RTL#: A9.621B

Beaver Valley Power Station

Unit 1/2

1/2-ODC-3.01

ODCM: Dispersion Calculation Procedure and Source Term Inputs

Document Owner
Manager, Nuclear Environmental & Chemistry

Revision Number	1
Level Of Use	General Skill Reference
Safety Related Procedure	Yes
Effective Date	12/29/06

TABLE OF CONTENTS

1.0 PURPOSE

1.1 This procedure contains the basic methodology that was used for calculating dispersion (χ/Q) and deposition (D/Q).

1.1.1 Prior to issuance of this procedure, these items were located in Appendix A of the old ODCM.

1.2 This procedure also contains the input parameters to the various computer codes used by the Licensee and its subcontractors for determination of the liquid and gaseous source term mixes.

1.2.1 Prior to issuance of this procedure, these items were located in Appendix B of the old ODCM.

2.0 SCOPE

2.1 This procedure is applicable to all station personnel (including subcontractors) that are qualified to perform activities as described and referenced in this procedure.

3.0 REFEFERENCES AND COMMITMENTS

3.1 References

3.1.1 NUS-2173, Development Of Terrain Adjustment Factors For Use At the Beaver Valley Power Station, For the Straight-Line Atmospheric Dispersion Model, NUS Corporation, June 1978

3.1.2 NUREG/CR-2919, XOQDOQ: Computer Program For The Meteorological Evaluation Of Routine Effluent Releases At Nuclear Power Stations, September, 1982

3.1.3 Regulatory Guide 1.23, Meteorological Measurement Program for Nuclear Power Plants

3.1.4 Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents In Routine Releases From Light-Water-Coded Reactors, Revision 1, July 1977

3.1.5 NRC Gale Code,

3.1.6 SWEC LIQ1BB Code,

3.1.7 SWEC GAS1BB Code,

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

3.1.9 1/2-ADM-1640, Control of the Offsite Dose Calculation Manual

3.1.10 1/2-ADM-0100, Procedure Writer's Guide

3.1.11 1/2-ADM-0101, Review and Approval of Documents

3.1.12 CR 05-01169, Chemistry Action Plan for Transition of RETS, REMP and ODCM. CA-19, Revise procedure 1/2-ODC-3.01 to change document owner from Manager, Radiation Protection to Manager, Nuclear Environmental & Chemistry.

12-29-06

3.2 Commitments

3.2.1 None

4.0 RECORDS AND FORMS

4.1 Records

4.1.1 Any calculation supporting generation of dispersion, deposition, or source term mixes 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 This procedure contains the information that was previously contained in Appendix A and Appendix B of the previous BV-1 and 2 Offsite Dose Calculation Manual.

5.1.1 In regards to this, the Tables that were transferred from Appendix A and Appendix B to the appropriate ATTACHMENTS of this procedure will still contain a prefix denoting an "A" or "B".

6.0 ACCEPTANCE CRITERIA

6.1 Any change 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 and Appendix I to 10 CFR 50, and not adversely impact the accuracy or reliability of effluent dose or setpoint calculation.

6.1.1 All changes to this procedure shall be prepared in accordance with 1/2-ADM-0100[3.1.10] and 1/2-ADM-1640.[3.1.9]

6.1.2 All changes to this procedure shall be reviewed and approved in accordance with 1/2 ADM-0101[3.1.11] and 1/2-ADM-1640.[3.1.9]

7.0 PREREQUISITES

7.1 The user of this procedure shall be familiar with ODCM structure and content.

8.0 PROCEDURE

8.1 Summary of Dispersion and Deposition Methodology

8.1.1 Annual average and grazing season average values of relative concentration (χ/Q) and deposition (D/Q) were calculated for continuous and intermittent gaseous releases of activity from the site according to the straight-line airflow (Gaussian) model described in RG-1.111.[3.1.4]

8.1.1.1 Undecayed and undepleted sector average χ/Q and D/Q values were obtained for each of sixteen 22.5-degree sectors at the site boundary and maximum individual receptors.

8.1.1.2 For an elevated release, (i.e.; occurring at a height that is twice the height or more of a nearby structure) credit was taken for the effective release height which is comprised of the physical release height plus momentum plume rise minus the terrain height at a given receptor.

8.1.1.3 A building wake correction factor was used to adjust calculations for ground-level releases.

8.1.1.4 Airflow reversals were also accounted for by applying site-specific terrain recirculation factors for both ground and elevated releases at the site.[3.1.1]

8.1.1.5 The methodology employed in the calculation of intermittent release χ/Q and D/Q values is that described in NUREG/CR-2919.[3.1.2]

8.1.2 The site continuous gaseous release points that have been evaluated include the following:

8.1.2.1 PV-1/2: The Unit 1/2 Gaseous Waste/Process Vent attached to the Unit 1 natural draft cooling tower

8.1.2.2 CV-1 and CV-2: The Unit 1 Rx Containment/SLCRS Vented the Unit 2 SLCRS Filtered Pathway

8.1.2.3 VV-1 and VV-2: The Unit 1 Ventilation Vent and the Unit 2 SLCRS Unfiltered Pathway

8.1.2.4 TV-2: The Unit 2 Turbine Building Vent

8.1.2.5 CB-2: The Unit 2 Condensate Polishing Building Vent

8.1.2.6 DV-2: The Unit 2 Decontamination Building Vent

8.1.2.7 WV-2: The Unit 2 Gaseous Waste Storage Tank Vault Vent

8.1.3 The intermittent releases are from PV-1/2, VV-1, VV-2, CV-1 and CV-2.

8.1.4 Only PV-1/2 was considered to be an elevated release with all other release points being treated as ground level releases. A summary of the release characteristics and their locations is given in ATTACHMENT A.

8.1.5 Onsite meteorological data for the period January 1, 1976 through December 31, 1980 were used as input for the annual-average calculations.

8.1.5.1 The grazing season was represented by a six-month period from May 1 through October 31 for each year of the 5-year meteorological data base. This grazing season corresponds reasonably well with the growing season.

8.1.5.2 The data were collected according to guidance in NRC RG-1.23[3.1.3] as described in Section 2.3 of the BVPS-2 FSAR.

8.1.5.3 The parameters used in the χ/Q and D/Q calculations consist of wind speed, wind direction, and ΔT as an indicator of atmospheric stability. The lower level winds (35 ft) and ΔT (150-35 ft) were used for all release points except the Process Vent which required the use of 500 ft winds and ΔT (500-35 ft) which are representative of the release height (510 ft).

8.1.6 The annual average and grazing season χ/Q and D/Q values for the continuous and intermittent radioactive releases were calculated at the site boundary, nearest resident, nearest vegetable garden, nearest milk cow, nearest milk goat, and nearest meat animal.

8.1.6.1 In the case of the Process Vent releases, several of each receptor type were evaluated in each downwind sector to determine the maximum χ/Q and D/Q values.

8.1.6.2 The distances of the limiting maximum individual receptors from the radioactive release points are given in ATTACHMENT E (Table 2.2-3) of 1/2-ODC-2.02.

8.1.6.3 The continuous release annual average χ/Q values at the special locations for the Containment Vents, Ventilation Vents, Process Vent, Turbine Building Vents, Decontamination Building Vent, Waste Gas Storage Vault Vent, and Condensate Polishing Building Vent are given in ATTACHMENT F (Tables 2.2-4 through 2.2-10) of 1/2-ODC-2.02. Continuous release annual average χ/Q's for these same release points are also given at ten incremental downwind distances of 0-5 miles.

8.1.6.4 Continuous release D/Q values for these same release points are given in ATTACHMENT K (Tables 2.3-21 through 2.3-27) of 1/2-ODC-2.02 for the same 0-5 mile incremental distances, and in ATTACHMENT L (Tables 2.3-28 through 2.3-34) of 1/2-ODC-2.02 for the special locations.

8.1.6.5 Due to their location adjacent to the Containment Building, the Decontamination Building and Gaseous Waste Storage Tank Vault χ/Q's and D/Q's are the same as the Containment Vent χ/Q's and D/Q's.

8.1.6.6 Likewise, the Turbine Building Vent χ/Q's and D/Q's apply to the Condensate Polishing Building as well due to its location adjacent to the Turbine Building.

8.1.7 ATTACHMENT M (Tables 2.3-35 through 2.3-38) of 1/2-ODC-2.02 contain short term χ/Q values for batch releases originating from the Containment Vent, Ventilation Vent, and Process Vent releases respectively.

8.1.7.1 The values in these tables are based on 32 hours per year of Containment and Ventilation Vent purges and 74 hours per year of Process Vent purges.

8.2 <u>Summary of Source Term Inputs</u>

8.2.1 <u>Liquid Source Term Inputs</u>

8.2.1.1 Inputs to the NRC Gale Code used for generation of BV-1 Liquid Source Term Mixes are shown in ATTACHMENT B (Table B:1a).

8.2.1.2 Inputs to the SWEC LIQ1BB Code used for generation of BV-2 Liquid Source Term Mixes are shown in ATTACHMENT B (Table B:1b)

8.2.2 <u>Gaseous Source Term Inputs</u>

8.2.2.1 Inputs to the SWEC GAS1BB Code for generation of BV-1 Gaseous Source Term Mixes are shown in ATTACHMENT C (Table B:2a)

8.2.2.2 Inputs to the SWEC GAS1BB Code for generation of BV-2 Gaseous Source Term Mixes are shown in ATTACHMENT C (Table B:2b)

Beaver Valley Power Station	Procedure Number: 1/2-ODC-3.01	
Title: ODCM: Dispersion Calculation Procedure and Source Term Inputs	Unit: 1/2	Level Of Use: General Skill Reference
	Revision: 1	Page Number: 8 of 12

ATTACHMENT A
Page 1 of 1
BV-1 AND 2 RELEASE CONDITIONS

TABLE A:1

	VV-1 VENTILATION VENT (PAB EXHAUST) VV-2 SLCRS UNFILTERED PATHWAY	CV-1 RX CONTAINMENT/ SLCRS VENT CV-2 RX CONTAINMENT/ SLCRS FILTERED PATHWAY	PV-1/2 GASEOUS WASTE/PROCESS VENT	TV-2 TURBINE BUILDING VENT
TYPE OF RELEASE	GROUND LEVEL	GROUND LEVEL	ELEVATED	GROUND LEVEL
	Long Term And Short Term	Long Term And Short Term	Long Term And Short Term	Long Term And Short Term
Release Point Height (m)	26	47	155	33
Adjacent Building Height (m)	19	44	155	33
Relative Location To Adjacent Structures	E. Side Of Primary Auxiliary Bldg	Top Center Of Containment Dome	Atop Cooling Tower	Turbine Building
Exit Velocity(m/sec)	NA	NA	9.4	NA
Internal Stack Diameter (m)	NA	NA	0.25	NA
Building Cross-Sectional Area (m^2)	1600	1600	NA	NA
Purge Frequency* (hours/year)	32	32	74	NA
Purge Duration (hrs/release)	8	8	NA	NA

*Applied to Short Term calculations only

ATTACHMENT B
Page 1 of 2
LIQUID SOURCE TERM INPUTS

TABLE B:1a
INPUTS TO GALE CODE FOR GENERATION OF BV-1 LIQUID SOURCE TERM MIXES

BV-1 PWR INPUTS	VALUE
Thermal Power Level (megawatts)	2766.000
Plant Capacity Factor	.800
Mass Of Primary Coolant (thousand lbs)	345.000
Percent Fuel With Cladding Defects	.120
Primary System Letdown Rate (gpm)	60.000
Letdown Cation Demineralizer Flow	6.000
Number Of Steam Generators	3.000
Total Steam Flow (million lbs/hr)	11.620
Mass Of Steam In Each Steam Generator (thousand lbs)	6.772
Mass Of Liquid In Each Steam Generator (thousand lbs)	97.000
Total Mass Of Secondary Coolant (thousand lbs)	1296.000
Mass Of Water In Steam Generator (thousand lbs)	291.000
Blowdown Rate (thousand lbs/hr)	33.900
Primary To Secondary Leak Rate (lbs/day)	100.000
Fission Product Carry-Over Fraction	.001
Halogen Carry-Over Fraction	.010
Condensate Demineralizer Flow Fraction	0.000
Radwaste Dilution Flow (thousand gpm)	22.500

BV-1 LIQUID WASTE INPUTS

STREAM	FLOW RATE (gal/day)	FRACTION OF PCA	FRACTION DISCHARGE	COLLECTION TIME (days)	DELAY TIME (days)	DECONTAMINATION FACTORS I	Cs	OTHERS
Shim Bleed Rate	1.32E4	1.000	0.000	11.260	7.220	1E7	1E7	1E7
Equipment Drains	6.00E2	1.000	0.000	11.260	7.220	1E7	1E7	1E7
Clean Waste Input	7.50E1	1.000	1.000	0.071	0.648	1E5	2E4	1E5
Dirty Waste Input	1.35E3	0.035	1.000	0.071	0.648	1E5	2E4	1E5
Blowdown	9.75E4	--	1.000	0.071	0.648	1E5	2E4	1E5
Untreated Blowdown	0.0	--	--	--	--	--	--	--

ATTACHMENT B
Page 2 of 2
LIQUID SOURCE TERM INPUTS

TABLE B:1b
INPUTS TO SWEC LIQ1BB CODE FOR GENERATION OF BV-2 LIQUID SOURCE TERM MIXES

BV-2 PWR INPUTS	VALUE
Thermal Power Level (megawatts)	2766.000
Plant Capacity Factor	.800
Mass Of Primary Coolant (thousand lbs)	385.000
Percent Fuel With Cladding Defects	.120
Primary System Letdown Rate (gpm)	57.000
Letdown Cation Demineralizer Flow	5.700
Number Of Steam Generators	3.000
Total Steam Flow (million lbs/hr)	11.600
Mass Of Steam In Each Steam Generator (thousand lbs)	8.700
Mass Of Liquid In Each Steam Generator (thousand lbs)	100.000
Total Mass Of Secondary Coolant (thousand lbs)	2000.000
Mass Of Water In Steam Generator (thousand lbs)	298.000
Blowdown Rate (thousand lbs/hr)	22.300
Primary To Secondary Leak Rate (lbs/day)	100.000
Fission Product Carry-Over Fraction	.001
Halogen Carry-Over Fraction	.010
Condensate Demineralizer Flow Fraction	.700
Radwaste Dilution Flow (thousand gpm)	7.800

BV-2 LIQUID WASTE INPUTS

STREAM	FLOW RATE (gal/day)	FRACTION OF PCA	FRACTION DISCHARGE	COLLECTION TIME (hrs)	DELAY TIME (hrs)	DECONTAMINATION FACTORS I	CsRb	OTHERS
Containment Sump	40	1.000	1.0	35.5	6.2	1E3	1E4	1E4
Auxiliary Building Sump	200	0.100	1.0	35.5	6.2	1E3	1E4	1E4
Miscellaneous Sources	700	0.010	1.0	35.5	6.2	1E3	1E4	1E4
Rx Plant Samples	35	1.000	1.0	35.5	6.2	1E3	1E4	1E4
Lab Drains	400	0.002	1.0	35.5	6.2	1E3	1E4	1E4
Cond. Demin. Rinse Water	2685	1.1E-4	1.0	35.5	6.2	1E3	1E4	1E4
CVCS	60	--	1.0	1300	173	1E4	4E3	1E5
Turbine Bldg.Drains	7200	--	1.0	--	--	--	--	--

ATTACHMENT C
Page 1 of 2

GASEOUS SOURCE TERM INPUTS

TABLE B:2a
INPUTS TO SWEC GAS1BB CODE FOR GENERATION OF BV-1 GASEOUS SOURCE TERM MIXES

BV-1 PWR INPUTS	VALUE
Thermal Power Level (megawatts)	2766.000
Plant Capacity Factor	.800
Mass Of Primary Coolant (thousand lbs)	385.000
Percent Fuel With Cladding Defects	.120
Primary System Letdown Rate (gpm)	57.000
Letdown Cation Demineralizer Flow	5.700
Number Of Steam Generators	3.000
Total Steam Flow (million lbs/hr)	11.600
Mass Of Steam In Each Steam Generator (thousand lbs)	8.700
Mass Of Liquid In Each Steam Generator (thousand lbs)	100.000
Total Mass Of Secondary Coolant (thousand lbs)	2000.000
Mass Of Water In Steam Generator (thousand lbs)	298.000
Blowdown Rate (thousand lbs/hr)	52.000
Primary To Secondary Leak Rate (lbs/day)	100.000
Fission Product Carry-Over Fraction	.001
Halogen Carry-Over Fraction	.010
Condensate Demineralizer Flow Fraction	0.000
Radwaste Dilution Flow (thousand gpm)	15.000

BV-1 GASEOUS WASTE INPUTS	VALUE
There Is Not Continuous Stripping Of Full Letdown Flow	
Hold Up Time For Xenon (days)	39.000
Hold Up Time For Krypton (days)	2.000
Primary Coolant Leak To Auxiliary Building (lb/day)	160.000
Auxiliary Building Leak Iodine Partition Factor	7.5E-3
Gas Waste System Particulate Release Fraction	0.000
Auxiliary Building Charcoiodine Release Fraction	1.000
Auxiliary Building Particulate Release Fraction	1.000
Containment Volume (million cu-ft)	1.800
Frequency Of Primary Coolant Degassing (times/yr)	2.000
Primary To Secondary Leak Rate (lb/day)	100.000
There Is A Kidney Filter	
Containment Atmosphere Cleanup Rate (thousand cfm)	2.000
Purge Time Of Containment (hours)	8.000
There Is Not A Condensate Demineralizer	
Iodine Partition Factor (gas/liq) In Steam Generator	0.010
Frequency Of Containment Building High Vol Purge (times/yr)*	4.000
Containment Volume Purge Iodine Release Fraction	1.000
Containment Volume Purge Particulate Release Fraction	1.000
Steam Leak To Turbine Building (lbs/hr)	1700.000
Fraction Iodine Released From Blowdown Tank Vent	0.000
Fraction Iodine Released From Main Condensate Air Ejector	0.440
There Is Not A Cryogenic Off Gas System	

*2 cold and 2 hot purges

ATTACHMENT C
Page 2 of 2
GASEOUS SOURCE TERM INPUTS

TABLE B:2b
INPUTS TO SWEC GAS1BB CODE FOR GENERATION OF BV-2 GASEOUS SOURCE TERM MIXES

BV-2 PWR INPUTS	VALUE
Thermal Power Level (megawatts)	2766.000
Plant Capacity Factor	.800
Mass Of Primary Coolant (thousand lbs)	385.000
Percent Fuel With Cladding Defects	.120
Primary System Letdown Rate (gpm)	57.000
Letdown Cation Demineralizer Flow	5.700
Number Of Steam Generators	3.000
Total Steam Flow (million lbs/hr)	11.600
Mass Of Steam In Each Steam Generator (thousand lbs)	8.700
Mass Of Liquid In Each Steam Generator (thousand lbs)	100.000
Total Mass Of Secondary Coolant (thousand lbs)	2000.000
Mass Of Water In Steam Generator (thousand lbs)	298.000
Blowdown Rate (thousand lbs/hr)	22.300
Primary To Secondary Leak Rate (lbs/day)	100.000
Fission Product Carry-Over Fraction	.001
Halogen Carry-Over Fraction	.010
Condensate Demineralizer Flow Fraction	.700
Radwaste Dilution Flow (thousand gpm)	7.800

BV-2 GASEOUS WASTE INPUTS	VALUE
There Is Not Continuous Stripping Of Full Letdown Flow	
Hold Up Time For Xenon (days)	45.800
Hold Up Time For Krypton (days)	2.570
Primary Coolant Leak To Auxiliary Building (lb/day)	160.000
Auxiliary Building Leak Iodine Partition Factor	7.5E-3
Gas Waste System Particulate Release Fraction	0.000
Auxiliary Building Charcoiodine Release Fraction	0.100
Auxiliary Building Particulate Release Fraction	0.010
Containment Volume (million cu-ft)	1.800
Frequency Of Primary Coolant Degassing (times/yr)	2.000
Primary To Secondary Leak Rate (lb/day)	100.000
There Is A Kidney Filter	
Containment Atmosphere Cleanup Rate (thousand cfm)	20.000
Purge Time Of Containment (hours)	8.000
There Is Not A Condensate Demineralizer	
Iodine Partition Factor (gas/liq) In Steam Generator	0.010
Frequency Of Containment Building High Vol Purge (times/yr)*	4.000
Containment Volume Purge Iodine Release Fraction	1.000
Containment Volume Purge Particulate Release Fraction	1.000
Steam Leak To Turbine Building (lbs/hr)	1700.000
Fraction Iodine Released From Blowdown Tank Vent	0.000
Fraction Iodine Released From Main Condensate Air Ejector	0.270
There Is Not A Cryogenic Off Gas System	

*2 cold and 2 hot purges