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	9. Initiating Doc. No. PDC 2406	21. Priority 1
3. From Robin Feuerbacher	4. Purchase Order/Contract No.	
5. Energy Northwest Cognizant Engineer Mohammed Abu-Shehadeh 6/15/04 Mohammed Abu-Shehadeh	14. Receipt Acknowledged	

6. Originator Remarks
Please make a copy for Mohammed Abu-Shehadeh

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1	NE-02-03-14		0	Control Room X/Q Using ARCON96 with the 1996-1999 Meteorological Data	X			A

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16. Energy Northwest Disposition

Engineering Manager Robin L. Feuerbacher 6/22/04 Plant Technical Services Manager (if required)

6. Engr. Req. Response Date / ACTION PARTIES	19. REQ APPROVE	19. REQ REVIEW	20. RESPONSE APPROVE	20. RESPONSE APPROVED AS NOTED	20. RESPONSE DISAPPROVE	SIGNATURE AND DATE	ACTION PARTIES	19. REQ APPROVE	19. REQ REVIEW	20. RESPONSE APPROVE	20. RESPONSE APPROVED AS NOTED	20. RESPONSE DISAPPROVE	SIGNATURE AND DATE
5. Cognizant Engineer Mohammed Abu-Shehadeh	x		x			6/15/04 Mohammed Abu-Shehadeh	18. Design ALARA						
17. Component/System Anal.							18. Penetrations						
17. Mechanical Engineering							18. ASME Code Compliance						
17. Electrical/I&C Engineering							18. Control Sys. Failure						
18. Overall Design Verif. Ted Messier	x	x	x			Ted Messier 6/15/04	18. Pipe Break.Missile						
18. Equip. Engineering							18. App. R/Electrical Sep.						
18. Human Factors							18. Health Safety/Fire Prot.						
18. Emergency Prep.							18. Security Tim Powell	x	x	x			T Powell 6-21-04
18. Environmental Larry Linik	x		x			6/16/04	18. Quality Assurance						
18. MEL Input Coord.							18. Project Engineer Abbas Mostala	x		x			A. Mostala 6/21/04

968-12310 R7 (12/00)

ENERGY NORTHWEST People · Vision · Solutions	CALCULATION COVER SHEET	BDC/PDC Page PDC 2406

Equipment Piece No.	Project Columbia	Page 1.0 Cont'd on Page
	Discipline Nuclear Engr	Calculation No. NE-02-03-14
		Quality Class 1
	Remarks	

TITLE/SUBJECT/PURPOSE

Control Room X/Q Using ARCON96 with the 1996-1999 Meteorological Data

Purpose: The purpose of this calculation is to determine the X/Q values for the Control Room using ARCON96 with the 1996 – 1999 meteorological data.

CALCULATION REVISION RECORD

REV NO.	STATUS/ F,P, OR S	REVISION DESCRIPTION	INITIATING DOCUMENTS	TRANSMITTAL NO.
0	F	New Calculation	PDC 2406	

PERFORMANCE/VERIFICATION RECORD

REV NO.	PERFORMED BY/DATE	VERIFIED BY/DATE	APPROVED BY/DATE
0	Mohammed Abu-Shehadeh Mohammed Abu-Shehadeh 6/15/04	Ted Messier Theodore A. Messier 6/18/04	Larry Linik 21 Jun 04 L.L. Linik

* Study Calculations shall be used only for the purpose of evaluating alternate design options or assisting the engineer in performing assessments.

ENERGY NORTHWEST People·Vision·Solutions	CALCULATION INDEX	Page No. 1.1	Cont'd on page
		Calculation No. NE-02-03-14	
		Revision No. 0	

APPENDICES:

ENERGY NORTHWEST People·Vision·Solutions	VERIFICATION CHECKLIST	Page No. 1.2	Cont'd on page
		Calculation No. NE-02-03-14	

Calculation/CMR NE-02-03-14 **Revision** 0
was verified using the following methods:

☒ Checklist Below ☐ Alternate Calculation(s)

Checklist Item	Verifier Initials
Clear statement of purpose of analysis	Jam
Methodology is clearly stated, sufficiently detailed, and appropriate for the proposed application	Jam
Does the analysis/calculation methodology (including criteria and assumptions) differ from that described in the Plant or ISFSI FSAR or NRC Safety Evaluation Report, or are the results of the analysis/calculation as described in the Plant or ISFSI FSAR or NRC Safety Evaluation Report affected? ☒ Yes ☐ No	Jam
If Yes, ensure that the requirements of 10 CFR 50.59 and/or 10 CFR 72.48 have been processed in accordance with SWP-LIC-02.	Jam
Does the analysis/calculation result require revising any existing output interface document as identified in DES-4-1, Attachment 7.3? ☒ Yes ☐ No	Jam
If Yes, ensure that the appropriate actions are taken to revise the output interface documents per DES-4-1, section 3.1.8 (i.e., document change is initiated in accordance with applicable procedures).	Jam
Logical consistency of analysis	Jam
• Completeness of documenting references	Jam
• Completeness of input	Jam
• Accuracy of input data	Jam
• Consistency of input data with approved criteria	Jam
• Completeness in stating assumptions	Jam
• Validity of assumptions	Jam
• Calculation sufficiently detailed	Jam
• Arithmetical accuracy	Jam
• Physical units specified and correctly used	Jam
• Reasonableness of output conclusion	Jam
Supervisor independency check (if acting as Verifier)	
- Did not specify analysis approach	
- Did not rule out specific analysis options	
- Did not establish analysis inputs	
If a computer program was used:	Jam
- Is the program appropriate for the proposed application?	
- Have the program error notices been reviewed to determine if they pose any limitations for this application?	
- Is the program name, revision number, and date of run inscribed on the output?	
- Is the program identified on the Calculation Method Form? If so, is it listed in Chapter 10 of the Engineering Standards Manual?	Jam
Other elements considered:	
_____	_____
_____	_____

If separate Verifiers were used for validating these functions or a portion of these functions, each sign and initial below.

Based on the foregoing, the Calculation/CMR is adequate for the purpose intended.

Verifier Signature(s)/Date	Verifier Initials
Theodore A. Messien 6/18/04	Jam
_____	_____
_____	_____

ENERGY NORTHWEST People·Vision·Solutions	CALCULATION REFERENCE LIST	Page No. 1.3	Cont'd on page
		Calculation No. NE-02-03-14	
Prepared by / Date: M Abu-Shehadeh 6/15/04	Verified by/Date: Ted Messier 6/18/04	Revision No.	0

NO	AUTHOR	ISSUE DATE/ EDITION OR REV.	TITLE	DOCUMENT NO.
1	J. V. Ramsdell, Jr. C. A. Simonen	May 1997 Rev. 1	Atmospheric Relative Concentrations in Building Wakes	NUREG/CR-6331 PNNL-10521
2	Burns and Roe, Inc	3/4/2002 Rev. 6	East Elevation (Reactor Building)	DWG. A502
3	Burns and Roe, Inc	9/9/1994 Rev. 9	HVAC Plan and Sections at 531'-0" Turbine Generator Building	DWG. M803
4	Burns and Roe, Inc	4/15/1983 Rev. 5	West Elevation (Reactor Building)	DWG. A504
5	WPPSS	5/30/1990	Civil Site Paving & Grading	DWG. C875B
6	WPPSS	5/30/1990	Civil Site Paving & Grading	DWG. C878B
7	NRC	June 2003	Atmospheric Relative Concentrations for Control Room Habitability Assessments at Nuclear Power Plants	Reg. Guide 1.194
8	Framatome, ANP (Ted Messier)	12/19/2003 rev. 1	Generation of Columbia Generating Station Meteorological Data Input Files for Computer Code ARCON96	32-5031898-01
9	Energy Northwest	1/16/2002	Industrial Master Data Sheet, EPN MET-TE-11A	DIC: 1801.1
10	Energy Northwest	1/16/2002	Industrial Master Data Sheet, EPN MET-TE-10A	DIC: 1801.1
11	Burns and Roe, Inc	4/13/1988 Rev. 7	North Elevation (Reactor Building)	DWG. A501
12	Burns and Roe, Inc	5/25/1983 Rev.19	Structural Reactor Building Exterior Walls	DWG. S737
13	Energy Northwest	November 1998	WNP-2 FSAR	
14	Energy Northwest	Amendment 169	Technical Specification Columbia Generating Station	
15	Energy Northwest Linda Woosley	11/15/2002 Rev. 1	Secondary Containment Bypass Leakage Limit	NE-02-85-12
16	Energy Northwest	4/02/01 Rev. 19	Turbine Generator Building HVAC system	Procedure No. 2.10.2
17	Burns and Roe, Inc	9/19/1975 Rev. 7	Condensate Storage Tanks	2-204-00, 88
18	WPPSS	5/30/1990 Rev. 0	Civil Site Paving & Grading	DWG. C876B

ENERGY NORTHWEST People · Vision · Solutions	CALCULATION OUTPUT INTERFACE DOCUMENT REVISION INDEX	Page No. 1.4	Cont'd on page
		Calculation No. NE-02-03-14	
Prepared by / Date: M Abu-Shehadeh 6/15/04	Verified by/Date: Ted Messier 6/18/04	Revision No. 0	

The below listed output interface calculations and/or documents are impacted by the current revision of the subject calculation. The listed output interfaces require revision as a result of this calculation. The documents have been revised, or the revision deferred with Manager approval, as indicated below.

AFFECTED DOCUMENT NO.	CHANGED BY (e.g., BDC, SCN, CMR, Rev.)	CHANGED DEFERRED (e.g., RFTS, LETTER NO.)	DEPT. MANAGER *
NE-02-99-13	PDC 2406	PTL-213162	
NE-02-88-27	PDC 2406	PTL-213162	

* Required for deferred changes only.

Discussion of Results:

The ARCON96 X/Q results presented in Appendix B are summarized below for both filtered flow and unfiltered inleakage into the control room. The filtered flow effective X/Q was calculated based on the procedure described in section 5, whereas the unfiltered inleakage X/Q for each source was taken as the X/Q at the local intake since it represents the most likely point of entry for the unfiltered inleakage.

Conclusion: A summary of X/Q for the filtered flow and the unfiltered inleakage is presented in the 4 tables below for the different possible control room intake flow rate combinations. The first table is for the 1600/900 cfm combination assuming one train is secured within the first 2 hours, the second table is for the 1300/800 cfm combination assuming one train is secured within the first 2 hours, the third table is for the 1300/800 cfm combination assuming one train is secured between 2 – 8 hours, and the fourth table is for the 1300 cfm flow rate assuming both trains remained on for 30 days. A detailed description is given in section 5.

Filtered CR Intake Flow (using the 1600/900 cfm flow rate and assuming one train is Secured between 0-2 hrs) and Unfiltered inleakage X/Q (s/m^3)

	Filtered				Unfiltered			
	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building
0 - t hrs	1.60E-04	4.07E-04	2.22E-04	4.41E-04	6.95E-04	5.34E-04	8.69E-04	4.70E-03
t - 2 hrs	1.47E-04	3.75E-04	2.05E-04	7.83E-04	6.95E-04	5.34E-04	8.69E-04	4.70E-03
2 - 8 hrs	1.08E-04	2.97E-04	1.48E-04	3.33E-04	3.36E-04	1.97E-04	4.40E-04	2.00E-03
8 - 24 hrs	4.25E-05	1.21E-04	5.88E-05	1.72E-04	1.28E-04	8.41E-05	1.75E-04	1.03E-03
1 - 4 days	3.61E-05	1.01E-04	5.13E-05	1.34E-04	9.72E-05	7.26E-05	1.38E-04	8.01E-04
4 - 30 days	3.10E-05	8.83E-05	4.29E-05	1.28E-04	7.69E-05	7.00E-05	1.10E-04	7.69E-04

Filtered CR Intake Flow (using the 1300/800 cfm flow rate and assuming one train is Secured between 0-2 hrs) and Unfiltered inleakage X/Q (s/m^3)

	Filtered				Unfiltered			
	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building
0 - t hrs	1.56E-04	3.98E-04	2.17E-04	5.42E-04	6.95E-04	5.34E-04	8.69E-04	4.70E-03
t - 2 hrs	1.43E-04	3.65E-04	1.99E-04	8.81E-04	6.95E-04	5.34E-04	8.69E-04	4.70E-03
2 - 8 hrs	1.05E-04	2.89E-04	1.44E-04	3.75E-04	3.36E-04	1.97E-04	4.40E-04	2.00E-03
8 - 24 hrs	4.14E-05	1.18E-04	5.73E-05	1.93E-04	1.28E-04	8.41E-05	1.75E-04	1.03E-03
1 - 4 days	3.52E-05	9.83E-05	5.00E-05	1.50E-04	9.72E-05	7.26E-05	1.38E-04	8.01E-04
4 - 30 days	3.03E-05	8.61E-05	4.18E-05	1.44E-04	7.69E-05	7.00E-05	1.10E-04	7.69E-04

Filtered CR Intake Flow (using the 1300/800 cfm flow rate and assuming one train is Secured Between 2-8 hrs) and Unfiltered inleakage X/Q (s/m^3)

	Filtered				Unfiltered			
	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building
0 - 2 hrs	1.56E-04	3.98E-04	2.17E-04	5.42E-04	6.95E-04	5.34E-04	8.69E-04	4.70E-03
2 - t hrs	1.15E-04	3.15E-04	1.57E-04	2.31E-04	3.36E-04	1.97E-04	4.40E-04	2.00E-03
t - 8 hrs	1.05E-04	2.89E-04	1.44E-04	3.75E-04	3.36E-04	1.97E-04	4.40E-04	2.00E-03
8 - 24 hrs	4.14E-05	1.18E-04	5.73E-05	1.93E-04	1.28E-04	8.41E-05	1.75E-04	1.03E-03
1 - 4 days	3.52E-05	9.83E-05	5.00E-05	1.50E-04	9.72E-05	7.26E-05	1.38E-04	8.01E-04
4 - 30 days	3.03E-05	8.61E-05	4.18E-05	1.44E-04	7.69E-05	7.00E-05	1.10E-04	7.69E-04

Filtered CR Intake Flow of 1300 cfm (Assuming Both Trains Remain on For 30 Days and Unfiltered inleakage X/Q (s/m^3)

	Filtered				Unfiltered			
	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building	SGT Roofline	KK doors SC Bypass	RBW SC Bypass	Turbine Building
0 - 2 hrs	1.56E-04	3.98E-04	2.17E-04	5.42E-04	6.95E-04	5.34E-04	8.69E-04	4.70E-03
2 - 8 hrs	1.15E-04	3.15E-04	1.57E-04	2.31E-04	3.36E-04	1.97E-04	4.40E-04	2.00E-03
8 - 24 hrs	4.51E-05	1.28E-04	6.24E-05	1.19E-04	1.28E-04	8.41E-05	1.75E-04	1.03E-03
1 - 4 days	3.83E-05	1.07E-04	5.44E-05	9.24E-05	9.72E-05	7.26E-05	1.38E-04	8.01E-04
4 - 30 days	3.30E-05	9.38E-05	4.56E-05	8.87E-05	7.69E-05	7.00E-05	1.10E-04	7.69E-04

ENERGY NORTHWEST People·Vision·Solutions	CALCULATION METHOD	Page No. 3.0	Cont'd on page 4.0
		Calculation No. NE-02-03-14	
Prepared by / Date: M Abu-Shehadeh 6/15/04	Verified by/Date: Ted Messier 6/18/04	Revision No. 0	

Analysis Method (Check appropriate boxes)

☐ Manual (As required, document source of equations in Reference List)

☒ Computer ☐ Main Frame ☒ Personal

☐ In-House Program
☐ Computer Service Bureau Program

☐ BCS ☐ CDC ☐ PCC ☐ OTHER _____

☒ Verified Program: Code name/Revision ARCON96 / Rev. 1

☐ Unverified Program: _____

_____

_____

Approach/Methodology

1- ARCON96 was used to calculate X/Q for the 3 control room intakes from all 5 potential sources at CGS. The intakes and the sources are discussed in section 5. The X/Q for the Condensate Storage Tanks (CST) is calculated separately in Attachment-1.
2- Input parameters were selected/calculated based on the recommendations provided in Regulatory Guide 1.194.
3- Four years of meteorological data (96, 97, 98, 99) were used in the ARCON96 calculations.

Sketches and Diagrams

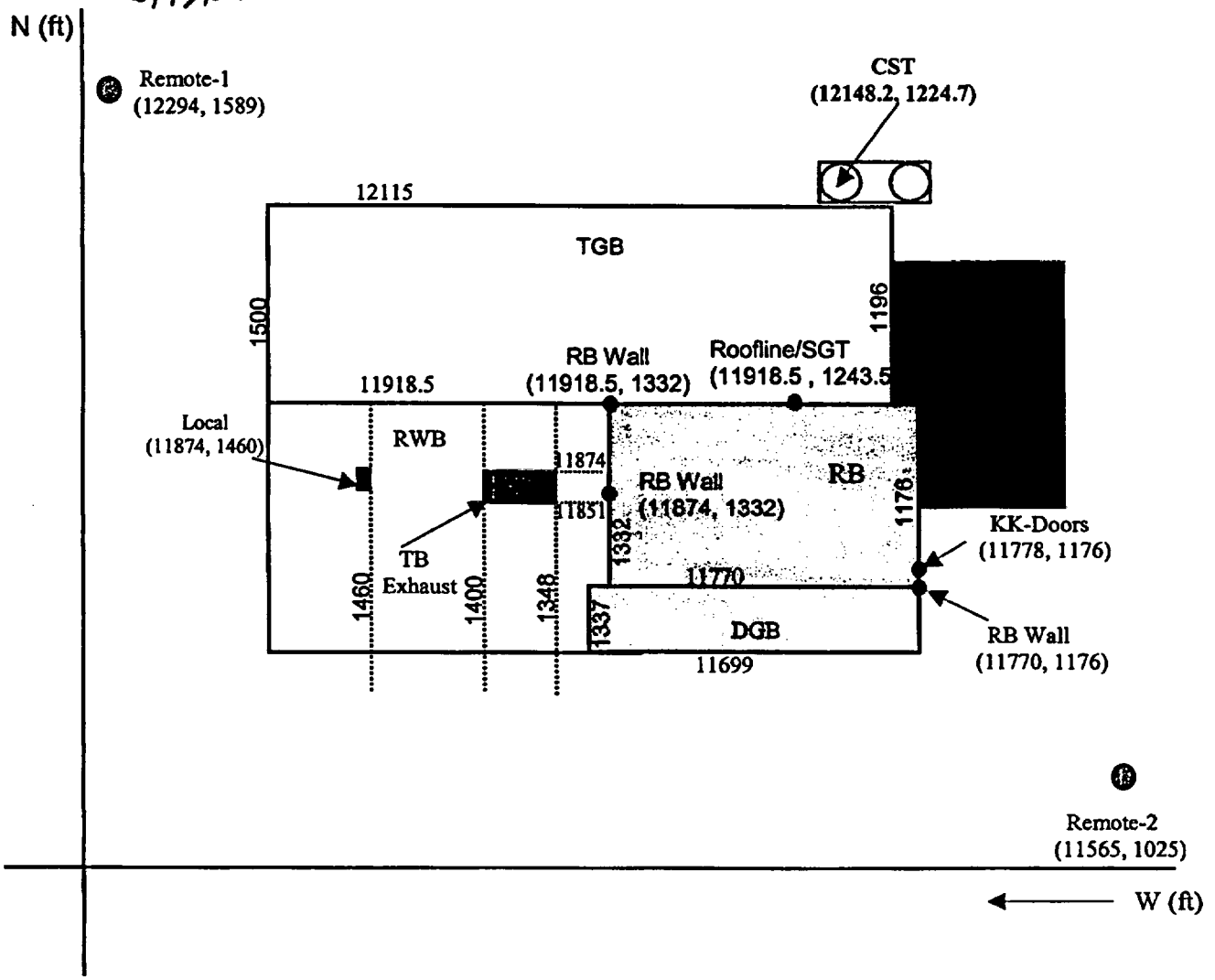

Figure 1. A schematic Layout of the Plant Structure Showing Sources and Intakes at CGS

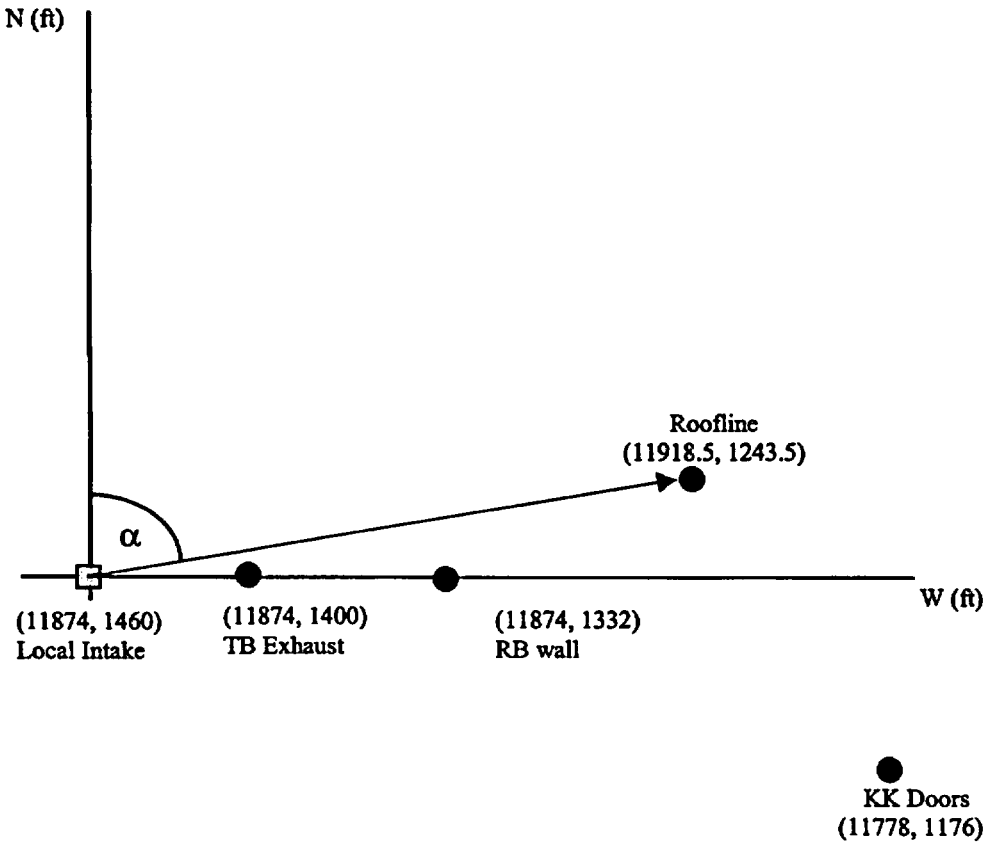

Figure 2. Location of Sources Relative to the Local Intake

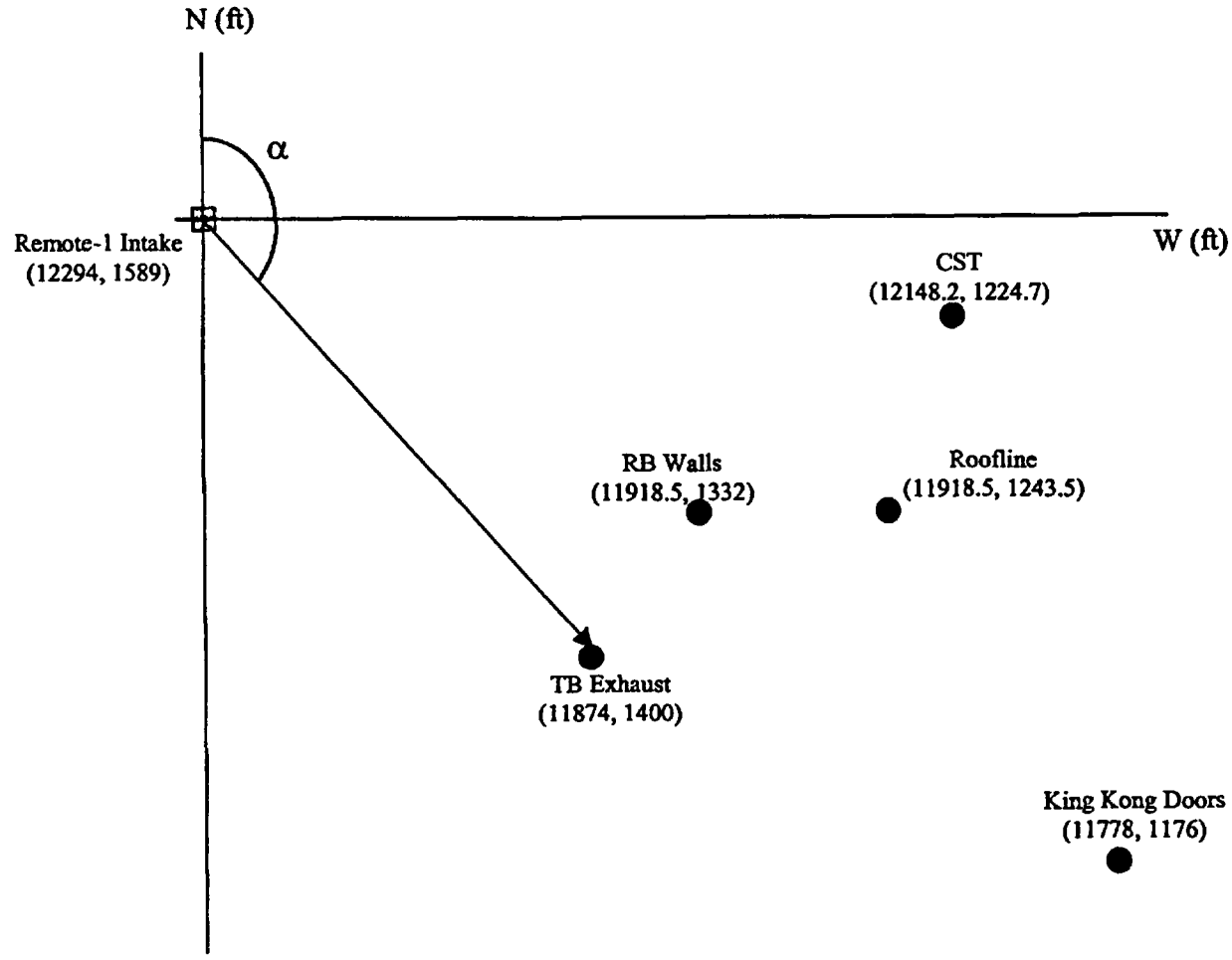

Figure 3. Location of Sources Relative to the Remote-1 Intake

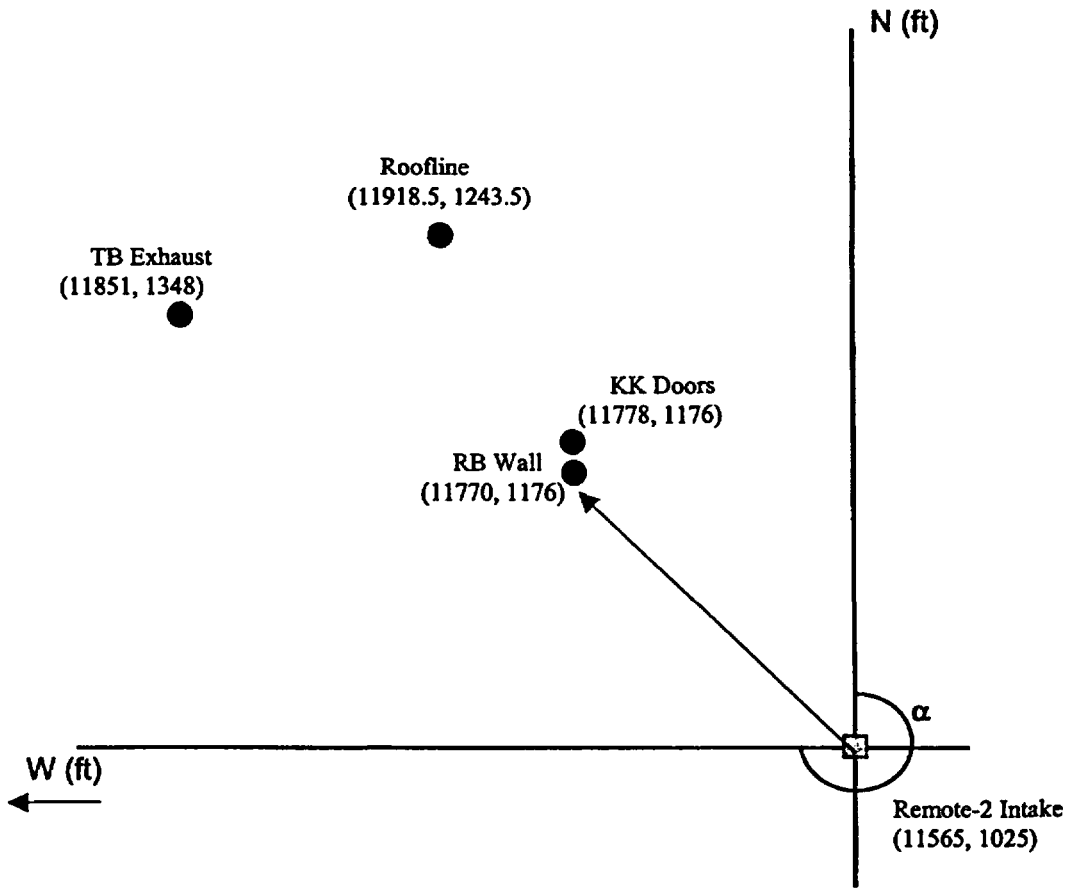

Figure 4. Location of Sources Relative to the Remote-2 Intake

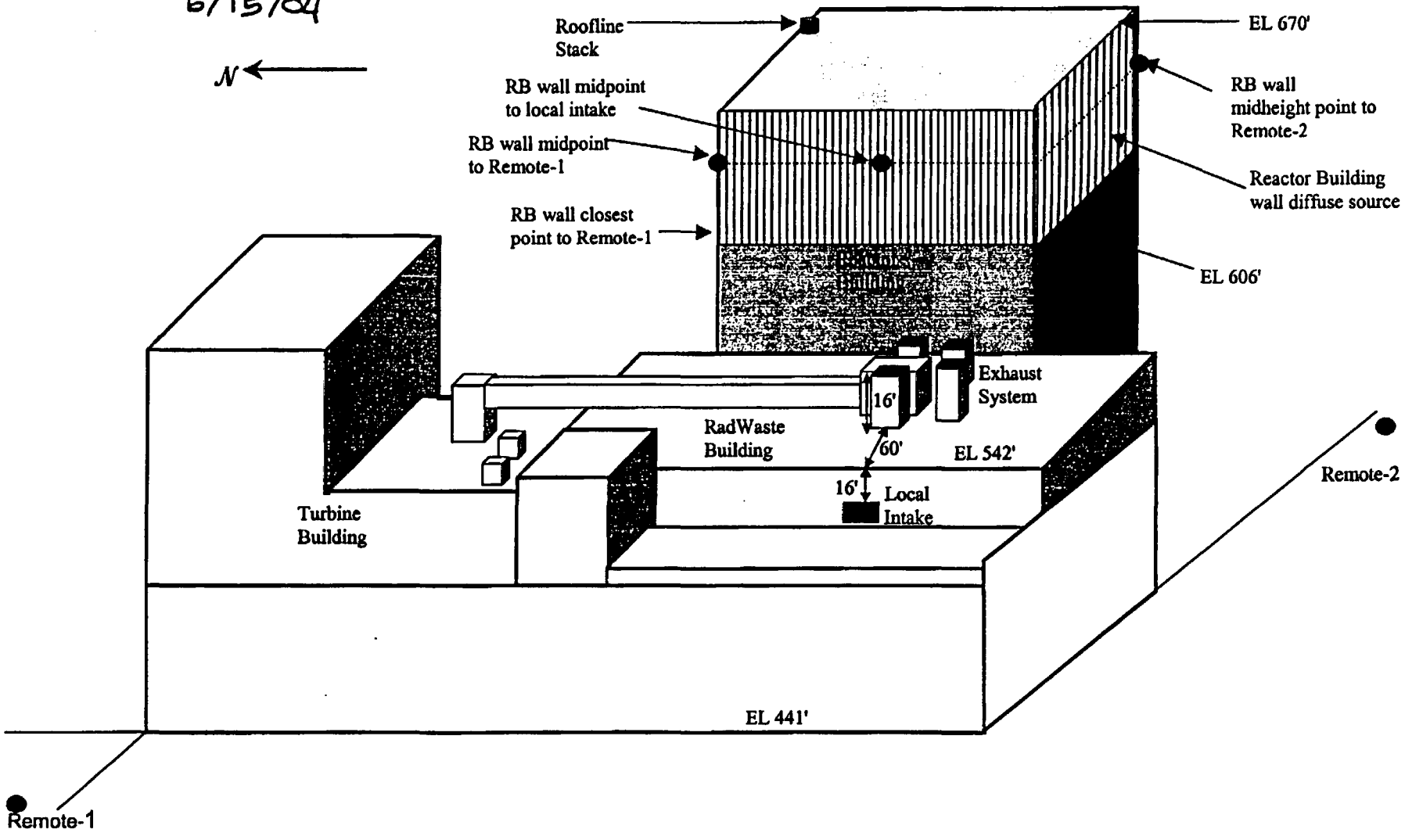

Figure 5. A 3-Dimentional Diagram Showing the Locations of the Sources and Intakes at CGS

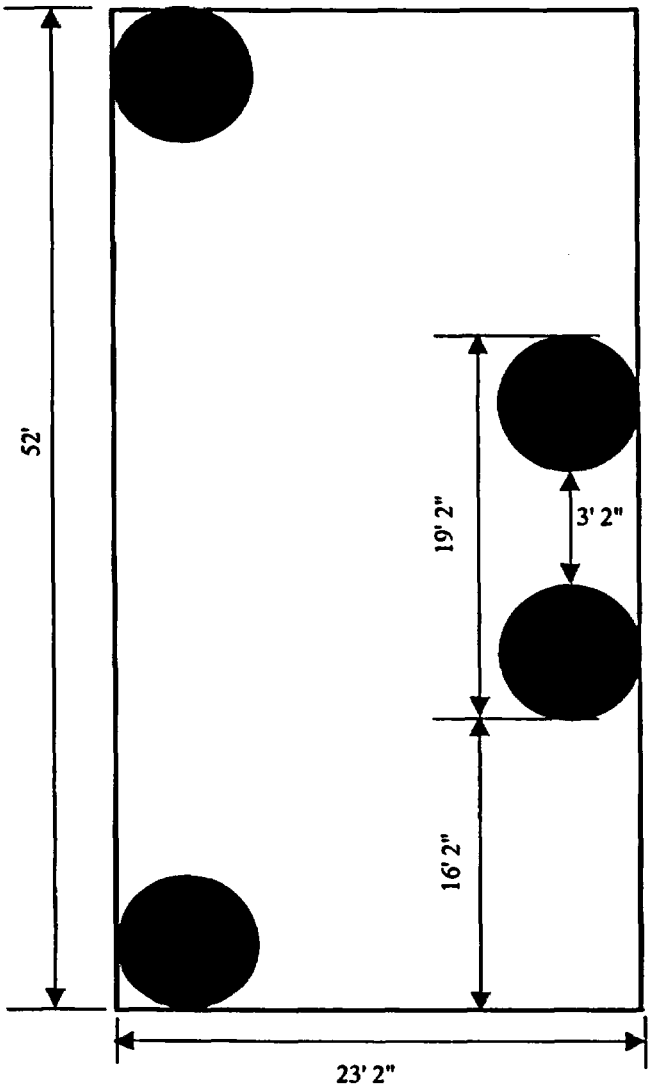

Figure 6. The Four Turbine Building Exhaust System Vents on Top of the Radwaste Building

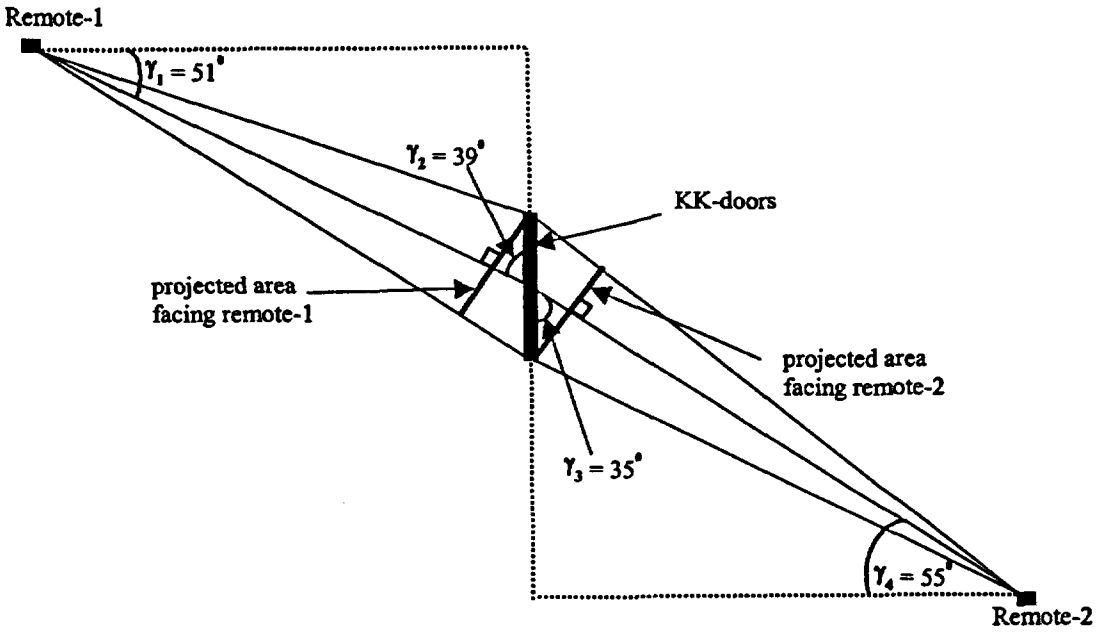

Figure 7. The Projected Areas of the King Kong Doors with Respect to the Remote Intakes

REV BAR.

PURPOSE: The purpose of this calculation is to perform control room air dispersion factors X/Q (X is the concentration of a radionuclide at a receptor location in Ci/m3-air normalized by the source emission rate Q in Ci/s) calculations using ARCON96 computer code (ref. 1) following a core damage accident at Columbia Generating Station, CGS, using the 1996 – 1999 meteorological data. Upon license amendment approval, this calculation shall supersede all previous control room X/Q calculations.

DESCRIPTION OF SOURCES: There are 5 sources at Columbia Generating Station (CGS) that could release radioactivity to the environment following an accident. The relative locations of these sources are shown in figures 1 and 5, and they are described below:

A. The roofline source is a vent (short stack) on top of the reactor building at a height of 229 ft (70 m) above the ground through which routine releases take place. Following an accident, the exhaust air from the reactor building passes through the SGT filtration system before exiting through the roofline stack. This source is treated as a ground level point source in the X/Q calculations.

B. The reactor building King Kong doors are located at the ground level on the eastside wall of the reactor building. It is assumed that some leakage to the environment takes place through these doors. The King Kong doors are treated as a rectangular diffuse source that is 23 ft high x 20 ft wide (ref. 2).

C. The reactor building walls from the 606 ft level to the 670 ft level (top of reactor building) are made of metal sheets and therefore they are assumed to be a diffuse source capable of leaking radioactive materials to the atmosphere, this source is also treated as a ground level release source.

D. The Turbine Building Exhaust System (TBES) is a set of four circular vents (short stacks) located on top of the radwaste building roof, each vent is 8 ft in diameter, (ref. 3). Air from the turbine building is exhausted to the atmosphere through these 4 vents, figures 5 and 6. A 52' x 23' rectangle was drawn around the four vents, figure 6, then the closest point on the perimeter of this rectangle is selected to calculate the distance between the source (one of the 4 vents) and the corresponding intake. A single vent located at the closest point represents the source. Instead of selecting the turbine building walls as the source of radioactivity released from the turbine building, the TBES has been selected due to its close proximity to the control room local intake resulting in higher concentrations (or X/Q) at the local intake point. The TBES can shut off if the offsite power is lost, however plant procedures instruct the reactor operators to recover and run the exhaust system when radiation is detected in the turbine building. Therefore, the TBES is the most likely path (source) when radioactivity is present in the turbine building.

E. Condensate Storage Tanks (CST): Two tanks located to the north of the turbine building with a potential to release radioactivity from liquid leakage originating from the suppression pool and bypassing the reactor building. The X/Q analysis for this release pathway is discussed separately in Attachment 1.

DESCRIPTION OF INTAKES (RECEPTORS): There are three intakes at CGS which draw air into the control room during normal operation as well as post accident. The relative locations of these three intakes are shown in figures 1 and 5, while a description of the intakes is given below:

1- Local intake point: The local intake point is a vent located on the west side of the radwaste building wall at an elevation of 527 ft (26.5 m above the ground, ref. 4).

2- Remote intakes: there are two ground level remote intake points which are approximately 180 degrees from each other. One remote intake is located to the north-west side of the turbine building and is labeled remote-1 (ref. 5), the other is located to the south-east side of the reactor building and is labeled remote-2 (ref. 6).

APPROACH/METHODOLOGY: Four years of meteorological data (from 1996 to 1999) were used as input to the ARCON96 computer program to generate X/Q values. Other input parameters have been calculated in appendix A, and the assumptions made in selecting/calculating those input parameters are also presented in the appendix. A summary of those parameters is presented in Table-1 below.

Considering the first 4 sources and the 3 intakes, it was necessary to run ARCON96 12 times called 12 scenarios. Table-2 presents a summary of the ARCON96 X/Q results for the 12 scenarios. Appendix B presents the ARCON96 output files, while appendix C contains a description of the meteorological data used in this analysis. The method for averaging X/Q values is described below following Table-2.

Table-1. ARCON96 Input Parameters

Source →	Roofline Stack			King Kong Doors			Reactor Building Walls			Turbine Building Exhaust		
Receptor →	Local	Rem-1	Rem-2	Local	Rem-1	Rem-2	Local	Rem-1	Rem-2	Local	Rem-1	Rem-2
Parameter	Sen-1 RL-L	Sen-2 RL-R1	Sen-3 RL-R2	Sen-4 KK-L	Sen-5 KK-R1	Sen-6 KK-R2	Sen-7 RBW-L	Sen-8 RBW-R1	Sen-9 RBW-R2	Sen-10 TBE-L	Sen-11 TBE-R1	Sen-12 TBE-R2
Meteorological Input												
Lower Met Tower Sensor Height (m)	10	10	10	10	10	10	10	10	10	10	10	10
Upper Met Tower Sensor Height (m)	75	75	75	75	75	75	75	75	75	75	75	75
Wind Speed Units	mph	mph	mph	mph	mph	mph	mph	mph	mph	mph	mph	mph
Receptor Input												
Distance to Receptor (m)	67.4	155.5	126.7	91.4	201.5	79.6	39	138.7	77.6	18.3	140.4	131.5
Intake Height Above Ground Level (m)	26.5	0	0	26.5	0	0	26.5	0	0	26.5	0	0
Elevation Difference (m)	0	0	0	0	0	0	0	0	0	0	0	0
Direction to Source (deg)	78.39	137.38	328.28	108.68	141.33	324.67	90	145.61	323.6	90	155.77	311.5
Source Input												
Release Type	ground	ground	ground	ground	ground	ground	ground	ground	ground	ground	ground	ground
Release Height Above Ground Level (m)	70	70	70	3.5	3.5	3.5	60.0	60.0	60.0	36.3	36.3	36.3
Building X-sec area (m^2)	1787	2861	2861	1787	2861	2861	1787	2861	2861	1787	2861	2861
Vertical Velocity (m/s)	0	0	0	0	0	0	0	0	0	0	0	0
Stack Flow Rate (m^3/s)	2.1	2.1	2.1	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	55	55	55
Stack Radius (m)	0	0	0	0	0	0	0	0	0	0	0	0
Default Values												
Surface Roughness (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Wind Direction Window (deg.)	90	90	90	90	90	90	90	90	90	90	90	90
Minimum Wind Speed (m/s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Average Sector Width Constant	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Initial Diffusion Coefficients: . Σ_Y (m)	0	0	0	1	0.64	0.58	6.8	10.2	10.2	0.41	0.41	0.41
. Σ_Z (m)	0	0	0	1.16	1.16	1.16	3.25	3.25	3.25	0	0	0

Table-2. ARCON96 X/Q (s/m³) for the 12 Source/Intake Scenarios

Scenario	Source-Intake 1	Time Period	X/Q	Scenario	Source-Intake	Time Period	X/Q
1	RL-L			7	RBW-L		
		0 - 2 hrs	6.95E-04			0 - 2 hrs	8.69E-04
		2 - 8 hrs	3.36E-04			2 - 8 hrs	4.40E-04
		8 - 24 hrs	1.28E-04			8 - 24 hrs	1.75E-04
		1 - 4 d	9.72E-05			1 - 4 d	1.38E-04
		4 - 30 d	7.69E-05			4 - 30 d	1.10E-04
2	RL-R1			8	RBW-R1		
		0 - 2 hrs	2.31E-04			0 - 2 hrs	2.41E-04
		2 - 8 hrs	1.20E-04			2 - 8 hrs	1.41E-04
		8 - 24 hrs	4.72E-05			8 - 24 hrs	5.40E-05
		1 - 4 d	3.65E-05			1 - 4 d	4.40E-05
		4 - 30 d	3.27E-05			4 - 30 d	3.88E-05
3	RL-R2			9	RBW-R2		
		0 - 2 hrs	3.52E-04			0 - 2 hrs	4.91E-04
		2 - 8 hrs	2.59E-04			2 - 8 hrs	3.54E-04
		8 - 24 hrs	1.02E-04			8 - 24 hrs	1.41E-04
		1 - 4 d	8.67E-05			1 - 4 d	1.23E-04
		4 - 30 d	7.45E-05			4 - 30 d	1.03E-04
4	KK-L			10	TBE-L		
		0 - 2 hrs	5.34E-04			0 - 2 hrs	4.70E-03
		2 - 8 hrs	1.97E-04			2 - 8 hrs	2.00E-03
		8 - 24 hrs	8.41E-05			8 - 24 hrs	1.03E-03
		1 - 4 d	7.26E-05			1 - 4 d	8.01E-04
		4 - 30 d	7.00E-05			4 - 30 d	7.69E-04
5	KK-R1			11	TBE-R1		
		0 - 2 hrs	1.85E-04			0 - 2 hrs	3.32E-04
		2 - 8 hrs	1.19E-04			2 - 8 hrs	2.08E-04
		8 - 24 hrs	4.18E-05			8 - 24 hrs	8.08E-05
		1 - 4 d	3.71E-05			1 - 4 d	6.94E-05
		4 - 30 d	3.27E-05			4 - 30 d	6.17E-05
6	KK-R2			12	TBE-R2		
		0 - 2 hrs	8.99E-04			0 - 2 hrs	3.92E-04
		2 - 8 hrs	7.12E-04			2 - 8 hrs	2.67E-04
		8 - 24 hrs	2.90E-04			8 - 24 hrs	1.08E-04
		1 - 4 d	2.42E-04			1 - 4 d	9.96E-05
		4 - 30 d	2.12E-04			4 - 30 d	8.63E-05

1 RL-L = Roof Line Stack to Local Intake
RL-R1 = Roof Line Stack to Remote-1 Intake
RL-R2 = Roof Line Stack to Remote-2 Intake
KK-L = King Kong doors to Local Intake
KK-R1 = King Kong doors to Remote-1 Intake
KK-R2 = King Kong doors to Remote-2 Intake
RBW-L = Reactor Building Walls to Local Intake
RBW-R1 = Reactor Building Walls to Remote-1 Intake
RBW-R2 = Reactor Building Walls to Remote-2 Intake
TBE-L = Turbine Building Exhaust to Local Intake
TBE-R1 = Turbine Building Exhaust to Remote-1 Intake
TBE-R2 = Turbine Building Exhaust to Remote-2 Intake

REV BAR.

Effective X/Q: Since the total intake to the control room is a mixture from the three intakes, the method described below has been used to calculate the effective X/Q that enters into the control room.

1. Immediately following an accident at CGS, the control room local intake is automatically secured and the control room pressurization process begins with 2 trains (A and B) drawing air from the 2 remote intakes, one of the trains can be shut off while the other remains on. The time at which one train can be shut off without adversely affecting the control room dose will be determined in the LOCA dose analysis. The flow rate to the control room had been measured under three test conditions, the usual surveillance testing, the system characterization testing, and the tracer gas testing. The intake flow rate results from these three tests are different due to different test conditions and different flow measurement locations:

   A) The surveillance testing uses a single train (either A or B) to draw air into the control room, while keeping both remote intakes open and the local intake closed. The flow measurement shows that the flow rate for these conditions is greater than 900 cfm.

   B) The characterization testing (per procedure PPM 8.3.440) showed that in dual train operation - with both remotes open - the combined flow rate was 1544 cfm. In this same test, dual train operation with a single remote open resulted in a combined flow rate of 1343 cfm. The local intake was secured during the tests.

   C) The tracer gas testing uses the conservative alignment of two trains (A and B) to draw air into the control room, with a single remote intake open. The flow rate measurement shows that the flow rate for these conditions is greater than 1300 cfm. Then, the test runs a single train only, keeping one remote closed and the other open, the flow rate measurement results shows that the flow rate for these conditions is greater than 800 cfm. The local intake was secured during the test.

   Since it is not clear which condition will result in higher doses, the effective X/Q will be calculated using all testing results. Table-3 shows the effective X/Q results using the surveillance/characterization testing flow rates of 1600/900 cfm assuming that one train is secured at time t with $0 < t < 2$ hrs, (notice that the 1544 cfm from the characterization testing has been approximated by 1600 cfm), while Table-4 shows the effective X/Q results using the tracer gas testing intake flow rate results of 1300/800 cfm, assuming that one train is secured at time t with $0 < t < 2$ hrs. Table-5 shows the effective X/Q results using the tracer gas testing intake flow rate results of 1300/800 cfm, assuming that one train is secured at time t with $2 < t < 8$ hrs, and Table-6 shows the effective X/Q results using the tracer gas testing dual train intake flow rate of 1300 cfm, assuming that both trains will remain on for 30 days.

2. The local intake vent is assumed to automatically close immediately following the accident upon the receipt of an FAZ signal. However, per Columbia Generating Station (CGS) acceptance criteria, it is assumed to continue to leak air (through its dampers) into the CR at a rate of 150 cfm of filtered leakage.

3. The two remote intakes are assumed to remain open for the duration of the accident, drawing equal amounts of air into the CR. No credit is taken for the fact that per plant procedures, the operator will close the contaminated remote within 3 hours following the start of the accident

4. The value of X/Q for the unfiltered inleakage is assumed to be equal to the highest local intake X/Q corresponding to the TBES source.

5. Since there are three control room intakes drawing air into the control room with different flow rates, equation 6b, section 3.3.2.2 of RG 1.194, (ref. 7), is used to calculate the effective X/Q values, the use of this equation is justified based on the fact that no more than one intake can be within the 90-degree window at any time from any release point, the equation has been slightly modified to account for the fact that there are 3 intakes instead of 2:

$$\left(\frac{\chi}{Q}\right)_{AV} = \frac{\max\left[\left(\frac{\chi}{Q}\right)_{L} \cdot F_{L} \cdot \left(\frac{\chi}{Q}\right)_{R1} \cdot F_{R1} \cdot \left(\frac{\chi}{Q}\right)_{R2} \cdot F_{R2}\right]}{F_{L} + F_{R1} + F_{R2}}$$

Where: L, R1, R2: denote the Local, Remote-1, and Remote-2 intakes respectively.
F: denotes the flow rate.

Table-3. Effective X/Q (s/m3) for the 12 Source/Intake Scenarios (the CR Intake is 1600/900 cfm)

			0 - t hrs	t - 2 hrs	2 - 8 hrs	8 - 24 hrs	1 - 4 d	4 - 30 d
Control Room Intake (cfm)			1600	900	900	900	900	900
		Intake	F = Flow Rate (cfm)					
		Local	150	150	150	150	150	150
		Remote 1	725	375	375	375	375	375
		Remote 2	725	375	375	375	375	375
Roofline	Scenario		ARCON96 (X/Q) RESULTS (s/m³)					
	1	Local	6.95E-04	6.95E-04	3.36E-04	1.28E-04	9.72E-05	7.69E-05
	2	Remote 1	2.31E-04	2.31E-04	1.20E-04	4.72E-05	3.65E-05	3.27E-05
	3	Remote 2	3.52E-04	3.52E-04	2.59E-04	1.02E-04	8.67E-05	7.45E-05
$(X/Q)_i*F_i/(F1+F2+F3)$		Local	6.52E-05	1.16E-04	5.60E-05	2.13E-05	1.62E-05	1.28E-05
		Remote 1	1.05E-04	9.63E-05	5.00E-05	1.97E-05	1.52E-05	1.36E-05
		Remote 2	1.60E-04	1.47E-04	1.08E-04	4.25E-05	3.61E-05	3.10E-05
Maximum Effective X/Q			1.60E-04	1.47E-04	1.08E-04	4.25E-05	3.61E-05	3.10E-05
King Kong doors	Scenario		ARCON96 (X/Q) RESULTS (s/m³)					
	4	Local	5.34E-04	5.34E-04	1.97E-04	8.41E-05	7.26E-05	7.00E-05
	5	Remote 1	1.85E-04	1.85E-04	1.19E-04	4.18E-05	3.71E-05	3.27E-05
	6	Remote 2	8.99E-04	8.99E-04	7.12E-04	2.90E-04	2.42E-04	2.12E-04
$(X/Q)_i*F_i/(F1+F2+F3)$		Local	5.01E-05	8.90E-05	3.28E-05	1.40E-05	1.21E-05	1.17E-05
		Remote 1	8.38E-05	7.71E-05	4.96E-05	1.74E-05	1.55E-05	1.36E-05
		Remote 2	4.07E-04	3.75E-04	2.97E-04	1.21E-04	1.01E-04	8.83E-05
Maximum Effective X/Q			4.07E-04	3.75E-04	2.97E-04	1.21E-04	1.01E-04	8.83E-05
Reactor building walls	Scenario		ARCON96 (X/Q) RESULTS (s/m³)					
	7	Local	8.69E-04	8.69E-04	4.40E-04	1.75E-04	1.38E-04	1.10E-04
	8	Remote 1	2.41E-04	2.41E-04	1.41E-04	5.40E-05	4.40E-05	3.88E-05
	9	Remote 2	4.91E-04	4.91E-04	3.54E-04	1.41E-04	1.23E-04	1.03E-04
$(X/Q)_i*F_i/(F1+F2+F3)$		Local	8.15E-05	1.45E-04	7.33E-05	2.92E-05	2.30E-05	1.83E-05
		Remote 1	1.09E-04	1.00E-04	5.88E-05	2.25E-05	1.83E-05	1.62E-05
		Remote 2	2.22E-04	2.05E-04	1.48E-04	5.88E-05	5.13E-05	4.29E-05
Maximum Effective X/Q			2.22E-04	2.05E-04	1.48E-04	5.88E-05	5.13E-05	4.29E-05
Turbine building Exhaust System	Scenario		ARCON96 (X/Q) RESULTS (s/m³)					
	10	Local	4.70E-03	4.70E-03	2.00E-03	1.03E-03	8.01E-04	7.69E-04
	11	Remote 1	3.32E-04	3.32E-04	2.08E-04	8.08E-05	6.94E-05	6.17E-05
	12	Remote 2	3.92E-04	3.92E-04	2.67E-04	1.08E-04	9.96E-05	8.63E-05
$(X/Q)_i*F_i/(F1+F2+F3)$		Local	4.41E-04	7.83E-04	3.33E-04	1.72E-04	1.34E-04	1.28E-04
		Remote 1	1.50E-04	1.38E-04	8.67E-05	3.37E-05	2.89E-05	2.57E-05
		Remote 2	1.78E-04	1.63E-04	1.11E-04	4.50E-05	4.15E-05	3.60E-05
Maximum Effective X/Q			4.41E-04	7.83E-04	3.33E-04	1.72E-04	1.34E-04	1.28E-04

Table-4. Effective X/Q (s/m3) for the Source/Intake Scenarios
(the CR Intake is 1300/800 cfm with one train secured at time t, with 0<t<2)

			0 - t hrs	t - 2 hrs	2 - 8 hrs	8 - 24 hrs	1 - 4 d	4 - 30 d
Control Room Intake (cfm)			**1300**	**800**	**800**	**800**	**800**	**800**
		Intake	**F = Flow Rate (cfm)**					
		Local	150	150	150	150	150	150
		Remote 1	575	325	325	325	325	325
		Remote 2	575	325	325	325	325	325
Roofline	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	1	Local	6.95E-04	6.95E-04	3.36E-04	1.28E-04	9.72E-05	7.69E-05
	2	Remote 1	2.31E-04	2.31E-04	1.20E-04	4.72E-05	3.65E-05	3.27E-05
	3	Remote 2	3.52E-04	3.52E-04	2.59E-04	1.02E-04	8.67E-05	7.45E-05
$(X/Q)_i * F_i / (F1 + F2 + F3)$		Local	8.02E-05	1.30E-04	6.30E-05	2.40E-05	1.82E-05	1.44E-05
		Remote 1	1.02E-04	9.38E-05	4.88E-05	1.92E-05	1.48E-05	1.33E-05
		Remote 2	1.56E-04	1.43E-04	1.05E-04	4.14E-05	3.52E-05	3.03E-05
Maximum Effective X/Q			1.56E-04	1.43E-04	1.05E-04	4.14E-05	3.52E-05	3.03E-05
King Kong doors	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	4	Local	5.34E-04	5.34E-04	1.97E-04	8.41E-05	7.26E-05	7.00E-05
	5	Remote 1	1.85E-04	1.85E-04	1.19E-04	4.18E-05	3.71E-05	3.27E-05
	6	Remote 2	8.99E-04	8.99E-04	7.12E-04	2.90E-04	2.42E-04	2.12E-04
$(X/Q)_i * F_i / (F1 + F2 + F3)$		Local	6.16E-05	1.00E-04	3.69E-05	1.58E-05	1.36E-05	1.31E-05
		Remote 1	8.18E-05	7.52E-05	4.83E-05	1.70E-05	1.51E-05	1.33E-05
		Remote 2	3.98E-04	3.65E-04	2.89E-04	1.18E-04	9.83E-05	8.61E-05
Maximum Effective X/Q			3.98E-04	3.65E-04	2.89E-04	1.18E-04	9.83E-05	8.61E-05
Reactor building walls	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	7	Local	8.69E-04	8.69E-04	4.40E-04	1.75E-04	1.38E-04	1.10E-04
	8	Remote 1	2.41E-04	2.41E-04	1.41E-04	5.40E-05	4.40E-05	3.88E-05
	9	Remote 2	4.91E-04	4.91E-04	3.54E-04	1.41E-04	1.23E-04	1.03E-04
$(X/Q)_i * F_i / (F1 + F2 + F3)$		Local	1.00E-04	1.63E-04	8.25E-05	3.28E-05	2.59E-05	2.06E-05
		Remote 1	1.07E-04	9.79E-05	5.73E-05	2.19E-05	1.79E-05	1.58E-05
		Remote 2	2.17E-04	1.99E-04	1.44E-04	5.73E-05	5.00E-05	4.18E-05
Maximum Effective X/Q			2.17E-04	1.99E-04	1.44E-04	5.73E-05	5.00E-05	4.18E-05
Turbine building Exhaust System	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	10	Local	4.70E-03	4.70E-03	2.00E-03	1.03E-03	8.01E-04	7.69E-04
	11	Remote 1	3.32E-04	3.32E-04	2.08E-04	8.08E-05	6.94E-05	6.17E-05
	12	Remote 2	3.92E-04	3.92E-04	2.67E-04	1.08E-04	9.96E-05	8.63E-05
$(X/Q)_i * F_i / (F1 + F2 + F3)$		Local	5.42E-04	8.81E-04	3.75E-04	1.93E-04	1.50E-04	1.44E-04
		Remote 1	1.47E-04	1.35E-04	8.45E-05	3.28E-05	2.82E-05	2.51E-05
		Remote 2	1.73E-04	1.59E-04	1.08E-04	4.39E-05	4.05E-05	3.51E-05
Maximum Effective X/Q			5.42E-04	8.81E-04	3.75E-04	1.93E-04	1.50E-04	1.44E-04

Table-5. Effective X/Q (s/m3) for the Source/Intake Scenarios (the CR Intake is 1300/800 cfm with one train secured at time t, with 2<t<8)

			0 - 2 hrs	2 - t hrs	t - 8 hrs	8 - 24 hrs	1 - 4 d	4 - 30 d
Control Room Intake (cfm)			**1300**	**1300**	**800**	**800**	**800**	**800**
		Intake	**F = Flow Rate (cfm)**					
		Local	150	150	150	150	150	150
		Remote 1	575	575	325	325	325	325
		Remote 2	575	575	325	325	325	325
Roofline	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	1	Local	6.95E-04	3.36E-04	3.36E-04	1.28E-04	9.72E-05	7.69E-05
	2	Remote 1	2.31E-04	1.20E-04	1.20E-04	4.72E-05	3.65E-05	3.27E-05
	3	Remote 2	3.52E-04	2.59E-04	2.59E-04	1.02E-04	8.67E-05	7.45E-05
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	8.02E-05	3.88E-05	6.30E-05	2.40E-05	1.82E-05	1.44E-05
		Remote 1	1.02E-04	5.31E-05	4.88E-05	1.92E-05	1.48E-05	1.33E-05
		Remote 2	1.56E-04	1.15E-04	1.05E-04	4.14E-05	3.52E-05	3.03E-05
Maximum Effective X/Q			1.56E-04	1.15E-04	1.05E-04	4.14E-05	3.52E-05	3.03E-05
King Kong doors	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	4	Local	5.34E-04	1.97E-04	1.97E-04	8.41E-05	7.26E-05	7.00E-05
	5	Remote 1	1.85E-04	1.19E-04	1.19E-04	4.18E-05	3.71E-05	3.27E-05
	6	Remote 2	8.99E-04	7.12E-04	7.12E-04	2.90E-04	2.42E-04	2.12E-04
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	6.16E-05	2.27E-05	3.69E-05	1.58E-05	1.36E-05	1.31E-05
		Remote 1	8.18E-05	5.26E-05	4.83E-05	1.70E-05	1.51E-05	1.33E-05
		Remote 2	3.98E-04	3.15E-04	2.89E-04	1.18E-04	9.83E-05	8.61E-05
Maximum Effective X/Q			3.98E-04	3.15E-04	2.89E-04	1.18E-04	9.83E-05	8.61E-05
Reactor building Exhaust System	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	7	Local	8.69E-04	4.40E-04	4.40E-04	1.75E-04	1.38E-04	1.10E-04
	8	Remote 1	2.41E-04	1.41E-04	1.41E-04	5.40E-05	4.40E-05	3.88E-05
	9	Remote 2	4.91E-04	3.54E-04	3.54E-04	1.41E-04	1.23E-04	1.03E-04
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	1.00E-04	5.08E-05	8.25E-05	3.28E-05	2.59E-05	2.06E-05
		Remote 1	1.07E-04	6.24E-05	5.73E-05	2.19E-05	1.79E-05	1.58E-05
		Remote 2	2.17E-04	1.57E-04	1.44E-04	5.73E-05	5.00E-05	4.18E-05
Maximum Effective X/Q			2.17E-04	1.57E-04	1.44E-04	5.73E-05	5.00E-05	4.18E-05
Turbine building walls	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**					
	10	Local	4.70E-03	2.00E-03	2.00E-03	1.03E-03	8.01E-04	7.69E-04
	11	Remote 1	3.32E-04	2.08E-04	2.08E-04	8.08E-05	6.94E-05	6.17E-05
	12	Remote 2	3.92E-04	2.67E-04	2.67E-04	1.08E-04	9.96E-05	8.63E-05
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	5.42E-04	2.31E-04	3.75E-04	1.93E-04	1.50E-04	1.44E-04
		Remote 1	1.47E-04	9.20E-05	8.45E-05	3.28E-05	2.82E-05	2.51E-05
		Remote 2	1.73E-04	1.18E-04	1.08E-04	4.39E-05	4.05E-05	3.51E-05
Maximum Effective X/Q			5.42E-04	2.31E-04	3.75E-04	1.93E-04	1.50E-04	1.44E-04

Table-6. Effective X/Q (s/m3) for the Source/Intake Scenarios (the CR Intake is 1300 cfm with both trains running for 30 days)

			0 - 2 hrs	2 - 8 hrs	8 - 24 hrs	1 - 4 d	4 - 30 d
Control Room Intake (cfm)			**1300**	**1300**	**1300**	**1300**	**1300**
		Intake	**F = Flow Rate (cfm)**				
		Local	150	150	150	150	150
		Remote 1	575	575	575	575	575
		Remote 2	575	575	575	575	575
Roofline	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**				
	1	Local	6.95E-04	3.36E-04	1.28E-04	9.72E-05	7.69E-05
	2	Remote 1	2.31E-04	1.20E-04	4.72E-05	3.65E-05	3.27E-05
	3	Remote 2	3.52E-04	2.59E-04	1.02E-04	8.67E-05	7.45E-05
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	8.02E-05	3.88E-05	1.48E-05	1.12E-05	8.87E-06
		Remote 1	1.02E-04	5.31E-05	2.09E-05	1.61E-05	1.45E-05
		Remote 2	1.56E-04	1.15E-04	4.51E-05	3.83E-05	3.30E-05
Maximum Effective X/Q			1.56E-04	1.15E-04	4.51E-05	3.83E-05	3.30E-05
King Kong doors	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**				
	4	Local	5.34E-04	1.97E-04	8.41E-05	7.26E-05	7.00E-05
	5	Remote 1	1.85E-04	1.19E-04	4.18E-05	3.71E-05	3.27E-05
	6	Remote 2	8.99E-04	7.12E-04	2.90E-04	2.42E-04	2.12E-04
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	6.16E-05	2.27E-05	9.70E-06	8.38E-06	8.08E-06
		Remote 1	8.18E-05	5.26E-05	1.85E-05	1.64E-05	1.45E-05
		Remote 2	3.98E-04	3.15E-04	1.28E-04	1.07E-04	9.38E-05
Maximum Effective X/Q			3.98E-04	3.15E-04	1.28E-04	1.07E-04	9.38E-05
Reactor building Exhaust System	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**				
	7	Local	8.69E-04	4.40E-04	1.75E-04	1.38E-04	1.10E-04
	8	Remote 1	2.41E-04	1.41E-04	5.40E-05	4.40E-05	3.88E-05
	9	Remote 2	4.91E-04	3.54E-04	1.41E-04	1.23E-04	1.03E-04
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	1.00E-04	5.08E-05	2.02E-05	1.59E-05	1.27E-05
		Remote 1	1.07E-04	6.24E-05	2.39E-05	1.95E-05	1.72E-05
		Remote 2	2.17E-04	1.57E-04	6.24E-05	5.44E-05	4.56E-05
Maximum Effective X/Q			2.17E-04	1.57E-04	6.24E-05	5.44E-05	4.56E-05
Turbine building walls	Scenario		**ARCON96 (X/Q) RESULTS (s/m³)**				
	10	Local	4.70E-03	2.00E-03	1.03E-03	8.01E-04	7.69E-04
	11	Remote 1	3.32E-04	2.08E-04	8.08E-05	6.94E-05	6.17E-05
	12	Remote 2	3.92E-04	2.67E-04	1.08E-04	9.96E-05	8.63E-05
$(X/Q)_i*F_i/(F_1 + F_2 + F_3)$ =		Local	5.42E-04	2.31E-04	1.19E-04	9.24E-05	8.87E-05
		Remote 1	1.47E-04	9.20E-05	3.57E-05	3.07E-05	2.73E-05
		Remote 2	1.73E-04	1.18E-04	4.78E-05	4.41E-05	3.82E-05
Maximum Effective X/Q			5.42E-04	2.31E-04	1.19E-04	9.24E-05	8.87E-05

APPENDIX A

Descriptions / Calculations of the ARCON96 Parameters

The purpose of this appendix is to provide detailed calculations and descriptions of all ARCON96 input parameters presented in Table 1.

1.0 Meteorological Input

a. Number of Met Data Files: Four met data files have been used as an input for ARCON96 spanning the period from 1996 to 1999. The certified data has been formatted in accordance with the recommended regulatory procedure and the formatting process is described in reference 8.

b. Lower Measurement Height: Wind speed, wind direction, and temperature sensors are placed at a height of 33 feet (10 m) on the met tower (ref. 9).

c. Upper Measurement Height: Wind speed, wind direction, and temperature sensors are placed at a height of 245 feet (75 m) on the met tower (ref. 10).

d. Wind Speed Units: miles per hour (mph), (ref. 8).

2.0 Receptor Input

a. Distance to receptor: the plant civil drawings (ref. 5 and 6) have been used to determine the North and West coordinates of the sources, intakes, and building walls. Those coordinates are given in units of feet and have been used to calculate the source to intake distances and directions. Figure 1 is a layout of the Columbia plant buildings showing these coordinates. Table-A1 is a summary of the source to intake distance calculations showing for each source the coordinates of the closest point to the intake. The distance has been calculated using the following formula:

$$d = 0.3048\sqrt{(N_r - N_s)^2 + (W_r - W_s)^2}$$

where:

N_r = North coordinate for the receptor, ft
N_s = North coordinate for the source, ft
W_r = West coordinate for the receptor, ft
W_s = West coordinate for the source, ft
0.3048 = The feet to meter conversion factor

Example: calculate the horizontal distance between the roofline source and the local intake.

Roofline Source coordinates = (N_s, W_s) = (11918.5, 1243.5)
Local Intake (receptor) coordinates = (N_r, W_r) = (11874, 1460)
Distance = d = 0.3048 x SQRT $[(11874 - 11918.5)^2 + (1460 - 1243.5)^2]$
= 67.4 m

b. Intake Height: as previously mentioned, there are three control room intakes, two ground level remote intakes (remote-1 and remote-2) and one local intake at a height of 26.5 m above ground located on the eastern wall of the radwaste building (ref. 4).

c. Elevation Difference: this is the difference in terrain elevation between the source and the receptor. At CGS all plant buildings and structures are at the same level (no difference in elevation), therefore the value of this parameter is zero in all cases.

d. Direction to Source: per reference 7, section 3.4, the direction from the receptor (intake) to the source is obtained by imagining that a person is standing at the location of the intake facing the release point (source), if the source is to the north, the direction is 360°, if the source is to the

east, the direction is 90 °, to the south, the direction is 180° , to the west, the direction is 270° , and so forth. Figures 2, 3, and 4 show the locations of the four sources relative to each intake where angle α represents the direction . Table-A2 is a summary of the intake to source distance and direction. An example of calculating the direction angle is given below:

Calculate the angle α between the local intake and the roofline stack.
From figure 2, (repeated below), the coordinates for the local intake and the roofline stack are as follows:

Local intake coordinates = (11874, 1460)
Roofline stack coordinates = (11918.5, 1243.5)

$$\tan(90-\alpha) = \frac{11918.5-11874}{1460-1243.5} = 0.20554$$

$$90-\alpha = 11.61^{\circ}$$

$$\alpha = 78.39^{\circ}$$

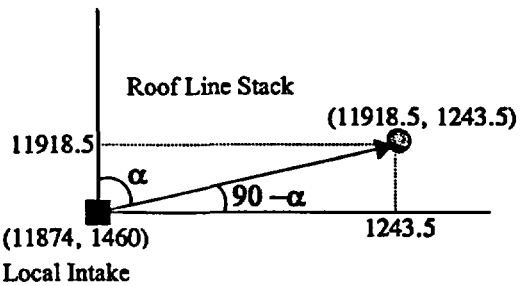

Table-A1. Source to Intake Distances (m)

		Local intake	Remote-1 intake	Remote-2 intake
	North (y)	11874	12294	11565
	West (x)	1460	1589	1025
Roofline Coordinates				
North (y)	11918.5	67.4	155.5	126.7
West (x)	1243.5			
King Kong Doors Coordinates				
North (y)	11778	91.4	201.5	79.6
West (x)	1176			
Reactor Building Walls Nearest Point Coordinates to				
Local Intake				
North (y)	11874	39.0		
West (x)	1332			
Remote-1				
North (y)	11918.5		138.7	
West (x)	1332			
Remote-2				
North (y)	11770			77.6
West (x)	1176			
1.2. TB Exhaust Nearest Point Coordinates to				
Local Intake				
North (y)	11874	18.3		
West (x)	1400			
Remote-1				
North (y)	11874		140.4	
West (x)	1400			
Remote-2				
North (y)	11851			131.5
West (x)	1348			

Table-A2. Source to Intake Distance and Direction

Source \ Intake	Local intake		Remote-1 intake		Remote-2 intake	
	Distance (m)	Direction α (deg)	Distance (m)	Direction α (deg)	Distance (m)	Direction α (deg)
1.3. Roofline	67.4	78.39	155.5	137.38	126.7	328.28
1.4. King Kong Doors	91.4	108.68	201.5	141.33	79.6	324.67
1.5. Reactor Building Walls	39.0	90.00	138.7	145.6	77.6	323.63
1.6. TB Exhaust	18.3	90.00	140.4	155.77	131.5	311.5

3.0 Source Input

A. Release Type: ground release has been used in all cases for all sources since none of the sources at CGS meets the requirements for elevated (or stack) release.

B. Release Height: the height of each of the four sources is discussed below:

1. Roofline Stack: this is a short stack located on top of the reactor building at elevation 670 ft (ref. 11). The ground level of the reactor building (and all of the plant structures) is at an elevation of 441 ft above sea level, therefore the height of the top of the reactor building is 229 ft (670 – 441 =229 ft = 69.8 m).
2. King Kong Doors: this door is at ground level with a height of 23 ft and width of 20 ft (ref. 2). Therefore, per RG 1.194, the source height is the midpoint at 11.5 ft = 3.5m.
3. Reactor Building Walls: the metal sheets of the reactor building which is considered a diffuse source starts at the 606 ft elevation and ends at the 670 ft elevation (ref. 2). Per RG 1.194, the midpoint is at 638 ft elevation, hence the height of this source is 197 ft (638 – 441 = 197 ft = 60.0 m).
4. Turbine Building Exhaust: four short stacks (16 ft high = 4.9 m) located on top of the radwaste building at elevation 544 ft (544 – 441 = 103 ft = 31.4 m) make up the TB exhaust system (ref. 3). The total height of the source is 36.3 m (4.9 + 31.4 = 36.3 m).

C. Building Area: the width of the east and west walls of the reactor building is 135 ft (41 m), whereas that of the north and south walls is 151 ft (46 m), (ref. 12). The area of the smallest reactor building wall is 2861 m^2 (69.8 x 41 = 2861 m^2), this area is applicable to the remote intakes only. However, since the local intake is at a higher elevation (elevation 527 ft), only the portion of the reactor building wall above this elevation is considered in calculating the area, this partial wall is 41 m wide and 43.6 m high (670 – 527 = 143 ft = 43.6 m), therefore its area is 41 x 43.6 = 1787 m^2.

D. Vertical Velocity: the vertical velocity of the release is applicable only to stack releases, since we have ground release only, the vertical velocity is zero.

E. Flow Rate: the flow rate , if entered, is used to ensure that effluent concentrations in the atmosphere are always less than the concentration at the release point. Effluent flow from the four sources is discussed below:

1) Roofline Stack: this source releases through the SGT system at a flow rate of 4457 cfm (2.1 m^3/s), (ref. 13, FSAR section 6.5.1.1).
2) Reactor Building Walls and King Kong Doors: these two diffuse sources leak radioactivity to the environment as a result of two primary containment leakages. The first primary containment (PC) leakage is from the PC to the inside of the reactor

building (RB) and has a volumetric flow rate of 0.5 % PC volume per day (ref. 14, section 5.5.12). It is assumed that before the Secondary Containment (SC) drawdown is complete, the 0.5% PC volume per day will directly leak to the environment via the KK-Doors and RB-walls. The second PC leakage is from the PC directly to the environment bypassing the secondary containment; this SC bypass leakage has a flow rate of 0.04% PC volume per day (ref. 15, p. 2.000). This leakage takes place through pipes that start inside the PC and end outside of the SC. The flow rates have been calculated as follows:

Volume of drywell = 200,540 ft^3 (ref.13, 6.2-1)
Volume of wet well above water = 144,184 ft^3 (ref.13, 6.2-1)
Total PC volume = 344,724 ft^3 (9761.5 m^3)
Leakage rate = 0.5% + 0.04% v/d = 0.54% v/d = 52.7 m^3/d = 6.1E-4 m^3/s

This flow rate is assumed to be applicable to the KK doors and the RB walls. However, since the flow rate is extremely low, ARCON96 automatically rounds it up to zero.

3) Turbine Building Exhaust: the turbine building exhaust system consists of 4 exhaust fans (TEA-FN-1 A, B, C, and D), each fan has a flow rate of 120,000 cfm (55 m^3/s). During non-outage times, at least two exhaust fans will be running for a total flow rate of 110 m^3/s (ref. 16, section 5.1.10). However, only one fan with 55 m^3/s flow rate is considered as the source. This is conservative since higher flow rates usually generate lower X/Q values, furthermore considering 2 fans means the second fan is further away from the intake which also results in lower X/Q values.

F. **Stack Radius:** this parameter is not applicable to ground release, it is required for stack release only.

4.0 Default Values

1. **Surface Roughness length:** per reference 7, a surface roughness length of 0.2 m should be used in lieu of the 0.1 m default value given in ARCON96 manual (ref. 1).
2. **Wind Direction Window:** per references 1 and 7 , the preferred value for this parameter is 90°.
3. **Minimum Wind Speed:** per references 1 and 7, the preferred value for this parameter is 0.5 m/s.
4. **Average Sector Width Constant:** per RG-1.194 (ref. 7), an average sector width constant of 4.3 should be used in lieu of the 4.0 default value given in ARCON96 manual.
5. **Initial Diffusion Coefficients:** the initial diffusion coefficients Σy and Σz for the three diffuse sources are calculated based on the equations below given in RG-1.194, the details are given below and the results are summarized in Table-A3.

$$\sum_y = \frac{\text{width}_{\text{area source}}}{6}$$

$$\sum_z = \frac{\text{Height}_{\text{area source}}}{6}$$

1) King Kong Door: the bottom of this door is at ground level (441" elevation), its height is 23 ft (7 m) and its width is approximately 20 ft (6.1 m) (ref. 2). The diffusion coefficients are calculated as follows:

a. Local Intake: the local intake faces the doors directly, hence the diffusion coefficients are:

$\Sigma_y = 6.1/6 = 1.0$ m

$\Sigma_z = 7/6 = 1.16$ m

b. The remote intakes do not face the doors directly, therefore the projected width of the doors is calculated based on the angles shown in figure 7 and Table-A2.

1. Remote-1 intake

projected Width = $6.1\sin(39^\circ) = 6.1 \times 0.63 = 3.84$ m,
hence the diffusion coefficients are:

$\Sigma_y = 3.84/6 = 0.64$ m
$\Sigma_z = 7/6 = 1.16$ m

2. Remote-2 Intake

projected Width = $6.1\sin(35^\circ) = 6.1 \times 0.57 = 3.48$ m,
hence the diffusion coefficients are:

$\Sigma_y = 3.48/6 = 0.58$ m

$\Sigma_z = 7/6 = 1.16$ m

2) Reactor Building Walls: Σ_y and Σ_z for the reactor building wall (the diffuse source above 606' level) are calculated as follows:

a. local intake: the local intake faces the east side wall of the reactor building which has a width of 41 m, with a source height of 64 ft = 19.5 m. Therefore, the diffusion coefficients are:

$\Sigma_y = 41/6 = 6.8$ m
$\Sigma_z = 19.5/6 = 3.25$ m

b. remotes 1 and 2 intakes: these two intakes face the reactor building diagonal which has a length of 61.6 m calculated by taking the square root of the sum of squares of the widths of two walls ($\sqrt{41^2 + 46^2} = 61.6$ m (with 41 and 46 being the widths of the reactor building walls in meters). The height of the source is 64 ft = 19.5 m, (670 – 606 = 64 ft), therefore, the diffusion coefficients are:

$\Sigma_y = 61.6/6 = 10.2$ m
$\Sigma_z = 19.5/6 = 3.25$ m

3) Turbine Building Exhaust System: as mentioned earlier, this diffuse source is a single vent that is 8-ft (2.44 m) in diameter. Since this source is horizontal its height is zero, therefore Σy and Σz for all intakes are calculated as follows:

$\Sigma_y = 2.44/6 = 0.41$ m
$\Sigma_z = 0/6 = 0$ m

Table-A3. Initial Diffusion Coeficients for the CGS Diffuse (Area) Sources

	Σ_y (m)	Σ_z (m)
KK Doors		
1- Local Intake	1	1.16
2- Remotes 1	0.64	1.16
3- Remotes 2	0.58	1.16
RB Walls		
1- Local Intake	6.8	3.25
2- Remotes 1,2	10.2	3.25
TB Exhaust		
1- Local Intake	0.41	0
2- Remotes 1,2	0.41	0

APPENDIX B
ARCON96 OUTPUT FILES

Roofline Stack to Local Intake with 96 - 99 Met Data Files
RL-L-4

```
Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyll@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  14:51:50

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  4
    Meteorological Data File Names
      U:\ARCON96\METDAT-2\CGSAR96.MET
      U:\ARCON96\METDAT-2\CGSAR97.MET
      U:\ARCON96\METDAT-2\CGSAR98.MET
      U:\ARCON96\METDAT-2\CGSAR99.MET
    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     75.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     70.0
    Building Area (m^2)                  =   1787.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =      2.1
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      078
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   033 - 123
    Distance to intake (m)               =     67.4
    Intake height  (m)                   =     26.5
    Terrain elevation difference (m)     =       .0

    Output file names
      RL-L-4.OUT
      RL-L-4.CFD
```

```
      Minimum Wind Speed (m/s)             =      .5
      Surface roughness length (m)         =      .20
      Sector averaging constant            =     4.3

      Initial value of sigma y             =      .00
      Initial value of sigma z             =      .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   2836
      Hours elevated plume w/ dir. in window =    0
      Hours of calm winds                  =   1982
      Hours direction not in window or calm =  27474

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.        1        2        4        8       12       24       96      168      360      720
     UPPER LIM.  1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02
       LOW LIM.  1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06
    ABOVE RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
       IN RANGE    4818.    6785.    9497.   12785.   15902.   20978.   27709.   27931.   27370.   26608.
    BELOW RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
          ZERO   27474.   25134.   21700.   17035.   14668.    8875.     477.       5.       0.       0.
     TOTAL X/Qs  32292.   31919.   31197.   29820.   30570.   29853.   28186.   27936.   27370.   26608.
     % NON ZERO    14.92    21.26    30.44    42.87    52.02    70.27    98.31    99.98   100.00   100.00

      95th PERCENTILE X/Q VALUES
                 6.95E-04 5.47E-04 4.92E-04 4.26E-04 3.35E-04 2.27E-04 1.30E-04 1.11E-04 9.22E-05 8.39E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        6.95E-04
      2 to 8 hours        3.36E-04
      8 to 24 hours       1.28E-04
      1 to 4 days         9.72E-05
      4 to 30 days        7.69E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       1.27E-03             6.03E-05
           SECTOR-AVERAGE   7.44E-04             3.51E-05

NORMAL PROGRAM COMPLETION
```

Roofline Stack to Remote-1 Intake with 96 - 99 Met Data FileS
RL-R1-4

```
Program Title:  ARCON96.
 Developed For:  U.S. Nuclear Regulatory Commission
                 Office of Nuclear Reactor Regulation
                 Division of Reactor Program Management
 Date:           June 25, 1997    11:00 a.m.
 NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                  e-mail: jyl1@nrc.gov
                 J. J. Hayes      Phone: (301) 415 3167
                                  e-mail: jjh@nrc.gov
                 L. A  Brown      Phone: (301) 415 1232
                                  e-mail: lab2@nrc.gov
 Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                  e-mail: j_ramsdell@pnl.gov
 Code Documentation:  NUREG/CR-6331 Rev. 1
 The program was prepared for an agency of the United States Government. Neither
 the United States Government nor any agency thereof, nor any of their
 employees, makes any warranty, expressed or implied, or assumes any legal
 liability or responsibilities for any third party's use, or the results of such
 use, of any portion of this program or represents that its use by such third
 party would not infringe privately owned rights.

 Program Run  12/14/2003  at  14:53:50
  ******* ARCON INPUT **********
     Number of Meteorological Data Files  =  4
     Meteorological Data File Names
       C:\ARCON96\ARCON9-1\CGSAR96.MET
       C:\ARCON96\ARCON9-1\CGSAR97.MET
       C:\ARCON96\ARCON9-1\CGSAR98.MET
       C:\ARCON96\ARCON9-1\CGSAR99.MET

     Height of lower wind instrument (m)  =     10.0
     Height of upper wind instrument (m)  =     75.0
     Wind speeds entered as miles per hour

     Ground-level release
     Release height (m)                   =     70.0
     Building Area (m^2)                  =   2861.0
     Effluent vertical velocity (m/s)     =      .00
     Vent or stack flow  (m^3/s)          =     2.1
     Vent or stack radius (m)             =      .00

     Direction .. intake to source (deg)  =     137
     Wind direction sector width (deg)    =      90
     Wind direction window (deg)          =  092 - 182
     Distance to intake (m)               =   155.5
     Intake height  (m)                   =      .0
     Terrain elevation difference (m)     =      .0


     Output file names
       RL-R1-4.OUT
       RL-R1-4.CFD
```

```
      Minimum Wind Speed (m/s)             =      .5
      Surface roughness length (m)         =      .20
      Sector averaging constant            =     4.3

      Initial value of sigma y             =      .00
      Initial value of sigma z             =      .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   5673
      Hours elevated plume w/ dir. in window =    0
      Hours of calm winds                  =   1982
      Hours direction not in window or calm =  24637

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.        1        2        4        8       12       24       96      168      360      720
     UPPER LIM.  1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03
       LOW LIM.  1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07
    ABOVE RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
       IN RANGE    7655.   10072.   13258.   16971.   20422.   25196.   28109.   27936.   27370.   26608.
    BELOW RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
           ZERO   24637.   21847.   17939.   12849.   10148.    4657.      77.       0.       0.       0.
     TOTAL X/Qs   32292.   31919.   31197.   29820.   30570.   29853.   28186.   27936.   27370.   26608.
     % NON ZERO   23.71    31.55    42.50    56.91    66.80    84.40    99.73   100.00   100.00   100.00

      95th PERCENTILE X/Q VALUES
                 2.31E-04 2.10E-04 1.79E-04 1.48E-04 1.16E-04 8.08E-05 4.76E-05 4.21E-05 3.81E-05 3.47E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        2.31E-04
      2 to 8 hours        1.20E-04
      8 to 24 hours       4.72E-05
      1 to 4 days         3.65E-05
      4 to 30 days        3.27E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       3.06E-04             8.39E-06
           SECTOR-AVERAGE   1.79E-04             4.89E-06

NORMAL PROGRAM COMPLETION
```

Roofline Stack to Local Intake with 96 - 99 Met Data Files
RL-R2-4

```
 Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  12/14/2003  at  14:55:15

 ******* ARCON INPUT **********

   Number of Meteorological Data Files  =  4
   Meteorological Data File Names
     U:\ARCON96\METDAT-2\CGSAR96.MET
     U:\ARCON96\METDAT-2\CGSAR97.MET
     U:\ARCON96\METDAT-2\CGSAR98.MET
     U:\ARCON96\METDAT-2\CGSAR99.MET

   Height of lower wind instrument (m)  =     10.0
   Height of upper wind instrument (m)  =     75.0
   Wind speeds entered as miles per hour

   Ground-level release
   Release height (m)                   =     70.0
   Building Area (m^2)                  =   2861.0
   Effluent vertical velocity (m/s)     =      .00
   Vent or stack flow  (m^3/s)          =     2.1
   Vent or stack radius (m)             =      .00
   Direction .. intake to source (deg)  =     328
   Wind direction sector width (deg)    =      90
   Wind direction window (deg)          =   283 - 013
   Distance to intake (m)               =   126.7
   Intake height  (m)                   =      .0
   Terrain elevation difference (m)     =      .0
   Output file names
     RL-R2-4.OUT
     RL-R2-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =       .00
      Initial value of sigma z             =       .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =  10562
      Hours elevated plume w/ dir. in window =      0
      Hours of calm winds                  =   1982
      Hours direction not in window or calm =  19748

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
       LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE     12544.    15137.    18393.    21644.    24645.    27499.    28149.    27936.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
           ZERO     19748.    16782.    12804.     8176.     5925.     2354.       37.        0.        0.        0.
     TOTAL X/Qs     32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO      38.85     47.42     58.96     72.58     80.62     92.11     99.87    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                  3.52E-04  3.34E-04  3.10E-04  2.82E-04  2.28E-04  1.62E-04  1.06E-04  9.59E-05  8.33E-05  7.87E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        3.52E-04
      2 to 8 hours        2.59E-04
      8 to 24 hours       1.02E-04
      1 to 4 days         8.67E-05
      4 to 30 days        7.45E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       4.15E-04             1.06E-05
           SECTOR-AVERAGE   2.42E-04             6.17E-06

NORMAL PROGRAM COMPLETION
```

King Kong Doors to Local Intake with 96 - 99 Met Data Files
KK-L-4

```
Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  12/14/2003  at  14:56:38
 ******* ARCON INPUT **********
    Number of Meteorological Data Files  =  4
    Meteorological Data File Names
      U:\ARCON96\METDAT-2\CGSAR96.MET
      U:\ARCON96\METDAT-2\CGSAR97.MET
      U:\ARCON96\METDAT-2\CGSAR98.MET
      U:\ARCON96\METDAT-2\CGSAR99.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     75.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =      3.5
    Building Area (m^2)                  =   1787.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =     109
    Wind direction sector width (deg)    =      90
    Wind direction window (deg)          =   064 - 154
    Distance to intake (m)               =    91.4
    Intake height  (m)                   =    26.5
    Terrain elevation difference (m)     =      .0
    Output file names
      KK-L-4.OUT
      KK-L-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =      1.00
      Initial value of sigma z             =      1.16

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   3503
      Hours elevated plume w/ dir. in window =      0
      Hours of calm winds                  =   1534
      Hours direction not in window or calm =  27255

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
       LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE      5037.     7406.    10698.    14679.    18282.    23705.    28063.    27936.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          ZERO     27255.    24513.    20499.    15141.    12288.     6148.      123.        0.        0.        0.
     TOTAL X/Qs    32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO     15.60     23.20     34.29     49.23     59.80     79.41     99.56    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                 5.34E-04  3.87E-04  3.43E-04  2.81E-04  2.19E-04  1.50E-04  9.20E-05  8.27E-05  7.54E-05  7.30E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        5.34E-04
      2 to 8 hours        1.97E-04
      8 to 24 hours       8.41E-05
      1 to 4 days         7.26E-05
      4 to 30 days        7.00E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       8.78E-04             9.06E-05
           SECTOR-AVERAGE   5.12E-04             5.28E-05

NORMAL PROGRAM COMPLETION
```

King Kong Doors to Remote-1 Intake with 96 - 99 Met Data Files
KK-R1-4

```
 Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997     11:00 a.m.
NRC Contacts:   J. Y. Lee         Phone: (301) 415 1080
                                  e-mail: jyl1@nrc.gov
                J. J. Hayes       Phone: (301) 415 3167
                                  e-mail: jjh@nrc.gov
                L. A  Brown       Phone: (301) 415 1232
                                  e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell    Phone: (509) 372 6316
                                  e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  14:59:10

******* ARCON INPUT **********

   Number of Meteorological Data Files  =  4
   Meteorological Data File Names
     U:\ARCON96\METDAT-2\CGSAR96.MET
     U:\ARCON96\METDAT-2\CGSAR97.MET
     U:\ARCON96\METDAT-2\CGSAR98.MET
     U:\ARCON96\METDAT-2\CGSAR99.MET

   Height of lower wind instrument (m)  =     10.0
   Height of upper wind instrument (m)  =     75.0
   Wind speeds entered as miles per hour

   Ground-level release
   Release height (m)                   =      3.5
   Building Area (m^2)                  =   2861.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      141
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   096 - 186
   Distance to intake (m)               =    201.5
   Intake height  (m)                   =       .0
   Terrain elevation difference (m)     =       .0
   Output file names
     KK-R1-4.OUT
     KK-R1-4.CFD
```

```
      Minimum Wind Speed (m/s)             =      .5
      Surface roughness length (m)         =      .20
      Sector averaging constant            =     4.3

      Initial value of sigma y             =      .64
      Initial value of sigma z             =     1.16

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =     2772
      Hours direction in window            =     8223
      Hours elevated plume w/ dir. in window =      0
      Hours of calm winds                  =     1534
      Hours direction not in window or calm =    22535

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.        1        2        4        8       12       24       96      168      360      720
     UPPER LIM.  1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03
       LOW LIM.  1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07
    ABOVE RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
       IN RANGE    9757.   12447.   15810.   19413.   22766.   26575.   28165.   27936.   27370.   26608.
    BELOW RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
           ZERO   22535.   19472.   15387.   10407.    7804.    3278.      21.       0.       0.       0.
     TOTAL X/Qs   32292.   31919.   31197.   29820.   30570.   29853.   28186.   27936.   27370.   26608.
     % NON ZERO   30.21    39.00    50.68    65.10    74.47    89.02    99.93   100.00   100.00   100.00

      95th PERCENTILE X/Q VALUES
                 1.85E-04 1.75E-04 1.57E-04 1.35E-04 1.07E-04 7.29E-05 4.60E-05 4.07E-05 3.70E-05 3.45E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        1.85E-04
      2 to 8 hours        1.19E-04
      8 to 24 hours       4.18E-05
      1 to 4 days         3.71E-05
      4 to 30 days        3.27E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       2.20E-04             1.36E-05
           SECTOR-AVERAGE   1.29E-04             7.92E-06

NORMAL PROGRAM COMPLETION
```

King Kong Doors to Remote-2 Intake with 96 - 99 Met Data Files
KK-R2-4

```
 Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  15:00:16

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  4
    Meteorological Data File Names
      U:\ARCON96\METDAT-2\CGSAR96.MET
      U:\ARCON96\METDAT-2\CGSAR97.MET
      U:\ARCON96\METDAT-2\CGSAR98.MET
      U:\ARCON96\METDAT-2\CGSAR99.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     75.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =      3.5
    Building Area (m^2)                  =   2861.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      325
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   280 - 010
    Distance to intake (m)               =     79.6
    Intake height  (m)                   =       .0
    Terrain elevation difference (m)     =       .0
    Output file names
      KK-R2-4.OUT
      KK-R2-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =       .58
      Initial value of sigma z             =      1.16

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =  10976
      Hours elevated plume w/ dir. in window =     0
      Hours of calm winds                  =   1534
      Hours direction not in window or calm =  19782

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
       LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE     12510.    15316.    18619.    21854.    24787.    27542.    28147.    27936.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
           ZERO     19782.    16603.    12578.     7966.     5783.     2311.       39.       0.        0.        0.
     TOTAL X/Qs     32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO      38.74     47.98     59.68     73.29     81.08     92.26     99.86    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                  8.99E-04  8.82E-04  8.33E-04  7.59E-04  6.20E-04  4.46E-04  2.93E-04  2.70E-04  2.41E-04  2.23E-04

      95% X/Q for standard averaging intervals

      0 to 2 hours        8.99E-04
      2 to 8 hours        7.12E-04
      8 to 24 hours       2.90E-04
      1 to 4 days         2.42E-04
      4 to 30 days        2.12E-04

                                HOURLY VALUE RANGE
                              MAX X/Q              MIN X/Q
           CENTERLINE         1.19E-03             4.45E-05
           SECTOR-AVERAGE     6.94E-04             2.60E-05

NORMAL PROGRAM COMPLETION
```

Reactor Building Walls to Local Intake with 96 - 99 Met Data Files
RBW-L-4

```
Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyll@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  15:01:42

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  4
    Meteorological Data File Names
      U:\ARCON96\METDAT-2\CGSAR96.MET
      C:\ARCON96\ARCON9~1\CGSAR97.MET
      U:\ARCON96\METDAT-2\CGSAR98.MET
      U:\ARCON96\METDAT-2\CGSAR99.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     75.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     60.0
    Building Area (m^2)                  =   1787.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      090
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   045 - 135
    Distance to intake (m)               =     39.0
    Intake height  (m)                   =     26.5
    Terrain elevation difference (m)     =       .0
    Output file names
      RBW-L-4.OUT
      RBW-L-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =      6.80
      Initial value of sigma z             =      3.25

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   2528
      Hours elevated plume w/ dir. in window =    0
      Hours of calm winds                  =   2055
      Hours direction not in window or calm =  27709

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
       LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE      4583.     6554.     9274.    12708.    15916.    21188.    27814.    27931.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
           ZERO     27709.    25365.    21923.    17112.    14654.     8665.      372.        5.        0.        0.
     TOTAL X/Qs     32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO      14.19     20.53     29.73     42.62     52.06     70.97     98.68     99.98    100.00    100.00

      95th PERCENTILE X/Q VALUES
                  8.69E-04  7.07E-04  6.42E-04  5.47E-04  4.36E-04  2.99E-04  1.79E-04  1.51E-04  1.34E-04  1.19E-04

      95% X/Q for standard averaging intervals

      0 to 2 hours        8.69E-04
      2 to 8 hours        4.40E-04
      8 to 24 hours       1.75E-04
      1 to 4 days         1.38E-04
      4 to 30 days        1.10E-04

                              HOURLY VALUE RANGE
                            MAX X/Q               MIN X/Q
           CENTERLINE       1.53E-03              1.05E-04
           SECTOR-AVERAGE   8.93E-04              6.12E-05

NORMAL PROGRAM COMPLETION
```

Reactor Building Walls to Remote-1 Intake with 96 - 99 Met Data Files
RBW -R1-4

```
 Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  17:59:31

 ******* ARCON INPUT **********

   Number of Meteorological Data Files  =  4
   Meteorological Data File Names
     U:\ARCON96\METDAT-2\CGSAR96.MET
     U:\ARCON96\METDAT-2\CGSAR97.MET
     U:\ARCON96\METDAT-2\CGSAR98.MET
     U:\ARCON96\METDAT-2\CGSAR99.MET

   Height of lower wind instrument (m)  =     10.0
   Height of upper wind instrument (m)  =     75.0
   Wind speeds entered as miles per hour

   Ground-level release
   Release height (m)                   =     60.0
   Building Area (m^2)                  =   2861.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      146
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   101 - 191
   Distance to intake (m)               =    138.7
   Intake height  (m)                   =       .0
   Terrain elevation difference (m)     =       .0

   Output file names
     RBW-R1-4.OUT
     RBW-R1-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =     10.20
      Initial value of sigma z             =      3.25

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   6929
      Hours elevated plume w/ dir. in window =      0
      Hours of calm winds                  =   2055
      Hours direction not in window or calm  =  23308

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
       LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE      8984.    11469.    14672.    18235.    21599.    26051.    28143.    27936.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
           ZERO     23308.    20450.    16525.    11585.     8971.     3802.       43.        0.        0.        0.
     TOTAL X/Qs     32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO      27.82     35.93     47.03     61.15     70.65     87.26     99.85    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                  2.41E-04  2.20E-04  1.95E-04  1.66E-04  1.31E-04  9.12E-05  5.58E-05  4.91E-05  4.37E-05  4.11E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        2.41E-04
      2 to 8 hours        1.41E-04
      8 to 24 hours       5.40E-05
      1 to 4 days         4.40E-05
      4 to 30 days        3.88E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       3.08E-04             1.45E-05
           SECTOR-AVERAGE   1.80E-04             8.44E-06

NORMAL PROGRAM COMPLETION
```

Reactor Building Walls to Remote-2 Intake with 96 - 99 Met Data Files
RBW -R2-4

```
 Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  18:00:02

 ******* ARCON INPUT **********

   Number of Meteorological Data Files  =  4
   Meteorological Data File Names
     U:\ARCON96\METDAT-2\CGSAR96.MET
     U:\ARCON96\METDAT-2\CGSAR97.MET
     U:\ARCON96\METDAT-2\CGSAR98.MET
     U:\ARCON96\METDAT-2\CGSAR99.MET

   Height of lower wind instrument (m)  =     10.0
   Height of upper wind instrument (m)  =     75.0
   Wind speeds entered as miles per hour

   Ground-level release
   Release height (m)                   =     60.0
   Building Area (m^2)                  =   2861.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      324
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   279 - 009
   Distance to intake (m)               =     77.6
   Intake height  (m)                   =       .0
   Terrain elevation difference (m)     =       .0
   Output file names
     RBW-R2-4.OUT
     RBW-R2-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =     10.20
      Initial value of sigma z             =      3.25

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =  10533
      Hours elevated plume w/ dir. in window =      0
      Hours of calm winds                  =   2055
      Hours direction not in window or calm =  19704

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
       LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
   ABOVE RANGE          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      IN RANGE      12588.    15203.    18490.    21760.    24803.    27594.    28149.    27936.    27370.    26608.
   BELOW RANGE          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          ZERO      19704.    16716.    12707.     8060.     5767.     2259.       37.        0.        0.        0.
    TOTAL X/Qs      32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
    % NON ZERO       38.98     47.63     59.27     72.97     81.14     92.43     99.87    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                  4.91E-04  4.67E-04  4.30E-04  3.88E-04  3.14E-04  2.23E-04  1.48E-04  1.34E-04  1.18E-04  1.09E-04

      95% X/Q for standard averaging intervals

      0 to 2 hours        4.91E-04
      2 to 8 hours        3.54E-04
      8 to 24 hours       1.41E-04
      1 to 4 days         1.23E-04
      4 to 30 days        1.03E-04

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       5.90E-04             1.91E-05
           SECTOR-AVERAGE   3.44E-04             1.12E-05

NORMAL PROGRAM COMPLETION
```

Turbine Building Exhaust to Local Intake with 96 - 99 Met Data Files
TBE-L-4

```
Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyll@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  15:06:32
 ******* ARCON INPUT **********
    Number of Meteorological Data Files  =  4
    Meteorological Data File Names
      U:\ARCON96\METDAT-2\CGSAR96.MET
      U:\ARCON96\METDAT-2\CGSAR97.MET
      U:\ARCON96\METDAT-2\CGSAR98.MET
      U:\ARCON96\METDAT-2\CGSAR99.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     75.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     36.3
    Building Area (m^2)                  =   1787.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =     55.00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      090
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   045 - 135
    Distance to intake (m)               =     18.3
    Intake height  (m)                   =     26.5
    Terrain elevation difference (m)     =       .0

    Output file names
      TBE-L-4.OUT
      TBE-L-4.CFD
```

```
      Minimum Wind Speed (m/s)             =      .5
      Surface roughness length (m)         =      .20
      Sector averaging constant            =     4.3

      Initial value of sigma y             =      .41
      Initial value of sigma z             =      .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   2325
      Hours elevated plume w/ dir. in window =    0
      Hours of calm winds                  =   1534
      Hours direction not in window or calm =  28433

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.        1        2        4        8       12       24       96      168      360      720
     UPPER LIM.  1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02
       LOW LIM.  1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06
    ABOVE RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
       IN RANGE    3859.    5835.    8639.   12215.   15513.   20900.   27585.   27928.   27370.   26608.
    BELOW RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
           ZERO   28433.   26084.   22558.   17605.   15057.    8953.     601.       8.       0.       0.
     TOTAL X/Qs   32292.   31919.   31197.   29820.   30570.   29853.   28186.   27936.   27370.   26608.
     % NON ZERO   11.95    18.28    27.69    40.96    50.75    70.01    97.87    99.97   100.00   100.00

      95th PERCENTILE X/Q VALUES
                 4.70E-03 3.68E-03 3.17E-03 2.66E-03 2.17E-03 1.57E-03 9.86E-04 9.02E-04 8.36E-04 7.91E-04

      95% X/Q for standard averaging intervals

      0 to 2 hours        4.70E-03
      2 to 8 hours        2.00E-03
      8 to 24 hours       1.03E-03
      1 to 4 days         8.01E-04
      4 to 30 days        7.69E-04

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       8.81E-03             1.67E-03
           SECTOR-AVERAGE   6.44E-03             1.01E-03

NORMAL PROGRAM COMPLETION
```

Turbine Building Exhaust to Remote-1 Intake with 96 - 99 Met Data Files
TBE-R1-4

```
 Program Title:  ARCON96.
 Developed For:  U.S. Nuclear Regulatory Commission
                 Office of Nuclear Reactor Regulation
                 Division of Reactor Program Management
 Date:           June 25, 1997    11:00 a.m.
 NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                  e-mail: jyl1@nrc.gov
                 J. J. Hayes      Phone: (301) 415 3167
                                  e-mail: jjh@nrc.gov
                 L. A  Brown      Phone: (301) 415 1232
                                  e-mail: lab2@nrc.gov
 Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                  e-mail: j_ramsdell@pnl.gov
 Code Documentation:  NUREG/CR-6331 Rev. 1
 The program was prepared for an agency of the United States Government. Neither
 the United States Government nor any agency thereof, nor any of their
 employees, makes any warranty, expressed or implied, or assumes any legal
 liability or responsibilities for any third party's use, or the results of such
 use, of any portion of this program or represents that its use by such third
 party would not infringe privately owned rights.
 Program Run  12/14/2003  at  15:08:20
  ******* ARCON INPUT **********
     Number of Meteorological Data Files  =  4
     Meteorological Data File Names
       U:\ARCON96\METDAT-2\CGSAR96.MET
       U:\ARCON96\METDAT-2\CGSAR97.MET
       U:\ARCON96\METDAT-2\CGSAR98.MET
       U:\ARCON96\METDAT-2\CGSAR99.MET

     Height of lower wind instrument (m)  =     10.0
     Height of upper wind instrument (m)  =     75.0
     Wind speeds entered as miles per hour

     Ground-level release
     Release height (m)                   =     36.3
     Building Area (m^2)                  =   2861.0
     Effluent vertical velocity (m/s)     =      .00
     Vent or stack flow  (m^3/s)          =    55.00
     Vent or stack radius (m)             =      .00

     Direction .. intake to source (deg)  =      156
     Wind direction sector width (deg)    =       90
     Wind direction window (deg)          =   111 - 201
     Distance to intake (m)               =    140.4
     Intake height  (m)                   =       .0
     Terrain elevation difference (m)     =       .0

     Output file names
       TBE-R1-4.OUT
       TBE-R1-4.CFD
```

```
      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =       .41
      Initial value of sigma z             =       .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =  10197
      Hours elevated plume w/ dir. in window =     0
      Hours of calm winds                  =   1534
      Hours direction not in window or calm =  20561

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
       LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE     11731.    14316.    17478.    20715.    23786.    26980.    28164.    27936.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
           ZERO     20561.    17603.    13719.     9105.     6784.     2873.       22.        0.        0.        0.
     TOTAL X/Qs     32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO      36.33     44.85     56.02     69.47     77.81     90.38     99.92    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                  3.29E-04  3.11E-04  2.76E-04  2.39E-04  1.88E-04  1.33E-04  8.52E-05  7.53E-05  6.89E-05  6.47E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours         3.32E-04
      2 to 8 hours         2.08E-04
      8 to 24 hours        8.08E-05
      1 to 4 days          6.94E-05
      4 to 30 days         6.17E-05

                              HOURLY VALUE RANGE
                            MAX X/Q              MIN X/Q
           CENTERLINE       4.04E-04             6.71E-06
           SECTOR-AVERAGE   2.38E-04             3.91E-06

NORMAL PROGRAM COMPLETION
```

Turbine Building Exhaust to Remote-2 Intake with 96 - 99 Met Data Files
TBE-R2-4

```
Program Title:  ARCON96.
Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management
Date:           June 25, 1997    11:00 a.m.
NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov
Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov
Code Documentation:  NUREG/CR-6331 Rev. 1
The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.
Program Run  12/14/2003  at  15:09:58
 ******* ARCON INPUT **********
    Number of Meteorological Data Files  =  4
    Meteorological Data File Names
      U:\ARCON96\METDAT-2\CGSAR96.MET
      U:\ARCON96\METDAT-2\CGSAR97.MET
      U:\ARCON96\METDAT-2\CGSAR98.MET
      U:\ARCON96\METDAT-2\CGSAR99.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     75.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     36.3
    Building Area (m^2)                  =   2861.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =     55.00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      312
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   267 - 357
    Distance to intake (m)               =    131.5
    Intake height  (m)                   =       .0
    Terrain elevation difference (m)     =       .0
```

```
 Output file names
   TBE-R2-4.OUT
   TBE-R2-4.CFD

 Minimum Wind Speed (m/s)             =       .5
 Surface roughness length (m)         =       .20
 Sector averaging constant            =      4.3

 Initial value of sigma y             =       .41
 Initial value of sigma z             =       .00

 Expanded output for code testing not selected

 Total number of hours of data processed =  35064
 Hours of missing data                   =   2772
 Hours direction in window               =  10645
 Hours elevated plume w/ dir. in window  =      0
 Hours of calm winds                     =   1534
 Hours direction not in window or calm   =  20113

 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.          1         2         4         8        12        24        96       168       360       720
 UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
   LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
 ABOVE RANGE        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
    IN RANGE    12179.    15089.    18630.    22163.    25252.    27866.    28153.    27936.    27370.    26608.
 BELOW RANGE        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        ZERO    20113.    16830.    12567.     7657.     5318.     1987.       33.        0.        0.        0.
 TOTAL X/Qs     32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
 % NON ZERO      37.72     47.27     59.72     74.32     82.60     93.34     99.88    100.00    100.00    100.00

 95th PERCENTILE X/Q VALUES
            3.92E-04  3.64E-04  3.32E-04  2.98E-04  2.39E-04  1.72E-04  1.18E-04  1.10E-04  9.83E-05  9.04E-05

 95% X/Q for standard averaging intervals

 0 to 2 hours        3.92E-04
 2 to 8 hours        2.67E-04
 8 to 24 hours       1.08E-04
 1 to 4 days         9.96E-05
 4 to 30 days        8.63E-05

                        HOURLY VALUE RANGE
                      MAX X/Q              MIN X/Q
     CENTERLINE      4.52E-04             1.23E-05
     SECTOR-AVERAGE  2.66E-04             7.20E-06
```

Condensate Storage Tanks (CST) to Remote-1 Intake with 96 - 99 Met Data Files
CST-R1-1

```
Program Title:  ARCON96.
 Developed For:  U.S. Nuclear Regulatory Commission
                 Office of Nuclear Reactor Regulation
                 Division of Reactor Program Management
 Date:           June 25, 1997    11:00 a.m.
 NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                  e-mail: jyll@nrc.gov
                 J. J. Hayes      Phone: (301) 415 3167
                                  e-mail: jjh@nrc.gov
                 L. A  Brown      Phone: (301) 415 1232
                                  e-mail: lab2@nrc.gov
 Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                  e-mail: j_ramsdell@pnl.gov
 Code Documentation:  NUREG/CR-6331 Rev. 1
 The program was prepared for an agency of the United States Government. Neither
 the United States Government nor any agency thereof, nor any of their
 employees, makes any warranty, expressed or implied, or assumes any legal
 liability or responsibilities for any third party's use, or the results of such
 use, of any portion of this program or represents that its use by such third
 party would not infringe privately owned rights.
 Program Run   4/ 7/2004  at  14:29:54

  ******* ARCON INPUT **********

     Number of Meteorological Data Files  =  4
     Meteorological Data File Names
       U:\ARCON96\METDAT-2\CGSAR96.MET
       U:\ARCON96\METDAT-2\CGSAR97.MET
       U:\ARCON96\METDAT-2\CGSAR98.MET
       U:\ARCON96\METDAT-2\CGSAR99.MET

     Height of lower wind instrument (m)  =     10.0
     Height of upper wind instrument (m)  =     75.0
     Wind speeds entered as miles per hour

     Ground-level release
     Release height (m)                   =     13.0
     Building Area (m^2)                  =    146.0
     Effluent vertical velocity (m/s)     =      .00
     Vent or stack flow  (m^3/s)          =      .00
     Vent or stack radius (m)             =      .00

     Direction .. intake to source (deg)  =     112
     Wind direction sector width (deg)    =      90
     Wind direction window (deg)          =  067 - 157
     Distance to intake (m)               =   119.6
     Intake height  (m)                   =      .0

     Terrain elevation difference (m)     =      .0
```

```
      Output file names
        CST-R1-3.OUT
        CST-R1-3.CFD

      Minimum Wind Speed (m/s)             =      .5
      Surface roughness length (m)         =      .20
      Sector averaging constant            =     4.3

      Initial value of sigma y             =      .00
      Initial value of sigma z             =      .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  35064
      Hours of missing data                =   2772
      Hours direction in window            =   3857
      Hours elevated plume w/ dir. in window =    0
      Hours of calm winds                  =   1534
      Hours direction not in window or calm =  26901

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.          1         2         4         8        12        24        96       168       360       720
     UPPER LIM.   1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03  1.00E-03
       LOW LIM.   1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07  1.00E-07
    ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       IN RANGE      5391.     7850.    11236.    15284.    18908.    24283.    28130.    27936.    27370.    26608.
    BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          ZERO     26901.    24069.    19961.    14536.    11662.     5570.       56.        0.        0.        0.
     TOTAL X/Qs    32292.    31919.    31197.    29820.    30570.    29853.    28186.    27936.    27370.    26608.
     % NON ZERO     16.69     24.59     36.02     51.25     61.85     81.34     99.80    100.00    100.00    100.00

      95th PERCENTILE X/Q VALUES
                 4.18E-04  3.00E-04  2.71E-04  2.24E-04  1.74E-04  1.17E-04  7.25E-05  6.57E-05  6.04E-05  5.79E-05

      95% X/Q for standard averaging intervals

      0 to 2 hours        4.18E-04
      2 to 8 hours        1.59E-04
      8 to 24 hours       6.31E-05
      1 to 4 days         5.78E-05
      4 to 30 days        5.57E-05

                              HOURLY VALUE RANGE
                            MAX X/Q                MIN X/Q
          CENTERLINE        6.51E-04               6.22E-05
          SECTOR-AVERAGE    3.79E-04               3.63E-05

NORMAL PROGRAM COMPLETION


NORMAL PROGRAM COMPLETION
```

Meteorological Data

Purpose: The purpose of this appendix is to give a brief description about the meteorological data used in this calculation.

Four years ('96, '97, '98, and '99) of data were used in the calculations instead of five because it was difficult for Energy Northwest to find 5 consecutive years of high quality data that would meet all regulatory requirements. The process for the clean-up and formatting of the raw data is described in the Framatome ANP, Inc. report (ref. 8). The electronic data files used in the calculation were given the following file names:

CGSAR96.MET
CGSAR97.MET
CGSAR98.MET
CGSAR99.MET

Each file contains hourly meteorological data lines that include the following information:

1) Location identifier, ID.

2) The number of the Julian day of the year, for January 1 the number is 1, for February 3 the number is 34 and so forth to 365.

3) hour of the day (0 to 23)

4) Lower wind direction, LWD.

5) Lower wind speed, LWS. The LWS is in miles per hour (mph), entered with an implied decimal point. For example a LWS value of 53 in the table means 5.3 mph, and so on.

6) Stability class (ST: 1=A, 2=B, 3=C, 4=D, 5=E, 6=F, and 7=G)

7) Upper wind direction, UWD.

8) Upper wind speed, UWS. The UWS is in miles per hour (mph), entered with an implied decimal point. For example a UWS value of 80 in the table means 8.0 mph, and so on.

Missing data for stability classes, wind directions, and wind speeds were denoted by 99, 999, and 9999, respectively.

The first and last 10 lines (hours) of met data from each data file are given in Table-C1 below:

Table-C1. First and Last 11 Met Data Lines for Each Year

1996 First 11 lines of Met data								
ID	Yr	Day	Hr	LWD	LWS	ST	UWD	UWS
CGS	1996	1	0	332	47	4	999	58
CGS	1996	1	1	329	50	4	999	62
CGS	1996	1	2	341	59	4	999	74
CGS	1996	1	3	5	58	4	999	74
CGS	1996	1	4	348	36	4	999	49
CGS	1996	1	5	354	45	4	999	55
CGS	1996	1	6	330	19	4	999	24
CGS	1996	1	7	2	20	4	999	28
CGS	1996	1	8	293	14	4	999	22
CGS	1996	1	9	317	32	4	999	37
CGS	1996	1	10	351	29	3	999	30
1996 Last 11 lines of Met data								
CGS	1996	366	13	347	41	7	80	79
CGS	1996	366	14	342	48	6	62	119
CGS	1996	366	15	329	83	6	22	77
CGS	1996	366	16	289	92	6	322	112
CGS	1996	366	17	311	111	6	322	200
CGS	1996	366	18	318	95	6	328	177
CGS	1996	366	19	319	41	6	346	76
CGS	1996	366	20	319	48	6	342	71
CGS	1996	366	21	336	39	6	352	52
CGS	1996	366	22	319	40	6	18	36
CGS	1996	366	23	310	48	5	328	10
1997 First 11 lines of Met data								
ID	Yr	Day	Hr	LWD	LWS	ST	UWD	UWS
CGS	1997	1	0	280	153	6	282	231
CGS	1997	1	1	222	225	6	241	381
CGS	1997	1	2	177	204	7	214	347
CGS	1997	1	3	186	216	6	209	358
CGS	1997	1	4	204	57	6	219	198
CGS	1997	1	5	195	220	6	216	392
CGS	1997	1	6	189	142	6	210	279
CGS	1997	1	7	161	148	5	199	213
CGS	1997	1	8	174	127	5	201	170
CGS	1997	1	9	190	162	4	208	187
CGS	1997	1	10	188	133	4	208	156
1997 Last 11 lines of Met data								
CGS	1997	365	14	180	87	4	186	101
CGS	1997	365	15	193	63	4	199	70
CGS	1997	365	16	258	42	4	258	53
CGS	1997	365	17	222	53	4	226	62
CGS	1997	365	18	203	36	4	201	45
CGS	1997	365	19	187	37	4	183	43
CGS	1997	365	20	205	19	4	194	25
CGS	1997	365	21	202	37	4	201	41
CGS	1997	365	22	240	41	4	234	44
CGS	1997	365	23	220	43	4	213	50

Table-C1. (cont.)

1998 First 11 lines of Met data								
ID	Yr	Day	Hr	LWD	LWS	ST	UWD	UWS
CGS	1998	1	0	273	35	5	243	38
CGS	1998	1	1	239	26	5	193	45
CGS	1998	1	2	207	33	5	185	42
CGS	1998	1	3	180	49	5	175	56
CGS	1998	1	4	175	57	5	159	63
CGS	1998	1	5	152	52	5	151	75
CGS	1998	1	6	155	67	6	154	131
CGS	1998	1	7	172	92	6	167	115
CGS	1998	1	8	178	69	6	167	114
CGS	1998	1	9	185	71	7	161	146
CGS	1998	1	10	174	103	7	176	171
1998 Last 11 lines of Met data								
CGS	1998	365	14	999	9999	99	999	9999
CGS	1998	365	15	999	9999	99	999	9999
CGS	1998	365	16	999	9999	99	999	9999
CGS	1998	365	17	286	67	5	293	124
CGS	1998	365	18	259	70	5	286	141
CGS	1998	365	19	297	56	6	295	170
CGS	1998	365	20	268	44	7	282	95
CGS	1998	365	21	241	33	5	291	66
CGS	1998	365	22	209	49	7	236	73
CGS	1998	365	23	192	74	7	219	74
1999 First 11 lines of Met data								
ID	Yr	Day	Hr	LWD	LWS	ST	UWD	UWS
CGS	1999	1	0	191	77	7	213	103
CGS	1999	1	1	169	64	7	203	108
CGS	1999	1	2	183	57	7	208	72
CGS	1999	1	3	184	59	7	210	44
CGS	1999	1	4	189	85	7	214	71
CGS	1999	1	5	185	88	7	231	99
CGS	1999	1	6	177	65	7	269	59
CGS	1999	1	7	194	40	6	293	55
CGS	1999	1	8	235	60	6	278	81
CGS	1999	1	9	208	49	6	261	55
CGS	1999	1	10	24	11	6	278	34
1999 Last 11 lines of Met data								
CGS	1999	365	14	131	75	5	150	93
CGS	1999	365	15	139	82	5	154	102
CGS	1999	365	16	128	87	5	148	123
CGS	1999	365	17	155	88	5	180	133
CGS	1999	365	18	175	61	6	220	74
CGS	1999	365	19	183	29	6	199	48
CGS	1999	365	20	230	31	6	225	25
CGS	1999	365	21	231	37	7	276	15
CGS	1999	365	22	310	33	7	341	19
CGS	1999	365	23	308	32	7	324	40

ENERGY NORTHWEST People·Vision·Solutions	ATTACHMENT 1	Page No. AT-1	Cont'd on page AT-2
		Calculation No. NE-02-03-14	
Prepared by / Date: M Abu-Shehadeh 6/15/04	Verified by/Date: Ted Messier 6/18/04	Revision No. 0	

REV BAR.

Calculation of CST X/Q

REV BAR.

Purpose: The purpose of this attachment is to provide a detailed calculation of the control room X/Q from the Condensate Storage Tanks (CST) source to the remote-1 intake. This X/Q is needed for the calculation of the radiation dose due to the secondary containment (SC) Liquid Leakage Bypass (LLB).

Description of the Source: Liquid leakage from the suppression pool to the CST via the HPCS and RCIC isolation valves is assumed to occur bypassing the SC. The CST is a set of two tanks located to the north of the TGB (Figure 1) with the remote-1 control room intake being the closest of the 3 intakes to the tanks. Each of the 2 tanks has a vent on the top located in the center of the tank roof (Ref. 17). Each tank has a diameter of 45 ft (13.72 m) and a height (including the height of the dome shaped-roof) of 43.5 ft (~13 m), Ref. 17. The tank that is closer to the remote-1 intake was conservatively assumed to represent the source.

Input Parameters: The ARCON96 input parameters for the remote-1 intake were provided in Appendix A, whereas those for the CST were determined using the methodology provided in Appendix A with the details provided below:

Distance from the source (CST) to receptor (remote-1): The North and West coordinates for the source were taken from reference 18, the distance is calculated using the formula given in Appendix A, section 2, as stated in the Appendix the coordinates are given in units of feet and the distance was calculated using the conversion factor 0.3048 meter per foot. MAS

CST coordinates = $(N_s, W_s) = (12148.2, 1224.7)$

Remote-1 Intake (receptor) coordinates = $(N_r, W_r) = (12294, 1589)$

Distance = $d = 0.3048 \times SQRT [(12294 - 12148.2)^2 + (1589 - 1224.7)^2]$

$= 119.6$ m

Height of the source: The height of the vent on top of the tank roof is 13 m (Ref 17).

Direction: The angle between the source and the receptor was calculated using the method explained in Appendix A. Using the coordinates given above, the angle was calculated to be 112^0.

Building Area: The building area is the cross-sectional area of the tank.

45 ft (diameter) x 35 ft (height) = 1575 ft^2 = 146.3 m^2

The 35 ft height does not include the height of the tank roof.

Initial Diffusion Coefficients: A point source has been assumed with Σy and Σz are set to zero.

The rest of the ARCON96 parameters have the same values listed in Table –1.

The ARCON96 output file is included at the end of Appendix B. The X/Q values are summarized below:

Table AT-1. X/Q (s/m^3) Values from the CST to Remote-1 Intake

Time Period	X/Q (s/m^3)
0 - 2 h	4.18E-04
2 - 8 h	1.59E-04
8 - 24 h	6.31E-05
1 - 4 d	5.78E-05
4 - 30 d	5.57E-05