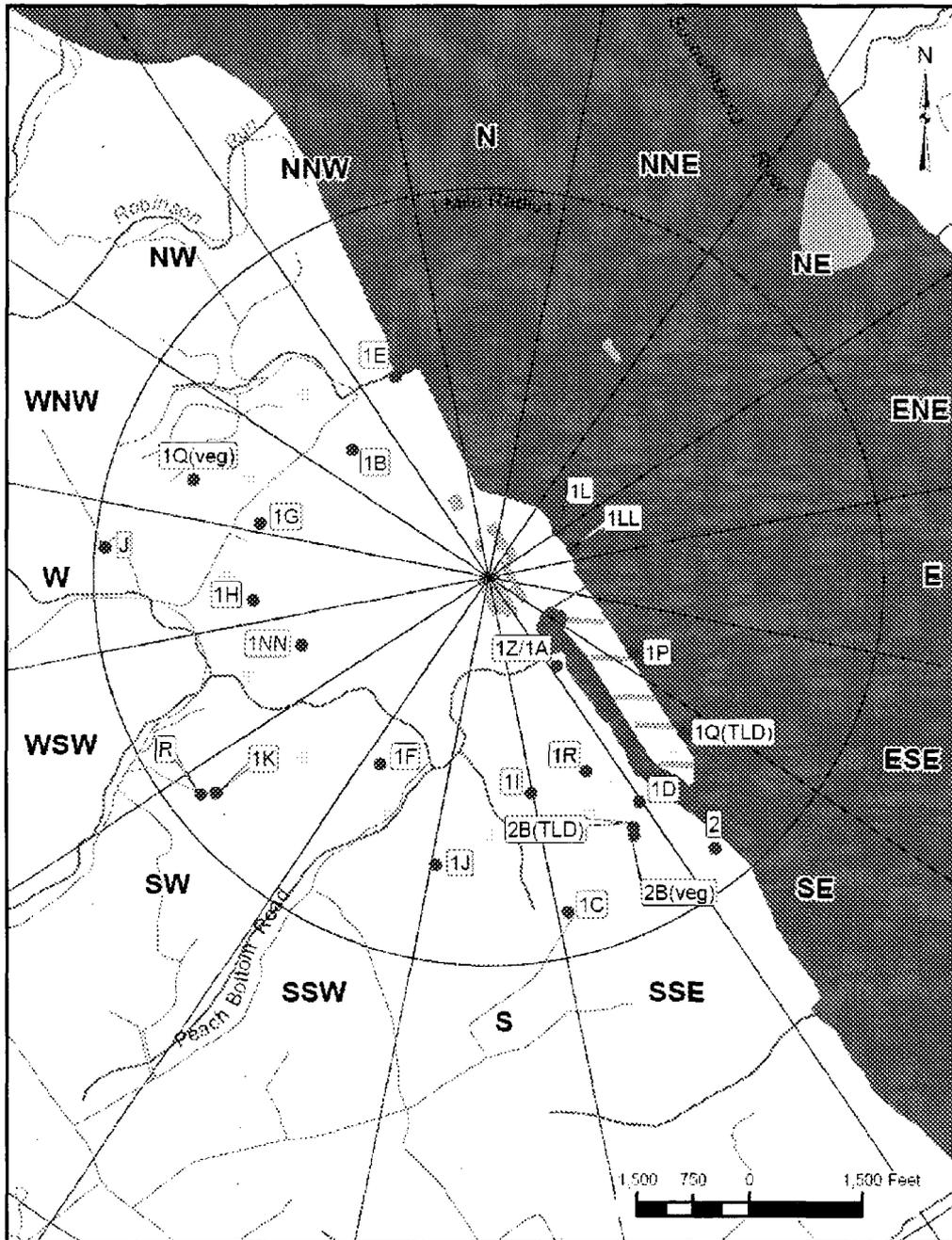


FIGURE VII.A.1  
ENVIRONMENTAL SAMPLING STATIONS AT  
SITE BOUNDARY AREA TO PEACH BOTTOM



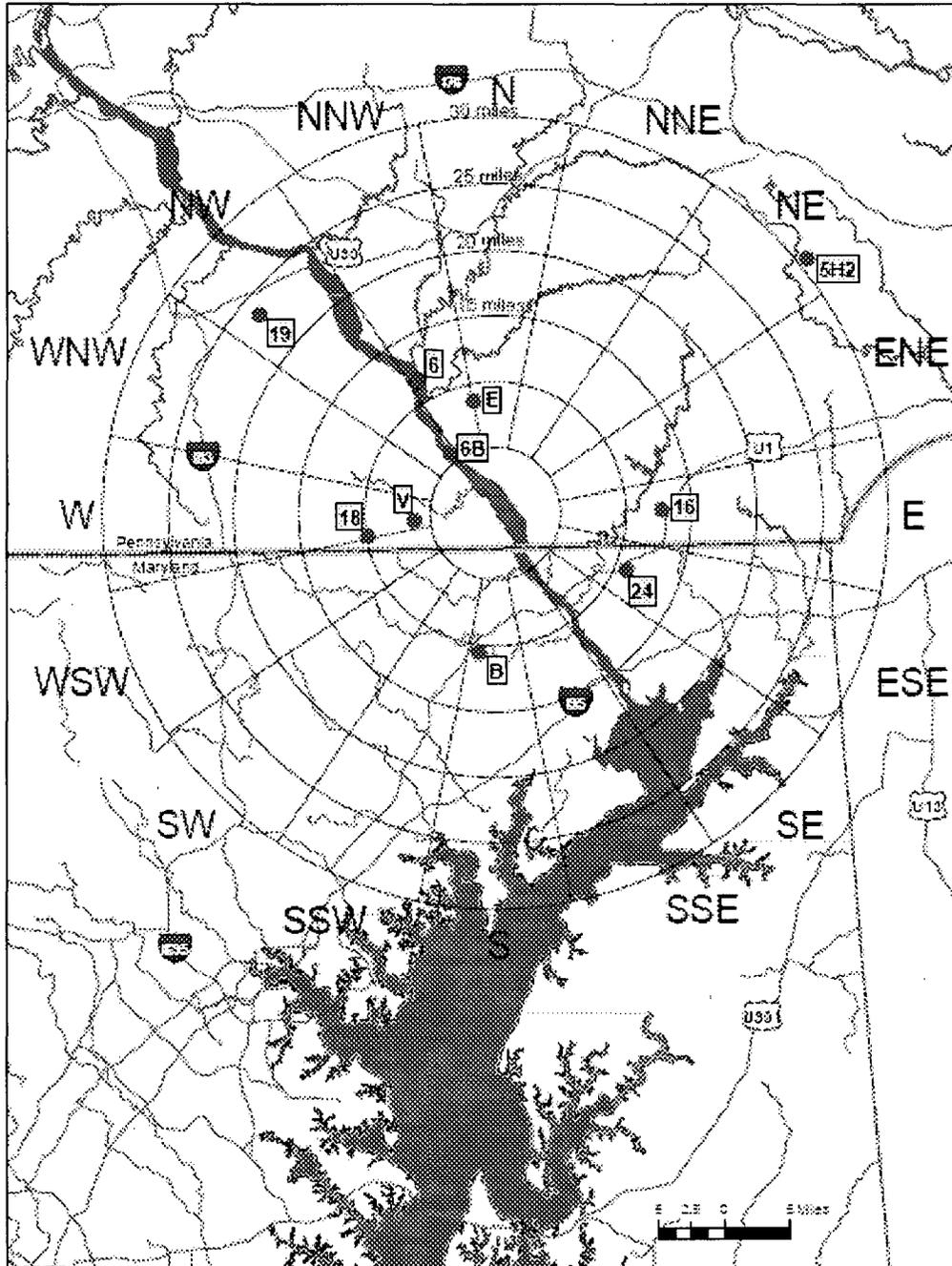


FIGURE VII.A.3  
ENVIRONMENTAL SAMPLING STATIONS AT  
REMOTE DISTANCES FROM PEACH BOTTOM SITE

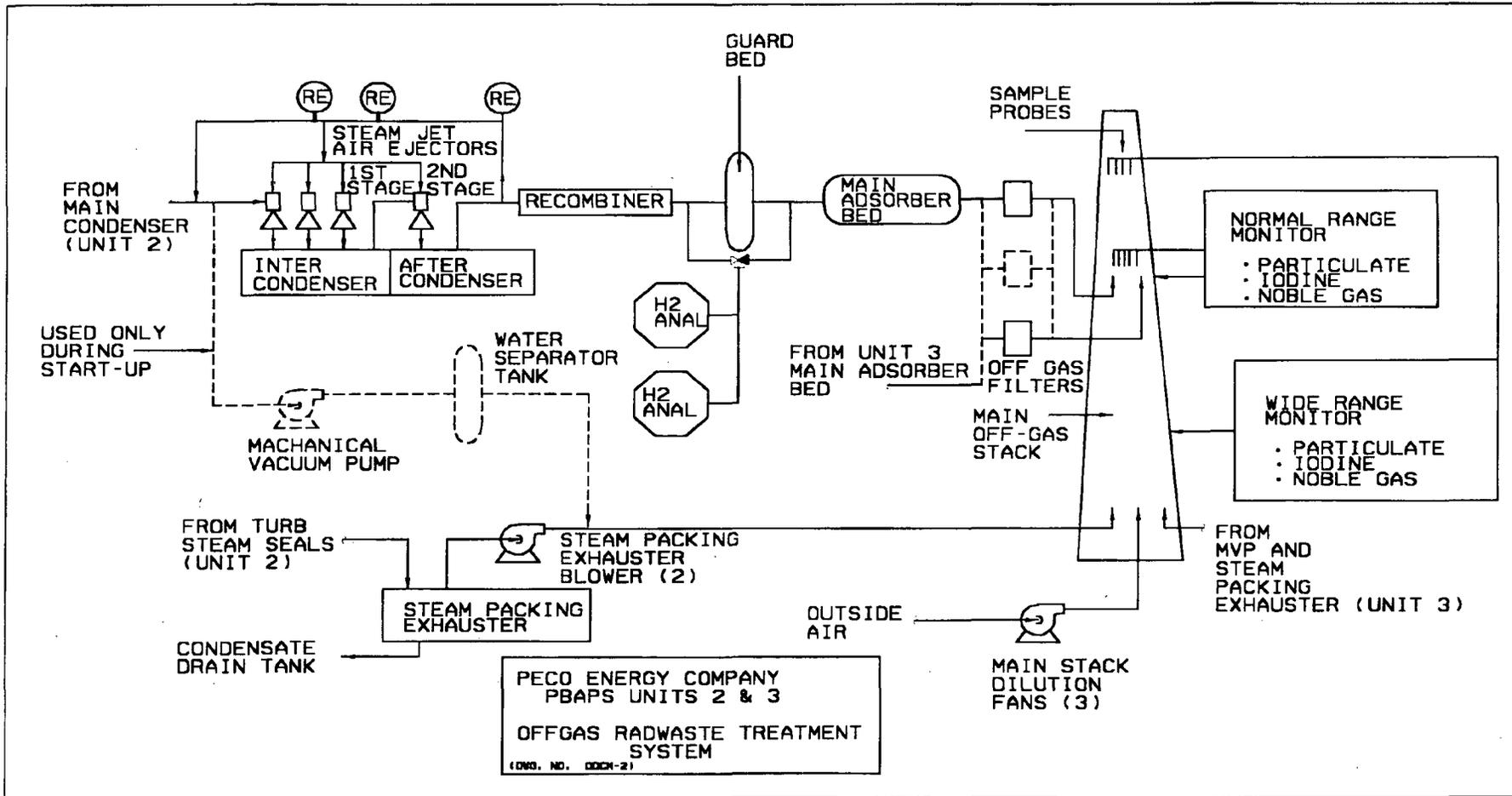


Figure 1

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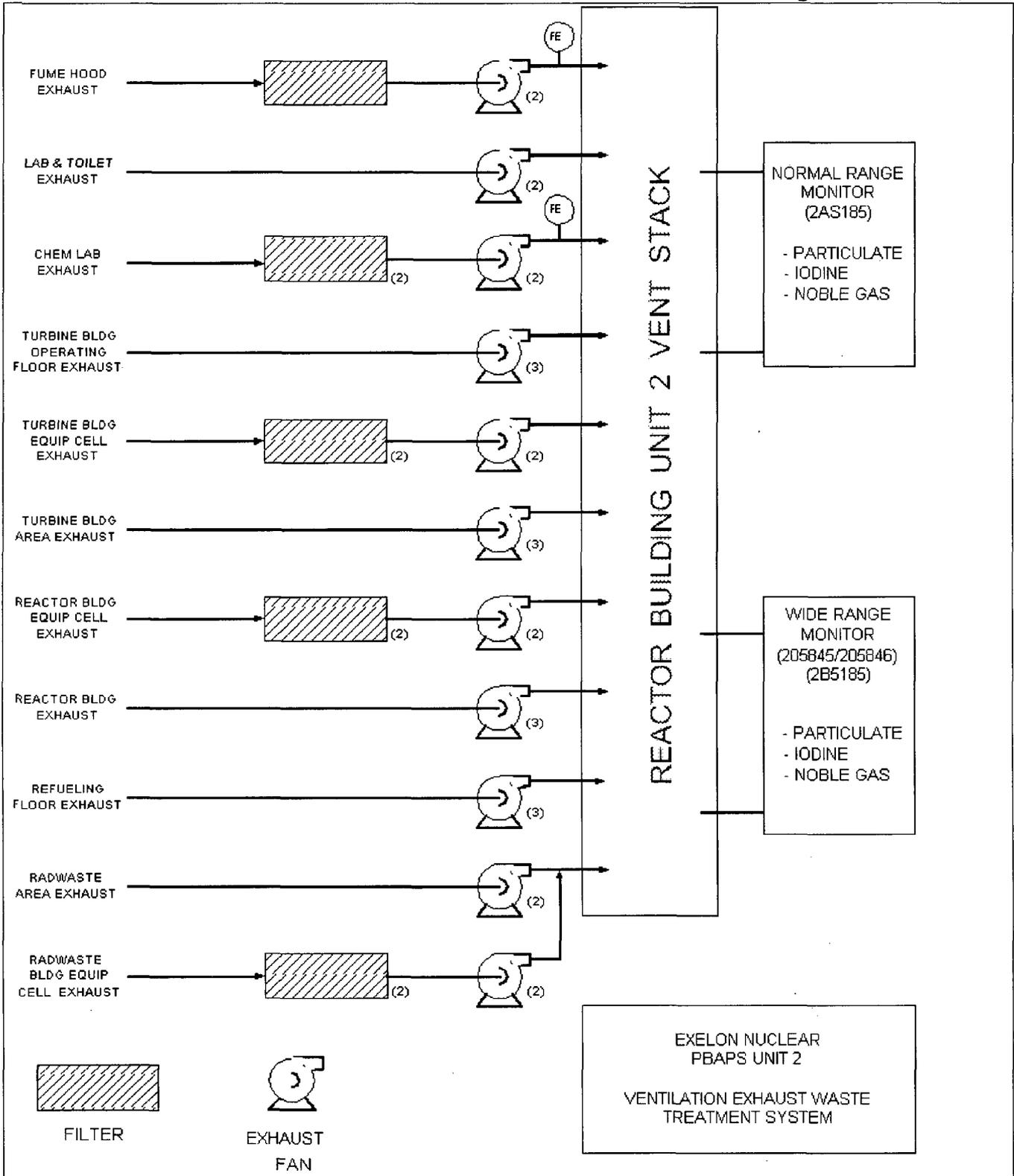


Figure 2

02.2008

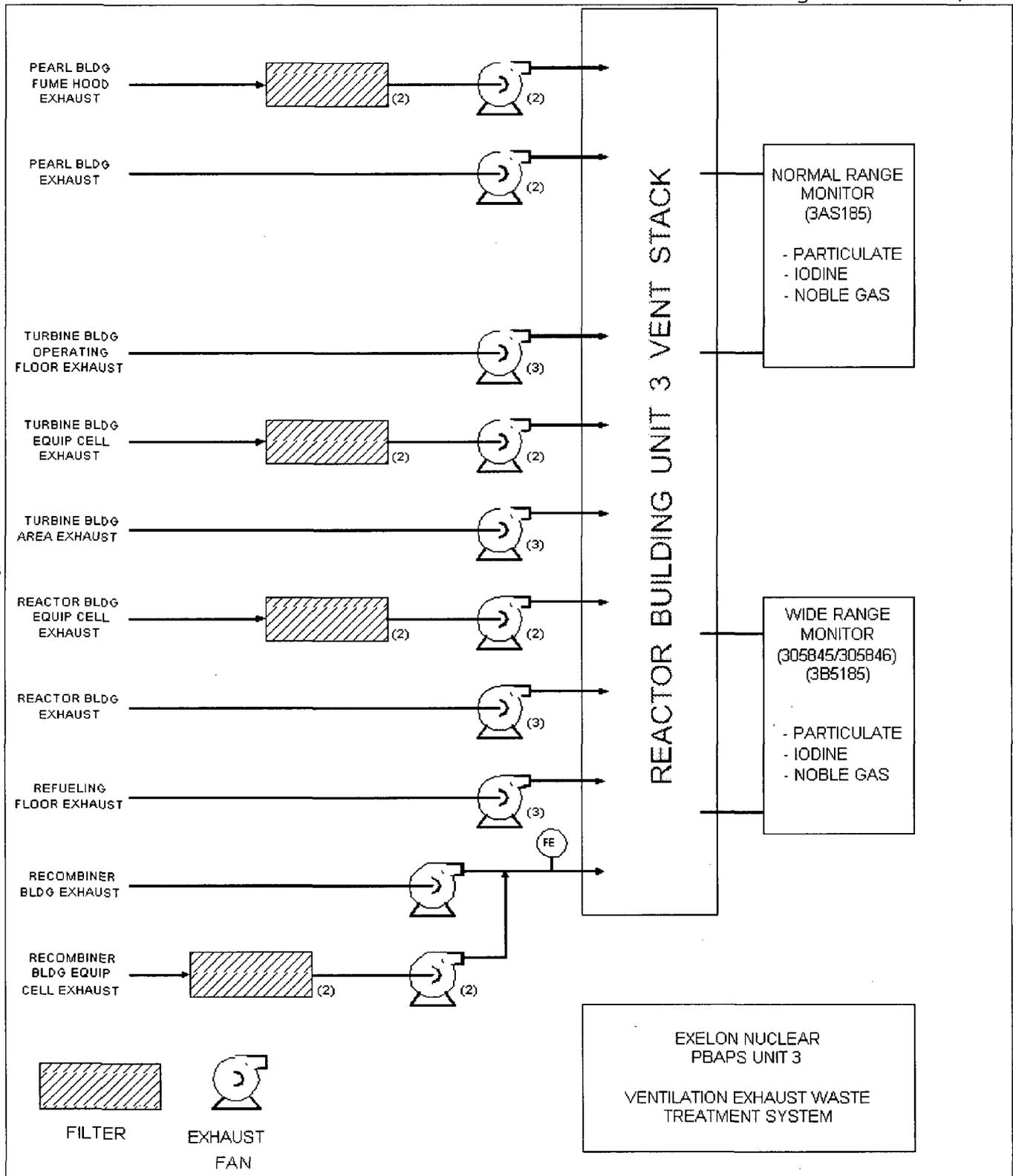
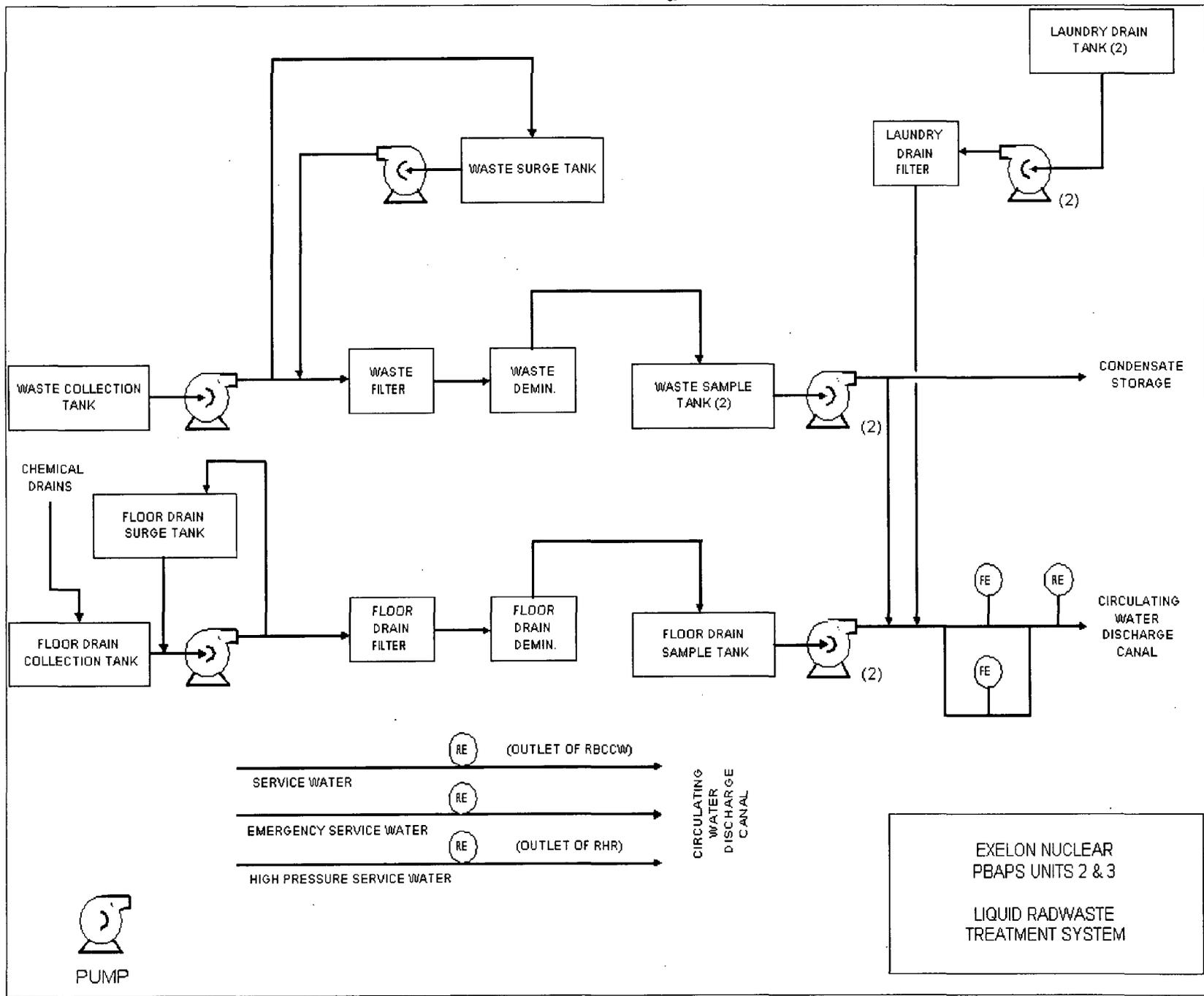


Figure 3

Figure 4



VII. BasesLiquid Effluent Release Flow Rate Determination

Non-gamma emitting radionuclides (H-3, Fe-55, Sr-89/90) are not detected by the effluent monitor and, therefore, are not directly included in the release flow rate determination. While tritium accounts for nearly all the activity released, it is not a significant contributor when determining the permissible flow rate. Examining releases over the years 2004 - 2006, the average diluted H-3 contribution to its limiting concentration in liquid effluents was 0.03%. This contribution is not expected to change significantly over time, since the concentration of H-3 in effluents can be expected to remain fairly consistent in effluent releases regardless of fuel conditions, activation product releases, and waste processing.

Based on relative abundances, other non-gamma emitting radionuclides only contributed up to nearly 3 % of the concentration limit. It is reasonable to assume that the abundances of these non-gamma will remain the same relative to other fission and/or activation products under varying conditions. Therefore, under conditions of elevated effluent radionuclide levels, the gamma-emitting radionuclides can be expected to be the main contributors to limiting conditions on liquid effluent concentrations. The maximum permissible release flow rate determination methodology presented in III.A offers an additional factor of conservatism of 30 to 50 which is more than adequate to account for the non-gamma emitting radionuclides.

Site Specific DataNOTE 1

Liquid dose factors,  $A_{ir}$ , for section III.B were developed using the following site specific data. The liquid pathways involved are drinking water and fish.

$$A_{ir} = (U_w / D_w + U_F \times BF_i) \times k_0 \times DF_i \times RC \times e^{-24\lambda_i}$$

$U_w$  = liters per year; maximum age group usage of drinking water (Reg. Guide 1.109, Table E-5)

$D_w$  = 5.4; average annual dilution at Conowingo intake

$U_F$  = kg per year; maximum age group usage of fish (Reg. Guide 1.109, Table E-5)

$BF_i$  = bioaccumulation factor for nuclide,  $i$ , in freshwater fish. Reg. Guide 1.109, Table A-1, except P-32 which uses a value of  $3.0 \times 10^3$  pCi/kg per pCi/liter.

$$k_0 = 1.14 \times 10^5 = (10^6 \text{ pCi}/\mu\text{Ci} \times 10^3 \text{ ml/l}) / 8760 \text{ hr/yr) units conversion factor.}$$

$DF_i$  = dose conversion factor for nuclide,  $i$ , for the age group in total body or organ, as applicable. Reg. Guide 1.109, Table E-11, except P-32 bone which uses a value as indicated below.

$$3.0 \times 10^{-5} \text{ mrem/pCi}$$

$RC$  = 1.16; reconcentration from PBAPS discharge back through PBAPS intake.

$\lambda_i$  = decay constant for nuclide  $i$ ,  $\text{hr}^{-1}$

02.2008

The data for  $D_w$  and  $RC$  were derived from data published in Peach Bottom Atomic Power Station Units 2 and 3 (Docket Nos. 50-277 and 50-278) Radioactive Effluent Dose Assessment, Enclosure A, September 30, 1976. All other data except P-32 BF and DF were used as given in Reg. Guide 1.109, Revision 1, October 1977. The P-32 BF and DF were used in accordance with information supplied in Branagan, E.F., Nichols, C.R., and Willis, C.A., "The Importance of P-32 in Nuclear Reactor Liquid Effluents", NRC, 6/82. The teen and child dose factors were derived by the ratio of the adult bone dose factors in Reg. Guide 1.109 and Branagan, et al.

## VII. (Cont'd)

## NOTE 2

To develop constant R for the ingestion pathway in section IV.C, the following site specific data were used:

$$R_i^c (D/Q) = K' \frac{Q_F (U_{ap})}{\lambda_i + \lambda_w} F_m (r) (DFL_i) \left[ \frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f}$$

where:

- $K'$  =  $10^6$  pCi/ $\mu$ Ci; unit conversion factor
- $Q_F$  = 50 kg/day; cow's consumption rate
- $U_{ap}$  = 330 l/yr; yearly milk consumption by an infant
- $\lambda_i$  = radioactive decay constant for nuclide of interest,  $\text{sec}^{-1}$  (e.g.  $9.97 \times 10^{-7} \text{ sec}^{-1}$  for I-131)
- $\lambda_w$  =  $5.73 \times 10^{-7} \text{ sec}^{-1}$ ; decay constant for removal of activity in leaf and plant surfaces
- $F_m$  = stable element transfer coefficient for nuclide of interest, day/liter (e.g.  $6.0 \times 10^{-3}$  day/liter for I-131)
- $r$  = fraction of deposited nuclide retained in cow's feed grass, 1.0 for radioiodine; 0.2 for particulates
- $DFL_i$  = ingestion dose factor in infant for nuclide of interest, mrem/pCi (e.g.  $1.39 \times 10^{-2}$  mrem/pCi for I-131)
- $f_p$  = 0.6; the fraction of the year the cow is on pasture (average of all farms)
- $f_s$  = 0.487; the fraction of cow feed that is pasture grass while the cow is on pasture (average of all farms)
- $Y_p$  =  $0.7 \text{ kg/m}^2$ ; the agricultural productivity of pasture feed grass
- $Y_s$  =  $2.0 \text{ kg/m}^2$ ; the agricultural productivity of stored feed

VII. (Cont'd)

$t_f$  =  $1.73 \times 10^5$  sec (2 days); the transport time from pasture, to cow, to milk, to receptor

$t_h$  =  $7.78 \times 10^6$  sec (90 days); the transport time from pasture, to harvest, to cow, to milk, to receptor

NOTE 3

To develop constant R for tritium for the ingestion pathway in section IV.C, the following site specific data were used:

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. The following additional constants and formula are used:

$$R_{H-3}^c (\chi/Q) = K' K'' F_m Q_F U_{ap} (DFL_i) [0.75(0.5/H)]$$

where:

$K''$  =  $10^3$  gm/kg; a constant of unit conversion

$H$  =  $14.61$  gm/m<sup>3</sup>; absolute humidity of the atmosphere

0.75 = the fraction of total feed that is water

0.5 = the ratio of the specific activity of the feed grass water to the atmospheric water

The pathway is the grass-cow-milk ingestion pathway. These data were derived from data published in Peach Bottom Atomic Power Station Units 2 and 3 (Docket Nos. 50-277 and 50-278) Radioactive Effluent Dose Assessment, Enclosure A, September 30, 1976. All other data were used as given in Reg. Guide 1.109, Revision 1, October 1977.

ODCMS 4.8.B.2.1, Liquid Pathway Dose Calculations

The equations for calculating the doses due to the actual release rates of radioactive materials in liquid effluents were developed from 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 NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", October 1978.

ODCMS 4.8.C.1.1 and 4.8.C.1.2Dose Rate Noble Gases

The equations for calculating the dose rate due to the actual release rates of radioactive noble gases in gaseous effluents were developed from 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, NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", August 1978, and the atmospheric dispersion model presented in Information Requested in Enclosure 2 to letter from George Lear to E. G. Bauer dated February 17, 1976, September 30, 1976. The specified equations provide for determining the dose rates in areas at and beyond the SITE BOUNDARY based upon the historical average atmospheric conditions.

02.2008 | The dose rate due to noble gas release as calculated by the Gross Release Method is much more conservative than the dose calculated by the Isotopic Analysis Method. Assuming the release rates given in Radioactive Effluent Dose Assessment, September 30, 1976, the values calculated by the Gross Release Method for total body dose rate and skin dose rate are 6.0 times and 5.7 times, respectively, the values calculated by the Isotopic Analysis Method.

Dose Rate I-131, I-133, Tritium and Radioactive Material in Particulate Form.

The model Technical Specification LCO of NUREG-0133 for all radionuclides and radioactive materials in particulate form and radionuclides other than noble gases requires that the instantaneous dose rate be less than the equivalent of 1500 mrem per year.

The release data from 1994 to 1996 were evaluated and the critical organs were determined to be the child thyroid or teenager lung. The child thyroid dose rate is limiting when iodine releases exceed 10 percent of the total release rates. The teenager lung dose rate is limiting when iodine is either not present or a small fraction of the total release.

Because of good fuel performance the amount of I-131 released has decreased. The thyroid may not be the critical organ. When it is not clear which organ dose is limiting, doses for the child thyroid and teenage lung are calculated.

ODCMS 4.8.C.2.1Dose Noble Gases

The equations for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents were developed from 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, NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", August 1978, and the atmospheric dispersion model presented in Information Requested in Enclosure 2 to letter from George Lear to E. G. Bauer dated February 17, 1976, September 30, 1976. The specified equations provide for determining the air doses in areas at and beyond the SITE BOUNDARY based upon the historical average atmospheric conditions.

The dose due to noble gas releases as calculated by the Gross Release Method is much more conservative than the dose calculated by the Isotopic Analysis Method. Assuming the releases rates given in Radioactive Effluent Dose Assessment, September 30, 1976, the values calculated by the Gross Release Method for total body dose rate and skin dose rate are 4.3 times and 7.2 times, respectively, the values calculated by the Isotopic Analysis Method.

ODCMS 4.8.C.3.1Dose, Iodine-131, Iodine-133, Tritium, and Radioactive Material in Particulate Form

The equation for calculating the doses due to the actual release of radioiodines, radioactive material in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days were developed using 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, NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", October 1978, and the atmospheric dispersion model presented in Information Requested in Enclosure 2 to Letter from George Lear to E. G. Bauer dated February 17, 1976, September 30, 1976. These equations provide for determining the actual doses based upon the historical average atmospheric conditions.

## VII. (Cont'd)

Compliance with the 10 CFR 50 limits for radioiodines, radioactive materials in particulate form and radionuclides other than noble gases with half lives greater than eight days is to be determined by calculating the infant thyroid, infant liver and infant bone dose. These organs were determined to be the critical organs based on the release data from 1994 to 1996.

Because of a decrease in the amount of I-131 released, the thyroid may not be the critical organ. The isotopic analysis method is used to calculate dose to the infant thyroid, infant liver and infant bone.

APPENDIX A

RADIOACTIVE EFFLUENTS CONTROLS PROGRAM

CONTAINING

OFFSITE DOSE CALCULATION MANUAL  
SPECIFICATIONS (ODCMS) AND BASES

FOR

PEACH BOTTOM ATOMIC POWER STATION

UNITS 2 AND 3

REVISION 13

RADIOACTIVE EFFLUENTS CONTROLS PROGRAM

TABLE OF CONTENTS

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3.8.A	Definitions .....	ODCM 3.8.A-1
3.8.B	Liquid Radwaste Effluents .....	ODCM 3.8.B-1
3.8.C	Gaseous Effluents .....	ODCM 3.8.C-1
3.8.D	40 CFR 190 and 10 CFR 72.104 .....	ODCM 3.8.D-1
3.8.E	Radiological Environmental Monitoring .....	ODCM 3.8.E-1
3.10	Reporting Requirements .....	ODCM 3.10-1
B 3.8	ODCM Specifications Bases .....	ODCM B 3.8-1

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ODCMS 3.8.A Definitions

-----NOTE-----

The defined terms of this section appear in capitalized type and are applicable throughout these Offsite Dose Calculation Manual Specifications and Bases.

<u>Term</u>	<u>Definition</u>
FUNCTIONAL TESTS	A FUNCTIONAL TEST is the manual operation or initiation of a system, subsystem, or component to verify that it functions within design tolerances (e.g., the manual start of a core spray pump to verify that it runs and that it pumps the required volume of water).
OPERABLE - OPERABILITY	A system, subsystem, division, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and all necessary attendant instrumentation, controls, normal and emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, division, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).
2.2008   GASEOUS RADWASTE TREATMENT SYSTEM	Any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system off gases from the main condenser evacuation system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.
2.2008   INSTRUMENT CALIBRATION	An INSTRUMENT CALIBRATION means the adjustment of an instrument signal output so that it corresponds, within acceptable range, and accuracy, to a known value(s) of the parameter, which the instrument monitors. The INSTRUMENT CALIBRATION shall encompass the entire instrument including the sensors and alarm, interlock and/or trip functions and shall include the INSTRUMENT FUNCTIONAL TEST. The known value of the parameter shall be injected into the instrument as close to the primary sensor as practicable.

ODCMS 3.8.A Definitions (continued)

2.2008	INSTRUMENT CHECK	An INSTRUMENT CHECK is a qualitative determination of acceptable FUNCTIONALITY by observation of instrument behavior during operation. This determination shall include, where possible, comparison of the instrument with other independent instruments measuring the same variable.
2.2008	INSTRUMENT FUNCTIONAL TEST	An INSTRUMENT FUNCTIONAL TEST means the injection of a simulated signal into the instrument as close to the primary sensor as practicable to verify the FUNCTIONALITY including alarm and/or trip functions and channel failure trips.
	MEMBERS OF THE PUBLIC	MEMBERS OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational, or other purposes not associated with the plant.
2.2008	OFFSITE DOSE CALCULATION MANUAL	Contains the current methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Radiological Environmental Monitoring Program.
2.2008	FUNCTIONAL-FUNCTIONALITY	An attribute of SSCs that is not controlled by TS. An SSC is functional or has functionality when it is capable of performing its specified function, as set forth in the CLB. Functionality does not apply to specified safety functions, but does apply to the ability of non-TS SSCs to perform other specified functions that have a necessary support function.
	PURGE - PURGING	PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

SITE BOUNDARY

That line beyond which the land is not owned, leased, or otherwise controlled by licensee as defined in Figure 3.8.A.1.

SOURCE CHECK

A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

2.2008

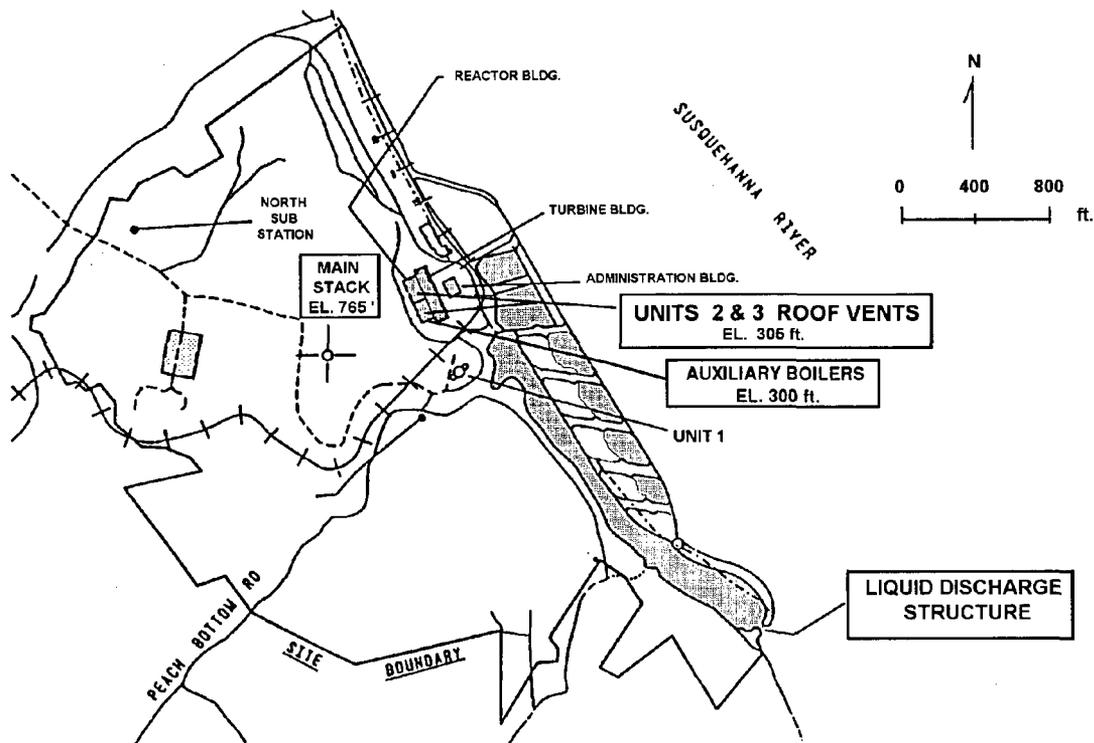


Figure 3.8.A.1

SITE BOUNDARY  
(including gaseous and liquid effluent release points)

3.8.B Liquid Radwaste Effluents

ODCMS 3.8.B.1 The concentration of radioactive material released to areas at or beyond the SITE BOUNDARY shall be limited to:

- a. 10 times the concentration specified in 10 CFR 20 Appendix B, Table 2, Column 2 for radionuclides other than noble gases; and
- b.  $2 \times 10^{-4}$   $\mu$ Ci/ml total activity concentration for all dissolved or entrained noble gases.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
A. Concentration of radioactive material released to areas at or beyond the SITE BOUNDARY exceeding limits.	A.1 Initiate actions to decrease the release rate of radioactive materials to restore concentration to within limits.	Immediately
	<u>OR</u> A.2 Initiate actions to increase the dilution flow rate to restore concentration within limits.	Immediately
	<u>OR</u> A.3 Initiate actions to decrease the release rate of radioactive materials and increase the dilution flow rate to restore concentration within limits.	Immediately

2.2008

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
<p>ODCMS 4.8.B.1.1 Take a sample of each batch of liquid effluent and analyze for the concentration of each significant gamma energy peak. Base the release rate on the circulating water flow rate at the time of discharge.</p>	<p>Prior to each release</p>
<p>ODCMS 4.8.B.1.2 Record radioactive concentrations and volume before dilution of each batch of liquid effluent released, the average dilution flow, and length of time over which each discharge occurred.</p>	<p>During each release</p>
<p>ODCMS 4.8.B.1.3 Perform radioactive liquid waste sampling and activity analysis.</p>	<p>In accordance with Table 4.8.B.1</p>

Table 4.8.B.1 (Page 1 of 2)  
Radioactive Liquid Waste Sampling and Analysis

SAMPLE TYPE	SAMPLE FREQUENCY	SAMPLE ANALYSIS	SAMPLE LOWER LIMIT OF DETECTION (LLD) (a), (d), (e)
Waste Tank to be released	Each batch (b)	Quantitative Analysis of Identifiable Gamma Emitters	$5 \times 10^{-7} \mu\text{Ci/ml}$
		I-131	$1 \times 10^{-6} \mu\text{Ci/ml}$
Proportional Composite of Batches	31 days (c)	Fe-55	$1 \times 10^{-6} \mu\text{Ci/ml}$
		Tritium	$1 \times 10^{-5} \mu\text{Ci/ml}$
		Gross Alpha	$1 \times 10^{-7} \mu\text{Ci/ml}$
Proportional Composite of Batches	31 days (c)	Sr-89	$5 \times 10^{-8} \mu\text{Ci/ml}$
		Sr-90	$5 \times 10^{-8} \mu\text{Ci/ml}$
One Batch	31 days	Dissolved noble gases	$1 \times 10^{-5} \mu\text{Ci/ml}$

- (a) The Sample Lower Limit of Detection is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. The values for the lower limit of detection are based on a 95% confidence level.
- (b) A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analysis, each batch shall be isolated and thoroughly mixed to assure representative sampling.
- (c) A composite sample is one in which the quantity of the sample is proportional to the quantity of liquid waste discharged and in which the method of sampling results in a sample representative of the liquids released.

Table 4.8.B.1 (Page 2 of 2)  
Radioactive Liquid Waste Sampling and Analysis

- (d) The principal gamma emitters for which the minimum detectable level specification will apply are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the sample detectable limit for the analyses should not be reported as being present at the sample detectable limit level. When unusual circumstances result in sample detectable limits higher than required, the reasons shall be documented in the Radioactive Effluent Release Report. The values listed are believed to be attainable.
- (e) Certain mixtures of radionuclides may cause interference in the measurement of individual radionuclides at their detectable limit especially if other radionuclides are at much higher concentrations. Under these circumstances use of known ratios of radionuclides will be appropriate to calculate the levels of such radionuclides.

3.8.B Liquid Radwaste Effluents

ODCMS 3.8.B.2 The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive material in liquid effluent releases from the two reactors at the site to the areas at or beyond the SITE BOUNDARY shall be limited to:

- a.  $\leq 3.0$  mrem to the total body and  $\leq 10.0$  mrem to any organ during any calendar quarter; and
- b.  $\leq 6.0$  mrem to the total body and  $\leq 20.0$  mrem to any organ during any calendar year.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
<p>A. Calculated dose from the release of radioactive materials in liquid effluents exceeds required limits.</p>	<p>A.1 Submit a Special report to the NRC that will identify cause(s) for exceeding limits, action(s) taken to reduce releases of radioactive materials in liquid effluents, corrective action(s) taken to assure subsequent releases are within limits, results of radiological analyses of the drinking water source, and the radiological impact on the potentially affected drinking water supplies with regard to 40 CFR 141, Safe Drinking Water Act.</p>	<p>31 days</p>

2.2008

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.B.2.1 Determine cumulative dose contributions in accordance with the methodology and parameters in the ODCM.	31 days

3.8.B Liquid Radwaste Effluents

ODCMS 3.8.B.3 The following conditions shall be met:

- a. Dilution water flow rates necessary to satisfy requirements of ODCMS 3.8.B.1 shall be maintained;
- b. The gross activity monitor and the flow monitor on the waste effluent line shall be FUNCTIONAL; and
- c. The liquid effluent control monitor shall be set in accordance with methodology and parameters in the ODCM to alarm and automatically close the waste discharge valve prior to exceeding limits in ODCMS 3.8.B.1; and
- d. The service water, emergency service water, and high pressure service water effluent line radiation monitors shall be FUNCTIONAL.

2.2008 |

2.2008 |

2.2008 |

APPLICABILITY: During release of radioactive wastes.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
A. Gross activity monitor on the waste activity line inoperable.	A.1 Initiate action to restore monitor to FUNCTIONAL status.	Immediately
	<u>AND</u>	
	A.2 Analyze two independent samples of tank's contents.	Prior to release
	<u>AND</u>	
	A.3 Perform independent verification of the release rate calculations and discharge line valve line-up using at least two technically qualified members of the facility staff.	Prior to release

2.2008



COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
2.2008   E. Liquid radwaste effluents radiation monitors inoperable for > 30 days.	E.1 Submit a Special Report to the NRC to determine the reason the inoperability was not corrected in a timely manner.	
ODCMS REQUIREMENT		FREQUENCY
ODCMS 4.8.B.3.1 Perform INSTRUMENT CHECK of liquid radwaste effluents radiation monitor.	24 hours during release	
ODCMS 4.8.B.3.2 Perform INSTRUMENT CHECK of liquid effluent flow monitor.	24 hours during release	
2.2008   ODCMS 4.8.B.3.3 Perform INSTRUMENT FUNCTIONAL TEST of liquid radwaste effluents radiation monitor, including FUNCTIONALITY demonstration of the radwaste discharge automatic isolation valve and control room annunciation in response to alarm/trip setpoint being exceeded and an instrument INOP failure.	31 days	
ODCMS 4.8.B.3.4 Perform SOURCE CHECK of liquid radwaste effluents radiation monitor.	92 days	
ODCMS 4.8.B.3.5 Perform INSTRUMENT CALIBRATION of the liquid radwaste effluents radiation monitor with a known radiation source positioned in a reproducible geometry with respect to the sensor.	12 months	

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.B.3.6 Perform INSTRUMENT CALIBRATION of the liquid effluents flow monitor.	12 months
ODCMS 4.8.B.3.7 Perform INSTRUMENT CHECK of service water effluent line radiation monitor.	24 hours during release
ODCMS 4.8.B.3.8 Perform INSTRUMENT FUNCTIONAL TEST of service water effluent line radiation monitor, including FUNCTIONALITY demonstration of the control room annunciation in response to alarm/trip setpoint being exceeded and an instrument INOP failure.	92 days
ODCMS 4.8.B.3.9 Perform SOURCE CHECK of service water effluent line radiation monitor.	31 days
ODCMS 4.8.B.3.10 Perform INSTRUMENT CALIBRATION of the service water effluent line radiation monitor with a known radiation source.	18 months
ODCMS 4.8.B.3.11 Perform INSTRUMENT CHECK of emergency service water effluent line radiation monitor.	24 hours during release
ODCMS 4.8.B.3.12 Perform INSTRUMENT FUNCTIONAL TEST of emergency service water effluent line radiation monitor, including FUNCTIONALITY demonstration of the control room annunciation in response to alarm/trip setpoint being exceeded and an instrument INOP failure.	92 days

2.2008

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.B.3.13 Perform SOURCE CHECK of emergency service water effluent line radiation monitor.	31 days
ODCMS 4.8.B.3.14 Perform INSTRUMENT CALIBRATION of the emergency service water effluent line radiation monitor with a known radiation source.	18 months
ODCMS 4.8.B.3.15 Perform INSTRUMENT CHECK of high pressure service water effluent line radiation monitor.	24 hours during release
ODCMS 4.8.B.3.16 Perform INSTRUMENT FUNCTIONAL TEST of high pressure service water effluent line radiation monitor, including FUNCTIONALITY demonstration of the control room annunciation in response to alarm/trip setpoint being exceeded and an instrument INOP failure.	92 days
ODCMS 4.8.B.3.17 Perform SOURCE CHECK of high pressure service water effluent line radiation monitor.	31 days
ODCMS 4.8.B.3.18 Perform INSTRUMENT CALIBRATION of the high pressure service water effluent line radiation monitor with a known radiation source.	18 months

2.2008

3.8.B Liquid Radwaste Effluents

ODCMS 3.8.B.4 Liquid effluent releases shall be processed through one of the radwaste subsystems or combination of subsystems listed below:

- a. waste collector filter and demineralizer;
- b. floor drain filter and demineralizer;
- c. fuel pool filter demineralizer;
- d. chemical/oily waste cleanup subsystem;
- e. laundry drain filter

2.2008 |

APPLICABILITY: Prior to all liquid effluent release(s) whenever the release(s) would cause the projected dose, when it is averaged over 31 days to exceed 0.12 mrem to the total body or 0.4 mrem to any organ (combined total from the two reactors at the site).

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
<p>A. Liquid waste discharged without required processing.</p>	<p>A.1 Submit a Special Report to the NRC that includes, an explanation of why liquid radwaste was discharged without required processing, identification of any inoperable equipment or subsystems and the reason for the inoperability, the action taken to restore the inoperable equipment to FUNCTIONAL status, and the action(s) taken.</p>	<p>31 days</p>

2.2008

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.B.4.1 Project doses due to liquid effluent releases to areas at and beyond the SITE BOUNDARY in accordance with the methodology and parameters in the ODCM.	31 days
ODCMS 4.8.B.4.2 Demonstrate FUNCTIONALITY of the waste collector filter and demineralizer and the floor drain filter by analyzing the liquid processed through the subsystem and determining it meets the requirements of ODCMS 3.8.B.1.	92 days
ODCMS 4.8.B.4.3 Demonstrate FUNCTIONALITY of the fuel pool filter demineralizer by analyzing the liquid processed through the subsystem and determining it meets the requirements of ODCMS 3.8.B.1.	Prior to release of liquid effluents processed by this subsystem
ODCMS 4.8.B.4.4 Demonstrate FUNCTIONALITY of the chemical/oily waste cleanup subsystem by analyzing the liquid processed through the subsystem and determining it meets the requirements of ODCMS 3.8.B.1.	Prior to release of liquid effluents processed by this subsystem
ODCMS 4.8.B.4.5 Demonstrate FUNCTIONALITY of the laundry drain filter by analyzing the liquid processed through the subsystem and determining it meets the requirements of ODCMS 3.8.B.1.	Prior to release of liquid effluents processed by this subsystem

2.2008

3.8.C Gaseous Effluents

ODCMS 3.8.C.1 The dose rate at or beyond the SITE BOUNDARY due to radioactive materials in gaseous effluents released from the two reactors at the site shall be limited to the following:

- a. For noble gases,  $\leq 500$  mrem per year to the total body and  $\leq 3000$  mrem per year to the skin; and
- b. For iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives  $> 8$  days,  $\leq 1500$  mrem per year to any organ.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
2.2008 A. Dose rates at or beyond the SITE BOUNDARY exceed limits due to radioactive material in gaseous effluents.	A.1 Initiate actions to decrease release rates to comply with limits.	Immediately

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.1.1 Verify the dose rate due to noble gases in gaseous effluents is within limits in accordance with methods and procedures of the ODCM.	In accordance with sampling and analysis program specified in Table 4.8.C.1

(continued)

ODCMS REQUIREMENTS (Continued)

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.1.2 Obtain representative samples and verify the dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives > 8 days in gaseous effluents are within limits in accordance with the methods and procedures of the ODCM.	In accordance with sampling and analysis program specified in Table 4.8.C.1

Table 4.8.C.1 (page 1 of 2)  
Radioactive Gaseous Waste Sampling and Analysis from  
Main Stack, Vent Stacks, and Auxiliary Boiler Exhaust Stack

SAMPLE TYPE	SAMPLE FREQUENCY	SAMPLE ANALYSIS	SAMPLE LOWER LIMIT OF DETECTION (LLD) (a) (d)
Grab Sample	31 days (b)	Quantitative analysis of identifiable gamma emitters	$1 \times 10^{-4} \mu\text{Ci/cc(c)}$
Grab Sample	92 days	Tritium	$1 \times 10^{-6} \mu\text{Ci/cc}$
Charcoal Filters	7 days (c)	I-131	$1 \times 10^{-12} \mu\text{Ci/cc(c)}$
Particulate Filters	7 days (c)	Quantitative analysis of identifiable gamma emitters	$1 \times 10^{-10} \mu\text{Ci/cc(c)}$
		I-131	$1 \times 10^{-12} \mu\text{Ci/cc(c)}$
Particulate Filters (composite of weekly filters)	31 days	Gross Alpha	$1 \times 10^{-11} \mu\text{Ci/cc}$
Particulate Filters (composite of weekly filters)	31 days	Sr-89	$1 \times 10^{-11} \mu\text{Ci/cc}$
		Sr-90	$1 \times 10^{-11} \mu\text{Ci/cc}$
Noble Gas Monitor (Main Stack)	Continuously	Noble Gas Gross $\beta$ or $\gamma$	$1 \times 10^{-6} \mu\text{Ci/cc}$
Noble Gas Monitor (Roof Vents)	Continuously	Noble Gas Gross $\beta$ or $\gamma$	$1 \times 10^{-6} \mu\text{Ci/cc}$
Auxiliary Boiler Waste Oil Grab Sample	Prior to batch release for burn	Quantitative analysis of identifiable gamma emitters	$5 \times 10^{-7} \mu\text{Ci/ml}$

Table 4.8.C.1 (page 2 of 2)  
Radioactive Gaseous Waste Sampling and Analysis from  
Main Stack, Vent Stacks, and Auxiliary Boiler Exhaust Stack

- (a) The sample lower limit of detection is defined as an a priori (before the fact) limit representing the capability of measurement system and not as an a posteriori (after the fact) limit for a particular measurement. The values for the lower limit of detection are based on a 95% confidence level.
- (b) Sampling and analysis shall be performed following shutdown, startup or a thermal power change exceeding 15% of rated thermal power within 1 hour from a steady state condition unless (1) analysis shows that the dose equivalent I-131 concentration in the primary coolant has not increased more than a factor of 3, and (2) the noble gas activity monitor shows that effluent activity has not increased by more than a factor of 3.
- (c) Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing. Sampling shall also be performed at least once per 24 hours for at least 3 days following each shutdown, startup or thermal power change exceeding 15% of rated thermal power in 1 hour and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLD may be increased by a factor of 10. This requirement does not apply if (1) analysis has shown that the dose equivalent I-131 concentration in the primary coolant has not increased more than a factor of 3, and (2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.
- (d) Certain mixtures of radionuclides may cause interference in the measurement of individual radionuclides at their detectable limit especially if other radionuclides are at much higher concentrations. Under these circumstances use of known ratios of radionuclides will be appropriate to calculate the levels of such radionuclides. Nuclides which are below the sample detectable limit for the analyses should not be reported as being present at the sample detectable limit level.

3.8.C Gaseous Effluents

ODCMS 3.8.C.2 The air dose at or beyond the SITE BOUNDARY due to noble gases in gaseous effluents released from the two reactors at the site shall be limited to the following:

- a. For gamma radiation,  $\leq 10$  mrad during any calendar quarter;
- b. For beta radiation,  $\leq 20$  mrad during any calendar quarter;
- c. For gamma radiation,  $\leq 20$  mrad during any calendar year; and
- d. For beta radiation,  $\leq 40$  mrad during any calendar year.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
A. Calculated air dose at or beyond the SITE BOUNDARY from radioactive noble gases in gaseous effluents exceeds limits.	A.1 Submit a Special Report to the NRC that identifies causes for exceeding limits, corrective actions taken to reduce the releases, and corrective actions to assure that subsequent releases are within limits.	31 days

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.2.1 Determine cumulative dose contributions for noble gases in accordance with the methodology and parameters in the ODCM.	31 days

3.8.C Gaseous Effluents

ODCMS 3.8.C.3 The dose to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY from iodine-131, iodine-133, tritium and all radionuclides in particulate form, with half lives > 8 days, in gaseous effluents released from the two reactors at the site shall be limited to:

- a.  $\leq$  15 mrem during any calendar quarter; and
- b.  $\leq$  30 mrem during any calendar year.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
A. Calculated dose from the release of iodine-131, iodine-133, tritium and radionuclides in particulate form, with half-lives > 8 days in gaseous effluents exceeds limits.	A.1 Submit a Special Report to the NRC that identifies causes for exceeding limits, corrective actions taken, and proposed corrective actions to assure that subsequent releases are within limits.	31 days

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.3.1 Determine cumulative dose contributions for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half lives > 8 days in accordance with the methodology and parameters in the ODCM.	31 days

3.8.C Gaseous Effluents

ODCMS 3.8.C.4 The following conditions shall be met:

- a. Main stack dilution flow shall be  $\geq 10,000$  cfm;
- 2.2008 | b. One vent stack noble gas monitor and one main stack noble gas monitor shall be FUNCTIONAL and set to alarm in accordance with the methodology and parameters in the ODCM;
- 2.2008 | c. One vent stack iodine filter and one main stack iodine filter and one vent stack particulate filter and one main stack particulate filter with their respective flow rate monitors shall be FUNCTIONAL; and
- 2.2008 | d. One vent stack flow rate monitor and one main stack flow rate monitor shall be FUNCTIONAL and set to alarm in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: During release of radioactive wastes.



COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
<p>2.2008   B. One required vent stack iodine filter inoperable.</p> <p><u>OR</u></p> <p>One required vent stack particulate filter inoperable.</p> <p><u>OR</u></p> <p>One required main stack iodine filter inoperable.</p> <p><u>OR</u></p> <p>One required main stack particulate filter inoperable.</p>	<p>B.1 Initiate action to collect samples from the affected effluent release pathway continuously with auxiliary sampling equipment such that each sample period duration is approximately 7 days.</p> <p><u>AND</u></p> <p>B.2 Analyze collected samples.</p>	<p>Immediately</p> <p>48 hours after end of each sampling period</p>
<p>C. One required vent stack flow rate monitor inoperable.</p> <p><u>OR</u></p> <p>One required main stack flow rate monitor inoperable.</p>	<p>C.1 Estimate flow rate from the affected effluent release pathway.</p>	<p>4 hours</p> <p><u>AND</u></p> <p>Once per 4 hours thereafter</p>
<p>D. Main off-gas stack dilution flow &lt; 10,000 cfm.</p>	<p>D.1 Initiate action to re-establish main off-gas stack flow <math>\geq</math> 10,000 cfm.</p>	<p>Immediately</p>

(continued)

COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
2.2008 E. One or more required radioactive gaseous effluent monitoring instrumentation channels inoperable for > 30 days.	E.1 Initiate a Condition Report to explain the reason inoperability was not corrected in a timely manner.	

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.4.1 Perform INSTRUMENT CHECK of the vent stack and main stack noble gas radiation monitors.	24 hours
ODCMS 4.8.C.4.2 Perform INSTRUMENT CHECK of the vent stack and the main stack flow rate monitors.	24 hours
ODCMS 4.8.C.4.3 Section Removed	
ODCMS 4.8.C.4.4 Perform INSTRUMENT FUNCTIONAL TEST of the vent stack and main stack noble gas radiation monitors, including control room alarm annunciation in response to alarm setpoint being exceeded and an instrument downscale failure.	92 days
ODCMS 4.8.C.4.5 Section Removed	

(Continued)

ODCMS REQUIREMENTS (Continued)

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.4.6 Perform INSTRUMENT CALIBRATION of the vent stack and main stack noble gas radiation monitors with a known radioactive source positioned in a reproducible geometry with respect to the sensor.	18 months
ODCMS 4.8.C.4.7 Perform INSTRUMENT CALIBRATION of the vent stack and main stack flow rate monitors.	18 months
ODCMS 4.8.C.4.8 Perform INSTRUMENT CALIBRATION of the vent stack and main stack iodine and particulate sample flow rate monitors.	18 months
ODCMS 4.8.C.4.9 Section Removed	
ODCMS 4.8.C.4.10 Perform SOURCE CHECK of vent stack and main stack noble gas radiation monitors.	92 days
ODCMS 4.8.C.4.11 Perform SOURCE CHECK of vent stack and main stack flow rate monitors.	92 days

2.2008

3.8.C Gaseous Effluents

- ODCMS 3.8.C.5 Gaseous effluents shall be processed through the Gaseous Waste Treatment System described below prior to discharge:
- a. Steam jet air ejector discharge shall be processed through the recombiner, holdup pipe, off-gas filter, and off-gas stack;
  - b. Mechanical vacuum pump and gland steam exhauster discharge shall be processed through the off-gas stack;
  - c. Auxiliary boiler exhaust shall be processed through the auxiliary boiler stack when burning radioactive waste oil;
  - d. Reactor, turbine, radwaste, and recombiner building atmospheres shall be processed through permanently or temporarily installed equipment in the appropriate building ventilation system and the vent stack, with the exception of the following unmonitored exhausts:
    1. Recirculation M-G set and reactor building cooling water equipment rooms;
    2. Control room utility and toilet rooms;
    3. Cable spread room;
    4. Emergency switchgear rooms;
    5. 125/250 VDC battery rooms and the 250 VDC battery rooms, and
    6. Administration building maintenance decontamination area.

APPLICABILITY: Prior to all gaseous release(s) whenever the release(s) would cause the projected dose, when it is averaged over 31 days to exceed 0.6 mrem to any organ (combined total from the two reactors at the site).

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
2.2008 A. Gaseous waste discharged without required processing.	A.1 Submit a Special Report to the NRC that explains the reasons gaseous radwaste was discharged without processing, identifies inoperable equipment or subsystems and the reasons for the inoperability, identifies actions taken to restore the inoperable equipment to FUNCTIONAL status, and action(s) taken.	Immediately

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.5.1 Project doses due to gaseous effluent releases at and beyond the SITE BOUNDARY in accordance with the methodology and parameters in the ODCM.	31 days
ODCMS 4.8.C.5.2 Collect and analyze air samples from each building area with an unmonitored exhaust.	31 days

(continued)

ODCMS REQUIREMENTS (Continued)

2008

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.5.3 Demonstrate FUNCTIONALITY of required gaseous radioactive waste system equipment by analyzing the gaseous waste processed through the required equipment to determine it meets the requirements of ODCMS 3.8.C.1	92 days

3.8.C Gaseous Effluents

ODCMS 3.8.C.6 PURGING of the primary containment shall be:

- a. Through the Standby Gas Treatment System whenever primary containment is required to be FUNCTIONAL; and
- b. Through the Reactor Building Ventilation Exhaust System or the Standby Gas Treatment System whenever primary containment is not required to be FUNCTIONAL.

2.2008 |

2.2008 |

APPLICABILITY: During PURGING of the primary containment.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
A. Requirement of ODCMS 3.8.C.6 not met.	A.1 Initiate action to suspend PURGING.	Immediately

2.2008 |

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.6.1 Verify primary containment PURGING is through required effluent release pathway of ODCMS 3.8.C.6.	Prior to PURGING primary containment

## 3.8.C Gaseous Effluents

ODCMS 3.8.C.7 Burning of radioactive waste oil shall be allowed:

- a. In accordance with the requirements of 10CFR20.2004.
- b. Through the Auxiliary Boilers (Common) with the exhaust stack of the affected auxiliary boiler as a release point for radioactive effluents.
- c. With the radioactive content of the oil determined prior to incineration.
- d. With the radioactive effluents from this pathway summed with other effluents from the site and reported to the Commission in the Radioactive Effluent Release Report.

APPLICABILITY: At all times

## COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
2.2008 A. Gaseous effluents discharge without required processing or Gaseous effluents exceed limits specified in 3.8.C.3	A.1 Submit a Special Report to the NRC that explains the reasons gaseous radwaste was discharged without processing, identifies inoperable equipment or subsystems and the reasons for the inoperability, identifies actions taken to restore the inoperable equipment to FUNCTIONAL status, and action(s) taken.	Immediately

## ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.C.7.1 Project doses due to gaseous effluent releases at or beyond the SITE BOUNDARY.	Each Batch Incinerated
ODCMS 4.8.C.7.2 Determine dose and dose rate contributions for radionuclides in particulate form with half lives > 8 days in accordance with the methodology and parameters in ODCM Section IV.F.	Each Batch Incinerated

3.8.D 40 CFR 190 and 10 CFR 72.104

- ODCMS 3.8.D.1 The annual dose equivalent to a real individual who is located beyond the SITE BOUNDARY from all uranium fuel cycle sources within 8 kilometers shall be:
- a.  $\leq$  25 mrem to the total body;
  - b.  $\leq$  75 mrem to the thyroid.
  - c.  $\leq$  25 mrem to any other critical organ; and
  - d.  $\leq$  3.0 mrem contribution from liquid and gaseous effluents for whole body and critical organ doses.
  - e.  $\leq$  55 mrem contribution from gaseous effluents for thyroid dose.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
<p>A. Annual cumulative liquid and gaseous effluents dose does not meet ODCMS 3.8.D.1 items d or e.</p>	<p>-----NOTE-----  Calculations shall include direct radiation contributions from reactor units and outside storage tanks.  -----  A.1 Initiate actions to determine whether the limits in ODCMS 3.8.D.1 items a, b or c have been exceeded.</p>	<p>Immediately</p>

(continued)



ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
<p>ODCMS 4.8.D.1.1 Determine total gas and liquid cumulative dose contributions in accordance with methodology and parameters in the ODCM.</p>	<p>31 days</p>
<p>ODCMS 4.8.D.1.2 Determine the cumulative dose contribution from gas and liquid effluents and the direct radiation from the reactor units and from high and low level radwaste storage in accordance with the methodology and parameters in the ODCM.</p>	<p>92 days</p>



Radiological Environmental Monitoring  
3.8.E.1

COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
<p>B. Level of radioactivity as a result of plant effluents in an environmental sampling medium at one or more locations specified in the ODCM exceeds the action levels of Table 3.8.E.1 when averaged over the calendar quarter.</p> <p><u>OR</u></p> <p>2.2008 Level of radioactivity as a result of plant effluents in an environmental sampling medium at one or more locations specified in the ODCM exceeds the action levels of Table 3.8.E.1 when averaged over the calendar quarter and more than one radionuclide from Table 3.8.E.1 is detected and the equation in ODCMS 4.8.E.1.2 is satisfied.</p>	<p>B.1 Submit a Special Report to the NRC which includes an evaluation of any release conditions, environmental factors, or other aspects which caused the action level of Table 3.8.E.1 to be exceeded and the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year reporting level of Table 3.8.E.1.</p>	<p>Immediately</p>

(continued)

COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
<p>C. Radionuclides other than those in Table 3.8.E.1 detected and the potential annual dose to a MEMBER OF THE PUBLIC is greater than or equal to the calendar year limits of ODCMS 3.8.B.2, or ODCMS 3.8.C.2, or ODCMS 3.8.C.3, or ODCMS 3.8.D.1.</p>	<p>C.1      -----NOTE----- Only required if the radionuclides detected are the result of plant effluents. ----- Submit a Special Report to the NRC to evaluate any release conditions, environmental factors, or other aspects which caused the action level of Table 3.8.E.1 to be exceeded; and the corrective actions to be taken to reduce radioactive effluents so that potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year reporting level of Table 3.8.E.1</p> <p><u>AND</u></p>	<p>31 days after end of affected calendar quarter</p> <p style="text-align: right;">(continued)</p>

2.2008

COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
C. (continued)	<p>C.2      -----NOTE-----                      Only required if the radionuclides detected are not the result of plant effluents.                      -----</p> <p>Describe the condition in the Annual Radiological Environmental Operating Report.</p>	<p>Prior to submittal of next Annual Radiological Environmental Operating Report</p>
D. Requirements of ODCMS 3.8.E.1 not met.	<p>D.1      Prepare and submit, in the Annual Radiological Environmental Operating Report, a description of the reasons for not conducting the radiological environmental monitoring program as required and the actions taken to prevent recurrence.</p>	<p>Immediately</p>

2.2008

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
<p>ODCMS 4.8.E.1.1 -----NOTES-----</p> <p>1. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailabilities, malfunction of automatic sampling equipment or other legitimate reasons.</p> <p>2. If equipment malfunction occurs, an effort shall be made to complete corrective actions prior to the end of the next sampling period.</p> <p>-----</p> <p>Collect radiological environmental monitoring samples at the locations and analyze as specified in Table 4.8.E.1 and the ODCM.</p>	<p>In accordance with Table 4.8.E.1</p>
<p>ODCMS 4.8.E.1.2 -----NOTE-----</p> <p>All radionuclides used in this evaluation shall be averaged on a calendar quarterly basis.</p> <p>-----</p> <p>Evaluate the concentration of radioactivity as a result of plant effluents in an environmental sampling medium against the following equation:</p> $\frac{\text{concentration}(1)}{\text{reporting level}(1)} + \frac{\text{concentration}(2)}{\text{reporting level}(2)} + \dots \geq 1.0$	<p>92 days</p>

Radiological Environmental Monitoring  
3.8.E.1

Table 3.8.E.1 (page 1 of 1)  
Reporting Levels for Radioactivity Concentration in Environmental Samples

2.2008 |

Action Levels

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m <sup>3</sup> )	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131		0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

\*For drinking water samples. This is 40 CFR part 141 value.

Table 4.8.E.1 (page 1 of 3)  
Radiological Environmental Monitoring Program

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF SAMPLES AND SAMPLE LOCATION(a)	SAMPLING AND COLLECTION FREQUENCY (b), (c)	TYPE AND FREQUENCY OF ANALYSIS
1. Direct Radiation(e)	At least 40 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously to be placed as follows: 1) an inner ring of stations in the general area of the SITE BOUNDARY and an outer ring in the 3 to 6 mile range from the site. A station is in each sector of each ring except as dictated by local geography. The balance of the stations are in special interest areas such as population centers, nearby residences, schools and in areas to serve as control stations.	Every 31 days or Every 92 days	Every 31 days (Gamma dose) or Every 92 days (Gamma dose)
2. Airborne  Radioiodine and Particulates	Samples from 5 locations: a. 3 samples from close to the SITE BOUNDARY locations (in different sectors) of the highest calculated annual average ground level D/Q. b. 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q. c. 1 sample from a control location unlikely to be affected by the plant.	Continuous sampler operation with sample collection every 7 days or required by dust loading, whichever is more frequent.	Radioiodine canisters: I-131 analysis every 7 days  Particulate sampler: (f) gross beta radioactivity analysis following filter change; gamma isotopic analysis of composite (by location) 92 days
3. Waterborne  a. Surface	a. 1 sample upstream b. 1 sample downstream	Composite (b) sample over 31 day period.	Gamma isotopic (d) analysis every 31 days. Composite for tritium analysis at least every 92 days  (continued)

Radiological Environmental Monitoring  
3.8.E.1

Table 4.8.E.1 (page 2 of 3)  
Radiological Environmental Monitoring Program

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF SAMPLES AND SAMPLE LOCATION	SAMPLING AND COLLECTION FREQUENCY (b), (c)	TYPE AND FREQUENCY OF ANALYSIS
3. Waterborne (cont'd)			
b. Drinking	<ul style="list-style-type: none"> <li>a. 1 sample of each of 1 to 3 of the nearest water supplies that could be affected by its discharge.</li> <li>b. 1 sample from a control location.</li> </ul>	Composite (b) sample over 31 day composite period	Composite for gross beta and gamma (d) isotopic analyses every 31 days. Composite for tritium analysis at least every 92 days
c. Sediment from Shoreline	1 sample from downstream area with existing or potential recreational value.	Every 6 months	Gamma isotopic (d) analysis every 6 months
4. Ingestion			
a. Milk	<ul style="list-style-type: none"> <li>a. Samples from milking animals in 3 locations within 3 miles distance having the highest dose potential.</li> <li>b. 1 sample from milking animals at a control location (unlikely to be affected by the plant).</li> </ul>	Every 14 days when animals are on pasture, every 31 days at other times.	Gamma isotopic (d) analysis or 134, 137 Cs by chemical separation every 92 days. I-131 analysis of each sample.
b. Fish	<ul style="list-style-type: none"> <li>a. 1 sample of each commercially and recreationally important species in vicinity of discharge point when available.</li> <li>b. 1 sample of same species in areas not influenced by plant discharge when available.</li> </ul>	Sample in season, or every 6 months if they are not seasonal.	Gamma isotopic (d) analysis on edible portions.
c. Food Products	<ul style="list-style-type: none"> <li>a. Samples of 3 different kinds of broad leaf vegetation grown nearest offsite garden of highest annual average ground level D/Q if milk sampling is not performed.</li> <li>b. 1 sample of each of the similar broad leaf vegetation grown 15 - 30 km distant in the least prevalent wind direction if milk sampling is not performed.</li> </ul>	<p>Every 31 days when available if milk sampling is not performed.</p> <p>Every 31 days when available if milk sampling is not performed</p>	<p>Gamma isotopic (d) and I-131 analysis</p> <p>Gamma isotopic (d) and I-131 analysis</p>

Table 4.8.E.1 (page 3 of 3)  
Radiological Environmental Monitoring Program

NOTES

- (a) Fixed sample locations are shown in the Offsite Dose Calculation Manual, Table VII.A.1 and Figures VII.A.1, VII.A.2, and VII.A.3. At times it may not be possible or practicable to obtain samples of the media of choice at the most desired location or time. In those instances suitable alternative media and locations may be chosen for the particular pathway in question. Such necessary deviations are reported in the Annual Radiological Environmental Operating Report.
- (b) Composite samples shall be collected by collecting an aliquot at intervals not exceeding 2 hours.
- (c) Sample collection frequencies are defined as follows:
- |          |                                 |
|----------|---------------------------------|
| 7 days   | 7 calendar days $\pm$ 2 days    |
| 14 days  | 14 calendar days $\pm$ 3 days   |
| 31 days  | 31 calendar days $\pm$ 8 days   |
| 92 days  | 92 calendar days $\pm$ 10 days  |
| 6 months | 6 calendar months $\pm$ 20 days |
- (d) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
- (e) Each phosphor is considered one thermoluminescent dosimeter.
- (f) If the gross beta activity in air attributable to plant operation is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

Table 4.8.E.2 (page 1 of 2)  
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS<sup>(a)</sup>  
Lower Limit Of Detection (LLD)<sup>(b)</sup>

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE (pCi/m <sup>3</sup> )	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2,000					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	-	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

Table 4.8.E.2 (page 2 of 2)

Notes:

- (a) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable at 95% confidence level, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report.
- (b) The LLD is defined, for purposes of these controls, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

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

Where:

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

$S_{\beta}$  is the standard deviation of the background counting rate or of the counting rate of blank sample as appropriate (as counts per minute),

E is the counting efficiency (as counts per disintegration),

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield (when applicable)

$\lambda$  is the radioactive decay constant for the particular radionuclide, and

$\Delta t$  for the environmental samples is the elapsed time between sample collection (or end of the sample collection period) and time of counting.

Typical values of E, V, Y, and  $\Delta t$  should be used in calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an after the fact limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.



COMPENSATORY MEASURES (Continued)

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
A. (continued)	<p>A.2 -----NOTE-----                      The indicator sampling location having the lowest calculated dose or dose commitment (via the same exposure pathway) may be deleted from the radiological environmental monitoring program after October 31 of the year in which land use census was conducted.                      -----</p> <p>Identify the new location in the Radioactive Dose Assessment Report and include the revised figures and tables for the ODCM reflecting the new location.</p>	<p>Prior to submittal of the next Radioactive Dose Assessment Report</p>
B. Land use census identifies a location which yields a calculated dose or dose commitment that is greater than values currently being calculated in ODCMS 3.8.C.3.	B.1 Identify the new location in the Radioactive Dose Assessment Report.	<p>Prior to submittal of the next Radioactive Dose Assessment Report</p>

Radiological Environmental Monitoring  
3.8.E.2

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.E.2.1 Conduct a land use census by a door-to-door survey or by consulting local agriculture authorities or by some other appropriate means.	12 months

Radiological Environmental Monitoring  
3.8.E.3

3.8.E Radiological Environmental Monitoring

ODCMS 3.8.E.3 Analyses shall be performed on radioactive materials supplied as part of the EPA Environmental Radioactivity Intercomparison Studies Program, or another Interlaboratory Comparison Program traceable to NIST.

APPLICABILITY: At all times.

COMPENSATORY MEASURES

CONDITION	REQUIRED COMPENSATORY MEASURE	COMPLETION TIME
2.2008 A. Requirements of ODCMS 3.8.E.3 not met.	A.1 Include corrective actions to prevent recurrence in the Annual Radiological Environmental Operating Report.	Immediately

ODCMS REQUIREMENTS

ODCMS REQUIREMENT	FREQUENCY
ODCMS 4.8.E.3.1 Include a summary of the results of the Interlaboratory Comparison Program in the Annual Radiological Environmental Operating Report.	In accordance with Technical Specification 5.6.2

### 3.10 Reporting Requirements

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#### ODCMS 3.10.1 Annual Radiological Environmental Operating Report

The Annual Radiological Environmental Operating Report shall be submitted in accordance with the requirements of Technical Specification 5.6.2. In addition to the requirements of Technical Specification 5.6.2, the Annual Radiological Environmental Operating Report shall include or reference from previous reports:

- a. A summary description of the radiological environmental monitoring program including sampling methods for each sample type, size, and physical characteristics of each sample type, sample preparation methods, and measuring equipment used;
- b. At least two maps of all sampling locations keyed to a table giving distances and directions from the midpoint between reactor vents;
- c. Results of the land use census required by ODCMS 3.8.E.2; and
- d. Results of the Interlaboratory Comparison Program required by ODCMS 3.8.E.3 and discussion of all analyses in which the LLD required by Table 4.8.E.2 was not achievable.

#### ODCM 3.10.2 Radioactive Effluent Release Report

The Radioactive Effluent Release Report shall be submitted in accordance with the requirements of Technical Specification 5.6.3. In addition to the requirements of Technical Specification 5.6.3, the requirements of Technical Specification 5.6.3 the Radioactive Effluent Release Report shall include:

- a. Information for each class of solid waste (as defined by 10 CFR 61) shipped offsite during the report period:
  1. Container volume;
  2. Total curie quantity (specify whether determined by measurements or estimate);
  3. Principal radionuclides (specify whether determine by measurement of estimate);

4. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottomed); and
  5. Type of container (e.g., LSA, Type A, Type B, Large Quantity).
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- b. A list and description of unplanned releases from the site to areas at or beyond the SITE BOUNDARY of radioactive materials in gaseous and liquid effluents made during the reporting period.
  - c. Changes made during the reporting period to the Offsite Dose Calculation Manual (ODCM) and a list of new locations for dose calculations and/or environmental monitoring identified by the land use census required by ODCM 3.8.E.2.
  - d. Annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. The licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.
  - e. An assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year.
  - f. Radiation doses from radioactive liquid and gaseous effluent to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY during the report period. All assumptions used in making these assessments (i.e., specific activity, exposure time and location) shall be included in these reports.
  - g. The meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents (as determined by sampling frequency and measurement) shall be used for determining the gaseous pathway doses. Approximate methods are acceptable. The assessment of radiation doses shall be performed in accordance with the Offsite Dose Calculation Manual (ODCM).

- h. An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation. Guidance for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Revision 1, October 1977.

## B 3.8 ODCM SPECIFICATIONS

### BASES

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#### General

It is expected that releases of radioactive material in effluents will be kept at small fractions of the limits specified in Section 20.1302 of 10 CFR, Part 20. At the same time, the licensee is permitted the flexibility of operation, compatible with consideration of health and safety, to assure that the public is provided a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such small fractions, but still within the limits specified in Section 20.1302 of 10 CFR, Part 20. It is expected that in using this operational flexibility under unusual operating conditions the licensee will exert his best efforts to keep levels of radioactive material in effluents as low as practicable.

#### Liquid Radwaste Effluents

##### Concentration

This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to areas at and beyond the SITE BOUNDARY will be within 10 times the concentration levels specified in 10 CFR, Part 20, Appendix B, Table 2, Column 2. This instantaneous limitation provides additional assurance that the levels of radioactive materials in bodies of water in areas at or beyond the SITE BOUNDARY will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR, Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR, Part 20.1302 to the population. The concentration limit for noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the International Commission on Radiological Protection (ICP) Publication 2.

##### Dose

This specification is provided to implement the requirements of Sections I.E., IXIA and I.E. of Appendix I, 10 CFR Part 50. ODCMS 3.8.B.2 implements the guidance set forth in Section I.E. of Appendix I and provides the required operating flexibility to implement the guides set forth in Section I.E. of Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as reasonably achievable." The dose calculations in the ODCM implement the requirements in Section IXIA of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations described in the Offsite Dose Calculation Manual for calculating the doses due to the actual release rates

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BASES

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Liquid Radwaste Effluents

Dose (continued)

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. This specification applies to the release of liquid effluents from the site.

Instrumentation

2.2008

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential release of liquid effluents. The FUNCTIONALITY 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.

System Operation

2.2008

The FUNCTIONALITY of the Liquid 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 assurance that the releases of radioactive materials in liquid effluents will be kept "as low as 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 design objective Section II.D of Appendix I to 10 CFR, Part 50. The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as a suitable fraction of the guide set forth in Section II.A of Appendix I, 10 CFR, Part 50, for liquid effluents.

The chemical/oily waste cleanup subsystem may include the portable Epicor oil/water emulsion system (as described in RW-625), an installed chemical/oily waste cleanup subsystem, or equivalent chemical/oil waste system.

The laundry drain filter may be used to process liquid wastes containing detergents or similar cleaning agents. Wastewater such as river water that is acceptable for release may be processed through the laundry drain filter.

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## BASES (continued)

Gaseous Effluents

## Dose

This specification is provided to ensure that the dose from radioactive materials in gaseous effluents at and beyond the SITE BOUNDARY will be within the annual dose limits of 10 CFR Part 20. The annual dose limits are the doses associated with 10 times the concentrations of 10 CFR Part 20, Appendix B, Table 2, and Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table 2 of 10 CFR part 20.1302. For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC with the appropriate occupancy factors are given in the ODCM. The specified limits restrict, at all times, the gamma and beta dose rates above background to a MEMBER OF THE PUBLIC, at or beyond the SITE BOUNDARY to  $\leq 500$  mrem/year to the total body or to  $\leq 3000$  mrem/year to the skin. These dose rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to  $\leq 1500$  mrem/year.

## Dose, Noble Gases

This specification is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. ODCMS 3.8.C.2 implements the guidance set forth in Section II.B of Appendix I and provides the required operating flexibility to 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 reasonably achievable." ODCMS 4.8.C.2.1 implements the requirements in Section III.A of Appendix I that conformance with the guidance of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through the appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I," Revision 1, October 1977 and the atmospheric dispersion model submitted on September 30, 1976, in a report titled: "Information Requested in Enclosure 2 to letter from George Lear to E. G. Bauer dated February 17, 1976." The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

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BASES

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Gaseous Effluents (continued)

Dose - Iodine-131, Tritium and Radionuclides in Particulate Form

This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. ODCMS 3.8.C.3 implements the guidance set forth in Section II.C of Appendix I and provides the required operating flexibility to implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as reasonably achievable." The ODCM calculational methods specified in the ODCMS 4.8.C.3.1 implements the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational 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, "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 the Atmospheric Dispersion Model submitted on September 30, 1976 in a report titled: "Information Requested in Enclosure 2 to letter from George Lear to E. G. Bauer dated February 17, 1976." These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for iodine-131, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent on the existing radionuclide pathways to man in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

Instrumentation

2.2008 | The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The FUNCTIONALITY and use of instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR, Part 50.

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BASES

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Gaseous Effluents (continued)

System Operation

2.2008 | The FUNCTIONALITY of the Gaseous Radwaste Treatment System ensures that this system will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that appropriate portions of this system be used when specified provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR, Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR, Part 50 and design objective Section II.D of Appendix I to 10 CFR, Part 50. The specified limits governing the use of appropriate portions of the Gaseous Radwaste Treatment System were specified as a suitable fraction of the guidance set forth in Section II.B and II.C of Appendix I, 10 CFR, Part 50, for gaseous effluents.

To determine if gaseous effluents shall be processed through installed treatment equipment, the average projected dose will be determined. For gaseous effluent pathways other than the specified unmonitored exhausts, treatment and monitoring will only be required for pathways that are significant. Regulatory Guide 1.109, "Calculations of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", states that a pathway is considered significant if a conservative evaluation yields an additional dose increment equal to or more than 10 percent of the total from all pathways. Therefore, the total dose from all release pathways that do not require treatment or monitoring can not exceed 10 percent of the limit specified in Section II.C of Appendix I, 10 CFR Part 50.

Containment PURGE

ODCMS 3.8.C.6 requires that the primary containment atmosphere receive treatment for the removal of gaseous iodine and particulates prior to release to provide reasonable assurance that PURGING operations will not result in exceeding the annual dose limits of 10 CFR Part 20 for areas at or beyond the SITE BOUNDARY.

BASES

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40 CFR 190 and 10 CFR 72.104

This specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR 20.1301(d) as well as the dose limitations specific to Independent Spent Fuel Storage Installation (ISFSI) operations in accordance with 10 CFR 72.104.

Over the long term, as more ISFSI casks are placed on the ISFSI pad, it is expected that ISFSI operations will become the prominent contributor to the limits in this section. ISFSI dose contribution is in the form of direct radiation as no liquid or gas releases are expected to occur. The 10 CFR 72.212 report prepared in accordance with ISFSI requirements assumes a certain array of casks exists on the pad. The dose contribution from this array of casks in combination with historical uranium fuel cycle operations (e.g. PBAPS 2 & 3) prior to ISFSI operations was analyzed to be within the 40 CFR 190 and 10 CFR 72.104 limits. The difference between 40 CFR 190/10 CFR 72.104 limits and the analyzed ISFSI cask array contribution are identified in ODCMS 3.8.D.1 items d and e. Therefore, these values are used as assumptions in calculating combined ISFSI and PBAPS 2 & 3 doses. If these PBAPS 2 & 3 liquid and gas radiation values are exceeded, an evaluation is performed to determine if the overall 40 CFR 190 and 10 CFR 72.104 limits have been exceeded.

If the dose limits of 40 CFR 190 or 10 CFR 72.104 are exceeded, a special report to the NRC as well as an appropriate request for exemption /variance is required to be submitted to the NRC.

The requirement that the dose limits of 10CFR 72.104 apply to "any real individual" are controlled for ISFSI activities in the ISFSI 72.212 report. Therefore, for the purposes of analyzing dose in the south end of the site, the member of the public as defined in 40 CFR 190 at this area is the same as the "real individual" identified in the 72.212 report. The location for the real individual identified in the ISFSI 72.212 report is the limiting individual for calculating dose.

BASES

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Radiological Environmental Monitoring

Monitoring Program

The radiological environmental monitoring program required by this specification 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 MEMBERS OF THE PUBLIC resulting from the two reactors at the sites. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and supplements the radiological effluent monitoring program 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 the modeling of the environmental exposure pathways.

The required detection capabilities for environmental sample analyses are tabulated in terms of the Lower Limit of Detection (LLD). The LLD's required by Table 4.8.E.2 of the specifications are considered optimum for routine environmental measurements in industrial laboratories. The monitoring program was developed utilizing the experience of the first seven years of commercial operation. Program changes may be initiated based on the additional operational experience.

Land Use Census

This specification is provided to ensure that significant changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the radiological environmental monitoring program are made if required by the results of this census. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50.

Interlaboratory Comparison Program

The requirement for participation in an Interlaboratory Comparison Program 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 Part 50.

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