RTL #A9.621B

Beaver Valley Power Station

Unit 1/2

1/2-ODC-2.02

ODCM: GASEOUS EFFLUENTS

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3.0 REFERENCES AND COMMITMENTS

3.1 References

3.1.1 References for BV-1 Gaseous Effluent Monitor Setpoints

3.1.1.1 Beaver Valley Power Station, Appendix I Analysis - Docket No. 50-334 and 50-412; Table 2.1-3

3.1.1.2 Beaver Valley Power Station, Unit 2 UFSAR; Table 11.3-1

3.1.1.3 BVPS Specification No. BVS 414, Table V Nuclide Data,; Table 1 and Figure 1, Table 3, and Figure 2, May 30, 1974

3.1.1.4 Calculation Package No. ERS-SFL-85-031, Unit 1 Gaseous Effluent Monitor Efficiency Data

3.1.1.5 Calculation Package No. ERS-HHM-87-014, Unit 1/Unit 2 ODCM Gaseous Alarm Setpoint Determinations

3.1.1.6 Calculation Package No. ERS-ATL-87-026,BVPS-1 and BVPS-2 ODCM T Factor Justification

3.1.1.7 Letter ND1SHP:776, dated February 12, 1988, BVPS-1 ODCM Table 2.2-2, Appendix B

3.1.1.8 Stone and Webster Calculation No. UR(B)-262, Gaseous Releases From Containment Vacuum Pumps

3.1.2 References for BV-2 Gaseous Effluent Monitor Setpoints

3.1.2.1 Calculation Package No. ERS-SFL-86-026, Unit 2 DRMS Isotopic Efficiencies

3.1.2.2 Calculation Package No. ERS-HHM-87-014, Unit 1/Unit 2 ODCM Gaseous Alarm Setpoint Determinations

3.1.2.3 Beaver Valley Power Station, Unit 2 UFSAR; Table 11.3-2

3.1.2.4 Calculation Package No. ERS-ATL-87-026, BVPS-1 and BVPS-2 ODCM T Factor Justification

3.1.2.5 Stone and Webster Calculation No. UR(B)-262, Gaseous Releases From Containment Vacuum Pumps

3.1.3 References used in other sections of this procedure

3.1.3.1 NUREG-0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants

3.1.3.2 NUREG-1301, Offsite Dose Calculation Manual Guidance; Standard Radiological Effluent Controls for Pressurized Water Reactors (Generic Letter 89-01, Supplement No. 1)

3.1.3.3 NUREG-0324; XOQDOQ Program for the Meteorological Evaluation of Routine Releases at Nuclear Power Stations, September 1977

3.1.3.4 NUREG-0017; Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents form PWR's Revision 0.

3.1.3.5 Regulatory Guide 1.109, Calculation of Annual Dose to Man from Routine Releases of Reactor Effluents for the Purpose of Implementing Appendix I, April 1977

3.1.3.6 NUREG-0172, Age - Specific Radiation Dose Commitment Factors for a one-year Chronic Intake

3.1.3.7 1/2-ADM-1640, Control of the Offsite Dose Calculation Manual

3.1.3.8 1/2-ADM-0100, Procedure Writers Guide

3.1.3.9 NOP-SS-3001, Procedure Review and Approval

3.1.3.10 CR03-04830, Containment Vacuum Pump Replacement Increases ODCM Source Term. CA-03, Revise Unit 1 Containment Vacuum Pump Source-Term in ODCM procedure 1/2-ODC-2.02, Attachment A, Table 2.1-1a.

3.1.3.11 CR 05-01169, Chemistry Action Plan for Transition of RETS, REMP and ODCM. CA-16, Revise procedure 1/2-ODC-2.02 to change document owner from Manager, Radiation Protection to Manager, Nuclear Environmental & Chemistry.

3.1.3.12 Unit 1 Technical Specification Amendment No. 275 (LAR 1A-302) to License No. DPR-66. This amendment to the Unit 1 license was approved by the NRC on July 19, 2006.

3.1.3.13 Vendor Calculation Package No. 8700-UR(B)-223, Impact of Atmospheric Containment Conversion, Power Uprate, and Alternative Source Terms on the Alarm Setpoints for the Radiation Monitors at Unit 1.

3.1.3.14 Engineering Change Package No. ECP-04-0440, Extended Power Uprate.

3.1.3.15 CR 06-04908, Radiation Monitor Alarm Setpoint Discrepancies. CA-03; revise ODCM procedure 1/2-ODC-2.02 to update the alarm setpoints of gaseous effluent radiation monitor for incorporation of the Extended Power Uprate per Unit 1 TS Amendment No. 275.

3.1.3.16 MELCOR Accident Consequence Code System for the Calculation of the Health and Economic Consequences of accidental Atmospheric Radiological Releases (MACCS2 V.1.12), Oak Ridge National Laboratory.

3.1.3.17 Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake And Air Concentration and Dose Conversion Factors For Inhalation, Submersion, and Ingestion, September 1988.

3.1.3.18 Federal Guidance Report No. 12: External Exposure to Radionuclides in Air, Water, and Soil, September 1993.

3.1.3.19 L. R. McKay (Ed.), A Methodology for Calculating Radiation Doses from Radioactivity Released to the Environment (ORNL-4992), Oak Ridge National Laboratory, 1975.

3.1.3.20 CR 10-85877, Selenium-75 (Se-75) discharge via U1/U2 Process Vent. CA-02 revises ODCM procedure 1/2-ODC-2.02 to include dose factors for Se-75.

3.1.3.21 Technical Evaluation Package ERS-LMR-12-001, ODCM Piτ and R values for Carbon-14.

3.1.3.22 Notification 600727275 and CR #2012-17177, Revise 1/2-ODC-2.02, Gaseous Effluents, with the R values for Sb-126.

3.1.3.23 Notification 600737534 Item #4, Revise ODCM for Carbon-14.

3.1.3.24 10 CFR 72.104, Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS.

3.2 **Commitments**

3.2.1 Beaver Valley Technical Specifications: [**TS**] 5.5.2, Radioactive Effluent Controls Program.

4.0 RECORDS AND FORMS

4.1 **Records**

4.1.1 Any calculation supporting ODCM changes shall be documented, as appropriate, by a retrievable document (e.g.; letter or calculation package) with an appropriate RTL number.

4.2 **Forms**

4.2.1 None

5.0 PRECAUTIONS AND LIMITATIONS

5.1 **Precautions**

5.1.1 None.

5.2 **Limitations**

5.2.1 Offsite Dose Calculation Manual (ODCM) controls applicable to dose rate apply to the site. The site dose rate is calculated by summing the releases from both units.

5.2.2 ODCM controls applicable to accumulated dose apply individually to each unit.

5.2.3 Releases at the Beaver Valley site are characterized as Ground Level or Elevated in nature.

5.2.3.1 Ground Level releases are attributed to the specific unit for which the release occurs. Determination of site dose rate and dose is assigned to the specific unit.

5.2.3.2 Elevated releases are attributed to both units because they originate, by design from a shared radwaste system. Elevated releases are discharged from a common release point, the Process Vent, at the top of the BV-1 cooling tower.

5.2.4 Dose from continuous and batch (Gas Waste Storage Tanks) releases at BV-1 and BV-2 via the shared radwaste system (Process Vent) are normally attributed equally to the units. Containment purge through the Process Vent is attributed to the specific unit for which it originates. Continuous and batch releases via non-shared radwaste systems shall be attributed to the specific unit for which it originates.

5.2.5 A difference in alarm setpoint terminology presentations for the radiation monitoring systems of BV-1 and BV-2 is described as follows:

5.2.5.1 HIGH and HIGH-HIGH terminology are used for the BV-1 Victoreen monitors, ALERT and HIGH terminology are used for the BV-1 Mirion PING monitors and the BV-2 monitors.

5.2.5.2 BV-1 alarm setpoints are expressed in counts per minute (cpm) and BV-2 alarm setpoints are expressed in microcurie per cubic centimeters (uCi/cc). The difference is due to BV-2 software which applies a conversion factor to the raw data (cpm) to convert units to uCi/cc. Note that the uCi/cc presentation is technically correct only for the specific isotopic mix used in the determination of the conversion factors. Therefore, BV-2 setpoints determined on analysis prior to release will be correct for properly controlling dose rate, but the indicated uCi/cc value may differ from the actual value.

5.2.5.3 BV-1 and BV-2 effluent monitors specified in this procedure have Upper Alarm Setpoints established at sixty (60) percent of the site limit and Lower Alarm Setpoints established at thirty (30) percent of the site limit.

5.2.6 Releases are characterized as batch or continuous in nature.

5.2.6.1 Batch refers to releases that are intermittent in radionuclide concentrations or flow, such as releases from gas storage tanks, containment purges, and venting of systems or components with infrequent use.

5.2.6.2 Batch releases may occur due to operational variations which result in radioactive releases greater than fifty (50) % of the releases normally considered as continuous. Batch releases from these sources during normal operation, including anticipated operational occurrences, are defined as those which occur for a total of five-hundred (500) hours or less in a calendar year, but not more than one-hundred (150) hours in any quarter.

5.2.6.3 The batch relative concentration value has been calculated in accordance with the guidelines provided in NUREG-0324[3.1.3.3] for short-term release.

5.2.6.4 If a batch and continuous release occur simultaneously from the same vent path, then use the lowest setpoint obtained as determined in Sections 8.1.1.1 through 8.1.3.2.

5.2.7 This procedure also contains information that was previously contained in Section 5 of the previous BV-1 and BV-2 Offsite Dose Calculation Manual.

5.2.7.1 In regards to this, the site boundary for gaseous effluents was included in this procedure.

5.2.7.2 The Site Boundary for Gaseous Effluents is shown in ATTACHMENT P Figure 5-1.

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6.0 ACCEPTANCE CRITERIA

6.1 Changes to this procedure shall contain sufficient justification that the change will maintain the level of radioactive effluent control required by 10 CFR 20.1302, 40 CFR Part 190, 10 CFR 50.36a, 10 CFR 72.104, and Appendix I to 10 CFR 50, and not adversely impact the accuracy or reliability of effluent dose or alarm setpoint calculation.(3.1.3.2)

6.1.1 Changes to this procedure shall be prepared in accordance with 1/2-ADM-0100, PROCEDURE WRITER'S GUIDE (3.1.3.8) and 1/2-ADM-1640, CONTROL OF THE OFFSITE DOSE CALCULATION MANUAL.(3.1.3.7)

6.1.2 Changes to this procedure shall be reviewed and approved in accordance with NOP-SS-3001, PROCEDURE REVIEW AND APPROVAL (3.1.3.9) and 1/2-ADM-1640. (3.1.3.7)

7.0 PREREQUISITES

7.1 None.

8.0 PROCEDURE

8.1 Alarm Setpoints

8.1.1 BV-1 Monitor Alarm Setpoint Determination

ODCM CONTROL 3.11.2.1 require that the dose rate in unrestricted areas due to noble gas radionuclides in the gaseous effluent released from the site shall be limited to $\leq$ 500 mrem/yr to the total body and to $\leq$ 3000 mrem/yr to the skin.

This section describes the methodology used to maintain the release of noble gas radionuclides within ODCM CONTROL 3.11.2.1 for the site, and determines monitor setpoints for BV-1.

The methodologies described in Section 8.1.1.2, 8.1.2.2, and 8.1.3.2 provide an alternate means of determining monitor alarm setpoints that may be used when an analysis is performed prior to release.

Control of the site dose rate limit due to noble gases is shown in the following Table. Dose rate control is exercised through a total of eight (8) effluent stream monitors, of which three (3) are located at BV-1 (alternates exists for these monitors), and five (5) are located at BV-2. As previously noted, BV-1 and BV-2 elevated releases are via the PV-1/2 Process Vent.

Monitor Setpoint Specifications Based On Fraction Of Site Limit

UNIT RELEASE POINT MONITOR NO.	FRACTION OF SITE LIMITING DOSE RATE	
	Upper Alarm	Lower Alarm
(VV-1) Unit 1, Auxiliary Building Vent		
Pri.: RM-1VS-101B or	60% (HIGH-HIGH)	30% (HIGH)
Alt.: RM-1VS-109 LRNG	60% (HIGH)	30% (ALERT)
(CV-1) Unit 1, Rχ Containment/SLCRS Vent		
Pri.: RM-1VS-107B or	60% (HIGH-HIGH)	30% (HIGH)
Alt.: RM-1VS-110 LRNG	60% (HIGH)	30% (ALERT)
(PV-1/2), Unit 1/2, Gaseous Waste/Process Vent		
Pri.: RM-1GW-108B or	60% (HIGH-HIGH)	30% (HIGH)
Alt.: RM-1GW-109 LRNG	60% (HIGH)	30% (ALERT)
(CV-2), Unit 2, SLCRS Filtered Pathway		
2HVS-RQ109E	60% (HIGH)	30% (ALERT)
(VV-2), Unit 2, SLCRS Unfiltered Pathway		
2HVS-RQ101B	60% (HIGH)	30% (ALERT)
(WV-2), Unit 2, Waste Gas Storage Vault Vent		
2RMQ-RQ303B	60% (HIGH)	30% (ALERT)
(DV-2), Unit 2, Decontamination Building Vent		
2RMQ-RQ301B	60% (HIGH)	30% (ALERT)
(CB-2), Condensate Polishing Building Vent		
2HVL-RQ112B	60% (HIGH)	30% (ALERT)

With the monitor setpoints based on fractions of the site limit as defined above, the following criteria may be applied to determine that the dose rate due to noble gas released from the site complies with ODCM CONTROL 3.11.2.1:

- The site dose rate is thirty (30) % of the site dose rate limit when any monitor is indicating a Lower Alarm.
- The site dose rate is sixty (60) % of the site dose rate limit when any two monitors are indicating Lower Alarms.
- The site dose rate is sixty (60) % of the site dose rate limit when any monitor is indicating an Upper Alarm.
- The site dose rate is ninety (90) % of the site dose rate limit when any monitor is indicating an Upper Alarm and any other monitor is indicating a Lower Alarm.

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8.1.1.1 **BV-1 Setpoint Determination Based On A Calculated Mix For VV-1 and CV-1 Ground Releases**

The table below gives the calculated monitor count rate above background (CR), in ncpm, and provides the equivalent monitor indication (DV) in net uCi/sec associated with the most limiting site dose rate limit (i.e.; 500 mrem/yr Total Border or 3000 mrem/yr skin). The monitor HIGH-HIGH alarm setpoint above background (HHSP), and the monitor HIGH alarm setpoint above background (HSP) for each vent and operational condition shall be as follows:

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BV1 ALARM SETPOINTS FOR GROUND RELEASES

	(P) PRIMARY* MONITOR (A) ALTERNATE MONITOR	CR	DV	NET ABOVE BACKGROUND 60% SITE LIMIT UPPER ALARM	NET ABOVE BACKGROUND 30% SITE LIMIT LOWER ALARM
• Continuous Release Via The BV-1 Auxiliary Building Vent (VV-1)	(P)RM-1VS-101B	3000 cpm		≤ 1800 cpm	≤ 900 cpm
	(A)RM-1VS-109 LRNG [1]	6.25 cps	2640 µCi/sec	≤ 1584 µCi/sec	≤ 792 µCi/sec
• Batch Release Of Containment Purge Via The BV-1 Auxiliary Building Vent (VV-1)	(P)RM-1VS-101B	1200 cpm		≤ 718 cpm	≤ 359 cpm
	(A)RM-1VS-109 LRNG [1]	6.36 cps	1055 µCi/sec	≤ 632 µCi/sec	≤ 316 µCi/sec
• Continuous Release Via The BV-1 Rx Containment/SLCRS Vent (CV-1)	(P)RM-1VS-107B	6440		≤ 3870	≤ 1930
	(A)RM-1VS-110 LRNG [1]	13.9 cps	3790 µCi/sec	≤ 2274 µCi/sec	≤ 1137 µCi/sec
• Batch Release Of Containment Purge Via The BV-1 Rx Containment/SLCRS Vent (CV-1)	(P)RM-1VS-107B	12,700		≤ 7630	≤ 3810
	(A)RM-1VS-110 LRNG [1]	27.4 cps	1137 µCi/sec	≤ 682 µCi/sec	≤ 341 µCi/sec

*IF the primary monitor is out of service, THEN ODCM CONTROL 3.3.3.10 is met for the respective alternate monitor. The alternate setpoints shall be utilized.

[1]Each Mirion PING Monitor skid is equipped with a low range monitor (LRNG) and a high range monitor (HRNG). The low range monitor has three setpoints: ALERT, HIGH, and HIGH-HIGH. The HIGH-HIGH setpoint will be used to swap from the low range monitor to the high range monitor.

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The setpoints were determined using the following conditions and information:

- Source terms given in ATTACHMENT A Table 2.1-1a. The gaseous source terms were derived from Stone & Webster computer code GAS1BB (similar to NUREG-0017),[3.1.3.4] and computer code DRAGON 4 (for the containment vacuum pump sources). ATTACHMENT A Table 2.1-1a does not include particulates and iodines, which are not used in site noble gas dose rate calculations.

- Onsite meteorological data for the period January 1, 1976 through December 31, 1980.
- Discharge flow rate of 62,000 cfm for a VV-1 Continuous Release.
- Discharge flow rate of 92,000 cfm for a VV-1 Batch Release of Containment Purge. This is comprised of 30,000 cfm from the containment purge plus 62,000 cfm for VV-1.
- Discharge flow rate of 49,300 cfm for a CV-1 Continuous Release.
- Discharge flow rate of 56,800 cfm for a CV-1 Batch Release of Containment Purge. This is comprised of 7,500 cfm from the containment purge plus 49,300 cfm for CV-1.
- Information listed under References for BV-1 Gaseous Effluent Monitor Setpoints.

The calculation method given in Sections 8.1.1.1.1 through 8.1.1.1.7 was used to derive the monitor setpoints for the following operational conditions:

- Continuous release via VV-1.
- Continuous release via CV-1.
- Batch release of BV-1 Containment Purge via VV-1.
- Batch release of BV-1 Containment Purge via CV-2.

8.1.1.1.1 **BV-1 Mix Radionuclides**

The "mix" (noble gas radionuclides and composition) of the gaseous effluent was determined as follows:

- The gaseous source terms that are representative of the "mix" of the gaseous effluent were selected. Gaseous source terms are the radioactivity of the noble gas radionuclides in the effluent. Gaseous source terms can be obtained from ATTACHMENT A Table 2.1-1a.
- The fraction of the total radioactivity in the gaseous effluent comprised of noble gas radionuclide "i" (Si) for each individual noble gas radionuclide in the gaseous effluent was determined by:

$$S_i = \frac{A_i}{\sum_i A_i} \qquad [2.1(1)\text{-}1]$$

where:

A_i = The total radioactivity or radioactivity concentration of noble gas radionuclide "i" in the gaseous effluent from ATTACHMENT A Table 2.1-1a.

8.1.1.1.2 **BV-1 Maximum Acceptable Release Rate (Whole Body Exposure)**

The maximum acceptable total release rate (uCi/sec) of all noble gas radionuclides in the gaseous effluent (Q_t) based upon the whole body exposure limit was calculated by:

$$Q_t = \frac{500}{(X/Q)\sum_i K_i \; S_i} \qquad [2.1(1)\text{-}2]$$

where:

$(X/Q)_{vv}$ = The highest calculated annual average relative concentration of effluents released via VV-1 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-5.

= 1.03E-4 sec/m^3 for continuous releases.

$(X/q)_{vv}$ = The highest calculated short term relative concentration of effluents released via VV-1 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-36.

= 3.32E-4 sec/m^3 for batch release of containment purge.

$(X/Q)_{cv}$ = The highest calculated annual average relative concentration of effluents released via CV-1 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-4.

= 9.24E-5 sec/m^3 for continuous releases.

$(X/q)_{cv}$ = The highest calculated short term relative concentration of effluents released via CV-1 for any area at or beyond the unrestricted area boundary for any sectors (sec/m^3) from ATTACHMENT M Table 2.3-35.

= 3.08E-4 sec/m^3 for batch release of containment purge.

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

S_i = From equation [2.1(1)-1] above.

8.1.1.1.3 **BV-1 Maximum Acceptable Release Rate (Skin Exposure)**

Q_t was also determined based upon the skin exposure limit by:

$$Q_t = \frac{3000}{(X/Q)\sum_i (L_i + 1.1M_i)\, S_i}$$

where:

L_i = The skin dose factor due to beta emissions from noble gas radionuclide "i"(mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

M_i = The air dose factor due to gamma emissions from noble gas radionuclide "i"(mrad/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of the photons of interest, (mrem/mrad).

(X/Q) = Same as in Section 8.1.1.1.2.

8.1.1.1.4 **BV-1 Maximum Acceptable Release Rate (Individual Radionuclide)**

The maximum acceptable release rate (uCi/sec) of noble gas radionuclide "i" in the gaseous effluent (Q_i) for each individual noble gas radionuclide in the gaseous effluent was determined by:

$$Q_i = S_i\, Q_t \qquad [2.1(1)\text{-}4]$$

NOTE: Use the lower of the Q_t values obtained in Section 8.1.1.1.2 and 8.1.1.1.3.

8.1.1.1.5 **BV-1 Maximum Acceptable Concentrations (Individual Radionuclide)**

The maximum acceptable radioactivity concentration (uCi/cc) of noble gas radionuclide "i" in the gaseous effluent (C_i) for each individual noble gas radionuclide "i" in the gaseous effluent was determined by:

$$C_i = \frac{2.12E\text{-}3\ Q_i}{F} \qquad [2.1(1)\text{-}5]$$

where:

F = The maximum acceptable effluent flow rate at the point of release (cfm) as listed in Section 8.1.1.1.

2.12E-3 = Unit conversion factor (60 sec/min x 3.53E-5 ft^3/cc).

8.1.1.1.6 **BV-1 Monitor Count Rate**

The calculated monitor count rate (ncpm for Victoreen Monitors and ncps for Mirion Monitors) above background attributed to the noble gas radionuclide. CR was determined by:

$$CR = \sum_i C_i E_i \qquad [2.1(1)\text{-}6)]$$

where:

E_i = The detection efficiency of the monitor for noble gas radionuclide "i" (cpm/uCi/cc for Victoreen or cps/uCi/cc for Mirion) from ATTACHMENT B Table 2.1-2a.

8.1.1.1.7 **BV-1 Monitor Setpoints**

The monitor alarm setpoints above background were determined as follows:

- The Victoreen monitor HIGH-HIGH Alarm Setpoint above background (ncpm) was determined by:

  $$HHSP = 0.60 \times CR \qquad [2.1(1)\text{-}7]$$

- The Victoreen monitor HIGH Alarm Setpoint above background (ncpm) was determined by:

  $$HSP = 0.30 \times CR \qquad [2.1(1)\text{-}8]$$

NOTE: The values 0.60 for the HHSP and 0.30 for the HSP are fractions of the total radioactivity concentration that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from both units.

- The Mirion monitor HIGH Alarm Setpoint above background (uCi/sec) was determined by:

  $$HSP = 0.60 \times Q_t \qquad [2.1(1)\text{-}9]$$

- The Mirion monitor ALERT Alarm Setpoint above background (uCi/sec) was determined by:

  $$ASP = 0.30 \times Q_t \qquad [2.1(1)\text{-}10]$$

NOTE: Use the lower of the Q_t values obtained in Section 8.1.1.1.2 and 8.1.1.1.3.

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8.1.1.2 **BV-1 Setpoint Determination Based On Analysis Prior To Release For VV-1 and CV-1 Ground Releases**

When the setpoints established using "the calculated mix" for ground releases do not provide adequate flexibility for operational needs, the method described below may be used in lieu of that set forth in Step 8.1.1.1. In this case, the results of sample analysis are used to determine the source term "mix." This calculational method applies to gaseous releases via VV-1 and CV-1 when determining the setpoint for the maximum acceptable discharge flow rate and the associated HIGH-HIGH Alarm Setpoint based on this flow rate during the following operational conditions:

- Batch release of Containment Purge via VV-1.
- Batch release of Containment Purge via CV-1.

8.1.1.2.1 **BV-1 Maximum Acceptable Release Rate**

The maximum acceptable discharge flow rate from VV-1 and CV-1 during purging is determined as follows:

- The maximum acceptable gaseous discharge flow rate (f) from VV-1 and CV-1 (cfm) during purging based upon the whole body exposure limit is calculated by:

$$f = \frac{1.06\ S\ T}{(X/q)\sum_i K_i\ C_i} \qquad [2.1(1)\text{-}17]$$

where:

1.06 = 500 mrem/yr x 2.12E-3

500 mrem/yr = dose rate limit

2.12E-3 = unit conversion factor
= (60 sec/min x 3.53E-5 ft^3/cc)

S = Percent of site dose rate released via this pathway. Up to 60% of the site dose rate is permissible for one release point under the alarm set point rules of Section 8.1.1.

T = Maximum valve for T is 16 based on the limiting restriction in ODCM CONTROL 3.11.2.1 where the dose rate for a containment purge may be averaged over a time period not to exceed 960 minutes. (As containment air volume change time period is 60 minutes; T = 960/60 = 16).[3.1.1.6]

$(X/q)_{vv}$ = The highest calculated short term relative concentration of effluents released via VV-1 for any area at or beyond the

unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-36.

= 3.32E-4 sec/m^3

$(X/q)_{cv}$ = The highest calculated short term relative concentration of effluents released via CV-1 for areas at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-37.

= 3.08E-4 sec/m^3

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

C_i = The undiluted radioactivity concentration of noble gas radionuclide "i" in the gaseous source (uCi/cc) as determined by analysis of the gas to be released.

- The flow rate (f) is also determined based upon the skin exposure limit as follows:

$$f = \frac{6.36\ S\ T}{(X/q)\sum_i (L_i + 1.1M_i)\ C_i} \qquad [2.1(1)\text{-}18]$$

where:

6.36 = 3000 mrem/yr x 2.12E-3

3000 mrem/yr = dose rate limit

2.12E-3 = unit conversion factor
= (60 sec/min x 3.53E-5 ft^3/cc)

L_i = The skin dose factor due to beta emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

M_i = The air dose factor due to gamma emissions from noble gas radionuclide "i" (mrad/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

(X/q) = Same as above.

- The flow rate (f) is determined by selecting the smaller of the calculated (f) values based on the whole body exposure limit, or the skin exposure limit

shown above. The actual purge flow rate (cfm) must be maintained at or below this calculated (f) value or the discharge cannot be made from the vent.

8.1.1.2.2 **BV-1 Monitor Setpoints**

The monitor alarm setpoints above background are determined as follows:

- The calculated Victoreen monitor HIGH-HIGH Alarm Setpoint above background (ncpm) attributed to noble gas radionuclides is determined by:

$$HHSP = \frac{f \sum_i C_i E_i}{F'} \qquad [2.1(1)\text{-}19]$$

where:

f = The maximum acceptable gaseous discharge flow rate (cfm) determined in Section 8.1.1.2.1.

F′ = The maximum actual or design effluent flow rate (cfm) at the point of release.

= 92,000 cfm for VV-1

= 56,800 cfm for CV-1

C_i = The undiluted radioactivity concentration of noble gas radionuclide "i" in the gaseous source (uCi/cc) as determined by analysis of the gas to be released.

E_i = The detection efficiency of the monitor for noble gas radionuclide "i" (cpm/uCi/cc) from ATTACHMENT B Table 2.1-2a.

- When a Victoreen monitor HIGH-HIGH set point has been calculated according to this section, the monitor HIGH Alarm Setpoint above background (ncpm) is determined as follows:

$$HSP = HHSP \times 0.5 \qquad [2.1(1)\text{-}20]$$

8.1.2 **BV-2 Monitor Alarm Setpoint Determination**

See Section 8.1.1 for a description of Monitor Alarm Setpoint Determinations.

8.1.2.1 **BV-2 Setpoint Determination Based On A Calculated Mix For VV-2, CV-2, DV-2, WV-2 and CB-2 Ground Releases.**

The table below gives the calculated monitor count rate above background (CR) in ncpm, and provides the equivalent monitor indication (DV) in net uCi/cc associated with the most limiting site dose rate limit (i.e., 500 mrem/yr Total Body or 3000 mrem/yr Skin). The HIGH alarm setpoint (HSP) in uCi/cc above background, and

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the ALERT alarm setpoint (ASP) in uCi/cc above background for each vent and operational condition shall be as follows:

BV2 ALARM SETPOINTS FOR GROUND RELEASES
uCi/cc ABOVE BACKGROUND
(unless otherwise specified)

	MONITOR	CR ncpm	DV	60% SITE LIMIT UPPER ALARM	30% SITE LIMIT LOWER ALARM
• Continuous Release Via The BV-2 SLCRS Unfiltered Pathway (VV-2)	2HVS-RQ101B	8260	3.01E-4	≤ 1.81E-4	≤ 9.04E-5
• Batch Release Of Containment Purge Via The BV-2 SLCRS Unfiltered Pathway (VV-2)	2HVS-RQ101B	2020	7.39E-5	≤ 4.43E-5	≤ 2.22E-5
• Continuous Release Via The BV-2 SLCRS Filtered Pathway (CV-2)	2HVS-RQ109E	4320	2940 µCi/sec	≤ 1770 µCi/sec	≤ 883 µCi/sec
• Batch Release Of Containment Purge Via The BV-2 SLCRS Filtered Pathway (CV-2)	2HVS-RQ109E	16,400	1130 µCi/sec	≤ 676 µCi/sec	≤ 338 µCi/sec
• Continuous Release Via The BV-2 Condensate Polishing Building Vent (CB-2)	2HVL-RQ112B	28,900	1.61E-3	≤ 9.63E-4	≤ 4.82E-4
• Continuous Release Via The BV-2 Decontamination Building Vent (DV-2)	2RMQ-RQ301B	56,600	3.15E-3	≤ 1.89E-3	≤ 9.44E-4
• Continuous Release Via The BV-2 Waste Gas Storage Vault Vent (WV-2)	2RMQ-RQ303B	912,000	2.58E-2	≤ 1.55E-2	≤ 7.74E-3

The setpoints were determined using the following conditions and information:

- The Decontamination Building and Condensate Polishing Building ventilation exhaust are not expected to be radioactive. However, for purposes of determining an alarm setpoint, it is conservatively assumed that Xe-133 is in the ventilation exhaust at concentrations that would result in the appropriate dose rate limits.
- The Waste Gas Storage Vault ventilation exhaust is also not normally radioactive. However, the monitor alarm setpoint is based on the assumption that the ventilation exhaust radionuclide spectrum is similar to the gaseous inventory in the system housed by the waste gas storage vault. This spectrum is listed in ATTACHMENT A Table 2.1-1b under Gaseous Waste System.
- Onsite meteorological data for the period January 1, 1976 through December 31, 1980.
- Discharge flow rate of 23,700 cfm for a VV-2 Continuous Release.
- Discharge flow rate of 53,700 cfm for a VV-2 Batch Release of Containment Purge. This is comprised of 30,000 cfm from the containment purge plus 23,700 cfm from the CV-2.
- Discharge flow rate of 59,000 cfm for a CV-2 Continuous Release.
- Discharge flow rate of 59,000 cfm for a CV-2 Batch Release of Containment Purge. This is comprised of 7,500 cfm from the containment purge plus 51,500 cfm from CV-2.
- Discharge flow rate of 30,556 cfm for a CB-2 Continuous Release.
- Discharge flow rate of 12,400 cfm for DV-2 Continuous Release.
- Discharge flow rate of 2,000 cfm for WV-2 Continuous Release.
- Information listed under References for BV-2 Gaseous Effluent Monitor Setpoints.

The calculation method given in Sections 8.1.2.1.1 through 8.1.2.1.7 was used to derive the alarm setpoints for the following operational conditions:

- Continuous release via VV-2.
- Continuous release via CV-2.
- Batch release of BV-2 Containment Purge via VV-2.
- Batch release of BV-2 Containment Purge via CV-2.

- Continuous release via CB-2.
- Continuous release via DV-2.
- Continuous release via WV-2.

8.1.2.1.1 **BV-2 Mix Radionuclides**

The "mix" (noble gas radionuclides and composition) of the gaseous effluent was determined as follows:

- The gaseous source terms that are representative of the "mix" of the gaseous effluent were selected based on the relative stream composition and volumetric flowrate. Gaseous source terms are the radioactivity of the noble gas radionuclides in the effluent. Gaseous source terms can be obtained from ATTACHMENT A Table 2.1-1b.
- The fraction of the total radioactivity in the gaseous effluent comprised of noble gas radionuclide "i" (Si) for each individual noble gas radionuclide in the gaseous effluent was determined by:

$$S_i = \frac{A_i}{\sum_i A_i} \qquad [2.1(2)\text{-}1]$$

where:

A_i = The radioactivity concentration of noble gas radionuclide "i" in the gaseous effluent (for VV-2, CV-2 and WV-2) is from ATTACHMENT A Table 2.1-1b. However, SINCE releases via CB-2 and DV-2 do not have a valid source term mix, THEN the noble gas radioactivity concentration is assumed to be Xe-133.

8.1.2.1.2 **BV-2 Maximum Acceptable Release Rate (Whole Body Exposure)**

The maximum acceptable total release rate (uCi/sec) of all noble gas radionuclides in the gaseous effluent (Q_t) based upon the whole body exposure limit was calculated by:

$$Q_t = \frac{500}{(X/Q)\sum_i K_i\, S_i} \qquad [2.1(2)\text{-}2]$$

where:

$(X/Q)_{vv}$ = The highest calculated annual average relative concentration of effluents released via VV-2 for any area at or beyond the

unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-5.

= 1.03E-4 sec/m^3 for continuous releases.

$(X/q)_{vv}$ = The short term relative concentration of effluents released via VV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-36.

= 3.32E-4 sec/m^3 for batch release of containment purge.

$(X/Q)_{cv}$ = The highest calculated annual average relative concentration of effluents released via CV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-4.

= 9.24E-5 sec/m^3 for continuous releases.

$(X/q)_{cv}$ = The short term relative concentration of effluents released via CV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-35.

= 3.08E-4 sec/m^3 for batch release of containment purge.

$(X/Q)_{cp}$ = The highest calculated annual average relative concentration of effluents released via CB-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-10.

= 7.35E-5 sec/m^3 for continuous releases.

$(X/Q)_{dv}$ = The highest calculated annual average relative concentration of effluents released via DV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-8.

= 9.24E-5 sec/m^3 for continuous releases.

$(X/Q)_{wv}$ = The highest calculated annual average relative concentration of effluents released via WV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-9.

= 9.24E-5 sec/m^3 for continuous releases.

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3)from ATTACHMENT G Table 2.2-11.

S_i = From equation [2.1(2)-1].

8.1.2.1.3 **BV-2 Maximum Acceptable Release Rate (Skin Exposure)**

Q_t was also determined based upon the skin exposure limit by:

$$Q_t = \frac{3000}{(X/Q)\sum_i (L_i + 1.1M_i)\,S_i} \qquad [2.1(2)\text{-}3]$$

where:

L_i = The skin dose factor due to beta emissions from noble gas radionuclide "i"(mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

M_i = The air dose factor due to gamma emissions from noble gas radionuclide "i"(mrad/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of the photons of interest, (mrem/mrad).

(X/Q) = Same as in Section 8.1.2.1.2.

8.1.2.1.4 **BV-2 Maximum Acceptable Release Rate (Individual Radionuclide)**

The maximum acceptable release rate (uCi/sec) of noble gas radionuclide "i" in the gaseous effluent (Q_i) for each noble gas radionuclide in the gaseous effluent was determined by:

$$Q_i = S_i\,Q_t \qquad [2.1(2)\text{-}4]$$

NOTE: Use the lower of the Q_t values obtained in Section 8.1.2.1.2 and 8.1.2.1.3.

8.1.2.1.5 **BV-2 Maximum Acceptable Concentrations (Individual Radionuclide)**

The maximum acceptable radioactivity concentration (uCi/cc) of noble gas radionuclide "i" in the gaseous effluent (Ci) for each individual noble gas radionuclide in the gaseous effluent was determined by:

$$C_i = \frac{2.12E\text{-}3\,Q_i}{F} \qquad [2.1(2)\text{-}5]$$

where:

F = The maximum acceptable effluent flow rate at the point of release (cfm) as listed in Section 8.1.2.1.

2.12E-3 = Unit conversion factor (60 sec/min x 3.53E-5 ft^3/cc).

8.1.2.1.6 **BV-2 Monitor Count Rate**

The calculated monitor count rate (ncpm) above background attributed to the noble gas radionuclide (CR) was determined by:

$$CR = \sum_i C_i \, E_i \qquad [2.1(2)\text{-}6)]$$

where:

Ei = The detection efficiency of the monitor for noble gas radionuclide "i" (cpm/uCi/cc) from ATTACHMENT B Table 2.1-2b.

8.1.2.1.7 **BV-2 Monitor Setpoints**

The monitor alarm setpoints above background were determined as follows:

- The monitor HIGH Alarm Setpoint above background (uCi/cc) was determined by:

$$HSP = \frac{0.60 \times CR}{E_{i\,ave}} \qquad [2.1(2)\text{-}7]$$

where;

$E_{i\,ave}$ = The CR of equation [2.1(2)-6] divided by the sum of the C_i for the respective mix.

- The monitor ALERT Alarm Setpoint above background (uCi/cc) was determined by:

$$ASP = \frac{0.30 \times CR}{E_{i\,ave}} \qquad [2.1(2)\text{-}8]$$

8.1.2.2 **BV-2 Setpoint Determination Based On Analysis Prior To Release for VV-2 and CV-2 Ground Releases**

When the setpoints established using "the calculated mix" do not provide adequate flexibility for operational needs, the method described below may be used in lieu of that set forth in Section 8.1.2.1. In this case, the results of sample analysis are used to determine the appropriate nuclide mix. This calculational method applies when determining the setpoint for the maximum acceptable discharge flow rate and the associated HIGH Alarm Setpoint based on respective vent flow rate during the following operational conditions:

- Batch release of Containment Purge via VV-2.

- Batch release of Containment Purge via CV-2.

8.1.2.2.1 **BV-2 Maximum Acceptable Release Rate**

The maximum acceptable discharge flow rate from VV-2 or CV-2 during purging is determined as follows:

- The maximum acceptable gaseous discharge flow rate (f) from VV-2 or CV-2 (cfm) during purging based upon the whole body exposure limit is calculated by:

$$f = \frac{1.06\ S\ T}{(X/q) \sum_i K_i\ C_i} \qquad [2.1(2)\text{-}17]$$

where:

1.06 = 500 mrem/yr x 2.12E-3

500 mrem/yr = dose rate limit, whole body exposure

2.12E-3 = unit conversion factor
= (60 sec/min x 3.53E-5 ft^3/cc)

S = Percent of site dose rate released via this pathway. Up to 60% of the site dose rate is permissible for one release point under the alarm setpoint rules of Section 8.1.2.

T = Maximum value for T is 16 based on the limiting restriction in ODCM CONTROL 3.11.2.1 where the dose rate for a containment purge may be averaged over a time period not to exceed 960 minutes. (As containment air volume change time period is 60 minutes; T = 960/60 = 16).(3.1.2.4)

$(X/q)_{vv}$ = The highest calculated short term relative concentration of effluents released via VV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-36.

= 3.32E-4 sec/m^3

$(X/q)_{cv}$ = The highest calculated short term relative concentration of effluents released via CV-2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT M Table 2.3-37.

= 3.08E-4 sec/m^3

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

C_i = The undiluted radioactivity concentration of noble gas radionuclide "i" in the gaseous source (uCi/cc) as determined by analysis of the gas to be released.

- The flow rate (f) is also determined based upon the skin exposure limit as follows:

$$f = \frac{6.36\ S\ T}{(X/q) \sum_i (L_i + 1.1 M_i)\ C_i} \qquad [2.1(2)\text{-}18]$$

where:

6.36 = 3000 mrem/yr x 2.12E-3

3000 mrem/yr = dose rate limit, skin exposure

2.12E-3 = unit conversion factor
= (60 sec/min x 3.53E-5 ft^3/cc)

L_i = The skin dose factor due to beta emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

M_i = The air dose factor due to gamma emissions from noble gas radionuclide "i" (mrad/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of the photons of interest, (mrem/mrad).

(X/q) = Same as above.

- The flow rate (f) is determined by selecting the smaller of the calculated (f) values based on the whole body exposure limit, or the skin exposure limit shown above. The actual purge flow rate (cfm) must be maintained at or below this calculated (f) value or the discharge cannot be made from the vent.

8.1.2.2.2 **BV-2 Monitor Setpoints**

The monitor alarm setpoints above background are determined as follows:

- The calculated monitor HIGH Alarm Setpoint above background (net uCi/cc) attributed to the noble gas radionuclides is determined by:

$$HSP = \frac{f \sum_i C_i E_i}{F' E_{i\,ave}} \qquad [2.1(2)\text{-}19]$$

where:

f = The maximum acceptable containment purge flow rate (cfm) determined in Section 8.1.2.2.1.

F' = The maximum actual or design effluent flow rate (cfm) at the point of release.

= 53,700 cfm for VV-2

= 59,000 cfm for CV-2

C_i = The undiluted radioactivity concentration of noble gas radionuclide "i" in the gaseous source (uCi/cc) as determined by analysis of the gas to be released.

E_i = The detection efficiency of the monitor for noble gas radionuclide "i" (cpm/uCi/cc) from ATTACHMENT B Table 2.1-2b.

$E_{i\,ave}$ = The CR of equation [2.1(2)-6] divided by the sum of the Ci for the respective mix.

NOTE: To enable maintaining a constant conversion factor from cpm to uCi/cc in the Digital Radiation Monitoring System software, the "calculated mix" is used rather than the analysis mix to calculate $E_{i\,ave}$ above. This does not cause any change in the function of the monitor setpoint to properly control dose rate. However, the monitor indicated uCi/cc value may differ from the actual value.

- When a HIGH Alarm Setpoint has been calculated according to this section, the monitor ALERT Alarm Setpoint above background (net uCi/cc) is determined as follows:

$$ASP = HSP \times 0.5 \qquad [2.1(2)\text{-}20]$$

8.1.3 **BV-1/2 Monitor Alarm Setpoint Determination**

See Section 8.1.1 for a description of Monitor Alarm Setpoint Determination.

8.1.3.1 **BV-1/2 Setpoint Determination Based On A Calculated Mix For PV-1/2 Elevated Releases**

The calculated monitor count rate above background (CR), in ncpm, the monitor HIGH-HIGH alarm setpoint above background (HHSP), and the monitor HIGH alarm setpoint above background (HSP) for each operational condition are shown in the following Table:

BV-1/2 ALARM SETPOINTS FOR GROUND RELEASES
ncpm ABOVE BACKGROUND
(unless otherwise specified)

	(P) PRIMARY* MONITOR (A) ALTERNATE MONITOR	CR	DV	60% SITE LIMIT UPPER ALARM	30% SITE LIMIT LOWER ALARM
• Continuous Release	(P)RM-1GW-108B	3.49E7		≤ 3.60E5	≤ 1.20E5
	(A)RM-1GW-109 LRNG[1]	1.07E5 cps	1.09E6 µCi/sec	≤ 6.55E5 µCi/sec	≤ 3.27E5 µCi/sec
• Batch Release Of BV-1 Decay Tanks or BV-2 Storage Tanks	(P)RM-1GW-108B	3.93E5		≤ 2.36E5	≤ 1.18E5
	(A)RM-1GW-109 LRNG[1]	3.54E4 cps	2.25E5 µCi/sec	≤ 1.35E5 µCi/sec	≤ 6.75E4 µCi/sec

*IF the primary monitor is out of service, THEN ODCM CONTROL 3.3.3.10 is met for the respective alternate monitor. The alternate setpoints shall be utilized.
[1]Each Mirion PING Monitor skid is equipped with a low range monitor (LRNG) and a high range monitor (HRNG). The low range monitor has three setpoints: ALERT, HIGH, and HIGH-HIGH. The HIGH-HIGH setpoint will be used to swap from the low range monitor to the high range monitor.

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The setpoints were determined using a calculated mix from the UFSAR and discharge flow rate of 1450 cfm for PV-1/2.

The calculational method below was used to derive the monitor setpoints for the following operational conditions:

- Continuous release via PV-1/2.
- Batch release of BV-1 or BV-2 Waste Gas Decay Tank via PV-1/2.
- Batch release of BV-1 or BV-2 Containment Purge via PV-1/2 is not shown in the above table. However, if it is necessary to perform a BV-1 or BV-2 Containment Purge via this release point, the alarm setpoint shall be calculated in accordance with Section 8.1.3.2.

8.1.3.1.1 **BV-1/2 Mix Radionuclides**

The "mix" (noble gas radionuclides and composition) of the gaseous effluent was determined as follows:

- The gaseous source terms that are representative of the "mix" of the gaseous effluent were evaluated. Gaseous source terms are the radioactivity of the noble gas radionuclides in the effluent. The gaseous source terms can be obtained from ATTACHMENT A Tables 2.1-1a. and 2.1-1b.

- The fraction of the total radioactivity in the gaseous effluent comprised by noble gas radionuclide "i" (Si) for each individual noble gas radionuclide in the gaseous effluent was calculated by:

$$S_i = \frac{A_i}{\sum_i A_i} \qquad [2.1\text{-}9]$$

where:

A_i = The total radioactivity or radioactivity concentration of noble gas radionuclide "i" in the gaseous effluent from ATTACHMENT A Table 2.1-1a and 2.1.1b.

8.1.3.1.2 **BV-1/2 Maximum Acceptable Release Rate (Whole Body Exposure)**

The maximum acceptable total release rate (uCi/sec) of all noble gas radionuclides in the gaseous effluent (Q_t) based upon the whole body exposure limit was determined by:

$$Q_t = \frac{500}{\sum_i V_i S_i} \qquad [2.1.10]$$

where:

V_i = The constant for noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume (mrem/year/uCi/sec) from ATTACHMENT G Table 2.2-12.

S_i = From equation [2.1-9]

8.1.3.1.3 **BV-1/2 Maximum Acceptable Release Rate (Skin Exposure)**

Q_t was also determined based upon the skin exposure limit as follows:

$$Q_t = \frac{3000}{\sum_i [L_i (X/Q)_{pv} + 1.1 B_i] S_i} \qquad [2.1\text{-}11]$$

where:

L_i = The skin dose factor due to beta emissions from noble gas radionuclide "i"(mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

$(X/Q)_{pv}$ = The highest calculated annual average relative concentration of effluents releases via PV-1/2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-6.

= 2.31E-6 sec/m^3 (0.5 – 1.0 miles)

$(X/q)_{pv}$ = The highest calculated short term relative concentration of effluents released via PV-1/2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT N Table 2.3-38.

= 1.07E-5 sec/m^3 (0.5 – 1.0 miles)

B_i = The constant for long term releases (greater than 500 hrs/year) for noble gas radionuclide "i" accounting for the gamma radiation dose from the elevated finite plume (mrad/year/uCi/sec) from ATTACHMENT G Table 2.2-12.

8.1.3.1.4 **BV-1/2 Maximum Acceptable Release Rate (Individual Radionuclide)**

The maximum acceptable release rate (uCi/sec) of noble gas radionuclide "i" in the gaseous effluent (Q_i) for each individual noble gas radionuclide in the gaseous effluent was determined by:

$$Q_i = S_i Q_t \qquad [2.1\text{-}12]$$

NOTE: Use the lower of the Q_t values obtained in Section 8.1.3.1.2 and 8.1.3.1.3.

8.1.3.1.5 **BV-1/2 Maximum Acceptable Concentrations (Individual Radionuclide)**

The maximum acceptable radioactivity concentration (uCi/cc) of noble gas radionuclide "i" in the gaseous effluent (C_i) for each individual noble gas radionuclide in the gaseous effluent was determined by:

$$C_i = \frac{2.12E-3\,Q_i}{F} \qquad [2.1\text{-}13]$$

where:

2.12E-3 = Unit conversion factor (60 sec/min x 3.53E-5 ft^3/cc).

F = The maximum acceptable effluent flow rate at the point of release (cfm) as listed in Section 8.1.3.1.

8.1.3.1.6 **BV-1/2 Monitor Count Rate**

The calculated monitor count rate (ncpm for Victoreen Monitors and ncps for Mirion Monitors) above background attributed to the noble gas radionuclide. (CR) was determined by:

$$CR = \sum_i C_i E_i \qquad [2.1\text{-}14]$$

where:

E_i = The detection efficiency of the monitor for noble gas radionuclide "i" (cpm/uCi/cc for Victoreen or cps/uCi/cc for Mirion) from ATTACHMENT B Table 2.1-2a and 2.1-2b.

8.1.3.1.7 **BV-1/2 Monitor Setpoints**

The monitor alarm setpoints above background were determined as follows:

- The Victoreen monitor HIGH-HIGH Alarm Setpoint above background (ncpm) was determined by:

  HHSP = 0.60 x CR [2.1-15]

- The Victoreen monitor HIGH Alarm Setpoint above background (ncpm) was determined by:

  HSP = 0.30 x CR [2.1-16]

- The Mirion monitor HIGH Alarm Setpoint above background (uCi/sec) was determined by:

  HSP = 0.60 x Q_t [2.1-17]

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- The Mirion monitor ALERT Alarm Setpoint above background (uCi/sec) was determined by:

$$ASP = 0.30 \times Q_t \qquad [2.1\text{-}18]$$

NOTE: Use the lower of the Q_t values obtained in Section 8.1.3.1.2 and 8.1.3.1.3.

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8.1.3.2 **BV-1/2 Setpoint Determination Based On Analysis Prior To Release For PV-1/2 Elevated Releases**

The following calculation method applies to gaseous releases via the PV-1/2 Gaseous Waste/Process Vent when the "calculated mix" does not provide adequate operational flexibility. This method is used to determine the setpoint for the maximum acceptable discharge flow rate and the associated HIGH-HIGH Alarm Setpoint based on this flow rate for the BV-1/2 Gaseous Waste Gas Monitor (RM-GW-108B) or alternate (RM-1GW-109 CH 5) during the following operational conditions:

- Continuous release via PV-1/2.
- Batch release of BV-1 or BV-2 Waste Gas Decay Tank via PV-1/2.
- Batch release of BV-1 or BV-2 Containment Purge via PV-1/2.

8.1.3.2.1 **BV-1/2 Maximum Acceptable Release Rate**

Determine the maximum acceptable discharge flow rate for the release from the Process Vent for the analyzed mix.

- The maximum acceptable gaseous discharge flow rate (f) from the Process Vent (cfm) based upon the whole body exposure limit is determined by:

$$f = \frac{1.06\,S}{\sum_i V_i\,C_i} \qquad [2.1\text{-}21]$$

where:

1.06 = 500 mrem/yr x 2.12E-3

500 mrem/yr = dose rate limit, whole body exposure

2.12E-3 = unit conversion factor
= (60 sec/min x 3.53E-5 ft^3/cc)

S = Percent of site dose rate released via this pathway. Up to 60% of the site dose rate is permissible for one release point under the alarm setpoint rules of Section 8.1.3.

V_i = The constant for noble gas radionuclide "i" accounting for the gamma radiation from the elevated plume (mrem/year/uCi/sec) from ATTACHMENT G Table 2.2-12.

C_i = The undiluted radioactivity concentration of noble gas radionuclide "i" in the gaseous source (uCi/cc) as determined by analysis of the gas to be released.

- Based upon the skin exposure limit, (f) is calculated by:

$$f = \frac{6.36\,S}{\sum_i [L_i\,(X/Q)_{pv} + 1.1B_i]\,C_i} \qquad [2.1\text{-}22]$$

where:

6.36 = 3000 mrem/yr x 2.12E-3

3000 mrem/yr = dose rate limit, skin exposure

2.12E-3 = unit conversion factor
= (60 sec/min x 3.53E-5 ft^3/cc)

L_i = The skin dose factor due to beta emissions from noble gas radionuclide "i" (mrem/year/uCi/m^3) from ATTACHMENT G Table 2.2-11.

$(X/Q)_{pv}$ = The highest calculated annual average relative concentration of effluents released via PV-1/2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT F Table 2.2-6.

= 2.31E-6 sec/m^3

$(X/q)_{pv}$ = The highest calculated short term relative concentration of effluents released via PV-1/2 for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from ATTACHMENT N Table 2.3-38.

= 1.07E-5 sec/m^3

B_i = The constant for long-term releases (greater than 500 hrs/year) for noble gas radionuclide "i" accounting for the gamma radiation from

the elevated finite plume (mrad/year/uCi/sec) from ATTACHMENT G Table 2.2-12.

- Select the smaller of the calculated f values based on the whole body exposure limit and based on the skin exposure limit shown above. The actual discharge flow rate (cfm) must be maintained at or below this (f) value.

8.1.3.2.2 **BV-1/2 Monitor Setpoints**

The monitor alarm setpoints above background are determined as follows:

- The calculated monitor HIGH-HIGH Alarm Setpoint above background (ncpm) attributed to the noble gas radionuclides is determined by:

$$HHSP = \frac{f \sum_i C_i E_i}{F'} \qquad [2.1\text{-}23]$$

where:

f = The maximum acceptable gaseous discharge flow rate (cfm) determined in Section 8.1.3.2.1.

F′ = The maximum actual or design effluent flow rate (cfm) at the point of release.

= 1450 cfm for PV-1/2

C_i = The undiluted radioactivity of noble gas radionuclide "i" in the gaseous source (uCi/cc) as determined by analysis of the gas to be released.

E_i = The detection efficiency of the respective monitor (RM-1GW-108B) or (RM-1GW-109 CH 5) for noble gas radionuclide "i" (cpm/uCi/cc) from ATTACHMENT B Table 2.1-2a and 2.1-2b.

When a HIGH-HIGH Alarm Setpoint has been calculated according to this section the monitor HIGH Alarm setpoint above background (ncpm) is determined by:

$$HSP = HHSP \times 0.5 \qquad [2.1\text{-}24]$$

8.2 Compliance With 10 CFR 20 Dose Rate Limits (ODCM CONTROL 3.11.2.1)

8.2.1 Dose Rate Due To Noble Gases

The dose rate in unrestricted areas resulting from noble gas effluents from the site is limited to 500 mrem/yr to the total body and 3,000 mrem/yr to the skin. Site gaseous effluents are the total of BV-1 and BV-2 specific ground releases and a shared elevated

release, the PV-1/2 Gaseous Waste/Process Vent. Based upon NUREG-0133 (3.1.3.1) the following equations are used to show compliance with ODCM CONTROL 3.11.2.1.a.

$$\sum_i \left[V_i Q_{is} + K_i (\overline{X/Q})_v \, Q_{iv}\right] < 500 \text{ mrem/yr} \qquad [2.2\text{-}1]$$

$$\sum_i \left[[L_i (\overline{X/Q})_s + 1.1 B_i] \, Q_{is} + [L_i + 1.1 M_i] \, (\overline{X/Q})_v \, Q_{iv}\right] \leq 3000 \text{ mrem/yr} \qquad [2.2\text{-}2]$$

where:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide "i", mrem/year/uCi/m^3.

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide "i", mrem/year/uCi/m^3.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide "i", mrad/year/uCi/m^3.

V_i = The constant for each identified noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume, mrem/year/uCi/sec.

B_i = The constant for long-term releases (greater than 500 hrs/year) for each identified noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume, mrad/year/uCi/sec.

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of the photon of interest, mrem/mrad.

Q_{is} = The release rate of noble gas radionuclide "i" in gaseous effluents from free-standing stack, uCi/sec.

Q_{iv} = The release rate of noble gas radionuclide "i" in gaseous effluents from all vent releases, uCi/sec.

$(\overline{X/Q})_s$ = The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary for elevated releases (sec/m^3).

$(\overline{X/Q})_v$ = The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary for elevated releases (sec/m^3).

At the Beaver Valley site gaseous releases may occur from the following Release Points (RP's) as shown in ATTACHMENT P Figure 2.4.2:

RP 1 & 4. The BV-1 Auxiliary Building Vent and the BV-2 SLCRS Unfiltered Pathway atop the Auxiliary Buildings (VV-1 and VV-2)

RP 2 & 5. The BV-1 Rx Containment/SLCRS Vent and the BV-2 SLCRS Filtered Pathway atop the Containment Domes (CV-1 and CV-2)

RP 3. The BV-1/2 Gaseous Waste/Process Vent atop the BV-1 Cooling Tower (PV-1/2)

RP 6. The BV-2 Condensate Polishing Building Vent (CB-2)

RP 7. The BV-2 Waste Gas Storage Vault Vent (WV-2)

RP 8. The BV-2 Decontamination Building Vent (DV-2)

RP 9. The BV-2 Turbine Building Vent (TV-2)

- The effluents from Release Point 1 & 4 are ground level in nature. At BV-1 the sources of these releases are Containment Purges and normal Auxiliary Building Ventilation. At BV-2 the sources of these releases are Containment Purges and Contiguous Area ventilation.

- Effluent from the Release Point 2 & 5 are assumed ground level in nature. At BV-1 the source of these releases is the Supplementary Leak Collection and Release System (SLCRS). At BV-2 the source of these releases is normal Auxiliary Building Ventilation. It is also possible to release Containment Purges from these vents.

- Release Points 6, 7, 8 and 9 are not normally radioactive release points.

- The effluent from Release Point 3 are elevated, and the sources of these releases are the Main Condenser Air Ejectors, the Waste Gas Decay Tanks and the Containment Vacuum Pumps.

Noble gas releases may normally occur from Release Points 1 through 5 above. To show compliance with the site limits of ODCM CONTROL 3.11.2.1.a, Equations [2.2-1] and [2.2-2] are expressed in terms of the actual release points for the site. Note that the expressions for release points 6, 7, 8 and 9 are included for use if radioactive releases via these release points are identified in the future.

8.2.1.1 **Total Body Dose Rate (All Release Points)**

$$\sum_i V_i Q_{i_{pv}} + \Sigma_i K_i [(\overline{X/Q})_{cv} Q_{i_{cv1}} + (\overline{X/Q})_{vv} Q_{i_{vv1}} + (\overline{X/Q})_{cv} Q_{i_{cv2}} + (\overline{X/Q})_{vv}$$

$$Q_{i_{vv2}} + (\overline{X/Q})_{tv} Q_{i_{tv2}} + (\overline{X/Q})_{cb} Q_{i_{cb2}} + (\overline{X/Q})_{dv} Q_{i_{dv2}} + (\overline{X/Q})_{wv} Q_{i_{wv2}}]$$

$\leq$ 500 mrem/yr [2.2-3]

8.2.1.2 **Skin Dose Rate (All Release Points)**

$$\sum_i \left[L_i (\overline{X/Q})_{pv} + 1.1 B_i \right] Q_{i_{pv}} + \sum_i \left[L_i + 1.1 M_i \right] [(\overline{X/Q})_{cv} Q_{i_{cv2}} + (\overline{X/Q})_{vv} Q_{i_{vv1}} +$$

$$(\overline{X/Q})_{cv} Q_{i_{cv2}} + (X/Q)_{vv} Q_{i_{vv2}} + (\overline{X/Q})_{tv} Q_{i_{tv2}} + (\overline{X/Q})_{cb} Q_{i_{cb2}} + (\overline{X/Q})_{dv}$$

$$Q_{i_{dv2}} + (\overline{X/Q})_{wv} Q_{i_{wv2}}] \leq 3000 \text{ mrem/yr} \quad [2.2\text{-}4]$$

where:

$Q_{i_{pv}}$ = Release rate of radionuclide "i" from the PV-1/2, uCi/sec.

$Q_{i_{cv1}}$ = Release rate of radionuclide "i" from CV-1, uCi/sec.

$Q_{i_{cv2}}$ = Release rate of radionuclide "i" from CV-2, uCi/sec.

$Q_{i_{vv1}}$ = Release rate of radionuclide "i" from VV-1 Auxiliary Building, uCi/sec.

$Q_{i_{vv2}}$ = Release rate of radionuclide "i" from VV-2, uCi/sec.

$Q_{i_{tv2}}$ = Release rate of radionuclide "i" from TV-2, uCi/sec.

$Q_{i_{cb}}$ = Release rate of radionuclide "i" from CB-2, uCi/sec.

$Q_{i_{dv2}}$ = Release rate of radionuclide "i" from DV-2, uCi/sec.

$Q_{i_{wv2}}$ = Release rate of radionuclide "i" from WV-2, uCi/sec.

$(\overline{X/Q})_{pv}$ = Highest calculated annual average relative concentration for releases from the PV-1/2, sec/m^3.

$(\overline{X/Q})_{cv}$ = Highest calculated annual average relative concentration for releases from CV-1 and CV-2, sec/m^3.

$(\overline{X/Q})_{vv}$ = Highest calculated annual average relative concentration for releases from VV-1 and VV-2, sec/m^3.

$(\overline{X/Q})_{tv}$ = Highest calculated annual average relative concentration for releases for TV-2, sec/m^3.

$(\overline{X/Q})_{cb}$ = Highest calculated annual average relative concentration for releases for CB-2, sec/m^3.

$(\overline{X/Q})_{dv}$ = Highest calculated annual average relative concentration for releases for DV-2, sec/m^3.

$(\overline{X/Q})_{wv}$ = Highest calculated annual average relative concentration for releases for WV-2, sec/m^3.

The release rate for a containment purge is based on an averaged release rate in uCi/sec for the entire purge (not to exceed 960 min in accordance with ODCM CONTROL 3.11.2.1).

All other terms remain the same as those defined previously.

For the site, 4 potential modes of release are possible. The release modes identify the various combinations of sources of radioactivity and their release points which are used to determine the controlling locations. They are presented in ATTACHMENT C Table 2.2-1. For Release Modes 1, 2, and 3, the controlling location for implementation of ODCM CONTROL 3.11.2.1.a is 0.35 miles NW. Inserting the appropriate X/Q's from ATTACHMENT F Tables 2.2-4 through 2.2-10 for this location, Equations [2.2-3] and [2.2-4] become:

8.2.1.3 **Total Body Dose Rate (at 0.35 Miles NW)**

$$\sum_i V_i Q_{i_{pv}} + \sum_i K_i [9.24E-5\, Q_{i_{cv^1}} + 1.03E-4\, Q_{i_{vv^1}} + 9.24E-5\, Q_{i_{cv^2}} +$$

$$1.03E-4\, Q_{i_{vv^2}} + 7.35E-5\, Q_{i_{tv^2}} + 9.24E-5\, Q_{i_{dv^2}} + 9.24E-5\, Q_{1_{wv^2}} +$$

$$7.35E-5\, Q_{i_{cb^2}}] \leq 500 \text{mrem/yr} \qquad [2.2\text{-}5]$$

8.2.1.4 **Skin Dose Rate (at 0.35 Miles NW)**

$$\sum_i [7.0E-10\, L_i + 1.1 B_i] Q_{i_{pv}} \sum_i [L_i + 1.1 M_i] + 9.24E-5\, Q_{i_{cv^1}} + 1.03E-4$$

$$Q_{i_{vv^1}} + 9.24E-5\, Q_{i_{cv^2}} + 1.03E-4\, Q_{i_{vv^2}} + 7.35E-5\, Q_{i_{tv^2}} + 9.24E-5\, Q_{i_{dv^2}} +$$

$$9.24E-5\, Q_{i_{wv^2}} + 7.35E-5\, Q_{i_{cb^2}}] \leq 3000 \text{ mrem/yr} \qquad [2.2\text{-}6]$$

For Release Mode 4, the controlling location is 0.75 miles N. Inserting the appropriate X/Q's from ATTACHMENT F Tables 2.2-4 through 2.2-10 for this location, Equations [2.2-3 and 2.2-4] become:

8.2.1.5 **Total Body Dose Rate (at 0.75 Miles N)**

$$\sum_i V_i\, Q_{i_{pv}} + \sum_i K_i [3.95E-6\, Q_{i_{cv^1}} + 4.99E-6\, Q_{i_{vv^1}} + 3.95E-6\, Q_{i_{cv^2}} + 4.99E-$$

$$6\, Q_{i_{vv^2}} + 4.26E-6\, Q_{i_{tv^2}} + 3.95E-6\, Q_{i_{dv^2}} + 3.95E-6\, Q_{i_{wv^2}} + 4.26E-6\, Q_{i_{cb^2}}]$$

$$\leq 500 \text{ mrem/yr} \qquad [2.2\text{-}7]$$

8.2.1.6 **Skin Dose Rate (at 0.75 Miles N)**

$$\sum_i [2.31E-6\, L_i + 1.1 B_i] Q_{i_{pv}} + \sum_i [L_i + 1.1 M_i] [3.95E-6\, Q_{i_{cv^1}} + 4.99E-6\, Q_{i_{vv^1}} +$$

$$3.95E-6\, Q_{i_{cv^2}} + 4.99E-6\, Q_{i_{vv^2}} + 4.26E-6\, Q_{i_{tv^2}} + 3.95E-6\, Q_{i_{dv}} + 3.95E-$$

$$6\, Q_{i_{wv}} + 4.26E - 6\, Q_{i_{cb}}] \leq 3000 \text{ mrem/yr} \qquad [2.2\text{-}8]$$

8.2.1.7 **Determination of Controlling Location**

The determination of controlling location for implementation of ODCM CONTROL 3.11.2.1.a for noble gases is a function of the following parameters:

- Radionuclide mix and their isotopic release rate
- Release Mode
- Meteorology

The incorporation of these 3 parameters into Equations [2.2-3] and [2.2-4] resulted in the equations for the controlling locations as presented in Equations [2.2-5 through 2.2-8].

The radionuclide mix used to determine controlling locations was based on source terms calculated with the Stone and Webster Engineering Corporation computer code GAS1BB (similar to NUREG-0017.[3.1.3.4] Inputs were based on operating modes of the respective plants. The code inputs utilized are presented in 1/2-ODC-3.01. The source term is presented in ATTACHMENT D Tables 2.2-2a and 2.2-2b as a function of release type and Release Point.

The X/Q values utilized in the equations for implementation of ODCM CONTROL 3.11.2.1.a are based upon the maximum long-term annual average X/Q in the unrestricted area. ATTACHMENT E Table 2.2-3 presents the distances from the Release Points to the nearest unrestricted area for each of the 16 sectors as well as to the nearest vegetable garden, cow, goat, and beef animal. ATTACHMENT F Tables 2.2-4 through 2.2-10 present the long-term annual average (X/Q) values for all Release Points to the special locations presented in ATTACHMENT E Table 2.2-3. A description of their derivation is provided in 1/2-ODC-3.01.

For Release Modes 1, 2, and 3, dose calculations were performed using the highest calculated site boundary X/Q values applicable to the release points involved and the projected radionuclide mix applicable to the release source. In that a simultaneous, continuous elevated release could contribute to the dose at a given location, the selection of the two highest sector X/Q values at the site boundary considered this contribution. From these results, the distance and sector associated with the highest calculated site boundary dose were selected as the controlling location.

For Release Modes 1, 2, and 3 the controlling location is 0.35 miles NW. In Release Mode 1, the dominant release is via VV-1 and CV-2. In Release Modes 2 and 3, the dominant release is a Containment Purge from the VV-1 or VV-2.

For Release Mode 4, a similar evaluation was performed. Long-term annual average X/Q values were calculated at the mid-point of the 10 standard distances listed in ATTACHMENT F Table 2.2-4 through 2.2-10. In that a simultaneous, ground level release could contribute to the dose at a given location, the selection of the two highest X/Q values at the controlling distance considered this contribution. Since the two maximum X/Q values occurred in the 0.5 - 1.0 mile radial band, the controlling distance was selected at 0.75 miles. From the calculated dose results, the controlling sector was shown to be North. In this Release Mode, the dominant release is a Containment Purge via the PV-1/2 Gaseous Waste/Process Vent. Neither of the controlling receptor locations are presently inhabited.

Values for K_i, L_i, and M_i, which were used in the determination of the controlling receptor location and which are to be used in Equations [2.2-5] through [2.2-8] to show compliance with ODCM CONTROL 3.11.2.1.2, are presented in Table 2.2-11. Values taken from Table B-1 of NRC Regulatory Guide 1.109, Revision 1,[3.1.3.5] were multiplied by 1E6 to convert picocuries to microcuries for use in ATTACHMENT G Table 2.2-11.

Values for V_i and B_i for the finite plume model can be expressed as shown in Equation [2.2-9] and [2.2-10]. Values were calculated using the NRC code RABFIN at the site boundary location which would receive the highest total dose from all Release Points. These values are presented in ATTACHMENT G Table 2.2-12 and calculated from the following equation:

$$B_i = \frac{K}{r_d} \sum_j \sum_k \sum_l \frac{f_{jk} A_{li} u_a E_l I}{u_j} \qquad [2.2\text{-}9]$$

where:

I = The results of numerical integration over the plume spatial distribution of the airborne activity as defined by the meteorological condition of wind speed (u_j) and atmospheric stability class "k" for a particular wind direction.

K = A numerical constant representing unit conversions.

$$= \frac{(260 \text{ mrad})(\text{radians})\ (\text{m}^3)\ (\text{transformation})}{(\text{sec})(\text{Mev})(\text{Ci})} \left[\frac{16 \text{ sectors}}{2\pi \text{ radians}}\right]$$

$$\left[1\text{E}-6 \frac{\text{Ci}}{\text{uCi}}\right]\left[3.15\text{E}7 \frac{\text{sec}}{\text{yr}}\right]$$

= 2.1E4 mrad (m^3) (transformation)/yr(Mev)(uCi).

r_d = The distance from the release point to the receptor location, meters.

u_j = The mean wind speed assigned to the "j" th wind speed class, meters/sec.

f_{jk} = The joint frequency of occurrence of the "j" th wind speed class and kth stability class (dimensionless).

A_{li} = The number of photons of energy corresponding to the "l" th energy group emitted per transformation of the "i" th radionuclide, number/transformation.

E_l = The energy assigned to the "l" th energy group, Mev.

u_a = The energy absorption coefficient in air for photon energy H_l, meters $^{-1}$.

The V_i factor is computed with conversion from air dose to tissue depth dose, thus:

$$V_i = 1.1 \frac{K}{r_d} \sum_j \sum_k \sum_l \frac{f_{jk} A_{li} u_a E_l I_e - u_T T_d}{u_j} \qquad [2.2\text{-}10]$$

where:

u_T = The tissue energy absorption coefficient for photons of energy E_l, cm^2/gm.

T_d = The tissue density thickness taken to represent the total body dose ($5 gm/cm^2$).

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of photons of interest, mrem/mrad.

8.2.2 **Dose Rate Due To Radioiodines And Particulates**

The dose rate in unrestricted areas resulting from the of inhalation of I-131, tritium, and all radionuclides in particulate form (excluding C-14) with half lives greater than 8 days released in gaseous effluents from the site shall be limited to 1,500 mrem/yr to any organ. Based upon NUREG-0133,[3.1.3.1] the following basic equation is used to show compliance with ODCM CONTROL 3.11.2.1.b:

$$\sum_i P_{i\tau} \left[(\overline{X/Q})_s \, Q_{is} + (\overline{X/Q})_v \, Q_{iv} \right] \leq 1{,}500 \text{ mrem/yr} \qquad [2.2\text{-}11]$$

where:

$P_{i\tau}$ = Dose parameter for any organ τ for each identified radionuclide "i", mrem/yr per uCi/m3.

Q_{is} = The release rate of radionuclide "i", in gaseous effluents from elevated releases, uCi/sec.

Q_{iv} = The release rate of radionuclide "i", in gaseous effluents from ground level releases, uCi/sec.

$(\overline{X/Q})_s$ = The highest calculated annual average relative concentration at the unrestricted area boundary for elevated releases, sec/m^3.

$(\overline{X/Q})_v$ = The highest calculated annual average relative concentration at the unrestricted area boundary for ground level releases, sec/m^3.

NOTE: The dispersion parameters specified in Section 8.2.2 are limited to the site boundary as defined above.

Releases may occur from any Release Point in the Release Modes listed in ATTACHMENT C Table 2.2-1. To show compliance with ODCM CONTROL 3.11.2.1.b, Equation [2.2-11] is now expressed in terms of the actual Release Points for the site.

$$\sum_i P_{i\tau} [(\overline{X/Q})_{pv} Q_{i_{pv}} + (\overline{X/Q})_{cv} Q_{i_{cv^1}} + (\overline{X/Q})_{vv} Q_{i_{vv^1}} + (\overline{X/Q})_{cv} Q_{i_{cv^2}} + (\overline{X/Q})_{vv}$$

$$(\overline{X/Q})_{tv} Q_{i_{tv^2}} + (\overline{X/Q})_{cb} Q_{i_{cb^2}} + (\overline{X/Q})_{dv} Q_{i_{dv^2}} + (\overline{X/Q})_{wv} Q_{i_{wv^2}}] \leq 1500 \text{ mrem/yr}$$

[2.2-12]

where:

$(\overline{X/Q})_{pv}$ = Highest calculated annual average relative concentration for releases from PV-1/2, sec/m^3.

$(\overline{X/Q})_{cv}$ = Highest calculated annual average relative concentration for releases from CV-1 and CV-2, sec/m^3.

$(\overline{X/Q})_{vv}$ = Highest calculated annual average relative concentration for releases from VV-1 and VV-2, sec/m^3.

$(\overline{X/Q})_{tv}$ = Highest calculated annual average relative concentration for releases from TV-2, sec/m^3.

$(\overline{X/Q})_{cb}$ = Highest calculated annual average relative concentration for releases from CB-2, sec/m^3.

$(\overline{X/Q})_{dv}$ = Highest calculated annual average relative concentration for releases from DV-2, sec/m^3.

$\overline{(X/Q)}_{wv}$ = Highest calculated annual average relative concentration for release from WV-2, sec/m^3.

$Q_{i_{pv}}$ = Long-term release rate of radionuclide "i" from PV-1/2, uCi/sec.

$Q_{i_{cv1}}$ = Long-term release rate of radionuclide "i" from CV-1, uCi/sec.

$Q_{i_{cv2}}$ = Long-term release rate of radionuclide "i" from CV-2, uCi/sec.

$Q_{i_{vv1}}$ = Long-term release rate of radionuclide "i" from VV-1, uCi/sec.

$Q_{i_{vv2}}$ = Long-term release rate of radionuclide "i" from VV-2, uCi/sec.

$Q_{i_{tv2}}$ = Long-term release rate of radionuclide "i" from TV-2, uCi/sec.

$Q_{i_{cb2}}$ = Long-term release rate of radionuclide "i" from CB-2, uCi/sec.

$Q_{i_{dv2}}$ = Long-term release rate of radionuclide "i" from DV-2, uCi/sec.

$Q_{i_{wv2}}$ = Long-term release rate of radionuclide "i" from WV-2, uCi/sec.

All other terms are the same as those defined previously.

TV-2, CB-2, DV-2 and WV-2 are not normal radioactive Release Points. These Release Points are included only for use if radioactive releases via these vents are identified in the future. In the calculation to show compliance with ODCM CONTROL 3.11.2.1.b only the inhalation pathway is considered.

Values of the organ dose parameters, $P_{i\tau}$, were calculated using methodology given in NUREG-0133.[3.1.3.1] For the child age group, the following equation was used for all nuclides. The $P_{i\tau}$, values are presented in ATTACHMENT H Table 2.2-13.

$$P_{i\tau} = 3.7E9\ DFA_{i\tau} \qquad [2.2\text{-}13]$$

where:

3.7E9 = Breathing rate of child (3,700 m^3/yr) x unit conversion factor (1E6 pCi/uCi).

$DFA_{i\tau}$ = The organ inhalation dose factor for a child from Table 6 of NUREG-0172,(3.1.3.6) for organ τ, nuclide "i", in units of mrem/pCi.

For Release Modes 1 through 4, the controlling location is the site boundary, 0.35 miles NW.

Equation [2.2-12] becomes:

$$\sum_i P_{i\tau}\,[7.00E-10\,Q_i{}_{pv} + 9.24E-5\,Q_i{}_{cv1} + 1.03E-4\,Q_i{}_{vv1} + 7.35E-5\,Q_i{}_{tv1} +$$

$$9.24E-5\,Q_i{}_{cv2} + 1.03E-4\,Q_i{}_{vv2} + 7.35E-5\,Q_i{}_{tv2} + 7.35E-5\,Q_i{}_{cb2} + 9.24E-$$

$$5\,Q_i{}_{dv2} + 9.24E-5\,Q_i{}_{wv2}\,] \leq 1500 \text{ mrem/yr} \qquad [2.2\text{-}14]$$

8.2.2.1 **Determination of Controlling Location**

The determination of the controlling location for implementation of ODCM CONTROL 3.11.2.1.b for radioiodines and particulates is a function of the same 3 parameters as for noble gases plus a fourth, the actual receptor pathways. The incorporation of these parameters into Equation [2.2-12] results in the respective equations for each Release Mode at the site boundary controlling locations. The radionuclide mix was again based upon the source terms presented in ATTACHMENT D Tables 2.2-2a and 2.2-2b as a function of release type and Release Point.

In the determination of the controlling site boundary for each Release Mode, the highest 2 site boundary X/Q values for each Release Point were utilized in conjunction with the radionuclide mix and the release rate for each Release Point to determine the controlling location.

The $P_{i\tau}$ values are presented in ATTACHMENT H Table 2.2-13.

The X/Q values in Equation [2.2-14] were obtained from ATTACHMENT F Tables 2.2-4 through 2.2-10.

A description of the derivation of the X/Q values is provided in 1/2-ODC-3.01.

8.3 Compliance With 10 CFR 50 Dose Limits (ODCM CONTROLS 3.11.2.2 And 3.11.2.3) (Gaseous)

At the Beaver Valley site all elevated gaseous releases are considered to originate from a shared radwaste system. The effluent from both units are mixed and discharged from a common Release Point, the PV-1/2 Gaseous Waste/Process Vent, at the top of the Unit 1 Cooling Tower. The resulting dose for the purpose of implementing 10 CFR 50 is normally apportioned equally to each unit. The only exception would be a Containment Purge via the Process Vent. The resulting dose shall be attributed to the contributing reactor unit. Since this operation is expected to be rare, equations are shown throughout this section with the apportionment set at 0.5.

8.3.1 Dose Due To Noble Gases

8.3.1.1 Cumulation Of Doses

Section II.B.1 of Appendix I of 10 CFR 50 (ODCM CONTROL 3.11.2.2) limits the releases of gaseous effluents from each reactor such that the estimated annual gamma air dose is limited to 10 millirad and the beta air dose is limited to 20 millirad. In addition, ODCM CONTROL 3.11.2.4 requires use of radwaste system if air doses when averaged over 31 days exceed 0.2 mrad for gamma and 0.4 mrad for beta. Based upon NUREG-0133,[3.1.3.1] the air dose limits in the unrestricted area due to noble gases released in gaseous effluents are defined by the following equations:

8.3.1.1.1 Gamma Radiation Quarter Limit

$$3.17E-8 \sum_i \left[M_i \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv} \right] + \left[B_i Q_{is} + b_i q_{is} \right] \right] \leq 5 \text{ mrad} \qquad [2.3\text{-}1]$$

8.3.1.1.2 Beta Radiation Quarter Limit

$$3.17E-8 \sum_i N_i \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv} + (\overline{X/Q})_s Q_{is} + (\overline{X/q})_s q_i s \right] \leq 10 \text{ mrad} \quad [2.3\text{-}2]$$

8.3.1.1.3 Gamma Radiation Year Limit

$$3.17E-8 \sum_i [M_i [(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv}] + [B_i Q_{is} + b_i q_{is}]] \leq 10 \text{ mrad}$$

8.3.1.1.4 Beta Radiation Year Limit

$$3.17E-8 \sum_i N_i \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv} + (\overline{X/Q})_s Q_{is} + (\overline{X/q})_s q_i s \right] \leq 20 \text{ mrad}$$

[2.3-4]

8.3.1.1.5 **Gamma Radiation Projection Averaged Over 31 Days**

$$3.17E-8\sum_i \left[M_i \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv}\right] + \left[B_i Q_{is} + b_i q_{is}\right]\right] \leq 0.2 \text{ mrad} \quad [2.3\text{-}5]$$

8.3.1.1.6 **Beta Radiation Projection Averaged Over 31 Days**

$$3.17E-8\sum_i N_i \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv} + (\overline{X/Q})_s Q_{is} + (\overline{X/q})_s q_i s\right] \leq 0.4 \text{ mrad} \quad [2.3\text{-}6]$$

where:

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide "i" (mrad/yr per uCi/m^3).

N_i = The air dose factor due to beta emissions for each identified noble gas radionuclide "i" (mrad/yr per uCi/m^3).

$(\overline{X/Q})_v$ = The annual average relative concentration for areas at or beyond the unrestricted area boundary for long-term vent releases greater than 500 hrs/year (sec/m^3).

$(\overline{X/q})_v$ = The relative concentration for areas at or beyond the unrestricted area boundary for short-term vent releases equal to or less than 500 hrs/year (sec/m^3).

$(\overline{X/Q})_s$ = The annual average relative concentration for areas at or beyond the unrestricted area boundary for long-term free standing stack releases greater than 500 hrs/year (sec/m^3).

$(\overline{X/q})_s$ = The relative concentration for areas at or beyond the unrestricted area boundary for short-term free standing stack releases equal to or less than 500 hrs/year (sec/m^3).

q_{is} = Release of noble gas radionuclide "i" in gaseous effluents for short-term stack releases equal to or less than 500 hrs/year (uCi).

q_{iv} = Release of noble gas radionuclide "i" in gaseous effluents for short-term vent releases equal to or less than 500 hrs/year (uCi).

Q_{is} = Release of noble gas radionuclide "i" in gaseous effluents for long-term free standing stack releases greater than 500 hrs/year (uCi).

Q_{iv} = Release of noble gas radionuclide "i" in gaseous effluents for long-term vent releases greater than 500 hrs/year (uCi).

B_i = The constant for long-term releases (greater than 500 hrs/year) for each identified noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume (mrad/yr per uCi/sec).

b_i = The constant for short-term releases (equal to or less than 500 hrs/year) for each identified noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume (mrad/yr per uCi/sec).

3.17E-8 = The inverse of the number of seconds in a year.

NUREG 0133[3.1.3.1] permits eliminating the short-term release term and short-term meteorological terms in the determination of doses when short-term releases are sufficiently random in both time of day and duration to be represented by annual average dispersion conditions. This special consideration is applied in Equations [2.3-1] through [2.3-6], however, a summary of the "real time" meteorological data coupled with the corresponding releases shall be included in the Annual Radioactive Effluent Release Report.

Short-term releases are also evaluated annually in computer codes technically consistent with XOQDOQ and GASPAR for inclusion in the Annual Radiological Environmental Report.

The incorporation of this option and the Release Modes of ATTACHMENT I Table 2.3-1 results in the following equations to show compliance with 10 CFR 50 for the calendar quarter or year.

8.3.1.1.7 **Gamma Radiation Dose Equation**

$$3.17E-8 \sum_i [M_i [(\overline{X/Q})_{cv} Q_{i_{cv}} + (\overline{X/Q})_{vv} Q_{i_{vv}} + (\overline{X/Q})_{cb} Q_{i_{cb}} + (\overline{X/Q})_{dv} Q_{i_{dv}} + (\overline{X/Q})_{wv} Q_{i_{wv}}] + 0.5 B_i Q_{i_{pv}}] \quad [2.3\text{-}7]$$

$\leq$ 0.2 mrad (per 31 days), or
$\leq$ 5.0 mrad (per quarter), or
$\leq$ 10.0 mrad (per year)

8.3.1.1.8 **Beta Radiation Dose Equation**

$$3.17E-8 \sum_i N_i \left[(\overline{X/Q})_{cv} Q_{i_{cv}} + (\overline{X/Q})_{vv} Q_{i_{vv}} + (\overline{X/Q})_{cb} Q_{i_{cb}} + (\overline{X/Q})_{dv} Q_{i_{dv}} + (\overline{X/Q})_{wv} Q_{i_{wv}} + 0.5\,(\overline{X/Q})_{pv} Q_{i_{pv}}\right] \quad [2.3\text{-}8]$$

$\leq$ 0.4 mrad (per 31 days), or
$\leq$ 10.0 mrad (per quarter), or
$\leq$ 20.0 mrad (per year)

where:

$(\overline{X/Q})_{cv}$ = Annual average relative concentration for releases from CV-1 and CV-2 (sec/m^3).

$(\overline{X/Q})_{vv}$ = Annual average relative concentration for releases from VV-1 and VV-2 (sec/m^3).

$(\overline{X/Q})_{pv}$ = Annual average relative concentration for releases from PV-1/2 (sec/m^3).

$(\overline{X/Q})_{tv}$ = Annual average relative concentration for releases from TV-2 (sec/m^3).

$Q_{i_{cv}}$ = Release of radionuclide "i" from CV-1 and CV-2 (uCi).

$Q_{i_{vv}}$ = Release or radionuclide "i" from VV-1 and VV-2 (uCi).

$Q_{i_{pv}}$ = Release of radionuclide "i" from PV-1/2 (uCi).

$Q_{i_{tv}}$ = Release of radionuclide "i" from TV-2 (uCi).

$Q_{i_{cb}}$ = Release of radionuclide "i" from the CB-2 (uCi).

$Q_{i_{dv}}$ = Release of radionuclide "i" from DV-2 (uCi).

$Q_{i_{wv}}$ = Release of radionuclide "i" from WV-2 (uCi).

For Release Modes 1, 2, 3, and 4 the controlling location is 0.35 miles NW. Substitution of the appropriate X/Q values into Equations [2.3-7] and [2.3-8] results in the following:

8.3.1.1.9 **Gamma Radiation Dose Determination**

$$3.17E-8 \sum_i [M_i [9.24E-5\, Q_i{}_{cv} + 1.03E-4\, Q_i{}_{vv} + 7.35E-5\, Q_i{}_{tv} + 7.35E-5\, Q_i{}_{cb} + 9.24E-5\, Q_i{}_{dv} + 9.24E-5\, Q_i{}_{wv}] + 0.5\, B_i Q_i{}_{pv} \quad [2.3\text{-}9]$$

$\leq$ 0.2 mrad (per 31 days), or
$\leq$ 5.0 mrad (per quarter), or
$\leq$ 10.0 mrad (per year)

8.3.1.1.10 **Beta Radiation Dose Determination**

$$3.17E-8 \sum_i N_i [9.24E-5\, Q_i{}_{cv} + 1.03E-4\, Q_i{}_{vv} + 7.35E-5\, Q_i{}_{tv} + 7.35E-5\, Q_i{}_{cb} + 9.24E-5\, Q_i{}_{dv} + 9.24E-5\, Q_i{}_{wv} + (0.5)\, 7.0E-10\, Q_i{}_{pv}] \quad [2.3\text{-}10]$$

$\leq$ 0.4 mrad (per 31 days), or
$\leq$ 10.0 mrad (per quarter), or
$\leq$ 20.0 mrad (per year)

8.3.1.1.11 **Determination of Controlling Location**

The determination of the controlling locations for implementation of 10 CFR 50 is a function of the following parameters:

- Radionuclide mix and their isotopic release
- Release Mode
- Meteorology

The incorporation of these parameters into Equations [2.3-7] and [2.3-8] resulted in the equations for the controlling locations as presented in Equations [2.3-9] and [2.3-10]. The radionuclide mix was based upon source terms calculated using the NRC GALE Code (see 1/2-ODC-3.01 for inputs) and are shown in ATTACHMENT D Tables 2.2-2a and 2.2-2b as a function of release type and Release Point.

As in Section 8.2.1, for each Release Mode, the two highest boundary X/Q values for each release point and release duration were utilized in conjunction with the radionuclide mix and release for each release point to determine the controlling site boundary location. Since elevated releases occur from the BVPS site and their maximum X/Q values may not decrease with distance (i.e., the site boundary may not have highest X/Q values), the two highest X/Q values for those distances, greater than the site boundary, were also considered in conjunction with the radionuclide mix to determine the controlling location. These values of X/Q were obtained for the midpoint of the 10 standard distance intervals previously presented in ATTACHMENT F Tables 2.2-4 through 2.2-10.

For each Release Mode, a particular combination of Release Point mix and meteorology dominates in the determination of the controlling location. For Release Modes 1, 2, 3, and 4 the controlling release is VV-1 and VV-2. For Release Mode 3, the controlling release is CV-1 and CV-2.

Values for M_i and N_i, which were used in the determination of the controlling location and which are to be used by BV-1 and BV-2 in Equations [2.3-9] and [2.3-10] to show compliance with 10 CFR 50 were presented in ATTACHMENT G Table 2.2-11. Values taken from Table B-1 of Regulatory Guide 1.109, Revision 1[3.1.3.5] were multiplied by 1E6 to convert from picocuries to microcuries for use in ATTACHMENT G Table 2.2-11.

In determination of the controlling location for Release Modes 1, 2, 3, and 4, ATTACHMENT F Tables 2.2-4 through 2.2-7 are utilized for X/Q values. The B_i values to be utilized are the same values which were presented in ATTACHMENT G Table 2.2-12. A description of the derivation of the various X/Q values is presented in 1/2-ODC-3.01.

The following relationship must hold for BV-1 or BV-2 to show compliance with ODCM CONTROL 3.11.2.2:

For The Calendar Quarter

$D_\gamma \leq 5.0$ mrad [2.3-11]

$D_\beta \leq 10$ mrad [2.3-12]

For The Calendar Year

$D_\gamma \leq 10$ mrad [2.3-13]

$D_\beta \leq 20$ mrad [2.3-14]

where:

D_γ = The air dose from gamma radiation (mrad).

D_β = The air dose from beta radiation (mrad).

The quarterly limits given above represent one-half the annual design objective of Section II.B.1 of Appendix I of 10 CFR 50. If any of the limits of Equations [2.3-11] through [2.3-14] are exceeded, a special report pursuant to both Section IV.A of Appendix I of 10 CFR 50 and ODCM CONTROL 3.11.2.2.a must be filed with the NRC at the identified locations.

In addition, ODCM CONTROL 3.1.2.4 requires that the gaseous radwaste system must be used to reduce radioactive materials in that waste when projected doses from each reactor unit when averaged over 31 days exceed any of the following:

$D_\gamma \leq 0.2$ mrad [2.3-15]

$D_\beta \leq 0.4$ mrad [2.3-16]

8.3.1.2 **Projection Of Doses (Noble Gas)**

Doses due to gaseous releases from BV-1 and BV-2 shall be projected at least once per 31 days in accordance with ODCM CONTROL 4.11.2.4 and this section. (Also see Section 8.3.2.2 Projection Of Doses for additional specifications). The Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous waste prior to their discharge in accordance with ODCM CONTROL 3.11.2.4 when the projected gaseous effluent air dose due to gaseous effluent releases from each reactor unit, when averaged over 31 days, would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation. (Also see Section 8.3.2.2 Projection Of Doses for additional specifications). The doses used in the 31-day dose projection will be calculated using Equations [2.3-9] and [2.3-10] as appropriate. The 31-day dose projection shall be performed according to the following equations:

8.3.1.2.1 **When Including Pre-Release Data,**

$$D_{31} = \left[\frac{A + B}{T}\right](31) + C \qquad [2.3\text{-}17]$$

8.3.1.2.2 **When Not Including Pre-Release Data,**

$$D_{31} = \left[\frac{A}{T}\right](31) + C \qquad [2.3\text{-}18]$$

where:

D_{31} = Projected 31 day dose (mrad).

A = Cumulative dose for quarter (mrad).

B = Projected dose from this release (mrad).

T = Current days into quarter.

C = Value which may be used to anticipate plant trends (mrad).

8.3.2 **Dose Due To Radioiodines And Particulates**

8.3.2.1 **Cumulation Of Doses**

Section II.C of Appendix I of 10 CFR 50 (ODCM CONTROLS 3.11.2.3 and 3.11.2.4) limits the release of radioiodines and radioactive material in particulate form from each reactor unit such that estimated dose or dose commitment to an individual in an unrestricted area from all pathways of exposure is not in excess of 15 mrem to any organ. In addition, ODCM CONTROL 3.11.2.4 requires the use of gaseous radwaste treatment system when the projected dose due to gaseous effluent releases from each reactor unit, when averaged over 31 days, would exceed 0.3 mrem to any organ. Based upon NUREG-0133,[3.1.3.1] the dose to an organ of an individual from radioiodines and particulates, and radionuclides other than noble gases with half-lives greater than 8 days in gaseous effluents released to unrestricted areas, can be determined by the following equation:

8.3.2.1.1 **Radioiodines and Particulates Month, Quarter, and Year Limits**

$$3.17E-8 \sum_i R_{i\tau} [W_s Q_{is} + w_s q_{is} + W_v Q_{iv} + w_v q_{iv}]$$

$\leq$ 0.3 mrem (per 31 days), or [2.3-19]
$\leq$ 7.5 mrem (per quarter), or
$\leq$ 15.0 mrem (per calendar year)

where:

Q_{is} = Release of radionuclide "i" for long-term free standing stack releases greater than 500 hrs/yr (uCi).

Q_{iv} = Release of radionuclide "i" for long-term vent releases greater than 500 hrs/yr (uCi).

q_{is} = Release of radionuclide "i" for short-term free standing stack releases equal to or less than 500 hrs/yr (uCi).

q_{iv} = Release of radionuclide "i" for short-term vent releases equal to or less than 500 hrs/yr (uCi).

w_s = Dispersion parameter for estimating dose to an individual at the controlling location for long-term free standing stack releases greater than 500 hrs/yr.

= sec/m^3 for the inhalation pathway, $(\overline{W/Q})s$.

= $meters^{-2}$ for the food and ground plane pathway, $(\overline{D/Q})s$.

W_v = The dispersion parameter for estimating the dose to an individual at the controlling location for long-term vent releases greater than 500 hrs/yr.

= sec/m^3 for the inhalation pathway, $(\overline{X/Q})_v$.

= $meters^{-2}$ for the food and ground plane pathway, $(\overline{D/Q})_v$.

w_s = Dispersion parameter for estimating the dose to an individual at the controlling location for short-term stack releases equal to or less than 500 hrs/yr.

= sec/m^3 for the inhalation pathway, $(\overline{W/q})_s$.

= $meters^{-2}$ for the food and ground plane pathway, $(\overline{D/q})_s$.

w_v = The dispersion parameter for estimating the dose to an individual at the controlling location for short-term vent releases equal to or less than 500 hrs/yr.

= sec/m^3 for the inhalation pathway, $(\overline{X/q})_v$.

= $meters^{-2}$ for the food and ground plane pathway, $(\overline{D/q})_v$.

3.17E-8 = The inverse of the number of seconds in a year.

$R_{i\tau}$ = The dose factor for each identified radionuclide "i" for the organ "τ" of interest (mrem/yr per uCi/sec per m^{-2} or mrem/yr per uCi/m^3).

Radionuclides and particulates may be released from any of the BV-1 and BV-2 Release Points in the Release Modes identified in ATTACHMENT I Table 2.3-1. As described previously in Section 8.3.1.1, NUREG 0133[3.1.3.1] permits use of long-term annual average dispersion calculations (which with the release modes of Table 2.3-1 results in the following equations) to show compliance with ODCM CONTROLS 3.11.2.3 and 3.11.2.4. For a particular organ, Equation [2.3-19] becomes:

8.3.2.1.2 **Radioiodines and Particulates Dose Equation**

$$3.17E-8 \sum_i R_{i\tau} [0.5\, W_{pv} Q_{i_{pv}} + W_{cv} Q_{i_{cv}} + W_{vv} Q_{i_{vv}} + W_{tv} Q_{i_{tv}} + W_{cb} Q_{i_{cb}} + W_{dv} Q_{i_{dv}} + W_{wv} Q_{i_{wv}}] \quad [2.3\text{-}20]$$

$\leq$ 0.3 mrem (per 31 days), or
$\leq$ 7.5 mrem (per quarter), or
$\leq$ 15.0 mrem (per calendar year)

where:

$0.5\, W_{pv}$ = Dispersion parameter for releases from PV-1/2. The value of 0.5 represents the portion of dose assigned to each Unit due to this being a shared Release Point

W_{cv} = Dispersion parameter for releases from CV-1 and CV-2.

W_{vv} = Dispersion parameter for releases from VV-1 and VV-2.

W_{tv} = Dispersion parameter for releases from TV-2.

W_{cb} = Dispersion parameter for releases from CB-2.

W_{dv} = Dispersion parameter for releases from DV-2.

W_{wv} = Dispersion parameter for releases from WV-2.

$Q_{i_{pv}}$ = Release of radionuclide "i" from PV-1/2 (uCi).

$Q_{i_{cv}}$ = Release of radionuclide "i" from CV-1 and CV-2 (uCi).

$Q_{i_{vv}}$ = Release of radionuclide "i" from VV-1 and VV-2 (uCi).

$Q_{i_{tv}}$ = Release of radionuclide "i" from TV-2 (uCi).

$Q_{i_{cb}}$ = Release of radionuclide "i" from CB-2 (uCi).

$Q_{i_{dv}}$ = Release of radionuclide "i" from DV-2 (uCi).

$Q_{i_{wv}}$ = Release of radionuclide "i" from WV-2 (uCi).

TV-2, CB-2, DV-2 and WV-2 are not normally radioactive Release Points. These are included only for use if a radioactive release is identified in the future.

In determining the dose at a particular location, dispersion parameter W is a function of the pathway. For the food and ground plane pathway, W is in terms of D/Q. If the inhalation pathway is considered, W is in terms of X/Q. Incorporation of the various pathways into Equation [2.3-20] results in the following equation for a particular organ:

8.3.2.1.2.1 **Radioiodines and Particulates Dose Determination**

$$3.17E-8\sum_i [[R_{i\tau_G} + R_{i\tau_M} + R_{i\tau_V} + R_{i\tau_B}][0.5\,W_{pv}Q_{i_{pv}} + W_{cv}Q_{i_{cv}} + W_{vv}Q_{i_{vv}} + W_{tv}Q_{i_{tv}} + W_{cb}Q_{i_{cb}} + W_{dv}Q_{i_{dv}} + W_{wv}Q_{i_{wv}}] + R_{i\tau_I}[0.5\,(X/Q)_{pv}Q_{i_{pv}} + (X/Q)_{cv}Q_{i_{cv}} + (X/Q)_{vv}Q_{i_{vv}} + (X/Q)_{tv}Q_{i_{tv}} + (X/Q)_{cb}Q_{i_{cb}} + (X/Q)_{dv}Q_{i_{dv}} + (X/Q)_{wv}Q_{i_{wv}}]] \quad [2.3\text{-}21]$$

$\leq$ 0.3 mrem (per 31 days), or
$\leq$ 7.5 mrem (per quarter), or
$\leq$ 15.0 mrem (per year)

where:

$R_{i\tau_G}$ = Dose factor for an organ "τ" for radionuclide "i" for the ground plane exposure pathway (mrem/yr per uCi/sec per m^{-2}).

$R_{i\tau_M}$ = Dose factor for an organ "τ" for radionuclide "i" for either the cow milk or goat milk pathway (mrem/yr per uCi/sec per m^{-2}).

$R_{i\tau_V}$ = Dose factor for an organ "τ" for radionuclide "i" for the vegetable pathway (mrem/yr per uCi/sec per m^{-2}).

$R_{i\tau_B}$ = Dose factor for an organ "τ" for radionuclide "i" for the meat pathway (mrem/yr per uCi/sec per m^{-2}).

$R_{i\tau_I}$ = Dose factor for an organ "τ" for radionuclide "i" for the inhalation pathway (mrem/yr per uCi/m^3).

It should be noted that W_{pv}, W_{cv}, W_{vv}, W_{tv}, W_{cp}, W_{dv}, and W_{wv} in Equation [2.3-21] are in terms of $D/Q(m^{-2})$.

Values of the dose factor, $R_{i\tau}$, were calculated using the methodology of NUREG-0133.[3.1.3.1] The following equations are used for all nuclides, unless specifically listed for tritium or carbon-14:

8.3.2.1.2.2 **Dose Factors For Inhalation Pathway**

$$R_{i\tau_I} = K'(BR)_a(DFA_{i\tau})_a$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}22]$$

where:

K' = A constant of unit conversion (1E6 pCi/uCi).

$(BR)_a$ = The breathing rate of the receptor of age group "a" (m^3/yr).

$(DFA_{i\tau})_a$ = Each organ inhalation dose factor for the receptor of age group "a" for the "i" th radionuclide (mrem/pCi). Inhalation dose factors (DFA_{it}) by organ for the various age groups are given in Table E-7 through E-10 of Regulatory Guide 1.109, Rev. 1[3.1.3.5] or Tables 5 through 8 of NUREG-0172 for all nuclides except Se-75.[3.1.3.6] Se-75 DFA_{it} were provided by ABS Consulting and were derived from MACCS2[3.1.3.16], FGR 11/12[3.1.3.17 and 18] and ORNL-4992[3.1.3.19] using conversion factors for the adult pathway only.

The breathing rates (BR)a used for the various age groups are tabulated below, as given in Table E-5 of the Regulatory Guide 1.109.[3.1.3.5]

Age Group(a)	Breathing Rate (m^3/yr)
Infant	1400
Child	3700
Teen	8000
Adult	8000

8.3.2.1.2.3 **Dose Factors For Ground Plane Pathway**

$$R_{i\tau_G} = K'K'' (SF)DFG_{i\tau}[(1 - e^{-\lambda i t})/\lambda_i]$$

$= m^2$ -mrem/yr per uCi/sec [2.3-23]

where:

K' = A constant of unit conversion (1E6 pCi/uCi).

K'' = A constant of unit conversion (8760 hr/year).

λi = The decay constant for the "i" th radionuclide (sec^{-1}).

t = The exposure time (4.73E8 sec or 15 years).

$DFG_{i\tau}$ = The groundplane dose conversion factor for organ "τ" for the "i" th radionuclide (mrem/hr per pCi/m^2). A tabulation of $DFG_{i\tau}$ values is presented in Table E-6 of Regulatory Guide 1.109.[3.1.3.5] for all nuclides except Se-75.[3.1.3.6] Se-75 DFG_{it} were provided by ABS Consulting and were derived from MACCS2[3.1.3.16], FGR 11/12[3.1.3.17 and 18] and ORNL-4992[3.1.3.19] using conversion factors for the adult pathway only.

SF = The shielding factor (dimensionless). A shielding factor of 0.7 as suggested in Table E-15 of Regulatory Guide 1.109 is used.[3.1.3.5]

8.3.2.1.2.4 **Dose Factors For Cow Milk or Goat Milk Pathway**

$$R_{i\tau_M} = K' \frac{Q_F(U_{ap})}{\lambda_i + \lambda_w} F_m(r)(DFL_{i\tau})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda i t h}}{Y_S} \right] e^{-\lambda i t f}$$

$= m^2$ -mrem/yr per uCi/sec [2.3-24]

where:

K' = A constant of unit conversion (1E6 pCi/uCi).

QF = The animal's consumption rate, wet weight (kg/day).

U_{ap} = The receptor's milk consumption rate, for age "a" (liters/yr).

Y_p = The agricultural productivity by unit area of pasture feed grass (kg/m2).

Y_S = The agricultural productivity by unit area of stored feed (kg/m2).

F_m = The stable element transfer coefficients (days/liter).

r = Fraction of deposited activity retained on animals feed grass.

$(DFL_{i\tau})_a$ = The maximum organ ingestion dose factor for the "i" th radionuclide for the receptor in age group "a" (mrem/pCi). Ingestion dose factors $(DFL_{i\tau})_a$ for the various age groups are given in Table E-11 through E-14 of Regulatory Guide 1.109[3.1.3.5] or Tables 1 through 4 of NUREG-0172.[3.1.3.6] for all nuclides except Se-75.[3.1.3.6] Se-75 DFL_{it} were provided by ABS Consulting and were derived from MACCS2[3.1.3.16], FGR 11/12[3.1.3.17 and 18] and ORNL-4992[3.1.3.19] using conversion factors for the adult pathway only.

λ_i = The decay constant for the "i" th radionuclide (sec-1).

λ_w = The decay constant for removal of activity on leaf and plant surfaces by weathering 5.73E-7 sec^{-1} (corresponding to a 14 day half-life).

t_f = The transport time from pasture, to animal, to milk, to receptor (sec).

t_h = The transport time from pasture, to harvest, to animal, to milk, to receptor (sec).

f_p = Fraction of the year that the animal is on pasture (dimensionless).

f_s = Fraction of the animal feed that is pasture grass while the animal is on pasture (dimensionless).

Tabulated below are the parameter values used for cow's milk and their reference to Regulatory Guide 1.109.[3.1.3.5]

Parameter	Value	RG. 1.109 Table
r (dimensionless)	1.0 for radioiodine 0.2 for particulates	E-15 E-15
F_m (days/liter)	each stable element	E-1 (cow milk) E-2 (goat milk)
U_{ap} (liters/yr) - infant	330	E-5
child	330	E-5
teen	400	E-5
adult	310	E-5
$(DLF_{i\tau})_a$ (mrem/pCi)	each radionuclide	E-11 to E-14
Y_p (kg/m^2)	0.7	E-15
Y_s (kg/m^2)	2.0	E-15
t_f (seconds)	1.73E5 (2 days)	E-15
t_h (seconds)	7.78E6 (90 days)	E-15
Q_F (kg/day)	50	E-3
f_p	0.5	--
f_s	1.0	--

For goat's milk, all values remain the same except for Q_F, which is 6 kg/day.

8.3.2.1.2.5 **Dose Factors For Meat Pathway**

$$R_{i\tau_B} = K' \frac{Q_F\left(U_{ap}\right)}{\lambda_i + \lambda_w} F_f(r)(DFL_{i\tau})_a \left[\frac{f_p f_s}{Y_p} + \frac{\left(1 - f_p f_s\right) e^{-\lambda_i t_h}}{Y_S} \right] e^{-\lambda_i t_f}$$

$= m^2$ -mrem/yr per uCi/sec [2.3-25]

where:

F_f = The stable element transfer coefficients (days/kg).

U_{ap} = The receptor's meat consumption rate for age "a" (kg/yr).

t_f = The average time from slaughter of meat animal to consumption (sec).

t_h = The transport time from crop field to receptor (sec).

All parameter values are the same as the milk pathway parameter values except F_f which is obtained from Table E-1. Parameter t_f is obtained from Table E-15, and U_{ap} is obtained from Table E-5. These values, as obtained from Regulatory Guide 1.109,(3.1.3.5) are as follows:

Parameter	Value	RG-1.109 Table
F (days/kg)	each stable element	E-1
t_f (seconds)	1.73E6 (20 days)	E-15
U_{ap} (kg/yr) - infant	0	E-5
Child	41	E-5
Teen	65	E-5
Adult	110	E-5

Man is considered to consume 2 types of vegetation (fresh and stored) that differ only in the time period between harvest and consumption; therefore:

8.3.2.1.2.6 **Dose Factors For Vegetation Pathway**

$$R_{i\tau_v} = K'\left[\frac{(r)}{Y_v(\lambda_i + \lambda_w)}\right](DFL_{i\tau})_a\left[U_a^L f_L e^{-\lambda_i t_L} + U_a^S f_g e^{-\lambda_i t_h}\right]$$

$= m^2$ -mrem/yr per uCi/sec [2.3-26]

where:

K' = A constant of unit conversion (1E6 pCi/uCi).

U_a^L = The consumption rate of fresh leafy vegetation by the receptor in age group "a" (kg/yr).

U_a^S = The consumption rate of stored vegetation by the receptor in age group "a" (kg/yr).

f_L = The fraction of the annual intake of fresh leafy vegetation grown locally.

f_g = The fraction of the annual intake of stored vegetation grown locally.

t_L = The average time between harvest of leafy vegetation and its consumption (seconds).

t_h = The average time between harvest of stored vegetation and its consumption (seconds).

Y_v = The vegetation area density (kg/m^2).

all other factors are defined previously.

Tabulated below are the appropriate parameter values and their reference to Regulatory Guide 1.109.[3.1.3.5]

Parameter	Value	RG-1.109 Table
r (dimensionless)	1.0 for radioiodines	E-15
	0.2 for particulates	E-15
$(DFL_{i\tau})_a$ (mrem/pCi)	each stable element	E-11 to E-14
U_a^L (kg/yr) - infant	0	E-5
Child	26	E-5
teen	42	E-5
adult	64	E-5
U_a^S (kg/yr) - infant	0	E-5
child	520	E-5
teen	630	E-5
adult	520	E-5
f_L (dimensionless)	1.0	E-15
F_g (dimensionless)	0.76	E-15
t_L (seconds)	8.6E4 (1 day)	E-15
t_h (seconds)	5.18E6 (60 days)	E-15
Y_v (kg/m^2)	2.0	E-15

As discussed in Section 8.2.2 for tritium, the parameter W for the food pathway is based upon X/Q. The ground plane pathway is not appropriate for tritium. Therefore, the

left-hand portion of Equation [2.3-20] may be expressed for purposes of implementation of 40 CFR 190, discussed in 1/2-ODC-2.04, as follows:

8.3.2.1.2.7 **Tritium Dose Equation**

$$3.17E-8\,(R_{T\tau_M}+R_{T\tau_V}+R_{T\tau_B}+R_{T\tau_I})\,[0.5\,(X/Q)_{pv}Q_{T_{pv}}+(X/Q)_{cv}Q_{T_{cv}}+$$

$$(X/Q)_{vv}Q_{T_{vv}}+(X/Q)_{tv}Q_{T_{tv}}+(X/Q)_{cb}Q_{\tau_{cb}}+(X/Q)_{dv}Q_{\tau_{dv}}+(X/Q)_{wv}Q_{\tau_{wv}}\,]$$

[2.3-27]

where:

$R_{T\tau_M}$ = Dose factor for organ "τ" for tritium for the milk pathway (mrem/yr per uCi/m^3).

$R_{T\tau_V}$ = Dose factor for organ "τ" for tritium for the vegetable pathway (mrem/yr per uCi/m^3).

$R_{T\tau_B}$ = Dose factor for organ "τ" for tritium for the beef pathway (mrem/yr per uCi/m^3).

$R_{T\tau_I}$ = Dose factor for organ "τ" for tritium for the inhalation pathway (mrem/yr per uCi/m^3).

Equation [2.3-27] is used to show compliance with 40 CFR 190, as discussed in 1/2-ODC-2.04.

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. Therefore, the $R_{T\tau_M}$ is based on [X/Q]:

8.3.2.1.2.8 **Tritium Dose Factors For Milk Pathway**

$$R_{T\tau_M} = K'K''F_mQ_FU_{ap}(DLF_{i\tau})_a[0.75(0.5/H)]$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}28]$$

where:

K" = A constant of unit conversion (1000 gm/kg).

H = Absolute humidity of the atmosphere (8 gm/m^3).

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.

and other parameters and values are the same as for $R_{i\tau_M}$.

The concentration of tritium in vegetation is based on the airborne concentration rather than the deposition. Therefore, the $R_{t\tau_v}$ is based on [X/Q]:

8.3.2.1.2.9 **Tritium Dose Factors For Vegetation Pathway**

$$R_{T\tau_V} = K'K''\left[U_a^L f_L + U_a^S f_g\right]\left(DFL_{i\tau}\right)_a [0.75(0.5/H)]$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}29]$$

where all terms have been defined above.

The concentration of tritium in meat is based on its airborne concentration rather than the deposition. Therefore, the $R_{T\tau_B}$ is based on [X/Q]:

8.3.2.1.2.10 **Tritium Dose Factors For Beef Pathway**

$$R_{T\tau_B} = K'K''F_f Q_F U_{ap}\left(DFL_{i\tau}\right)_a [0.75(0.5/H)]$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}30]$$

where all terms have been defined above.

In determining the dose for carbon-14, the plume and ground pathways are not applicable. The concentration of carbon-14 is based on the airborne concentration rather than the deposition in all pathways. Therefore, the $R_{c\tau}$ is based on [X/Q]. Incorporation of the various pathways into Equation [2.3-20] results in the following equation for a particular organ:

8.3.2.1.2.11 **Carbon-14 Dose Determination**

$$3.17E-8\,(pR_{c\tau_M} + pR_{c\tau_V} + pR_{c\tau_B} + R_{c\tau_I})\,[0.5\,(X/Q)_{pv}Q_{c_{pv}} + (X/Q)_{cv}Q_{c_{cv}} + (X/Q)_{vv}Q_{c_{vv}} + (X/Q)_{tv}Q_{c_{tv}} + (X/Q)_{cb}Q_{c_{cb}} + (X/Q)_{dv}Q_{c_{dv}} + (X/Q)_{wv}Q_{c_{wv}}]$$

[2.3-31]

where:

$R_{c\tau_M}$ = Dose factor for an organ "τ" for carbon-14 for either the cow milk or goat milk pathway mrem/yr per uCi/m^3).

$R_{c\tau_V}$ = Dose factor for an organ "τ" for carbon-14 for the vegetable pathway (mrem/yr per uCi/m^3).

$R_{c\tau_B}$ = Dose factor for an organ "τ" for carbon-14 for the meat pathway (mrem/yr per uCi/m^3).

$R_{c\tau_I}$ = Dose factor for an organ "τ" for carbon-14 for the inhalation pathway (mrem/yr per uCi/m^3).

p = The fractional equilibrium ratio, dimensionless. For batch releases, the parameter p is defined as the ratio of the total annual atmospheric release time to the total annual time during which photosynthesis occurs (assumed to be 4400 hours). Under this condition, p should never exceed 1. For continuous releases, p = 1.

NOTE: Because photosynthesis only occurs during daylight hours, it may be acceptable to take this into further consideration.

Values of the dose factor, $R_{c\tau}$, were calculated using the methodology of NUREG-0133.(3.1.3.1) Carbon-14 inhalation dose factors were calculated according to Equation [2.3-22] and are therefore not repeated in this section. The following equations were used for other pathways to determine carbon-14 dose factors:

8.3.2.1.2.12 **Carbon-14 Dose Factors For Cow Milk or Goat Milk Pathway**

$$R_{c\tau_M} = K'K''F_m Q_F U_{ap} (DFL_{i\tau})_a (0.11/0.16)$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}32]$$

where:

0.11 = The fraction of total plant mass that is natural carbon, dimensionless.

0.16 = The concentration of natural carbon in the atmosphere (g/m^3).

and other parameters as defined above.

8.3.2.1.2.13 **Carbon-14 Dose Factors For Meat Pathway**

$$R_{i\tau_B} = K'K''F_f Q_F U_{ap} (DFL_{i\tau})_a (0.11/0.16)$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}33]$$

where all terms have been defined above.

8.3.2.1.2.14 **Carbon-14 Dose Factors For Vegetation Pathway**

$$R_{c\tau_V} = K'K''\left[U_a^L f_L + U_a^S f_g\right](DFL_{i\tau})_a (0.11/0.16)$$

$$= \text{mrem/yr per uCi/m}^3 \qquad [2.3\text{-}34]$$

where all other terms have been defined above.

The following sections explain the determination of the controlling locations and limits for dose of radioiodines and particulates. While carbon-14 was used to determine controlling locations, there are currently no regulatory limits on carbon-14 effluents from the plant. Equations [2.3-31] though [2.3-34] should be used to calculate dose at the controlling location (0.89 miles NW) for the Annual Radioactive Effluent Release Report.

To show compliance with ODCM CONTROLS 3.11.2.3 and 3.11.2.4, Equation [2.3-21] is evaluated at the controlling pathway location. For Release Modes 1 through 4, the controlling location is a residence 0.89 miles in the NW sector. Inserting appropriate X/Q values from ATTACHMENT F Tables 2.2-4 to 2.2-10 and D/Q values from ATTACHMENT L Tables 2.3-28 to 2.3-34, Equation [2.3-21] becomes:

8.3.2.1.3 **Radioiodines and Particulates (excluding C-14) Dose Determination**

$$Q_{i_{vv}} + 1.55E-8\,Q_{i_{tv}} + 1.55E-8\,Q_{i_{cb}} + 1.56E-8\,Q_{i_{dv}} + 1.56E-8$$

$$Q_{i_{wv}}] + R_{i\tau_I}\,[(0.5)\,7.30E-9\,Q_{i_{pv}} + 2.00E-5\,Q_{i_{cv}} + 2.71E-5\,Q_{i_{vv}}$$

$$+ 2.22E-5\,Q_{i_{tv}} + 2.22E-5\,Q_{i_{cb}} + 2.00E-5\,Q_{i_{dv}} + 2.00E-5\,Q_{i_{wv}}]$$

$\leq$ 0.3 mrem (per 31 days), or
$\leq$ 7.5 mrem (per quarter), or
$\leq$15.0 mrem (per year) [2.3-35]

For tritium, for purposes of implementation of 40 CFR 190, as discussed in 1/2-ODC-2.04, Equation [2.3-28] reduces to:

$$3.17E-8\,[R_{T\tau_V} + R_{T\tau_I}]\,[(0.5)7.30E-9\,Q_{i_{pv}} + 2.00E-5\,Q_{i_{cv}} + 2.71E-$$

$$5Q_{i_{vv}} + 2.22E-5\,Q_{i_{tv}} + 2.22E-5\,Q_{i_{cb}} + 2.00E-5Q_{i_{dv}} +$$

$$2.00E-5\,Q_{i_{wv}}] \qquad [2.3\text{-}36]$$

8.3.2.1.4 **Determination of Controlling Location**

The determination of a controlling locating for implementation of ODCM CONTROLS 3.11.2.3 and 3.11.2.4 for radioiodines and particulates is a function of:

- Radionuclide mix and their isotopic release
- Release Mode
- Meteorology
- Exposure pathway
- Receptor's age

The incorporation of these parameters into Equation [2.3-19] results in the respective equations for each Release Mode at the controlling location.

In determination of the controlling location for each Release Mode, the radionuclide mix of radioiodines and particulates was based upon the source terms calculated using the GALE code. This mix was presented in ATTACHMENT D Tables 2.2-2a and 2.2-2b as a function of Release Mode and Release Point. For the ground plane exposure pathway, all radionuclides (excluding H-3 and C-14) were considered in determination of the controlling location. For the inhalation and food pathways H-3 and C-14 were also considered in determination of the controlling location.

In determination of the controlling location for each Release Mode, all of the exposure pathways, as presented in ATTACHMENT E Table 2.2-3, were evaluated. These include cow milk, goat milk, beef and vegetable ingestion and inhalation and ground plane exposure. An infant was assumed to be present at all milk pathway locations. A child was assumed to be present at all vegetable garden and beef animal locations. The ground plane and inhalation exposure pathways were considered to be present at all locations.

For determination of the controlling location, the highest D/Q and X/Q values for each Release Point and Release Mode for the vegetable garden, cow milk, and goat milk pathways were selected. The organ dose was calculated at each of these locations using the radionuclide mix and Release Points of ATTACHMENT D Tables 2.2-2a and 2.2-2b Based upon these calculations, it was determined that the controlling location for Release Modes 1 through 4 is the residence (vegetable garden)/child pathway.

For Release Modes 1 through 4, the controlling Release Point and mix is VV-1 and VV-2.

ATTACHMENT J Tables 2.3-2 through 2.3-20 present Ri values for the total body, GI-LLI, bone, liver, kidney, thyroid, and lung organs for the ground plane, inhalation, cow milk, goat milk, vegetable, and meat ingestion pathways for the infant, child, teen, and adult age groups as appropriate to the pathways. These values were calculated using the methodology described in NUREG-0133[3.1.3.1] using a grazing period of 6 months.

In determination of the controlling location for Release Modes 1-4, ATTACHMENT F Tables 2.2-4 through 2.2-10 are utilized for X/Q's, and ATTACHMENT L Tables 2.3-28 through 2.3-34 are utilized for long term D/Q values. A description of the derivation of the various X/Q and D/Q values is presented in 1/2-ODC-3.01.

Long-term D/Q values for PV-1/2, CV-1, CV-2, VV-1, VV-2, TV-2, CB-2, DV-2 AND WV-2 are provided for the midpoints of the following distances:

0.0-0.5 mi., 0.5-1.0 mi., 1.0-1.5 mi., 1.5-2.0 mi., 2.0-2.5 mi., 2.5-3.0 mi., 3.0-3.5 mi., 3.5-4.0 mi., 4.0-4.5 mi., 4.5-5.0 mi.

The values appear in ATTACHMENT K Tables 2.3-21 through 2.3-27. These values may be utilized if an additional special location arises different from those presented in the special locations of ATTACHMENT E Table 2.2-3.

The following relationship must hold for BV-1 or BV-2 to show compliance with ODCM CONTROL 3.11.2.3.

For The Calendar Quarter:

$D_\tau \leq 7.5$ mrem to any organ [2.3-37]

For The Calendar Year:

$D_\tau \leq 15$ mrem to any organ [2.3-38]

where:

D_τ = The dose to any organ from radioiodines and particulates (mrem).

The quarterly limits given above represent one-half the annual design objective of Section II.C of Appendix I of 10 CFR 50. If any of the limits of Equations [2.3-33] and [2.3-34] are exceeded, a Special Report pursuant to both Section IV.A of Appendix I of 10 CFR 50 and ODCM CONTROL 3.11.2.3.a must be filed with the NRC at the identified locations.

8.3.2.2 **Projection Of Doses (Radioiodines And Particulates)**

Doses due to gaseous releases from BV-1 or BV-2 shall be projected at least once per 31 days in accordance with ODCM CONTROL 4.11.2.4 and this section. (Also see Section 8.3.1.2, Projection Of Doses for additional specifications). The appropriate portions of the Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous waste prior to their discharge in accordance with ODCM CONTROL 3.11.2.4 when the projected doses due to gaseous effluent releases from each reactor unit, when averaged over 31 days, would exceed 0.3 mrem to any organ. (Also see Section 8.3.1.2, Projection Of Doses for additional specifications). Doses resulting from the gaseous effluent release of radioiodines and particulates will be calculated for use in the 31-day dose projection using Equation [2.3-31]. The 31-day dose projection shall be performed according to the following equations:

8.3.2.2.1 **When Including Pre-Release Data,**

$$D_{31} = \left[\frac{A + B}{T}\right](31) + C \qquad [2.3\text{-}39]$$

8.3.2.2.2 **When Not Including Pre-Release Data,**

$$D_{31} = \left[\frac{A}{T}\right](31) + C \qquad [2.3\text{-}40]$$

where:

D_{31} = Projected 31 day dose (mrem).

A = Cumulative dose for quarter (mrem).

B = Projected dose for this release (mrem).

T = Current days into quarter.

C = Value which may be used to anticipate plant trends (mrem).

8.4 Gaseous Radwaste System

The gaseous radwaste system has the capability to control, collect, process, store, recycle, and dispose of gaseous radioactive waste generated as a result of plant operations, including anticipated operational occurrences.

A simplified flow diagram of the gaseous radwaste system for BV-1 and BV-2 is provided as ATTACHMENT N Figure 2.4-1. A diagram showing the gaseous effluent Release Points is provided as ATTACHMENT P Figure 2.4-2. Since the concept of a shared gaseous radwaste system is used, then gaseous waste generated can be stored, processed, and discharged from either BV-1 or BV-2.

8.4.1 BV-1 Gaseous Radwaste System Components

8.4.1.1 BR-1EV-2A/2B: Degasifiers

There are two Degasifiers. They are designed to continuously process reactor coolant letdown for reducing entrained noble gases in the liquid.

8.4.1.2 GW-1E-1A/1B: Waste Gas Chillers

There are two Chillers. Non-condensable gases from the degasifiers are directed by system pressure to the Waste Gas Chillers.

8.4.1.3 GW-1TK-3A thru 3D: Gaseous Waste Charcoal Delay Beds

There are four Charcoal Beds. The dry effluent from the Chillers is directed to the Waste Gas Charcoal Delay Beds for holdup of xenon and krypton and adsorption of radioiodines. When four beds are operated in series, they provide a holdup of xenon isotopes for about 30 days.

8.4.1.4 GW-1FL-5A/5B: Overhead Gas Compressor Prefilters

There are two Prefilters. The gaseous effluent (primarily hydrogen) is directed from the Gaseous Waste Charcoal Delay Beds to one of the Overhead Gas Compressor Prefilters. The filters remove carbon solids from the gas stream.

8.4.1.5 GW-1C-1A/1B: Gas Compressors

There are two Compressors. The waste gas enters one of the compressors after passing through the Prefilters.

8.4.1.6 GW-1TK-2: Gaseous Waste Surge Tank

There is one Surge Tank. It has a capacity of 52 cuft. After compression to about 65 psig, the waste gas is sent to the Surge Tank. This can be done automatically or manually.

8.4.1.7 **GW-1TK-1A thru 1C: Waste Gas Decay Tanks**

There are three Decay Tanks. Each has a capacity of 132 cuft. The contents of the Surge Tank is transferred to the Decay Tanks for storage and decay. After 30 days of storage, all xenon and iodine should have decayed, and the resulting predominant nuclide should be krypton 85.

8.4.1.8 **RM-1GW-108 And RM-1GW-109: Gaseous Effluent Radiation Monitors**

There are redundant Radiation Monitors on the combined PV-1/2 Gaseous Waste/Process Vent release path. These Radiation Monitors continuously analyze gaseous waste as it is being discharged. Gaseous Monitor RM-1GW-108B is an off-line gamma scintillator, while RM-1GW-109 Channel 5 is an off-line beta scintillator. The upper activity alarm on the gaseous Channels of these Radiation Monitors have setpoints that would indicate we are approaching the Total Body Dose Rate or Skin Dose Rate limits for radioactive gas leaving the site. If an upper activity alarm on RM-1GW-108B is received, it automatically terminates the discharge by closing an isolation valve downstream of the Decay Tanks.

8.4.2 **BV-2 Gaseous Radwaste System Components**

8.4.2.1 **2BRS-EV21A/21B: Degasifiers**

There are four Degasifiers (two at Unit 1 and two at Unit 2). They are designed to continuously process reactor coolant letdown for reducing entrained noble gases in the liquid.

8.4.2.2 **2GWS-E21A/21B: Waste Gas Chillers**

There are four Chillers (two at Unit 1 and two at Unit 2). Non-condensable gases from the degasifiers are directed by system pressure to the Waste Gas Chillers.

8.4.2.3 **2GWS-TK22A thru 22D: Waste Gas Charcoal Delay Beds**

There are four Charcoal Beds (four at Unit 1 and four at Unit 2). The dry effluent from the Chillers is directed to the Waste Gas Charcoal Delay Beds for holdup of xenon and krypton and adsorption of radioiodines. When four beds are operated in series, they provide a holdup of xenon isotopes for about 30 days.

8.4.2.4 **2GWS-FLT24A/24B: Overhead Gas Compressor Prefilters**

There are two Prefilters. The gaseous effluent (primarily hydrogen) is directed from the Waste Gas Charcoal Delay Beds to one of the Overhead Gas Compressor Prefilters. The filters remove carbon solids from the gas stream.

8.4.2.5 **2GWS-C21A/21B: Gas Compressors**

There are two Compressors. The waste gas enters one of the compressors after passing through the Prefilters.

8.4.2.6 **2GWS-TK21: Gaseous Waste Surge Tank**

There is one Surge Tank. It has a capacity of 52 cuft. After compression to about 65 psig, the waste gas is sent to the Surge Tank. This can be done automatically or manually.

8.4.2.7 **2GWS-TK25A thru 25G: Gaseous Waste Storage Tanks**

There are seven Storage Tanks. Each has a capacity of 132 cuft. The contents of the Surge Tank is transferred to the Storage Tanks for storage and decay. After 30 days of storage, all xenon and iodine should have decayed, and the resulting predominant nuclide should be krypton 85.

8.4.2.8 **RM-1GW-108 And RM-1GW-109: Gaseous Effluent Radiation Monitors**

Previously described in Section 8.4.1.

- END -

ATTACHMENT A
Page 1 of 2
GASEOUS SOURCE TERM

TABLE 2.1-1a

BV-1 RADIONUCLIDE MIX FOR GASEOUS EFFLUENTS
(Ci/yr)

	RX CONTAINMENT/ SLCRS VENT Long Term, And	AUXILIARY BUILDING VENT	GASEOUS WASTE/PROCESS VENT		
NUCLIDE[2]	CONTAINMENT BUILDING[1]	AUXILIARY BUILDING VENTILATION	MAIN CONDENSER/ AIR EJECTOR	CONTAINMENT VACUUM PUMPS[3]	GASEOUS WASTE SYSTEM
	Short Term	Long Term	Long Term	Long Term	Short Term
Kr-83m	2.2E-02	4.2E-01	2.7E-01	5.2E-03	0.0
Kr-85m	1.5E-01	1.9E+00	1.2E+00	5.5E-02	7.3E-02
Kr-85	6.1E+01	2.5E+00	1.6E+00	1.0E+01	2.3E+02
Kr-87	5.4E-02	1.3E+00	8.2E-01	1.1E-02	0.0
Kr-88	2.4E-01	3.8E+00	2.4E+00	7.0E-02	0.0
Kr-89	4.7E-04	1.2E-01	7.7E-02	4.3E-05	0.0
Xe-131m	7.4E-01	1.3E-01	8.0E-02	1.8E-01	1.3E+00
Xe-133m	8.9E-01	8.9E-01	5.6E-01	3.1E-01	0.0
Xe-133	8.9E+01	3.6E+01	2.3E+01	2.7E+01	2.3E+01
Xe-135m	4.5E-03	3.2E-01	2.0E-01	6.2E-04	0.0
Xe-135	7.0E-01	4.5E+00	2.8E+00	2.7E-01	0.0
Xe-137	1.0E-03	2.1E-01	1.3E-01	8.8E-05	0.0
Xe-138	1.5E-02	1.1E+00	6.6E-01	1.7E-03	0.0
Ar-41	2.5E+01	0.0	0.0	0.0	0.0

(1) Containment can be purged via VV-1 (Auxiliary Building Vent), CV-1 (Rx Containment/SLCRS Vent), or PV-1/2 (Gaseous Waste/Process Vent)

(2) Source Term from BVPS-2 UFSAR Table 11.3.1[3.1.1.2]

(3) Original Source Term from Calculation No. UR(B)-262 was adjusted for a factor of 14 increase in pump flowrate due to installation of high capacity pumps during 1R15. This change in Source Term is documented in Condition Report CR03-04830 and Calculation No. ERS-HHM-87-014.[3.1.1.5] [3.1.1.8] [3.1.3.10]

ATTACHMENT A
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GASEOUS SOURCE TERM

TABLE 2.1-1b
BV-2 RADIONUCLIDE MIX FOR GASEOUS EFFLUENTS
(Ci/yr)

	SLCRS UNFILTERED PATHWAY Long Term, And	SLCRS FILTERED PATHWAY	TURBINE BUILDING VENT	GASEOUS WASTE/PROCESS VENT		
NUCLIDE[2]	CONTAINMENT BUILDING[1]	AUXILIARY BUILDING VENTILATION	TURBINE BUILDING VENTILATION	MAIN CONDENSER/ AIR EJECTOR	CONTAINMENT VACUUM PUMPS[3]	GASEOUS WASTE SYSTEM
	Short Term	Long Term	Long Term	Long Term	Long Term	Short Term
Kr-83m	4.0E-05	4.2E-01	3.9E-05	2.7E-01	3.7E-04	0.0
Kr-85m	1.4E-02	1.9E+00	1.7E-04	1.2E+00	3.9E-03	1.2E-02
Kr-85	6.1E+01	2.5E+00	2.3E-04	1.6E+00	7.2E-01	2.3E+02
Kr-87	5.3E-06	1.3E+00	1.1E-04	8.2E-01	7.8E-04	0.0
Kr-88	4.1E-03	3.8E+00	3.5E-04	2.4E+00	5.0E-03	0.0
Kr-89	0.0	1.2E-01	1.1E-05	7.7E-02	3.1E-06	0.0
Xe-131m	7.2E-01	1.3E-01	1.2E-05	8.0E-02	1.3E-02	8.3E-01
Xe-133m	7.6E-01	8.9E-01	8.1E-05	5.6E-01	2.2E-02	0.0
Xe-133	8.4E+01	3.6E+01	3.4E-03	2.3E+01	1.9E-00	8.2E+00
Xe-135m	0.0	3.2E-01	2.9E-05	2.0E-01	4.4E-05	0.0
Xe-135	2.4E-01	4.5E+00	4.2E-04	2.8E+00	1.9E-02	0.0
Xe-137	0.0	2.1E-01	2.1E-05	1.3E-01	6.3E-06	0.0
Xe-138	0.0	1.1E+00	9.7E-05	6.6E-01	1.2E-04	0.0
Ar-41	2.5E+01	0.0	0.0	0.0	0.0	0.0

(1) Containment can be purged via VV-2 (SLCRS Unfiltered Pathway), CV-2 (SLCRS Filtered Pathway), or PV-1/2 (Gaseous Waste/Process Vent)
(2) Source Term from BVPS-2 UFSAR Table 11.3.2[3.1.2.3]
(3) Source Term from Calculation No. UR(B)-262[3.1.2.5]

ATTACHMENT B
Page 1 of 2
GASEOUS EFFLUENT MONITOR DETECTION EFFICIENCIES

TABLE 2.1-2a

BV-1 MONITOR DETECTOR EFFICIENCIES

NUCLIDE	AUXILIARY BUILDING VENT		GASEOUS WASTE/ PROCESS VENT		Rx CONTAINMENT/ SLCRS VENT	
	PRIMARY MONITOR[1] RM-VS-101B (cpm/uCi/cc)	ALTERNATE MONITOR[2] RM-VS-109 LRNG (cps/uCi/cc)	PRIMARY MONITOR[1] RM-GW-108B (cpm/uCi/cc)	ALTERNATE MONITOR[2] RM-GW-109 LRNG (cps/uCi/cc)	PRIMARY MONITOR[1] RM-VS-107B (cpm/uCi/cc)	ALTERNATE MONITOR[2] RM-VS-110 LRNG (cps/uCi/cc)
Kr-83m	--	--	--	--	--	--
Kr-85m	9.80 E7	1.14 E5	9.00 E7	1.14 E5	5.16 E7	1.14 E5
Kr-85	3.88 E5	1.14 E5	3.56 E5	1.14 E5	5.04 E7	1.14 E5
Kr-87	7.38 E7	1.77 E5	6.78 E7	1.77 E5	9.60 E7	1.77 E5
Kr-88	1.14 E8	1.05 E5	1.05 E8	1.05 E5	5.16 E7	1.05 E5
Kr-89	1.39 E8	1.89 E5	1.28 E8	1.89 E5	9.59 E7	1.89 E5
Kr-90	1.34 E8	1.89 E4	1.23 E8	1.89 E4	9.87 E7	1.89 E4
Xe-131m	2.25 E6	7.22 E4	2.07 E6	7.22 E4	2.94 E7	7.22 E4
Xe-133m	1.26 E7	1.28 E5	1.16 E7	1.28 E5	4.17 E7	1.28 E5
Xe-133	1.01 E7	4.39 E4	9.24 E6	4.39 E4	2.28 E7	4.39 E4
Xe-135m	7.15 E7	3.28 E4	6.58 E7	3.28 E4	1.51 E7	3.28 E4
Xe-135	1.12 E8	1.37 E5	1.03 E8	1.37 E5	6.42 E7	1.37 E5
Xe-137	3.16 E7	1.83 E5	2.91 E7	1.83 E5	1.05 E8	1.83 E5
Xe-138	1.15 E8	1.43 E5	1.06 E8	1.43 E5	7.35 E7	1.43 E5
Ar-41	7.17 E7	1.60 E5	6.59 E7	1.60 E5	7.19 E7	1.60 E5

(1) The listed detector efficiencies for the respective primary monitors (Victoreen) are corrected for the reduced pressures observed and documented during operation.
(2) Efficiencies from Calculation Package ERS-SFL-85-031.(3.1.1.4)

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ATTACHMENT B
Page 2 of 2
GASEOUS EFFLUENT MONITOR DETECTION EFFICIENCIES

TABLE 2.1-2b
BV-2 MONITOR DETECTOR EFFICIENCIES
(cpm/uCi/cc)

NUCLIDE[1]	SLCRS UNFILTERED PATHWAY 2HVS-RQ101B	SLCRS FILTERED PATHWAY 2HVS-RQ109B	WASTE GAS STORAGE VAULT VENT 2RMQ-RQ303B	DECON BUILDING VENT 2RMQ-RQ301B	CONDENSATE POLISHING BUILDING VENT 2HVL-RQ112B
Kr-83m	--	--	--	--	--
Kr-85m	3.20E7	5.83E7	3.20E7	3.20E7	3.20E7
Kr-85	3.60E7	7.19E7	3.60E7	3.60E7	3.60E7
Kr-87	3.73E7	8.85E7	3.73E7	3.73E7	3.73E7
Kr-88	3.05E7	6.80E7	3.05E7	3.05E7	3.05E7
Kr-89	3.72E7	8.73E7	3.72E7	3.72E7	3.72E7
Kr-90	3.86E7	8.80E7	3.86E7	3.86E7	3.86E7
Xe-131m	2.44E7	4.61E4	2.44E7	2.44E7	2.44E7
Xe-133m	2.86E7	6.06E4	2.86E7	2.86E7	2.86E7
Xe-133	1.80E7	2.94E7	1.80E7	1.80E7	1.80E7
Xe-135m	7.22E6	1.55E4	7.22E6	7.22E6	7.22E6
Xe-135	3.86E7	7.48E7	3.86E7	3.86E7	3.86E7
Xe-137	3.78E7	9.07E7	3.78E7	3.78E7	3.78E7
Xe-138	3.52E7	7.74E7	3.52E7	3.52E7	3.52E7
Ar-41	3.79E7	7.90E7	3.79E7	3.79E7	3.79E7

(1) Efficiencies from Calculation Package ERS-SFL-86-026.[3.1.2.1]

ATTACHMENT C
Page 1 of 1
MODES OF GASEOUS RELEASE

Table 2.2-1
MODES OF GASEOUS RELEASE FROM BEAVER VALLEY SITE VENTS FOR IMPLEMENTATION OF 10 CFR 20 AND 10 CFR 50

RELEASE POINT	RELEASE MODE 1	RELEASE MODE 2	RELEASE MODE 3	RELEASE MODE 4
RP 1; VV-1, Auxiliary Building Vent[1]	Aux. Bldg. Ventilation	Containment Purge[3]	Same As Mode 1	Same As Mode 1
RP 2; CV-1, Rx Containment/SLCRS Vent[1]	Leakage Collection Exhaust	Same As Mode 1	Same As Mode 1 and Containment Purge[3]	Same As Mode 1
RP 3; PV-1/2, Gaseous Waste/Process Vent[2]	Main Cond. Air Ejector, Waste Gas, Containment Vacuum	Same As Mode 1	Same As Mode 1	Same As Mode 1 and Containment Purge
RP 4; VV-2 SLCRS Unfiltered Pathway[1]	Contiguous Areas	Containment Purge[3]	Same As Mode 1	Same As Mode 1
RP 5; CV-2, SLCRS Filtered Pathway Vent[1]	Aux. Bldg. Ventilation	Same As Mode 1	Same As Mode 1 and Containment Purge[3]	Same As Mode 1
RP 6; CB-2, Condensate Polishing Bldg Vent[1]	[4]	[4]	[4]	[4]
RP 7; WV-2, Waste Gas Storage Vault Vent[1]	[4]	[4]	[4]	[4]
RP 8; DV-2, Decontamination Bldg Vent[1]	[4]	[4]	[4]	[4]
RP 9; TV-2, Turbine Bldg Vent[1]	[4]	[4]	[4]	[4]

NOTE: For the purpose of implementing 10 CFR 50, batch discharges may use continuous meteorology since short term meteorology is used at the time of the annual report.

[1] Continuous ground level meteorology is applicable
[2] Continuous elevated meteorology is applicable
[3] Mode established by purge from one unit, all other release points remain same as Mode 1
[4] Not normally a radioactive release point

ATTACHMENT D
Page 1 of 2
RADIONUCLIDE MIX

TABLE 2.2-2a
BV-1 RADIONUCLIDE MIX FOR GASEOUS EFFLUENTS
(Ci/yr)

	RX CONTAINMENT/ SLCRS VENT	AUXILIARY BUILDING VENT	GASEOUS WASTE/PROCESS VENT		
NUCLIDE[2]	CONTAINMENT BUILDING[1] Long Term, And Short Term	AUXILIARY BUILDING VENTILATION Long Term	MAIN CONDENSER/ AIR EJECTOR Long Term	CONTAINMENT VACUUMM PUMPS[3] Long Term	GASEOUS WASTE SYSTEM Short Term
Kr-83m	2.2E-02	4.2E-01	2.7E-01	5.2E-03	0.0
Kr-85m	1.5E-01	1.9E+00	1.2E+00	5.5E-02	1.2E-02
Kr-85	6.1E+01	2.5E+00	1.6E+00	1.0E+01	2.3E+02
Kr-87	5.4E-02	1.3E+00	8.2E-01	1.1E-02	0.0
Kr-88	2.4E-01	3.8E+00	2.4E+00	7.0E-02	0.0
Kr-89	4.7E-04	1.2E-01	7.7E-02	4.3E-05	0.0
Xe-131m	7.4E-01	1.3E-01	8.0E-02	1.8E-01	8.3E-01
Xe-133m	8.9E-01	8.9E-01	5.6E-01	3.1E-01	0.0
Xe-133	8.9E+01	3.6E+01	2.3E+01	2.7E+01	8.2E+00
Xe-135m	4.5E-03	3.2E-01	2.0E-01	6.2E-04	0.0
Xe-135	7.0E-01	4.5E+00	2.8E+00	2.7E-01	0.0
Xe-137	1.0E-03	2.1E-01	1.3E-01	8.8E-05	0.0
Xe-138	1.5E-02	1.1E+00	6.6E-01	1.7E-03	0.0
I-131	1.2E-03	4.6E-02	2.1E-02	6.6E-03	0.0
I-132	0.0	0.0	0.0	3.5E-05	0.0
I-133	2.0E-04	6.7E-02	3.0E-02	1.2E-03	0.0
I-134	0.0	0.0	0.0	6.6E-06	0.0
I-135	0.0	0.0	0.0	2.0E-04	0.0
Co-58	7.5E-04	6.0E-02	0.0	2.2E-04	0.0
Co-60	3.4E-04	2.7E-02	0.0	1.0E-04	0.0
Mn-54	2.2E-04	1.8E-02	0.0	6.9E-05	0.0
Fe-59	7.5E-05	6.0E-03	0.0	2.2E-05	0.0
Sr-89	1.7E-05	1.3E-03	0.0	5.2E-06	0.0
Sr-90	3.0E-06	2.0E-04	0.0	9.2E-07	0.0
Cs-134	2.2E-04	1.8E-02	0.0	6.9E-05	0.0
Cs-137	3.8E-04	3.0E-02	0.0	1.2E-04	0.0
C-14	1.0E+00	0.0	0.0	0.0	7.0E+00
Ar-41	2.5E+01	0.0	0.0	0.0	0.0

(1) Containment can be purged via VV-1 (Auxiliary Building Vent), CV-1 (Rx Containment/SLCRS Vent), or PV-1/2 (Gaseous Waste/Process Vent)
(2) Source Term from BVPS-2UFSAR Table 11.3-1 (3.1.1.2)
(3) See Note (3) from ATTACHMENT A Table 2.1-1a (3.1.1.5) (3.1.1.8) (3.1.3.10)

ATTACHMENT D
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RADIONUCLIDE MIX

TABLE 2.2-2b
BV-2 RADIONUCLIDE MIX FOR GASEOUS EFFLUENTS
(Ci/yr)

	SLCRS UNFILTERED PATHWAY Long Term, And	SLCRS FILTERED PATHWAY	TURBINE BUILDING VENT	GASEOUS WASTE/PROCESS VENT		
NUCLIDE[2]	CONTAINMENT BUILDING[1] Short Term	AUXILIARY BUILDING VENTILATION Long Term	TURBINE BUILDING VENTILATION Long Term	MAIN CONDENSER/ AIR EJECTOR Long Term	CONTAINMENT VACUUM PUMPS[3] Long Term	GASEOUS WASTE SYSTEM Short Term
Kr-83m	4.0E-05	4.2E-01	3.9E-05	2.7E-01	3.7E-04	0.0
Kr-85m	1.4E-02	1.9E+00	1.7E-04	1.2E+00	3.9E-03	1.2E-02
Kr-85	6.1E+01	2.5E+00	2.3E-04	1.6E+00	7.2E-01	2.3E+02
Kr-87	5.3E-06	1.3E+00	1.1E-04	8.2E-01	7.8E-04	0.0
Kr-88	4.1E-03	3.8E+00	3.5E-04	2.4E+00	5.0E-03	0.0
Kr-89	0.0	1.2E-01	1.1E-05	7.7E-02	3.1E-06	0.0
Xe-131m	7.2E-01	1.3E-01	1.2E-05	8.0E-02	1.3E-02	8.3E-01
Xe-133m	7.6E-01	8.9E-01	8.1E-05	5.6E-01	2.2E-02	0.0
Xe-133	8.4E+01	3.6E+01	3.4E-03	2.3E+01	1.9E-00	8.2E+00
Xe-135m	0.0	3.2E-01	2.9E-05	2.0E-01	4.4E-05	0.0
Xe-135	2.4E-01	4.5E+00	4.2E-04	2.8E+00	1.9E-02	0.0
Xe-137	0.0	2.1E-01	2.1E-05	1.3E-01	6.3E-06	0.0
Xe-138	0.0	1.1E+00	9.7E-05	6.6E-01	1.2E-04	0.0
I-131	2.7E-05	4.6E-03	6.5E-04	2.1E-02	4.7E-04	0.0
I-132	0.0	0.0	0.0	0.0	2.5E-06	0.0
I-133	2.6E-06	6.7E-03	8.7E-04	3.0E-02	8.4E-05	0.0
I-134	0.0	0.0	0.0	0.0	4.7E-07	0.0
I-135	0.0	0.0	0.0	0.0	1.4E-05	0.0
Co-58	7.5E-02	6.0E-04	0.0	0.0	1.6E-05	0.0
Co-60	3.4E-02	2.7E-04	0.0	0.0	7.4E-06	0.0
Mn-54	2.2E-02	1.8E-04	0.0	0.0	4.9E-06	0.0
Fe-59	7.5E-03	6.0E-05	0.0	0.0	1.6E-06	0.0
Sr-89	1.7E-03	1.3E-05	0.0	0.0	3.7E-07	0.0
Sr-90	3.0E-04	2.0E-06	0.0	0.0	6.6E-08	0.0
Cs-134	2.2E-02	1.8E-04	0.0	0.0	4.9E-06	0.0
Cs-137	3.8E-02	3.0E-04	0.0	0.0	8.4E-06	0.0
C-14	1.0E+00	0.0	0.0	0.0	0.0	7.0E+00
Ar-41	2.5E+01	0.0	0.0	0.0	0.0	0.0

(1) Containment can be purged via VV-2 (SLCRS Unfiltered Pathway), CV-2 (SLCRS Filtered Pathway), or PV-1/2 (Gaseous Waste/Process Vent)
(2) Source Term from BVPS-2UFSAR Table 11.3-2(3.1.1.3)
(3) See Section 8.1.1.1

TABLE 2.2-3
DISTANCES OF LIMITING MAXIMUM INDIVIDUAL RECEPTORS TO RELEASE POINTS
FOR ANNUAL X/Q VALUES
(meters)

DOWNWIND SECTOR	SITE BOUNDARY*			VEGETABLE GARDEN		MILK COW		MILK GOAT		MEAT ANIMAL		RESIDENT	
	GROUND		ELEV	GROUND	ELEV	GROUND	ELEV	GROUND	ELEV	GROUND	ELEV	GROUND	ELEV
	(1)	(2)											
N	670	579	413	2,623	2,423	---	---	4,651	4,418	4,152	3,919	2,527	2,295
NNE	535	792	632	2,740	2,461	---	---	6,276	6,033	2,848	2,605	2,639	2,461
NE	490	442	327	724	901	7,741	7,526	20,760	20,545	7,741	7,526	708	790
ENE	490	448	394	1,674	1,658	---	---	6,824	6,671	---	---	708	1,562
E	545	546	551	1,979	1,922	7,065	6,998	4,265	4,200	4,265	4,200	756	1,922
ESE	575	607	672	1,577	1,619	---	---	2,865	2,899	1,577	1,619	1,577	1,650
SE	575	701	815	1,835	1,961	5,729	5,848	5,729	5,848	3,299	3,420	1,835	1,961
SSE	655	762	912	1,738	1,933	5,053	5,244	9,977	10,166	1,770	1,964	1,432	1,628
S	850	887	1,054	3,138	3,372	3,347	3,539	---	---	2,253	2,487	2,189	2,423
SSW	975	1,064	1,226	2,317	2,560	3,347	3,590	5,616	5,859	2,317	2,560	1,223	1,466
SW	1,435	1,439	1,574	2,221	2,439	---	---	2,993	3,210	2,414	2,632	2,221	2,439
WSW	595	561	660	2,301	2,463	5,182	5,341	---	---	2,446	2,608	2,301	2,463
W	685	640	681	3,556	3,635	5,118	5,195	---	---	4,088	4,166	3,556	3,635
WNW	810	701	676	3,605	3,590	4,538	4,521	22,529	22,507	3,605	3,590	3,605	3,590
NW	655	567	482	1,464	1,415	---	---	10,944	10,832	4,570	4,461	1,432	1,383
NNW	645	558	420	1,464	1,285	---	---	15,450	15,262	3,959	3,774	1,143	1,253

*Distances for ground releases are measured from the center point between the BV-1 and BV-2 Containment Buildings. Distances for elevated release are measured from the BV-1 Cooling Tower. Elevated release is applicable to PV-1/2. Ground release is applicable to all other release points.

(1) TV-2 and CB-2
(2) VV-1, CV-1, VV-2, CV-2, DV-2, WV-2

TABLE 2.2-4
CV-1 AND CV-2 ANNUAL AVERAGE, GROUND LEVEL,
X/Q VALUES FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS
(1E-7 sec/m^3)

	INDIVIDUAL RECEPTORS						DISTANCES TO THE CONTROL LOCATION, IN MILES								
DOWN-WIND SECTOR	SITE BOUND -ARY	VEGE-TABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESI-DENCE	0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	125.0	12.80	--	5.360	6.27	13.50	233.0	39.5	18.70	11.80	7.68	5.82	4.240	3.480	2.660	2.280
NNE	50.2	6.92	--	2.040	6.42	7.16	148.0	26.8	10.80	6.62	4.60	3.44	2.690	2.190	1.830	1.560
NE	102.0	47.40	1.200	0.265	1.20	49.10	120.0	21.6	11.60	6.99	4.81	3.55	2.370	1.910	1.450	1.230
ENE	85.8	12.50	--	0.124	--	42.20	103.0	18.4	9.55	5.70	4.14	3.04	2.340	1.880	1.260	1.060
E	54.5	6.16	0.807	1.910	1.91	32.60	89.5	15.7	6.08	3.65	2.49	1.83	1.300	1.040	0.859	0.726
ESE	31.1	6.92	--	3.010	6.92	6.92	59.1	10.5	5.16	3.10	1.95	1.43	1.020	0.815	0.612	0.517
SE	27.8	6.70	0.994	0.994	2.74	6.70	65.9	12.0	5.89	3.54	2.41	1.77	1.160	0.931	0.768	0.649
SSE	24.1	6.68	1.030	0.372	6.50	9.01	67.2	12.0	5.46	3.30	1.91	1.41	0.997	0.803	0.665	0.563
S	27.5	3.40	3.090	--	5.57	5.81	99.9	17.5	6.77	4.11	2.84	2.10	1.490	1.200	0.999	0.848
SSW	23.8	6.31	3.700	1.740	6.31	19.30	110.0	19.9	7.83	4.80	3.33	2.48	1.940	1.580	1.190	1.020
SW	22.3	13.90	--	9.050	12.30	13.90	160.0	29.2	16.10	9.94	5.85	4.37	3.430	2.790	2.110	1.800
WSW	163.0	19.30	5.720	--	17.70	19.30	283.0	49.8	23.50	14.60	10.30	7.72	5.690	4.650	3.620	3.090
W	278.0	15.70	9.540	--	13.00	15.70	615.0	103.0	49.00	31.00	15.40	11.70	9.320	7.660	6.460	5.550
WNW	487.0	40.70	30.100	1.810	40.70	40.70	1290.0	203.0	92.10	59.20	40.60	31.20	25.000	20.700	14.200	12.200
NW	924.0	194.00	--	8.660	40.50	200.00	1710.0	262.0	123.00	79.80	55.00	42.30	34.000	28.200	19.400	16.700
NNW	302.0	63.00	--	1.720	15.40	92.30	547.0	86.4	40.80	26.20	17.60	13.50	10.100	8.350	6.560	5.660

TABLE 2.2-5
VV-1 AND VV-2 ANNUAL AVERAGE, GROUND LEVEL,
X/Q VALUES FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS
(1E-7 sec/m^3)

	INDIVIDUAL RECEPTORS							DISTANCES TO THE CONTROL LOCATION, IN MILES								
DOWN-WIND SECTOR	SITE BOUND -ARY	VEGE-TABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESI-DENCE	0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	152.0	15.00	--	5.980	7.06	15.90	276.0	49.9	22.70	13.70	8.75	6.52	4.69	3.810	2.900	2.470
NNE	62.3	7.66	--	2.150	7.08	7.95	189.0	32.0	12.20	7.31	4.99	3.69	2.87	2.320	1.920	1.630
NE	132.0	57.90	1.240	0.269	1.24	60.20	156.0	24.8	12.70	7.51	5.09	3.73	2.47	1.980	1.500	1.270
ENE	110.0	13.60	--	1.270	--	50.40	135.0	20.6	10.20	6.01	4.31	3.14	2.41	1.930	1.290	1.080
E	67.8	6.66	0.828	1.990	1.99	38.80	116.0	17.7	6.57	3.86	2.61	1.90	1.34	1.070	0.883	0.774
ESE	38.0	7.64	--	3.200	7.64	7.64	76.7	11.9	5.59	3.29	2.05	1.49	1.05	0.842	0.630	0.531
SE	33.3	7.27	1.030	1.030	2.88	7.27	86.2	13.5	6.37	3.75	2.53	1.84	1.20	0.960	0.790	0.666
SSE	29.1	7.41	1.080	0.382	7.19	10.10	87.0	13.7	5.98	3.53	2.02	1.48	1.04	0.833	0.688	0.531
S	32.8	3.65	3.300	--	6.10	6.38	127.0	20.3	7.56	4.48	3.04	2.23	1.57	1.260	1.050	0.885
SSW	28.7	7.08	4.040	1.850	7.08	22.90	140.0	23.6	8.87	5.28	3.60	2.66	2.07	1.670	1.260	1.070
SW	26.2	15.70	--	9.980	13.80	15.70	204.0	34.8	18.40	11.40	6.38	4.71	3.66	2.960	2.230	1.900
WSW	201.0	22.40	6.230	--	20.40	22.40	347.0	61.3	27.70	16.60	11.40	8.49	6.19	5.020	3.880	3.300
W	345.0	18.00	10.600	--	14.70	18.00	715.0	132.0	60.30	36.50	17.70	13.20	10.40	8.440	7.060	6.040
WNW	598.0	48.60	35.000	1.920	48.60	48.60	1410.0	269.0	120.00	73.00	48.50	36.40	28.70	23.400	15.900	13.600
NW	1030.0	262.00	---	9.520	47.80	271.00	1820.0	350.0	164.00	100.00	66.60	50.10	39.50	32.300	21.900	18.800
NNW	345.0	83.40	--	1.840	18.10	121.00	601.0	114.0	52.80	32.20	21.00	15.80	11.60	9.460	7.360	6.310

TABLE 2.2-6
PV-1/2 ANNUAL AVERAGE, ELEVATED LEVEL, X/Q VALUES
FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS
(1E-7 sec/m^3)

	INDIVIDUAL RECEPTORS						DISTANCES TO THE CONTROL LOCATION, IN MILES								
DOWN-WIND SECTOR	SITE BOUND -ARY	VEGE-TABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESI-DENCE	0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	0.0082	6.720	--	1.910	2.27	6.790	0.0289	23.1000	8.2700	5.32	2.56	1.91	1.480	1.200	0.996	0.846
NNE	0.0280	6.690	--	1.430	6.14	6.890	0.0175	14.5000	6.9800	5.47	3.27	2.69	1.770	1.430	1.290	1.100
NE	0.0110	.074	1.610	0.350	1.61	0.055	0.0069	0.1160	.2300	7.10	5.38	3.68	2.880	2.090	1.880	1.570
ENE	0.0110	9.090	--	1.770	--	0.525	0.0135	0.3310	7.2800	6.02	4.75	3.22	2.620	2.030	1.710	1.100
E	0.0360	8.300	1.240	2.870	2.87	8.300	0.0124	17.1000	7.8600	6.20	3.67	2.83	2.190	1.730	1.280	1.200
ESE	0.0420	11.600	--	4.570	11.60	11.200	0.0208	12.7000	8.1400	4.78	3.00	2.20	1.360	1.160	0.830	0.737
SE	0.0750	7.890	1.230	1.230	3.05	7.890	0.4770	7.4000	7.5700	4.45	2.79	2.05	1.460	1.180	0.811	0.686
SSE	0.2060	7.390	1.160	0.357	7.20	9.770	0.3030	9.4400	6.9300	4.06	2.58	1.89	1.170	0.937	0.646	0.546
S	5.740	3.760	3.490	--	6.06	6.310	0.7960	8.5100	8.4900	4.98	3.37	2.47	1.380	1.110	0.774	0.655
SSW	7.640	3.610	2.140	0.872	3.61	5.820	26.1000	9.1000	4.0300	3.11	2.11	1.56	1.030	0.834	0.807	0.684
SW	6.500	3.900	--	2.560	3.47	3.900	36.1000	15.9000	4.9300	3.12	1.77	1.57	1.201	1.060	1.150	0.977
WSW	0.126	4.350	1.420	--	3.98	4.350	0.3870	17.8000	4.9000	3.53	2.36	1.64	1.460	1.210	0.920	0.781
W	0.029	2.490	0.764	--	2.02	2.490	0.0147	8.7200	6.2300	3.68	2.50	1.84	0.741	1.120	0.851	0.795
WNW	0.033	2.530	1.780	0.163	2.53	2.530	0.0202	0.0549	0.0809	3.07	2.50	1.84	1.110	0.686	0.791	0.731
NW	0.007	0.074	--	0.305	1.67	0.073	0.0084	0.0650	0.1170	3.66	2.30	1.69	1.210	0.903	0.804	0.683
NNW	0.008	6.460	--	0.224	1.81	6.590	0.0135	6.7800	5.0200	2.96	1.93	1.49	1.050	0.849	0.705	0.599

*Elevated release X/Q value at site boundary location where ground level release X/Qs maximize.

TABLE 2.2-7
TV-2 ANNUAL AVERAGE, GROUND LEVEL, X/Q VALUES
FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS
(1E-7 sec/m^3)

	INDIVIDUAL RECEPTORS							DISTANCES TO THE CONTROL LOCATION, IN MILES								
DOWN-WIND SECTOR	SITE BOUND -ARY	VEGE-TABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESI-DENCE	0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	105.0	14.00	--	5.740	6.74	14.80	244.0	42.6	20.50	12.70	8.18	6.15	4.45	3.640	2.770	2.380
NNE	102.0	7.37	--	2.130	6.83	7.64	161.0	28.8	11.40	6.94	4.79	3.56	2.78	2.250	1.870	1.590
NE	96.6	51.90	1.230	0.268	1.23	53.80	132.0	23.0	12.10	7.24	4.95	3.64	2.42	1.950	1.480	1.250
ENE	84.1	13.20	--	1.280	--	46.30	115.0	19.4	9.89	5.85	4.23	3.09	2.38	1.900	1.270	1.070
E	60.7	6.49	.829	1.980	1.98	35.70	99.2	16.6	6.32	3.75	2.55	1.87	1.32	1.060	0.871	0.735
ESE	37.1	7.25	--	3.100	7.25	7.25	65.8	11.1	5.36	3.19	2.00	1.46	1.03	0.829	0.621	0.524
SE	41.8	7.06	1.020	1.020	2.85	7.06	73.5	12.6	6.12	3.64	2.47	1.81	1.18	0.945	0.779	0.658
SSE	34.0	7.16	1.070	0.384	6.96	9.69	74.2	12.7	5.71	3.41	1.97	1.45	1.02	0.818	0.676	0.572
S	32.7	3.64	3.310	--	6.00	6.27	109.0	18.6	7.13	4.29	2.94	2.17	1.53	1.230	1.020	0.866
SSW	29.7	6.73	3.890	1.800	6.73	20.90	120.0	21.3	8.31	5.03	3.46	2.57	2.00	1.620	1.230	1.040
SW	24.1	14.80	--	9.550	13.10	14.80	174.0	31.2	17.20	10.40	6.10	4.54	3.54	2.870	2.170	1.850
WSW	159.0	20.80	6.010	--	19.10	20.80	301.0	53.6	25.30	15.60	10.80	8.09	5.93	4.830	3.750	3.200
W	264.0	16.90	10.100	--	13.90	16.90	636.0	111.0	53.90	33.50	16.50	12.40	9.82	8.040	6.760	5.790
WNW	404.0	44.50	32.500	1.870	44.50	44.50	1310.0	218.0	104.00	65.40	44.20	33.60	26.70	22.000	15.000	12.900
NW	735.0	216.00	--	9.100	43.90	222.00	1720.0	279.0	140.00	88.80	60.30	45.90	36.60	30.100	20.600	17.700
NNW	247.0	71.00	--	1.820	17.00	99.40	557.0	924.0	45.90	28.90	19.20	14.60	10.80	8.880	6.950	5.980

ATTACHMENT F
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0-5 MILE DISPERSION PARAMETERS

TABLE 2.2-8

DV-2 ANNUAL AVERAGE, GROUND LEVEL, X/Q VALUES
FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS
(1E-7 sec/m^3)

Same as Table 2.2-4

ATTACHMENT F
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0-5 MILE DISPERSION PARAMETERS

TABLE 2.2-9

WV-2 ANNUAL AVERAGE, GROUND LEVEL, X/Q VALUES
FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS
(1E-7 sec/m^3)

Same as Table 2.2-4

ATTACHMENT F
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0-5 MILE DISPERSION PARAMETERS

TABLE 2.2-10

CB-2 ANNUAL AVERAGE, GROUND LEVEL, X/Q VALUES
FOR CONTINUOUS RELEASES, SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E, TABLE 2.2-3), AND SELECTED CONTROL LOCATIONS

Same as Table 2.2-7

ATTACHMENT G
Page 1 of 2
NOBLE GAS DOSE FACTORS AND DOSE PARAMETERS

TABLE 2.2-11

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS

NUCLIDE[1]	K_i TOTAL BODY DOSE FACTOR mrem/yr Per uCi/m^3	L_i SKIN DOSE FACTOR mrem/yr Per uCi/m^3	M_i GAMMA AIR DOSE FACTOR mrad/yr Per uCi/m^3	N_i BETA AIR DOSE FACTOR mrad/yr Per uCi/m^3
Kr-83m	7.56E-02	--	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

(1) The listed dose factors are for radionuclides that may be detected in gaseous effluents.

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Page 2 of 2
NOBLE GAS DOSE FACTORS AND DOSE PARAMETERS

TABLE 2.2-12

DOSE PARAMETERS FOR FINITE ELEVATED PLUMES

NUCLIDE[4]	V_i[1] TOTAL BODY DOSE FACTOR mrem/yr Per uCi/sec	B_i[1],[2] GAMMA AIR DOSE FACTOR mrad/yr Per uCi/sec	M_i[3] TOTAL BODY DOSE FACTOR mrem/yr Per uCi/sec	B_i[3] GAMMA AIR DOSE FACTOR mrad/yr Per uCi/sec
Kr-83m	3.19E-10	1.75E-8	4.58E-8	3.96E-5
Kr-85m	7.81E-5	1.16E-4	4.70E-4	7.06E-4
Kr-85	1.55E-6	2.35E-6	5.54E-6	8.40E-6
Kr-87	5.13E-4	7.74E-4	1.45E-3	2.19E-3
Kr-88	1.39E-3	2.09E-3	4.09E-3	6.16E-3
Kr-89	7.99E-4	1.20E-3	1.25E-3	1.88E-3
Xe-131m	1.64E-5	2.47E-5	1.67E-4	3.09E-4
Xe-133m	1.38E-5	2.11E-5	1.32E-4	2.61E-4
Xe-133	1.05E-5	1.56E-4	1.54E-4	2.76E-4
Xe-135m	2.41E-4	3.66E-4	6.21E-4	9.50E-4
Xe-135	1.41E-4	2.12E-4	6.96E-4	1.05E-3
Xe-137	6.00E-5	9.05E-5	9.66E-5	1.46E-4
Xe-138	8.11E-4	1.22E-3	2.22E-3	3.34E-3
Ar-41	1.02E-3	1.53E-3	2.68E-3	4.02E-3

(1) V_i and B_i values used to implement Modes 1, 2, and 3 of Section 2.2.1 (10CFR20)

(2) B_i values used to implement Modes 1, 2, 3, and 4 of Section 2.3.1 (10CFR50)

(3) V_i and B_i values to implement Mode 4 of Section 2.2.1 (10CFR20) and to implement monitor setpoint determinations of Section 2.1.2 and 2.1.4

(4) The listed dose parameters are for radionuclides that may be detected in gaseous effluents.

ATTACHMENT H
Page 1 of 1
ORGAN DOSE PARAMETERS

Table 2.2-13

P_{iT} VALUES FOR A CHILD FOR THE BEAVER VALLEY SITE

(mrem/yr per uCi/cu meter)

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
2	C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
3	P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
4	Cr-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
5	Mn-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
6	Fe-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
7	Co-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04
8	Co-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
9	Co-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
10	Zn-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
11	Se-75	2.05E+04	1.50E+04	3.14E+04	1.15E+04	1.97E+04	7.45E+04	1.58E+04
12	Rb-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
13	Sr-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
14	Sr-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
15	Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
16	Zr-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
17	Nb-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
18	Nb-97	4.29E-01	7.70E-02	3.60E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+04
19	Mo-99	0.00E+00	1.72E+02	4.26E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
20	Tc-99m	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03
21	Ru-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
22	Ru-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
23	Ag-110m	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
24	Sb-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05
25	Sb-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04
26	Sb-126	6.36E+03	9.69E+01	2.28E+03	3.70E+01	0.00E+00	1.06E+06	2.10E+05
27	Te-127m	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
28	Te-129m	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
29	I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
30	I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
31	Cs-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
32	Cs-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
33	Cs-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
34	Ba-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
35	La-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
36	Ce-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
37	Ce-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05

Calculated per ODCM equation 2.2-13

ATTACHMENT I
Page 1 of 1
MODES OF GASEOUS RELEASE

TABLE 2.3-1

MODES OF GASEOUS RELEASE FROM BEAVER VALLEY SITE VENTS FOR IMPLEMENTATION OF 10 CFR 20 AND 10 CFR 50

RELEASE POINT	RELEASE MODE 1	RELEASE MODE 2	RELEASE MODE 3	RELEASE MODE 4
RP 1; VV-1, Auxiliary Building Vent[1]	Aux. Bldg. Ventilation	Containment Purge[3]	Same As Mode 1	Same As Mode 1
RP 2; CV-1, Rx Containment/SLCRS Vent[1]	Leakage Collection Exhaust	Same As Mode 1	Same As Mode 1 and Containment Purge[3]	Same As Mode 1
RP 3; PV-1/2, Gaseous Waste/Process Vent[2]	Main Cond. Air Ejector, Waste Gas, Containment Vacuum	Same As Mode 1	Same As Mode 1	Same As Mode 1 and Containment Purge
RP 4; VV-2 SLCRS Unfiltered Pathway[1]	Contiguous Areas	Containment Purge[3]	Same As Mode 1	Same As Mode 1
RP 5; CV-2, SLCRS Filtered Pathway[1]	Aux. Bldg. Ventilation	Same As Mode 1	Same As Mode 1 and Containment Purge[3]	Same As Mode 1
RP 6; CB-2, Condensate Polishing Bldg Vent[1]	[4]	[4]	[4]	[4]
RP 7; WV-2, Waste Gas Storage Vault Vent[1]	[4]	[4]	[4]	[4]
RP 8; DV-2, Decontamination Bldg Vent[1]	[4]	[4]	[4]	[4]
RP 9; TV-2, Turbine Bldg Vent[1]	[4]	[4]	[4]	[4]

NOTE: For the purpose of implementing 10 CFR 50, batch discharges may use continuous meteorology since short term meteorology is used at the time of the annual report.

[1] Continuous ground level meteorology is applicable
[2] Continuous elevated meteorology is applicable
[3] Mode established by purge from one unit, all other release points remain same as Mode 1
[4] Not normally a radioactive release point

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Table 2.3-2

R VALUES FOR BEAVER VALLEY SITE

(mrem/yr per uCi/cu meter)

Pathway = Inhalation
Age Group = Adult

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
2	C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03
3	P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
4	Cr-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
5	Mn-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
6	Fe-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
7	Co-57	0.00E+00	6.92E+02	6.71E+02	0.00E+00	0.00E+00	3.70E+05	3.14E+04
8	Co-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
9	Co-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
10	Zn-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
11	Se-75	4.44E+04	3.24E+04	6.78E+04	2.48E+04	4.26E+04	1.61E+05	3.42E+04
12	Rb-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
13	Sr-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
14	Sr-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
15	Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
16	Zr-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
17	Nb-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
18	Nb-97	2.22E-01	5.62E-02	2.05E-02	0.00E+00	6.54E-02	2.40E+03	2.42E+02
19	Mo-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05
20	Tc-99m	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03
21	Ru-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
22	Ru-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
23	Ag-110m	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
24	Sb-124	3.12E+04	5.89E+02	1.24E+04	7.55E+01	0.00E+00	2.48E+06	4.06E+05
25	Sb-125	5.34E+04	5.95E+02	1.26E+04	5.40E+01	0.00E+00	1.74E+06	1.01E+05
26	Sb-126	3.60E+03	7.30E+01	1.30E+03	2.20E+01	0.00E+00	7.66E+05	4.81E+05
27	Te-127m	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
28	Te-129m	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
29	I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
30	I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
31	Cs-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
32	Cs-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
33	Cs-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
34	Ba-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
35	La-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05
36	Ce-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
37	Ce-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05

Calculated per ODCM equation 2.3-22

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P&I ORGAN DOSE FACTORS

Table 2.3-3

R VALUES FOR BEAVER VALLEY SITE

(mrem/yr per uCi/cu meter)

Pathway = Inhalation
Age Group = Teen

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
2	C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03
3	P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
4	Cr-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
5	Mn-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
6	Fe-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
7	Co-57	0.00E+00	9.44E+02	9.20E+02	0.00E+00	0.00E+00	5.86E+05	3.14E+04
8	Co-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
9	Co-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
10	Zn-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
11	Se-75	4.44E+04	3.24E+04	6.78E+04	2.48E+04	4.26E+04	1.61E+05	3.42E+04
12	Rb-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
13	Sr-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
14	Sr-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
15	Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
16	Zr-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
17	Nb-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
18	Nb-97	3.14E-01	7.78E-02	2.84E-02	0.00E+00	9.12E-02	3.93E+03	2.17E+03
19	Mo-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05
20	Tc-99m	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03
21	Ru-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
22	Ru-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
23	Ag-110m	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
24	Sb-124	4.30E+04	7.94E+02	1.68E+04	9.76E+01	0.00E+00	3.34E+06	3.98E+05
25	Sb-125	7.38E+04	8.08E+02	1.72E+04	7.04E+01	0.00E+00	2.74E+06	9.92E+04
26	Sb-126	4.95E+03	1.02E+02	1.78E+03	2.80E+01	0.00E+00	1.24E+06	4.81E+05
27	Te-127m	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05
28	Te-129m	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
29	I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
30	I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
31	Cs-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
32	Cs-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
33	Cs-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
34	Ba-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
35	La-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05
36	Ce-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
37	Ce-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05

Calculated per ODCM equation 2.3-22

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P&I ORGAN DOSE FACTORS

Table 2.3-4

R VALUES FOR BEAVER VALLEY SITE

(mrem/yr per uCi/cu meter)

Pathway = Inhalation
Age Group = Child

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
2	C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
3	P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
4	Cr-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
5	Mn-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
6	Fe-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
7	Co-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04
8	Co-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
9	Co-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
10	Zn-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
11	Se-75	2.05E+04	1.50E+04	3.14E+04	1.15E+04	1.97E+04	7.45E+04	1.58E+04
12	Rb-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
13	Sr-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
14	Sr-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
15	Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
16	Zr-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
17	Nb-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
18	Nb-97	4.29E-01	7.70E-02	3.60E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+04
19	Mo-99	0.00E+00	1.72E+02	4.26E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
20	Tc-99m	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03
21	Ru-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
22	Ru-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
23	Ag-110m	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
24	Sb-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05
25	Sb-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04
26	Sb-126	6.36E+03	9.69E+01	2.28E+03	3.70E+01	0.00E+00	1.06E+06	2.10E+05
27	Te-127m	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
28	Te-129m	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
29	I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
30	I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
31	Cs-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
32	Cs-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
33	Cs-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
34	Ba-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
35	La-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
36	Ce-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
37	Ce-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05

Calculated per ODCM equation 2.3-22

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P&I ORGAN DOSE FACTORS

Table 2.3-5

R VALUES FOR BEAVER VALLEY SITE

(mrem/yr per uCi/cu meter)

Pathway = Inhalation
Age Group = Infant

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
2	C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03
3	P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
4	Cr-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
5	Mn-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
6	Fe-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
7	Co-57	0.00E+00	6.51E+02	6.41E+02	0.00E+00	0.00E+00	3.79E+05	4.86E+03
8	Co-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
9	Co-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
10	Zn-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
11	Se-75	7.77E+03	5.67E+03	1.19E+04	4.35E+03	7.46E+03	2.82E+04	5.98E+03
12	Rb-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
13	Sr-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
14	Sr-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
15	Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
16	Zr-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
17	Nb-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
18	Nb-97	3.42E-01	7.29E-02	2.63E-02	0.00E+00	5.70E-02	3.32E+03	2.69E+04
19	Mo-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04
20	Tc-99m	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03
21	Ru-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
22	Ru-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
23	Ag-110m	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
24	Sb-124	3.79E+04	5.56E+02	1.20E+04	1.01E+02	0.00E+00	2.65E+06	5.91E+04
25	Sb-125	5.17E+04	4.77E+02	1.09E+04	6.23E+01	0.00E+00	1.64E+06	1.47E+04
26	Sb-126	4.31E+03	8.41E+01	1.55E+03	3.29E+01	0.00E+00	9.63E+05	7.46E+04
27	Te-127m	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
28	Te-129m	1.41E+04	6.09E+03	2.23E+03	4.21E+03	3.18E+04	1.68E+06	6.90E+04
29	I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
30	I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
31	Cs-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
32	Cs-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
33	Cs-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
34	Ba-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
35	La-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04
36	Ce-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
37	Ce-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05

Calculated per ODCM equation 2.3-22

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P&I ORGAN DOSE FACTORS

Table 2.3-6

R VALUES FOR BEAVER VALLEY SITE

(sq meter-mrem/yr per uCi/sec)

Pathway = Ground

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	Cr-51	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
5	Mn-54	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09
6	Fe-59	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08
7	Co-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	Co-58	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08
9	Co-60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10
10	Zn-65	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08
11	Se-75	4.51E+08	4.51E+08	4.51E+08	4.51E+08	4.51E+08	4.51E+08	4.51E+08
12	Rb-86	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06
13	Sr-89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04
14	Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	Y-91	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06
16	Zr-95	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08
17	Nb-95	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08
18	Nb-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19	Mo-99	4.00E+06	4.00E+06	4.00E+06	4.00E+06	4.00E+06	4.00E+06	4.00E+06
20	Tc-99m	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05
21	Ru-103	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08
22	Ru-106	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08
23	Ag-110m	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	9.17E+04	9.17E+04	9.17E+04	9.17E+04	9.17E+04	9.17E+04	9.17E+04
28	Te-129m	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07
29	I-131	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07
30	I-133	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06
31	Cs-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09
32	Cs-136	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08
33	Cs-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10
34	Ba-140	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07
35	La-140	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07
36	Ce-141	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07
37	Ce-144	6.96E+07	6.96E+07	6.96E+07	6.96E+07	6.96E+07	6.96E+07	6.96E+07

Calculated per ODCM equation 2.3-23

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P&I ORGAN DOSE FACTORS

Table 2.3-7

R VALUES FOR BEAVER VALLEY SITE
(sq meter-mrem/yr per uCi/sec)

Pathway = Vegetation
Age Group = Adult

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
2	C-14	8.97E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05
3	P-32	1.40E+09	8.74E+07	5.43E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08
4	Cr-51	0.00E+00	0.00E+00	4.64E+04	2.78E+04	1.02E+04	6.16E+04	1.17E+07
5	Mn-54	0.00E+00	3.13E+08	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.59E+08
6	Fe-59	1.26E+08	2.96E+08	1.14E+08	0.00E+00	0.00E+00	8.28E+07	9.88E+08
7	Co-57	0.00E+00	1.17E+07	1.95E+07	0.00E+00	0.00E+00	0.00E+00	2.97E+08
8	Co-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
9	Co-60	0.00E+00	1.67E+08	3.69E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
10	Zn-65	3.17E+08	1.01E+09	4.56E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
11	Se-75	4.91E+08	3.11E+08	6.16E+08	2.68E+08	4.55E+08	3.93E+08	4.14E+08
12	Rb-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.33E+07
13	Sr-89	9.97E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
14	Sr-90	6.05E+11	0.00E+00	1.48E+11	0.00E+00	0.00E+00	0.00E+00	1.75E+10
15	Y-91	5.11E+06	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.81E+09
16	Zr-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
17	Nb-95	1.42E+05	7.92E+04	4.26E+04	0.00E+00	7.83E+04	0.00E+00	4.81E+08
18	Nb-97	2.16E-06	5.46E-07	1.99E-07	0.00E+00	6.37E-07	0.00E+00	2.02E-03
19	Mo-99	0.00E+00	6.15E+06	1.17E+06	0.00E+00	1.39E+07	0.00E+00	1.43E+07
20	Tc-99m	3.10E+00	8.77E+00	1.12E+02	0.00E+00	1.33E+02	4.30E+00	5.19E+03
21	Ru-103	4.77E+06	0.00E+00	2.06E+06	0.00E+00	1.82E+07	0.00E+00	5.57E+08
22	Ru-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
23	Ag-110m	1.05E+07	9.75E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
24	Sb-124	1.04E+08	1.96E+06	4.11E+07	2.51E+05	0.00E+00	8.07E+07	2.94E+09
25	Sb-125	1.37E+08	1.53E+06	3.25E+07	1.39E+05	0.00E+00	1.05E+08	1.50E+09
26	Sb-126	7.01E+06	1.43E+05	2.53E+06	4.29E+04	0.00E+00	4.30E+06	5.73E+08
27	Te-127m	3.49E+08	1.25E+08	4.26E+07	8.92E+07	1.42E+09	0.00E+00	1.17E+09
28	Te-129m	2.51E+08	9.38E+07	3.98E+07	8.64E+07	1.05E+09	0.00E+00	1.27E+09
29	I-131	8.08E+07	1.16E+08	6.62E+07	3.79E+10	1.98E+08	0.00E+00	3.05E+07
30	I-133	2.09E+06	3.63E+06	1.11E+06	5.33E+08	6.33E+06	0.00E+00	3.26E+06
31	Cs-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
32	Cs-136	4.27E+07	1.69E+08	1.21E+08	0.00E+00	9.38E+07	1.29E+07	1.91E+07
33	Cs-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
34	Ba-140	1.29E+08	1.61E+05	8.42E+06	0.00E+00	5.49E+04	9.24E+04	2.65E+08
35	La-140	1.98E+03	9.97E+02	2.63E+02	0.00E+00	0.00E+00	0.00E+00	7.32E+07
36	Ce-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.19E+04	0.00E+00	5.10E+08
37	Ce-144	3.29E+07	1.38E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-26
H-3 calculated per ODCM equation 2.3-29
C-14 calculated per ODCM equation 2.3-34 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-8

R VALUES FOR BEAVER VALLEY SITE

(sq m eter-m rem /yr per uCi/sec)

Pathway = Vegetation
Age Group = Teen

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
2	C-14	1.45E+06	2.91E+05	2.91E+05	2.91E+05	2.91E+05	2.91E+05	2.91E+05
3	P-32	1.61E+09	9.98E+07	6.24E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08
4	Cr-51	0.00E+00	0.00E+00	6.17E+04	3.43E+04	1.35E+04	8.81E+04	1.04E+07
5	Mn-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
6	Fe-59	1.79E+08	4.19E+08	1.62E+08	0.00E+00	0.00E+00	1.32E+08	9.90E+08
7	Co-57	0.00E+00	1.79E+07	3.00E+07	0.00E+00	0.00E+00	0.00E+00	3.33E+08
8	Co-58	0.00E+00	4.36E+07	1.00E+08	0.00E+00	0.00E+00	0.00E+00	6.01E+08
9	Co-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
10	Zn-65	4.24E+08	1.47E+09	6.87E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
11	Se-75	5.94E+08	3.77E+08	7.47E+08	3.24E+08	5.51E+08	4.77E+08	5.02E+08
12	Rb-86	0.00E+00	2.74E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	4.05E+07
13	Sr-89	1.51E+10	0.00E+00	4.34E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
14	Sr-90	7.51E+11	0.00E+00	1.85E+11	0.00E+00	0.00E+00	0.00E+00	2.11E+10
15	Y-91	7.84E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.21E+09
16	Zr-95	1.72E+06	5.43E+05	3.74E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
17	Nb-95	1.92E+05	1.07E+05	5.87E+04	0.00E+00	1.03E+05	0.00E+00	4.56E+08
18	Nb-97	2.00E-06	4.97E-07	1.81E-07	0.00E+00	5.81E-07	0.00E+00	1.19E-02
19	Mo-99	0.00E+00	5.65E+06	1.08E+06	0.00E+00	1.29E+07	0.00E+00	1.01E+07
20	Tc-99m	2.74E+00	7.64E+00	9.90E+01	0.00E+00	1.14E+02	4.24E+00	5.02E+03
21	Ru-103	6.82E+06	0.00E+00	2.92E+06	0.00E+00	2.41E+07	0.00E+00	5.70E+08
22	Ru-106	2.38E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
23	Ag-110m	1.52E+07	1.43E+07	8.72E+06	0.00E+00	2.74E+07	0.00E+00	4.03E+09
24	Sb-124	1.54E+08	2.84E+06	6.02E+07	3.50E+05	0.00E+00	1.35E+08	3.11E+09
25	Sb-125	2.14E+08	2.34E+06	5.01E+07	2.05E+05	0.00E+00	1.88E+08	1.67E+09
26	Sb-126	7.37E+06	1.51E+05	2.65E+06	4.17E+04	0.00E+00	5.28E+06	4.36E+08
27	Te-127m	5.52E+08	1.96E+08	6.56E+07	1.31E+08	2.24E+09	0.00E+00	1.37E+09
28	Te-129m	3.62E+08	1.34E+08	5.73E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
29	I-131	7.69E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
30	I-133	1.94E+06	3.29E+06	1.00E+06	4.59E+08	5.77E+06	0.00E+00	2.49E+06
31	Cs-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
32	Cs-136	4.38E+07	1.72E+08	1.16E+08	0.00E+00	9.37E+07	1.48E+07	1.39E+07
33	Cs-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
34	Ba-140	1.38E+08	1.69E+05	8.90E+06	0.00E+00	5.74E+04	1.14E+05	2.13E+08
35	La-140	1.81E+03	8.88E+02	2.36E+02	0.00E+00	0.00E+00	0.00E+00	5.10E+07
36	Ce-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.90E+04	0.00E+00	5.41E+08
37	Ce-144	5.27E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-26
H-3 calculated per ODCM equation 2.3-29
C-14 calculated per ODCM equation 2.3-34 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-9

R VALUES FOR BEAVER VALLEY SITE

(sq meter-mrem/yr per uCi/sec)

Pathway = Vegetation
Age Group = Child

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03
2	C-14	3.50E+06	7.01E+05	7.01E+05	7.01E+05	7.01E+05	7.01E+05	7.01E+05
3	P-32	3.37E+09	1.58E+08	1.30E+08	0.00E+00	0.00E+00	0.00E+00	9.32E+07
4	Cr-51	0.00E+00	0.00E+00	1.17E+05	6.50E+04	1.78E+04	1.19E+05	6.21E+06
5	Mn-54	0.00E+00	6.65E+08	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
6	Fe-59	3.98E+08	6.43E+08	3.20E+08	0.00E+00	0.00E+00	1.87E+08	6.70E+08
7	Co-57	0.00E+00	2.99E+07	6.04E+07	0.00E+00	0.00E+00	0.00E+00	2.45E+08
8	Co-58	0.00E+00	6.44E+07	1.97E+08	0.00E+00	0.00E+00	0.00E+00	3.76E+08
9	Co-60	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
10	Zn-65	8.13E+08	2.17E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
11	Se-75	4.91E+08	3.11E+08	6.16E+08	2.68E+08	4.55E+08	3.93E+08	4.14E+08
12	Rb-86	0.00E+00	4.52E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.91E+07
13	Sr-89	3.60E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
14	Sr-90	1.24E+12	0.00E+00	3.15E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
15	Y-91	1.86E+07	0.00E+00	4.99E+05	0.00E+00	0.00E+00	0.00E+00	2.48E+09
16	Zr-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.85E+08
17	Nb-95	4.11E+05	1.60E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.96E+08
18	Nb-97	3.65E-06	6.59E-07	3.08E-07	0.00E+00	7.31E-07	0.00E+00	2.03E-01
19	Mo-99	0.00E+00	7.71E+06	1.91E+06	0.00E+00	1.65E+07	0.00E+00	6.38E+06
20	Tc-99m	4.71E+00	9.24E+00	1.53E+02	0.00E+00	1.34E+02	4.69E+00	5.26E+03
21	Ru-103	1.53E+07	0.00E+00	5.90E+06	0.00E+00	3.86E+07	0.00E+00	3.97E+08
22	Ru-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
23	Ag-110m	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
24	Sb-124	3.52E+08	4.57E+06	1.23E+08	7.77E+05	0.00E+00	1.95E+08	2.20E+09
25	Sb-125	4.99E+08	3.85E+06	1.05E+08	4.63E+05	0.00E+00	2.78E+08	1.19E+09
26	Sb-126	1.39E+07	2.12E+05	4.98E+06	8.13E+04	0.00E+00	6.62E+06	2.80E+08
27	Te-127m	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
28	Te-129m	8.41E+08	2.35E+08	1.31E+08	2.71E+08	2.47E+09	0.00E+00	1.03E+09
29	I-131	1.43E+08	1.44E+08	8.17E+07	4.76E+10	2.36E+08	0.00E+00	1.28E+07
30	I-133	3.53E+06	4.37E+06	1.65E+06	8.12E+08	7.28E+06	0.00E+00	1.76E+06
31	Cs-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
32	Cs-136	8.24E+07	2.27E+08	1.47E+08	0.00E+00	1.21E+08	1.80E+07	7.96E+06
33	Cs-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
34	Ba-140	2.77E+08	2.42E+07	1.62E+07	0.00E+00	7.89E+04	1.45E+05	1.40E+08
35	La-140	3.25E+03	1.13E+03	3.83E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+07
36	Ce-141	6.56E+05	3.27E+05	4.86E+05	0.00E+00	1.43E+05	0.00E+00	4.08E+08
37	Ce-144	1.27E+08	3.98E+07	6.78E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-26
H-3 calculated per ODCM equation 2.3-29
C-14 calculated per ODCM equation 2.3-34 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-10

R VALUES FOR BEAVER VALLEY SITE

(sq meter-mrem/yr per uCi/sec)

Pathway = Meat
Age Group = Adult

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02
2	C-14	3.33E+05	6.66E+04	6.66E+04	6.66E+04	6.66E+04	6.66E+04	6.66E+04
3	P-32	3.95E+09	2.46E+08	1.53E+08	0.00E+00	0.00E+00	0.00E+00	4.44E+08
4	Cr-51	0.00E+00	0.00E+00	5.86E+03	3.50E+03	1.29E+03	7.78E+03	1.47E+06
5	Mn-54	0.00E+00	6.49E+06	1.24E+06	0.00E+00	1.93E+06	0.00E+00	1.99E+07
6	Fe-59	2.14E+08	5.04E+08	1.93E+08	0.00E+00	0.00E+00	1.41E+08	1.68E+09
7	Co-57	0.00E+00	4.01E+06	6.66E+06	0.00E+00	0.00E+00	0.00E+00	1.02E+08
8	Co-58	0.00E+00	1.42E+07	3.18E+07	0.00E+00	0.00E+00	0.00E+00	2.87E+08
9	Co-60	0.00E+00	5.12E+07	1.13E+08	0.00E+00	0.00E+00	0.00E+00	9.61E+08
10	Zn-65	2.54E+08	8.09E+08	3.66E+08	0.00E+00	5.41E+08	0.00E+00	5.10E+08
11	Se-75	1.15E+08	7.27E+07	1.44E+08	6.25E+07	1.06E+08	9.18E+07	9.67E+07
12	Rb-86	0.00E+00	4.11E+08	1.92E+08	0.00E+00	0.00E+00	0.00E+00	8.11E+07
13	Sr-89	2.41E+08	0.00E+00	6.92E+06	0.00E+00	0.00E+00	0.00E+00	3.87E+07
14	Sr-90	8.41E+09	0.00E+00	2.06E+09	0.00E+00	0.00E+00	0.00E+00	2.43E+08
15	Y-91	8.94E+05	0.00E+00	2.39E+04	0.00E+00	0.00E+00	0.00E+00	4.92E+08
16	Zr-95	1.47E+06	4.71E+05	3.19E+05	0.00E+00	7.39E+05	0.00E+00	1.49E+09
17	Nb-95	1.89E+06	1.05E+06	5.64E+05	0.00E+00	1.04E+06	0.00E+00	6.37E+09
18	Nb-97	5.32E-119	1.34E-119	4.91E-120	0.00E+00	1.57E-119	0.00E+00	4.96E-116
19	Mo-99	0.00E+00	8.51E+04	1.62E+04	0.00E+00	1.93E+05	0.00E+00	1.97E+05
20	Tc-99m	3.83E-21	1.08E-20	1.38E-19	0.00E+00	1.64E-19	5.30E-21	6.40E-18
21	Ru-103	8.57E+07	0.00E+00	3.69E+07	0.00E+00	3.27E+08	0.00E+00	1.00E+10
22	Ru-106	1.97E+09	0.00E+00	2.49E+08	0.00E+00	3.80E+09	0.00E+00	1.27E+11
23	Ag-110m	4.77E+06	4.41E+06	2.62E+06	0.00E+00	8.67E+06	0.00E+00	1.80E+09
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	8.38E+08	3.00E+08	1.02E+08	2.14E+08	3.40E+09	0.00E+00	2.81E+09
28	Te-129m	9.33E+08	3.48E+08	1.48E+08	3.21E+08	3.89E+09	0.00E+00	4.70E+09
29	I-131	9.13E+06	1.31E+07	7.48E+06	4.28E+09	2.24E+07	0.00E+00	3.45E+06
30	I-133	3.12E-01	5.42E-01	1.65E-01	7.96E+01	9.46E-01	0.00E+00	4.87E-01
31	Cs-134	4.53E+08	1.08E+09	8.81E+08	0.00E+00	3.49E+08	1.16E+08	1.89E+07
32	Cs-136	1.02E+07	4.04E+07	2.91E+07	0.00E+00	2.25E+07	3.08E+06	4.59E+06
33	Cs-137	5.90E+08	8.06E+08	5.28E+08	0.00E+00	2.74E+08	9.10E+07	1.56E+07
34	Ba-140	2.44E+07	3.06E+04	1.60E+06	0.00E+00	1.04E+04	1.75E+04	5.02E+07
35	La-140	3.16E-02	1.59E-02	4.21E-03	0.00E+00	0.00E+00	0.00E+00	1.17E+03
36	Ce-141	1.16E+04	7.83E+03	8.88E+02	0.00E+00	3.64E+03	0.00E+00	2.99E+07
37	Ce-144	1.03E+06	4.32E+05	5.55E+04	0.00E+00	2.56E+05	0.00E+00	3.50E+08

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-25
H-3 calculated per ODCM equation 2.3-30
C-14 calculated per ODCM equation 2.3-33 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-11

R VALUES FOR BEAVER VALLEY SITE

(sq meter-mrem/yr per uCi/sec)

Pathway = Meat
Age Group = Teen

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02
2	C-14	2.81E+05	5.62E+04	5.62E+04	5.62E+04	5.62E+04	5.62E+04	5.62E+04
3	P-32	3.34E+09	2.07E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	2.80E+08
4	Cr-51	0.00E+00	0.00E+00	4.69E+03	2.60E+03	1.03E+03	6.69E+03	7.88E+05
5	Mn-54	0.00E+00	4.95E+06	9.81E+05	0.00E+00	1.48E+06	0.00E+00	1.01E+07
6	Fe-59	1.71E+08	4.00E+08	1.54E+08	0.00E+00	0.00E+00	1.26E+08	9.45E+08
7	Co-57	0.00E+00	3.22E+06	5.40E+06	0.00E+00	0.00E+00	0.00E+00	6.01E+07
8	Co-58	0.00E+00	1.09E+07	2.52E+07	0.00E+00	0.00E+00	0.00E+00	1.51E+08
9	Co-60	0.00E+00	3.97E+07	8.95E+07	0.00E+00	0.00E+00	0.00E+00	5.17E+08
10	Zn-65	1.79E+08	6.21E+08	2.90E+08	0.00E+00	3.97E+08	0.00E+00	2.63E+08
11	Se-75	7.69E+07	4.89E+07	9.66E+07	4.20E+07	7.14E+07	6.17E+07	6.50E+07
12	Rb-86	0.00E+00	3.43E+08	1.61E+08	0.00E+00	0.00E+00	0.00E+00	5.08E+07
13	Sr-89	2.03E+08	0.00E+00	5.83E+06	0.00E+00	0.00E+00	0.00E+00	2.42E+07
14	Sr-90	5.44E+09	0.00E+00	1.34E+09	0.00E+00	0.00E+00	0.00E+00	1.53E+08
15	Y-91	7.53E+05	0.00E+00	2.02E+04	0.00E+00	0.00E+00	0.00E+00	3.09E+08
16	Zr-95	1.18E+06	3.71E+05	2.55E+05	0.00E+00	5.45E+05	0.00E+00	8.56E+08
17	Nb-95	1.47E+06	8.17E+05	4.50E+05	0.00E+00	7.92E+05	0.00E+00	3.49E+09
18	Nb-97	4.44E-119	1.10E-119	4.02E-120	0.00E+00	1.29E-119	0.00E+00	2.63E-115
19	Mo-99	0.00E+00	7.03E+04	1.34E+04	0.00E+00	1.61E+05	0.00E+00	1.26E+05
20	Tc-99m	3.04E-21	8.48E-21	1.10E-19	0.00E+00	1.26E-19	4.71E-21	5.57E-18
21	Ru-103	6.98E+07	0.00E+00	2.98E+07	0.00E+00	2.46E+08	0.00E+00	5.83E+09
22	Ru-106	1.28E+09	0.00E+00	2.09E+08	0.00E+00	3.19E+09	0.00E+00	7.94E+10
23	Ag-110m	3.61E+06	3.42E+06	2.08E+06	0.00E+00	6.52E+06	0.00E+00	9.60E+08
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	7.07E+08	2.51E+08	8.41E+07	1.68E+08	2.87E+09	0.00E+00	1.76E+09
28	Te-129m	7.82E+08	2.90E+08	1.24E+08	2.52E+08	3.27E+09	0.00E+00	2.93E+09
29	I-131	7.59E+06	1.06E+07	5.71E+06	3.10E+09	1.83E+07	0.00E+00	2.10E+06
30	I-133	2.61E-01	4.42E-01	1.35E-01	6.17E+01	7.75E-01	0.00E+00	3.34E-01
31	Cs-134	3.60E+08	8.48E+08	3.93E+08	0.00E+00	2.69E+08	1.03E+08	1.05E+07
32	Cs-136	7.98E+06	3.14E+07	2.11E+07	0.00E+00	1.71E+07	2.69E+06	2.53E+06
33	Cs-137	4.90E+08	6.51E+08	2.27E+08	0.00E+00	2.22E+08	8.61E+07	9.27E+06
34	Ba-140	2.02E+07	2.47E+04	1.30E+06	0.00E+00	8.38E+03	1.66E+04	3.11E+07
35	La-140	2.60E-02	1.28E-02	3.40E-03	0.00E+00	0.00E+00	0.00E+00	7.33E+02
36	Ce-141	9.72E+03	6.49E+03	7.46E+02	0.00E+00	3.06E+03	0.00E+00	1.86E+07
37	Ce-144	8.72E+05	3.61E+05	4.68E+04	0.00E+00	2.15E+05	0.00E+00	2.19E+08

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-25
H-3 calculated per ODCM equation 2.3-30
C-14 calculated per ODCM equation 2.3-33 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-12

R VALUES FOR BEAVER VALLEY SITE

(sq meter-mrem/yr per uCi/sec)

Pathway = Meat
Age Group = Child

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02
2	C-14	5.29E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05
3	P-32	6.29E+09	2.94E+08	2.43E+08	0.00E+00	0.00E+00	0.00E+00	1.74E+08
4	Cr-51	0.00E+00	0.00E+00	7.31E+03	4.06E+03	1.11E+03	7.41E+03	3.88E+05
5	Mn-54	0.00E+00	5.66E+06	1.51E+06	0.00E+00	1.59E+06	0.00E+00	4.75E+06
6	Fe-59	3.04E+08	4.91E+08	2.45E+08	0.00E+00	0.00E+00	1.42E+08	5.12E+08
7	Co-57	0.00E+00	4.21E+06	8.52E+06	0.00E+00	0.00E+00	0.00E+00	3.45E+07
8	Co-58	0.00E+00	1.28E+07	3.91E+07	0.00E+00	0.00E+00	0.00E+00	7.45E+07
9	Co-60	0.00E+00	4.72E+07	1.39E+08	0.00E+00	0.00E+00	0.00E+00	2.61E+08
10	Zn-65	2.68E+08	7.15E+08	4.44E+08	0.00E+00	4.50E+08	0.00E+00	1.25E+08
11	Se-75	4.65E+07	2.95E+07	5.84E+07	2.54E+07	4.32E+07	3.73E+07	3.93E+07
12	Rb-86	0.00E+00	4.87E+08	2.99E+08	0.00E+00	0.00E+00	0.00E+00	3.13E+07
13	Sr-89	3.85E+08	0.00E+00	1.10E+07	0.00E+00	0.00E+00	0.00E+00	1.49E+07
14	Sr-90	7.03E+09	0.00E+00	1.78E+09	0.00E+00	0.00E+00	0.00E+00	9.47E+07
15	Y-91	1.42E+06	0.00E+00	3.81E+04	0.00E+00	0.00E+00	0.00E+00	1.90E+08
16	Zr-95	2.09E+06	4.59E+05	4.09E+05	0.00E+00	6.57E+05	0.00E+00	4.79E+08
17	Nb-95	2.54E+06	9.90E+05	7.07E+05	0.00E+00	9.30E+05	0.00E+00	1.83E+09
18	Nb-97	8.24E-119	1.49E-119	6.95E-120	0.00E+00	1.65E-119	0.00E+00	4.59E-114
19	Mo-99	0.00E+00	9.79E+04	2.42E+04	0.00E+00	2.09E+05	0.00E+00	8.09E+04
20	Tc-99m	5.33E-21	1.05E-20	1.73E-19	0.00E+00	1.52E-19	5.31E-21	5.95E-18
21	Ru-103	1.26E+08	0.00E+00	4.85E+07	0.00E+00	3.18E+08	0.00E+00	3.26E+09
22	Ru-106	3.12E+09	0.00E+00	3.89E+08	0.00E+00	4.21E+09	0.00E+00	4.85E+10
23	Ag-110m	5.99E+06	4.04E+06	3.23E+06	0.00E+00	7.53E+06	0.00E+00	4.81E+08
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	1.33E+09	3.59E+08	1.58E+08	3.19E+08	3.80E+09	0.00E+00	1.08E+09
28	Te-129m	1.47E+09	4.11E+08	2.29E+08	4.75E+08	4.33E+09	0.00E+00	1.80E+09
29	I-131	1.41E+07	1.42E+07	8.04E+06	4.68E+09	2.32E+07	0.00E+00	1.26E+06
30	I-133	4.84E-01	5.99E-01	2.27E-01	1.11E+02	9.98E-01	0.00E+00	2.41E-01
31	Cs-134	6.35E+08	1.04E+09	2.20E+08	0.00E+00	3.23E+08	1.16E+08	5.62E+06
32	Cs-136	1.38E+07	3.78E+07	2.45E+07	0.00E+00	2.01E+07	3.00E+06	1.33E+06
33	Cs-137	9.02E+08	8.63E+08	1.27E+08	0.00E+00	2.81E+08	1.01E+08	5.40E+06
34	Ba-140	3.72E+07	3.26E+06	2.17E+06	0.00E+00	1.06E+04	1.94E+04	1.89E+07
35	La-140	4.76E-02	1.66E-02	5.61E-03	0.00E+00	0.00E+00	0.00E+00	4.63E+02
36	Ce-141	1.83E+04	9.13E+03	1.36E+04	0.00E+00	4.00E+03	0.00E+00	1.14E+07
37	Ce-144	1.64E+06	5.15E+05	8.77E+04	0.00E+00	2.85E+05	0.00E+00	1.34E+08

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-25
H-3 calculated per ODCM equation 2.3-30
C-14 calculated per ODCM equation 2.3-33 (reference ERS-LMR-12-001)

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Table 2.3-13

R VALUES FOR BEAVER VALLEY SITE

(sq m eterm rem /yr per uCi/sec)

Pathway = Cow Milk
Age Group = Adult

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02
2	C-14	3.63E+05	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04
3	P-32	1.45E+10	9.01E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	1.63E+09
4	Cr-51	0.00E+00	0.00E+00	2.38E+04	1.42E+04	5.24E+03	3.15E+04	5.98E+06
5	Mn-54	0.00E+00	5.95E+06	1.13E+06	0.00E+00	1.77E+06	0.00E+00	1.82E+07
6	Fe-59	2.40E+07	5.63E+07	2.16E+07	0.00E+00	0.00E+00	1.57E+07	1.88E+08
7	Co-57	0.00E+00	9.10E+05	1.51E+06	0.00E+00	0.00E+00	0.00E+00	2.31E+07
8	Co-58	0.00E+00	3.67E+06	8.22E+06	0.00E+00	0.00E+00	0.00E+00	7.43E+07
9	Co-60	0.00E+00	1.12E+07	2.46E+07	0.00E+00	0.00E+00	0.00E+00	2.10E+08
10	Zn-65	9.80E+08	3.12E+09	1.41E+09	0.00E+00	2.09E+09	0.00E+00	1.96E+09
11	Se-75	1.85E+09	1.17E+09	2.32E+09	1.01E+09	1.71E+09	1.48E+09	1.56E+09
12	Rb-86	0.00E+00	2.19E+09	1.02E+09	0.00E+00	0.00E+00	0.00E+00	4.32E+08
13	Sr-89	1.16E+09	0.00E+00	3.33E+07	0.00E+00	0.00E+00	0.00E+00	1.86E+08
14	Sr-90	3.16E+10	0.00E+00	7.76E+09	0.00E+00	0.00E+00	0.00E+00	9.14E+08
15	Y-91	6.78E+03	0.00E+00	1.81E+02	0.00E+00	0.00E+00	0.00E+00	3.73E+06
16	Zr-95	7.40E+02	2.37E+02	1.61E+02	0.00E+00	3.72E+02	0.00E+00	7.52E+05
17	Nb-95	6.77E+04	3.77E+04	2.03E+04	0.00E+00	3.72E+04	0.00E+00	2.29E+08
18	Nb-97	2.81E-12	7.11E-13	2.60E-13	0.00E+00	8.30E-13	0.00E+00	2.62E-09
19	Mo-99	0.00E+00	2.11E+07	4.01E+06	0.00E+00	4.77E+07	0.00E+00	4.88E+07
20	Tc-99m	2.83E+00	7.99E+00	1.02E+02	0.00E+00	1.21E+02	3.91E+00	4.73E+03
21	Ru-103	8.29E+02	0.00E+00	3.57E+02	0.00E+00	3.16E+03	0.00E+00	9.68E+04
22	Ru-106	1.43E+04	0.00E+00	1.81E+03	0.00E+00	2.77E+04	0.00E+00	9.27E+05
23	Ag-110m	4.16E+07	3.84E+07	2.28E+07	0.00E+00	7.56E+07	0.00E+00	1.57E+10
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	3.44E+07	1.23E+07	4.19E+06	8.79E+06	1.40E+08	0.00E+00	1.15E+08
28	Te-129m	4.95E+07	1.85E+07	7.84E+06	1.70E+07	2.07E+08	0.00E+00	2.49E+08
29	I-131	2.52E+08	3.60E+08	2.06E+08	1.18E+11	6.17E+08	0.00E+00	9.50E+07
30	I-133	3.29E+06	5.72E+06	1.75E+06	8.41E+08	9.99E+06	0.00E+00	5.14E+06
31	Cs-134	3.89E+09	9.27E+09	7.58E+09	0.00E+00	3.00E+09	9.96E+08	1.62E+08
32	Cs-136	2.23E+08	8.82E+08	6.35E+08	0.00E+00	4.91E+08	6.73E+07	1.00E+08
33	Cs-137	4.99E+09	6.82E+09	4.47E+09	0.00E+00	2.32E+09	7.70E+08	1.32E+08
34	Ba-140	2.28E+07	2.87E+04	1.49E+06	0.00E+00	9.74E+03	1.64E+04	4.70E+07
35	La-140	3.84E+00	1.93E+00	5.11E-01	0.00E+00	0.00E+00	0.00E+00	1.42E+05
36	Ce-141	3.99E+03	2.70E+03	3.06E+02	0.00E+00	1.25E+03	0.00E+00	1.03E+07
37	Ce-144	2.54E+05	1.06E+05	1.36E+04	0.00E+00	6.29E+04	0.00E+00	8.58E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

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Table 2.3-14

R VALUES FOR BEAVER VALLEY SITE

(sq m eter-m rem /yr per uCi/sec)

Pathway = Cow Milk
Age Group = Teen

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02
2	C-14	6.70E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05
3	P-32	2.67E+10	1.66E+09	1.04E+09	0.00E+00	0.00E+00	0.00E+00	2.25E+09
4	Cr-51	0.00E+00	0.00E+00	4.15E+04	2.31E+04	9.10E+03	5.93E+04	6.97E+06
5	Mn-54	0.00E+00	9.91E+06	1.96E+06	0.00E+00	2.95E+06	0.00E+00	2.03E+07
6	Fe-59	4.18E+07	9.76E+07	3.77E+07	0.00E+00	0.00E+00	3.08E+07	2.31E+08
7	Co-57	0.00E+00	1.60E+06	2.68E+06	0.00E+00	0.00E+00	0.00E+00	2.98E+07
8	Co-58	0.00E+00	6.17E+06	1.42E+07	0.00E+00	0.00E+00	0.00E+00	8.51E+07
9	Co-60	0.00E+00	1.89E+07	4.26E+07	0.00E+00	0.00E+00	0.00E+00	2.46E+08
10	Zn-65	1.51E+09	5.23E+09	2.44E+09	0.00E+00	3.34E+09	0.00E+00	2.21E+09
11	Se-75	2.38E+09	1.51E+09	2.99E+09	1.30E+09	2.21E+09	1.91E+09	2.01E+09
12	Rb-86	0.00E+00	3.99E+09	1.87E+09	0.00E+00	0.00E+00	0.00E+00	5.91E+08
13	Sr-89	2.14E+09	0.00E+00	6.12E+07	0.00E+00	0.00E+00	0.00E+00	2.55E+08
14	Sr-90	4.47E+10	0.00E+00	1.10E+10	0.00E+00	0.00E+00	0.00E+00	1.25E+09
15	Y-91	1.25E+04	0.00E+00	3.35E+02	0.00E+00	0.00E+00	0.00E+00	5.11E+06
16	Zr-95	1.29E+03	4.08E+02	2.81E+02	0.00E+00	6.00E+02	0.00E+00	9.42E+05
17	Nb-95	1.16E+05	6.41E+04	3.53E+04	0.00E+00	6.21E+04	0.00E+00	2.74E+08
18	Nb-97	5.13E-12	1.27E-12	4.65E-13	0.00E+00	1.49E-12	0.00E+00	3.04E-08
19	Mo-99	0.00E+00	3.80E+07	7.25E+06	0.00E+00	8.70E+07	0.00E+00	6.81E+07
20	Tc-99m	4.90E+00	1.37E+01	1.77E+02	0.00E+00	2.04E+02	7.59E+00	8.98E+03
21	Ru-103	1.47E+03	0.00E+00	6.30E+02	0.00E+00	5.20E+03	0.00E+00	1.23E+05
22	Ru-106	2.03E+04	0.00E+00	3.32E+03	0.00E+00	5.08E+04	0.00E+00	1.26E+06
23	Ag-110m	6.87E+07	6.50E+07	3.95E+07	0.00E+00	1.24E+08	0.00E+00	1.83E+10
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	6.34E+07	2.25E+07	7.54E+06	1.51E+07	2.57E+08	0.00E+00	1.58E+08
28	Te-129m	9.06E+07	3.36E+07	1.43E+07	2.92E+07	3.79E+08	0.00E+00	3.40E+08
29	I-131	4.57E+08	6.39E+08	3.43E+08	1.87E+11	1.10E+09	0.00E+00	1.26E+08
30	I-133	6.01E+06	1.02E+07	3.11E+06	1.42E+09	1.79E+07	0.00E+00	7.71E+06
31	Cs-134	6.76E+09	1.59E+10	7.38E+09	0.00E+00	5.06E+09	1.93E+09	1.98E+08
32	Cs-136	3.80E+08	1.50E+09	1.01E+09	0.00E+00	8.15E+08	1.28E+08	1.20E+08
33	Cs-137	9.05E+09	1.20E+10	4.19E+09	0.00E+00	4.10E+09	1.59E+09	1.71E+08
34	Ba-140	4.12E+07	5.05E+04	2.65E+06	0.00E+00	1.71E+04	3.39E+04	6.35E+07
35	La-140	6.89E+00	3.39E+00	9.01E-01	0.00E+00	0.00E+00	0.00E+00	1.94E+05
36	Ce-141	7.32E+03	4.89E+03	5.62E+02	0.00E+00	2.30E+03	0.00E+00	1.40E+07
37	Ce-144	4.67E+05	1.93E+05	2.51E+04	0.00E+00	1.15E+05	0.00E+00	1.17E+08

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

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Table 2.3-15

R VALUES FOR BEAVER VALLEY SITE

(sq m eterem rem /yrperuCi/sec)

Pathway = Cow Milk
Age Group = Child

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03
2	C-14	1.65E+06	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05
3	P-32	6.59E+10	3.09E+09	2.54E+09	0.00E+00	0.00E+00	0.00E+00	1.82E+09
4	Cr-51	0.00E+00	0.00E+00	8.46E+04	4.70E+04	1.28E+04	8.58E+04	4.49E+06
5	Mn-54	0.00E+00	1.48E+07	3.95E+06	0.00E+00	4.16E+06	0.00E+00	1.24E+07
6	Fe-59	9.70E+07	1.57E+08	7.82E+07	0.00E+00	0.00E+00	4.55E+07	1.63E+08
7	Co-57	0.00E+00	2.73E+06	5.52E+06	0.00E+00	0.00E+00	0.00E+00	2.24E+07
8	Co-58	0.00E+00	9.43E+06	2.89E+07	0.00E+00	0.00E+00	0.00E+00	5.50E+07
9	Co-60	0.00E+00	2.94E+07	8.67E+07	0.00E+00	0.00E+00	0.00E+00	1.63E+08
10	Zn-65	2.95E+09	7.87E+09	4.89E+09	0.00E+00	4.96E+09	0.00E+00	1.38E+09
11	Se-75	1.97E+09	1.25E+09	2.47E+09	1.07E+09	1.82E+09	1.58E+09	1.66E+09
12	Rb-86	0.00E+00	7.40E+09	4.55E+09	0.00E+00	0.00E+00	0.00E+00	4.76E+08
13	Sr-89	5.29E+09	0.00E+00	1.51E+08	0.00E+00	0.00E+00	0.00E+00	2.05E+08
14	Sr-90	7.55E+10	0.00E+00	1.91E+10	0.00E+00	0.00E+00	0.00E+00	1.02E+09
15	Y-91	3.08E+04	0.00E+00	8.24E+02	0.00E+00	0.00E+00	0.00E+00	4.11E+06
16	Zr-95	3.00E+03	6.60E+02	5.88E+02	0.00E+00	9.45E+02	0.00E+00	6.89E+05
17	Nb-95	2.61E+05	1.02E+05	7.26E+04	0.00E+00	9.54E+04	0.00E+00	1.88E+08
18	Nb-97	1.25E-11	2.25E-12	1.05E-12	0.00E+00	2.50E-12	0.00E+00	6.94E-07
19	Mo-99	0.00E+00	6.92E+07	1.71E+07	0.00E+00	1.48E+08	0.00E+00	5.72E+07
20	Tc-99m	1.12E+01	2.20E+01	3.65E+02	0.00E+00	3.20E+02	1.12E+01	1.25E+04
21	Ru-103	3.49E+03	0.00E+00	1.34E+03	0.00E+00	8.78E+03	0.00E+00	9.01E+04
22	Ru-106	6.49E+04	0.00E+00	8.10E+03	0.00E+00	8.76E+04	0.00E+00	1.01E+06
23	Ag-110m	1.49E+08	1.01E+08	8.05E+07	0.00E+00	1.87E+08	0.00E+00	1.20E+10
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	1.56E+08	4.21E+07	1.86E+07	3.74E+07	4.46E+08	0.00E+00	1.27E+08
28	Te-129m	2.23E+08	6.24E+07	3.47E+07	7.20E+07	6.56E+08	0.00E+00	2.72E+08
29	I-131	1.11E+09	1.11E+09	6.33E+08	3.68E+11	1.83E+09	0.00E+00	9.92E+07
30	I-133	1.46E+07	1.81E+07	6.83E+06	3.36E+09	3.01E+07	0.00E+00	7.28E+06
31	Cs-134	1.56E+10	2.56E+10	5.40E+09	0.00E+00	7.93E+09	2.85E+09	1.38E+08
32	Cs-136	8.58E+08	2.36E+09	1.53E+09	0.00E+00	1.26E+09	1.87E+08	8.29E+07
33	Cs-137	2.18E+10	2.09E+10	3.08E+09	0.00E+00	6.80E+09	2.45E+09	1.31E+08
34	Ba-140	9.94E+07	8.71E+06	5.80E+06	0.00E+00	2.84E+04	5.19E+04	5.04E+07
35	La-140	1.65E+01	5.77E+00	1.94E+00	0.00E+00	0.00E+00	0.00E+00	1.61E+05
36	Ce-141	1.80E+04	8.99E+03	1.34E+04	0.00E+00	3.94E+03	0.00E+00	1.12E+07
37	Ce-144	1.15E+06	3.61E+05	6.15E+04	0.00E+00	2.00E+05	0.00E+00	9.41E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

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Table 2.3-16

R VALUES FOR BEAVER VALLEY SITE

(sq m eter-m rem /yr per uCi/sec)

Pathway = Cow Milk
Age Group = Infant

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
2	C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05
3	P-32	1.36E+11	7.99E+09	5.27E+09	0.00E+00	0.00E+00	0.00E+00	1.84E+09
4	Cr-51	0.00E+00	0.00E+00	1.34E+05	8.75E+04	1.91E+04	1.70E+05	3.91E+06
5	Mn-54	0.00E+00	2.76E+07	6.25E+06	0.00E+00	6.11E+06	0.00E+00	1.01E+07
6	Fe-59	1.81E+08	3.16E+08	1.25E+08	0.00E+00	0.00E+00	9.35E+07	1.51E+08
7	Co-57	0.00E+00	6.36E+06	1.03E+07	0.00E+00	0.00E+00	0.00E+00	2.17E+07
8	Co-58	0.00E+00	1.89E+07	4.70E+07	0.00E+00	0.00E+00	0.00E+00	4.70E+07
9	Co-60	0.00E+00	6.00E+07	1.42E+08	0.00E+00	0.00E+00	0.00E+00	1.43E+08
10	Zn-65	3.97E+09	1.36E+10	6.27E+09	0.00E+00	6.60E+09	0.00E+00	1.15E+10
11	Se-75	1.97E+09	1.25E+09	2.47E+09	1.07E+09	1.82E+09	1.58E+09	1.66E+09
12	Rb-86	0.00E+00	1.88E+10	9.28E+09	0.00E+00	0.00E+00	0.00E+00	4.81E+08
13	Sr-89	1.01E+10	0.00E+00	2.89E+08	0.00E+00	0.00E+00	0.00E+00	2.07E+08
14	Sr-90	8.22E+10	0.00E+00	2.09E+10	0.00E+00	0.00E+00	0.00E+00	1.03E+09
15	Y-91	5.79E+04	0.00E+00	1.54E+03	0.00E+00	0.00E+00	0.00E+00	4.15E+06
16	Zr-95	5.33E+03	1.30E+03	9.22E+02	0.00E+00	1.40E+03	0.00E+00	6.47E+05
17	Nb-95	4.87E+05	2.01E+05	1.16E+05	0.00E+00	1.44E+05	0.00E+00	1.69E+08
18	Nb-97	2.63E-11	5.62E-12	2.03E-12	0.00E+00	4.39E-12	0.00E+00	1.77E-06
19	Mo-99	0.00E+00	1.77E+08	3.45E+07	0.00E+00	2.64E+08	0.00E+00	5.83E+07
20	Tc-99m	2.34E+01	4.82E+01	6.21E+02	0.00E+00	5.19E+02	2.52E+01	1.40E+04
21	Ru-103	7.06E+03	0.00E+00	2.36E+03	0.00E+00	1.47E+04	0.00E+00	8.59E+04
22	Ru-106	1.34E+05	0.00E+00	1.67E+04	0.00E+00	1.58E+05	0.00E+00	1.01E+06
23	Ag-110m	2.75E+08	2.01E+08	1.33E+08	0.00E+00	2.88E+08	0.00E+00	1.04E+10
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	3.16E+08	1.05E+08	3.83E+07	9.14E+07	7.79E+08	0.00E+00	1.28E+08
28	Te-129m	4.58E+08	1.57E+08	7.06E+07	1.76E+08	1.15E+09	0.00E+00	2.74E+08
29	I-131	2.31E+09	2.72E+09	1.20E+09	8.95E+11	3.18E+09	0.00E+00	9.72E+07
30	I-133	3.08E+07	4.49E+07	1.31E+07	8.17E+09	5.28E+07	0.00E+00	7.60E+06
31	Cs-134	2.51E+10	4.69E+10	4.73E+09	0.00E+00	1.21E+10	4.95E+09	1.27E+08
32	Cs-136	1.68E+09	4.93E+09	1.84E+09	0.00E+00	1.97E+09	4.02E+08	7.49E+07
33	Cs-137	3.48E+10	4.07E+10	2.89E+09	0.00E+00	1.09E+10	4.43E+09	1.27E+08
34	Ba-140	2.05E+08	2.05E+05	1.05E+07	0.00E+00	4.86E+04	1.26E+05	5.02E+07
35	La-140	3.45E+01	1.36E+01	3.50E+00	0.00E+00	0.00E+00	0.00E+00	1.60E+05
36	Ce-141	3.57E+04	2.18E+04	2.57E+03	0.00E+00	6.72E+03	0.00E+00	1.13E+07
37	Ce-144	1.65E+06	6.75E+05	9.25E+04	0.00E+00	2.73E+05	0.00E+00	9.47E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-17

R VALUES FOR BEAVER VALLEY SITE

(sq m eterm rem /yr per uC i/sec)

Pathway = G oat M ilk
Age G roup = Adult

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	G I-LLI
1	H-3	0.00E+00	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03
2	C-14	3.63E+05	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04
3	P-32	1.74E+10	1.08E+09	6.72E+08	0.00E+00	0.00E+00	0.00E+00	1.96E+09
4	Cr-51	0.00E+00	0.00E+00	2.85E+03	1.70E+03	6.28E+02	3.78E+03	7.17E+05
5	Mn-54	0.00E+00	7.14E+05	1.36E+05	0.00E+00	2.12E+05	0.00E+00	2.19E+06
6	Fe-59	3.12E+05	7.32E+05	2.81E+05	0.00E+00	0.00E+00	2.05E+05	2.44E+06
7	Co-57	0.00E+00	1.09E+05	1.82E+05	0.00E+00	0.00E+00	0.00E+00	2.77E+06
8	Co-58	0.00E+00	4.40E+05	9.86E+05	0.00E+00	0.00E+00	0.00E+00	8.91E+06
9	Co-60	0.00E+00	1.34E+06	2.96E+06	0.00E+00	0.00E+00	0.00E+00	2.52E+07
10	Zn-65	1.18E+08	3.74E+08	1.69E+08	0.00E+00	2.50E+08	0.00E+00	2.36E+08
11	Se-75	2.22E+08	1.41E+08	2.78E+08	1.21E+08	2.06E+08	1.78E+08	1.87E+08
12	Rb-86	0.00E+00	2.63E+08	1.22E+08	0.00E+00	0.00E+00	0.00E+00	5.18E+07
13	Sr-89	2.43E+09	0.00E+00	6.99E+07	0.00E+00	0.00E+00	0.00E+00	3.91E+08
14	Sr-90	6.64E+10	0.00E+00	1.63E+10	0.00E+00	0.00E+00	0.00E+00	1.92E+09
15	Y-91	8.14E+02	0.00E+00	2.18E+01	0.00E+00	0.00E+00	0.00E+00	4.48E+05
16	Zr-95	8.87E+01	2.85E+01	1.93E+01	0.00E+00	4.47E+01	0.00E+00	9.02E+04
17	Nb-95	8.13E+03	4.52E+03	2.43E+03	0.00E+00	4.47E+03	0.00E+00	2.74E+07
18	Nb-97	3.38E-13	8.54E-14	3.12E-14	0.00E+00	9.96E-14	0.00E+00	3.15E-10
19	Mo-99	0.00E+00	2.53E+06	4.81E+05	0.00E+00	5.72E+06	0.00E+00	5.86E+06
20	Tc-99m	3.39E-01	9.59E-01	1.22E+01	0.00E+00	1.46E+01	4.70E-01	5.67E+02
21	Ru-103	9.95E+01	0.00E+00	4.29E+01	0.00E+00	3.80E+02	0.00E+00	1.16E+04
22	Ru-106	1.72E+03	0.00E+00	2.18E+02	0.00E+00	3.32E+03	0.00E+00	1.11E+05
23	Ag-110m	4.99E+06	4.61E+06	2.74E+06	0.00E+00	9.07E+06	0.00E+00	1.88E+09
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	4.13E+06	1.48E+06	5.03E+05	1.05E+06	1.68E+07	0.00E+00	1.38E+07
28	Te-129m	5.94E+06	2.22E+06	9.41E+05	2.04E+06	2.48E+07	0.00E+00	2.99E+07
29	I-131	3.02E+08	4.32E+08	2.48E+08	1.42E+11	7.40E+08	0.00E+00	1.14E+08
30	I-133	3.95E+06	6.87E+06	2.09E+06	1.01E+09	1.20E+07	0.00E+00	6.17E+06
31	Cs-134	4.67E+08	1.11E+09	9.09E+08	0.00E+00	3.60E+08	1.19E+08	1.95E+07
32	Cs-136	6.70E+08	2.65E+09	1.90E+09	0.00E+00	1.47E+09	2.02E+08	3.01E+08
33	Cs-137	1.50E+10	2.05E+10	1.34E+10	0.00E+00	6.95E+09	2.31E+09	3.96E+08
34	Ba-140	2.74E+06	3.44E+03	1.79E+05	0.00E+00	1.17E+03	1.97E+03	5.64E+06
35	La-140	4.60E-01	2.32E-01	6.13E-02	0.00E+00	0.00E+00	0.00E+00	1.70E+04
36	Ce-141	4.79E+02	3.24E+02	3.68E+01	0.00E+00	1.51E+02	0.00E+00	1.24E+06
37	Ce-144	3.05E+04	1.27E+04	1.64E+03	0.00E+00	7.55E+03	0.00E+00	1.03E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-18

R VALUES FOR BEAVER VALLEY SITE

(sq m eter-m rem /yr per uCi/sec)

Pathway = Goat Milk
Age Group = Teen

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03
2	C-14	6.70E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05
3	P-32	3.21E+10	1.99E+09	1.24E+09	0.00E+00	0.00E+00	0.00E+00	2.70E+09
4	Cr-51	0.00E+00	0.00E+00	4.98E+03	2.77E+03	1.09E+03	7.11E+03	8.37E+05
5	Mn-54	0.00E+00	1.19E+06	2.36E+05	0.00E+00	3.55E+05	0.00E+00	2.44E+06
6	Fe-59	5.44E+05	1.27E+06	4.90E+05	0.00E+00	0.00E+00	4.00E+05	3.00E+06
7	Co-57	0.00E+00	1.92E+05	3.21E+05	0.00E+00	0.00E+00	0.00E+00	3.57E+06
8	Co-58	0.00E+00	7.40E+05	1.71E+06	0.00E+00	0.00E+00	0.00E+00	1.02E+07
9	Co-60	0.00E+00	2.27E+06	5.11E+06	0.00E+00	0.00E+00	0.00E+00	2.96E+07
10	Zn-65	1.81E+08	6.27E+08	2.93E+08	0.00E+00	4.01E+08	0.00E+00	2.66E+08
11	Se-75	2.86E+08	1.82E+08	3.59E+08	1.56E+08	2.65E+08	2.29E+08	2.41E+08
12	Rb-86	0.00E+00	4.79E+08	2.25E+08	0.00E+00	0.00E+00	0.00E+00	7.09E+07
13	Sr-89	4.49E+09	0.00E+00	1.29E+08	0.00E+00	0.00E+00	0.00E+00	5.35E+08
14	Sr-90	9.39E+10	0.00E+00	2.32E+10	0.00E+00	0.00E+00	0.00E+00	2.64E+09
15	Y-91	1.50E+03	0.00E+00	4.01E+01	0.00E+00	0.00E+00	0.00E+00	6.14E+05
16	Zr-95	1.55E+02	4.90E+01	3.37E+01	0.00E+00	7.19E+01	0.00E+00	1.13E+05
17	Nb-95	1.39E+04	7.69E+03	4.23E+03	0.00E+00	7.45E+03	0.00E+00	3.29E+07
18	Nb-97	6.15E-13	1.53E-13	5.57E-14	0.00E+00	1.79E-13	0.00E+00	3.65E-09
19	Mo-99	0.00E+00	4.56E+06	8.70E+05	0.00E+00	1.04E+07	0.00E+00	8.17E+06
20	Tc-99m	5.88E-01	1.64E+00	2.13E+01	0.00E+00	2.45E+01	9.11E-01	1.08E+03
21	Ru-103	1.77E+02	0.00E+00	7.56E+01	0.00E+00	6.24E+02	0.00E+00	1.48E+04
22	Ru-106	2.44E+03	0.00E+00	3.98E+02	0.00E+00	6.10E+03	0.00E+00	1.52E+05
23	Ag-110m	8.24E+06	7.80E+06	4.75E+06	0.00E+00	1.49E+07	0.00E+00	2.19E+09
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	7.61E+06	2.70E+06	9.05E+05	1.81E+06	3.08E+07	0.00E+00	1.90E+07
28	Te-129m	1.09E+07	4.03E+06	1.72E+06	3.51E+06	4.55E+07	0.00E+00	4.08E+07
29	I-131	5.48E+08	7.67E+08	4.12E+08	2.24E+11	1.32E+09	0.00E+00	1.52E+08
30	I-133	7.21E+06	1.22E+07	3.73E+06	1.71E+09	2.15E+07	0.00E+00	9.26E+06
31	Cs-134	8.11E+08	1.91E+09	8.86E+08	0.00E+00	6.07E+08	2.32E+08	2.38E+07
32	Cs-136	1.14E+09	4.49E+09	3.02E+09	0.00E+00	2.44E+09	3.85E+08	3.61E+08
33	Cs-137	2.71E+10	3.61E+10	1.26E+10	0.00E+00	1.23E+10	4.77E+09	5.14E+08
34	Ba-140	4.94E+06	6.06E+03	3.18E+05	0.00E+00	2.05E+03	4.07E+03	7.62E+06
35	La-140	8.27E-01	4.06E-01	1.08E-01	0.00E+00	0.00E+00	0.00E+00	2.33E+04
36	Ce-141	8.79E+02	5.87E+02	6.74E+01	0.00E+00	2.76E+02	0.00E+00	1.68E+06
37	Ce-144	5.60E+04	2.32E+04	3.01E+03	0.00E+00	1.39E+04	0.00E+00	1.41E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-IMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-19

R VALUES FOR BEAVER VALLEY SITE

(sq m eter-m rem /yr per uCi/sec)

Pathway = Goat Milk
Age Group = Child

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03
2	C-14	1.65E+06	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05
3	P-32	7.91E+10	3.70E+09	3.05E+09	0.00E+00	0.00E+00	0.00E+00	2.19E+09
4	Cr-51	0.00E+00	0.00E+00	1.02E+04	5.64E+03	1.54E+03	1.03E+04	5.39E+05
5	Mn-54	0.00E+00	1.78E+06	4.74E+05	0.00E+00	4.99E+05	0.00E+00	1.49E+06
6	Fe-59	1.26E+06	2.04E+06	1.02E+06	0.00E+00	0.00E+00	5.91E+05	2.12E+06
7	Co-57	0.00E+00	3.27E+05	6.63E+05	0.00E+00	0.00E+00	0.00E+00	2.68E+06
8	Co-58	0.00E+00	1.13E+06	3.46E+06	0.00E+00	0.00E+00	0.00E+00	6.60E+06
9	Co-60	0.00E+00	3.53E+06	1.04E+07	0.00E+00	0.00E+00	0.00E+00	1.95E+07
10	Zn-65	3.54E+08	9.44E+08	5.87E+08	0.00E+00	5.95E+08	0.00E+00	1.66E+08
11	Se-75	2.36E+08	1.50E+08	2.96E+08	1.29E+08	2.19E+08	1.89E+08	1.99E+08
12	Rb-86	0.00E+00	8.88E+08	5.46E+08	0.00E+00	0.00E+00	0.00E+00	5.71E+07
13	Sr-89	1.11E+10	0.00E+00	3.17E+08	0.00E+00	0.00E+00	0.00E+00	4.30E+08
14	Sr-90	1.59E+11	0.00E+00	4.02E+10	0.00E+00	0.00E+00	0.00E+00	2.14E+09
15	Y-91	3.70E+03	0.00E+00	9.89E+01	0.00E+00	0.00E+00	0.00E+00	4.93E+05
16	Zr-95	3.60E+02	7.92E+01	7.05E+01	0.00E+00	1.13E+02	0.00E+00	8.27E+04
17	Nb-95	3.13E+04	1.22E+04	8.71E+03	0.00E+00	1.14E+04	0.00E+00	2.25E+07
18	Nb-97	1.49E-12	2.70E-13	1.26E-13	0.00E+00	2.99E-13	0.00E+00	8.33E-08
19	Mo-99	0.00E+00	8.30E+06	2.05E+06	0.00E+00	1.77E+07	0.00E+00	6.87E+06
20	Tc-99m	1.35E+00	2.65E+00	4.39E+01	0.00E+00	3.84E+01	1.34E+00	1.51E+03
21	Ru-103	4.18E+02	0.00E+00	1.61E+02	0.00E+00	1.05E+03	0.00E+00	1.08E+04
22	Ru-106	7.79E+03	0.00E+00	9.72E+02	0.00E+00	1.05E+04	0.00E+00	1.21E+05
23	Ag-110m	1.79E+07	1.21E+07	9.65E+06	0.00E+00	2.25E+07	0.00E+00	1.44E+09
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	1.88E+07	5.05E+06	2.23E+06	4.48E+06	5.35E+07	0.00E+00	1.52E+07
28	Te-129m	2.68E+07	7.48E+06	4.16E+06	8.64E+06	7.87E+07	0.00E+00	3.27E+07
29	I-131	1.33E+09	1.34E+09	7.60E+08	4.42E+11	2.19E+09	0.00E+00	1.19E+08
30	I-133	1.75E+07	2.17E+07	8.20E+06	4.03E+09	3.61E+07	0.00E+00	8.73E+06
31	Cs-134	1.87E+09	3.07E+09	6.48E+08	0.00E+00	9.52E+08	3.42E+08	1.66E+07
32	Cs-136	2.58E+09	7.08E+09	4.58E+09	0.00E+00	3.77E+09	5.62E+08	2.49E+08
33	Cs-137	6.54E+10	6.26E+10	9.24E+09	0.00E+00	2.04E+10	7.34E+09	3.92E+08
34	Ba-140	1.19E+07	1.05E+06	6.96E+05	0.00E+00	3.40E+03	6.23E+03	6.04E+06
35	La-140	1.98E+00	6.92E-01	2.33E-01	0.00E+00	0.00E+00	0.00E+00	1.93E+04
36	Ce-141	2.16E+03	1.08E+03	1.60E+03	0.00E+00	4.73E+02	0.00E+00	1.35E+06
37	Ce-144	1.38E+05	4.33E+04	7.37E+03	0.00E+00	2.40E+04	0.00E+00	1.13E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

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P&I ORGAN DOSE FACTORS

Table 2.3-20

R VALUES FOR BEAVER VALLEY SITE

(sq meter-mrem/yr per uCi/sec)

Pathway = GoatMilk
Age Group = Infant

	Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
1	H-3	0.00E+00	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03
2	C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05
3	P-32	1.63E+11	9.59E+09	6.32E+09	0.00E+00	0.00E+00	0.00E+00	2.21E+09
4	Cr-51	0.00E+00	0.00E+00	1.61E+04	1.05E+04	2.29E+03	2.04E+04	4.69E+05
5	Mn-54	0.00E+00	3.31E+06	7.50E+05	0.00E+00	7.33E+05	0.00E+00	1.21E+06
6	Fe-59	2.35E+06	4.11E+06	1.62E+06	0.00E+00	0.00E+00	1.21E+06	1.96E+06
7	Co-57	0.00E+00	7.64E+05	1.24E+06	0.00E+00	0.00E+00	0.00E+00	2.60E+06
8	Co-58	0.00E+00	2.26E+06	5.64E+06	0.00E+00	0.00E+00	0.00E+00	5.64E+06
9	Co-60	0.00E+00	7.20E+06	1.70E+07	0.00E+00	0.00E+00	0.00E+00	1.71E+07
10	Zn-65	4.76E+08	1.63E+09	7.53E+08	0.00E+00	7.92E+08	0.00E+00	1.38E+09
11	Se-75	2.36E+08	1.50E+08	2.96E+08	1.29E+08	2.19E+08	1.89E+08	1.99E+08
12	Rb-86	0.00E+00	2.25E+09	1.11E+09	0.00E+00	0.00E+00	0.00E+00	5.77E+07
13	Sr-89	2.11E+10	0.00E+00	6.06E+08	0.00E+00	0.00E+00	0.00E+00	4.34E+08
14	Sr-90	1.73E+11	0.00E+00	4.39E+10	0.00E+00	0.00E+00	0.00E+00	2.16E+09
15	Y-91	6.94E+03	0.00E+00	1.85E+02	0.00E+00	0.00E+00	0.00E+00	4.98E+05
16	Zr-95	6.40E+02	1.56E+02	1.11E+02	0.00E+00	1.68E+02	0.00E+00	7.77E+04
17	Nb-95	5.84E+04	2.41E+04	1.39E+04	0.00E+00	1.72E+04	0.00E+00	2.03E+07
18	Nb-97	3.16E-12	6.74E-13	2.43E-13	0.00E+00	5.27E-13	0.00E+00	2.13E-07
19	Mo-99	0.00E+00	2.12E+07	4.14E+06	0.00E+00	3.17E+07	0.00E+00	6.99E+06
20	Tc-99m	2.81E+00	5.79E+00	7.46E+01	0.00E+00	6.23E+01	3.03E+00	1.68E+03
21	Ru-103	8.47E+02	0.00E+00	2.83E+02	0.00E+00	1.76E+03	0.00E+00	1.03E+04
22	Ru-106	1.60E+04	0.00E+00	2.00E+03	0.00E+00	1.90E+04	0.00E+00	1.22E+05
23	Ag-110m	3.30E+07	2.41E+07	1.60E+07	0.00E+00	3.45E+07	0.00E+00	1.25E+09
24	Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	Te-127m	3.80E+07	1.26E+07	4.59E+06	1.10E+07	9.35E+07	0.00E+00	1.53E+07
28	Te-129m	5.50E+07	1.89E+07	8.47E+06	2.11E+07	1.38E+08	0.00E+00	3.28E+07
29	I-131	2.77E+09	3.27E+09	1.44E+09	1.07E+12	3.82E+09	0.00E+00	1.17E+08
30	I-133	3.70E+07	5.39E+07	1.58E+07	9.80E+09	6.34E+07	0.00E+00	9.12E+06
31	Cs-134	3.02E+09	5.62E+09	5.68E+08	0.00E+00	1.45E+09	5.93E+08	1.53E+07
32	Cs-136	5.03E+09	1.48E+10	5.52E+09	0.00E+00	5.90E+09	1.21E+09	2.25E+08
33	Cs-137	1.04E+11	1.22E+11	8.66E+09	0.00E+00	3.28E+10	1.33E+10	3.82E+08
34	Ba-140	2.45E+07	2.45E+04	1.26E+06	0.00E+00	5.83E+03	1.51E+04	6.03E+06
35	La-140	4.14E+00	1.63E+00	4.19E-01	0.00E+00	0.00E+00	0.00E+00	1.92E+04
36	Ce-141	4.29E+03	2.62E+03	3.08E+02	0.00E+00	8.07E+02	0.00E+00	1.35E+06
37	Ce-144	1.98E+05	8.11E+04	1.11E+04	0.00E+00	3.28E+04	0.00E+00	1.14E+07

All nuclides (except H-3 and C-14) calculated per ODCM equation 2.3-24
H-3 calculated per ODCM equation 2.3-28
C-14 calculated per ODCM equation 2.3-32 (reference ERS-LMR-12-001)

TABLE 2.3-21

PV-1/2 DEPOSITION PARAMETERS (D/Q) FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
(meters^{-2})

	DISTANCES TO THE CONTROL LOCATIONS, IN MILES									
SECTOR	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.0	2.0 - 2.5	2.5 - 3.0	3.0 - 3.5	3.5 - 4.0	4.0 - 4.5	4.5 - 5.0
N	6.00E-10	8.60E-09	3.14E-09	1.76E-09	8.12E-10	5.70E-10	4.24E-10	3.29E-10	2.63E-10	2.15E-10
NNE	6.66E-10	5.64E-09	1.98E-09	2.55E-09	1.33E-09	1.07E-09	6.75E-10	5.23E-10	4.56E-10	3.74E-10
NE	1.03E-09	1.57E-09	1.32E-09	3.62E-09	2.63E-09	1.64E-09	1.23E-09	6.13E-10	7.85E-10	6.42E-10
ENE	1.13E-09	1.55E-09	3.69E-09	3.27E-09	2.31E-09	1.29E-09	1.21E-09	6.78E-10	6.72E-10	3.89E-10
E	1.35E-09	1.28E-08	4.09E-09	3.12E-09	1.91E-09	1.36E-09	1.01E-09	7.83E-10	4.15E-10	5.10E-10
ESE	9.82E-10	7.85E-09	4.40E-09	2.46E-09	1.47E-09	1.03E-09	5.65E-10	5.05E-10	3.25E-10	3.00E-10
SE	2.76E-09	6.41E-09	3.52E-09	1.97E-09	1.18E-09	8.27E-10	5.68E-10	4.40E-10	2.93E-10	2.43E-10
SSE	2.22E-09	4.66E-09	3.01E-09	1.68E-09	1.02E-09	7.14E-10	4.25E-10	3.29E-10	2.19E-10	1.80E-10
S	3.00E-09	4.81E-09	3.76E-09	2.10E-09	1.36E-09	9.52E-10	5.12E-10	3.96E-10	2.68E-10	2.20E-10
SSW	1.44E-08	2.89E-09	7.83E-10	8.84E-10	5.70E-10	4.00E-10	2.55E-10	1.98E-10	1.84E-10	1.51E-10
SW	1.89E-08	5.55E-09	1.55E-09	8.71E-10	2.61E-10	3.94E-10	1.57E-10	2.50E-10	2.54E-10	2.08E-10
WSW	1.57E-09	6.63E-09	1.36E-09	1.04E-09	5.44E-10	2.39E-10	3.84E-10	2.98E-10	2.17E-10	1.78E-10
W	3.78E-10	2.95E-09	1.84E-09	1.03E-09	6.63E-10	4.66E-10	1.37E-10	2.68E-10	1.12E-10	1.75E-10
WNW	4.54E-10	4.13E-10	3.09E-10	4.71E-10	7.35E-10	5.16E-10	1.93E-10	1.10E-10	1.12E-10	1.80E-10
NW	4.52E-10	4.09E-10	2.86E-10	1.18E-09	7.04E-10	4.94E-10	3.37E-10	2.10E-10	2.09E-10	1.71E-10
NNW	3.40E-10	2.05E-09	1.63E-09	9.12E-10	5.86E-10	4.13E-10	2.79E-10	2.16E-10	1.73E-10	1.42E-10

ATTACHMENT K
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (0-5 MILES)

TABLE 2.3-22

CV-1 AND CV-2 DEPOSITION PARAMETERS (D/Q) FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
(meters^{-2})

DISTANCES TO THE CONTROL LOCATIONS, IN MILES

SECTOR	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.0	2.0 - 2.5	2.5 - 3.0	3.0 - 3.5	3.5 - 4.0	4.0 - 4.5	4.5 - 5.0
N	4.46E-08	7.73E-09	3.24E-09	1.81E-09	1.08E-09	7.57E-10	5.16E-10	4.00E-10	2.91E-10	2.38E-10
NNE	5.42E-08	9.39E-09	3.37E-09	1.89E-09	1.22E-09	8.54E-10	6.35E-10	4.92E-10	3.94E-10	3.22E-10
NE	7.32E-08	1.27E-08	6.21E-09	3.47E-09	2.24E-09	1.57E-09	1.00E-09	7.77E-10	5.69E-10	4.66E-10
ENE	7.77E-08	1.35E-08	6.51E-09	3.64E-09	2.50E-09	1.76E-09	1.31E-09	1.01E-09	6.58E-10	5.39E-10
E	6.08E-08	1.05E-08	3.79E-09	2.12E-09	1.37E-09	9.59E-10	6.54E-10	5.06E-10	4.05E-10	3.32E-10
ESE	3.23E-08	5.60E-09	2.54E-09	1.42E-09	8.46E-10	5.94E-10	4.05E-10	3.14E-10	2.28E-10	1.87E-10
SE	3.29E-08	5.70E-09	2.59E-09	1.45E-09	9.32E-10	6.55E-10	4.12E-10	3.19E-10	2.55E-10	2.09E-10
SSE	2.84E-08	4.92E-09	2.06E-09	1.15E-09	6.29E-10	4.42E-10	2.99E-10	2.32E-10	1.85E-10	1.52E-10
S	3.67E-08	6.37E-09	2.26E-09	1.26E-09	8.14E-10	5.71E-10	3.86E-10	2.99E-10	2.39E-10	1.96E-10
SSW	2.61E-08	4.52E-09	1.60E-09	8.97E-10	5.78E-10	4.06E-10	3.02E-10	2.34E-10	1.70E-10	1.39E-10
SW	3.06E-08	5.30E-09	2.62E-09	1.47E-09	8.01E-10	5.62E-10	4.18E-10	3.24E-10	2.35E-10	1.93E-10
WSW	4.60E-08	7.97E-09	3.34E-09	1.87E-09	1.20E-09	8.45E-10	5.87E-10	4.55E-10	3.38E-10	2.77E-10
W	6.49E-08	1.13E-08	4.72E-09	2.64E-09	1.19E-09	8.36E-10	6.22E-10	4.82E-10	3.85E-10	3.15E-10
WNW	9.25E-08	1.60E-08	6.43E-09	3.60E-09	2.21E-09	1.55E-09	1.16E-09	8.96E-10	5.79E-10	4.75E-10
NW	1.19E-07	2.07E-08	8.68E-09	4.86E-09	2.99E-09	2.10E-09	1.56E-09	1.21E-09	7.83E-10	6.41E-10
NNW	5.22E-08	9.04E-09	3.79E-09	2.12E-09	1.28E-09	9.00E-10	6.25E-10	4.84E-10	3.59E-10	2.94E-10

ATTACHMENT K
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (0-5 MILES)

TABLE 2.3-23

VV-1 AND VV-2 DEPOSITION PARAMETERS ($\overline{D/Q}$) FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
($meters^{-2}$)

Same as Table 2.3-22

ATTACHMENT K
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (0-5 MILES)

TABLE 2.3-24

TV-2 DEPOSITION PARAMETERS ($\overline{D/Q}$) FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
($meters^{-2}$)

Same as Table 2.3-22

ATTACHMENT K
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (0-5 MILES)

TABLE 2.3-25

CB-2 DEPOSITION PARAMETERS $(\overline{D/Q})$ FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
(meters^{-2})

Same as Table 2.3-22

ATTACHMENT K
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (0-5 MILES)

TABLE 2.3-26

DV-2 DEPOSITION PARAMETERS ($\overline{D/Q}$) FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
($meters^{-2}$)

Same as Table 2.3-22

ATTACHMENT K
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (0-5 MILES)

TABLE 2.3-27

WV-2 DEPOSITION PARAMETERS ($\overline{D/Q}$) FOR
CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR
($meters^{-2}$)

Same as Table 2.3-22

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-28

PV-1/2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES
>500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

INDIVIDUAL RECEPTORS

DOWNWIND SECTOR	SITE BOUNDARY	VEGETABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESIDENCE
N	.600	2.340	--	.572	.707	2.510
NNE	.673	3.220	--	.524	2.920	3.220
NE	.766	1.280	.660	.111	.660	1.200
ENE	1.010	5.080	--	.702	--	1.760
E	1.370	4.420	.401	1.290	1.290	4.420
ESE	.984	6.390	--	2.340	6.390	6.180
SE	11.000	3.680	.466	.466	1.300	3.680
SSE	7.060	3.220	.423	.105	3.140	4.320
S	5.780	1.540	1.410	--	2.610	2.730
SSW	2.040	1.040	.578	.208	1.040	1.460
SW	1.610	1.120	--	.693	.979	1.120
WSW	1.710	1.310	.370	--	1.190	1.310
W	.377	.659	.138	--	.518	.659
WNW	.424	.746	.497	.029	.746	.746
NW	.447	.425	--	.070	.488	.422
NNW	.340	1.840	--	.043	.545	1.92

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-29

CV-1 AND CV-2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES >500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES (IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

INDIVIDUAL RECEPTORS

DOWNWIND SECTOR	SITE BOUNDARY	VEGETABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESIDENCE
N	25.40	2.05	--	.693	.847	2.19
NNE	18.80	2.02	--	.459	1.850	2.11
NE	63.40	29.30	.455	.078	.455	30.40
ENE	65.90	8.92	--	.661	--	32.20
E	38.00	3.90	.382	1.020	1.020	22.70
ESE	17.10	3.56	--	1.380	3.560	3.56
SE	13.80	3.03	.350	.350	1.100	3.03
SSE	10.50	2.65	.317	.094	2.570	3.68
S	10.60	1.05	.934	--	1.860	1.95
SSW	5.59	1.26	.663	.266	1.260	4.42
SW	3.94	2.21	--	1.320	1.920	2.21
WSW	27.50	2.65	.596	--	2.380	2.65
W	31.60	1.23	.645	--	.960	1.23
WNW	39.10	2.23	1.490	.045	2.230	2.23
NW	70.60	15.00	--	.276	1.990	15.60
NNW	31.50	6.52	--	.068	1.090	9.91

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-30

VV-1 AND VV-2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES
>500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

Same as Table 2.3-29

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-31

TV-2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES
>500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

	INDIVIDUAL RECEPTORS					
DOWNWIND SECTOR	SITE BOUNDARY	VEGETABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESIDENCE
N	20.20	2.05	--	.693	.847	2.190
NNE	34.90	2.02	--	.459	1.850	2.110
NE	54.20	29.30	.455	.078	.455	30.400
ENE	57.50	8.92	--	.661	--	32.200
E	38.10	3.90	.382	1.020	1.020	22.700
ESE	18.60	3.56	--	1.380	3.560	3.560
SE	19.00	3.03	.351	.351	1.100	3.030
SSE	13.30	2.65	.318	.094	2.570	3.690
S	11.30	10.40	.934	--	1.860	1.950
SSW	6.44	1.26	.664	.266	1.260	4.430
SW	3.95	2.21	--	1.320	1.920	2.210
WSW	25.10	2.65	.597	--	2.380	2.650
W	28.40	1.23	.646	--	.961	1.230
WNW	30.90	2.23	1.490	.045	2.230	2.230
NW	56.10	14.90	--	.276	1.980	15.500
NNW	25.10	6.53	--	.068	1.100	9.920

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-32

CB-2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES
>500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

Same as Table 2.3-31

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-33

DV-2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES
>500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

Same as Table 2.3-29

ATTACHMENT L
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CONTINUOUS RELEASE DEPOSITION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-34

WV-2 DEPOSTION PARAMETERS (D/Q) FOR CONTINUOUS RELEASES
>500 HRS/YR OR >150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(1E-9 meters^{-2})

Same as Table 2.3-29

ATTACHMENT M
Page 1 of 3
BATCH RELEASE DISPERSION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-35

CV-1 AND CV-2 DISPERSION PARAMETERS (X/Q) FOR BATCH RELEASES
≥500 HRS/YR OR ≥150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(sec/m^3)

INDIVIDUAL RECEPTORS

DOWNWIND SECTOR*	SITE BOUNDARY	VEGETABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESIDENCE
N	8.21E-5	8.38E-6	--	3.72E-6	4.34E-6	8.82E-6
NNE	3.04E-5	4.71E-6	--	1.40E-6	4.38E-6	4.87E-6
NE	4.59E-5	2.21E-5	6.05E-7	1.38E-7	6.05E-7	2.28E-5
ENE	3.72E-5	5.25E-6	--	5.66E-7	--	1.88E-5
E	2.93E-5	3.79E-6	5.15E-7	1.17E-6	1.17E-6	1.78E-5
ESE	2.47E-5	5.61E-6	--	2.34E-6	5.61E-6	5.61E-6
SE	2.14E-5	5.00E-6	8.13E-7	8.13E-7	2.03E-6	5.00E-6
SSE	2.21E-5	6.31E-6	1.11E-6	3.92E-7	6.13E-6	8.49E-6
S	2.15E-5	3.03E-6	2.76E-6	--	4.93E-6	5.14E-6
SSW	2.18E-5	6.58E-6	3.81E-6	1.82E-6	6.58E-6	1.78E-5
SW	1.82E-5	1.03E-5	--	6.67E-6	9.12E-6	1.03E-5
WSW	1.09E-4	1.29E-5	4.10E-6	--	1.19E-5	1.29E-5
W	1.49E-4	1.05E-5	6.55E-6	--	8.77E-6	1.05E-5
WNW	1.91E-4	1.72E-5	1.28E-5	1.23E-6	1.72E-5	1.72E-5
NW	3.08E-4	6.13E-5	--	3.80E-6	1.36E-5	6.36E-5
NNW	1.80E-4	3.54E-5	--	1.35E-6	9.27E-6	5.29E-5

*Measured relevant to center point between BV-1 and BV-2 Containment Buildings

Period of Record: 1976 - 1980

ATTACHMENT M
Page 2 of 3
BATCH RELEASE DISPERSION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-36

VV-1 AND VV-2 DISPERSION PARAMETERS (X/Q) FOR BATCH RELEASES
≥500 HRS/YR OR ≥150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(sec/m^3)

INDIVIDUAL RECEPTORS

DOWNWIND SECTOR*	SITE BOUNDARY	VEGETABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESIDENCE
N	9.75E-5	1.00E-5	--	4.21E-6	4.95E-6	1.06E-5
NNE	3.78E-5	5.11E-6	--	1.43E-6	4.72E-6	5.30E-6
NE	6.13E-5	2.70E-5	6.20E-7	1.40E-7	6.20E-7	2.81E-5
ENE	4.83E-5	5.58E-6	--	5.71E-7	--	2.24E-5
E	3.66E-5	3.99E-6	5.25E-7	1.19E-6	1.19E-6	2.10E-5
ESE	2.99E-5	6.13E-6	--	2.43E-6	6.13E-6	6.13E-6
SE	2.55E-5	5.29E-6	8.24E-7	8.24E-7	2.13E-6	5.29E-6
SSE	2.65E-5	6.72E-6	1.12E-6	3.95E-7	6.53E-6	9.22E-6
S	2.52E-5	3.14E-6	2.83E-6	--	5.29E-6	5.53E-6
SSW	2.60E-5	7.34E-6	4.15E-6	1.92E-6	7.34E-6	2.09E-5
SW	2.13E-5	1.18E-5	--	7.41E-6	1.04E-5	1.18E-5
WSW	1.34E-4	1.51E-5	4.46E-6	--	1.38E-5	1.51E-5
W	1.77E-4	1.25E-5	7.40E-6	--	1.02E-5	1.25E-5
WNW	2.33E-4	2.07E-5	1.49E-5	1.30E-6	2.07E-5	2.07E-5
NW	3.32E-4	8.57E-5	--	4.24E-6	1.64E-5	8.85E-5
NNW	1.90E-4	4.69E-5	--	1.45E-6	1.09E-5	6.75E-5

*Measured relevant to center point between BV-1 and BV-2 Containment Buildings

Period of Record: 1976 - 1980

ATTACHMENT M
Page 3 of 3
BATCH RELEASE DISPERSION PARAMETERS (SPECIAL DISTANCES)

TABLE 2.3-37

PV-1/2 DISPERSION PARAMETERS (X/Q) FOR BATCH RELEASES
≥500 HRS/YR OR ≥150 HRS/QTR FOR SPECIAL DISTANCES
(IDENTIFIED IN ATTACHMENT E TABLE 2.2-3)
(sec/m^3)

INDIVIDUAL RECEPTORS

DOWNWIND SECTOR*	SITE BOUNDARY	VEGETABLE GARDEN	MILK COW	MILK GOAT	MEAT ANIMAL	RESIDENCE
N	3.09E-9	3.30E-6	--	1.13E-6	1.34E-6	3.36E-6
NNE	2.85E-9	2.68E-6	--	6.52E-7	2.47E-6	2.68E-6
NE	2.02E-10	7.42E-9	5.44E-7	1.24E-7	5.44E-7	5.51E-9
ENE	1.02E-9	3.21E-6	--	6.29E-7	--	1.67E-9
E	2.15E-9	2.91E-6	4.96E-7	1.14E-6	1.14E-6	2.91E-6
ESE	6.90E-9	4.97E-6	--	1.95E-6	4.97E-6	4.81E-6
SE	2.91E-6	3.52E-6	6.02E-7	6.02E-7	1.43E-6	3.52E-6
SSE	4.91E-6	3.56E-6	6.53E-7	2.18E-7	3.47E-6	4.71E-6
S	2.41E-6	1.78E-6	1.65E-6	--	2.84E-6	2.96E-6
SSW	4.83E-6	2.52E-6	1.50E-6	6.60E-7	2.52E-6	3.96E-6
SW	4.82E-6	2.75E-6	--	1.78E-6	2.44E-6	2.75E-6
WSW	5.77E-7	2.81E-6	8.79E-7	--	2.57E-6	2.81E-6
W	2.88E-9	1.68E-6	4.89E-7	--	1.37E-6	1.68E-6
WNW	3.40E-9	1.61E-6	1.13E-6	1.10E-7	1.61E-6	1.61E-6
NW	1.34E-9	3.31E-8	--	2.03E-7	1.07E-6	3.10E-8
NNW	1.52E-9	3.73E-6	--	1.73E-7	1.31E-6	3.81E-6

*Measured relevant to BV-1 natural draft cooling tower

Period of Record: 1976 - 1980

TABLE 2.3-38

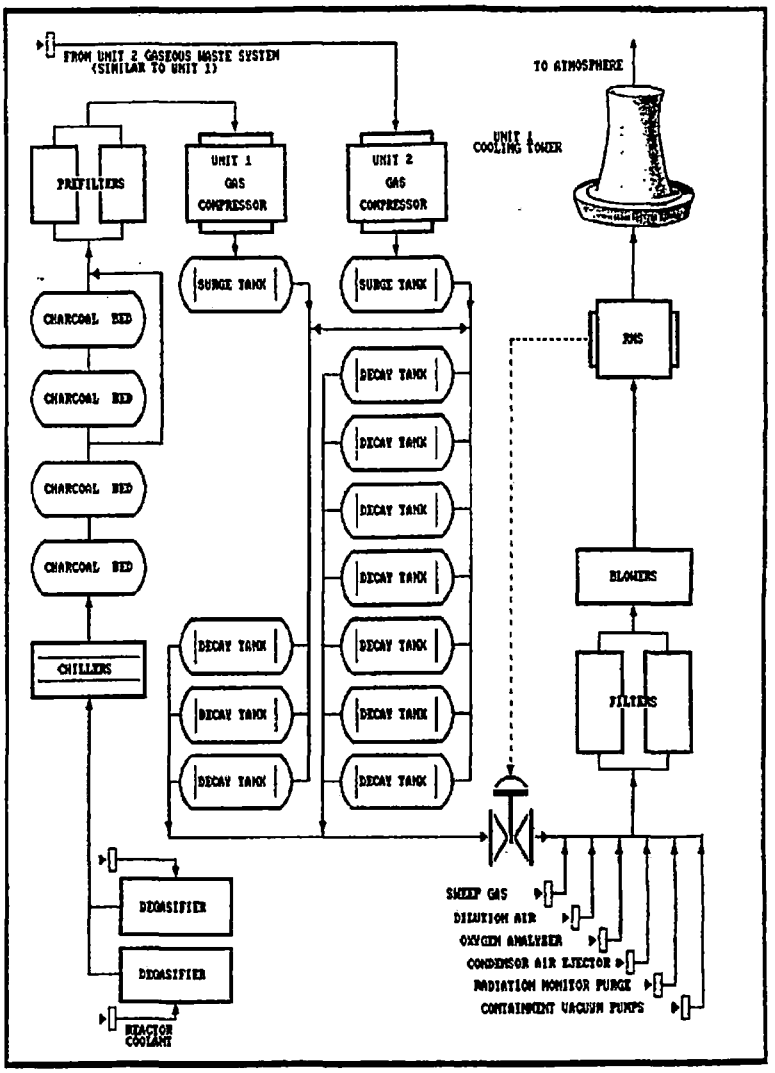
PV-1/2 DISPERSION PARAMETERS (D/Q) FOR
CONTINUOUS RELEASES ≥500 HRS/YR OR ≥150 HRS/QTR
(sec/m^3)

	DISTANCES TO THE CONTROL LOCATIONS, IN MILES									
SECTOR	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.0	2.0 - 2.5	2.5 - 3.0	3.0 - 3.5	3.5 - 4.0	4.0 - 4.5	4.5 - 5.0
N	2.75E-15	1.07E-5	4.10E-6	2.61E-6	1.51E-6	1.13E-6	8.84E-7	7.13E-7	5.93E-7	5.06E-7
NNE	5.90E-17	5.39E-6	2.83E-6	2.19E-6	1.36E-6	1.13E-6	8.05E-7	6.51E-7	5.64E-7	4.81E-7
NE	4.45E-16	1.67E-8	7.39E-8	2.28E-6	1.72E-6	1.19E-6	9.28E-7	6.76E-7	7.34E-7	5.32E-7
ENE	1.92E-15	8.87E-8	2.60E-6	2.21E-6	1.66E-6	1.13E-6	9.25E-7	7.23E-7	6.06E-7	3.82E-7
E	1.84E-15	5.10E-6	2.77E-6	2.23E-6	1.44E-6	1.12E-6	8.74E-7	6.92E-7	5.11E-7	4.82E-7
ESE	2.96E-13	5.26E-6	3.48E-6	2.04E-6	1.34E-6	9.93E-7	6.70E-7	5.76E-7	4.37E-7	3.83E-7
SE	9.16E-8	3.13E-6	3.38E-6	1.99E-6	1.31E-6	9.58E-7	7.14E-7	5.74E-7	4.32E-7	3.68E-7
SSE	3.50E-8	4.86E-6	3.33E-6	1.95E-6	1.29E-6	9.42E-7	6.55E-7	5.24E-7	3.95E-7	3.32E-7
S	1.22E-7	4.12E-6	3.97E-6	2.34E-6	1.59E-6	1.17E-6	7.75E-7	6.24E-7	4.74E-7	4.00E-7
SSW	1.75E-5	6.22E-6	2.84E-6	2.18E-6	1.48E-6	1.08E-6	7.83E-7	6.31E-7	5.62E-7	4.77E-7
SW	2.08E-5	9.11E-6	3.47E-6	2.19E-6	1.25E-6	1.11E-6	8.19E-7	7.17E-7	6.89E-7	5.85E-7
WSW	8.56E-8	9.35E-6	3.16E-6	2.29E-6	1.46E-6	1.01E-6	9.06E-7	7.52E-7	5.99E-7	5.07E-7
W	5.44E-17	4.52E-6	4.21E-6	2.49E-6	1.69E-6	1.25E-6	4.86E-7	7.68E-7	5.80E-7	5.48E-7
WNW	9.25E-18	1.44E-8	5.66E-8	1.92E-6	1.59E-6	1.17E-6	7.75E-7	4.61E-7	5.28E-7	4.89E-7
NW	2.61E-16	1.98E-8	8.37E-8	2.24E-6	1.46E-6	1.08E-6	8.09E-7	6.12E-7	5.42E-7	4.60E-7
NNW	1.91E-15	3.91E-6	3.66E-6	2.15E-6	1.40E-6	1.08E-6	8.03E-7	6.48E-7	5.37E-7	4.56E-7

ATTACHMENT O
Page 1 of 1
GASEOUS RADWASTE SYSTEM

FIGURE 2.4-1

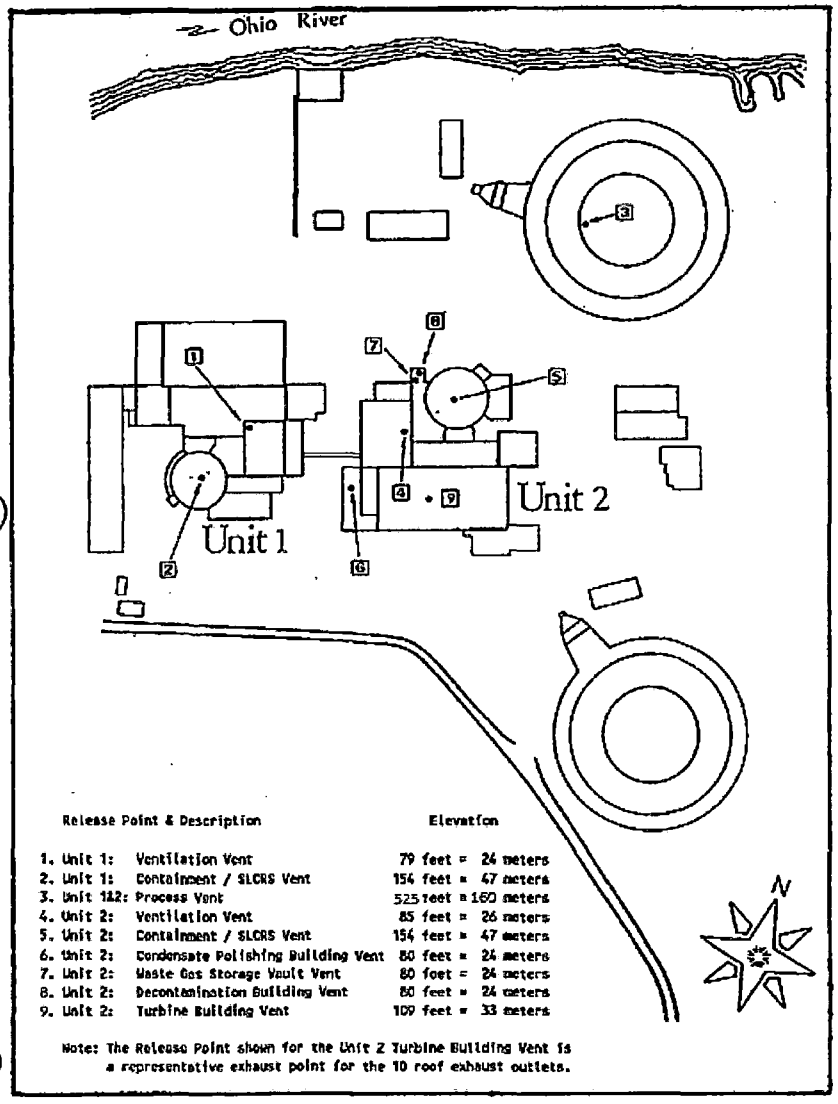
BV-1 AND 2 GASEOUS RADWASTE SYSTEM



ATTACHMENT P
Page 1 of 1
BV-1 AND BV-2 GASEOUS EFFLUENT RELEASE POINTS

FIGURE 2.4-2

BV-1 AND 2 GASEOUS EFFLUENT RELEASE POINTS



Release Point & Description		Elevation
1. Unit 1:	Ventilation Vent	79 feet = 24 meters
2. Unit 1:	Containment / SLCRS Vent	154 feet = 47 meters
3. Unit 1&2:	Process Vent	525 feet = 160 meters
4. Unit 2:	Ventilation Vent	85 feet = 26 meters
5. Unit 2:	Containment / SLCRS Vent	154 feet = 47 meters
6. Unit 2:	Condensate Polishing Building Vent	80 feet = 24 meters
7. Unit 2:	Waste Gas Storage Vault Vent	80 feet = 24 meters
8. Unit 2:	Decontamination Building Vent	80 feet = 24 meters
9. Unit 2:	Turbine Building Vent	109 feet = 33 meters

Note: The Release Point shown for the Unit 2 Turbine Building Vent is a representative exhaust point for the 10 roof exhaust outlets.

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ATTACHMENT Q
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SITE BOUNDARY FOR GASEOUS EFFLUENTS

Figure 5-1